

Challenges to care coordination posed by the use of multiple health IT applications

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Abstract. Coordinating care for hospitalized patients requires the use of multiple sources of information. Using a macroergonomic framework (i.e. the work system model), we conducted interviews and observations of care managers involved in care coordination across transitions of care. When information is distributed across multiple health IT applications, care managers experience a range of challenges, including organizational barriers, technology design problems, skills and knowledge issues, and task performance demands (i.e. issues related to individual information processing and management and sharing of information). These challenges can be used as a checklist to evaluate the proposed IT infrastructure that will allow the integration of multiple health IT applications and, therefore, support coordination across transitions of care.

Keywords: Care coordination, transitions of care, health information technology, macroergonomics, work system

1. Introduction

Care coordination for patients with chronic diseases such as COPD (Chronic Obstructive Pulmonary Disease) or CHF (Congestive Heart Failure) and post-surgical patients can be challenging [1,5], especially when patients receive care from multiple providers in hospitals, clinics, emergency departments and post-acute care facilities with limited information sharing. The Keystone Beacon Community project aims to implement and evaluate a care-coordination model [8] using health information technology (IT) that supports clinical management of the patient; therefore, resulting in improved information flow and access (www.

keystonebeaconcommunity.org). Care managers (licensed case managers) were hired to work in hospitals and support transitional care of COPD and CHF patients admitted to the hospitals, as well as patients undergoing major surgery. The care managers have access to patient information through a variety of electronic and paper documents. In this research, we use a macroergonomic framework (i.e. work system model) to identify the challenges experienced by the care managers when using multiple health IT applications. The design of the overall Keystone Beacon Community project includes careful evaluation and mitigation of the challenges in coordinating the care of patients across multiple venues (e.g., hospitals, clinics and long-term

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care facilities) (www.keystonebeaconcommunity.org).

2. Methods

2.1 Design

Combined qualitative observations and interviews were conducted as a first round of data collection in the longitudinal study. The study aims to evaluate the implementation of health information exchange (HIE) and cross-venue care coordination [8], and to investigate the impact of HIE on care managers' work. The limited research conducted on the work of care managers [4,6] has not addressed the work challenges they experience. Therefore, an exploratory qualitative research approach was used to identify challenges specifically related to the use of multiple health IT applications.

2.2 Study participants

Five care managers in 4 hospitals located in a rural area of the US were interviewed and observed; participation was voluntary. An information sheet describing the study was distributed to all participating care managers; they were then asked if they were willing to be interviewed and observed. The same process was followed with patients who were present during the observations. In a few instances, a patient refused to be observed or a care manager asked the researchers to stay outside of the patient room. Participating care managers have nursing experience ranging from 8 to 30 years in various domains such as medical orthopedics and cardiology. Three care managers have prior experience in case management. All care managers work day shifts on weekdays.

2.3 Procedures

Institutional Review Board (IRB) approval was obtained from the Human Subjects Committee of one of the participating hospitals and the researchers' academic institution. Two teams comprised of two or three human factors engineers and social science researchers conducted a total of 20 hours of interviews and observations. In general the care managers were first interviewed for 30-40 minutes, then observed for 90-120 minutes, and finally interviewed for about 30-45 minutes. Combining

observations and interviews helped care managers better explain their challenges by providing examples and other detailed information while they worked. Because we began our data collection with interviews, the care managers were also able to better understand the study objectives and thus felt more comfortable when we subsequently observed them. In the second interview, that was conducted after the observation, researchers asked follow-up questions related to their observations.

Researchers used a written interview guide containing open-ended questions aimed at understanding the work of care managers and identifying work challenges they face. The interview guide included questions about the care manager's background, typical work shift, tools or software applications, work system obstacles and facilitators, impact on patient outcomes, and workload and job satisfaction. The core of the interview guide was a single open-ended question aimed at identifying performance obstacles:

"Please think of instances when you feel your performance was challenged or below par due to problems in your "work system". These instances may have been related to workspace or work environment, resources (e.g., equipment, internet access, other workers), information, interactions with patients/family, work schedule, training, policies and procedures, or/and others. For example, when you perform medication reconciliation, what can occur (or not occur) that can interfere with your ability to efficiently and accurately perform medication reconciliation?"

