Chapter 3.5 Monitoring knowledge use and evaluating outcomes

Sharon E. Straus,1 Jacqueline Tetroe,2 Onil Bhattacharyya,1 Merrick Zwarenstein,3 and Ian D. Graham4

1Li Ka Shing Knowledge Institute, St. Michael’s Hospital, University of Toronto, Toronto, ON, Canada
2Knowledge Translation Portfolio, Canadian Institutes of Health Research, Ottawa, ON, Canada
3Centre for Studies in Family Medicine, Department of Family Medicine, Schulich School of Medicine and Dentistry, Western University, London, ON, Canada and Institute for Clinical Evaluative Sciences, Toronto, ON, Canada
4School of Nursing, University of Ottawa, Ottawa Hospital Research Institute, Clinical Epidemiology Program, Ottawa, ON, Canada

Key learning points

• Knowledge use can be instrumental (concrete application of knowledge), conceptual (changes in understanding or attitude) or persuasive (use of knowledge as ammunition).
• While knowledge use is important, the impact of its use on patient, provider, and system outcomes is of greatest interest.
• Strategies for evaluating knowledge implementation should use explicit and rigorous methods and should consider both qualitative and quantitative methodologies.

Monitoring knowledge use

In the Knowledge to Action cycle, after the knowledge translation intervention has been implemented (Chapter 3.4), knowledge use should be monitored. This step is necessary to determine how and to what extent the
knowledge has diffused through the target decision maker groups [1]. Measuring and attributing knowledge use is still in its infancy within health research. How we proceed to measure knowledge use depends on our definition of knowledge and knowledge use and on the perspective of the knowledge user.

There have been several models or classifications of knowledge use [2, 2–6]. Larsen described conceptual and behavioral knowledge use [2]. Conceptual knowledge use refers to using knowledge to change the way users think about issues. Instrumental knowledge use refers to changes in action as a result of knowledge use. Dunn further categorized knowledge use by describing that it could be done by the individual or a collective [3]. Weiss also described several frameworks for knowledge use including the problem solving model which she described as the direct application of the results of a study to a decision [4]. In this model she mentions that research can “become ammunition for the side that finds its conclusions congenial and supportive. Partisans flourish the evidence . . . to neutralize opponents, convince wavering and bolster supporters” [4]. Beyer and Trice considered this to be a different form of knowledge use and labeled it as symbolic knowledge use which they added to Larsen’s framework [5]. Symbolic use involves the use of research as a political or persuasive tool. Estabrooks has described a similar framework for knowledge use including direct, indirect and persuasive research utilization where these terms are analogous to instrumental, conceptual and symbolic knowledge use respectively [6].

We find it useful to consider conceptual, instrumental and persuasive knowledge use [1]. As mentioned above, conceptual use of knowledge implies changes in knowledge, understanding or attitudes. 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 [7, 8] we understand a newly diagnosed patient’s concern about self-monitoring.

Instrumental knowledge use is the concrete application of knowledge and describes changes in behavior or practice for example [1]. Knowledge can be translated into a usable form such as a care pathway and is used in making a specific decision. For example, a clinician orders deep venous thrombosis (DVT) prophylaxis in patients admitted to the intensive care unit. This type of knowledge could be measured by assessing how frequently DVT prophylaxis is ordered in appropriate patients.

Persuasive knowledge use is also called strategic or symbolic knowledge use 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 goals (i.e.
knowledge as ammunition) [1]. 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.

All types of knowledge use can be partial or complete. For example, a clinician may be aware of and understand several of the recommendations in a clinical practice guideline but not of all of them (partial conceptual knowledge use); similarly, she may implement some of these recommendations in her own setting but may not be able to implement all of them (partial instrumental knowledge use).

**How can knowledge use be measured?**

There are many tools for assessing knowledge use. Dunn completed an inventory of tools available for conducting research on knowledge use [3]. He identified 65 strategies to study knowledge use and categorized them into naturalistic observation, content analysis, and questionnaires and interviews [3]. He also identified several scales for assessing knowledge use but found that most had unknown or unreported validity and reliability. Squires and colleagues completed a systematic review of the psychometric properties of self-reported research utilization measures [9]. The authors identified 60 unique measures but only 7 were assessed in more than 1 study. Most measures targeted health care provider use of knowledge. Only 6 measures reported validity from 3 or more sources (including content, response processes, internal structure, and relations validity). Four of these 6 measures target nurses, 1 targets allied health care professionals, and 1 targets public health decision makers. Overall, the review highlights substantive gaps in the literature supporting the validity of these measures.

