MEDINFO 2010
C. Safran et al. (Eds.)
IOS Press, 2010

doi:10.3233/978-1-60750-588-4-704

Understanding Effective Clinical Communication in Medical Errors

Saif Khairat[a], Yang Gong[a,b]

[a] *MU Informatics Institute,*
[b] *Department of Health Management & Informatics, School of Medicine*
University of Missouri, Columbia, MO, USA

Abstract

Clinical Communication failures are considered the leading cause of medical errors [1]. Minimizing communication problems among clinical team members could directly reduce medical errors and hence, increase patient safety and improve health care quality. Our main focus is, through knowledge representation approach, to develop an understanding of communication problems applied to health care settings. This will serve as the foundation to our long term goal of building an ontology-driven educational tool that will be used to educate clinicians about miscommunication issues and as a means to improve it.

Keywords:

Clinical communication, Knowledge representation, Model, Human-computer interaction, Medical errors.

Introduction

Medical Errors in health care are estimated to cost more than $5 million per year in a large teaching hospital [1]. The causes behind those errors are various; however, clinical communication is listed as the main cause of medical mishaps [2-5]. According to a report by the Institute of Medicine (IOM) [6], preventable health care-related injuries cost the economy from $17 to $29 billion annually, of which half are health care costs. On the societal level, the massive cost of medical errors affects the health care industry as well as the U.S. economy at large. In 2006, the IOM stated that at least 1.5 million preventable adverse drug events occur annually in the United States as a result of medication errors [7]. This remarkably high cost of injuries has a significant impact on individual's well being as well as the society. By understanding the causes of medical errors and efficiently evaluating possible solutions, preventable medical errors can be minimized and hence, improve patient safety and reduce health care costs.

In this research, we define communication as the exchange of ideas, messages or knowledge between two or more entities through oral and written forms, or signals. In health care, professionals carry dialogues using traceable mediums such as Electronic Medical Record (EMR) systems, paper chart or emails; and untraceable channels like face-to-face discussions. Communication problems arise when the instructions are incomplete or incoherent and therefore, incorrect tasks are performed which lead to medical errors. However, communication failures, whether traceable or untraceable, are hard to catch.

In 2003, a research was conducted to observe communication patterns between physicians, nurses and pharmacists, also known as clinical-to-clinical communication. Results suggested that through the use of technology and EMR to enhance communication better communication can be reached [8]. The use of technology to reduce medical errors is necessary however, the need to understand how and why medical errors occur as a result of miscommunication is essential. In another study carried out in Denver, some of the causes behind miscommunication were attributed to the complexity of health care structure and differences in education and training among health professionals [9]. Those results provide the necessary background for diagnosing the causes behind miscommunication between health professionals.

The role of communication in healthcare

The clinical communication space, which resembles total information transactions clinician time, accounts for the major part of the information flow in health care [10]. According to the Joint Commission on Accreditation of Healthcare Organizations, problems related to communication represent 60% of sentinel events reported [11].

A study carried in Australia shows that in a 16,000 in-hospital deaths, communication errors were found to be the leading cause, twice as frequent as errors due to clinical malpractice [4]. Results show that poor communication can lead to negative outcomes such as misunderstandings and medical errors and thus, poor patient safety [12]. Therefore, the need for better communication skills among health professionals is a must.

Clinical Information Systems

Computer-based systems, such as Clinical Decision Support Systems (CDSS) and EMRs, have facilitated evidence-based and patient care by reducing serious medication errors [13] and enhancing the delivery of preventive care services[14] [15]. However, about 34% of computer-based systems have shown insignificant progress in clinical practice [15]. One of

the major reasons for this inefficiency is, as the use of Health Information Systems (HIS) and Computer Information Systems (CIS) increase, new medical errors are introduced. The types of errors produced by both systems differ for each type; HIS mainly keeps track of administrative issues and CIS concentrates on patient-related data such EMRs. However, many errors from both systems can be related to miscommunication. Therefore, the communication model proposed addresses communication limitations in both HIS and CIS.

A previous study shows that there are two categories of errors that occur during human-computer interactions. The first is errors submitting and retrieving information to and from an information system and secondly, errors in the communication and coordination processes that (CIS) is supposed to support [16]. In order to improve clinical communication, human-computer interaction has to be considered as a major component of the communication process. We believe that CIS should facilitate communication between clinicians, ensure correct clinical data flow and most importantly, improve health care services to the maximum effect.

