

Online Supplementary Material

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Supplemental Appendix 2. Methods

A mixed methods study using a convergence design was conducted.¹ A quantitative longitudinal study was combined with a qualitative multiple case study.² Cases were critical searches for information by practicing physicians for specific patients. To obtain a systematic and comprehensive description of these cases, quantitative and qualitative data were integrated at both collection and analysis stages.³ The quantitative data collection documented physicians' searches for clinical information as well as their reflection on each search. Guided by quantitative data, we recorded and analyzed physicians' explanation of the clinical situation, the objectives of the search, the cognitive impact of retrieved information, their use of this information, and the benefits for their patients. We defined patient health benefits as the physicians' perception that health outcomes for this patient were better with than without an answer to their clinical question. Quantitative and qualitative data were then merged into clinical stories (hereinafter called vignettes). Some concepts and technical terms from mixed methods research and information studies are defined in Supplemental Appendix 1.

Theoretical Model

This study is based on a theoretical model called the acquisition-cognition-application / levels of outcome model (hereinafter the ACA-LO model). This model was adapted from information studies to conceptualize the value of information for health professionals using four levels of outcome of information-seeking.⁴ This model can be summarized as follows: Clinicians may find one or more information objects to fulfill a search objective, eg, a Web page addressing a clinical question (acquisition). Level 1: At least one objective is met. Next, they integrate with their previous knowledge the information objects deemed relevant for achieving this objective (cognition). Level 2: A positive cognitive impact is observed. Only a fraction of this information may be pertinent for one specific patient, sometimes simply to better understand the clinical situation (application). Level 3: Information is used. On occasion, one information object is applied to the management of this patient and associated with expected health benefits (patient outcomes). Level 4: A patient health outcome is observed. The Information Assessment Method (IAM) is based on the ACA-LO model, and was developed and validated using literature reviews, qualitative research and mixed methods research (www.mcgill.ca/iam).⁵

Quantitative Data Collection

In the longitudinal study, 41 Canadian family physicians searched Essential Evidence Plus on a handheld computer for clinical information, and rated their searches using the IAM.⁶ Updates to content were released by the publisher (Wiley & Sons, Inc.) roughly every 2-3 months. The initial database version used was version 72, and the final was version 79. Essential Evidence Plus is a specialized search engine over databases such as decision support calculators or Abstracts of the Cochrane Database of Systematic Reviews. A tracking function documented information hits in a log file on each handheld computer. An information hit was an information object with a unique identifier, eg, one abstract of a Cochrane Review, opened by one participant. One search by a participant could result in one information hit (objective met at

the first hit) or more than one hit (reiteration). Log files provided the date and time of each information hit as well as their title and source database. For each search and its corresponding hits, physicians were prompted to complete the 2007 version of the IAM questionnaire. Over an average of 320 days, 2,131 searches for clinical information were documented by 40 physicians (about 1.2 searches per participant per week). Of those, 1,767 (83%) searches were rated. One participant provided no data. The IAM 2007 documented each physician's reflection on their searches and hits with regard to the situational relevance of retrieved information (7 items), its cognitive impact (10 items), and the use of this information for a specific patient (yes/no).

Qualitative Data Collection

Qualitative data consisted of observations, log reports, archives, and interviews with respect to a sub-sample of 1,193 (56.0%) rated searches (the most recent searches) conducted over an average of 86 days in 2008-2009 by 39 physicians (one participant being unavailable for interview). The sample was based on a list of searches from participant log files: the interviewer went through this list as time allowed, moving from the newest to the oldest search. These multiple sources of evidence allowed us to critically examine interviews, specifically the coherence between interviews and the content of corresponding information hits. Physicians were interviewed twice regarding their most recent searches (midstudy and end-of-study). The time window between searches and interviews varied from 1 day to 250 days (mean 85 days; median 78 days). Interview length varied from 59 to 142 minutes (mean 107 minutes; median 112 minutes). Interviews retrospectively described searches for information. One author (J.J.L.) conducted all interviews, and our interview guide is available on request. J.J.L. is an anthropologist, and was unknown to the interviewees.