Examples of questionnaires available to measure knowledge use include the Evaluation Utilisation Scale [10] and Brett’s Nursing Practice Questionnaire [11]. This latter questionnaire focuses primarily on the stages of adoption as outlined by Rogers [12] including awareness, persuasion, decision, and implementation. Most frequently, knowledge utilization tools measure instrumental knowledge use [9, 13]. And, often these measures rely on self report and are subject to recall bias. For example, an exploratory case study described call centre nurses’ adoption of a decision support protocol [14]. Participating nurses were surveyed about whether they used the decision support tool in practice. Eleven of 25 respondents stated that they had used the tool and 22 of 25 said they would use it in the future. The authors identified potential limitations to this study including recall bias and a short follow-up period (1 month) without repeated observation [14]. In a more
valid assessment of instrumental knowledge use, participants also underwent a quality assessment of their coaching skills during simulated calls [15]. Assessing instrumental knowledge use can also be done by measuring adherence to recommendations or quality indicators. For example, Grol and colleagues completed a series of studies involving family physicians in the Netherlands who recorded their adherence to 30 national guidelines [16]. A total of 342 specific adherence indicators were constructed and physicians received educational sessions on how to record their performance on these indicators. Computer software was developed to relate actual performance to clinical conditions to assess adherence. They were able to determine that guidelines with lowest adherence scores included those for otitis externa and diagnosis of asthma in adults while those with highest adherence scores were those for micturition problems in older men and the diagnosis of heart failure [16].

In addition to considering the type of knowledge use, we should also consider who are the targets for knowledge use (i.e. the public, health care professionals, policy makers). Different targets may require different strategies for monitoring knowledge use. Assessing use of knowledge by policy makers may require strategies such as interviews and document analysis [17]. When assessing knowledge use by physicians, we could consider measuring use of care paths or ordering of relevant medications. And, when assessing knowledge use by patients, we could monitor adherence to exercise or medication regimens for example.

What is the target level of knowledge use that we are aiming for? As mentioned in Chapter 3.1, this target will be based on discussions with relevant stakeholders including consideration of what is acceptable and feasible and whether a ceiling effect may exist. If the degree of knowledge use is found to be adequate, strategies for monitoring sustained knowledge use should be considered. If the degree of knowledge use is less than expected or desired, it may be useful to reassess barriers to knowledge use. In particular, the target decision makers could be asked about their intention to use the knowledge. This exploration may uncover new barriers. In the case study of the use of decision support for a nurse call centre, it was identified through a survey that use of the decision support tool might be facilitated through its integration in the call centre database, incorporating decision support training for staff, and informing the public of this service [14].

When should we measure knowledge use versus the impact of knowledge use? If the implementation intervention targets a behavior for which there is a strong evidence of benefit, it may be appropriate to measure the impact of the intervention in terms of whether the behavior has occurred (instrumental knowledge) rather than whether a change in clinical outcomes has
occurred [18]. For example, we recently completed a study of a strategy to implement the Osteoporosis Canada guidelines in a northern Ontario community setting [19]. The primary outcome of this randomized trial was appropriate use of osteoporosis medications (instrumental knowledge) rather than patient fractures (clinical outcome). We felt that there was sufficient evidence in support of use of osteoporosis medication to prevent fragility fractures that we did not need to measure fractures as the primary outcome. In cases such as this study, outcome measurement at the patient level could be prohibitively expensive but failure to measure at the patient level does not address whether the intervention improves relevant clinical outcomes.

Evaluating the impact of knowledge use

The next phase of the Knowledge to Action Cycle is to determine the impact of knowledge implementation [1]. In this phase we want to determine if the knowledge use impacts health, provider, and system outcomes. While assessing knowledge use is important, its use is of particular interest if it influences important clinical measures such as quality indicators.

Evaluation should start with formulating the question of interest. As mentioned in Chapter 2.2, we find using the PICO framework to be useful for this task. Using this framework, the “P” refers to the population of interest which could be the public, health care providers, or policy makers. The “I” refers to the KT intervention which was implemented and which might be compared to another group (“C”). The “O” refers to the outcome of interest which in this situation refers to health, provider, or organizational outcomes.

In the previous section we described strategies for considering knowledge use which can be used to frame outcomes. Donabedian proposed a framework for considering quality of care that separates quality into structure, process, and outcome. It can be used to categorize quality indicators and to frame outcomes of both knowledge use and the impact of knowledge use [20]. Structural indicators focus on organizational aspects of service provision which could be analogous to instrumental knowledge use. Process indicators focus on care delivered to patients and include when evidence is communicated to patients and caregivers. These indicators are analogous to instrumental knowledge use. Outcome indicators refer to the ultimate goal of care such as patient quality of life or admission to hospital. For example, if we want to look at the issue of prophylaxis against DVT in patients admitted to the intensive care unit, structural measures would include the availability of DVT prophylaxis strategies at the institution (instrumental
knowledge use). Process measures include prescription of DVT prophylaxis strategies such as heparin in the critical care unit (instrumental knowledge use). And, outcome measures include risk of DVT in these patients in the intensive care unit. Table 3.5.1 provides a framework for differentiating knowledge use from outcomes.

