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Report on Knowledge Transfer and Exchange Practices: A systematic review of the quality and types of instruments used to assess KTE implementation and impact

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Report on Knowledge Transfer and Exchange Practices: A systematic review of the quality and types of instruments used to assess KTE implementation and impact

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1.0 Introduction

Knowledge transfer and exchange (KTE) is a burgeoning organizational practice at research institutions worldwide. Funders and policy-makers demand to know whether their investments are making a difference. However, the effectiveness of current KTE practices has not been routinely or consistently evaluated (Lavis et al., 2003, 2010). KTE practitioners note the need to evaluate both how well plans are being implemented and the impact of these plans in order to improve KTE practices (Eccles et al., 2005). The paucity of valid and reliable tools may be one reason for this lack of evaluation. As the concept of knowledge to action moves to the forefront in the research community, a common set of quality tools could provide opportunities to consistently evaluate the impact of KTE implementation.

There is an ongoing healthy debate in the KTE literature about concepts, theory, models and frameworks (Thompson et al., 2006; Estabrooks et al., 2006; Best et al., 2008; Nutley et al., 2001; Tugwell et al., 2011). This is a necessary step as this field develops and moves to establish itself through better methods and evaluation of KTE processes. However, KTE practitioners have a more fundamental/practical need – to better measure the impact of KTE implementation. This need exists regardless of the theory or framework, context, type of KTE approach or outcomes employed.

Previous reviews on KTE implementation and impacts

The field of knowledge transfer and exchange encompasses varied theoretical perspectives from different disciplines and can be applied in various contexts (Estabrooks et al., 2006). Estabrooks et al. (2006) and Denis et al. (2004) have commented on the variety of theoretical perspectives and resulting models/frameworks that are applicable to KTE practices. In fact an entire book (Lemieux-Charles and Champagne, 2004) has been devoted to describing the multiple perspectives impacting this field. In all cases, KTE practitioners and researchers indicate that context is important. The context-specific nature of KTE adds an additional degree of complexity in evaluating the impact of KTE.

In a review and synthesis of *literature on effectiveness of health-care policy KTE*, Mitton and colleagues (2007) examined peer-reviewed and grey literature research studies that evaluated the transfer and exchange of knowledge between researchers and policy- and decision-makers. While they found 81 relevant articles, 63 of these did not report on implementation, so they concluded that inadequate evidence existed for “evidence-based” KTE for health policy.

Greenhalgh et al. (2004) set out to better understand how to spread and sustain innovations in health care. Their focus was on innovations in service delivery and organization that aimed to improve health. The “meta-narrative” review findings were used to develop a model of determinants, dissemination and implementation of

innovation. Through this model, Greenhalgh noted where the literature was lacking with respect to diffusion of innovation, including both a lack of empirical studies and limited generalizabilty across those that exist.

A number of reviews of KTE *effectiveness* focus on specific knowledge topics (e.g. diabetes or depression) or specific subcomponents of the broad range of KTE practices (e.g. use of printed materials and workshops). In contrast, Grimshaw and colleagues (2001) built on these to provide a synthesis of 41 systematic reviews on the *effectiveness of KTE implementation* among clinicians. The synthesis examined two types of interventions: those that were focused on broad strategies such as continuing medical education and those that looked at interventions to improve specific behaviours such as prescribing. They identified a variety of dissemination and implementation strategies that are effective under certain conditions. They focused on studies reporting measures of professional performance or patient outcomes.

We have included the abstracts of some key studies and reviews regarding KTE evaluation in Appendix A to provide the reader with more detail than we are able to provide here.

Focus on measurement

None of these reviews focused on the approaches or instruments used to measure KTE impacts, including the measurement properties or development of the instruments used to collect those measures. In a review of the literature, Skinner et al. (2007) summarized studies describing knowledge outcomes and those KTE tools used, a very useful starting point for the present review. The summary information was used in developing an instrument to measure *knowledge exchange outcomes* – a questionnaire about dissemination of best practices. The tool was in a development phase and further testing of measurement properties was planned.

Measurement principles from psychology (Nunnally and Bernstein, 1994) and clinical sciences (Streiner and Norman, 1995; Beaton et al., 2003) should be applied to the types of instruments used to measure most quantitative KTE outcomes. This applies to the development of new instruments as well as to the adoption of existing instruments (both within KTE and other disciplines). The measurement principles of KTE instruments must be suitable, declared and understood to be useful and consistently comparable. The key steps in establishing or understanding the measurement properties include ensuring a conceptual match, establishing face and content validity, and feasibility. In addition and more importantly, establishing reliability and construct validity is necessary for good measurement (Estabrooks et al., 2008; Beaton et al., 2008).

Estabrooks and colleagues (2008) have taken well considered steps to ensure good measurement properties of an instrument to measure *organizational context and research utilization*. The development stages considered conceptual match and

feasibility, and pilot testing has been carried out to determine reliability and validity. More recently, French and colleagues (2009) compared measurement tools relevant to the organizational contexts for evidence-based practice in health care. Measurement instruments were gathered from four domains: research utilization (RU), research activity (RA), knowledge management (KM) and organizational learning (OL). Instruments were primarily appraised for face and content validity, as well as development and testing methods. Measurement tool items were extracted and categorized within a constructed framework. The latter was oriented towards the receptive and absorptive capacities of organizations, rather than impacts per se.

The need for a comprehensive review

The research team wondered whether or not, across different fields of KTE application, such measurement work exists that is oriented towards KTE implementation and impact evaluation. As active researchers engaged in KTE, we were keen to find methods, instruments and designs that would help us in our work. Due to the diverse background of the team members and our appreciation for the contributions of researchers of many disciplines, we looked across a broad spectrum of application fields, KTE approaches, contexts and KTE outcomes with an explicit link to a research evidence base. We were interested in studies that outlined their approach to evaluation and the methods, tools, instruments and designs they employed. Among quantitative studies, we wanted to assess whether solid measurement principles had been applied, with the hope that some instruments could be used in our work, either directly or with some adaptation.

1.2 Review question

The primary objective of the knowledge synthesis was to answer the following question: Are there reliable, valid and/or useful instruments to apply in the assessment of KTE implementation and its impact?

Since the KTE literature describes instruments for implementation evaluation, our secondary objectives were to: (a) make recommendations about common elements of KTE that are most effective; and (b) make recommendations about how to evaluate the impact of KTE.

In answering the primary question, we provide a synthesis that documents/describes the instruments used in assessment and evaluation (including their measurement properties) and the common elements among these tools.

2.0 Decision-maker and stakeholder engagement

2.1 Decision-makers

Our three formal decision maker partners for this review were the (1) Mr. David Clements of Canadian Health Services Research Foundation, (2) Ms. Rhoda Reardon of the College of Physicians and Surgeons of Ontario, and (3) Dr. Andreas Laupacis of Li Ka Shing Knowledge Institute at St**.** Michael's Hospital.

We worked directly with Mr. David Clements, Vice President Knowledge Exchange at the Canadian Health Services Research Foundation (CHSRF). CHSRF supports evidence-informed decision making in the organization, management and delivery of health services in Canada. The Foundation accomplishes this through funding research, building capacity to use research and transferring knowledge. Mr. Clements has recently moved to a new position outside of CHSRF but he continues to act as a decision maker for the project. We have a new contact at CHSRF who will assist in the dissemination of the results of the review.

Ms. Rhoda Reardon is Education Coordinator and Acting Manager, Research and Evaluation, at the College of Physicians and Surgeons of Ontario (CPSO). She provided feedback and direction throughout the review. CPSO regulates the practice of medicine in Ontario to protect and serve the public interest. The College is in the knowledge transfer business and is interested in understanding how to measure performance and effectiveness in this area. It's primary interest includes maintaining standards of practice through peer assessment and education.

With the mission to be a world leader in the ethical generation and use of knowledge to benefit the patients and surrounding community of St. Michael's Hospital, the Li Ka Shing Knowledge Institute was a decision-maker partner for this review. Dr Andreas Laupacis, Executive Director was engaged in this review as a decision-maker providing guidance and suggestions throughout. He has indicated interest in using the results through the knowledge transfer activities at the Li Ka Shing Knowledge Institute.

2.2 Identification of additional KTE stakeholders

We sought to engage KTE researchers and practitioners as key stakeholders for this review.

Ontario has a very active KTE Community of Practice based out of Toronto. Key members from this group, including members of its coordinating committee were identified as stakeholders for this research synthesis project. These stakeholders

included KTE researchers and practitioners from the fields of children's health, mental health, education and occupational health and safety.

The Institute for Work & Health (IWH) has a KTE Advisory Committee (KTEAC) which was identified as a stakeholder group for this project. The KTEAC meets annually to provide feedback and input into the KTE department's directions and practice. This group is made up of representatives from the KTE research community, communication experts and target audiences for IWH research.

Presentations about the review were made to each of these groups to solicit feedback related to the scope of this project and to discuss the direction of the review and preliminary findings.

Two additional individuals provided feedback throughout the process of the review, in conjunction with the input received from the identified decision-makers; Dr. Claire Bombardier, Canada Research Chair in Knowledge Translation for Musculoskeletal Care and Dr. John Frank, Director Medical Research Council (MRC) - Chief Scientist Office (SCO) Scottish Collaboration for Research and Policy.

2.3 Decision-maker and stakeholder feedback

At the very early stages of this synthesis, prior to conducting the literature search, a meeting was held with the decision-makers to capture their feedback and comments on our research question and literature search terms. Discussions with Dr. Bombardier and Dr. Frank also occurred at this stage. These discussions helped to shape our question and guide the review process from the methodological perspective as well as to help maintain our focus on practical outcomes with respect to KTE evaluation.

As the synthesis progressed, e-mail updates were sent to our decision-makers. These updates included detailed reports on the progress being made by the research team. They also asked the decision-makers for their input into particular problems or details of the review process.

As preliminary results became available, presentations were made to the IWH KTE Advisory Committee (June 2009) and the Ontario KTE Community of Practice (November 2010). Both of these presentations allowed for discussions among knowledge users about the findings and how best to present them at the conclusion of the project.

A final feedback meeting was also organized with a group of KTE stakeholders from the KTE Community of Practice and several academic KTE researchers and members of the knowledge translation branch of the Canadian Institutes of Health Research (CIHR). The meeting took place on February 15, 2011. Participants were

asked to provide feedback on the findings and assist with the development of key messages from the review.

Participants believed that the results of the review were useful to KTE practitioners. Of particular interest was the list of evaluation instruments found in the literature. The list provides a summary of modifiable instruments that can be used by KTE practitioners, which complement the organizational measurement tools already reviewed (French et al., 2009). The participants recognized that none of the instruments could be identified as "the standard" because the instruments were not repeated across studies and their measurement properties were either not reported or not tested. The stakeholders suggested that, as organizations build their KTE capacity, this review and others from the literature would be helpful to gauge their readiness for KTE.

There was a concern voiced that our search strategy and inclusion/exclusion criteria may have limited our ability to find all possible instruments that could be used in the evaluation of KTE applications. This led to the suggestion to clearly describe our search strategy and indicate the reasons for our exclusion criteria.

The group also agreed on the need for more research to help develop tools with well defined measurement properties for the evaluation of KTE applications. It was suggested that the final report present the instruments in such a way that practitioners can adapt them for their own particular needs. Furthermore there was a suggestion to provide recommendations to the field – to *both* researchers and practitioners of KTE. Finally, it was suggested that recommendations be made on how to best report a KTE evaluation to advance knowledge in the field.

Prior to finalizing the research report, the team again sought input from the review's decision makers in the form of e-mail feedback on the draft report. The decision makers provided feedback related to clarity and presentation of findings. They specifically helped to frame the recommendations and suggested that the summary clearly describe the instruments that may be most useful for KTE researchers and practitioners.

This report reflects the feedback from our decision-maker partners and KTE stakeholders from Ontario. We gratefully acknowledge these individuals for the time and effort taken to consider our process and results.

3.0 Methods

3.1 Literature search

The search strategy aimed to be broad and inclusive, capturing a wide spectrum of KTE approaches across different disciplines and contexts. As such, it comprised searches of a number of electronic databases from different domains: medicine, psychology, education, agriculture, library and information science, social science, and business, with search terms falling within three major definitional categories: "knowledge transfer", "knowledge transfer outcomes", and "evaluation methods". To capture publications not indexed in electronic databases, we hand-searched selected journals, consulted with content experts and review team members about publications within their personal library collections, and scanned the references of included studies. Further details on each on these activities are described in the steps below (see also Appendix B).

Step 1: Search of electronic bibliographic databases

The searches of electronic bibliographic databases took place between August 27 and September 29, 2009. The following electronic bibliographic databases were searched from inception onwards:

> MEDLINE(OVID), EMBASE, CINAHL, PsycINFO, ERIC, CAB Abstracts, Library and Information Science Abstracts (LISA), Social Science Abstracts, and Business Source Premier

The search strategy employed within these databases combined three broad categories: "**knowledge transfer**", "**knowledge transfer outcomes**", and "**evaluation methods**". Each category was populated with search terms that convey that concept. Because authors use diverse terminology in writing about KTE and because indexing within databases is not consistent (McKibbon et al., 2010), attempts were made to be as inclusive as possible. The terms within each of the categories were combined using the Boolean "OR" operator, and then all three categories were combined using the Boolean "AND" operator. Accordingly, references had to contain at least one search term in all three categories in order to be captured by the search.

As the controlled vocabulary used in each database differs significantly, the terms used in our search were customized for each database. Controlled vocabulary was used whenever possible. Additionally, titles and abstracts were searched using the predetermined set of search terms. A detailed list of the terms used may be found in Appendix B.

The search was limited to peer-reviewed journals in databases where this was appropriate but was not limited by language. However, due to the language proficiency of review team members, only articles written in English or French were selected for review.

Step 2: Consultation with content experts and team members

A list of articles was gathered from content experts and review team members. All articles discussed some element of KTE and were used to assist in developing a thorough list of search terms in this area. As noted by McKibbon et al (2010), the language used to describe KTE is diverse and inconsistent, reflective perhaps of such a new field. This makes information retrieval difficult, as there is no core set of terms that can be used in order to ensure all articles in this area are captured. Further, many of the terms are broad in and of themselves, leading to the capture of references that cite these terms but for very different purposes. Finding a balance between a search that was sensitive as well as a specific was challenging. We therefore used this list of articles as a means of finding a balance of terms that provided as many relevant articles as possible, but also produced yields that were manageable for the team to review given our time and resource constraints.

Fifty-five experts were recommended by the review team. Of those, four could not be reached for a variety of reasons (see Appendix B for a list of content experts). The remaining fifty-one content experts were contacted via e-mail to suggest relevant articles, articles in press, articles accepted for review and grey literature documents (e.g., technical reports, book chapters, theses or dissertations, and conference presentations) that may be relevant to our primary and secondary research questions.[1] The geographic location of the content experts was as follows: 27 were working in Canada, 11 in the United States and 18 in the United Kingdom. Seventeen of the 51 content experts responded to the e-mail request (33% response rate). Seven of those forwarded the e-mail to 11 additional “content experts.” Seven of the 11 responded to the e-mail request. Overall, with the addition of these new referrals, 24 content experts responded to the e-mail request.

Step 3: Hand-searching Journals

Review team members and content experts identified journals that may not have been indexed in the databases searched and, therefore, required hand-searching in order to capture relevant articles. These journals included: Academy of Management Journal, Academy of Management Review, Administrative Science Quarterly Journal, Canadian Journal of Program Evaluation, Evidence & Policy, Implementation Science, and Science Communication. It was determined that all but Evidence & Policy and Implementation Science were indexed in at least one of the databases searched. As a result, only these two journals were hand-searched. The table of contents of Evidence & Policy and Implementation Science were hand-

[1] Note that grey literature was used as background material only, as this review was limited to peer-review literature.

searched from 2005 and 2006 (earliest years for which table of contents were available on the Internet) to October 9, 2009, respectively. Relevant articles not already captured in our search of electronic databases were included for review.

Step 4: Reference lists

In later stages of the review, the reference lists of all relevant documents selected for review were manually searched for potentially relevant articles. The references identified by reviewers were checked against the list of references from our search for duplicates. Those that were unique and relevant were added to the review.

3.2 Document relevance

The references from the literature searches were downloaded into Reference Manager, a bibliographic management software program, and duplicates were screened out. References were then loaded into a web-based systematic review software program called DistillerSR (Evidence Partners, Ottawa, Canada). This software was used to manage the stages of the review. For each stage of the review, the necessary criteria were presented as a series of questions that reviewers answered as they reviewed the titles and abstracts or full articles, allowing for centralized tracking and access.

Throughout the review, particularly for relevance, we were guided by a definition of KTE that the team (and decision-makers) agreed upon:

> **Knowledge transfer and exchange** refers to an iterative and dynamic process by which relevant *research* information is created, synthesized, disseminated and exchanged through an interactive engagement between researchers and decision-makers/knowledge users to improve outcomes, provide more effective services and products and strengthen the use of evidence in decision-making, practice, planning, and policy-making.

While the team believes that KTE can be applied to more than the transfer and exchange of research information, we considered this definition useful to help focus the review. We decided that KTE applications that were not explicitly linked to a research evidence base (e.g., practice evidence or health behaviour) was outside of the scope of this review.

Furthermore, the team used the term KTE application to capture the concept of a KTE method or KTE intervention that could be evaluated. We chose not to use the term “intervention” as it is commonly used to refer to treatments and processes to improve specific outcomes. Therefore, to avoid confusion, we used the term KTE application and defined it as follows:

> **Knowledge transfer and exchange application** refers to any activity or practice in which KTE is a stated goal that is linked to specific outcomes (i.e.

the activities/practices are intended to change something, be it knowledge, behaviour, attitudes, capacity, decision-making, policies, programs etc.).

The references were reviewed for relevance through an iterative process. The criteria for relevance were developed through team consensus using the definitions above.

3.2.1 Single reviewer screen of titles and abstracts

Due to the large number of references obtained in our comprehensive literature search, the first step in determining relevance was a screening process. To answer our primary review question, the team decided it would most likely find instruments to evaluate KTE in studies that carried out an evaluation of KTE. Therefore, our main inclusion criteria/question was: Does the article describe a KTE outcome or a tool to measure a KTE outcome as a result of a KTE application? Single reviewers independently reviewed titles and abstracts to answer the question. To help answer this question, the review team considered the following additional inclusion and exclusion criteria, which were developed with input from our decision-makers:

Inclusion criteria:

- Any mode/method of disseminating research information to any audience (see exclusions below)
- All article types

Exclusion criteria:

- Models, theories and/or conceptual frameworks that only document or describe KTE processes (i.e. how to do KTE)
- "Social marketing" or "public communication campaigns" or "public education campaigns" alone
- Curriculum changes or curriculum evaluations affecting students in a school or academic setting
- Evaluations of a program, policy, practice, or intervention in which no explicit KTE question/objective is answered/addressed (e.g. evaluating the implementation of an established evidence-based program, quality improvement studies (QIS), return-on-investment (ROI) studies, health promotion programs, and training programs that did not have KTE, as we defined it, as a stated goal)

The team developed the criteria for inclusion and exclusion with the intention of being inclusive and capturing as many relevant articles as possible. For instance, the addition of the phrase “…or a tool to measure a KTE outcome” to the primary screening question emerged through team communication in order to capture those articles that describe the development of a tool even when not specifically part of an evaluation of a KTE application. While the team maintained an inclusive focus, we also considered where we would find the studies that would answer our research question. We were aware of the knowledge utilization literature, especially the work

of Estabrooks and colleagues in the development of evaluation instruments (Estabrooks et al., 2009). We considered our review as a complement to this work and did not seek to address knowledge utilization specifically for this reason. We were also aware of the breadth of literature that examines evidence-based practice, quality improvement and program evaluation -- all of which would describe evaluation instruments. As a team, we decided that when we encountered studies in these areas we would include them only if there was an explicit indication that the evaluation targeted the transfer of research knowledge (as per our definition) to practitioners. We decided it was possible for a study to examine the implementation of an evidence-based program with a program evaluation that did not address the transfer of research knowledge. We acknowledge that there may be useful instruments that could be adapted for KTE evaluation from various literatures; however, we decided that these are beyond the scope of this review.

Since the title and abstract screen was done by a single reviewer, there was a possibility for selection biases. Therefore a quality control (QC) check was done with an independent reviewer (QC reviewer) using the same criteria as the review team. The titles and abstracts reviewed by the QC reviewer were a randomly chosen set of 228 references. The target was to check at least two percent of the total references in the single reviewer titles and abstracts screen step. The randomization process relied on the number of references reviewed by each reviewer, which varied at this level. There were far more references excluded than included at this level therefore we slightly oversampled the number of excluded references, resulting in 2.3 % of the total references from this step. The review team did not feel that these idiosyncrasies in the references selected would bias the results of our assessment of agreement between the QC reviewer and the team.

A dataset was created by entering the responses from the QC reviewer with the data from the review team into a spreadsheet. SAS (v9.0) was used to calculate the Kappa score. The level of agreement between the reviewers and the QC reviewer was examined. The Kappa score of 0.32 indicates only fair agreement (Landis and Koch, 1977). On further examination, the QC reviewer included 47 references that the review team excluded and excluded 31 references that the review team included. Upon inspection of the 47 references included by the QC reviewer, in 79% of cases the QC reviewer responded with "uncertain" indicating inclusiveness. Of the 31 references excluded by the QC reviewer, all were excluded in subsequent relevance steps of the review. Therefore, we consider the quality of the single reviewer screen of titles and abstracts to be reasonable.

3.2.2 Two reviewer screen of titles and abstracts

Pairs of reviewers again reviewed the titles and abstracts considering the initial screening criterion/question. The same inclusion and exclusion criteria were used except for article type (article, book review/commentary/editorial/letter to editor or literature review). In addition, the language of the references were considered. Pairs of reviewers independently reviewed the titles and abstracts and then came to

consensus. The reviewers were paired across the team to minimize potential bias. References that were not articles and references in languages other than English or French were not included for further review. If, however, a reviewer's response was "uncertain" to any of these screening criteria/questions, the reference was moved to the next level of relevance review and the full article was obtained.

3.2.3 Two reviewer screen of full articles

Following the title and abstract screening, the review team felt that there were still many potentially relevant articles. However, we also decided that the information available in the titles and abstracts was often insufficient to confidently judge relevance. So the full articles were obtained and loaded into the systematic review software. Two reviewers, who had done much of the title and abstract screening conducted a screen of the full articles. They used same screening question, "does the article describe a KTE outcome or a tool to measure a KTE outcome as a result of a KTE application?", and the same inclusion and exclusion criteria. This was done in consultation with the entire team and with a focus on inclusivity. The two reviewers independently reviewed the full articles and came to consensus. If the reviewers could not reach consensus the review team was consulted and a decision reached regarding relevance.

3.3 Study classification, instrument availability, and quality appraisal

Prior to assessing the methodological quality of the articles, the articles were classified according to their overall study approach: descriptive, qualitative, quantitative or mixed-methods.

Descriptive articles were those that did not carry out an evaluation of KTE but described how an evaluation could be carried out or a proposal to do so. These articles may have also described theory/frameworks relevant to KTE evaluation. While articles of a descriptive nature were to be excluded in earlier stages of the review, it was often difficult to tell if an actual evaluation of a KTE application was done in the screening stages. At this stage, the articles were read for quality, and it became clear in some cases that no evaluation had taken place. A subset of reviewers examined the descriptive articles using a brief data extraction instrument developed by the entire review team. A single reviewer reviewed each descriptive article and extracted the data. Bias was not considered an issue given the nature of the data extracted. The team believed that these data, when compared to the data from the relevant articles with instruments, could reveal gaps or whether the descriptive articles (those without an evaluation of a KTE application) differed on these dimensions. This was done because the team felt there may be something unique about descriptions compared to actual evaluations of KTE applications. These descriptive articles did not progress through further stages of the review.