Before each interview, log reports containing IAM ratings were analyzed by the interviewer to identify searches rated as "I used (or will use) this information for a specific patient"; then, to stimulate recall of past events, log reports and IAM ratings were reviewed with each physician. For each search, interviewees were asked to describe the clinical situation including the patient's age, gender and health problems, elaborate on their IAM ratings, and then report patient health outcomes associated with their use of information (physician behavior). Interviews were audio taped, and transcripts were analyzed. Physicians' qualitative descriptions of critical searches were extracted from interviews. Critical searches were identified using the *critical incident technique*,⁷ which has been commonly used to assess the performance of health professionals, specifically their information behavior.⁸ This technique is usually considered valid to provide detailed empirical illustrations.⁹ A critical incident is a clear event from the observers' perspective, and has clear effects. Following this definition, a search was critical when the clinical situation and the use of information were clearly described.

Mixing Quantitative and Qualitative Data

We then analyzed data on critical searches (cases) to describe physicians' use of clinical information and subsequent effects on patient health. Using specialized software (NVivo7), qualitative and quantitative data were integrated. For each case, data were comprised of content from information hits, ie, the Essential Evidence Plus pages, the corresponding log file containing IAM ratings, and interview transcripts. We combined a deductive with an inductive thematic analysis.¹⁰ Data were assigned to pre-defined themes derived from IAM items (types of information use and health benefits based on prior literature reviews, qualitative and mixed methods studies).⁵ Data were also analyzed to explore new themes (emerging types of use and benefits). Transcripts were analyzed by three of us (J.J.L., P.P., R.M.G.). First, J.J.L. assigned extracts of transcripts to themes by going back and forth from textual data to themes. For each case, J.J.L. synthesized the data into a brief clinical vignette, which integrated quantitative and qualitative data to provide a comprehensive picture.

Second, P.P. reviewed all data (all searches), and the initial vignettes. Disagreements between J.J.L. and P.P. regarding the interpretation of the data (summarized in the vignettes) were resolved by discussion and consensus. P.P. has expertise in qualitative case studies and mixed methods studies.¹¹ To ensure rigor in

mixing data, J.J.L. and P.P. specifically discussed the divergences between qualitative and quantitative data, and systematically documented strategies to solve these issues, eg, "exclusion" of unclear searches from the set of critical searches.¹²

Third, R.M.G. independently reviewed transcripts and vignettes corresponding to critical searches (cases) with patient health benefits. R.M.G. judged the trustworthiness of the clinical content, and the relationship between the use of information and patient health benefits. For each vignette, R.M.G. answered yes to the following two questions: Is this clinical story clear, convincing and coherent, from a medical perspective? Can these reported patient health outcomes be associated with these information hits and information use? No stories were deemed to be untrustworthy. R.M.G. is a practicing family physician, while P.P. is a full-time researcher (and former general practitioner). Disagreements between R.M.G. and P.P. regarding outcomes were resolved by discussion and consensus.

Thus, in line with the mixed methods matrix technique for integrating data,³ in-depth interviews were conducted for a purposeful sample of rated searches, creating a subset of critical searches for which there were both quantitative and qualitative data. Mixing data led us to write vignettes, and build a meta-matrix in Excel where rows represented vignettes and columns mixed data on each case. Then, a visual diagram was created to represent this matrix (all vignettes). This diagram was composed of paths organized by each of the four constructs of the ACA-LO model and corresponding IAM items. It was created using Excel, a relational database (MySQL), and diagram creation software (live.gnome.org/Dia). Compared with tabulations, we chose a path diagram to more clearly represent vignettes, grouped by type of item for each ACA-LO construct. Finally, to estimate the NNBI, we divided the number of rated searches for a specific patient (reported via IAM ratings) by the number of critical searches with at least one patient health outcome (reported in vignettes).

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