Methods

To our knowledge, there is no communication model that represents clinical communication. This research aims at developing a communication model that fits health care. Initially, we analyzed general communication models through identifying the strengths, limitations, overall applicability in health care for each model. Then, using literature reviews and domain experts, we identified medical error cases to indentify miscommunication factors. Table 1 shows a sample of selected cases, the scenario, and communication factors we identified. The table distinguishes between general communication models and the proposed model by displaying the coverage level of each model. Through the previous steps, we developed a communication model that can better represent communication in clinical settings.

A need for a communication model

As the largest industry in the United States in 2006, the health care industry provides about 14 million jobs [17]. This shows the diversity in education, training and culture among employees. Therefore, a communication model that articulately demonstrates the communication framework among clinicians is essential. We believe that a communication model is a significant step towards improving the concept of communication in health care. By demonstrating a communication model, there will be more opportunities to raise questions and to encourage more research in this field. The model will show the complexity of the process and hence, display the order and coherence of procedures. Moreover, a practical model will open more research doors to new discoveries and better approaches about enhancing clinical communication which is our ultimate goal.

We expect the model to go through cycles of modifications and refinements as more cases are reported. However, our research does not stop at the model; in fact the model is just the beginning point in a roadmap to increase patient safety. Using the model, we plan to build ontology of possible clinical miscommunication causes which would help healthcare professionals understand medical incidents and increase their awareness of effective communication. The cases collected enable classification of communication factors at a lower level taxonomy. The communication model classifies the communication barriers and hence, provides higher level categorization of the communication model. Both, cases studied and the proposed model will provide a vision towards building a communication ontology which is exhaustive and complete.

Proposed Model

To build the model, we used previously reported error cases, where miscommunication is the main cause behind the error. Through studying the relevant literature and analyzing reported cases, we believe that to build an inclusive model there needs to be two main subcomponents to clinical communication; Human-Human and Human-Computer communication.

We define human-human interaction in health care in the following scenario: a communicator tries to send a message through a given means of communication, while delivering the message some noise is usually introduced. The noise can occur due to external and/or internal factors.

External factors include interruption during communication and incoherent messages. Internal factors can be multitasking or assumptions made by a recipient. Those noise factors usually introduce distortion of some sort in the true meaning of the message and hence, it affects the overall efficiency of the communication process. The message is received by recipient but, the message is usually different from what was originally sent by communicator. Therefore we introduce a distortion variable 'Y' to the message; this variable can hold negative or positive values. A negative value means the message received is incomplete. A positive value means the message received had either more or different details than what was intended. Upon receiving the message, the recipient sends a feedback to the sender to ensure that the meaning received was the meaning intended by the sender. In some cases the message sent is the same message received however, miscommunication can still occur due to factors such as differences in training, cognitive factors. However, the feedback process is also viable to noise introduction and thus, more distortion could be added to the process.

As for human-computer interaction, the user submits a request through the interface; requests vary from entering data to a request to retrieve information. Upon receiving user's query, the computer system takes legitimate action to perform the requested set of actions. Once data has been extracted and formatted, the system displays the information to the user in a meaningful manner through the Graphical User Interface (GUI). Medical errors occur due to miscommunication between the user and the information system. Factors causing communication breakdown include GUI issues, user skills to enter or retrieve the right information, knowledge represented by the system and how it is interpreted by user, and miscellaneous factors represent access problems and ways to work around error messages.