In a systematic review of methods used to measure change in outcomes following a KT intervention, Hakkennes and Green grouped measures into 3 main categories [18] which we have modified to focus on impact of knowledge use:

1 Patient level
(a) Measurement of an actual change in health status such as mortality or quality of life
(b) Surrogate measurement such as length of stay in hospital or attitudes towards an intervention.
2 Health care provider level
(a) Measurement of provider satisfaction.

3 Organizational or process level
(a) Measurement of change in health care system (e.g. wait lists) or costs.
Hakkennes and Green found that of 228 studies evaluating strategies for guideline implementation, 93% measured outcomes at the level of clinician and 13% used surrogate measures at the level of the provider [18]. Less than one-third of studies used patient level outcomes. In a review of 53 guideline implementation studies in nursing and allied health professions, 86% of the studies included provider outcomes, 43% included patient outcomes, and 38% of the studies had system level outcomes [21].

We encourage readers to look at the Grid-Enabled Measures (GEM) Database [22] which is a project initiated by the Canada Research Network Cancer Communication Research Centre at Kaiser Permanente in Colorado and the National Cancer Institute’s Division of Cancer Control and Population Sciences. The goal of GEM is to provide a database of standardized and validated KT measures. Each item in the repository includes the name of the tool, the construct it measures, its content area, target population and mode of administration. Links to the tool and ratings by those who have used it are also available.

Methods for evaluating KT interventions
After formulating the question, we need to match it to the appropriate evaluation design. When developing an evaluation, we need to consider rigor and feasibility. By rigor we mean the strategy for evaluation should use explicit and valid methods. Both qualitative and quantitative methodologies could be used. By feasible, we mean the evaluation strategy is realistic and appropriate given the setting and circumstances. As with any evaluation, the strategy should be ethical.

Selection of our evaluation strategy also depends on whether we want to enhance local knowledge or provide generalizable information on the validity of the KT intervention. As mentioned in Chapter 5.1, those interested in local applicability of knowledge (i.e. whether an intervention worked or not in the context in which it was implemented) should use the most rigorous study designs feasible. These may include observational evaluations whereby the researcher does not have control over allocation of study participants to the intervention or a comparable control. Those interested in generalizable knowledge (i.e. whether an intervention is likely to work in comparable settings) should use the most rigorous research evaluation
design that they can afford such as randomized trials (or experimental evaluation). A third form of evaluation to consider is process evaluation. Process evaluation may involve determining the extent to which target decision makers were actually exposed to the intervention or the dose of the intervention. It may also include a description of the experience of those exposed to the intervention and potential barriers to the intervention. For example, a study designed to evaluate the effectiveness of an educational intervention on the use of radiography for diagnosis of acute ankle injuries revealed no impact of the active dissemination of the Ottawa Ankle Rules. However, less than a third of those receiving the intervention were physicians who had authority to order X-rays, raising the question about whether the intervention was not effective or simply not directed to the appropriate target decision makers [23]. This type of evaluation is also useful to allow corrections to the intervention or implementation strategy based on what is revealed. We believe that process evaluation should occur alongside observational and experimental evaluation.

Qualitative methods of evaluation can be helpful in exploring the “active ingredients” of a KT intervention and thus are particularly useful in process evaluation. In a randomized trial of a comprehensive, multifaceted guideline implementation strategy for family physicians, no changes in cholesterol testing were noted after a 1 year intervention [24]. This finding led to completion of interviews with family physicians who expressed concern about the extra workload associated with implementation of the guidelines and suggested revisions to the diagnostic algorithm [25]. Triangulation should be considered in qualitative studies whereby a variety of strategies for data collection (e.g. interviews, surveys, focus groups) are used to enhance validity. Qualitative research can also be useful for identifying unintended impacts of the intervention. For a more comprehensive description of qualitative research methods we encourage readers to review the textbook by Denzin and Lincoln [26].

Quantitative evaluation methods included randomized and quasi-experimental studies. Randomized trials are more logistically demanding but provide more reliable results than non-randomized studies. Non-randomized studies can often be implemented more easily and are appropriate when randomization is not possible. For complete description of these strategies, we refer you to Chapter 5.1.

Mixed methods can be used to evaluate KT interventions and are particularly helpful in the evaluation of complex KT interventions. We propose that the evaluation phase is also an opportunity to explore factors that can contribute to sustainability of the intervention. Both quantitative and
qualitative evaluation strategies can help identify factors that can influence sustained knowledge use. Sustainability is further discussed in Chapter 3.6.

**Future research**

There are several areas of potential research including the development and evaluation of tools for measuring knowledge use, outside of instrumental knowledge use. And, enhanced methods for exploring and assessing sustained knowledge use should be developed.

**References**