The *qualitative, quantitative, and mixed-methods* articles (with *mixed methods* defined as those that combined collection and analysis of both qualitative and quantitative data) proceeded to an appraisal of methodological quality.

Qualitative articles that clearly described an approach to the evaluation of the impact of KTE applications were reviewed for methodological quality using questions adapted from the Critical Appraisal Skills Programme (CASP) (Public Health Resource Unit, 2006) (see Appendix C).

As the review team considered each *quantitative* article for methodological quality, we also considered whether the article described an evaluation of KTE that required an instrument. We defined an instrument as a questionnaire, survey, interview or series of questions. Although the team initially wanted to consider all KTE evaluation articles, it was not feasible to do so due to the number of articles at this stage of the review. Only articles that described or referenced an instrument used to evaluate a KTE application proceeded to further review.

Quantitative articles that employed an instrument in the evaluation of a KTE application were assessed for methodological quality using appraisal criteria developed by the review team. The criteria to assess methodological quality was based primarily on the Consolidated Standards of Reporting Trials (CONSORT) statement criteria (Moher et al., 2010) and on instruments used in previous IWH reviews. The review team carefully considered the range of potential study designs that have been used to evaluate KTE applications in designing the quality appraisal instrument (see Appendix C).

Mixed-methods articles were reviewed using all questions relevant to both the quantitative and qualitative criteria (see Appendix C).
The three methodological quality assessment instruments (*qualitative, quantitative, and mixed methods*) were pilot tested prior to use. For all articles at this stage, quality appraisal questions were answered by two reviewers independently. To reduce potential reviewer bias, the same two members did not review all of the same articles. Reviewer pairs were required to reach consensus on all criteria. In cases where agreement could not be reached, a third reviewer was consulted to ensure consensus was reached. Team members did not review articles they had consulted on, authored, or co-authored.

Articles were not excluded from further review based on quality appraisal, nor were the studies scored according to quality at this stage. The team decided to extract data from all relevant studies to be inclusive of all instruments. Study and reporting quality were judged during the data-extraction stage. In addition, while completing the quality appraisal, reviewers were asked to scan the reference lists to identify other possible relevant articles for review. Potentially relevant references were checked against the initial literature search and, if unique, they were added to the review.

3.4 Data extraction

Data were extracted from all relevant articles that reported on an evaluation of a KTE application (or described the development of an instrument to evaluate a KTE application) and described an explicit approach (qualitative) or instrument (quantitative) in the evaluation. To do this, the team developed and tested data extraction (DE) instruments (see Appendix C). Data was extracted from the articles by two reviewers independently, who then came to consensus on the data extracted. Reviewer pairs were not static and team members did not extract data from articles they had consulted on, authored, or co-authored.

Using the DE instruments, data were extracted from *all articles* about jurisdiction, domain, KTE theory, type of knowledge use, KTE application, and target audience (see Appendix C for descriptions of type of knowledge use and a list of the KTE applications used).

The data extracted from *qualitative* articles included: research objectives, research design/approach, participants, analysis scope/integrity/depth (Public Health Resource Unit, 2006), and study findings.

The data extracted from the *quantitative* articles included research objectives, study design, study sample characteristics, follow-up period, and the authors report of the impact of the KTE application. For instruments used to evaluate a KTE application, we extracted data on the measurement properties described (or referenced). We used basic definitions of the measurement properties to guide the reviewers and asked them to look for validity, reliability, and responsiveness as follows:

Validity: Does the instrument measure what it says it measures?
- Content: Are domains covered
- Face: Does it look like it measures what is intended

Reliability: Does the instrument measure construct in a reproducible fashion
- Internal consistency (related to validity)
- Intra-observer, inter-observer, test-retest

Responsiveness: Is the instrument able to detect change resulting from a KTE application?

At this stage of the review, we identified articles that reported on the same KTE application at the same location (for instance, separate articles describing results from the same study). When more than one article reported on the same KTE application(s), we grouped related articles together for review and assigned one as the primary document and the other(s) as supplemental articles. Supplemental articles are clearly indicated in the reference list of the report. Relevant data were extracted from all articles that described a study.

3.5 Synthesis

The team considered three levels of synthesis of the extracted data. The information we extracted from *all* articles would provide a characterization of the studies and the types of KTE applications. The *qualitative* studies would provide information on the broad approaches to the evaluation of KTE applications and their impact.. The *quantitative* studies would provide information about the various instruments that could be used to evaluate KTE applications and the study objectives, designs and outcomes reported.

3.5.1 All articles

For all studies, we examined the data-extraction tables and summarized the jurisdiction, domain, type of knowledge use and target audience. This descriptive approach provided the context for each of the different types of articles reviewed.

3.5.2 Qualitative articles

The synthesis of the qualitative articles was based on the data extracted and a discussion among a subset of the review team. Four reviewers completed the data extraction for the 12 qualitative articles, each being paired with all the others during this step. Extracted data was submitted on-line so that each member of a pair of reviewers could read the other's responses. A verbal discussion took place between the two of them, with agreement on which extracted data would stand. A consensus was also reached on the scope, depth and integrity of the analysis in each study.

For this report, one of the qualitative review team members took the lead in conducting a narrative synthesis of extracted data. The three other team members, who all had qualitative methodological experience and had reviewed and extracted data from the qualitative articles, contributed to the narrative synthesis.

3.5.3 Quantitative articles

The data from the quantitative articles were synthesized according to the evaluation instruments, measurement properties and study outcomes (those specific to the instruments used) from the studies. The quantitative articles were grouped according to their stated objectives. This resulted in four groups: those that developed instruments, those that stated KTE evaluation as a secondary objective, those that were used in pilot (or feasibility) studies, and those that proposed to examine the impact of KTE applications.

Note that no mixed-methods articles proceeded to data extraction or synthesis.

4.0 Results and Discussion

4.1 Literature search

The findings from the various searches are presented in Table 1. The total yield, with duplicates removed, was 9,998 references. This large yield was primarily due to the broad scope of the search across multiple disciplines and databases. It was also due to the challenges of information retrieval in this area, given the numerous terms used by authors and their broad use across disciplines for different purposes (McKibbon et al., 2010).

Table 1: Literature search yields.

Database*/Source	Yield
Medline (OVID)	3945
EMBASE	3857
CINAHL	1693
PsycINFO	1198
CAB Abstracts	1064
ERIC	424
Business Source Premier	310
Library & Info Science Abstracts (LISA)	222
Social Science Abstracts	192
Other sources: hand-search of Implementation Science	72
Other sources: team members and content experts	71
Other sources: from reference lists of Included Studies	23
Other sources: hand-search of Evidence & Policy	18
Total yield	13089
Duplicates removed	3091
Total unique references	9998

*Electronic databases and hand-searches conducted up to September 29, 2009

4.2 Document relevance

The challenge of reviewing almost 10,000 references in a systematic and unbiased manner was formidable. The review team considered many options and adopted an approach that was iterative, transparent and attempted to minimize bias.

In a screen of 9998 titles and abstracts by single reviewers, 7783 were considered non-relevant. The review team was inclusive at this step to ensure that we captured articles that may contain instruments used in the evaluation of KTE applications. We note, that of the 2215 references that moved to the next screening level, 1378 had a

response of “uncertain” to the screening question (see methods above and Appendix C).

A second screen of the 2215 titles and abstracts was undertaken, in which we also considered the type of article and the language of the article. Using these criteria, 733 of 2215 references were considered to be potentially relevant; 1367 references were considered non-relevant based on the initial screening question. Of the remaining 115, 14 were in a language other than English (there were no relevant French-language articles), 28 were commentaries, and 73 were literature reviews.

At this point, the review team decided that no more screening would be done without the full articles. Therefore the process of retrieving 733 articles was undertaken. At this step, we screened the full article to determine if it met the inclusion criteria associated with the initial screening question; 346 of 733 were considered relevant.

Furthermore, the team considered relevance at each of the remaining steps of the review. This was done because with the large number of references and the time required to review them, the team was purposely inclusive. Therefore if there were errors in judging relevance it was likely that we had included a non-relevant article. As a result, the team found articles that were not relevant at the quality appraisal and data extraction stages because of the team’s attempt to be inclusive during previous steps. Figure 1 depicts the non-relevant articles at each step of the review.

Overall we found 66 articles to be relevant to answering our review question.

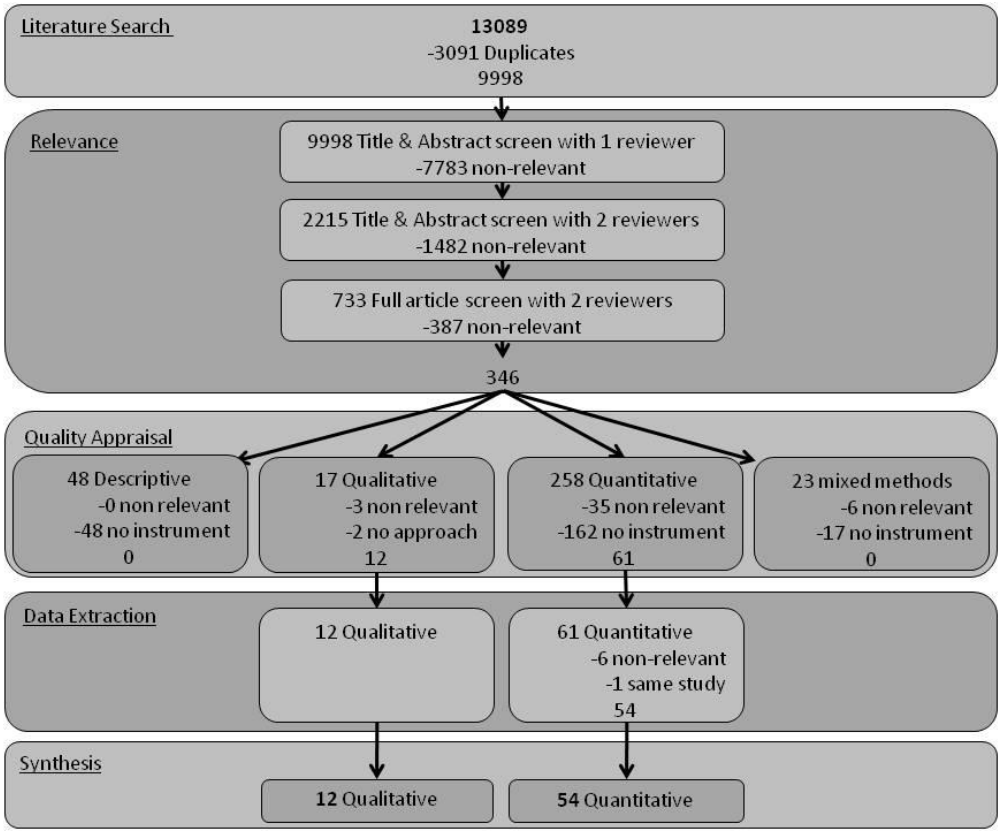

Figure 1: Flowchart of documents progressing through review steps.

4.3 Study classification, instrument availability, and quality appraisal

Of the 346 articles deemed to be relevant, 17 were classified as qualitative, 258 as quantitative, 23 as mixed methods and 48 as descriptive.

The study quality of the relevant articles was not scored and was not used to exclude articles from further review. The review team wished to extract data from all studies that contained an instrument to evaluate a KTE application. Accordingly, the team considered study quality after data extraction using all available data rather than using the checklist approach.

It was at this level of the review that the team decided to focus primarily on articles with an instrument that collected data from practitioners as the target audience. This was done in part due to feasibility, as there were a large number of articles from

which to extract data. It also partly reflected a debate among team members throughout the review about the appropriate audience for KTE applications.

4.3.1 Qualitative articles

Five of the 17 *qualitative* articles were either not relevant (n=3) or did not provide sufficient information about the qualitative approach employed in the evaluation of a KTE application (n=2). These were not reviewed further. The presence of an instrument was not necessary for the qualitative studies. The remaining 12 articles were appraised for methodological quality.

4.3.2 Quantitative articles

Thirty-five of 258 quantitative articles were not relevant, and a further 162 did not provide sufficient information about an instrument used in the evaluation of a KTE application. The remaining 61 articles were appraised for methodological quality.

4.3.3 Mixed methods articles

All 23 of the mixed-methods articles were excluded at this stage of the review. Six were deemed not relevant, and the remaining 17 did not include a survey instrument (or details about a qualitative approach) in the evaluation of KTE. The review team noted that, although the articles were described as mixed methods, in many cases one methodological approach was dominant, while the other was not well carried out or described.

4.3.4 Descriptive articles

The 48 articles that we considered descriptive were explored further to capture some of their key elements.

The descriptive articles were predominantly from health care (69% of articles), as well as from agriculture (13%), business (6%) and education (6%). The target audience across these articles were the practitioners (92%) within each domain. Note that we included farmers and teachers as practitioners. A variety of KTE applications were described in this set of articles. Those mentioned most often were in-person workshops (44%), printed materials (44%) and opinion leaders (29%). Train-the-trainer (15%), in-person presentations (13%), distance participation presentations (13%), and distance participation interactive sessions (10%) were also mentioned as KTE applications. In many of the articles, more than one KTE application was used and evaluated. Often the descriptions of KTE applications did not fit the categories we had created a priori (see Appendix D).

4.4 Data extraction and synthesis

Synthesizing this literature presented considerable challenges. We included a variety of types of articles in this review, including research studies with varying designs and approaches. The articles described KTE applications that differed considerably in

their approach, audience and intended outcomes. This made direct comparisons between the articles difficult and limited the type of synthesis we could accomplish.

4.4.1 All relevant articles

Overall, we found 66 articles relevant to our review question. During the data extraction stage, we found six of 61 quantitative articles that were not relevant and one that was supplementary to a study already included. Therefore, we extracted data from 54 quantitative articles. This section presents the data extracted from 12 qualitative and 54 quantitative articles (see Figure 1) under the following headings: context; domain and target audience; theoretical origins of KTE; and types of KTE applications and type of knowledge use.

Context

Context included geographical location(s) of the studies, domain of the KTE application, nature of the KTE application, and the theoretical origins of KTE.

The articles reviewed here report on KTE applications from many different jurisdictions and domains (see Table 2). The majority of the articles report on KTE in the United States (30%), Canada (26%) and the United Kingdom (18%). Finland, Germany, The Netherlands, Sweden, Switzerland, Australia, Iran, Thailand and the African nations of Cameroon, Kenya, Botswana and Tanzania are all represented in the literature reviewed.

Table 2: Reference, country, domain, target audience, theoretical origins, type of knowledge use, and KTE application for all studies

First author (Year) Country	*Domain* of the KTE application, and target audience	Theoretical origins reported as informing the KTE approach	Type(s) *of knowledge use*, and KTE applications
QUALITATIVE STUDIES			
Kite (1995) UK	*Healthcare* Practitioners: Nurses	Research utilisation literature Hunt (1987); Implementation of research MacGuire (1990); Rogers' model for the diffusion of innovations (1983); Action research approach Carr and Kemmis (1986)	*Conceptual, Instrumental* Applications: In person (workshop) Printed material Other: Presentation/ Conference
Kothari (2005) Canada	*Healthcare* Practitioners: Public health practitioners	A conceptual model was presented based on: Landry (2001), Beyer and Trice (1982), Lomas (1997), Caplan (1979), Oh and Rich (1996)	*Conceptual, Instrumental* Applications: Other: Communication/ Networking
Kramer (2003) Canada	*Other: workplace health and safety* Organization/workplace: Organization and workplace parties	Conceptual framework presented based on broad narrative review of KTE literature including Rogers (1995), Weiss (1981), Huberman (1994), Lomas (1997) and Lavis (2000)	*Conceptual, Instrumental* Applications: Opinion leader
Martin (1998) Canada	*Healthcare* Organization/workplace: Managers at 41 Referral Centres Practitioners: Designated therapists	Social marketing and diffusion theory Rogers (1995), Kotler and Zaltman (1971)	*Instrumental* Applications: In person (workshop) Other: Telephone Presentation/ Conference
Mubyazi (2005) Tanzania	*Healthcare* Practitioners: Clinicians	Research to policy framework Hanney (2002)	*Instrumental, Strategic/persuasive* Applications: In person (workshop) Printed material Academic detailing Other: Media

First author (Year) Country	***Domain* of the KTE application, and target audience**	**Theoretical origins reported as informing the KTE approach**	**Type(s) *of knowledge use*, and KTE applications**
Oreszczyn (2008) UK	*Agriculture* Jurisdictional policy makers: range of stakeholders interested in genetically modified food and its social implications	User-engagement initiatives Smith (2004); Nutley (2003); models of participatory and inclusive communication; Young (2002) research should inform public debate about policy decisions.	*Conceptual* Applications: In person (workshop)
Reed (2007) Botswana	*Agriculture* Practitioners: Rangeland stakeholders or "Pastoralists"	Social learning approach based on stakeholder participation (based on Kolb's learning phases) Kolb (1984)	*Conceptual, Instrumental* Applications: Other: Focus group
Ring (2005) Scotland	*Healthcare* Practitioners: Registered nurses	Evidence based practice literature broadly Davis & Taylor-Vaisey (1997); Cheater & Closs (1997); Feder (1999) - stated as theoretical background	*Conceptual, Instrumental* Applications: Unknown
Robinson 2004) Canada	*Healthcare* Jurisdictional policy makers Network/community of practice	Linking systems approach based on Rogers (1962) diffusion of innovation. Later developed by Havelock (1973), Kolbe and Iverson (1981) and Orlandi (1987)	*Conceptual, Instrumental* Applications: Other: Communication/ Networking Research activity
Ross (2005) UK	*Healthcare* Organization/workplace Practitioners: Community staff and hospital ward staff	Organizational change as process Pettigrew (1992) and Van de Ven (1999)	*Conceptual, Instrumental* Applications: Opinion leader Printed material Electronic materials (e.g. reminders)
Stetler (2007) USA	*Healthcare* Organization/workplace Practitioners: Managers	Evaluation based on Stetler (1994, 2001) and Baystate models of EBP Stetler (1998).	*Conceptual, Instrumental, Strategic/persuasive* Applications: Opinion leader In person (didactic presentation) Other: Research activity

First author (Year) Country	*Domain* of the KTE application, and target audience	Theoretical origins reported as informing the KTE approach	Type(s) *of knowledge use*, and KTE applications
Wright (2003) UK	*Healthcare* Organization/workplace: General practices Practitioners: Physicians	N/A	*Conceptual, Instrumental* Applications: Opinion leader Train the trainer In person (workshop) Printed material Electronic materials (e.g. reminders) Academic detailing Audit
INSTRUMENT DEVELOPMENT STUDIES			
Bahtsevani (2008) Sweden	*Healthcare* Practitioners: Different health professionals, but primarily registered nurses	Promoting Action on Research Implementation in Health Services (PARHIS) model Rycroft-Malone (2004)	*Conceptual, Instrumental, Strategic/persuasive* Applications: Printed material
Grad (2008) Canada	*Healthcare* Practitioners: Family physicians	Acquisition-Cognition-Application model Pluye (2005; 2007)	*Conceptual* Applications: Electronic materials (e.g. reminders)
Shiffman (2005) NR	*Healthcare* Practitioners: Clinicians who are meant to implement the guidelines Other: Guideline developers	N/A	*Other: NA* Applications: Other: Research activity
KTE IMPACT AS SECONDARY			

First author (Year) Country	*Domain* of the KTE application, and target audience	Theoretical origins reported as informing the KTE approach	Type(s) *of knowledge use*, and KTE applications
Bartholomew (2000) USA	*Healthcare* Organization/workplace Practitioners: Staff of Cystic Fibrosis(CF) centres	Social Cognitive theory Bandura (1986), Rogers Diffusion theory Rogers (1983)	*Conceptual, Instrumental* Applications: Opinion leader Train the trainer In person (workshop) Printed material Academic detailing Other: Presentation/ Conference
Levine (2007) USA	*Healthcare* Practitioners: Physicians	Learner-centered model, and peer training based on peer training methods of the Stanford Faculty Development Center Skeff (1992)	*Conceptual* Applications: Train the trainer In person (workshop) Printed material Electronic materials (e.g. reminders)
Lewis (2005) Canada	*Healthcare* Practitioners: Front-line clinical staff (mostly nurses)	Strategy used for dissemination was the framework developed by the National Health Service in the U.K. (NHS Centre for Reviews and Dissemination, 1999)	*Conceptual, Instrumental* Applications: In person (workshop) Printed material
Price (2008) USA	*Healthcare* Practitioners: Nurses	N/A	*Conceptual* Applications: Train the trainer Other: Computer Based Training (CBT)
Shirazi (2008) Iran	*Healthcare* Practitioners: Primary care physicians	N/A	*Conceptual* Applications: In person (workshop) In person (didactic presentation)

First author (Year) Country	*Domain* of the KTE application, and target audience	Theoretical origins reported as informing the KTE approach	Type(s) *of knowledge use*, and KTE applications
Tracy (2006) USA	*Healthcare* Other: Patients	Collaborative research utilization model Dufault (2004). Noted influence of Roger's Diffusions of Innovations Theory Janken and Dufault (2002)	*Conceptual, Instrumental* Applications: Printed material Other: Video/ Audio
PILOT STUDIES OF KTE IMPACT			
Armstrong (2006) USA	*Education* Practitioners: Teachers Other: School personnel	N/A	*Conceptual* Applications: In person (workshop) Printed material Electronic materials (e.g. reminders)
Legare (2007) Canada	*Healthcare* Organization/workplace: Family medicine group Practitioners: Physicians	Shared decision making (SDM) model as strategy for KTE Santesso (2006)	*Conceptual, Instrumental* Applications: Train the trainer In person (workshop) Printed material Other: Mail (e.g. reminders) Communication/ Networking
Okon (2004) USA	*Healthcare* Practitioners: Internal medicine residents	N/A	*Conceptual* Applications: In person (workshop) Printed material
KTE IMPACT STUDIES			
Ammendolia (2004) Canada	*Healthcare* Practitioners: Chiropractors Other: Public	N/A	*Conceptual* Applications: In person (workshop) Printed material Academic detailing Other: Media

First author (Year) Country	***Domain* of the KTE application, and target audience**	**Theoretical origins reported as informing the KTE approach**	**Type(s) *of knowledge use*, and KTE applications**
Barwick (2009) Canada	*Healthcare* Network/community of practice Practitioners: Children's mental health practitioners	KT process Oh & Rich (1996), Huberman (1994), Lomas (2000) and Community of Practice Wenger (2002)	*Conceptual, Instrumental* Applications: Train the trainer In person (workshop) Printed material Other: Communication/ Networking
Beaulieu (2004) Canada	*Healthcare* Practitioners: Physicians	N/A	*Conceptual, Instrumental* Applications: In person (workshop) Printed material
Bekkering (2005) The Netherlands	*Healthcare* Organization/workplace: Practices Practitioners: Physiotherapists	Model of behaviour change – Wensing (1998)	*Conceptual, Instrumental* Applications: In person (workshop) Printed material Other: Mail (e.g. reminders)
Bonetti (2005) England and Scotland	*Healthcare* Practitioners: General Practitioners (GPs)	Theory of behaviour change Ajzen (1991) and Social Cognitive Theory Bandura (1997; 2000)	*Conceptual* Applications: Printed material Audit Other: Mail (e.g. reminder)
Bowman (2005) USA	*Healthcare* Practitioners: Nurses	Iowa Model of Evidence-based Practice to Promote Quality Care Titler (2001)	*Conceptual, Instrumental* Applications: Printed material Audit Other: One-to-One sessions
Bunyatta (2006) Kenya	*Agriculture* Practitioners: Farmers	Farmer Filed Schools Mathur (1978) Perceptual Theory of Psychology Verduin (1979) Motivational and Personality theory “Stimulus-Response theory “Cognitive theory Pontius (2002) Diffusion of Innovation Rogers (1995)	*Conceptual, Instrumental* Applications: In person (workshop) In person (didactic presentation) Other: Communication/ Networking

