An Interdisciplinary Computer-based Information Tool for Palliative Severe Pain Management

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Abstract

Objectives: As patient care becomes more collaborative in nature, there is a need for information technology that supports interdisciplinary practices of care. This study developed and performed usability testing of a standalone computer-based information tool to support the interdisciplinary practice of palliative severe pain management (SPM).

Design: A grounded theory-participatory design (GT-PD) approach was used with three distinct palliative data sources to obtain and understand user requirements for SPM practice and how a computer-based information tool could be designed to support those requirements.

Results: The GT-PD concepts and categories provided a rich perspective of palliative SPM and the process and information support required for different SPM tasks. A conceptual framework consisting of an ontology and a set of three problem-solving methods was developed to reconcile the requirements of different interdisciplinary team members. The conceptual framework was then implemented as a prototype computer-based information tool that has different modes of use to support both day-to-day case management and education of palliative SPM. Usability testing of the computer tool was performed, and the tool tested favorably in a laboratory setting.

Conclusion: An interdisciplinary computer-based information tool can be developed to support the different work practices and information needs of interdisciplinary team members, but explicit requirements must be sought from all prospective users of such a tool. Qualitative methods such as the hybrid GT-PD approach used in this research are particularly helpful for articulating computer tool design requirements.

Introduction

Palliative care is defined by the World Health Organization “an approach that improves the quality of life of patients and their families facing the problem associated with life-threatening illness, through the prevention and relief of suffering by means of early identification and impeccable assessment and treatment of pain and other problems, physical, psychosocial and spiritual”.

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being stricken with and surviving longer with multiple diseases, the need for palliative care services will increase in the coming years. Developing IT applications that facilitate bringing the wisdom of interdisciplinary team approaches to complex aspects of palliative care is one way of ensuring that even general practitioners can continue to provide quality palliative care to a growing population of patients. However, developing IT for use in palliative care is complex: palliative care is a comprehensive approach to patient care that incorporates multiple dimensions of medicine, including physical, psychosocial, and spiritual dimensions. Palliative care also emphasizes an interdisciplinary team approach to care, and thus palliative IT needs to support the practice needs of multiple types of clinicians, including physicians, nurses, counselors, and social workers. To date there has been little research on IT to support interdisciplinary practices and the communication and provision of care across multiple disciplines. Thus there is a need for a better understanding of collaborative practices and how IT can be designed to support such practices.

Developing IT applications such as computer-based information tools and health care information systems (HIS) is a challenge because despite a number of different systems design approaches, many health care IT projects end up being problematic after implementation. One source of the problems lies in the difficulty of effectively capturing the complexities of interdisciplinary care. It is plausible that
approaches such as the grounded theory-participatory design (GT-PD) approach described in this article can help avoid these problems by making explicit some of the key dimensions of interdisciplinary care. It has been reported that up to 50% of health care IT projects fail on implementation, and that number is still thought to be conservative given the reluctance to publish failures.\(^3\)\(^4\) Introducing IT into a health care setting can enhance clinical tasks by providing access to information and communication technologies, but the key is to ensure that the IT provides utility for users. Heeks\(^5\) points to the need to pay closer attention to developing the content, tools, roles, and competencies around an HIS to help close the design-reality gap.

This article describes our research on developing a computer-based information tool for palliative severe pain management (SPM). The computer-based information tool is a specific IT application that supports the SPM needs of different types of clinicians, emphasizes an interdisciplinary team approach to palliative SPM, and also supports different roles such as case development and education. The computer-based information tool described in this article is a fully functional standalone IT application that has not yet been implemented as an integrated HIS. The value from this research is the interpretive approach used to characterize complex care to guide a specialized IT application design because we believe the approach and its application to IT design can inform other IT work in health care. The article describes the conceptual framework of the computer-based information tool consisting of an ontology and set of problem-solving methods, illustrates the design of a prototype interdisciplinary computer-based information tool, and also provides usability testing results of the prototype tool. The article concludes with a discussion of the research and system design implications of this research and next steps based on the findings.

### Palliative Severe Pain Management

Our research using IT design in palliative care addresses one specific area of palliative care: severe pain management (SPM). Severe pain is defined as pain of 8, 9, or 10 on a 10-point numeric rating scale. Although all pain is distressful to patients, families, and clinicians, this research focuses on SPM because it is particularly distressful. There is a need for new approaches to SPM because it has been reported that 20% to 40% of severe pain cases are not properly managed.\(^6\) However, palliative SPM is complex because pain has multiple components (physical, spiritual, and psychosocial aspects). Further, because palliative care is defined as a patient-centered approach to care, any pain must be defined by the context of the individual person experiencing it. Thus palliative SPM is a good area for development of an interdisciplinary computer-based information tool.