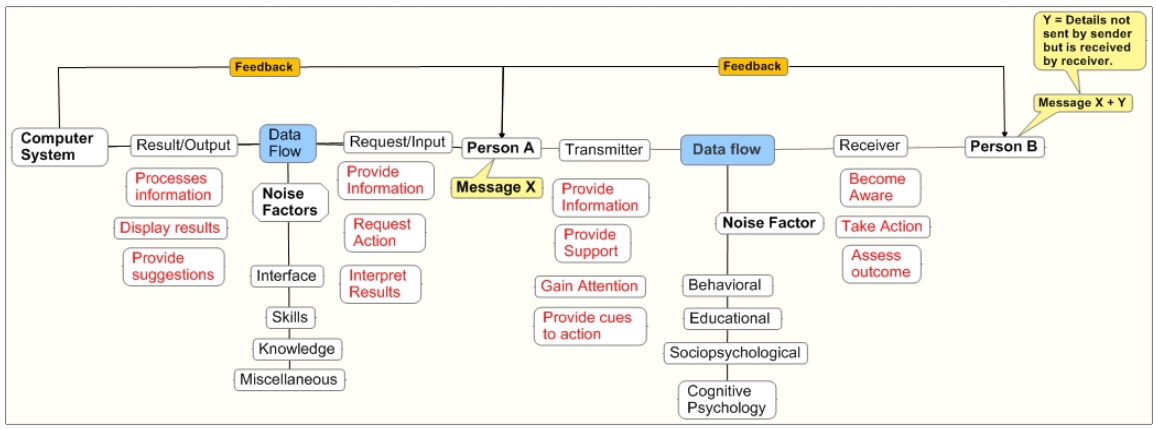

Figure 1- Proposed Communication Model with an emphasis on human-human and human-computer interaction

Comparing Communication Models

Table 1 shows 5 medical error cases we chose from the pool of cases. The cases were chosen carefully to represent the wide range of variability in miscommunication cases and they demonstrate our initiative to validate the model we proposed. We compared the proposed communication model against major communication models in other fields. Among those models were Shannon's, Schramm's, Riley's [18], Berlo's, Ecological, and Coorientation model [19-21]. The table displays a summary of each incident, factors leading to communication breakdown, factors covered by general communication models, and factors covered by the proposed model. The specific aim of this study is to provide a communication model that expresses the strengths and weakness of the communication process between clinicians.

Results

General communication models cover major communication aspects such as feedback, message medium and noise. However, the 5 cases show that in healthcare there are specific characteristics to communication. There are factors that are not expressed in general models. The model proposed, besides including more factors, has categories that are inclusive and well displayed which will facilitate future research.

Based on communication literature reviews, fragmented keywords were identified as communication factors for each case shown in the third column of the table 1. Then, factors from literature review were mapped with the current communication model to identify which factors, if any, are covered by which model, as shown in column 4. In some cases, some models do not have any overlaps with factors from the review. Another mapping was conducted between the literature factors and the model proposed, shown in last column. The proposed model includes taxonomy of the communication problem and hence, includes a higher level classification of the factors. For example, in case 1 the factor of lack of experience is mapped in the proposed model under educational factors. The proposed model has an advantage over current communication models in Human-Computer communication. The new model expresses Human-Computer interaction in more details than other models. Through real cases, the factors suggested have played an important role in communication between clinicians and computer systems.

Table 1 demonstrates the challenge in applying general communication model in health care. Through the five cases we studied in this paper, it can be concluded that other models can represent some of the problems but not all. The same cases show the ability of our proposed model to represent communication scenarios in health care. Therefore, we believe the results from this study support our model as an initial representative model to health care communication that requires more work to maximize cases covered by the model.

Discussion and Future Work

One of the obstacles to understanding clinical miscommunication is the scarcity of data. The absence of a mandatory reporting system has resulted in many medical errors occurring and not being reported. With the exception of Veterans Health Administration [27] and the Department of Defense, there are no nationwide reporting systems that mandate error reporting. Some of the reasons why such a system has not been implemented yet are the lack of anonymity, lack of knowledge on what to report, fear of blame, and most importantly lawsuits [28]. To our knowledge, very little research has been conducted to minimize clinical miscommunication. Researchers have explored the causes of miscommunication and ways to improve it [8, 9, 28-30]. We believe this research provides a new approach for physicians, nurses and other clinicians to improve communication within a single team.

