

Understanding how social influence and social networks influence EMR implementation

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ABSTRACT

Purpose: The purpose of this study is to examine whether clinicians' social networks influence their beliefs and use of an electronic medical record (EMR) system.

Scope: EMR systems have the potential to improve patient safety and quality of care; however, adopting organizations often do not realize these benefits because clinicians fail to use the systems as skillfully and consistently as needed. While most studies of technology acceptance focus on individual and organizational-level factors leading to adoption, the social network perspective suggests clinicians' social networks – defined as a set of actors connected by a set of social ties – may also play a critical role in shaping technology acceptance and use.

Methods: Longitudinal (nine months) mixed methods approach that employed both quantitative (i.e., surveys) and qualitative (i.e., interviews and observations) methods.

Results: We find that the beliefs embedded in clinicians' social networks are positively associated with: (1) changes in individuals' beliefs about the EMR system over time and (2) individuals' use of the EMR system. We also identify key behaviors that super users (i.e., nurses who receive additional training on the EMR system) use to influence others, and ultimately, EMR implementation success.

Key Words: health information technology, implementation, social networks

(A) PURPOSE

AIM 1: To examine the effect of social networks on individual beliefs about the usefulness of electronic medical record (EMR) systems over time.

AIM 2: To examine the effect of social networks on individual EMR system use.

AIM 3: To identify the behaviors that super users (i.e., nurses who receive additional training on the EMR system) use to influence others, and ultimately, EMR implementation success.

(B) SCOPE

B.1. Background

Electronic medical record (EMR) systems, defined as computerized medical information systems that collect, store and display patient information (1), are increasingly recognized as an important tool for improving patient safety and quality of care (2-4). Despite the potential of EMR systems to improve the health of individuals and the performance of providers, significant barriers to their use remain (1, 5, 6). One important subset of challenges relates to the implementation process (7, 8), which involves gaining targeted organizational members' skillful, consistent, and committed use of a practice (9).

The implementation of EMR systems is a complex process that can lead to major shifts in the work practices of clinicians and other personnel (5, 10). Due to the tremendous organizational changes precipitated by EMR systems, implementation failure, in which employees use the practice less frequently, less consistently, or less assiduously than required for the potential benefits of the system to be realized (11), is common. Although the exact percentage of EMR implementation failures is unknown, it is estimated that 23% of IT implementations fail outright and an additional 49% of IT projects are challenged during implementation (12). Similar rates of implementation failure have been reported for health IT projects (13, 14), with one study finding that hospital staff interfere with or sabotage "nearly

half' of implementation projects (15). The failure to successfully implement EMRs is a serious concern because it can result in threats to patient safety (16), workarounds (17), staff dissatisfaction (18), and massive costs that often cannot be recovered (19).

Although prior research has attributed implementation failure to managerial factors such as poor project planning or difficulties with the design and use of the technology itself (2, 20), social influence theory suggest that clinicians' tendency to adopt new practices may be influenced significantly by their colleagues' perceptions and use of an innovation (21). For example, social information processing theory – a prominent theory of social influence in organizational settings – suggests that individuals' technology use is influenced by the opinions, information, and behaviors of salient others (22); and that social networks – defined as a set of actors connected by a set of social ties (23) – serve as the mechanism by which individuals are proximate to, or exposed, to others' influence (24). Despite theoretical support for the role of social influence in technology adoption, however, there is little empirical work that has examined *whether*, and if so *how*, social networks influence clinicians' acceptance and use of EMR systems.

B.2. Research Setting

The research setting was six clinical units of a large, academic hospital in the Northeastern region of the United States that was implementing a commercial off-the-shelf EMR system. The hospital's objective in implementing the new technology was to create an integrated EMR system across hospital departments (which had been using separate EMR systems) and across other hospitals within the larger health system so as to facilitate communication between providers, improve access to health information, and standardize patient care.