To date there has been limited IT research in palliative SPM, and the HIS that exist focus on pain assessment and do not extend to pain management or education, nor do they emphasize the interdisciplinary nature of care. Such systems include PAINReportIt,\(^7\) an electronic extension of the McGill Pain Questionnaire (MPQ), and a PDA-based acute pain management system (APMS) developed at Queen’s University in Ontario that records pain scores, medications, and adverse effects from the medication.\(^8\) A shortcoming of tools such as the APMS was that although it enhanced data collection for research and audit purposes, it did not provide supporting resources such as assessment tools or templates to carry out a more comprehensive assessment.\(^8\)

### Study Design

#### Methods

A hybrid grounded theory-participatory design (GT-PD) approach\(^9\)\(^,\)\(^10\) was used for this study. Participatory design (PD) is a way to understand knowledge by doing and to make sense of the traditional, tacit, and often invisible ways that people perform their everyday activities.\(^11\) Grounded theory (GT) is a "qualitative research method that uses a systematic set of procedures to develop an inductively derived grounded theory about a phenomenon."\(^12\) A GT study does not begin with a preconceived theory that needs to be proven, but rather the theory emerges from the data. The hallmark of GT is three coding cycles: open, axial, and selective coding.\(^13\) Data are coded in open coding into concepts and categories that are refined and interconnected in axial coding. Selective coding establishes the final concepts and categories.

GT and PD were combined into a hybrid GT-PD approach to draw on the strengths of both methods. PD provides the means of user engagement to obtain a rich perspective on palliative practice and how a computer tool needs to be designed to support SPM. GT provides the means of analyzing and coding the data to allow us to understand the processes in SPM and the information used within those processes. The GT-PD approach emphasizes the methodological approach of capturing and understanding both the content and context of the data that is being used. The GT-PD approach differs from standard use of both methods in that we are not using GT to develop theory but rather using it to develop concepts and categories for ontology design. Using GT for ontology development ensures that the ontology is empirically derived and accurately represents the problem being studied. PD has been used primarily in health care IT research for understanding user needs for design of interfaces or system communication functionalities. An example of using PD for IT design in health care is illustrated by Weng et al,\(^14\) who used PD to design a clinical trial protocol writing system. Our GT-PD approach used PD in the data collection stages to obtain the data for GT coding. We believe a user-involved method like PD has value beyond just designing IT components such as interfaces. Effective IT design starts with a solid conceptual model. PD is a very effective means of obtaining data to facilitate understanding of tacit and explicit user requirements, and those requirements can then be analyzed and applied to the design of conceptual models such as an ontology.

Usability testing that draws on the methodology described by Kushniruk and Patel\(^15\) was used to evaluate the computer-based information tool. Usability testing refers to the evaluation of information systems that involves testing of participants who are representative of the target population performing representative tasks as they use the system.\(^16\)

### Data Sources

Three palliative data sources were collected through PD and coded into concepts and categories using GT. One of the authors (C.E.K.) was the researcher who collected the practice experience data and also performed the primary literature search. The chart audits were performed by a physician...
and nurse involved in the study. All patient data was made anonymous before being analyzed. Ethical approval was obtained from both the University of Victoria and the Vancouver Island Health Authority before commencing the study. The three palliative data sources are described below.

**Practice Experience**
This data source provided a perspective of SPM practice in clinical settings. Two different yet complimentary types of practice experience data were collected: clinician meetings and clinical observations. Clinician meetings involved one of the authors (C.E.K.) attending 150 hours of meetings with twelve clinicians (three physicians, three nurses, and three counselors) to discuss and model how severe pain gets managed. Those meetings included discussions of clinical cases as well as conceptual aspects of SPM. Clinical observations involved the same author spending 40 hours doing qualitative observation and documentation of pain management on the clinical ward of a 17-bed inpatient hospice.

**Patient Charts**
A chart audit was done of 88 retrospective patient cases with at least one severe pain episode. Data collected included medical data (such as current and past disease), severe pain episode (such as onset, duration, location, quality), and interventions (both pharmacological and nonpharmacological).