First author (Year) Country	***Domain* of the KTE application, and target audience**	**Theoretical origins reported as informing the KTE approach**	**Type(s) *of knowledge use*, and KTE applications**
Byszewski (2003) Canada	*Healthcare* Practitioners: GPs	N/A	*Conceptual* Applications: Printed material
David (2007) Cameroon	*Agriculture* Practitioners: Farmers	Farmer Field Schools (FFS) Khisa (2005) Diffusion of Innovations Rogers (1995)	*Conceptual, Instrumental* Applications: Train the trainer In person (workshop)
Dufault (1999) USA	*Healthcare* Practitioners: Nurses Other: Patients	Evaluation was primarily based on: 1) Rogers (1983). 2) Orlando's Nursing Theory as theoretical evidence for patient-centered practice. 3) Philosophy of Collaboration in which clinicians, scientists, and students participate in all aspects of the research project. 4) Undergirding the model is philosophy that research utilization will only occur in environment of mutual respect where a spirit of clinical inquiry is fostered. Crane (1985); Dufault (2001); Horsley (1978); Lomas & Haynes (1988).	*Conceptual, Instrumental* Applications: Opinion leader In person (workshop) Printed material Audit Other: Research activity
Eccles (2002) England	*Healthcare* Organization/workplace: Primary care practices	N/A	*Instrumental* Applications: In person (workshop) Printed material Electronic materials (e.g. reminders)
Edwards (2007) Australia	*Healthcare* Practitioners: Level 1 and level 2 RNs	Theory of planned behaviour Ajzen (1985)	*Conceptual* Applications: In person (workshop) Printed material
Forte-Gardner (2004) USA	*Agriculture* Practitioners: Farmers	Diffusion of innovation Rogers (1995)	*Conceptual* *Instrumental* Applications: Other: One-to-One sessions

First author (Year) Country	***Domain* of the KTE application, and target audience**	**Theoretical origins reported as informing the KTE approach**	**Type(s) *of knowledge use*, and KTE applications**
Gunn (2003) Australia	*Healthcare* Practitioners: GP's	Adult social learning theories in the delivery of the programme Moulding (1999) Health programme planning model to implement and sustain the programme Hawe (1995)	*Conceptual, Instrumental* Applications: Opinion leader Train the trainer In person (workshop) Printed material Audit
Hammond (2005) UK and Ireland	*Healthcare* Practitioners: OTs	Stages of Change model Prochaska and DiClemente (1992), Keefe (2000), Social Cognition and behavioural theories Miller and Rollnick (2002).	*Conceptual, Instrumental* Applications: In person (workshop)
Haynes (2006) Canada	*Healthcare* Practitioners: Physicians	N/A	*Conceptual* Applications: Printed material Electronic materials (e.g. reminders)
Heinemann (2003) USA	*Healthcare* Practitioners: Doctor and non-doctor health care professionals	N/A	*Conceptual, Instrumental* Applications: In person (didactic presentation) Printed material
Huston (2006) Canada	*Healthcare* Organization/workplace Practitioners: Family physicians	Outreach facilitation model Cohen (1994); Hulscher (1998); Lemelin (2001)	*Instrumental* Applications: Train the trainer Printed material Academic detailing Audit
Jeannot (2003) Switzerland	*Healthcare* Practitioners: Physicians	N/A	*Instrumental* Applications: Electronic materials (e.g. reminders)

First author (Year) Country	*Domain* of the KTE application, and target audience	Theoretical origins reported as informing the KTE approach	Type(s) *of knowledge use*, and KTE applications
Joseph (2004) USA	*Healthcare* Organization/workplace Practitioners: Many disciplines including physicians, nurses, psychologists and pharmacists	N/A	*Instrumental* Applications: In person (workshop) Electronic materials (e.g. reminders) Academic detailing Other: Change in clinical processes e.g. training promoting treatment in the primary care setting, rather than use of referral based care.
Jousimaa (2002) Finland	*Healthcare* Practitioners: Physicians	N/A	*Instrumental* Applications: Printed material Electronic materials (e.g. reminders)
Kleindorfer (2008) USA	*Healthcare* Practitioners: Beauticians	N/A	*Conceptual* Applications: Train the trainer Printed material Other: One-to-One sessions
Kulkarni (1998) USA	*Healthcare* Practitioners: Dieticians Other: Diabetes patients	N/A	*Instrumental* Applications: Printed material Other: Telephone
Lasch (2000) USA	*Healthcare* Practitioners: Oncology nurses	Adult education Elliot (1995)	*Conceptual* Applications: In person (workshop) In person (didactic presentation) Other: One-to-One sessions Focus Group

First author (Year) Country	***Domain* of the KTE application, and target audience**	**Theoretical origins reported as informing the KTE approach**	**Type(s) *of knowledge use*, and KTE applications**
Mann (2009) Canada	*Healthcare* Practitioners: Nurses, pharmacists, and physicians	Kirkpatrick's framework (1994) for evaluation of outcomes of educational interventions, and the PRECEDE model (Predisposing, Reinforcing and Enabling Construct in Educational Diagnosis and Evaluation) (Green and Kreuter 1991), which includes assessment of the factors that influence change in response to an intervention.	*Conceptual* Applications: In person (workshop) Printed material
Meijers (2007) The Netherlands, Germany, UK	*Healthcare* Organization/workplace Practitioners: Clinicians	Rogers Innovation-decision process Rogers (2003)	*Conceptual, Instrumental* Applications: Other: Communication/ Networking
Mukohara (2005) USA	*Healthcare* Practitioners: General internists	A theoretical model of how delivery of newly published research findings influence doctors use of evidence in practice derived from Linzer (1988).	*Conceptual, Instrumental* Applications: Electronic materials (e.g. reminders)
Neitzel (1999) USA	*Healthcare* Organization/workplace: Fiscal outcomes Practitioners: Nurses, physicians	Diffusion of Innovation Rogers (1983) and Detailing theory Soumerai and Avorn (1990)	*Conceptual, Instrumental* Applications: In person (didactic presentation) Printed material Other: Chart reminders (pain management orders)
Norman (2006) USA, Canada, Australasia	*Healthcare* Practitioners: but mix of researchers, practitioners, policy makers and consumers/citizens (conference attendees)	Communities of Practice model Drawing on systems thinking, the science of networks and complexity theory which explores the behaviour of self-organizing structures. Axelrod (1997,1999); Monge (2003); Sanders (1998).	*Conceptual, Instrumental* Applications: In person (workshop) Other: Communication/ Networking
Oberdorfer (2004) Australia	*Healthcare* *Business* Organization/workplace: Managers Practitioners: Tattooists	N/A	*Conceptual, Instrumental* Applications: Printed material Audit

First author (Year) Country	***Domain* of the KTE application, and target audience**	**Theoretical origins reported as informing the KTE approach**	**Type(s) *of knowledge use*, and KTE applications**
Ohmart (2008) USA	*Agriculture* Practitioners: Wine growers	N/A	*Instrumental* Applications: In person (workshop) Printed material
Price (2006) England	*Other: social services* Organization/workplace Practitioners: Social care practitioners, consultants, educational advisors interested in fostering services	EBM, research dissemination findings Davies (2005); Nutley (2003a); Walter (2005)	*Conceptual* Applications: Printed material Electronic materials (e.g. reminders) Other: Video/Audio
Rashotte (2008) Canada	*Healthcare* Practitioners: Nurses	The organizing framework used for the study was the Ottawa Model of Research Use Logan and Graham (1998).	*Instrumental* Applications: Strategic/persuasive Opinion leader In person (workshop) Printed material Audit Other: One-to-One sessions
Rebbeck (2006) Australia	*Healthcare* Practitioners: Physiotherapists	Implementation was based on the Australian National Health and Medical Research Council (NHMRC) guide (NHMRC 1999).	*Conceptual, Instrumental* Applications: Opinion leader Train the trainer In person (workshop) In person (didactic presentation) Printed material Audit

First author (Year) Country	***Domain* of the KTE application, and target audience**	**Theoretical origins reported as informing the KTE approach**	**Type(s) *of knowledge use*, and KTE applications**
Renzi (2006) Canada	*Healthcare* Practitioners: Physicians	N/A	*Conceptual, Instrumental* Applications: In person (workshop) Printed material Other: A self-inking paper stamp memory aid tool Media Mail (e.g. reminders)
Roy (2008) UK	*Healthcare* Other: Prison, homeless sector Practitioners: Prison officials, homeless sector managers and staff	N/A	*Conceptual, Instrumental* Applications: Printed material
Sung (2008) Taiwan	*Healthcare* Practitioners: Nurses	N/A	*Conceptual, Instrumental* Applications: Opinion leader In person (workshop) Printed material Electronic materials (e.g. reminders)
Titler (2009) USA	*Healthcare* Practitioners: Physicians and nurses	A translation research model Titler and Everett (2001), developed from Rogers' (2003) diffusion of innovations model, provided the guiding framework for this study	*Instrumental* Applications: Opinion leader In person (workshop) Distance participation (didactic) Printed material Other: Video/Audio

First author (Year) Country	***Domain* of the KTE application, and target audience**	**Theoretical origins reported as informing the KTE approach**	**Type(s) *of knowledge use*, and KTE applications**
Udomratn (2002) Thailand	*Healthcare* Practitioners: Psychiatrists	N/A	*Conceptual* Applications: In person (didactic presentation) Printed material Electronic materials (e.g. reminders) Other: Mail (e.g. reminders)
Verhoeven (2004) The Netherlands	*Healthcare* Practitioners: General Practitioners	N/A	*Conceptual* Applications: In person (workshop)
Wallin (2000) Sweden	*Healthcare* Practitioners: Nurse managers	N/A	*Conceptual, Instrumental* Applications: Printed material Other: Presentation/ Conference
Watson (2002) Scotland	*Healthcare* Practitioners: Community pharmacies	N/A	*Instrumental* Applications: Opinion leader In person (didactic presentation) Printed material Academic detailing

Domain and target audience

A majority of the articles were from health care (89%) (see Tables 2 and 3). While we did not focus on health care, it is perhaps not surprising that our process yielded many KTE articles from health care. Recent literature about KTE has emerged from the evidence-based medicine literature according to a bibliographic analysis by Estabrooks et al., (2008). Using a longitudinal author co-citation analysis, Estabrooks and colleagues showed that the KTE literature has grown rapidly since the 1960s. From the mid-1960s to the mid-1980s, the focus was on diffusion of innovation and knowledge utilization. Since that time, the focus has grown to include evidence-based medicine (EBM), with many newer citations in that area. The increased focus on EBM in part helps to explain the predominance of health-care literature in this review.

Table 3: Domain, by percentage and number (n) of articles

Domain	**% of articles, (n)**
Healthcare	89 (59)
Agriculture	9 (6)
Education	3 (2)
Business	2 (1)
Other	3 (2)

As for target audience, the relevant articles in this review focused on practitioners, which included clinicians, teachers and farmers (see Tables 2 and 4). This was the case for a number of possible reasons: the predominance of the health-care literature, our relevance criteria (including our focus on evaluation), our definition of KTE and its emphasis on the transfer of research evidence, and our decision not to include KTE applications (e.g. social marketing campaigns) that would typically target end-users such as patients. The review team had many debates about the focus of KTE activities and, while we purposely kept the focus broad during the initial steps of the review, we decided to focus on practitioner-level data during the data extraction step.

Table 4: Target Audience, by percentage and number (n) of articles

Target	**% of articles, (n)**
Practitioners (Clinicians, Teachers, Farmers...)	92 (61)
Organization/ workplace	23 (15)
Other	11 (7)
Jurisdictional policy makers	3 (2)
Network/ community of practice	3 (2)

Theoretical origins of KTE

A number of recent articles suggest the need for theoretical and conceptual background in KTE practice and evaluation (Thompson et al., 2006; Estabrooks et al., 2006; Tugwell et al., 2011; Colquhoun et al., 2010).

Estabrooks and colleagues (2006) described four main theories used within the field of KTE: Diffusion of Innovation, including Greenhalgh's expansion (Rogers, 2003; Greenhalgh et al., 2004), Research Dissemination Utilization Framework (Havelock, 1969), Promoting Action on Research in Health Services Model (PARiHS) (Rycroft-Malone et al, 2004), and the Ottawa Model of Research Use (Logan and Graham, 1998).

The theory most often mentioned in this review was Diffusion of Innovation (Rogers – from various years: 1962, 1983, 1995, 2003) (see Table 2). However, a great deal of heterogeneity existed within this set of articles, with many general and specific theories reported, much as Estabrooks et al. (2006) noted in their article. We similarly noted that the theories could be categorized along the lines of those denoted by Estabrooks and colleagues (2006). Beyond the diffusion-of-innovation theories, more general dissemination/utilization theories (e.g. Havelock, 1973; Orlandi,1987) and the Ottawa Model (Logan and Graham, 1998) were also mentioned. Theories and models from health care and EBM were also found, varying from Huberman (1994) and Weiss (1981) to Rycroft-Malone et al. (2004) and the PARiHS model. Also noted were specific theories related to the concepts of KTE explored in the particular articles, such as the theory of planned behaviour, shared decision-making, and communities-of-practice frameworks. However, we also found that information about theoretical origins of KTE was often not explicitly indicated in the articles.

Types of KTE applications and type of knowledge use

The articles described and evaluated a variety of KTE applications (see Tables 2 and 5). The review team prepared a list of KTE applications a priori based on the experience of the KTE practitioners and researchers on the team. The most commonly described KTE applications were printed materials such as booklets or guideline checklists (reported in 66% of the articles), and interactive in-person workshops (reported in 50% of the articles). A large percentage of applications (48%) were not easily categorized according to our list of KTE applications and were therefore categorized as "other." Of these, the most common were communication/networking (reported in 9%), one-to-one communication (7%) and mail reminders (6%).

The variety of KTE applications reported and evaluated is not surprising. There are suggestions that multiple applications are better than single approaches (Grimshaw

et al., 2001; Greenhalgh et al., 2004; Mitton et al., 2007). Most of the articles from this review (75%) described multiple applications.
This review did not focus on the differential impacts of the various applications. It focused on the instruments used to evaluate KTE applications and their impact. We were interested in capturing instruments that could be used regardless of the application. However, we realize instruments can be specific to the application and context of the study.

Table 5: KTE application, by percentage and number (n) of articles

KTE application	**% of articles, (n)**
Printed material	65 (43)
In person (workshop)	52 (34)
Electronic materials	21 (14)
Opinion leader	18 (12)
Train the trainer	17 (11)
In person (didactic presentation)	14 (9)
Audit	14 (9)
Academic detailing	11 (7)
Distance participation (didactic)	2 (1)
Other	48 (32)

The articles often mentioned conceptual and instrumental types of knowledge use (see Tables 2 and 6). This is to be expected, since the concept of strategic/persuasive knowledge use is not generally considered a positive one. In the four articles that mention strategic/persuasive knowledge use, it was not the target of the approach or evaluation, but rather was most often reported as an unintended (or undesired) outcome.

It is important to note that we extracted data from articles that mention and consider different types of knowledge use. However, this does not mean that the instruments used in the articles were focused on these specific types of knowledge use. In a later section, we report more details about the instruments in these articles.

We further note that these articles may not be representative of all KTE impact evaluation literature. However, they are representative of the literature that evaluates KTE using a specific approach or instrument (as was the focus of our review).

Table 6: Types of knowledge use, by percentage and number (n) of articles

Type of knowledge use*	**% of articles, (n)****
Conceptual	80 (53)
Instrumental	71 (47)
Strategic/Persuasive	6 (4)

* Note that, in one case, “other” was indicated as type of knowledge use because the type of knowledge use was not stated in the article.
** The numbers in this column add up to more than 100 per cent because more than one type of knowledge use could be indicated in an article.

4.4.2 Synthesis of the qualitative articles

Although the literature search for this systematic review was as inclusive as possible, only 12 qualitative articles met the relevance criteria. This relatively small number of qualitative articles may in part reflect the quantitative nature of the review question: Does the article describe a KTE outcome or a tool to measure a KTE outcome as the result of a KTE application? The terms and concepts used in this review question are not commonly found within the qualitative paradigm.

The 12 articles that made it through the review process were notable for their diversity. They differed substantially in the questions they asked, theoretical aspects of KTE noted, their jurisdictions and sectors, their knowledge transfer approaches, and their evaluation methods. Most of the studies (like the quantitative papers) were conducted within the health care domain, but a couple were from the agriculture sector and one was workplace-based. Four were from Canada, four from the UK, one from Scotland, one from Botswana and one from Tanzania. The studies varied in the size of the population being targeted by the KTE approach, from country-wide to a neighbourhood health district.

The *focus* of these studies varied considerably. A couple of studies examined the research-to-policy process; i.e. how the interaction between researchers and policy-makers can promote the use of research findings. One of these studies examined the influence of research on changing anti-malarial drug policy in Tanzania (Mubyazi and Gonzalez-Block, 2005). A study based in Africa’s Kalahari examined how local and scientific knowledge could contribute to the adaptation of rangeland to land degradation (Reed et al., 2007). Another study in the UK used a workshop to engage senior policy actors in discussions on the precautionary principle relative to genetically modified crops (Oreszczyn and Carr, 2008). Three studies specifically focused on stakeholder engagement in the research process. One looked at management and worker engagement to achieve workplace-based change in the manufacturing sector (Kramer and Cole, 2003), another at the design and delivery of health-care programs on breast-cancer prevention to public health units (Kothari et al., 2005), and yet another at the engagement of researchers, policy-makers and public health practitioners to implement a province-wide heart-health strategy (Robinson et al., 2004).

Dissemination and adoption of evidence-based guidelines/practice in the health-care sector dominated the qualitative studies. The six studies that addressed this topic examined the following: the adoption of EBPs on asthma and angina within two health districts (Wright et al., 2003); early intervention programs in addiction treatment centres (Martin et al., 1998); mouth-cleaning strategies by nurses in an intensive care unit (Kite, 1995); standardized assessments of older people in regard to their readiness to be discharged from hospital (Ross et al., 2005); the adoption by nurses across Scotland of five best practices (Ring et al., 2005); and the adoption of EBP among nurses in a large acute-care teaching hospital (Stetler and Caramanica, 2007). Two other studies were health-related, although not health-care per se. Robinson et al. (2004) focused on a collaborative process to disseminate a health promotion program, and Kramer and Cole (2003) examined the role of knowledge brokers in disseminating health research to workplaces.

All but one study mentioned the *theoretical focus of KTE*. No particular theory dominated. Two used Rogers' Diffusion of Innovation theory (Rogers, 2005). Others used knowledge-transfer theory (Weiss, 1979; Rich, 1997; Huberman, 1989), social learning theory (Bandura, 1986), participatory action-research theory; social marketing theory and research-to-policy theory (Weiss, 1980; Nutley et al., 2003a), the PARiHS model (Kitson et al., 2008), and the innovation journey model together with organizational change theories (Van de Ven et al., 1999; Pettigrew et al., 1992). The Baystate model of evidence-based practice and research on guideline utilization (Greenhalgh et al., 2004; Grol and Grimshaw, 2003; Nutley et al., 2003b; Stetler, 1994, Stetler and Caramanica, 2007) was also used. Some of the studies focused on a sustained and intensive user-engagement in the research process, alternatively called integrated knowledge translation or the linking system approach (CIHR, 2010; Huberman, 1989; Nutbeam, 1996; Orlandi, 1990, 1996).

All of the studies used *multiple knowledge transfer applications*; however, the studies did not compare the different applications. The KTE techniques used included a wide range of change-management strategies, as well as use of opinion leaders and knowledge brokers. Five studies had highly interactive strategies, such as holding researcher-stakeholder workshops to identify priorities, building collaborations between research centres and health units, facilitating scenario workshops, holding focus groups, observing participants, and involving users in the research process by creating teams to identify research priorities or create best-practice guidelines. Educational strategies were both interactive and didactic, and included 20-minute demonstrations, in-service teaching, two-day workshops, monthly educational sessions, meetings, outreach visits, support programs and professional conferences. Communication strategies included both passive and active strategies and print and electronic forms. There was dissemination by mail, the distribution of information packages including press releases, newsletters and brochures, making research articles available, and sending electronic reminders. One study (Robinson, et al., 2005) listed multiple interventions including training, retreats, collaboration, so-sponsorship, networking, facilitation, informal training, advocacy, research

information exchange, and volunteer development. Another study (Stetler and Caramanica, 2007) evaluated a number of self-identified clinical teams in a hospital that had engaged in identifying the need for evidence-based practice, literature searches, and the application of the research findings to practice over six years.

Overall, the studies did not report the *study design or approach* well. Case studies and cross-case studies dominated this set of articles. The size and complexity of the case studies varied, from the observation of a group of ten nurses (though only five were interviewed) in one hospital (Kite, 1995), to a rich and rigorous multi-method reporting and analysis of a drug policy change within Tanzania (Mubyazi and Gonzaelez-Block, 2005). There were also cross-case comparisons. Reed et al., (2007) compared three communally-managed rangelands with different biophysical and cultural settings in Botswana. Kramer and Cole (2003) compared three different medium-sized manufacturing sites in Ontario, Canada. Kothari et al., 2005) compared three teams within six interacting public health units in Ontario, Canada. The study by Ross et al., (2004) involved nine different healthcare settings using a quasi-experimental before-and-after evaluation, however the qualitative component was based on the findings from one ward in a general hospital in South London, UK.

Three of the studies used an *evaluation framework* to help guide their data collection, analysis and findings. Kramer and Cole (2003) and Stetler and Caramanica (2007) used “knowledge-utilization science relative to types of research use” (Weiss, 1979; Weiss and Bucuvalas, 1980) as a framework to guide evaluation. The *types of knowledge use* included instrumental; conceptual; and strategic/persuasive. Kramer and Cole (2003) also used an adaptation of the hierarchically-ordered scale of knowledge use proposed by Knott and Wildavsky (1980) which included reference, effort, adoption, and implementation. Robinson et al. (2004) used a framework that examined documented changes in capacity and program implementation to evaluate the intervention effect. Changes in capacity referred to knowledge or skill development; partnerships, resource acquisition, and organizational infrastructure. Changes in implementation included level of program delivery, program type and scope, and a measure of program sustainability.

There were multiple methods of *data collection* described, including the observation of behavior and participant observation, to field notes, key-informant interviews, semi-structured interviews, patient telephone interviews, focus groups, audits of records to examine prescription rates, content analysis of project reports, journal publications and funder reports (Robinson et al., 2004), and workshop thematic mapping. Studies also augmented their data collection with more quantitative methods such as surveys. Stetler and Caramanica (2007) included a rich level of detail regarding the data collection process.

Multiple *analytic methods* were described, including the use of causal grounded theory for systematic case comparisons (Miles and Huberman, 1994), grounded theory (Creswell, 2009), and content analysis of reports.

The reviewers considered the *scope, depth and integrity of the analysis* as defined by the CASP criteria (Public Health Resource Unit, 2008) for each of the relevant qualitative articles. There were two major critiques of the studies. First, the KTE applications were often rather simple educational or training sessions. Second, there were often important methodological details missing in the article, which made evaluation of the quality of the findings difficult. Key details regarding how subjects were recruited, how interviews or focus groups were conducted, and how the data was collected, managed and analyzed were often missing. While the studies generally reported on the theoretical basis or framework employed they often lacked a clear linkage between the study implementation and the theoretical framework.

