**IRB Protocol**

Using Social Network Analysis and National Language Processing to Describe Communication Practices of Interdisciplinary Teams in Primary Care

Lori Popejoy, Sean Goggins, and Jenny Bossaller

**1. Abstract:**

This research aims to describe communication practices across healthcare settings. The Electronic Medical Record (EMR) serves different purposes including documentation of care and billing. One part of the EMR at the University of Missouri Hospital and Clinics is the message center. Many people, including healthcare providers, nurses, social workers, therapists, office staff, and nurse care managers (hereafter known as the interdisciplinary team, or IDT) work together to deliver healthcare. The EMR is used document care delivery, monitor ongoing clinical conditions, and the repository of patients’ healthcare story. Members of the IDT also use secure messaging via message center to communicate with, and receive communication from, patients via eHealth (patient portal). Message center is a place for ongoing follow-up and communication about patient’s care needs, and serves as a way to facilitate vital communication between the IDT, and patients. However, we do not fully understand how and when message center use impacts patient care related to care coordination.

We begin with a few core premises: a) message center is part of the EMR; b) message center is used to document detailed notes related to care coordination and communication of patient care activities not captured in structured notes; c) it is possible to extract and quantify care coordination activities using an established ontology of care coordination; and d) an essential part of care coordination is communication, making it highly likely that social networks of nurse care managers will offer insight into the complexity of care coordination. In other words, as patients’ needs increase, so do the social networks of nurse care managers.

We are working with a unique EHR environment developed for the Leveraging High Tech, High Touch Care (LIGHT2) study funded by the Centers for Medicaid and Medicare. This study aimed to improve care to patients who received primary care in Family Community Medicine, or Internal Medicine at the University of Missouri Healthcare system by developing a new workforce in the form of care coordinators, and health information analysts to work with the existing healthcare team to develop new technology and reports to improve outcomes of 10,074 Medicare and Medicaid beneficiaries in the LIGHT2 study. There was no formal opt-in or opt-out process for participation as all patients who were in the primary care clinics who met the criteria for participation were included making LIGHT2 part of the routine care delivery process. In other words, patients did not sign consent to be included in LIGHT2.

*Nursing Care Coordination Ontology*

The Nursing Care Coordination Ontology developed by Popejoy et al. (2015) contains 394 concepts that describe activities that nurse’s use while coordinating care for patients. It has five top level concepts (the number of associated terms are noted in parenthesis):

1. (66) *Care coordination activities*: action verbs used by nurses when coordinating care.
2. (156) *Care coordination foci:* objects the activities acted upon
3. (53) *Actors* who interacted with care coordinators
4. (90) *Patient-specific problems* identified by care coordinators.
5. (18) *Physical spaces* where patients were when they received care.

Candidate terms for the ontology were associated with the appropriate class in the ontology using a “is-a” relationship. <http://bioportal.bioontology.org/ontologies/NCCO>

*LIGHT2 Documentation*

LIGHT2 documentation was developed in order to document care coordination activities and the time spent in completing those activities in a structured, easily retrievable way. Using the Agency for Healthcare Quality and Research Care Coordination Atlas as the guiding framework a workgroup of nurse care managers from the University of Missouri Healthcare System, and representatives from the Tiger Institute and Cerner Healthcare Systems developed a documentation system based on nine domains of care coordination activities: (1) establish accountability and negotiate responsibility, (2) communicate, (3) facilitate transitions, (4) assess needs and goals, (5) create a proactive plan of care, (6) monitor, follow-up, and respond to change, (7) support self-management goals, (8) link to community resources, and (9) align resources to needs. These data have been compiled in a single database for all 10,894 LIGHT2 patients.

This research will examine how the message center is used in primary care by nurse care managers to document care coordination activities, including communication between patients, patient identified family or significant other, and the IDT. Social network analysis will be used to expose and map the communication between different users of message center. Finally, care coordination activities, and the focus of those activities will be extracted and described, and a method to quantify care coordination delivery will be explored and validated using LIGHT2 documentation data.

**Hypothesis:**

[H1] A social network analysis of communications recorded within the message center will reveal who is communicating with whom, and how frequently they are communicating.

[H2] The message center will reveal important communication relationship within the IDT, allowing us to describe how the IDT functions.