We conducted the interviews in a private room during the care manager's work. All interviews were audio taped and later transcribed; before data analysis, all personal and organizational identifiers were removed from the interview transcripts and observation notes.

An observation-recording document was used to facilitate the observers' note taking. The document was designed based on the macroergonomic work system model of the SEIPS [Systems Engineering Initiative for Patient Safety] framework [2,3,7] to capture information related to the work system (individuals, tasks, tools and technologies, organization, and environment); we also recorded time spent on types of tasks.

Prior to data collection, the researchers reviewed documents about the care managers' work (e.g., job descriptions and description of processes), and participated in demonstrations of the HIE and case

management software applications used by care managers.

2.4 Data analysis

To identify challenges to care coordination experienced by care managers who used multiple health IT applications, we conducted a qualitative content analysis of interview transcripts and observation and interview notes, which produced categories and sub-categories of challenges (i.e. a node structure). The node structure was created in the following iterative process: (1) an initial node structure was created based on review of the data; (2) the initial node structure was reviewed by another researcher and changes were made to the node structure; (3) all data and the initial node structure were entered in NVivo© qualitative data analysis software; (4) the data for one hospital were coded using the revised node structure; (5) a researcher reviewed the node structure and the coding and changes were made to the node structure; (6) the node structure was updated in NVivo© and the data for a second hospital were coded; (7) steps 5 and 6 were repeated for the data from each of the remaining 3 hospitals; (8) two other researchers reviewed the node structure and coding and additional changes were made to the node structure; and (9) other members of the research team reviewed the node structure and final changes were made. The final node structure includes a total of 19 challenges that were grouped in 5 categories.

3. Results

Care managers use multiple health IT applications to accomplish their tasks related to care coordination of patients with COPD and CHF and post-surgical patients. These health IT applications fulfill various functions that sometimes overlap (see Table 1). In three of the four hospitals, the care managers access patient-related information in both paper records and EHRs; the fourth hospital has a fully-implemented EHR. All care managers use the case management software for documentation, their daily “to do” list and communication with other care managers. In addition to health IT, some of the care managers use instant messaging to communicate efficiently and quickly with other care managers. Some of the care managers use the health information exchange (KeyHIE®; www.keyhie.org) to access information

about patient encounters from other hospitals and physician offices.

Table 2 shows the five categories of challenges experienced by care managers when dealing with multiple health IT applications: (1) organizational barriers to effective health IT use, (2) technology design problems, (3) health IT training and knowledge issues, (4) shared information management issues, and (5) issues with individual information processing and management.

3.1 Organizational barriers to effective health IT use

In the hospital with the full EHR system (hospital A), the care managers use computers on the unit and easily access the patient’s record and other Internet resources (e.g., educational materials for the patient). In other hospitals, the care managers have to find the paper chart on the unit in order to access patient-related information (e.g., notes for admission to the emergency room, list of medications) (challenge 1.3). They also experience delay in accessing patient information (e.g., discharge note) when it is not entered electronically or not created in a timely manner (challenge 1.1).

Care managers use the case management software only at their workstation (challenge 1.2); therefore, all patient care documentation is performed at the workstation.

3.2 Technology design problems

Many of the health IT applications used by care managers are not interoperable (therefore interfering with effective information sharing) (challenge 2.1). This challenge contributes to many other challenges, such as duplicate data entry and documentation (challenge 5.1).

Because the care managers have to use multiple applications, they need to have multiple passwords (challenge 2.2) that they must remember and update regularly.

A range of usability issues were identified (challenge 2.3), such as inadequate lists in drop-down menus, excessive clicking (screen flipping) to access information, multiple windows open simultaneously which contributes to potential confusion, and unclear terminology.