Overall, four studies stood out as high quality: Kramer and Cole (2003); Mubyazi and Gonzalez-Block (2005); Robinson et al. (2004); and Stetler and Caramanica (2007). These studies acknowledged their theoretical underpinnings; described a complex knowledge transfer strategy or application; set out an explicit research design or approach; included an evaluation framework with rich detail about the evaluation criteria; described data collection and analysis clearly; and tied together the theory or framework and the findings in the discussion.

4.4.3 Synthesis of the quantitative articles

In total, 54 quantitative articles met our relevance criteria and contained an instrument for the evaluation of KTE applications. We classified these studies into four categories reflecting the objectives of the individual studies. Three articles developed an instrument to evaluate KTE, six articles had a secondary objective to evaluate a KTE application, three articles reported on pilot studies to evaluate a KTE application. and the remaining 42 articles had as their primary objective the evaluation of a KTE application.

We refer to and comment on all of these articles when we describe the instruments and the measurement properties of the instruments. However when we describe how the instruments relate to the study outcomes and objectives we refer to the subset of articles that have described measurement properties for the instruments.

Impact of KTE applications (in a review of instruments)

The secondary objectives of the review were to a) make recommendations about common elements of KTE that are most effective; and b) make recommendations about how to evaluate the impact of KTE. We initially felt these objectives could be addressed because we specifically looked for instruments within articles that reported on evaluations of KTE applications.

We examined the subset of studies that provided measurement property information in order to explore common elements of KTE that are most effective. The studies used a variety of different KTE applications, often using multiple KTE applications (such as printed material, and in person workshop). Each study's use of different KTE applications made it difficult to answer our secondary objective regarding

common elements of KTE that are *most* effective. Due to the high degree of heterogeneity, it was not possible to contrast these studies in order to address this question. We note that many studies emphasized explicitly that "bundles of strategies" have synergistic effects and are in keeping with KTE principles (e.g. Rashotte et al., 2008; Grimshaw et al. 2001). However, the small number of studies in this subset and their limited detail did not allow us to explore this concept of "bundling" or multiple applications further.

To address our objective about how to evaluate the impact of KTE, we focused on the 21 studies that provided measurement properties of the instruments. Given that these were evaluation studies, it is somewhat surprising that about half of the study designs did not include a non-intervention referent group (10/21), and three of these employed post only measures, though one was highly innovative in its community-of-practice mapping approach (Norman and Huerta, 2006). Such uncontrolled designs may reflect the relatively underdeveloped nature of measurement work in the KTE evaluation field, or it may indicate a desire of groups of researchers and health-care managers to conduct more pragmatic evaluations to inform local practice, as has been advocated by Bhattacharyya and colleagues (2011). To address internal validity, a number of studies did include a referent group or some effort at finding a comparable population (n=4; pre-post with referent or quasi experimental). Six studies were randomized controlled trials, three randomized at a cluster level. and three individually randomized, while all were more pragmatic in nature (Bhattacharyya et al., 2011). We agree with Bhattacharyya and colleagues (2011) that evaluation studies that adequately address internal validity and generalizability are most desirable and will advance the field of KTE evaluation.

Instruments and measurement properties

Across the 54 articles, a wide variety of instruments were used in the evaluation of KTE applications and their impact. While patient-based outcomes are useful instruments and often required for the complete evaluation of KTE applications in health care (where the ultimate goal is to change patient outcomes), we focused more on practitioner-level changes. This focus arose in part because it was more feasible, but also because of our relevance criteria. As we moved away from KTE applications that targeted student, patient, client or public audiences, the focus became practitioner knowledge and/or behaviour. Our team had lengthy debates about the review's scope. We maintained a broad focus initially and came to hone in on the practitioner level as we moved from quality appraisal to data extraction. At these levels, we realized that many studies did not use patient- or client-level instruments. but more often used counts of events from administrative data. There were articles that described instruments examining specific patient-level outcomes (such as pain, adherence or satisfaction) that were expected to change as a result of a KTE application. In one study alone, seven patient-level instruments were used to evaluate the KTE application (Tierney et al., 2005, not included in synthesis). Some of the patient-level instruments had well established measurement properties.

As a team, we recognize the importance of patient/client-level outcomes but decided to focus on the practitioner-level outcomes for this review.

We found that there were practitioner instruments that are non-specific and tend to focus on modifiers of KTE agency such as:

- 'Modified Prochaska Questionnaire' (MPQ)
- Modified Organizational Readiness for Change Scale
- States of Change Questionnaire
- Decisional Conflict Scale (DCS)

All the above scales are theory-based measures that seek to identify whether individuals or organizations have moved towards action.

Some instruments also focused on very specific targeted content changes of the KTE activity. Some examples are:

- Pharmacy satisfaction questionnaire
- Integrated pest management survey
- Fever management survey
- Knowledge and Attitude Survey Regarding Pain
- A 'Music Knowledge' Questionnaire
- Pain assessment audit instrument
- Barriers to optimal pain management tool

Finally, there was a general class of instruments that capture the knowledge transfer process:

- The Perceived Stage of Adoption Instrument
- Use of Research Findings in Practice Scale
- Use of Innovations Questionnaire
- Competency in Research Utilization
- Attitudes Towards Research Utilization Scales

While the lists above may be useful for KTE researchers and practitioners as examples of instruments that could be used in the evaluation of KTE and impact, we note that it is important to understand key measurement properties about the instruments.

Measurement properties of the instruments used to evaluate KTE applications

Overall the measurement properties of the instruments used in this set of articles was not well described. Fifty-five per cent of the articles do not provide measurement property information about the instruments they used. Validity was reported in 26 per cent and reliability was mentioned in 30 per cent of the articles (see Tables 7 and 8), and both were mentioned in nine per cent of these studies. In one article

(Heinemann et al., 2003), non-classical techniques were used to describe the measurement properties.

Table 7: Measurement properties reported, by percentage and number (n) of articles (n=54) (see Table 8 for details)

Measurement property	**% of articles, (n)****
Validity	26* (14)
Content/Face Validity (Expert Review)	15 (8)
Construct Validity (Factor Analysis)	6 (3)
Concurrent Validity	2 (1)
Reliability	30* (16)
Internal Consistency	20 (11)
Test-Retest	9 (5)
Inter-Rater	7 (4)
Other	2 (1)
Rasch analysis	2 (1)
Referenced but no data reported	7 (4)
No measurement properties mentioned or referenced	55 (30)

* Validity and reliability were described together in five (9%) of the articles.
**The percentages in this column add up to more than 100 because multiple properties per instrument and multiple instruments per article were possible.

Due to the fact that measuring the outcomes of KTE activities is still an emerging research area, only three articles sought to develop instruments and report on their measurement properties (Bahtsevani et al., 2008; Grad et al., 2008; Shiffman et al., 2005) (see Table 8). However a majority developed instruments and did not report any measurement properties. Some used instruments already developed demonstrating the usability of the instrument in different populations. While there are many articles that consider the face or content validity of the instrument or report on using expert reviewers to assess content, this is the most minimal development, but was included in our assessment. Despite the advances in measurement sciences only one study (Heinemann et al, 2003) used modern psychometric methods.

The three measure development articles were relatively recent and described foundational instrument properties such as iterative content validity (Shiffman et al., 2005), construct validity using factor analysis (Grad et al., 2008), and test-retest reliability based on instrument designed on PARIHS model (Bahtsevani et al., 2008).

In addition to the instrument development articles some evaluation articles presented clear and informative information about the validity and reliability of the instruments used. Only one research group presented information on concurrent validity (Shirazi et al., 2008) and scale construct validity was explored in only three studies using factor analysis (Grad et al., 2008) and expert review/rating (Shiffman et al., 2005;

Sung et al., 2008). The majority of the validity results presented were about content/face validity as determined by experts or users (Shiffman et al., 2005; Price et al., 2008; Shirazi et al., 2008; Dufault et al., 1999; Edwards et al., 2007; Neitzel et al, 1999; Sung et al., 2009; Titler et al., 2009).

By far the most commonly cited measurement property was the internal consistency of the scale items. This was most commonly established through the Cronbach's alpha (Bartholomew et al., 2000; Armstrong et al., 2006; Legare et al., 2007; Okon et al., 2004; Bonetti et al., 2005; Dufault et al., 1999; Lasch et al., 2000; Mukohara and Schwartz, 2005; Neitzel et al., 1999; Titler et al., 2009). It was also established through the Kuder-Richardson KR-20 (Sung et al., 2008). Some considered the assessment of internal consistency a measure of validity and others of reliability. We report it as a reliability measure. Other reliability measures reported include test-retest reliability (Bahtsevani et al., 2008; Dufault et al., 1999; Neitzel et al., 1999; Titler et al., 2009) and inter-rater or intra-rater reliability (Ammendolia et al., 2004; Bekkering et al., 2005; Gunn et al., 2003; Titler et al., 2009).

Overall, the measurement properties were not consistently presented, and a majority of studies (30) did not provide any information at all. In four studies, the researchers referred to reliability and/or validity but did not provide any information or reference another study (Mann et al., 2009; Norman and Huerta, 2006; Rashotte et al., 2008; Ammendolia et al., 2004). In one instance, the reference was clearly to a psychometric study (Titler et al., 2009). Those that did report measurement properties did not always provide consistent or complete information (see Table 8).

Table 8: Name and description of instruments and their measurement properties

First author (Year) Country	*Name* and description of the instrument used to evaluate the KTE application	Measurement properties: details about the measurement properties for tools at this level
INSTRUMENT DEVELOPMENT STUDIES		
Bahtsevani (2008) Sweden	*Name: not given* Description: 23 item instrument for evaluating implementation of clinical practice guidelines (CPGs). Questions: 7 on respondent characteristics; 10 on use (in which one consisted of 5 Visual analogue scales constructed between the continuums of two contradictory statements drawn from the PARiHS framework, pertaining to clinical experiences and one 5 VAS related to patients' experiences); 4 on implementation (one included eight VAS related to the context of care); and 2 on evaluation of the CPG.	Reliability: Test-retest reliability. Use of CPG questions: 0.73 for use any, 0.79 for number used, both good agreement. Role of experiences as circumstances surrounding use question and VAS: clinical range 0.39 to 0.64; patients' range 0.38 to 0.69 so both fair to moderate agreement. Implementation question, 0.80 excellent agreement. Context of care and function of facilitator VAS: 0.42 to 0.64, moderate to good agreement.
Grad (2008) Canada	*Name:* "Cognitive impact assessment scale" Description: a ten item pop-up questionnaire to examine the global construct of cognitive impact of health information by email alert called InfoPOEM (Patient Oriented Evidence that Matters)	Validity: Construct validity tested using principal component analysis (PCA) with varimax rotation. An 8-factor solution explained 89.8% of total variance indicating different dimensions of the construct were being measured. Several moderately large residual correlations on exploratory multilevel factor analyses assessing PCA solution robustness to multiple ratings per InfoPOEM and per participant suggested a 9th factor may be needed.

First author (Year) Country	*Name* and description of the instrument used to evaluate the KTE application	Measurement properties: details about the measurement properties for tools at this level
Shiffman (2005) NR	*Name: GuideLine Implementability Appraisal (GLIA)* Description: GLIA consists of 31 items, arranged into 10 dimensions. Decidability and Executability are critical dimensions. Other dimensions are Global, Presentation and Formatting, Measurable Outcomes, Apparent Validity, Flexibility, Effect on Process of Care, Novelty/Innovation, and Computability. Questions from 9 of the 10 dimensions are applied individually to each recommendation of the guideline.	Validity: Preliminary evidence of GLIA's content and construct validity obtained through: validation of the construct of implementability via consistent expert ranking; content clarification, relevance confirmation, and comprehensiveness testing through expert review; and documenting agreement between GLIA ratings and expert assessment.
KTE IMPACT AS SECONDARY		
Bartholomew (2000) USA	*Name: Cystic Fibrosis Family Education Program diffusion questionnaire* Description: 47 item survey instrument, developed to measure: perceived program characteristics, center characteristics, adoption and implementation processes, and decision-making regarding program adoption. Item response 1-10.	Validity: Both the internal consistency (Cronbach's Alpha, 0.75 to 0.94) and split-half reliability coefficients (.75 to .97) acceptable for all 8 scales in both the coordinator and clinic director groups.
Levine (2007) USA	*Name: not given* Description: physicians' self-rating on knowledge, confidence, and practice related to tool kit content. Tool kit was used by peer-educators to run small-group learning centered continuing education sessions.	No measurement properties presented
Lewis (2005) Canada	*Name:* "Follow-up evaluation questionnaire" Description: self-report questionnaire with 4 open ended questions about awareness and use of guidelines and suggested improvements.	No measurement properties presented

First author (Year) Country	*Name* and description of the instrument used to evaluate the KTE application	Measurement properties: details about the measurement properties for tools at this level
Price (2008) USA	*Name*: *Not given* Description: survey questions were from the Sinclair School of Nursing survey (Bullock et al., 2004), including description of current recommendations and information sources, percent time using specific practices in routine care, and knowledge,facility characteristics, current infant care practices, knowledge of risk reduction recommendations.	Validity: The measures were provided to stakeholder groups including medical, nursing, public health, and non-profit professionals for review and revision in order to enhance face and content validity of individual items. [no further information provided]
Shirazi (2008) Iran	*Name: 'Modified Prochaska Questionnaire' (MPQ).* Description: the MPQ was used to assess readiness for change in a research transfer programme *and c*onsists of 11 statements answered by 'yes' or 'no' corresponding to the attitude stage (3), intention stage (4) and action stage (4)	Validity: Reliability: A panel of experts convened four times to review content and compile the final MPQ. Concurrent validity assessed in relation to semi-structured interviews (blinded categorization): item Kappa ranges 0.50 (1), 0.68 to 0.79 (3), >0.80 (7), total 0.93. Test–retest reliability, Kappas: items 0.74 & 0.77, remaining 9 all >0.80, total 0.88. (Shirazi, 2007).
Tracy (2006) USA	*Name: "the Audit Instrument"* Description: Applied to each patient's chart to determine whether individualized treatment plans and protocols were followed.	No measurement properties presented
PILOT STUDIES OF KTE IMPACT		

First author (Year) Country	***Name* and description of the instrument used to evaluate the KTE application**	**Measurement properties: details about the measurement properties for tools at this level**
Armstrong (2006) USA	*Name: "Planning Team Survey"* Description: survey to assess the extent to which participation in the curriculum and creation of a prevention plan affected the team member's perceptions of their capacity to engage in data-driven prevention planning. Comprised of 23 questions about knowledge in: (1) Familiarity with data-driven planning, (2) identifying and understanding evidence-based prevention strategies, (3) developing and executing a plan for implementation, (4) planning and conducting an outcomes analysis, and (5) identifying and addressing stakeholders. 5 point Likert scale responses.	Reliability: Internal consistency: Scale reliabilities (alpha) ranged from .54 to .92, with a mean of .78.
Legare (2007) Canada	*Name: 1) decision questionnaire* *2) Decisional Conflict Scale (DCS)* Description: 1) a self-administered questionnaire that: assessed the decision about using antibiotics (immediate use, delayed use, or no use); the respondent physician's perception of the quality of the decision (a single item on a 10-point Likert scale); and intentions to engage in shared decision making (SDM) and comply with clinical practice guidelines 2) Decisional Conflict Scale (DCS) (O'Connor, 1995) includes 16 items, scored on a 5-point Likert scale (1 = strongly agree to 5 = strongly disagree) with higher score associated with higher decisional conflict	Reliability: for Decisional Conflict: internal consistency coefficients (Cronbach's alpha) from previous studies (O'Connor, 1995) ranged from 0.78 to 0.90 in the physicians' version

First author (Year) Country	***Name* and description of the instrument used to evaluate the KTE application**	**Measurement properties: details about the measurement properties for tools at this level**
Okon (2004) USA	*Name: not given* Description: Survey modified from previously published instruments (Oneschuk et al., 1997) specifically designed to assess physicians' knowledge (16 items) and attitudes (9 items), the latter 5 point Likert scale. Additional questions asked re experience with regard to end-of-life care.	Reliability: Internal consistency, Cronbach's alpha of 0.69 for the attitude/opinion portion and 0.89 for the knowledge portion (Burge, 2000).
KTE IMPACT STUDIES		
Ammendolia (2004) Canada	*Name: not given* Description: A brief mailed survey to asses use of radiograph for acute low back pain	Validity: Reliability: The survey instrument had been used in a previous study and pretested for (intra-rater) reliability (kappa 0.81) and content validity (Aker, 1997).
Barwick (2009) Canada	*Name: 1)Practice Change Questionnaire* *2) CAFAS Knowledge Questionnaire* Description: 1) A 10-question Likert scale questionnaire developed based on best practice behaviours for CAFAS use 2) 20 true/false questions measuring specific knowledge related to clinical use of the CAFAS scale. Note: Child and Adolescent Functional Assessment Scale, (CAFAS)	No measurement properties mentioned

First author (Year) Country	***Name* and description of the instrument used to evaluate the KTE application**	**Measurement properties: details about the measurement properties for tools at this level**
Beaulieu (2004) Canada	*Name: not given* Questionnaire consisting of 8 multiple-choice questions, 2 types - those concerning patients with no gastro-intestinal (GI) risk factors and those concerning patients with GI risk factors. Each question was scored 1 or 0 according to whether or not the checked answer agreed with the workshop content.	No measurement properties presented
Bekkering (2005) The Netherlands	*Name: not given* Description: The patient registration form contained questions about: history taking and physical examination; treatment goals; content of the treatment; number of treatment sessions.	Reliability: <u>Inter-observer reliability</u>. The proportion of patients for whom each and all four criteria were fulfilled was calculated. Cohen's kappa for agreement of the separate criteria between all pairs of reviewers of the registration forms varied between 0.85 (95% CI 0.80 to 0.90) and 0.38 (95% CI 0.25 to 0.50).
Bonetti (2005) England and Scotland	*Name: not given* Description: Behavioural intention by 3 items re referral for X-ray summed to 0-30 score. Simulated behaviour via scenarios with different key clinical, GP and patient elements (10 per survey). Outcome referral for x-ray, summed 0-10	Reliability: <u>Internal consistency</u>: Cronbach alphas for behavioural intention were moderate to high (0.66 time 1 and 0.82 time 2). Cronbach alphas for simulated behaviour were relatively low (0.51, time 1 and 0.54, time 2) and were not improved by dropping scenarios least related to the total score.
Bowman (2005) USA	*Name: not given* Description: Chart audit and Staff survey assessing knowledge using true/false and multiple-choice questions.	No measurement properties presented

First author (Year) Country	***Name* and description of the instrument used to evaluate the KTE application**	**Measurement properties: details about the measurement properties for tools at this level**
Bunyatta (2006) Kenya	*Name: not given* Description: 20 questions face to face with farmers on agricultural knowledge and technologies, with a focus on new adoption or farm practices	No measurement properties presented
Byszewski (2003) Canada	*Name: not given* Description: nine knowledge-based questions (four multiple choice and five true or false) about awareness of key driving and dementia facts, 6 Likert scales tapping physician confidence, and selection of 8 questions they would use to assess fitness to drive.	No measurement properties presented
David (2007) Cameroon	*Name: not given* Description: survey covered question about uptake of practices/knowledge, diffusion of knowledge from Farmer Field Schools (FFS), method of diffusion, social impacts of FFS and knowledge related to four broad areas covered in FFS cocoa physiology, disease and pest management, rational pesticide use and post harvest operations.	No measurement properties presented

First author (Year) Country	***Name* and description of the instrument used to evaluate the KTE application**	**Measurement properties: details about the measurement properties for tools at this level**
Dufault (1999) USA	*Name: 1)Use of Innovations Questionnaire (Dufault, 1995)* *2) pain assessment audit instrument* *3) Competency in Research Utilization* *4) Attitudes Towards Research Utilization Scales (Kim 1988)* Description: Four instruments were used to measure changes in pain assessment practice, changes in nurses' research utilization competency and nurses' attitudes towards research: 1) The self-report "use of innovations" questionnaire is a three-item instrument (Dufault, 1995). 2) 25-item pain assessment audit instrument based on Ferrell (1991) which measures 25 indicators related to pain assessment used to validate change indicated by the use of innovations questionnaire. 3) Kim's (1988) research utilization competency scale 4) Kim's (1988) attitude towards research utilization scale were used to determine nurses' research competencies and attitudes	Validity: Reliability: 1) Use of innovations questionnaire: 3 item content validity determined by panel of experts. 2) Pain assessment audit instrument adapted from Ferrell (1991) (internal consistency) reliability coefficient 0.90 3) Kim's research utilization scale 13 item Likert scale (internal consistency) Cronbach's alpha =0.86. Test-retest reliability was r= 0.83. 4) Kim's attitudes towards research scale -10 items – (internal consistency) Cronbach's alpha = 0.94. Test-retest reliability was r= 0.80.
Eccles (2002) England	*Name: not given* Description: Patient chart abstraction	No measurement properties presented

First author (Year) Country	***Name* and description of the instrument used to evaluate the KTE application**	**Measurement properties: details about the measurement properties for tools at this level**
Edwards (2007) Australia	*Name: The Fever Management Survey (FMS)* comprised three instruments: *fever management knowledge (FMK) (24 items), fever management attitudes (FMA) (32 items), fever management practices (FMP) (28 items).* Description: The FMS instrument explored nurses' knowledge, and attitudes, and practices related to evidence-based fever management.	Validity: The FMS survey was developed from an instrument (Walsh, 2005) with content and face validity and total instrument Kappa of 0.644. Face and content validity of modified instrument were determined by team of experts including paediatric nurse researchers, Level 2 paediatric RNS and academic researchers.
Forte-Gardner (2004) USA	*Name: Ralston project growers' survey* 31 open-ended, partially open-ended, closed-ended and categorical questions about project implantation and uptake.	No measurement properties presented
Gunn (2003) Australia	*Name: 1) Guidelines for Assessing Postnatal Problems GAPP self-report questionnaire* *2)Simulated patient evaluators (SPEs)* rating scale (communication and case-specific items) Description: 1) The survey, contained nine sections covering common physical problems, postnatal depression, general postnatal role, interaction with maternal and child health nurses, interaction with other health professionals about maternal health, attitudes towards postnatal care, reflection about own practice, communication skills. Items 5 point Likert scales, specified categories and open-ended. 2) Consenting GPs were booked to conduct a standard consultation with a trained SPE. The SPEs participated in the consultation, then left the room for to complete a rating scale (communication and case-specific items)	Reliability: 1) no measurement properties presented on GAPP. 2) for the SPE rating scale Intra-rater reliability was high (median kappa score range 0.8–0.87); inter-rater reliability was moderate to almost perfect (percentage concordance range 62–68; kappa summary statistic 0.46–0.95).