[H3] Greater numbers of care coordination activities, and their associated foci are associated with more robust social networks, increased communication between interdisciplinary team members, and more time spent in the delivery of care coordination.

[H4] Through examination of care coordination, we will be able to identify patterns of interaction visible in social networks and communication structures that are antecedents to both a) patient health improvement as measured by the Medicare/Medicaid tiered ontology of chronic health severity (A/B/C/D) and b) patient health decline as measured by the Medicare/Medicaid tiered ontology of chronic health severity (A/B/C/D).

*Importance of the Research:* Communication about patients amongst members of the IDT is crucial, especially as their health care needs change. One promising intervention to help patient navigate the health system is care coordination. The number of care coordinators is rapidly increasing. Little is known about care coordinator workflows, or who should be doing the work of care coordination, and is it feasible to have care coordinators who are not nurses manage patients under certain circumstances. Understanding who nurse care managers communicated with and what they communicated about has the potential to guide healthcare administrators, payers, and regulators as this new role of care coordination rapidly emerges.

**2.** **Objectives**:

1. Discover how nurses are using the message center to communicate with members of the IDT about patients
2. Examine the networks of communication
3. Discover what are they communicating about using the ontology
4. Modify and improve the care coordination ontology
5. Explore methods of adapting the methods of documenting and quantifying the use of the care coordination ontology to unstructured data
6. Explore the relationship of the number of care coordination activities to documented care coordinator time in the LIGHT2 data.

**3.** **Background**:

EHR’s are a growth area for information technology (IT) - spurred by the ACA and HITECH Act. EHRs offer a way to meet the triple aim of healthcare: better health, better care, and lower costs (Berwick, Nolan, & Whittingon, 2008). An EMR serves several purposes that are, in fact, at odds with each other; there is one side that aims to capture structured information (i.e., assessment, lab tests and procedures) for efficient management of care delivery, inventory, billing and insurance, and another side that aims to document care in a way that describes the details of care and communication in a narrative format. Both aspects of the EHR are important, but offer very different information to the healthcare team. Structured information is usually assessment or diagnostic data, while unstructured documentation is often about concerns, conversations, instructions, treatment and care plans, and offers context about patient experiences.

There is currently a lot of diversity and competition among the major EMR companies. The companies have developed systems they have different designs and functionalities, such as open doctor’s notes or patient accessible electronic health records (PAEHRs) (Jilka et al., 2015). Others integrate third-party apps and services. The various technologies that are used to build the portals, and the interaction between the physician workflow system, billing, cription ordering, and third-party service complicate system security (Li and Xue, 2pres012).

A method used to communicate with patients at the University of Missouri Hospital and Clinics is the patient portal. The patient portal holds great potential but is currently underutilized with estimates of just 10-30% of patients using a patient portal (find cite). Goldzweig et al. (2013) found that evidence is insufficient regarding the effect of patient portals on improved health outcomes, cost, or utilization or adherence, although some people are more likely to benefit from them, especially people with chronic diseases.

In closing, knowing how communication takes place within the system will help us discern the effective use of the system. Understanding how teams use the EHR to communicate and function, and the role of EHRs in improving not only with the IDT but also with patient, has implications for patient safety and satisfaction. Teasing out the impact of EMR’s on patient care and patient outcomes is a complex problem space.

**4.** **Study Procedures**:

**a.** Methods (Study Design):

*Sample and Data Set*: We propose to use LIGHT2 patients message center and NCM manager documentation data. Currently 10,074 patients in primary care received LIGHT2 services. For this proposal we propose to extract the message center data for those patients and link it to the NCM documentation data in order to perform social network analysis, and natural language processing. As the original LIGHT2 program did not require patient consent it would be impossible to go back retrospectively and obtain consent from patients to do this research. Accordingly, the data will be linked by patient medical record number but not by name. The work we propose to do will not require reading patient records, but instead will be a very high level data driven analysis that uses natural language processing and social network analysis, and does not use classic qualitative analysis methods. The data will be housed in a secure compute environment called SECURE4 at MU that is Level 4 secure. This new environment was developed specifically for the research that uses protected health information, education, or other forms of data that require highly secure environments.