This setting was ideal for studying social influence for several reasons. First, use of the

system was mandatory for all employees, which limited the possibility of selection effects driving my results and allowed me to observe the extent to which social networks affected individuals' beliefs about the EMR system (AIM 1) and degree of system use (AIM 2). In addition, mandatory settings – but not voluntary settings – have been associated with significant social influence effects in past research on technology use and acceptance (25, 26) because mandatory settings exert greater pressure to comply with social norms (25). Second, the opportunity to study multiple units within the same hospital, including two intensive care units (ICU) (i.e., Cardiac ICU, Medical ICU), two general medical units (i.e., Cardiology, Geriatrics), and two specialty care units (i.e., hematology/ oncology, pediatric short-stay), allowed me to examine the role of social influence across different patient care contexts while holding constant three organizational-level factors that predict technology use: (1) senior management support; (2) implementation policies and practices; and (3) financial resource availability (11).

(C) METHODS

C.1. Study Design and Sample

The study used a longitudinal (nine months) mixed methods approach that employed both quantitative (i.e., surveys) and qualitative (i.e., interviews and observations) methods. The sample included full-time nurses, nurse managers, nurse super users, patient care associates, and secretaries. I focused on these clinical roles because they were based on the units throughout the 9-month data collection period. Other clinical roles, such as physicians and physician assistants, rotated in-and-out of the unit every few weeks (limiting the ability to collect longitudinal network data) or worked across many units (limiting the ability to set network boundaries around a finite set of actors, which is a prerequisite of social network analysis (27)).

C.2. Data Collection

C.2.a. Quantitative Arm (AIMS 1-3)

In order to conduct the quantitative arm of the study (AIMS 1 – 3), I administered a pre-implementation survey at T1 [2 – 4 months (October-December 2013) prior to the “go-live,” or start date, of the EMR system] and a follow-up survey at T2 [3-5 months (April-June 2013) after the EMR go-live]. I recruited respondents to participate in the survey during nurse “huddles” that occurred at the beginning of each shift (i.e., morning, afternoon, and night shifts). After briefly explaining the purpose of the study, paper copies of the surveys and return envelopes were distributed, with a piece of chocolate to thank respondents for their participation. The respondents were asked to complete the survey at their convenience and then drop off their completed survey in a designated box in the nurses’ break room. Recruitment was conducted across all days of the week and shifts. To encourage participation, the senior nurse manager also emailed an electronic link to the survey at the beginning and end of the data collection period. The survey response rate was 60% (N=256/429) for the pre-implementation survey (T1) and 68% (N = 284/415) for the follow-up survey (T2); we had longitudinal data for 192 individuals (out of a maximum of 232 individuals).

The survey instrument (available upon request) was designed to assess individuals’ beliefs about technology (e.g., perceived usefulness), unit-level factors related to organizational context (e.g., psychological safety), demographics (e.g., age), and social network ties. My focus on advice-seeking network ties, which are considered pathways for work-related help (28), was appropriate given my objective of exploring the effects of networks on individual technology use for work-related purposes. To elicit network ties, I used an open-ended survey question in which respondents were asked, “On this clinical unit, whose professional opinion do you value? Please

identify specific individuals (not professional roles) who work on this clinical unit.” They were further instructed to list as few or as many names as appropriate. I also assessed the strength of the tie to each person named by asking individuals, “How often do you ask this person for advice?” Response scale ranged from “very often” to “rarely.” The social network responses were used to construct an ego “advice” network for each individual which consisted of the focal individual (i.e., “ego”), the individuals nominated by ego as someone he/she turned to for advice (i.e., “outgoing ties”), and individuals who nominated ego as someone they turned to for advice (i.e., “incoming ties”).

C.2.c. Qualitative Arm (AIM 3)

In order to conduct the qualitative arm of the study (AIM 3), I observed 15 nurse “super users” during the first six weeks of the EMR implementation (January-March 2013). I also observed a purposeful sample of 9 non-super user clinicians who were selected because of their perceived influence on the unit (as assessed by social network data collected in a pre-implementation survey). Observations were conducted across all days of the week and all times of the day for a total of 115 hours. Each participant was observed on at least two occasions, with each observation period lasting approximately two hours. During the observation period, I collected extensive field notes about the interactions between super users and clinicians and the behaviors that super users used to support or hinder the implementation process. After each observation period, I reviewed the field notes and added reflective notes about emerging themes.