First author (Year) Country	***Name* and description of the instrument used to evaluate the KTE application**	**Measurement properties: details about the measurement properties for tools at this level**
Hammond (2005) UK and Ireland	*Name: not given* The questionnaire included four sections: - whether therapists' experience or service characteristics influenced Looking After Your Joints Programme (LAJP) implementation. - opinions of the LAJP and impact of training course on practice. The Stage of Change for implementing the LAJP was assessed using a similar format to an exercise Stage of Change questionnaire (Lowther, 1999). - intention to use LAJP in future and self-efficacy for implementing LAJP. The latter was evaluated using a format similar to the Arthritis Self-Efficacy Scale (Lorig, 1989) - how many programmes they had run to date and their self-efficacy for implementing the LAJP	No measurement properties presented
Haynes (2006) Canada	*Name: not given* Description: "online survey" automatically sent to each user monthly or after every tenth usage session. Primary utility outcome was how satisfied participants were with the Premium LiteratUre Service (PLUS) system. primary *usefulness* outcome was assessed as the average physician response to the effect of literature access on self-reported practice performance and patient outcomes, rated on a 10-point scale.	No measurement properties presented

First author (Year) Country	***Name* and description of the instrument used to evaluate the KTE application**	**Measurement properties: details about the measurement properties for tools at this level**
Heinemann (2003) USA	*Name: Pre test/Post test stroke questionnaire* Description: Developed to test knowledge of stroke rehabilitation and referral practices for stroke patients using the Agency for Health Research and Quality (AHRQ) Post-Stroke Guidelines. The knowledge test included 15 true/false and multiple-choice questions on risk factors, prevention, early intervention and complications.	Other (non classical properties): Rasch (or rating scale) analysis was used to develop a reliable, valid and interval-level measure of knowledge. Rasch analysis of the combined 852 questionnaires yielded an internal consistency coefficient of 0.73, which is equivalent to Cronbach's alpha.
Huston (2006) Canada	*Name: post intervention physician questionnaire* Physicians were asked to rate the usefulness of components of the intervention on a scale of 1 (not useful) to 5 (very useful) and whether they were practicing respiratory infection control more effectively.	No measurement properties presented
Jeannot (2003) Switzerland	*Name: physician questionnaire* Description: whether physician consulted the Web guidelines, reasons for non-consultation, length of consultation (total patient and online access to guidelines), difficulties in accessing or understanding the Web guidelines, appropriateness of the procedure, whether the procedure was proposed to the patient, and whether the patient would undergo the procedure	No measurement properties presented
Joseph (2004) USA	*Name: not given* Site leadership survey Description: survey covers services, waitlists and prescription restrictions [patient medical record review and site pharmacy data also included].	No measurement properties presented

First author (Year) Country	***Name* and description of the instrument used to evaluate the KTE application**	**Measurement properties: details about the measurement properties for tools at this level**
Jousimaa (2002) Finland	*Name: not given* Description: Brief questionnaire for each information search to support patient care about the reason for the search, the main sources of information searched, whether they had found the information they were searching for, and whether they complied with the information. Case note review for guideline compliance on patient visits	No measurement properties presented
Kleindorfer (2008) USA	*Name: not given* Description: Beautician survey that contained open-ended questions about stroke warning signs and risk factors and multiple choice questions around clinical scenarios of acute stroke and myocardial infarction.	No measurement properties presented
Kulkarni (1998). USA	*Name:* "Field-test dietician feedback form" Description: Reaction to the guidelines and documented nutrition care activities,	No measurement properties presented
Lasch (2000) USA	*Name: not given* Description: The test included 8 items about attitude10 (reduced to 3) knowledge of cancer pain as well as 21 items (reduced to 12) on the application of knowledge of cancer pain management plus 3 later items on culture and pain.	Validity: An item analysis was conducted each year to determine response-choice frequencies, item difficulty, and the mean test score for all students choosing each of the multiple-choice items. The internal consistency reliability of the test, using Cronbach's alpha, was alpha = 0.71 (not clear which version or year).

First author (Year) Country	***Name* and description of the instrument used to evaluate the KTE application**	**Measurement properties: details about the measurement properties for tools at this level**
Mann (2009) Canada	*Name: 1)Workshop evaluation questionnaire* *2)Intended changes questionnaire* *3)Three month follow-up questionnaire* Description: 1) a 15-item questionnaire assessing satisfaction with workshop content, format, and perceptions of learning in an inter-professional group 2) a 9-item immediate post-workshop questionnaire assessed intent to make changes in clinical practice and health professional interaction. 3) assessed changes in clinical practice and health professional interactions	Reliability: Reliability testing of the Workshop Evaluation Questionnaire was conducted using Cronbach's alpha but value not reported
Meijers (2007) The Netherlands, Germany, UK	*Name: not given* Description: The questionnaire was included 24 items: eight questions had a dichotomous outcome, two included a four point ordinal scales, and the remaining had a likert scale Developed by the European Pressure Ulcer Advisory Panel (EPUAP) nutritional working group following the Rogers Implementation stages.	No measurement properties presented

First author (Year) Country	***Name* and description of the instrument used to evaluate the KTE application**	**Measurement properties: details about the measurement properties for tools at this level**
Mukohara (2005) USA	*Name: not given* Description: web-based questionnaire to assess self-reported change in current use of published research evidence by doctors in daily practice (3 items). Secondary outcomes: - attitudes regarding the role of evidence in practice,(3 items) called 'clever nihilism', 1-4 scale - confidence in evidence-based medicine (EBM) skills (i.e. critical appraisal and interpretation of quantitative results), - reading habits (time spent reading and numbers of journals read each week).	Reliability: Internal consistency for the "clever nihilism" scale, a 3-item section with a Cronbach's alpha = 0.6.
Neitzel (1999) USA	*Name: The Knowledge and Attitude Survey Regarding Pain (Ferrell, 1995)* Description: The survey measures knowledge and attitudes and consists of 39 questions in true/false, multiple choice, and case history formats.	Validity: Reliability: Content validity was supported by inclusion of content from current standards (Ferrell, 1995). Test-retest reliability (r=0.80, n=60) and internal consistency (r=0.70, n=60) established previously (Ferrell,1993; McCaffrey & Ferrell, 1995)
Norman (2006) USA, Canada, Australasia	*Name: not given* A survey of expectations, knowledge, and interpersonal Web-assisted tobacco interventions (WATI)-related relationships	Validity: Reliability: Factor analyses were conducted on the items in the follow-up survey to create scales related to outcomes (knowledge, expectations, actions, networking, and information seeking) with coefficient alphas considered 'good' using psychometric guidelines (Comrey and Lee, 1992). However, analyses presented here were conducted at the item, not scale, level given questions about the reliability of such groupings with the current sample size
Oberdorfer (2004) Australia	*Name: not given* Description: Knowledge of skin penetration guidelines and attitudes toward infection control	No measurement properties presented

First author (Year) Country	***Name* and description of the instrument used to evaluate the KTE application**	**Measurement properties: details about the measurement properties for tools at this level**
Ohmart (2008) USA	*Name: not given* Description: grower surveys designed by Dlott and Dlott (2005). Questions focused on Integrated Pest Management (IPM) knowledge and practices.	No measurement properties presented
Price (2006) England	*Name: the "Stakeholder survey"* Description: developed to address the aims and objectives of the evaluation using a mixture of fixed-choice response and open-response questions.	No measurement properties presented
Rashotte (2008) Canada	*Name: The Pressure Ulcer Prevention (PUP) Questionnaire* Description: The PUP a self-report questionnaire on pressure-ulcer prevention.	Validity: The Pressure Ulcer Prevention Questionnaire (PUP) was pretested for content, readability, and usability by three PICU nurses ineligible to participate in the study.
Rebbeck (2006) Australia	*Name: not given* Description: Physiotherapist knowledge of the guidelines was measured using a custom-made questionnaire. Questions included: self-rating of knowledge of the guidelines, treatments currently used to manage whiplash, treatments understood to be evidence-based, when and why physiotherapists refer to other disciplines, treatment goals set for whiplash patients, reporting responsibilities, and understanding of yellow flags. Total score ranging from 0 to 28.	No measurement properties presented
Renzi (2006) Canada	*Name: not given* Description: Two questions regarding their current asthmatic patient management methods and their knowledge of the CPGs, as well as follow-up questions on their use and knowledge of the content of the paper stamp (the intervention).	No measurement properties presented

First author (Year) Country	***Name* and description of the instrument used to evaluate the KTE application**	**Measurement properties: details about the measurement properties for tools at this level**
Roy (2008) UK	*Name: not given* Description: Questionnaire examining the following areas: - Background information on TB - Awareness about symptoms of TB - Guidance and options available for supporting clients - Areas of knowledge/practice where guidelines are lacking The respondents were required to choose from a list of pre-determined options and, where appropriate more than one answer to a particular question was allowed. Scored based on correct answers.	No measurement properties presented
Sung (2008) Taiwan	*Name:1) the music knowledge questionnaire* *2)audit checklist* Description: 1) modified from nursing staff's knowledge assessment tool of individualized music (Gerdner, 2001) consisted of 18 true–false items. 2) A 10 item, self-report audit checklist to assess nursing staff's adherence to the music protocol containing yes–no items on implementation of the music protocol.	Validity: Reliability: 1) The internal consistency of the music knowledge questionnaire was established with a KR-20 (Kuder–Richardson) of 0.57. 2) Face validity was examined by two nursing home staff from another facility, and construct validity was examined by three experts in EBP and aged care.
Titler (2009) USA	*Name: 1) The Perceived Stage of Adoption Instrument* *Also used:* *2) Medical record abstract form(MRAF)* *3) Summative Index of Quality Care Pain Management* *4) Barriers to optimal pain management tool* *5) Use of Research Findings in Practice Scale* Description: 1) The Perceived Stage of Adoption Instrument measures nurses' and physicians' adoption of practices	Validity: Reliability: 1) Perceived Stage of Adoption Instrument has Internal consistency reliability of 0.95 – 0.75, with test–retest reliability of r = 0.83 (Brett, 1987; Rodgers, 1994; Rutledge, 1996; Shively, 1997). 2) medical record abstract form (MRAF): • Content validity was achieved through review by three investigators with expertise in acute pain.

First author (Year) Country	*Name* and description of the instrument used to evaluate the KTE application	Measurement properties: details about the measurement properties for tools at this level
	that have a research base (Brett, 1987; Rodgers, 1994; Rutledge, 1996; Shively, 1997). 2) medical record abstract form (MRAF): for measuring conformance to a guideline (Schoenbaum, 1995), a 19-page MR abstract instrument used to determine nurse and physician acute pain management practices. 3) Summative Index (SI) of Quality Care for Acute Pain Management 18 variables selected by consensus representing aspects of EB pain management, scored 1 or 0, summed to yield SI score (possible range 0–18). 4) The Barriers to Optimal Pain Management tool, a modification of the Pain Management Activities Questionnaire (Dalton, 1995,1996), addresses the extent that system and practice issues are perceived by nurses and physicians as barriers to pain management 5) Use of Research Findings in Practice Scale, a nine-point Guttman-type scale adapted from Meyer and Goes (1988) that asks respondents to select one statement that best reflects use of research-based acute pain management practices in the organization.	• Inter-rater reliability (r= 0.92 – 0.95) was demonstrated through abstraction of 10 records by two individuals trained in use of the instrument. • Intra-rater reliability was demonstrated by the trained research assistant re-abstracting 25 of the same records 6 months following initial abstraction. • Intraclass coefficients (for continuous variables) and k/tetrachoric values (for categorical data) ranged from .92 to 1.0. 3) Summative Index (SI) of Quality Care for Acute Pain Management: Construct validity and reliability of the SI are reported elsewhere (Titler in press). 4) Barriers to Optimal Pain Management tool, a modification of the Pain Management Activities Questionnaire (Dalton, 1995,1996): Content validity was established by review of three nurse and physician experts in acute pain and test–retest reliability resulted in r= 0.83. 5) no measurement properties presented for Use of Research Findings
Udomratn (2002) Thailand	*Name: not given* Description: The instrument listed 20 pharmacological interventions for TRS, participants were requested to indicate the interventions they would use with first, second, and third preferences.	No measurement properties presented

First author (Year) Country	***Name* and description of the instrument used to evaluate the KTE application**	**Measurement properties: details about the measurement properties for tools at this level**
Verhoeven (2004) The Netherlands	*Name: not given* Description: GP completed short questionnaire for each posed question (out of practice) with eight items regarding the effect of the answer on the GP and on the patient, and the perceived barriers in the GP and in the patient when implementing the answer.	No measurement properties presented
Wallin (2000) Sweden	*Name: not given* Self-report survey consisted of 56 items, of which 52 had fixed response alternatives and four were opened ended. Half of the fixed responses were statements measured by 5-point Likert scales, ranging from "agree totally" to disagree totally". For the remaining items, the fixed responses related directly to the content of the question.	No measurement properties presented
Watson (2002) Scotland	*Name : not given* « Questionnaire survey » about treatment knowledge Practice as registered through simulated patient visits.	No measurement properties presented

Table 9: Study objective, study design and reported impact *(refer to Table 8 for instrument descriptions)*

First author (Year)	Study question/objective	Study design	Data reported about KTE impact or lack thereof (specific to instrument used)
KTE IMPACT AS SECONDARY			
Bartholo-mew (2000) USA	To describe, a theory-based intervention used to diffuse the Cystic Fibrosis (CF) Family Education Program (FEP) ...including a cross-sectional study of the factors associated with program use, fidelity to the intent of the program design, and factors related to program maintenance and institutionalization. Specific questions [indicators were]: (1) the proportion of CF centers that adopted and implemented the CF FEP; (2) the number of center clients they had reached with the program 18 months into the diffusion; (3) the perceptions of program or center characteristics associated with program use, fidelity, and maintenance/institutionalization; and (4) how the method of decision-making used by the center to adopt the program was related to program use, fidelity, and maintenance/institutionalization.	Post only without control/ referent group	Selected question-indicators: (1) Centre directors (n=66) 86.4% reported program familiarity, 71% program use and 13.6% intention to use. Program coordinators (n=105) 94.3% reported familiarity, 81.9% use and 6.7% intention to use. (2) Average of 25.5% of families (as reported by center directors) and 24% of families (reported by coordinators) had begun program 18 months into diffusion. (3) and (4) Fidelity estimates were moderate 6.1 (SD 1.9) for centre directors and 6.1 (SD 1.6) for coordinators. Maintenance/ institutionalization reported as moderate: 4.8 (SD 1.1) for centre directors and 4.7 (SD 1.4) for coordinators.

First author (Year)	Study question/objective	Study design	Data reported about KTE impact or lack thereof (specific to instrument used)
Price (2008) USA	An initial and follow-up program evaluation [of Fostering Voices] including: (1) pre and post test [of] differences in knowledge, beliefs, and practice intentions for participating nurses immediately following the training; (2) [comments on] format of the training (train the trainer (TTT) vs. computer-based (CBT)) and to what extent the training format influenced desired knowledge, beliefs, practice intentions, and/or satisfaction; and (3) evaluation of whether training resulted in lasting effects on nurses knowledge, beliefs, and practices state-wide 3 months following the training.	Pre- post test with 2 groups and then a follow up survey [low response rate]	Focus on (1) Participants in both training formats reported statistically significant differences in risk-reduction adherent practice intention from pre to post test. Both the TTT group ($t = –8.07$, $df = 252$, $p < .0005$) and the CBT group ($t = –13.22$, $df = 240$, $p < .0005$) demonstrated statistically significant increases in intention to place babies in the supine only position for sleep. The perceived safety of specific sleep positions and environments also changed from pre to post test. First, the evaluation assessed beliefs about the safety of using crib bedding (blankets, pillows, bumper pads). Participants in both the TTT group ($v2 = 63.30$, $df = 2$, $p < .0005$) and the CBT group ($v2 = 69.31$, $df = 2$, $p < .0005$) reported more disagreement and less uncertainty with the statement that ‘‘most crib bedding was generally safe to use,’’ which was an intentionally false statement. Participants also reported a statistically significant increase in the belief that babies sleep safest in their own cribs from pre to post test for both the TTT ($v2 = 14.03$, $df = 2$, $p = .001$) and CBT ($v2 = 9.42$, $df = 2$, $p = .009$) groups. Prior to the presentation, 38.5% of TTT participants and 36% of CBT participants either agreed or were unsure about the common misconception that there was an increased risk for aspiration when babies were placed supine for sleep; by the post-test, 94.3% of the TTT participants and 97.7% of the CBT participants correctly responded to this item. Likewise, 75.9% of the TTT participants and 65.2% of the CBT participants were uncertain or in disagreement with the link between side sleep and SIDS risk; by the post test, 90.5% of the TTT participants and 93.8% of the CBT participants endorsed their belief that the side sleep position is associated with elevated risk for SIDS.
Shirazi (2008) Iran	To evaluate the impact on readiness to change of an educational intervention on management of depressive disorders	Randomized controlled trial (individual)	Primary care physicians (PCPs) in Stage I in the intervention arm moved to higher stages of change in significantly more cases than PCPs in the control arm (46/74 = 62% versus 9/73 = 12%; $P < 0.001$). The same was true for those initially in Stage II (11/22 = 50% versus 3/23 = 13%; $P = 0.001$).

First author (Year)	Study question/objective	Study design	Data reported about KTE impact or lack thereof (specific to instrument used)
Tracy (2006) USA	To show how the six steps of the collaborative research utilization (CRU) model can be used to translate research into practice, using an example of non-drug pain management protocols.	Pre-post without control/ referent group	A comparison of the means of specific *knowledge* related to each protocol showed a statistically significant positive difference in post-intervention vs pre-intervention means (total t score: t(34) = 2.95, p< .05). A paired samples t-test to compare differences from pre-intervention to post-intervention means for patient *attitudes* showed a statistically significant positive difference in attitude mean scores (t(32) = 3.81, p < .01). Data trend showed increased use of non-drug approaches.
PILOT STUDIES OF KTE IMPACT			
Armstrong (2006) USA	A pilot test of the School-Based Violence Prevention Planning Program (SBV3P and evaluation.	Pre-post without control/ referent group	Scale scores increased between the pre- and post-test, indicating increased perceived self-efficacy in each of the domains measured by the scales. Across four out of five of the scales, increases in perceptions of prevention self-efficacy were statistically significant (p < .05).
Legare (2007) Canada	To assess the feasibility of a larger clustered RCT aiming at evaluating the impact of DECISION+, a continuing professional development (CPD) program in shared decision making (SDM), on the optimal use of antibiotics according to clinical practice guidelines (CPGs)	Cluster Randomized controlled trial Immediate (experimental) vs delayed (control)	Difference between groups Mean ± SD score of the quality of the decision FPs difference score = 0.2 (-0.34 to 0.89), p=0.29 Mean ± SD score of intention FPs to engage in SDM = 0.5 (-0.2 to 1.3) p = 0.77 FPs to comply with CPGs = -0.1 (-0.7 to 0.5) p = 0.58 Correlation coefficient for DCS scores among FPs and patients in the experimental group was higher than in the control group (difference 0.26 (0.06 to 0.53), p= 0.06) In the experimental group, 21% fewer patients decided to use antibiotics immediately at T2 (35%) than at T0 (56%). In the control group, the reduction was only 8% between T2 (54%) and T0 (46%). This 13% difference indicates that DECISION+ program had greater effect in the experimental (immediate) group than in the replication (delayed) control group.

<table>
<tr><th>First author (Year)</th><th>Study question/objective</th><th>Study design</th><th>Data reported about KTE impact or lack thereof (specific to instrument used)</th></tr>
<tr><td>Okon (2004)
USA</td><td>An educational initiative in palliative care was piloted with the intention to improve the knowledge scores by an amount no less than that achieved in other successful interventions, that is, by an absolute mean improvement of 20%.</td><td>Pre-post with control (not matched)</td><td>Mean overall knowledge scores improved by an absolute difference of 23%, representing a relative difference of 46% in the intervention group as compared to the control group (11.8 versus 8.1, p < 0.001).</td></tr>
<tr><td colspan="4">KTE IMPACT STUDIES</td></tr>
<tr><td>Ammendolia (2004)
Canada</td><td>To evaluate the ability of a systematic educational intervention strategy to change the plain radiography ordering behaviour of chiropractors toward evidence-based practice for patients with acute low back pain (LBP).</td><td>Quasi-experi-mental (clustered)</td><td>Following the intervention, a 42% reduction in the self-reported need for plain radiography for uncomplicated acute LBP (P <.025) and a 50% reduction for patients with acute LBP < 1 month (P <.025) in the intervention community. No significant change in the self-reported need for plain radiography in the control community (P >.05).</td></tr>
<tr><td>Bekkering (2005)
The Netherlands</td><td>To evaluate the effects of an active multi-faceted strategy on the process of care and the adherence of physiotherapists to the main recommendations contained in guidelines.</td><td>Cluster-Randomized controlled trial</td><td>
<table>
<tr><th>Recommended strategy</th><th>Intervention group # fulfilled (%)</th><th>Control group # fulfilled (%)</th><th>OR (95% CI)</th></tr>
<tr><td>Limit # sessions in normal course</td><td>32 (27%)</td><td>14 (13%)</td><td>2.39 (1.12to5.12)</td></tr>
<tr><td>Set functional treatment goals</td><td>188 (79%)</td><td>180 (71%)</td><td>1.99 (1.06 to 3.72)</td></tr>
<tr><td>Use mainly active interventions</td><td>183 (77%)</td><td>154 (60%)</td><td>2.79 (1.19 to 6.55)</td></tr>
<tr><td>Give adequate information</td><td>229 (96%)</td><td>221 (87%)</td><td>3.59 (1.35 to 9.55)</td></tr>
<tr><td>All four recommendations</td><td>96 (42%)</td><td>75 (30%)</td><td>2.05 (1.15 to 3.65)</td></tr>
</table>
</td></tr>
</table>

First author (Year)	Study question/objective	Study design	Data reported about KTE impact or lack thereof (specific to instrument used)
Bonetti (2005) England and Scotland	The objectives were to: (1) Design Intervention Modelling Experiments by backward engineering a 'real-world' randomised controlled trial (NEXUS); (2) examine the applicability of psychological theories to clinical decision-making; (3) explore whether psychological theories can illuminate how interventions achieve their effects. Questions: 1. Do audit and feedback or educational reminder messages influence GPs' behavioural intention? 2. Do audit and feedback or educational reminder messages influence GPs' simulated behaviour? 3. Do audit and feedback or educational reminder messages influence GPs' cognitions (attitude, subjective norm, perceived behavioural control, self-efficacy and decision difficulty)? 4. Can cognitive variables derived from psychological models predict GPs' behavioural intention or simulated behaviour?	Randomized controlled trials (individual)	1. There were no significant main or interaction effects of the interventions on behavioural intention in the explanatory analysis. The results remained non-significant when the baseline measure was omitted as a covariate. 2. Both the audit and feedback and educational reminder message interventions significantly influenced simulated behaviour. The results were non-significant when the baseline measure was omitted as a covariate There were no significant interaction effects between audit and feedback and educational reminder message in any analysis. 3. There was a significant main effect of audit and feedback on GPs' perceptions of control- GPs who experienced audit and feedback increased their perceived behavioural control whereas GPs who did not decreased their perceived behavioural control. There was also a significant main effect of audit and feedback on decision difficulty-GPs who experienced audit and feedback found it less difficult to make a referral decision on the post-intervention scenario set compared to GPs who did not experience audit and feedback. No significant main effects or interaction effects of the interventions on attitude, subjective norm, or self-efficacy. Analyses showed perceived behavioural control did significantly mediate the relationship between the audit and feedback intervention and simulated behaviour (z = 2:35; > +- 1.96), but not decision difficulty (z = 1:66; < =- 1.96). 4. Attitude, perceived behavioural control, and self-efficacy significantly predicted behavioural intention at the p<0.05 level. Decision difficulty predicted behavioural intention at the p<0.10 level. When attitude, subjective norm, perceived behavioural control, self-efficacy and decision difficulty were entered into a stepwise regression model, only theory of planned behaviour variables entered the regression equation, together predicting 30% of the variance in behavioural intention.