**Research Literature**
A literature search was done on severe pain in palliative care as well as general pain management. Thirty relevant pieces of literature brought in current evidence on severe pain management, such as randomized controlled trials on medication, conceptual models on pain management, and educational resources on assessment, diagnosis, and management of different types of pain. The screening and identification of relevant literature was done by the clinician participants described above.

The three data sources were used to provide a comprehensive picture of palliative SPM and are complementary and validate one another. The two types of practice experience data allowed comparison of problem solving that were described in clinician meetings with what was observed in actual clinical settings. The two types of practice experience data also allowed us to bring in different problem-solving perspectives, such as how does problem solving differ between experts and novices or among physicians, nurses, and counselors. The patient charts provided historical cases to show existing vocabulary and charting of SPM. Research literature provided evidence-based practice, which allowed relationships to develop between the GT concepts and categories that represent severe pain management issues and supporting information or evidence to overcome those issues. Research literature also allowed relationships to develop between conceptual models of pain management and the empirical patient cases, which provided an understanding of how such conceptual models are represented through empirical cases.

The data sources for the usability testing were five representative users of the tool, three physicians and two nurses. The five testing subjects had a range of expertise in palliative SPM varying from a medical resident to a nurse with 25 years of palliative care experience. All five subjects rated their level of computer expertise as average or excellent. None of the testing subjects were involved in the design of the computer-based information tool.

**Results**
**Ontology**
The concepts and categories that emerged from the GT-PD approach were used to design an ontology of palliative SPM. Processes and Information Types emerged as the two core categories from selective coding, and thus those two categories represent the highest level of the SPM ontology. The rationale for choosing processes and information types as the core categories was that we not only need to define the processes that are done as part of SPM but also the information that supports those processes. Figure 1 shows a high-level view of the SPM ontology illustrating the processes and information types to support the interdisciplinary practice of palliative SPM. A number of the ontology concepts are described below and are italicized in the text to allow easy reference between the text and the ontological model in Figure 1.

The concept for the computer-based SPM tool was initially conceived by physicians to enhance the assessment, diagnosis, and management of severe pain. One of the ontology processes is core SPM, which represents the assessment, diagnosis, and management of a severe pain episode. Through the practice experience meetings and reviewing the patient charts, the clinicians determined that there are 11 categories by which a patient may report severe pain. Each category was formalized as a model category that describes severe pain.

![Figure 1. High-level SPM ontology.](image-url)
the signs, symptoms, interpretations, and management strategies for each category.

However, through the GT-PD approach a number of additional requirements were articulated, and many of those requirements were outside the core SPM processes. The computer tool was initially intended to allow viewing of the model category details about the 11 severe pain categories without permitting data entry of patient cases. However, nurses described how much of their work involves charting and communication of patient cases across different clinicians to ensure continuity of patient care. Therefore nurses would only use the computer tool if it provided them tangible benefits, such as support for charting. Communication and data entry ontology processes were added to recognize those aspects of nursing workflow, and a patient case ontology information type was created.

Further, as part of the interdisciplinary nature of palliative care, concern was expressed by the counseling staff that the computer tool may slot a patient into a category of physical pain and ignore the fact that the patient may also be suffering from psychosocial or spiritual pain. Counselors were adamant that total pain, which refers to the combination of all elements of pain (physical, spiritual, and psychosocial), needs to be considered in each episode of severe pain. An understanding pain ontology process was created that emphasizes the need to fully understand all elements of a patient’s severe pain episode.

The learning SPM ontology process refers to the fact that the computer tool needs to support different levels of SPM expertise. During a practice experience meeting, a palliative care physician described how parts of SPM involve knowledge such as general pain management or palliative care principles. Novices such as new physicians or nurses, or medical or nursing students, may require comprehensive learning resources to support SPM. The learning SPM process enables the computer tool to be used as a teaching tool.

The team development process emphasizes the need to support an interdisciplinary team perspective for SPM. That helps to ensure that all types of palliative clinicians contribute to the diagnosis and management of a patient case.

Problem-solving Methods
Problem-solving methods are the way of structuring the ontology concepts to facilitate the completion of SPM tasks. The problem-solving methods link the ontology processes and information types to ensure that the right information is available for the right process at the right time. Three problem-solving methods to support SPM were established: case management, quality improvement, and learning and reflections.