I then used in-depth interviews to reconcile our observations with participants’ own perceptions of how super users influenced implementation. Between March and May 2013, I interviewed a purposeful sample of 8 super users and 16 non-super user clinicians who were selected to ensure diversity with regards to age, shift (e.g., day, night), role (i.e., manager, super

user, nurse, patient care associate, and secretary), and whether the participant had been previously observed (half were both observed and interviewed). I conducted 24 interviews because theoretical saturation was reached at that point (i.e., no new concepts emerged). The interviews averaged between 30–45 minutes and were conducted in the nurses' break-room. I used a semi-structured discussion guide that began with a 'grand tour' question to elicit a broad picture of the participant's experience with the EMR implementation (i.e., "I am interested in hearing about your experience with the EMR implementation so far. What has gone well? What has not gone well?"). I then asked participants to reflect on how super users influenced others, probing on super users' behaviors (e.g., "Does [super user's name] use any specific strategies or actions to influence others?"), characteristics (e.g., "What about [super user's name] makes him or her influential?"), and the perceived impact of super users' actions [e.g., "In what ways do you think [super user's name] influenced you?"]. With interviewees' informed verbal consent, interviews were tape-recorded and professionally transcribed.

C.3. Limitations

The study has certain limitations that merit consideration. First, the research setting – that is, the implementation of a well-developed EMR in a single institution – may limit the generalizability of the study's findings. I chose to focus on a single institution because of the exploratory nature of the research questions, my interest in understanding the impact of social influence on individuals' technology acceptance (holding constant the organization's implementation policies and resources), and my commitment to ensuring the feasibility and success of my dissertation project. Second, although the study was longitudinal, the nine month data collection period was relatively brief. I chose to focus on the early stage of implementation because it is when disruptions in processes and loss in productivity compel users to look most to

others for guidance (29). As EMRs are continuously updated and optimized, however, it will be important for future work to explore how social networks influence sustained use of technology over time. Last, social influence is a notoriously difficult phenomenon to estimate. Although I try to account for alternative explanations (e.g., homophily, contextual effects), future research should employ more sophisticated quantitative methods (e.g., an instrumental variable approach) to test whether our findings hold under different specifications.

Table 1: Differences in Methods by Study Aim

		AIM 1	AIM 2	AIM 3
Study Design		Longitudinal study employing social network analysis	Cross-sectional study employing social network analysis	Longitudinal study employing mixed methods
Sample		Nurses, nurse managers, patient care associates, and secretaries (N = 192 individuals)	Nurses and nurse managers (N = 226 individuals)	Nurse super users, nurse managers, nurses, patient care associates, and secretaries (N = 43 individuals)
Data Sources		Survey (T1 and T2)	Survey (T2)	Survey (T1 and T2); Non-participant observations; in-depth interviews
Measures	Dependent Variable	<i>Perceived Usefulness</i> : individual's belief that using the system will enhance job performance	<i>System Use</i> : individual's percent compliance with scanning patients' wristband ID barcodes during medication administration	<i>IS Proficiency</i> : individual's belief that using a system will be free of effort
	Independent Variable(s)	<i>Network perceived usefulness</i> : mean perceived usefulness of an individual's social network	<i>Network perceived usefulness</i> ; <i>Network perceived ease of use</i>	<i>Clinical unit</i> : Unit 1 vs. Unit 2
	Covariates	Network Change (i.e., tie additions, tie deletions), Yules Q (homophily), network size, gender, age, occupational membership, and clinical unit dummies	Percent homophily, network centrality, network variation, subjective norm, gender, age, and clinical unit dummies	

(D) RESULTS

D.1. Principal Findings

Finding 1 (AIM 1): Changes in the beliefs embedded in social networks were positively associated with changes in individuals' beliefs over time (i.e., from baseline to follow-up).

Finding 2 (AIM 1): Changes in the social network structure (i.e., tie additions and tie deletions) moderate the effect of social networks on individuals' beliefs such that individuals who lose fewer ties than average (i.e., have more stable networks) are more affected by changes in network beliefs; whereas individuals who lose greater ties than average (i.e., have less stable networks) are less affected by changes in network beliefs. In other words, network stability appears to enhance the influence of networks whereas network instability appears to dampen the influence of networks.