Message Center data for LIGHT2 patients will be extracted by Cerner. The data will be placed in a secure file system on the SECURE4 compute environment. Nurse Care Manager data will also be supplied in the same secure file system by LIGHT2. Analysis steps, in the secure computing environment, will include:

1. Social network analysis maps and measures communications between participants within a system. The social network analysis in this study will demonstrate *who* is using the message center and the frequency of their communication.
2. Messages (message text) will be mapped to the Nursing Care Coordination Ontology. This will reveal the *purposes for* using the message center.
3. Structured care coordination documentation data will be used to validate message center data.

**5.** **Inclusion/Exclusion Criteria**: N/A

**6.** **Drugs/Substances/Devices**: N/A

**7.** **Study Statistics**:

Analysis will be completed from a qualitative perspective, and social network analysis. Descriptive statistics including frequencies, means, medians, and standard deviations will be done.

**8.** **Risks**:

Because there is patient data that is part of this study, the risk of patient data being released to unauthorized parties must be addressed. We have taken specific steps, working with Tim Middlekoop in research computing, to ensure patient data is secure at the network and server levels. Specifically, we have an environment SECURE4 that can only be accessed with the written permission of the Co-PI, Sean Goggins. Once access is authorized, the following specific security architecture is in place:

* The server itself is a “Level 4” secure computing environment. This is the most secure computing environment possible
* The server is secured, from a network perspective, behind a firewall and a “DMZ”, which prevents access from outside the university of Missouri physical, campus network.
* The hard drives in the server are encrypted with a USB key. If they are removed from the server the data on the hard drives is inaccessible without the encryption keys on the hard drives, combined with the server and USB key.
* Upon completion of this research project, the hard drives will be physically destroyed.
* Any unanticipated risks or breaches will be reported immediately to IRB.

**9.** **Benefits**:

As meaningful use expectations rise for both hospitals and governmental agencies, it is crucial to understand barriers to successful use of the EMR. This research centers on communication between patients and caregivers and will thus be beneficial to both parties. It will identify systemic methods for improving communication, which is crucial to improving patient health outcomes.

**10.** **Payment and remuneration**: n/a

**11.** **Costs:** The School of Information Science and Learning Technologies purchased this server to support the startup process for research in Health Information Management systems.

**12.** **References:**

Berwick, D. M., Nolan, T. W., & Whittington, J. (2008). The triple aim: care, health, and cost. *Health Affairs*, *27*(3), 759-769.

Popejoy, L.L., Khalilia, M., Popescu, M., Galambos, C., Lyons, V., Rantz, M., Hicks, L., & Stetzer, F. (2014). Quantifying Care Coordination Dose using Natural Language Processing and Domain Specific Ontology Corresponding. *Journal of American Informatics Association*. Published online first 10/21/2014. doi:10.1136/amia-jnl-2014-002702

Goldzweig, Caroline Lubick, Greg Orshansky, Neil M. Paige, Ali Alexander Towfigh, David A. Haggstrom, Isomi Miake-Lye, Jessica M. Beroes, and Paul G. Shekelle. “Electronic Patient Portals: Evidence on Health Outcomes, Satisfaction, Efficiency, and Attitudes: A Systematic Review.” *Annals of Internal Medicine* 159, no. 10 (November 19, 2013): 677–87. doi:10.7326/0003-4819-159-10-201311190-00006.

Jilka, Sagar Ramesh, Ryan Callahan, Nick Sevdalis, Erik K. Mayer, and Ara Darzi. “‘Nothing About Me Without Me’: An Interpretative Review of Patient Accessible Electronic Health Records.” *Journal of Medical Internet Research* 17, no. 6 (2015). <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4526966/>.

Li, Xiaowei, and Yuan Xue. “Protecting Web-Based Patient Portal for the Security and Privacy of Electronic Medical Records.” In *Proceedings of the 3rd USENIX Conference on Health Security and Privacy*, 2–2. USENIX Association, 2012. <https://www.usenix.org/system/files/conference/healthsec12/healthsec12-final10.pdf>.

Osborn, Chandra, Lindsay Mayberry, Shelagh Mulvaney, and Rachel Hess. “Patient Web Portals to Improve Diabetes Outcomes: A Systematic Review.” *Current Diabetes Reports* 10, no. 6 (December 2010): 422–35. doi:10.1007/s11892-010-0151-1.