Case Management
An ontological view of the case management problem-solving method is shown in Figure 2. Case management has two high-level functions: providing the means of doing SPM processes and managing the information types to do the processes. The core SPM processes consist of assessment, diagnosis, and management. For example, diagnosis is part of the core SPM process, and case management facilitates the capture of signs and symptoms through assessment to build a patient case and then matching the signs and symptoms to the 11 severe pain categories to provide diagnostic support for clinicians. Capturing signs and symptoms during assessment also supports the charting and communication processes.

Case management also supports different diagnostic practices. During the practice experience meetings, clinicians described the diagnosis part of the core SPM process as entailing two types of diagnosis: provisional and differential diagnosis. A provisional diagnosis is when a clinician is relatively sure of the category of severe pain that the patient

Figure 2. Case management problem-solving method.
is experiencing but they need some additional information to confirm the diagnosis. Thus they need supporting information to drill down within a severe pain category. A differential diagnosis is when a sign or symptom is present in multiple categories of severe pain and the clinician needs help determining the correct category. In that case they need contrasting information to navigate across severe pain categories to determine the category or categories of best fit.

In the ontology section it was described how one ontology concept is team development, reflecting the importance of an interdisciplinary team perspective in palliative care. However, during a practice experience meeting a question was raised asking what if the computer-based information tool was being used in a rural setting where there may only be a family physician or home care nurse and thus no direct access to an interdisciplinary team? Case management also provides supporting information on how to work within an interdisciplinary team perspective if no team is available. Electronic information such as links to websites can provide support for team practices, including real-time support such as messaging programs. The tool provides access to expertise, essentially mimicking a team if no team is available.

**Quality Improvement**

Quality improvement (QI) is a problem-solving method that supports the SPM processes by helping the user to look back to make sure that certain aspects of SPM have been completed. QI works in complement to the case management problem-solving method in that case management provides checklists for completing the fundamental considerations or check boxes for total pain assessment, whereas QI ensures that the checklists and boxes are actually done. Although total pain should be assessed as part of each severe pain assessment, the clinicians from this study acknowledge that it is not always done. Part of quality improvement is to use reminders to draw attention to particular aspects of SPM such as to ensure that total pain has been assessed and recorded.

Another aspect of the QI module is that it incorporates optional and mandatory fields to ensure that requisite data are collected for each severe pain episode to ensure that data are communicated to different staff. Nursing staff described how much of their work practices involve communicating data about patient cases, but not all requisite data get recorded and passed along among staff. For example, if a patient case is designated as confirmed diagnosis without any signs or symptoms being entered, the system provides the clinician with an alert notice to the fact that the case has no signs or symptoms entered.

**Learning and Reflections**

Learning and reflections is the third problem-solving method, and it complements the case management and QI problem-solving methods in that it encourages a clinician to reflect on what they have learned and/or experienced while using the computer-based information tool. Reflective practice refers to a process that starts when a clinician encounters a phenomenon that is outside their current knowledge, such as an unexpected outcome in a case, and has been described as a vehicle for learning by intertwining practice and theory. There is evidence that reflective practice can enhance decision making and learning in palliative care by transforming abstract theory into knowledge that is familiar to clinicians and grounded in the workplace.

**Prototype Computer-based Information Tool**

Architectural Framework

The ontology and problem-solving methods were used to design a functional prototype computer-based information tool to support palliative SPM. The prototype computer-based information tool was developed as a Microsoft Access database application. The programming that adds functionality to the database was done in Visual Basic for Applications.

Figure 3 shows the technical architectural framework of the computer-based information tool. The architecture framework is based on the Integrated Advanced Information Management System (IAIMS) architecture. Figure 3 illustrates that there are three main components to the computer-based information tool: problem-solving methods, processes, and databases. The relationship between the three components is the problem-solving methods are implemented through processes that interact with the databases.
The ontology concepts were used to develop a database schema, and the interfaces for the tool were based on the required problem-solving functionality as described in the previous section. A key aspect of designing the computer tool was ensuring the right information is available for the right SPM process.

A data entry process would be used to enter patient data or to enter a reflection on practice, whereas a data query process is used to retrieve data such as when doing a diagnosis or accessing supporting or contrasting information. Reminders provide a dialogue box to raise the user's attention to certain factors.