Other technology design challenges experienced by the care managers include slow response times and unavailable networks (challenges 2.4 and 2.5), which often occur when the care managers have

Table 1
Multiple Health IT Applications in Various Hospitals

Health IT applications and sources of information	Hospital A	Hospital B	Hospital C	Hospital D
Paper chart or EHR	Fully-implemented EHR available throughout the hospital.	<ul style="list-style-type: none"> • Paper census reports and patient face sheets from Registration • CM has limited EHR (the following functionalities are <u>not</u> in the EHR: order entry, eMAR and daily physician progress notes) • H&P frequently not present in EHR (or at all) when CM reviews patient on admission. 	<ul style="list-style-type: none"> • CM prints paper census reports and patient face sheets for each unit • CM has access to the following information in the EHR: ED admit notes, medication list (created in ED or by nurse on admission), H&P (promptly done because hospitalists staff medical inpatients), discharge summary from previous admissions • Daily physician progress notes are hand-written • CM sees minimal value in nursing notes because of charting by exception. 	<ul style="list-style-type: none"> • Paper census reports and patient face sheets from Registration • CM has limited EHR (the following functionalities are <u>not</u> in the EHR: order entry, eMAR and daily physician progress notes) • H&P frequently not present in EHR (or at all) when CM reviews patient on admission.
Case management application	Used for "to do" list, documentation and communication with other CMs.			
Instant messaging application	Not used.	Not used.	Used to communicate with other CMs	Used to communicate with other CMs
Other hospital EHRs	Not used.	Used to review patient charts for previous visits at other hospitals.	Used to review patient charts for previous visits at other hospitals.	Used to review patient charts for previous visits at other hospitals.
Health Information Exchange	Used only to check patient UA.	Used by CM to check patient UA.	<ul style="list-style-type: none"> • Check patient UA • Review patients' medical records from hospital A • When UA status needs to be updated, CM gives signed authorization to Registration to update. 	<ul style="list-style-type: none"> • Check patient UA • When UA status needs to be updated, CM gives signed authorization to Registration to update • Sometimes UA information is in the HIE but not in the EHR.

Notes: CM=care manager; EHR=electronic health record; eMAR=electronic medication administration record; ED=emergency department; H&P=history and physical; HIE=health information exchange; UA=user authorization (or authorization by patients to record sharing through the HIE)

multiple health IT applications open simultaneously. The varied ways of accessing patient-related information can be beneficial as care managers develop efficient ways of performing their work. For instance, one care manager used the HIE to access the local EHR system. Using this strategy, she had to open only one application (HIE) instead of two applications (HIE and EHR) to access patient-related information; this reduced connection problems.

3.3 Health IT training and knowledge issues

Because the care managers work in hospitals with different EHRs, they need to learn to use multiple EHRs (challenge 3.3). The larger the number of health IT applications used by care managers, the more difficult it is for them to become and remain proficient with each application (challenge 3.1). Therefore, some care managers tend to prefer to use

Table 2
Challenges Related to the Use of Multiple Health IT Applications by Care Managers in Various Hospitals

Categories	Challenges	Hospital A	Hospital B	Hospital C	Hospital D
1. Organizational barriers to effective health IT use	1.1 Delay in access to patient information		X	X	X
	1.2 Lack of access to health IT application in the hospital	X	X		X
	1.3 No access to some health IT applications			X	
2. Technology design problems	2.1 Lack of interoperability between applications	X	X	X	X
	2.2 Many passwords to access multiple applications		X	X	
	2.3 Poor interface design of health IT	X	X	X	X
	2.4 Slow response times	X	X	X	X
	2.5 Network connection unavailability		X	X	
3. Health IT training and knowledge issues	3.1 Limited knowledge of functions of specific health IT applications	X		X	
	3.2 Preference for specific health IT applications	X	X		X
	3.3 Time needed to learn multiple health IT applications	X	X	X	
4. Shared information management issues	4.1 Uncertainty regarding where to record information for timely access by others	X	X	X	X
	4.2 Difficulty of sharing electronic information	X	X	X	
	4.3 Difficulty of sharing paper information	X		X	
5. Issues with individual information processing and management	5.1 Duplicate documentation and information entry	X	X	X	X
	5.2 Memory demands		X	X	
	5.3 Looking for information across multiple health IT applications and paper documents	X	X	X	X
	5.4 Paper notes created by care manager	X	X	X	X
	5.5 Transferring information from paper to health IT	X	X	X	X

applications that they are familiar with despite the fact that this may not be the most efficient way to access patient information (challenge 3.2).