First author (Year)	Study question/objective	Study design	Data reported about KTE impact or lack thereof (specific to instrument used)
Dufault (1999) USA	To determine if involving clinicians (through their participation in the Collaborative Research Utilization (CRU) model) in generating and evaluating a research-based pain management standard leads to changes in practice and ultimately improves outcomes in the patients for whom they provide care	Quasi experimental	Chi square, independent t-test and ANCOVA were the statistical tests applied for hypothesis testing. Nurses significantly changed the way they assessed patients' pain with 67% of the experimental group indicating that they changed their practice ($x2 = 14.2$; $p < .05$). In the chart audit, Charts of the patients of the experimental group nurses were more likely to contain indicators of pain assessment in their progress notes, use of patient behavioural descriptions of pain, documentation about the types of interventions used, levels of pain relief, and pain's effect on patient's sleep ($t = 2.8$; $p < .008$). Evaluation data further supported the usefulness of the model when it was found that those who participated in its six steps achieved greater positive change scores in their attitudes towards research (Dufault, 1995) and in their competency in research utilization (Dufault, 1995) when compared to the control group.
Edwards (2007) Australia	To evaluate the effectiveness of a peer education program (PEP) in developing paediatric nurses' evidence-based knowledge and attitudes towards fever management and the sustainability of these changes. Hypotheses were that taking into account pre-PEP scores experimental group nurses' post-PEP and latency knowledge scores and latency attitudes would be better than control group nurses.	Quasi experimental	Examination of simple main effects identified the experimental group nurses compared with control group nurses were: significantly more knowledgeable overall at post-test ($P < 0.01$) and latency ($P < 0.01$); significantly more knowledgeable about the physiology of fever at post-test ($P < 0.01$) and latency ($P<0.01$); more knowledgeable about general fever management principles when latency data were collected ($P < 0.01$); and had significantly more positive attitudes towards evidence-based fever management in post-test ($P < 0.01$) and latency data ($P < 0.01$)

First author (Year)	Study question/objective	Study design	Data reported about KTE impact or lack thereof (specific to instrument used)
Gunn (2003) Australia	To increase the knowledge and skills of GP's to enable them to identify and manage common health problems experienced by women in the year following childbirth.	Pre-post without control/ referent group	The odds of a GP improving on the knowledge items ranged from 1.0 to 16, with the greatest change occurring in knowledge about the effectiveness of cognitive behavioural therapy for maternal depression. Of the GPs with an incorrect response at baseline, the percentage demonstrating improved knowledge at follow-up ranged from 22 to 100%. Around half of the GPs demonstrated excellent improved skills to detect common postnatal problems at follow-up. At baseline simulated patient visit, 70% of GPs inquired about sexual problems yet none inquired about the possibility of abuse, whereas at follow-up 94% inquired about sexual problems and 51.5% facilitated the disclosure of physical and emotional abuse. Anonymous feedback on the programme by participating GPs showed that 89% believed the programmed positively influenced their actual practice. Interestingly, GPs demonstrated greater knowledge and skills in the simulated setting than on the written questionnaire.
Heinemann (2003) USA	To evaluate changes in knowledge and practice following presentation of a lecture-based, educational programme about post-stroke rehabilitation guidelines.	Pre-post without control/ referent group	There was no significant change in knowledge over time ($F_{1,263}$ = 0.12, P = NS). We compared changes in number of referrals from pre-test to follow-up using a non-parametric, paired-comparison test (Wilcoxon signed ranks test). There were no significant changes in numbers of patients referred from pre-test to follow-up (Z = –1.88, P = NS).

First author (Year)	Study question/objective	Study design	Data reported about KTE impact or lack thereof (specific to instrument used)
Lasch (2000) USA	To examine nurse outcomes of a cancer pain education program for nurses of patients from 11 different ethnic groups. The hypothesis was that hands-on experience and an opportunity for nurses to examine and share their attitudes would lead to better retention of knowledge and greater durability of attitude change than a didactic-workshop-only approach.	Randomized controlled trial (individual)	Attitudes, knowledge, and application skills significantly improved for workshop-only and enriched-model nurses relative to controls. All who attended a workshop significantly changed pain management attitudes from pre- to posttest *(p* = 0.01). Attitude changes from pretest were maintained at follow-up for both workshop-only and enriched-model groups. Both the workshop-only and the enriched-model nurse groups significantly improved their knowledge and application test scores *(p* = 0.0001 and *p* = 0.0001; *p* = 0.0002 and p = 0.0001, respectively) between the pre- and posttests; the control group did not improve upon posttest. At follow-up both the workshop-only and the enriched-model groups significantly improved their knowledge and application test scores from pretest (p = 0.0001 and p = 0.0001; p = 0.03 and *p* = 0.0001, respectively). The control-group nurses did not significantly improve from pre-test to follow-up on knowledge questions (p = 0.26), but did significantly improve on application questions from pretest to follow-up (p = 0.03).

First author (Year)	Study question/objective	Study design	Data reported about KTE impact or lack thereof (specific to instrument used)
Mann (2009) Canada	To report on the educational outcomes of the ICC pilot programme, particularly the translation of learning into changes in practice and factors influencing these changes. Specific research questions included: 1) What was the impact of the programme upon health professionals' knowledge, skills and attitudes? 2) What was the impact of the programme upon changes to participating professionals' practice, particularly their inter-professional interactions? 3) What factors enabled or prevented these changes?	Post only	1) Participants agreed that the modules led to the acquisition and/or enhancement of knowledge and skills. 92% (309/336) to 95% (320/336) agreed or strongly agreed with items that assessed the acquisition of new knowledge or skills; for example, 'The session increased my awareness of existing resources for patients with cancer', or 'I gained a better understanding of other health professionals' roles and responsibilities'. 2) Although more participants reported intending to or considering changes to their clinical practice than to their interprofessional interactions, the 3-month follow-up evaluations revealed no difference in the number of participants reporting changes to clinical practice and interprofessional interactions. Notably, reported changes for interprofessional interactions increased to 94% of the population from only 44% who reported intending to change. Changes reported in the follow-up evaluations largely reflected intended changes listed by participants' immediately following the modules, although participants reported additional changes that they had made. Overall, participants reported more changes at an individual level (e.g. 'Questioning patients more thoroughly') than on a system-wide level (e.g. 'Development of paediatric support team').
Mukohara (2005) USA	To test the hypothesis that regularly exposing doctors to critically appraised summaries of recently published articles can improve their attitudes towards use of such evidence in practice, stimulate their motivation to learn about critical appraisal skills, and improve their reading habits. These changes can ultimately improve their use of evidence in daily practice.	Randomized controlled trial (individual)	After 3-month trial, no significant differences within or between the Weekly Browsing Journal Club (WBJC) and control groups in the frequency of finding an answer to clinical questions or in the proportion of patients for whom they incorporated or read published evidence for medical decision making. Although the WBJC group reported a slight improvement in their critical appraisal skills, no differences between groups were seen in either critical appraisal or quantitative skills. A non-significant trend suggested the WBJC group became somewhat less nihilistic about the role of evidence in practice compared with increased nihilism in the control group, with a mean difference in change in "clever nihilism" of -0.16 on a 4-point scale (95% CI, -0.32 to 0.01).

First author (Year)	Study question/objective	Study design	Data reported about KTE impact or lack thereof (specific to instrument used)
Neitzel (1999) USA	To test the effects of implementing evidence-based postoperative pain management content and strategies on patient pain management, provider (nurse and physician) behaviour, and fiscal outcomes (i.e., improving patient pain management, care provider behaviours and fiscal outcomes).	Pre-post without control/ referent group	Successful: 25% of charts at pre-implementation versus 75% at post-implementation had evidence-based pain management practices in place. Partial support that the appropriate drug would increase and inappropriate drug would decrease: Mederidine use decreased by 48% of patients and significantly less was delivered (t=4.4, df=67, p=0.000). Hydromorphone use increased by 18% of patients and significantly more hydromorphone was delivered (t=2.4, df=60, p=0.02) use of intravenous route of administration increased (chisq=4.4, df=1, p=0.04) means score on knowledge attitude survey increased 74% to 85% (paired t=43.6, df=55, p=0.0000 unsuccessful: documentation of pain assessment increase did not occur.
Norman (2006) USA, Canada, Australasia	(1) to assess the impact of a mixed-method, interactive approach to education and KTE on collaborative activity, (2) to provide an empirical foundation to guide the development of a Community of Practice within this group, (3) to pilot the implementation of a novel, systems-oriented approach to evaluating KTE using combined evaluation and social networking methodologies.	Post without control/ referent group	(1) The meeting met participants' expectations for learning (mean = 2.16, SD = 0.40) and networking (mean = 1.68, SD = 0.58). Participants reported increases in overall knowledge of WATI-related research (mean = 1.47, SD = 0.51) and resources (mean = 1.89, SD = 0.45). Most participants had attempted to contact another meeting attendee or reported having been contacted by someone they met at the event, while 57% of participants took action of some sort on ideas generated from the meeting (mean = 2.36, SD = 0.83), demonstrating an impact on KTE beyond the meeting.

First author (Year)	Study question/objective	Study design	Data reported about KTE impact or lack thereof (specific to instrument used)
Rashotte (2008) Canada	To examine the impact of implementing a two-part unit-based multiple intervention based on Best Practice Guidelines (BPG) called the Pressure Ulcer Prevention Program in the Pediatric ICU (PICU & PUPP) by answering: (1) if there is a difference in nurses' use of evidence-based pressure-ulcer prevention in the PICU following implementation of only part I (educational component) (T2) versus parts I and II (innovative components) (T3); and (2) if the change in practice is sustained 6 months after completion of the PUPP (T4).	Pre-and multiple post without control/ referent group	The results only showed a significant change in the implementation of 2 of 11 recommended practices following both interventions (parts I & II). Between T1 and T3, there was a statistically significant change in the implementation of: assessment of risk of pressure ulcers using an age-appropriate tool (BPG #1) ($p<0.001$), and the documentation of same (BPG#2) ($p<0.001$). Over 75% (n = 14/18) and 68% (n = 12/18) of nurses continued to use BPG #1 and BPG #2 at T4.
Sung (2008) Taiwan	To evaluate an implementation programme in improving nursing staff's knowledge of and adherence to an individualized music protocol for older people with dementia in long-term care settings and to see whether it differed between nurses and nurse aides.	Pre-post without control/ referent group	The nursing staff's knowledge of the music protocol was significantly improved after receiving the implementation programme ($Z = -3.64$, $p < 0.001$) compared with baseline. Both nurses' and nurse aides' knowledge of the music protocol improved significantly at week four. The scores for knowledge of the music protocol increased: nurses'from a median of nine (range, five to 11) at pre-test to a median of 15 (range,13–16) at post-test ($Z = -2.68$, $p < 0.01$); and nurse aides' , from a median of six (range,four to seven) at pre-test to a median of 13.50 (range,12–16) at post-test ($Z = -2.54$, $p < 0.05$). Before implementation of the implementation programme, none of the nursing staff had implemented any music intervention for their residents with dementia in their work setting. After receiving the programme, the total mean levels of adherence to the use of a music protocol reached 72.35% at week four. Nurses (80%) had a higher mean level of adherence to the music protocol than the nurse aides (63.75%).

First author (Year)	Study question/objective	Study design	Data reported about KTE impact or lack thereof (specific to instrument used)
Titler (2009) USA	To test an interdisciplinary, multifaceted, translating research into practice (TRIP) intervention to (a) promote adoption, by physicians and nurses, of evidence based (EB) acute pain management practices in hospitalized older adults, (b) decrease barriers to use of EB acute pain management practices, and (c) decrease pain intensity of older hospitalized adults.	Cluster randomized controlled trial	The TRIP intervention had a positive effect on nurses' self-reported adoption of evidence-based (EB) acute pain management practices. After controlling for baseline scores, nurses in the experimental (E) group had greater improvements in self-reported use of EB acute pain management practices (84 percent using EB pain management practices) than nurses in the control (C) group (50 percent using EB pain management practices) ($p< 0.0001$; OR= 3.2). Nurses in the E group also reported a more advanced stage of adoption (mean 2.8; SD 1.0) for using around-the-clock analgesics post-intervention (sometimes use) than those in the C group (mean 2.2; SD 0.9; believe they should use) ($p< 0.006$). Scores did not differ significantly between groups for pain assessment in older adults, pain assessment of confused elders, or avoiding use of meperidine. The TRIP intervention had less effect on physician's perceived adoption of EB acute pain management practices. A trend toward a significant treatment effect ($p= 0.10$) was found for avoiding prescription of meperidine; physicians in the E group reported almost always avoiding use of meperidine in older adults (mean 3.9; SD 0.4), while physicians in the C group reported sometimes avoiding meperidine (mean 3.4; SD 0.9).
Wallin (2000) Sweden	The clinical application of national guidelines for neonatal nursing was investigated 1 year after dissemination through a questionnaire survey.	Post only without control/ referent group	Differences in the progress of clinical application amongst the respondents: 1. In five units (14.3%) the guidelines were not used at all. 2. Guideline application was used as either educational material (in 10 units) or applied to change and evaluate clinical practice (in 20 units) 3. Units with an assistant and nurse manager were more likely to use the guidelines as a basis for changing clinical practice than those without as assistant manager (25 units, $p=0.01$) 4. Almost all of the 13 guidelines were applied. Of the 35 units, 24 reported 72 QI projects.

Instruments and their ability to assess change

For those studies with some information on measurement properties (see Table 8), we extracted information on their objectives, study design and authors' reports on the success of the KTE intervention. The last criteria meant that none of the measurement development studies were included. Three of the six studies in which KTE application was a secondary objective, all three of the KTE impact pilot studies, and 15 of the 42 KTE impact studies remained (n=21, see Table 9).

Table 9 shows that instruments were used to evaluate specific and "measureable" aspects of KTE. These 21 studies reflected the larger group in many ways. Health care was the most common domain (95%), and practitioners were the primary focus (although organizations were also important in four of these). This likely reflects the focus of our review on KTE evaluation instruments, and our strategies for collection of data which are similar to those laid out by Strauss and colleagues (2010). We were encouraged to see that a majority cited some theoretical origins that informed the authors' approach (67%). Multiple KTE applications predominated. Conceptual knowledge use (95%) was more common than instrumental knowledge use (67%), (although 57% of studies had both), also likely due to the focus of our review on instruments (Strauss et al., 2010).

Studies framed their purpose, objectives, questions or hypotheses in different ways. A few described their KTE purpose only (e.g. Gunn et al., 2003). More suggested broad evaluation aspirations, either as a simple reporting of results (e.g. Price et al., 2008) or as an objective such as "to evaluate the effects of an active multi-faceted strategy on the process of care and the adherence of physiotherapists to the main recommendations contained in guidelines" (Bekkering et al., 2005). Some were quite focused, such as "to evaluate the impact on readiness to change of an educational intervention on management of depressive disorders" (Shirazi et al., 2008). Others laid out specific questions, with the best basing them on a theoretical approach (e.g. Bonetti et al., 2005).

Given that our review of quantitative studies focused on instruments for assessment of KTE implementation and/or impact (and, as a result, we had already excluded those implementation and impact studies without instruments), we oriented our further analysis of this subset of articles to their potential to assess change. We note here that we did not conducting a rigorous evaluation of responsiveness (a characteristic of measurement instruments, otherwise referred to as sensitivity to change; Streiner and Norman, 1995). We explored the potential to assess change by carefully considering the instruments, outcomes, statistical approaches and study designs. Post-only measurement studies cannot assess this attribute because a prior measure is required (see Table 10a). The large majority of studies with pre-post assessments did show the potential to assess change among at least some of their instruments (86%, see Table 10b and note duplication if more than one instrument). The majority (62%), however, used instruments that were crafted to assess either

conceptual or instrumental knowledge use around very specific topics; for example, the use of x-rays for low back pain (Ammendolia et al., 2004).

In a minority of articles (24%), the instruments were framed in relation to more generic constructs that might be key in practitioner-related KTE impact assessments. They provide a set of instruments that have some documented measurement properties, including the potential to assess change, which can be adapted to use for assessing the impacts of practitioner-oriented KTE interventions. One set of studies informed the measurement of attitudes toward research and competency in research utilization (Dufault et al., 1999), complementing the work of Estabrooks and colleagues (2009). The instruments used by Armstrong and colleagues (2006) assessed self-efficacy in planning, implementation and outcome assessment in school-based violence prevention, which may be generalizable to other evidence-based health promotion programs. The other three tapped readiness for change (Shirazi et al., 2008), decisional conflict (Legare et al., 2007) and perceived control and self-efficacy (Bonetti et al., 2005), providing examples for such KTE impact assessment among clinical practitioners.

Table 10: Study designs and potential to assess change in studies reporting measurement properties. (See Table 8 for details about the instruments in these articles)

a) Study designs

Post only	Pre-Post		Simultaneous	
Without referent*	**Without referent****	**With Referent**	**Quasi experimental (or equivalent)**	**Randomized allocation (RCT)**
Bartholomew (2000) Mann (2009) Norman (2006)	Armstrong (2006) Gunn (2003) Heinemann (2003) Neitzel (1999) Price (2008) Rashotte (2008) Sung (2008)	Okon (2004)	Ammendolia (2004) Dufault (1999) Lasch (2000)	Bekkering (2005) Bonetti (2005) Legare (2007) Mukohara (2005) Shirazi (2008) Titler (2009)

*There were no post only studies with a referent
**These may have more than one intervention group but no true referent

b) Potential to assess change*

Not applicable	Specific to topic		Potentially generalizable	
	No	**Yes**	**No**	**Yes**
Bartholomew (2000) Mann (2009) Norman (2006)	Heinemann (2003) Mukohara (2005)	Ammendolia (2004) Bekkering (2005) Dufault (1999) Edwards (2007) Gunn (2003) Lasch (2000) Legare (2007) Neitzel (1999) Okon (2004) Price (2008) Rashotte (2008) Sung (2008) Titler (2009)	Mukohara (2005)	Armstrong (2006) Bonetti (2005) Dufault (1999) Legare (2007) Shirazi (2008)

*Some studies are in more than one column, as different instruments within a study may focus on specific or generalizable changes.

Are there valid and reliable instruments to evaluate KTE applications?
We have summarized the peer-reviewed quantitative articles that report instruments used to evaluate KTE applications. First we presented the domain (healthcare, agriculture, etc), target audience, type of knowledge use and types of KTE applications (see Table 2 and associated text). Next we presented detailed information about the instruments employed and the associated measurement properties (see Table 7 and associated text). And finally we describe the potential ability of these KTE instruments to assess change (see Tables 9 and 10 and associated text). Taking all of this information into account we found that there were some instruments that show promise for the evaluation of KTE applications (see Appendix E for more details).

We consider the instruments that have reported some aspects of both validity and reliability and show the potential to assess change as promising (Ammendolia et al., 2004; Dufault et al., 1999; Neitzel et al., 1999; Shirazi et al., 2008; Sung et al., 2008; and Titler et al., 2009). The instruments described in these articles are all focused in healthcare. However they vary with respect to types of knowledge use addressed and whether they are measure specific or more generic aspects of KTE applications. Further development focusing on responsiveness would be beneficial however we suggest that this set of instruments could be useful in the evaluation of KTE applications.

We note also that there are some articles which described the development of KTE evaluation instruments (Bahtsevani et al., 2008; Grad et al, 2008; and Shiffman et al., 2005). While more work is needed to further the development of these instruments they are also promising.

5.0 Summary and Conclusions

We engaged in a systematic and comprehensive search and review of the literature to identify and describe instruments for the evaluation of KTE applications. Essentially we looked for instruments in the peer-reviewed literature that could be used to evaluate KTE where research evidence/knowledge was transferred directly to practitioners (clinicians, farmers, teachers). The outcomes of the KTE applications were to change knowledge, attitudes and/or behaviour/practice.

Our approach focused on transparency, reproducibility and minimizing bias. A multidisciplinary team of KTE practitioners, qualitative and quantitative KTE researchers and review methodologists helped to ensure practical information about the instruments used in the evaluation of KTE was consistently captured. The team was engaged and debated issues during each step of the review as we grappled with a relatively young literature and the challenges inherent within.

Our decision-maker partners provided direction throughout the process, carefully considering the objectives and keeping the team focused on the practical results desired by the audiences they represented. In addition to the decision-makers, we engaged with a number of KTE stakeholders at various review steps. This exchange provided additional feedback about how our results may help the KTE practitioner community. The opportunity to engage with stakeholders was stimulating and, we believe, resulted in findings that are more likely to be taken up by this audience.

Our focus on the transfer of research evidence to practitioners was guided by a definition of KTE adapted from CIHR (http://www.cihr-irsc.gc.ca/e/39033.html). We did not seek to replicate the work and ongoing development of knowledge utilization (KU) instruments, such as those of Estabrooks and colleagues (2009). Instead, we sought to complement Estabrooks' work by looking for instruments in areas of KTE evaluation other than KU. We also did not seek instruments from literatures focused on change other than KTE as others have (French et al., 2009), but encourage this as important work.

We were purposely broad and inclusive in our literature search. Though focused on the peer-reviewed literature, we searched a variety of domains that could contain evaluations of KTE implementation or impact. Although captured in the search, we did not include social marketing, public education or academic curriculum research, nor did we address program evaluation in the review.

We found 12 qualitative studies that described case-study and case-comparison approaches for the evaluation of KTE applications. The studies provided rich descriptions of process, context and impact, as well as barriers and facilitators in the evaluation of KTE applications. However, the reporting of the methods employed and

the overall quality of the study methodologies used could be improved. Well designed and implemented qualitative studies are useful in the evaluation of KTE applications, providing detail and better understanding of how to improve KTE.

Our synthesis of 54 quantitative studies discovered a variety of instruments used to evaluate KTE applications (see Table 8). Many of the instruments described were developed by the authors/researchers for the specific context of their study. Instruments were also adapted from other fields and applied in a KTE evaluation. Overall, the description of the measurement properties of these instruments was not consistent and, in the majority of cases, no details of measurement properties were presented. When they were presented, they were often lacking in detail. In addition, there was no data indicating that the instruments captured meaningful change. There is a need to continue measurement research and development of KTE evaluation instruments. We recognize that many of the observations made about this portion of the KTE literature are also applicable to many other literatures.

However, a subset of articles, provided descriptions of instrument development and measurement properties. Examining this subset further, some instruments showed promise as potentially useful tools in the evaluation of KTE applications (Ammendolia et al., 2004; Dufault et al., 1999; Neitzel et al., 1999; Shirazi et al., 2008; Sung et al., 2008; Titler et al., 2009). The instruments described in these articles varied with respect to types of knowledge use addressed and whether they measured specific or more generic aspects of KTE applications. However, they all reported both validity and reliability and showed the potential to assess change. Some studies also described KTE evaluation instruments under development (Bahtsevani et al., 2008; Grad et al, 2008; and Shiffman et al., 2005).

A strength of this knowledge synthesis was the comprehensive and inclusive KTE literature search. We created search strategies for a variety of electronic databases that expanded on documented search strategies for the KTE literature in health care (McKibbon et al., 2010). Our search was not limited to a particular domain; instead. we searched health care, agriculture, business and education literatures. Such a broad search presented challenges when conducting a synthesis, mostly because of the large number of non-relevant references captured. This was particularly true in a “young” literature such as KTE, where there are a variety of inconsistently used terms. We agree with McKibbon and colleagues that work is needed to create a more standardized vocabulary for “… writing, collaborating, communicating and information retrieval (to) facilitate assessing and applying our own evidence to our practices” (p.8 – McKibbon et al., 2010).

Another strength of the review was the transparency of our review approach. This was particularly important given our iterative approach to determine relevance. An iterative approach was in part dictated by the breadth of the literature search. We, as a team, maintained an inclusive scope, but had to impose limits on the breadth of literature as we proceeded through the review. These limits, as opposed to

limitations, were necessary to complete the review but did not change the focus or the initial question we sought to address.

A likely limitation for this review was the possibility that we missed KTE articles with instruments. Despite our broad and inclusive literature search, we realize that the challenges of searching this young literature and our interpretation of the relevance criteria may have inadvertently resulted in relevant articles being excluded. However, we have been clear and transparent at each step about the decisions made, and we presented our results so that KTE researchers and practitioners can take into account the limits we placed on the review.