**Computer Tool Modes**

The computer-based information tool has two modes by which users can interact with the tool. The modes are Case Management and Learn SPM and are based on the problem-solving methods. The Case Management mode is used to develop and chart a patient case and is intended for day-to-

![Figure 4](image-url)
day clinical usage. The Learn SPM mode implements the learning and reflections problem-solving method in that it enables a clinician to directly access resources including different pain assessment tools or total pain and make reflective notes as they learn the material. The reflective notes can be printed, saved electronically, or e-mailed to the clinician to enable the development of a SPM dossier. However, there is a need for balance of how information is presented through a computer-based information tool to prevent overloading users. Clinicians doing day-to-day assessments and symptoms management through the Case Management mode do not want to be bombarded with excessive links to educational material. Similarly, a medical or nursing student or novice clinician wanting to learn about SPM does not want to have to develop a patient case in order to access educational information. Further learning about SPM will require a different presentation of the information.

The Case Management and Learn SPM modes draw on the same information from the database tables shown in Figure 3, but they use different information management approaches. If a clinician is in case management mode developing a case of a patient with neuropathic pain, the only supporting linkages they want, if any, are for neuropathic pain related resources. Alternatively a clinician using the Learn SPM mode may want to see all of the resources for a particular topic and have them organized in a logical fashion to support learning, similar to an index in a textbook.

Figures 4A and 4B provide screen shots of the computer-based information tool in the Case Management mode showing the screen where a patient case is developed. Figure 4A illustrates case management functionality, including data entry of a patient case and buttons to run reports and enter reflective practice notes. Figure 4B shows the same screen but with QI functionality as a reminder box. When a clinician goes to close a patient case, they must check off that total pain has been recorded, a set of fundamental considerations have been recorded, and that an interdisciplinary team has been consulted, or else a reminder box is raised. In the Case Details section of Figures 4A and 4B, there are places for checking off those details as completed. There is also an information button next to the check boxes that provides supporting information about interdisciplinary teams or total pain in case the clinician requires information to help with completing the tasks. For example, the information button for interdisciplinary teams provides supporting information on team practices as well as electronic information by connecting the clinician to a website that offers real-time consultation about interdisciplinary practices.

Figure 5 shows a screen shot of the Learn SPM mode, illustrating a screen with some of the pain assessment resources. All of the resources for pain assessment from the computer-based information tool are organized in sections and can be accessed from this one screen. Reflective practice notes (also shown in Figure 5) can be made as needed. The Learn SPM mode has similar screens for SPM diagnosis and management and for concepts such as total pain and interdisciplinary team practices.

Usability Testing
Each of the five testing subjects (described in the data source section) performed three cases of a patient presenting with severe pain. The three testing cases were developed by two palliative care physicians involved in this research. Neither of those two physicians was involved in the testing of the computer-based information tool. Each case had a number of tasks and subtasks such as entering data, performing a diagnosis, accessing different types of information, and entering reflective learning notes. The cases were developed to reflect a typical SPM case and to be similar in terms of information content and task complexity.

The testing was done in a laboratory setting in the office of the testing subject with the three testing cases completed on a tablet computer running the prototype computer-based information tool. The think-aloud method was used to capture the testers’ thoughts as they completed the testing cases. During each testing session the computer screen and think-aloud commentary were recorded using the HyperCam© software. After completion of the three cases, a set of interview questions was asked to gain insight about the computer-based information tool and what features the
transcribed verbatim and coded according to a coding scheme that was adapted from Kushniruk and Patel. The coding of usability issues was done by one of the investigators (C.E.K.) with another investigator (F.L.) providing assessment and verification of the codes. The coding scheme contains five categories of usability issues: information content, comprehension of graphics and text, issues in navigation, system understandability and user actions. Descriptive statistics were used to summarize the data from the coding scheme.

Table 1 shows the results of the descriptive statistics from the usability testing. As Table 1 shows, the five subjects had a total of 130 usability issues for an average of 26 issues per subject. Each subject completed a total of 50 tasks (19 for case one, 14 for case two, and 17 for case three). Many tasks had subtasks within them, for example, data entry may have 5 fields of data to be entered. The total number of subtasks was 154 (61 for case one, 40 for case two, and 53 for case three).

The most common usability issue was system understandability, which comprised 40 of 130 or 31% of the total issues. System understandability issues include when the subject did not understand how to do a task such as run a report or when they did not understand a system function such as a pop-up box. Navigation issues, which are when the subject could not find the required information or page, were the second most common error, comprising 32 of 130 or 25% of the total issues. When those two types of issues are combined (72 of 130), they are over half (55%) of the total issues that occurred. The remaining issues occurred less frequently, with all subjects having at least two issues because of inability to accomplish a goal and at least one error because of too much information. In all five subjects the number of issues decreased considerably from case one to case three as the subject became more familiar with the tool.