3.4 Shared information management issues

Care coordination for COPD, CHF and post-surgical patients requires the use of multiple health IT applications and paper documents to communicate with hospital staff, primary care providers, outpatient care managers and other healthcare organizations (e.g., nursing home, home health agency) (challenge 4.1). When outside providers do not have access to the respective hospital's or care manager's electronic and/or paper documentation, care managers must print numerous documents to fax to the primary care providers and/or outpatient care managers (challenge 4.3). They also incur a number of challenges in sharing electronic information (challenge 4.2), such as uncertainty regarding how to efficiently use the calendar function in the case management software.

3.5 Issues with individual information processing and management

In addition to using EHRs (local and regional), care managers use the case management software to document their work and access information. They also use the HIE to access patient information created during encounters at other nearby healthcare organizations. Because most health IT applications are not integrated (challenge 2.1), the care managers may need to enter the same information multiple times in multiple systems (challenge 5.1). They also have to remember information (e.g., home health resources) and where to find it (challenge 5.2).

Care managers need to look for patient information across multiple sources of information (e.g., health IT, paper documents) (challenge 5.3). In addition to finding information in various sources, they need to check the consistency, completeness and/or accuracy of the information (e.g., medication reconciliation).

While visiting patients on the hospital units, the care managers often access their paper notes and paper documents (e.g., case summaries) (challenge 5.4). Sometimes, they record notes on paper documents that later must be transferred to a health IT application (challenge 5.5). These paper notes generally reduce the care managers' cognitive workload and memory demands (challenge 5.2).

4. Conclusion

Care coordination for hospitalized COPD, CHF and surgical patients across multiple venues of care can be challenging because of the various health IT applications needed by care managers to access, process, document, and communicate information. We identified a range of challenges experienced by care managers when dealing with multiple health IT applications (see Table 2). The challenges are related to various work system elements [2, 3, 7], including organizational barriers, technology design, skills and knowledge of the care managers, and task performance demands.

In a later phase of this project, a new IT infrastructure will be implemented to integrate multiple health IT applications. We will evaluate the impact of the integration on the work and effectiveness of care managers and resulting care coordination. The list of challenges displayed in Table 2 will be used as a design and evaluation checklist to answer the question: "Does the proposed health IT infrastructure eliminate the challenges currently experienced by the care managers?"

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References

- [1] M. Bosch, M.J. Faber, J. Cuijssberg, G.E. Voerman, S. Leatherman, R.P.T.M. Grol, M. Hulscher, and M. Wensing, Effectiveness of patient care teams and the role of clinical expertise and coordination: A literature review, *Medical Care Research and Review* 66 (2009), 5S-35.
- [2] P. Carayon, A. Schoofs Hundt, B.-T. Karsh, A.P. Gurses, C.J. Alvarado, M. Smith, and P. Flatley Brennan, Work system design for patient safety: the SEIPS model, *Quality and Safety in Health Care* 15 (2006), i50-i58.
- [3] P. Carayon and M.J. Smith, Work organization and ergonomics, *Applied Ergonomics* 31 (2000), 649-662.
- [4] S.L. Maliski, B. Clerkin, and M.S. Litwin, Describing a nurse case manager intervention to empower low-income men with prostate cancer, *Oncology Nursing Forum* 31 (2004), 57-64.
- [5] K.M. McDonald, E. Schultz, L. Albin, N. Pineda, J. Lonhart, V. Sundaram, C. Smith-Spangler, J. Brustrom, and E. Malcolm, *Care Coordination Measures Atlas*, Agency for Healthcare Research and Quality, Rockville, MD, 2010.
- [6] N.L. Oliva, A closer look at nurse case management of community-dwelling older adults: Observations from a longitudinal study of care coordination in the chronically ill, *Professional Case Management* 15 (2010), 90-100
- [7] M.J. Smith and P.C. Sainfort, A balance theory of job design for stress reduction, *International Journal of Industrial Ergonomics* 4 (1989), 67-79.
- [8] G.D. Steele, J.A. Haynes, D.E. Davis, J. Tomcavage, W.F. Stewart, T.R. Graf, R.A. Paulus, K. Weikel, and J. Shikles, How Geisinger's advanced medical home model argues the case for rapid-cycle innovation, *Health Affairs* 29 (2010), 2047-2053.