In *conclusion*, we found few well developed instruments to evaluate KTE implementation or its impact in the KTE literature. We were surprised at the lack of theory-based instruments; however, when instruments were adapted, they were often based on a theory of change. Many studies developed context-specific instruments and did not clearly report instrument measurement properties.

Some instruments do appear to be promising for the evaluation of KTE implementation and impact (Ammendolia et al., 2004; Dufault et al., 1999; Neitzel et al., 1999; Shirazi et al., 2008; Sung et al., 2008; and Titler et al., 2009). As well, some work describing instrument development is also encouraging (Bahtsevani et al., 2008; Grad et al, 2008; and Shiffman et al., 2005).

We strongly encourage continued instrument development work with a focus on establishing measurement properties using classical (Nunnally and Bernstein, 1994) or modern (Baker, 2001) measurement approaches as appropriate. Furthermore, we point out the need for KTE evaluation studies to clearly present the measurement properties of the instruments used. This is necessary for the field to move forward in evaluating and developing theory-based instruments that can add to the evidence base.

6.0 Key Messages

The messages from this systematic review of the literature examining KTE evaluation instruments are organized into three categories as requested by our stakeholders:

- KTE researcher and practitioner
- KTE researcher
- KTE practitioner

The KTE practitioners on the review team offered their messages in two parts, as lessons and cautions.

Researcher and practitioner:

- Practitioners and researchers should be aware of and consider the evaluation instruments found in this review when planning an evaluation study. When considering an instrument from the literature, they should always look for a clear presentation of the measurement properties.
- Researchers and practitioners should select or construct well developed instruments for evaluation. The minimum measurement standards for an evaluation instrument should be demonstrated validity and reliability.
- Researchers and practitioners should consider developing instruments that can be used in various contexts. There is a need to separate implementation (where context is very important) from instrument development, which can be theory-based and context-independent.
- For KTE evaluation to advance, researchers and practitioners must systematically develop and use evaluation instruments with known measurement properties and clearly demonstrate that the instrument can capture meaningful change.

Researcher:

- KTE Researchers should consider involving practitioners in the development of their KTE instruments, and in the evaluation process. This could increase practitioners' knowledge of measurement and evaluation and increase researchers appreciation for practical demands.
- KTE researchers should consider developing reporting guidelines (such as CONSORT and others) to ensure KTE research articles and scientific reports are rigorously written, following standards of scientific reporting. The use of a

consistent format along with consistent terms and definitions would allow for better communication, information retrieval and, ultimately, better assessment of KTE practices.
- High quality qualitative approaches continue to be important in KTE, providing rich details about process *and* evaluation, as well as context.
- KTE researchers should endeavour to use (or develop) instruments that are shown to measure meaningful change to ensure evaluation will be fairly assessed.

Practitioner:

Lessons for practitioners

- Instruments do not come with a simple menu of options for how to use them. Evaluation instruments need to be understood and considered for application in specific research and evaluation contexts.
- Practitioners could benefit by ensuring there is time and the skills to build evaluation into practice.
- Instruments identified in this review may be most useful to KTE practitioners when considering knowledge translation/transfer methodologies where specific uses of knowledge are contemplated.

Cautions for practitioners:

- KTE evaluation does not always easily translate into practice environments due to variations in interventions, contexts, and actors. Choose evaluation tools carefully as they are often developed for use in a specific context that may not be generalizable.
- Practitioners are often working under time constraints and in paradigms that do not lend themselves to adapting methods of KTE evaluation to their circumstances.
- The instruments presented in this review often measure the effects of a single intervention not an integrated KTE system.
- The dominance of health care studies in the KTE literature needs to be considered when generalizing to other disciplines.

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APPENDICES

APPENDIX A: Abstracts of key KTE evaluation studies noted in the introduction

APPENDIX B: List of search terms and content experts

APPENDIX C: Instruments developed by the review team for the review steps:
- -Single reviewer screen of titles and abstracts
- -Two reviewer screen of titles and abstracts
- -Two reviewer full article screen
- -Study classification
- -Quality appraisal (quantitative and qualitative)
- -Data extraction (quantitative and qualitative)

APPENDIX D: Summary of Descriptive Articles

APPENDIX A: Abstracts for key KTE evaluation studies noted in the introduction

Thompson GN, Estabrooks CA, Degner LF. (2006) Clarifying the concepts in knowledge transfer: a literature review. J Adv Nurs. 53 (6): 691-701.

AIM: The aim of this paper is to examine the concepts of opinion leaders, facilitators, champions, linking agents and change agents as described in health, education and management literature in order to determine the conceptual underpinnings of each.

BACKGROUND: The knowledge utilization and diffusion of innovation literature encompasses many different disciplines, from management to education to nursing. Due to the involvement of multiple specialties, concepts are often borrowed or used interchangeably and may lack standard definition. This contributes to confusion and ambiguity in the exactness of concepts.

METHODS: A critical analysis of the literature was undertaken of the concepts opinion leaders, facilitators, champions, linking agents and change agents. A literature search using the concepts as keywords was conducted using Medline, CINAHL, Proquest and ERIC from 1990 to March 2003. All papers that gave sufficient detail describing the various concepts were included in the review. Several 'older' papers were included as they were identified as seminal work or were frequently cited by other authors. In addition, reference lists were reviewed to identify books seen by authors as essential to the field.

FINDINGS: Two similarities cut across each of the five roles: the underlying assumption that increasing the availability of knowledge will lead to behaviour change, and that in essence each role is a form of change agent. There are, however, many differences that suggest that these concepts are conceptually unique.

CONCLUSIONS: There is inconsistency in the use of the various terms, and this has implications for comparisons of intervention studies within the knowledge diffusion literature. From these comparisons, we concluded that considerable confusion and overlap continues to exist and these concepts may indeed be similar phenomena with different labels. All concepts appear to be based on the premise that interpersonal contact improves the likelihood of behavioural change when introducing new innovations into the health sector.

Estabrooks CA, Thompson DS, Lovely JJ, Hofmeyer A. (2006) A guide to knowledge translation theory. J Contin Educ Health Prof. 26 (1): 25-36.

Despite calls over several decades for theory development, there remains no overarching knowledge-translation theory. However, a range of models and theoretical perspectives focused on narrower and related areas have been available for some time. We provide an overview of selected perspectives that we believe are particularly useful for developing testable and useful knowledge-translation interventions. In addition, we discuss adjuvant theories necessary to complement these perspectives. We draw from organizational innovation, health, and social sciences literature to illustrate the similarities and differences of various theoretical perspectives related to the knowledge-translation field.A variety of theoretical perspectives useful to knowledge translation exist. They are often spread across disciplinary boundaries, making them difficult to locate and use. Poor definitional clarity, discipline-specific terminology, and implicit assumptions often hinder the use of complementary perspectives. Health care environments are complex, and assessing the setting prior to selecting a theory should be the first step in knowledge-translation initiatives. Finding a fit between setting

(context) and theory is important for knowledge-translation initiatives to succeed. Because one theory will not fit all contexts, it is helpful to understand and use several different theories. Although there are often barriers associated with combining theories from different disciplines, such obstacles can be overcome, and to do so will increase the likelihood that knowledge-translation initiatives will succeed.

Best A, Hiatt RA, Norman CD, on behalf of the National Cancer Institute of Canada Joint Working Group on Translational Research and Knowledge Integration of the Advisory Committee for Research and the Joint Advisory Committee for Cancer Control. (2008) Knowledge integration: Conceptualizing communications in cancer control systems. Patient Educ Couns. 71 (3): 319-27

Objective: This paper was prepared by the National Cancer Institute of Canada (NCIC) Working Group on Translational Research and Knowledge Transfer. The goal was to nurture common ground upon which to build a platform for translating what we know about cancer into what we do in practice and policy.

Methods: Methods included expert panels, literature review, and concept mapping, to develop a framework that built on earlier cancer control conceptualizations of communications that have guided researchers and end users.

Results: The concept of 'knowledge integration' is used to describe the resulting refinement and the nature of evidence necessary for decision-making to at the systems level. Current evidence for knowledge integration in cancer control is presented across the levels of individual, organizational and systems level interventions and across basic, clinical and population science knowledge bases.

Conclusion: A systems-oriented approach to integrating evidence into action assists organizations to conduct research and policy and practice.

Practice implications: Practitioners can use this framework to understand the challenges of implementing and evaluating cancer control strategies.

Nutley S, Walter I, Davies HTO. (2001) From Knowing to Doing A Framework for Understanding the Evidence-into-Practice Agenda. Med Care. 39 (8 Suppl 2): II2-45.

The past decade has witnessed widespread interest in the development of policy and practice that is better informed by evidence. Enthusiasm has, however, been tempered by recognition of the difficulties of devising effective strategies to ensure that evidence is integrated into policy and utilized in practice. There is already a rich but diverse and widely dispersed literature that can be drawn upon to inform such strategies. This article offers a guide to this literature by focusing on six main interrelated concerns: (1) the types of knowledge relevant to understanding research utilization/evidence-based practice (RU/EBP) implementation; (2) the ways in which research knowledge is utilized; (3) models of the process of utilization; (4) the conceptual frameworks that enable us to understand the process of RU/EBP implementation; (5) the main ways of intervening to increase evidence uptake and the effectiveness of these; (6) different ways of conceptualizing what RU/EBP means in practice.

Grimshaw JM, Shirran L, Thomas R, Mowatt G, Fraser C, Bero L, Grilli R, Harvey E, Oxman A, O'Brien MA. (2007) Changing provider behavior: an overview of systematic reviews of interventions. Milbank Q. 85 (4): 729-68.

BACKGROUND: Increasing recognition of the failure to translate research findings into practice has led to greater awareness of the importance of using active dissemination and implementation strategies. Although there is a growing body of research evidence about the effectiveness of different strategies, this is not easily accessible to policy makers and professionals.

OBJECTIVES: To identify, appraise, and synthesize systematic reviews of professional educational or quality assurance interventions to improve quality of care.

RESEARCH DESIGN: An overview was made of systematic reviews of professional behavior change interventions published between 1966 and 1998.

RESULTS: Forty-one reviews were identified covering a wide range of interventions and behaviors. In general, passive approaches are generally ineffective and unlikely to result in behavior change. Most other interventions are effective under some circumstances; none are effective under all circumstances. Promising approaches include educational outreach (for prescribing) and reminders. Multifaceted interventions targeting different barriers to change are more likely to be effective than single interventions.

CONCLUSIONS: Although the current evidence base is incomplete, it provides valuable insights into the likely effectiveness of different interventions. Future quality improvement or educational activities should be informed by the findings of systematic reviews of professional behavior change interventions.

Mitton C, Adair CE, McKenzie E, Patten SB, Waye Perry B. (2004) Knowledge transfer and exchange: review and synthesis of the literature. Milbank Q. 82 (4): 581-629.

Knowledge transfer and exchange (KTE) is as an interactive process involving the interchange of knowledge between research users and researcher producers. Despite many strategies for KTE, it is not clear which ones should be used in which contexts. This article is a review and synthesis of the KTE literature on health care policy. The review examined and summarized KTE's current evidence base for KTE. It found that about 20 percent of the studies reported on a real-world application of a KTE strategy, and fewer had been formally evaluated. At this time there is an inadequate evidence base for doing "evidence-based" KTE for health policy decision making. Either KTE must be reconceptualized, or strategies must be evaluated more rigorously to produce a richer evidence base for future activity.

Greenhalgh T, Robert G, Macfarlane F, Bate P, Kyriakidou O. (2005) Diffusion of innovations in service organizations: systematic review and recommendations. Milbank Q. 83 (1): 177-8; and author reply 178-9.

This article summarizes an extensive literature review addressing the question, How can we spread and sustain innovations in health service delivery and organization? It considers both content (defining and measuring the diffusion of innovation in organizations) and process (reviewing the literature in a systematic and reproducible way). This article discusses (1) a parsimonious and evidence-based model for considering the diffusion of innovations in health service organizations, (2) clear knowledge

gaps where further research should be focused, and (3) a robust and transferable methodology for systematically reviewing health service policy and management. Both the model and the method should be tested more widely in a range of contexts.

French B, Thomas LH, Baker P, Burton CR, Pennington L, Roddam H. (2009) What can management theories offer evidence-based practice? A comparative analysis of measurement tools for organisational context. Implement Sci. 19 (4): 28

Background: Given the current emphasis on networks as vehicles for innovation and change in health service delivery, the ability to conceptualise and measure organisational enablers for the social construction of knowledge merits attention. This study aimed to develop a composite tool to measure the organisational context for evidence-based practice (EBP) in healthcare.
Methods: A structured search of the major healthcare and management databases for measurement tools from four domains: research utilisation (RU), research activity (RA), knowledge management (KM), and organisational learning (OL). Included studies were reports of the development or use of measurement tools that included organisational factors. Tools were appraised for face and content validity, plus development and testing methods. Measurement tool items were extracted, merged across the four domains, and categorised within a constructed framework describing the absorptive and receptive capacities of organisations.
Results: Thirty measurement tools were identified and appraised. Eighteen tools from the four domains were selected for item extraction and analysis. The constructed framework consists of seven categories relating to three core organisational attributes of vision, leadership, and a learning culture, and four stages of knowledge need, acquisition of new knowledge, knowledge sharing, and knowledge use. Measurement tools from RA or RU domains had more items relating to the categories of leadership, and acquisition of new knowledge; while tools from KM or learning organisation domains had more items relating to vision, learning culture, knowledge need, and knowledge sharing. There was equal emphasis on knowledge use in the different domains.
Conclusion: If the translation of evidence into knowledge is viewed as socially mediated, tools to measure the organisational context of EBP in healthcare could be enhanced by consideration of related concepts from the organisational and management sciences. Comparison of measurement tools across domains suggests that there is scope within EBP for supplementing the current emphasis on human and technical resources to support information uptake and use by individuals. Consideration of measurement tools from the fields of KM and OL shows more content related to social mechanisms to facilitate knowledge recognition, translation, and transfer between individuals and groups.

Skinner K. (2007) Developing a tool to measure knowledge exchange outcomes. Canadian Journal of Program Evaluation. 22 (1): 49-73

This article describes the process of developing measures to assess knowledge exchange outcomes using the dissemination of a best practices in type 2 diabetes document as a specific example. A best practices model consists of knowledge synthesis, knowledge exchange (dissemination/adoption), and evaluation stages. Best practices are required at each stage. An extensive literature review found no previous knowledge syntheses of concrete tools and models for evaluating dissemination or exchange strategies. This project developed a practical and usable tool to measure the reach and uptake of disseminated innovations. The instrument itself facilitates an opportunity for knowledge exchange to occur between producers and adopters. At this point the tool has a strong theoretical basis. Initial pilot-testing has begun; however, the accumulation of evidence of validity and reliability is only in the planning stages. The instrument described here can be adapted to other areas of population health and evaluation research

APPENDIX B: List of search terms and content experts

List of Search Terms

The lists below represent the search terms utilized in the electronic database searches for this review. The development of this list was an iterative process and was guided by terms recommended in the following sources on KT:

- Graham ID. Knowledge translation at CIHR. Part 1: What is Knowledge Translation? 2007 [cited 2009 Aug 4] Available from http://www.cihr-irsc.gc.ca/e/33747.html
- Estabrooks CA, Derksen L, Winther C, Lavis JN, Scott SD, Wallin L, Profetto-McGrath J. The intellectual structure and substance of the knowledge utilization field: a longitudinal author co-citation analysis, 1945 to 2004. Implementation Science. 2008 Nov 13;3:49. [Additional file 1: Search strategy. Available from http://www.implementationscience.com/content/3/1/49/additional]
- WhatisKT. KT terms [wiki]. [cited 2009 July 20] Available from http://whatiskt.wikispaces.com/KT+Terms*

*For further information about KT terms and specifically those referenced in the WhatisKT wiki, consult:
McKibbon KA, Lokker C, Wilczynski NL, Ciliska D, Dobbins M, Davis DA, Haynes RB, Straus SE. A cross-sectional study of the number and frequency of terms used to refer to knowledge translation in a body of health literature in 2006: a Tower of Babel? Implementation Science. 2010 Feb 12;5:16.

This paper, published after our searches were executed, provides an overview of some of the challenges associated with terms used in the KT literature, many of which we encountered as well.

The search terms in the lists below were adapted to the controlled vocabularies of the electronic databases as much as possible. When searching terms within the title and abstract fields, we utilized advanced search functions such as adjacency (or proximity) operators as well as truncation and wildcard symbols in order to capture as many combinations of relevant terms as possible. For further information about these adjacency operators and wildcard symbols see the legend below the list of search terms.

Lists of search terms:

Knowledge Transfer Terms

- action research
- applied dissemination
- communit$ based research
- communities of practice
- data adj2 (diffusing or diffusion or dissemination or exchange or linking or network? or share or sharing or transfer$ or translat$)
- diffusion of innovation
- evidence adj2 (diffusing or diffusion or dissemination or exchange or linking or network? or partnership? or share or sharing or transfer$ or translat$)
- evidence informed decision making
- evidence-based decision making
- Evidence-Based Medicine
- Evidence-Based Practice

- implementation research
- implementation science
- industry liaison
- information adj2 diffusing
- information adj2 diffusion
- information adj2 exchange
- information adj2 linking
- information adj2 network?
- information adj2 partnership?
- information adj2 share
- information adj2 sharing
- information adj2 transfer$
- information adj2 translat$
- Information Dissemination
- integrated knowledge transfer
- integrated knowledge translation
- knowledge adj2 (diffusing or diffusion)
- knowledge adj2 exchang$
- knowledge adj2 partnership?
- knowledge adj2 share?
- knowledge adj2 sharing
- knowledge adj2 transfer$
- knowledge adj2 translat$
- knowledge adj2 utilization
- knowledge broker$
- knowledge creation
- knowledge development
- knowledge exchange and uptake
- knowledge generation
- knowledge integration
- knowledge mobili#ation
- knowledge network?
- knowledge to action"
- link$ evidence
- link$ practice
- link$ research"
- link$ science
- linkage and exchange"
- participatory research
- policy research
- practice based evidence
- research adj2 (translation or translating or translate)
- research adj2 disseminat$
- research adj2 transfer$
- scientific evidence
- technology transfer

Knowledge Transfer Outcome Terms

- behavior$ adj2 (change? or changing)
- behaviour$ adj2 (change? or changing)
- business case
- effective dissemination
- evidence adj2 aware$

- evidence adj2 impact$
- evidence adj2 implement$
- evidence adj2 uptak$
- evidence adj2 utiliz$
- guideline adherence
- improve$ adj3 knowledge
- improve$ adj3 learning
- improve$ adj3 practice?
- information adj2 spread
- innovation adj 2 adopt$
- innovation adj2 implement$
- knowledge adj2 uptak$
- knowledge adj2 utiliz$
- policies adj2 develop$
- policy adj2 develop$
- policy and practice"
- Policy Making
- practice adj2 change?
- practice adj2 changing
- program$ adj3 adopt$
- research adj 2 "use"
- research adj2 aware$
- research adj2 impact$
- research adj2 implement$
- research adj2 uptak$
- research adj2 utiliz$
- return on investment"
- science adj2 aware$
- science adj2 impact$
- science adj2 implement$
- science adj2 uptak$
- science adj2 utilizat$
- Social Values

Evaluation Methods

- case studies
- case study
- evaluat$
- Evaluation Studies as Topic
- evaluation studies
- instrument
- measur$
- model?
- outcome?
- process
- processes
- psychometric?
- Psychometrics
- Questionnaires
- reliability
- social network analys#s
- survey?
- tool?

- validation
- validation studies as topic
- validation studies
- validity

Legend:
adj2 is an adjacency operator that requires the words to be found within 2 words of each other, in any order
adj3 is an adjacency operator that requires the words to be found within 3 words of each other, in any order
$ is a truncation symbol that stands in place for multiple characters, allowing for the capture of various endings of a word
? is a wildcard symbol that stands in place for one or no characters, allowing for the capture of singular or plural forms of a word
is a wildcard symbol that stands in place for one character, allowing for the capture of different spellings of a word, for example: organi**z**ation or organi**s**ation

List of Content Experts

Contact name	**Title/Institution**
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APPENDIX C: Instruments Developed by the Review Team for the Review Steps

Single reviewer screen of titles and abstracts

1. Does the article describe a KTE outcome or a tool to measure a KTE outcome as a result of a KTE application?
a) Yes, instrumental outcome (e.g. change in behavior, policy, program or procedure)
b) Yes, knowledge/attitudes/beliefs outcome
c) Uncertain (about outcome or KTE application)
d) No

Inclusion Criteria
- Any mode/method of disseminating research information to any audience (see exclusions below)
- Any relevant systematic reviews, literature reviews etc.

Examples may include: Studies measuring/assessing/evaluating the uptake or adoption of evidence-based guidelines, research knowledge, evidence into practice, policymaking, decision-making etc.

Exclusion Criteria
- Models, theories and/or conceptual frameworks that simply document or describe KTE processes (i.e. how to do KTE)
- "Social marketing" or "public communication campaign" or public education campaign alone
- Curriculum change or curriculum evaluation affecting students in a school or academic setting
- An evaluation of a program, policy, practice or intervention in which no explicit KTE question/objective is answered/addressed

(e.g. evaluating an established evidence-based program, Quality Improvement Studies (QIS), Return-on-investment (ROI) studies, health promotion programs, and training programs that do not have KTE as a stated goal/intent).