The interview questions asked after completion of the cases included queries on specific features, such as “How helpful is the ability to build and develop a patient case?” as well as general questions such as “Does the computer tool fit with your practice workflow? Why or why not?” One of the interview questions asked how helpful was the computer-based information tool for providing practice support for palliative SPM, with 1 being not at all helpful and 5 being extremely helpful. Four of the subjects gave a score of 4 and one gave 3.5, for an average score of 3.9 of 5. The score does indicate that the computer-based information tool is useful for providing practice support for palliative SPM, although the small number of testing subjects does not permit any statistical validation to be done on the scores.

Overall, the computer-based information tool scored favorably for providing support for palliative SPM. Having access to supporting information and being able to develop a patient case through the case management mode as opposed to just viewing information were identified as particularly useful features.

**Discussion**

Although there is the need for IT tools to support interdisciplinary practices, there are few empirical studies that show how to design such tools. This article makes a contribution by presenting an interpretive methodological approach to understanding and modeling the interdisciplinary practices of palliative SPM in the form of an ontology and a set of problem-solving methods. The article also illustrated how the ontology and problem-solving methods were formalized into an architectural framework and how that framework was implemented as a prototype computer-based information tool.

The article has implications for systems design of IT to support interdisciplinary practice. The article illustrated the value of a GT-PD method for seeking and understanding multiple perspectives of system use from all members of the interdisciplinary team who are expected to use the computer tool. Although physicians were interested in support for the core SPM tasks such as assessment and diagnosis, it was nurses who insisted that the computer tool have charting and communication functionalities to support their work practices. Further, counselors insisted the computer tool have “understanding pain” functionality to ensure that all aspects of a patient’s pain are given due consideration. The article also illustrated the potential for using internet and communication technologies to support interdisciplinary team practices if a clinician has no access to a team. The computer tool provides access to team information resources and real-time support such as messaging programs to provide electronic team functionality. The article also showed how a computer tool can be developed with different modes to support different tasks such as day-to-day case management and education.

A key lesson learned was that understanding and modeling complex user needs for IT design of complex care delivery such as interdisciplinary practices requires a large time commitment from both the researchers and the clinicians who are taking part in the study. In particular, we emphasize that it is the data collection and analysis to understand
the process and information needs of IT users that takes up the largest percentage of the time. This research spent the better part of two years collecting data from the three palliative data sources and then analyzing the data and developing the ontology and problem-solving methods. It then took approximately eight months to design and perform usability testing of the computer-based information tool.

Finally, the article illustrated the value of robust evaluation methods such as usability testing. Despite using a detailed GT-PD method to obtain user requirements, there were still a number of usability issues, including navigation, system understandability, and access to and understanding of information. Usability testing was a very useful evaluation method for getting at the intricate details of how a computer tool needs to be designed to be accepted by users. The usability testing presented in this article was intended to get initial perceptions of the computer tool and only used physicians and nurses as subjects, even though counselors also contributed to the design of the computer tool. More detailed testing using counselors will be done once modifications are made to the tool to address the usability issues.

Limitations of the study include the fact that despite using a rich and comprehensive set of data to develop the tool, it was still based on the SPM practice at one palliative care unit. Attempts were made to make the tool usable in multiple settings, such as developing real-time interdisciplinary team resources. Another limitation is that our prototype computer-based information tool is currently a standalone system, which impedes community-based care and data exchange.

Future work to address the above limitations includes adapting and testing the computer tool in other settings and implementing the tool through a network to provide ubiquitous access to the computer tool. Network access would also enable the patient data from the computer tool to be incorporated into electronic medical records. We acknowledge that network access will require additional design work with respect to the need for system interoperability and data standards to integrate with other information systems. Extension of the tool to include other symptoms associated with palliative care such as nausea or dementia is also planned.

Conclusion

Interdisciplinary teams are becoming more common in health care delivery, and thus there is an increasing need to develop IT to support teams. The complexities of team practices and different information and process needs of team members present challenges to HIS design. Incorporating user-centered IT design and evaluation approaches can help understand team complexities and enhance our ability to design IT to support team practices.

References