Finding 3 (AIM 2): Beliefs embedded in social networks were positively associated with individuals' use of an EMR system.

Finding 4 (AIM 3): In the comparative case study of super user influence, super users on both units employed behaviors that supported and hindered implementation (Table 1). Four super user behaviors differed between the two units: proactivity, depth of explanation, framing, and information-sharing (Table 2).

Finding 5 (AIM 3): The unit in which super users were more proactive, provided more comprehensive explanations for their actions, used positive framing, and shared information more freely experienced significantly greater improvement in clinicians' IS proficiency ($p = 0.03$). Use of the four behaviors varied as a function of super users' role engagement, which was influenced by how the two units' managers selected super users and shaped the implementation climate.

Table 1. Super user behaviors shared across units

Super user behaviors that supported implementation	Super user behaviors that challenged implementation
(1) Reporting problems with the EHR to someone in a position to fix it	(1) Losing patience with coworkers
(2) Employing teaching strategies that promoted “learning by doing”	(2) Losing track of what material was taught to whom
(3) Providing extra support to individuals struggling with the change	(3) Spreading negative opinions about the EHR
	(4) Creating workarounds that undermined the appropriate use of the EHR

Table 2. Super user behaviors that differed between units

	Super user behaviors distinct to Unit 1	Super user behaviors distinct to Unit 2
(1) Proactivity	Proactively supporting their peers	Reactively supporting their peers
(2) Depth of explanation	Emphasizing why actions had to be performed in the EHR	Demonstrating how to accomplish tasks in the EHR but not explaining the logic behind these actions
(3) Framing	Using positive frames to diffuse tension	Using neutral frames to diffuse tension
(4) Information-sharing	Consistently sharing information about the EHR with all of the clinicians on the unit	Limiting the spread of information about the EHR to individuals they interacted with the most

D.2. Conclusions

A central challenge for healthcare organizations is getting clinicians to use new information technology. In this work, we examined the influence of clinicians’ social networks, and specifically, the beliefs embedded in their network, on individuals’ acceptance of technology. Our results suggest that social networks exert a positive influence on individuals’ beliefs and use of an EMR system. Furthermore, we find that the relationship between network beliefs and individuals’ beliefs is moderated by the amount of network change (with more stable networks exerting greater influence).

This study also deepens our understanding of the role of super users in EHR implementation by identifying the specific behaviors that super users used to influence their peers. The unit in which super users were more engaged (i.e., were more proactive, provided more comprehensive explanations for their actions, used positive framing, and shared information more freely), experienced greater implementation success, as indicated by clinicians' IS proficiency.

D.3. Implications

This work has implications for health care managers and information technology officers. The implementation of new technology fails at an alarming rate, in both the health care setting (13, 14) and beyond (30). This research shows that one of the factors that may be contributing to employees' use of new technology is the influence of social networks. Managers should therefore attend to clinicians' social networks, and take steps to cultivate supportive beliefs and behaviors at the network level.

(E) LIST OF PUBLICATIONS

E.1. Publications

Yuan CT, Bradley EH, Nembhard IN. A mixed methods study of how clinician ‘super users’ influence others during the implementation of electronic health records. *BMC Med Inform Decis Mak* 2015; 15(26).

- Health Data Management, a leading source of news on information technology, published an article about the manuscript’s implications for healthcare executives.
- Designated a “highly accessed article” by *BMC Medical Informatics and Decision Making*. The article was downloaded from the journal’s website a total of 2,518 times from April – July 2015.

E.2. Presentations

Yuan CT, Nembhard IM, Kane GC. Harnessing the flow of social network resources to improve employees’ use of health information technology. Paper presentation at the *Organization Theory in Health Care Association (OTHC) Conference*, 2015 May; Richmond, VA.

Yuan CT, Nembhard IM, Bradley EH. How do clinician ‘super users’ foster the successful implementation of electronic health records? Symposium presentation at the *Academy of Management Annual Meeting*, 2014 August; Philadelphia, PA.

Yuan CT, Nembhard IM, Bradley EH. Understanding super users’ experience of role stress in the implementation of an electronic medical record system. Poster presentation at the *AcademyHealth Annual Research Meeting*, 2014 June; San Diego, CA.

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