Two reviewer screen of titles and abstracts

1. Does the article describe a KTE outcome or a tool to measure a KTE outcome as a result of a KTE application?
a) Yes, instrumental outcome (e.g. change in behavior, policy, program or procedure)
b) Yes, knowledge/attitudes/beliefs outcome
c) Uncertain (about outcome or KTE application)
d) No

(Inclusion and Exclusion criteria as listed above)

2. In what language is the article written? Please check one:
a) English
b) French
c) Other (please specify)
d) Uncertain

3. What type of document is it? Please check one:
a) Article
b) Book review, commentary, editorial or letter to the editor
c) Literature review

d) Uncertain

Two reviewer full article screen

1. Does the article describe a KTE outcome or a tool to measure a KTE outcome as a result of a KTE application?

a) Yes, instrumental outcome (e.g. change in behavior, policy, program or procedure)
b) Yes, knowledge/attitudes/beliefs outcome
c) No

(Inclusion and Exclusion criteria as listed above)

Study classification

1. Which method(s) is used to measure KTE outcomes in this article?

a) Simple Counts Only
b) Quantitative Methods/ Approaches
c) Descriptive Articles
d) Qualitative Methods/Approaches
e) Models/Frameworks

Quality Assessment – Quantitative articles

1. Does the article describe a KTE outcome or a tool to evaluate a KTE outcome as a result of a KTE application?

a) Yes
b) No

2. What measure(s) are being used to evaluate KTE outcomes? (check all that apply)

a) Survey/questionnaire, series of questions/interview (with access or reference to it) _____
b) Survey/questionnaire, series of questions/interview (without access or reference to it)
c) Observational
d) Chart audit, administrative data
e) Other (please describe) ____

3. Is the specific objective/purpose of the study stated?

a) Yes
b) No

4. Is the research design appropriate to address the objective/purpose?

a) Yes
b) No

5. Are there clearly defined outcome measures?

a) Yes
b) No

6. Are characteristics of the study population presented?

a) Yes

b) No

7. **Is a comparison group used?**

a) Yes
b) No

8. **Is the intervention process adequately described to allow for replication?**

a) Yes
b) No

9. **Is an intervention allocation described?**

a) Yes
b) No

10. **Is the intervention allocation random?**

a) Yes
b) No

11. **Are the methods used to measure KTE outcomes appropriate?**

a) Yes
b) No

12. **Are the statistical analyses appropriate to the research design?**

a) Yes
b) No

13. **Are the authors' interpretations consistent with the results, balancing benefits and harms, and considering other relevant evidence?**

a) Yes
b) No

14. **Do the authors discuss the generalizability of the findings?**

a) Yes
b) No

15. **Are there other studies listed in this reference list that should be retrieved for consideration? (If "Yes", please include author/year/publication, etc.)**

a) Yes (please specify) ____
b) No

<u>Quality appraisal – Qualitative articles</u>

1. **Does the article describe a KTE outcome or a tool to evaluate a KTE outcome as a result of a KTE application?**

a) Yes
b) No _____

2. **Is there an explicit approach to evaluating KTE outcomes that can be extracted from this article?**

a) Yes
b) No

3. Is the objective/purpose of the study clear?

a) Yes
b) No

4. Is the recruitment strategy appropriate to the aims of the research?

a) Yes
b) No

5. Are the data collected in a way that addressed the research issue?

a) Yes
b) No

6. Is the data analysis sufficiently rigorous?

a) Yes
b) No

7. Is there a clear statement of findings?

a) Yes
b) No

8. Is the research design appropriate to address the aims of the research?

a) Yes
b) No

9. Is the research methodology appropriate to address the research question (i.e. ethnography, grounded theory, etc.)?

a) Yes
b) No

10. Are there other studies listed in this reference list that should be retrieved for consideration? (if "Yes", please include author/year/publication, etc.)

a) Yes (please specify) ____
b) No

Data extraction – Quantitative articles

1. What is the domain of the KTE application? Please select all that apply

a) Healthcare
b) Education
c) Agriculture
d) Business
e) Other _____

2. List the jurisdiction where the study was completed

a) Country _____
b) Province/State _____
c) Region _____
d) City _____

3. Are the theoretical origins of the KTE approach reported? If yes, please list which one(s)?

a) Yes (please specify) _____
b) No _____

4. State the research question/objective

5. What is the study design?
a) Randomized controlled trials i) individual
b) Randomized controlled trials ii) clustered
c) Non-randomized studies i) individual
d) Non-randomized studies ii) clustered
e) Pre-post without control/referent group
f) Other _____

6. Who is/are the target population/audience, as stated in the study? Please select all that apply
a) Jurisdictional policy makers _____
b) Network/community of practice
c) Organization/workplace
d) Practitioners (Clinicians, Teachers, Farmers....) _____
e) Other _____

7. At what levels of the target population/audience or their practice are data available? Select all that apply
a) Level 5: Jurisdictional policy makers
b) Level 4: Network/community of practice
c) Level 3: Organization/workplace
d) Level 2: Practitioners
e) Level 1: Patients, clients, students, fields...(of practitioners)

8. Is there an additional article (or articles) required to capture the complete study (including all levels of target audience) for data extraction?
a) Yes _____
b) No

9. What level of data are you extracting in the following questions (questions 10 to 27)? If available, please select the Practitioner level as this is the focus of our review. IF practitioner level is not available please select the highest level available.
Level _____

10 & 11. Describe the <u>Intervention</u> Group 1 and Group 2 at this level
Provide answer for each category - use "NR" where applicable

a) Sample Size	Group 1 = , Group 2 = , …
b) Age (mean, SD, range)	Group 1 = , Group 2 = , …
c) % female	Group 1 = , Group 2 = , …
d) Loss to Follow up (% or N)	Group 1 = , Group 2 = , …

12 & 13. Describe the <u>Referent</u> Group 1 and Group 2 at this level
Provide answer for each category - use "NR" where applicable

a) Sample Size	Group 1 = , Group 2 = , …
b) Age (mean, SD, range)	Group 1 = , Group 2 = , …
c) % female	Group 1 = , Group 2 = , …
d) Loss to Follow up (% or N)	Group 1 = , Group 2 = , …

14. Enter any additional Intervention or Referent Group information at this level

15. Describe the overall (study) group at this level. Please answer this question only if reported or simply extrapolated (e.g. proportions), even if you answered questions 10 to 14
Provide answer for each category - use "NR" where applicable
a) Sample size
b) Age (mean, SD, range)
c) % female
d) Loss to follow-up (% or N)

16. Indicate the time period between the baseline measurement and the last follow up measurements that were taken at this level

17. What is the type of knowledge use that is evaluated at this level? Please select all that apply
a) Conceptual
b) Instrumental
c) Strategic/persuasive
d) Other _____

NOTE: Definition of types of knowledge use to guide reviewers.
Conceptual *use of knowledge implies changes in knowledge, understanding or attitudes, but not practice. Research could change thinking and inform decision-making but not change practice. For example, based on knowledge that self-monitoring of blood glucose in newly diagnosed patients with type 2 diabetes mellitus is not cost-effective and is associated with lower quality of life, we understand a newly diagnosed patient's concern about self-monitoring.*

Instrumental *use of knowledge is the concrete application of knowledge and describes changes in behaviour or practice. Knowledge can be translated into a usable form, such as a pathway for care, and is used in making a specific decision. For example, we could measure how often a clinician orders prophylaxis for deep venous thrombosis in appropriate patients admitted to the intensive care unit.*

Persuasive *use of knowledge is also called strategic or symbolic use of knowledge and refers to research being used as a political or persuasive tool. It relates to the use of knowledge to attain specific power or profit (i.e., knowledge as ammunition). For example, we use our knowledge of adverse events associated with use of mechanical restraints on agitated inpatients to persuade the nursing manager on the medical ward to develop a ward protocol about their use.*

18. What is the nature of the KTE application at this level? Please select all that apply
a) Opinion leader
b) Train the trainer
c) In person (workshop)
d) In person (didactic presentation)
e) Distance participation (interactive)
f) Distance participation (didactic)
g) Printed material
h) Electronic materials (e.g. reminders)
i) Artistic presentation
j) Academic detailing
k) Audit
l) Other _____

19. Describe the KTE application(s) at this level

20. Do the authors report that the KTE application was successful at this level?
a) Yes
b) No

21. Are the data presented in the article consistent with the authors' report of success at this level (or lack thereof)?
a) Yes (please describe below in question 22)
b) No (please describe below in question 22)

22. Enter the data reported in the article about KTE success (or lack thereof) at this level

23. Are the barriers or facilitators to KTE at this level described?
a) Yes
b) No

24. Enter the name of the instrument used to evaluate the KTE application at this level

25. Are measurement properties of the instrument used to evaluate the KTE application at this level presented? Please enter the supporting data (or reference which reports the data) in question 26 below
a) Validity (please describe below in question 26)
b) Reliability (please describe below in question 26)
c) Responsiveness (please describe below in question 26)
d) Other (e.g. Predictive Validity) (please describe below in question 26)
e) No measurement properties presented (please enter "NR" below in question 26)

26. Describe all details about measurement properties for tools at this level

27. Is there another level for which data is available in the study?
a) Yes – If yes, respond to the questions in form 'Level 4b' in Distiller for all levels of data remaining
b) No – If no, no further forms are necessary for this refID

28. Is this the consensus (final) version of the DE form?
Please select "No" until all conflicts have been resolved and consensus has been achieved. NOTE: ONLY ONE REVIEWER SHOULD SELECT "Yes"
a) Yes _____
b) No _____

REPEAT QUESTIONS 7 ONWARDS
FOR ADDITIONAL LEVELS OF DATA

Data extraction – Qualitative articles

1. What is the domain of the KTE application? Please select all that apply
a) Healthcare
b) Education
c) Agriculture
d) Business
e) Other _____

2. List the jurisdiction where the study was completed
a) Country _____
b) Province/State _____
c) Region _____
d) City _____

3. Are the theoretical origins of the KTE approach reported? If yes, please list which one(s)?
a) Yes (please specify) _____
b) No _____

4. State the research question/objective

5. Who is/are the target population/audience, as stated in the study? Please select all that apply
a) Jurisdictional policy makers _____
b) Network/community of practice
c) Organization/workplace
d) Practitioners (Clinicians, Teachers, Farmers....) _____
e) Other _____

6. At what levels of the target population/audience or their practice are data available? Select all that apply
a) Level 5: Jurisdictional policy makers
b) Level 4: Network/community of practice
c) Level 3: Organization/workplace
d) Level 2: Practitioners
e) Level 1: Patients, clients, students, fields...(of practitioners)

7. Is there an additional article (or articles) required to capture the complete study (including all levels of target audience) for data extraction?.
a) Yes _____
b) No

8. What level of data are you extracting in the following questions (questions 9 to 20)? If available, please select the Practitioner level as this is the focus of our review. IF practitioner level is not available please select the highest level available.

9. Describe the research design/approach reported (including the theoretical perspective underlying the design/approach)

10. Describe the participants of this qualitative study

11. How were the participants recruited?

12. What is the type of knowledge use that is evaluated at this level? Please select all that apply
Conceptual: changes in levels of knowledge or understanding or in attitudes
Instrumental: changes in behaviour or practice
Strategic/persuasive: use of knowledge to support a position already held, or to use knowledge as ammunition in the attainment of power or profit.
a) Conceptual
b) Instrumental
c) Strategic/persuasive

d) Other _____

13. What is the nature of the KTE application at this level? Please select all that apply
a) Opinion leader
b) Train the trainer
c) In person (workshop)
d) In person (didactic presentation)
e) Distance participation (interactive)
f) Distance participation (didactic)
g) Printed material
h) Electronic materials (e.g. reminders)
i) Artistic presentation
j) Academic detailing
k) Audit
l) Other _____

14. Describe the KTE application(s) at this level

15. Give the author's description of how the analysis proceeded

16. Provide your comments on analysis scope, depth, integrity

17. Summarize the study findings (themes and key issues) about the KTE application (and its success or lack thereof) at this level

18. Are the barriers or facilitators to KTE at this level described?
a) Yes
b) No

19. Is there another level for which data is available in the study?
a) Yes
b) No

20. Is this the consensus (final) version of the DE form?
Please select "No" until all conflicts have been resolved and consensus has been achieved. NOTE: ONLY ONE REVIEWER SHOULD SELECT "Yes"
a) Yes _____
b) No _____

REPEAT QUESTIONS 7 ONWARDS
FOR ADDITIONAL LEVELS OF DATA

APPENDIX D: Summary of Descriptive Articles

First author (Year)	*Domain* of the KTE application, and target audience	Theoretical origins reported as informing the KTE approach	Type(s) *of knowledge use*, and KTE applications
DESCRIPTIVE ARTICLES			
Acolet (2007)	*Healthcare* Practitioners Other: Hospital administrators	Organizational development, social networking	*Other: protocol not yet started* Applications: Opinion leader In person (workshop) Printed material
Bateman (1999)	*Healthcare* Practitioners	CME / Adult education Davis et al	Other: how to find evidence Applications: In person (workshop)
Bohringer (1998)	*Agriculture* Practitioners: Farmers	No	*Instrumental* Applications: Train the trainer
Brachaniec (2009)	*Healthcare* Practitioners Other: FM organizations	Yes – but not extracted	*Conceptual* Applications: Printed Material
Codyre (2008)	*Healthcare* Practitioners	Clinical Practice Guidelines refs	*Instrumental* Applications: Distance participation (didactic) Printed material
Curran (2005)	*Healthcare* Practitioners	No	*Instrumental* Applications: Opinion leader In person (workshop) In person (didactic presentation) Distance participation (didactic) Printed material Other: Monitoring and feedback
DeLise (2001)	*Healthcare* Practitioners: Nurses	Evidence based practice	*Instrumental* Applications: Opinion leader In person (didactic presentation) Printed material
Demie (2003)	*Education* Policy makers Practitioners: Teachers Other: Governors and principles	No	*Conceptual* *Instrumental* Applications: Other: Feedback
Hurlock-Chorostecki (2006)	*Healthcare* Practitioners	No	*Instrumental* Applications: In person (didactic presentation) Distance participation (didactic)

First author (Year)	*Domain* of the KTE application, and target audience	Theoretical origins reported as informing the KTE approach	Type(s) *of knowledge use*, and KTE applications
Johnson (2006)	*Healthcare* Practitioners Other: Families	No	*Conceptual* *Instrumental* Applications: Opinion leader In person (workshop) Distance participation (interactive) Printed material
Keys (2000)	*Agriculture* Practitioner: Farmers	No	*Instrumental* Applications: In person (workshop) Printed material Other: Media
King (2008)	*Healthcare* Practitioners	Kitson et al	*Conceptual* *Instrumental* Applications: In person (workshop) Printed material Other: Expert on ward
Labresh (2003)	*Healthcare* Practitioners	No	*Conceptual* *Instrumental* Applications: Opinion leader In person (workshop) Printed material Other: Electronic data system with reminders and feedback
Lannon (2007)	*Healthcare* Practitioners: Primary care physicians	Chain of Effect Framework	*Conceptual* *Instrumental* Applications: Opinion Leader In person (workshop) In person (interactive) Other: Online modules
Mallikarjuna (2005)	*Agriculture* Practitioners: Farmers	Total Quality Management (TQM)	*Instrumental* Applications: Train the trainer
Matchar (2006)	*Healthcare* Practitioners:	TQM informs facilitated process improvement	None of the above/unknown Applications: Other: Not specified
McBride (2007)	*Education* Practitioners	Dissemination and capacity building	*Instrumental* Applications: Train the trainer In person (workshop) Printed material

First author (Year)	*Domain* of the KTE application, and target audience	Theoretical origins reported as informing the KTE approach	Type(s) *of knowledge use*, and KTE applications
McErlean (2006)	*Healthcare* Practitioners	Bataldi and Berwick	*Instrumental* Applications: Opinion leader In person (didactic presentation) Distance participation (interactive)
MacGregor (2005)	*Healthcare* Practitioners	No	*Instrumental* Applications: Printed material Other: Website
Muhamad (1995)	*Agriculture* Practitioners: Extension agents, Farmers	Interdependency model of Bennett, 1989.	*Instrumental* Applications: Train the trainer In person (workshop) Distance participation (interactive) Distance participation (didactic) Printed material Other: Mass media; group farming extension visits; method demonstrations; writing boards cocoa pilot projects on the smallholder's farm; for-fee consultation.
Nancarrow (2004)	*Healthcare* Practitioners: Podiatrists	Participatory action research (Chesler, 1991); Involvement of practitioners in the development of their own guidelines (Grimshaw and Hutchison, 1995)	*Instrumental* Applications: Other: Involvement of practitioners in the development of an assessment form that was based on guidelines
Nystedt (2005)	*Healthcare* Practitioners: Radiation therapy educators and nurses	N/A: But they followed a practice-guideline development cycle that was collaborative (Browman et al. (1995).	*Instrumental* Applications: Opinion leader Train the trainer In person (workshop) Printed material Other: Website
Ornstein (2001)	*Healthcare* Practitioners: Level 1 and level 2 RNs	No	*Instrumental* Applications: In person (workshop) Printed material Other: Site visits, investigator meetings, ongoing support

First author (Year)	*Domain* of the KTE application, and target audience	Theoretical origins reported as informing the KTE approach	Type(s) *of knowledge use*, and KTE applications
Owen (2001)	*Other: Public health* Practitioners: Teachers Other: School children	Yes – but not extracted	*Conceptual* *Instrumental* Applications: Opinion leader Train the trainer In person (didactic presentation) Distance participation (didactic) Printed material
Plouffe (2004)	*Healthcare* Practitioners	No	*Instrumental* Applications: Opinion leader In person (workshop) Printed material Other: Ongoing education
Signal (2007)	*Healthcare* Policy makers: Ministry of Health and district health boards	Yes – but not extracted	*Conceptual* Applications: In person (workshop)
Stetler (2006)	*Healthcare* Practitioners	No	*Instrumental* Applications: Other: Not specified
Stroebel (2004)	*Healthcare* Practitioners	No	*Instrumental* Applications: Train the trainer Printed material Other: Education, media campaign, leadership support, consultation and networking
Sullivan (1991)	*Healthcare* *Other:* Mental health Practitioners	No	*Instrumental* Applications: In person (workshop) Other: Consultation/consultants
Tully (1950)	*Healthcare* Practitioners	No	*Conceptual* *Instrumental* Applications: In person (workshop) Printed material
van Kammen (2006)	*Healthcare* Policy makers	No	*Strategic/persuasive* Applications: Other: Interviews with stakeholders and discussions of evidence with all stakeholders

First author (Year)	*Domain* of the KTE application, and target audience	Theoretical origins reported as informing the KTE approach	Type(s) *of knowledge use*, and KTE applications
Kramer (2004)	*Business* Other: Workers, managers	Two-communities theory; interactive engagement (Huberman)	*Conceptual* *Instrumental* *Strategic/persuasive* Applications: Other: One on one interviews and facilitated group meetings
BOTH DESCRIPTIVE ARTICLE AND MODEL			
Lovitt (1996)	*Education* Practitioners: Teachers	Three Steps	*Instrumental* Applications: In person (workshop) Other: Telephone and in-person follow up discussions
McConnell (2007)	*Healthcare* Practitioners:	Rogers diffusion of innovation	*Instrumental* Applications: Opinion leader In person (workshop)
Ortiz (1991)	*Agriculture* Practitioners: Farmers	Yes – but not extracted	*Instrumental* Applications: Opinion leader In person (workshop) In person (didactic presentation)
MODEL ONLY			
Bensley (2004)	*Healthcare* Other: Patients	Yes – but not extracted	*Instrumental* Applications: Distance participation (interactive)
Donaldson (2007)	*Healthcare* Practitioners	Eisenberg Pyramid	*Other: not clearly indicated* Applications: Other: Not specified
Dufault (2001) Sweden	*Healthcare* Practitioners:	Rogers Diffusion of Innovation	*Instrumental* Applications: Other: Not specified
Kresse (2007)	*Healthcare* Practitioners	Bodinson	*Conceptual* *Instrumental* Applications: Opinion leader In person (workshop) Printed material
Legare (2009)	*Healthcare* Practitioners Other: Patients		*None of the above/unknown* Applications: Other: Not specified

First author (Year)	***Domain* of the KTE application, and target audience**	**Theoretical origins reported as informing the KTE approach**	**Type(s) *of knowledge use*, and KTE applications**
Sheldon (2007)	*Other: Occupational health and safety* Practitioners: Occupational health practitioners	Yes – but not extracted	*Instrumental* Applications: Other: Not specified
Skinner (2007)	*Healthcare* Practitioners	Yes – but not extracted	*Conceptual* Applications: Printed material
Tran (2009)	*Other: Road Safety* Policy makers	No	*Strategic/persuasive* Applications: Other: Engagement of policy makers in the research process
Valente (1993)	*Healthcare* *Agriculture* Practitioners: Healthcare (not specified) Farmers	Diffusion of Innovation and mathematical modeling	*Instrumental* Applications: Opinion leader Other: mass media
Verkasalo (1998)	*Business* Practitioners: Engineers	Yes – but not extracted	*Conceptual* Applications: Distance participation (didactic) Printed material
Wynn (2009)	*Business* Other: Company owners	No	*Instrumental* Applications: Other: Business consultant as project manager
Kramer (2004)	*Other: Health and safety associations* Other: Consultants and ergonomists	models of network theory	*Conceptual* *Instrumental* *Strategic/persuasive* Applications: In person (workshop)
Black (1995)	*Healthcare* Practitioner: Hospital setting	Quality improvement innovation studies, not dissemination	*Other: small scale studies in hospital departments* Application: Other: Not specified

APPENDIX E: Annotated Bibliography Describing KTE Evaluation Tools

Ammendolia C, *et al*. Implementing evidence-based guidelines for radiography in acute low back pain: A pilot study in a chiropractic community. *Journal of Manipulative & Physiological Therapeutics*. 2004; 27(3):170-179.

Describes a brief mailed survey to assess the use of X-rays for acute low-back pain.

Armstrong TA and Webb V. The School-Based Violence Prevention Planning Program: A pilot test. *Journal of School Violence*. 2006; 5(4):79-97.

Describes a planning team survey to assess the degree to which participation in curriculum and plan development affects team members' perceptions of their capacity to engage in data-driven prevention planning.

Bekkering GE, *et al*. Implementation of clinical guidelines on physical therapy for patients with low back pain: Randomized trial comparing patient outcomes after a standard and active implementation strategy. Physical Therapy. 2005; 85(6):544-555.

Describes a registration form for physiotherapy patients to capture treatment goals, content of the treatment, number of treatment sessions and more.

Bonetti D, *et al*. Guiding the design and selection of interventions to influence the implementation of evidence-based practice: An experimental simulation of a complex intervention trial. *Social Science & Medicine*. 2005; 60(9):2135-2147.

Describes a tool to measure clinician referrals for X-ray according to evidence.

Dufault MA and Willey-Lessne C. Using a collaborative research utilization model to develop and test the effects of clinical pathways for pain management. *Journal of Nursing Care Quality*. 1999; 13(4):19-33.

Describes instruments used to measure changes in nurses' pain-assessment practices, research-use competency and attitudes toward research.

Edwards H, *et al*. Improving paediatric nurses' knowledge and attitudes in childhood fever management. *Journal of Advanced Nursing*. 2007; 57(3):257-269.

Describes a three-instrument survey that explores nurses' knowledge, attitudes and practices related to evidence-based fever management.

Gunn J, *et al*. Guidelines for assessing postnatal problems: Introducing evidence-based guidelines in Australian general practice. *Family Practice*. 2003; 20(4):382-389.

Describes a self-report questionnaire for general practitioners on post-natal care, as well as a simulated patient evaluator rating scale.

Lasch KE, *et al*. Is hands-on experience more effective than didactic workshops in postgraduate cancer pain education? *Journal of Cancer Education*. 2000; 15(4):218-222.

Describes a survey to assess application of knowledge about cancer pain management.

Legare F, *et al*. Does training family physicians in shared decision making promote optimal use of antibiotics for acute respiratory infections? Study protocol of a pilot clustered randomised controlled trial. *BMC Family Practice*. 2007; 8:65.

Describes a decision questionnaire and conflict scale on the use of antibiotics for respiratory infections according to clinical practice guidelines.

Neitzel JJ, *et al*. Improving pain management after total joint replacement surgery. *Orthopaedic Nursing*. 1999; 18(4):37-45.

Describes a survey measuring knowledge and attitudes regarding pain.

Okon TR, *et al*. Palliative educational outcome with implementation of PEACE tool integrated clinical pathway. *Journal of Palliative Medicine*. 2004; 7(2):279-295.

Describes a survey to assess physicians' knowledge and attitudes with respect to end-of-life care.

Price SK, *et al*. Changing hospital newborn nursery practice: Results from a statewide "back to sleep" nurses training program. *Maternal and Child Health Journal*. 2008; 12(3):363-371.

Describes a survey for nurses to assess their knowledge and use of infant care practices.

Rashotte J, *et al*. Implementation of a two-part unit-based multiple intervention: Moving evidence-based practice into action. *Canadian Journal of Nursing Research*. 2008; 40(2):94-114.

Describes a self-report questionnaire on pressure-ulcer prevention.

Shirazi M, *et al*. Effects on readiness to change of an educational intervention on depressive disorders for general physicians in primary care based on a modified Prochaska model: A randomized controlled study. *Family Practice*. 2008; 25(2):98-104.

Describes the evaluation of an educational intervention on the management of depressive disorders and its impact on readiness to change.

Sung H, *et al*. An implementation programme to improve nursing home staff's knowledge of and adherence to an individualized music protocol. *Journal of Clinical Nursin*g. 2008; 17(19):2573-2579.

Describes the evaluation of an implementation program designed to improve nursing staff knowledge of, and adherence to, a music protocol for people with dementia in long-term care settings.

Titler MG, *et al*. Translating research into practice intervention improves management of acute pain in older hip fracture patients. *Health Services Research*. 2009; 44(1):264-287.

Describes an interdisciplinary and multi-faceted KTE practice designed to promote use of evidence-based pain-management practices by physicians and nurses to decrease pain intensity among older, hospitalized adults.