Table 1- Medical Error Cases Analysis Guided by the Proposed Model

Case	Story [Reference]	Factors in communication literature	Factors in current Models	Factors in proposed Model
1	• Surgeon asks the anesthesiologist to give 10,000 Heparin. • The anesthesiologist hears the dose to be 2,000. Consequently, the Activated Clotting Time was low. The surgeon finds out the wrong dose of Heparin was given. The correct dose is given to the patient and a full recovery was achieved. [22]	• Assumptions • Ask Questions • Lack of Experience • Feedback	• Feedback (Shannon, Coorientation) • Experience (Schramm)	• Behavioral • Educational • Feedback
2	• Benny, 14-month old kid was admitted to the Care Unit. The nurse documents a verbal order as 0.7mg of Digoxin. • According to Benny's weight, the appropriate dose is 0.07mg. • When Digoxin was administered, Benny went into Cardiac Arrest and was announced dead. [23]	• Clinical Background • Training • Experience • Knowledge • Memory	• Culture (Berlo) • Social system (Ecological, Berlo, Riley) • Experience (Schramm)	• Educational • Cognitive Psychology
3	• A 47-year-old man was admitted and diagnosed with Pneumocystis jiroveci pneumonia (PCP). Two Biopsies were performed. • The intern finds a third biopsy in the hospital's EMR. The intern questioned her memory. • The team realized the third biopsy had been accidentally entered into this patient's record. • Dermatopathology department physicians and staff didn't have access to the hospital's EMR. [24]	• Human memory • Error Entering information to the system • Incorrect assumptions • Access to the system	• Experience (Schramm) • Feedback (Shannon, Coorientation)	• Behavioral • Cognitive Psychology • System skills • System knowledge • Miscellaneous
4	• An 85-year-old woman was admitted with a reported fall. • The surgery team decided that the patient is a candidate for nonsurgical treatment and noted in the EMR that the patient is able to weight-bear without pain. • The intern read the surgeon's note and found these comments ambulating odd. The team had evaluated the wrong patient. [25]	• Clinicians Feedback • EMR feedback • Memory	• Feedback (Shannon, Coorientation)	• Behavioral • Educational • System knowledge • Miscellaneous
5	• A 75-year-old woman admitted to the emergency department (ED) with chest pain. The patient could not recall of some of her medications. The physician printed the medication list from the EMR. • The patient developed a heart rate under 40. • On reviewing the patient's outpatient, the physician found a note stating the plan to discontinue some medications. [26]	• System design • System Interface • Usability skills	• Missing human-computer interaction	• System interface • System skills • System knowledge

The current communication model needs to be further verified and tested, through the analysis of more cases, in order to develop a more inclusive model. Case acquisition will come from literature databases such as Ovid database and Agency for Healthcare Research and Quality (AHRQ). Also, live observational study at the Critical Care Unit at the University of Missouri Hospital has been planned in an attempt to further identify the patterns and trends in clinical communication. The choice of Critical Care Unit is based on the fact that critically ill patients receive more services in short time spans which can be more error prone. Furthermore, critical care patients are prescribed twice as many medications as patients outside of the ICU which mean that the rate of preventable and potential adverse drug events is twice as high in ICUs and hence, higher chances of miscommunication occur in ICUs [3].

This ongoing project aims to utilize the data collected with domain expertise to build fully developed and exhaustive clinical communication ontology, which is in consistency with the early work [32]. Our effort would help healthcare professionals understand medical incidents and increase their awareness of effective communication. This ontology can serve as a classification methodology to communication problems in HIS. Also, as this ontology can be integrated with knowledge base systems to enhance clinical decision support systems. The long term plan is to utilize the built ontology to build an educational tool, that provides clinicians with the necessary information they need about clinical communication, its factors, and ways to improve it.

References

[1] Bates DW, Spell N, Cullen DJ, Burdick E, Laird N, Petersen LA, Small SD, Sweitzer BJ, Leape LL. The costs of adverse drug events in hospitalized patients. JAMA 1997;277(4):307-11. Abstract.

[2] Unknown. Sentinel Event Alert, June 23, 2003. Sentinel event statistics: Joint Commission on Accreditation of Healthcare Organizations 2003.

[3] Sutcliffe KM, Lewton E, Rosenthal MM. Communication failures: an insidious contributor to medical mishaps. Acad Med. 2004;79:186–94.

[4] Wilson RM, Runciman WB, Gibberd RW, Harrison BT, Newby L, Hamilton JD. The quality in Australian health care study. The Medical Journal of Australia. 1995;163:458-471.

[5] Donchin Y, Gopher D, Olin M, Badihi Y, Biesky M, Sprung CL, Pizov R, Cotev S. A look into the nature and causes of human errors in the intensive care unit. Crit Care Med. 1995;23(2):294-300.

[6] Institute of Medicine. To Err is Human: Building a Safer Health System. Washington, D.C.: National Academy Press; 1999. Publication.

[7] Institute of Medicine. Preventing Medication Errors: Quality Chasm Series. Washington, D.C.: National Academy Press; 2006. Publication.

[8] Woods DM, Holl JL, Angst D, Echiverri SC, Johnson D, Soglin DF, Srinivasan G, Barnathan J, Amsden L, Lamkin L, Weiss KB. Improving Clinical Communication and Patient Safety: Clinician Recommended Solutions. Agency for Healthcare Quality and Research. 2008.

[9] Dingley C,Daugherty K, Derieg MK, Persing R. Improving Patient Safety Through Provider Communication Strategy Enhancements. Agency for Healthcare Quality and Research. 2008.

[10] Coiera E., When Conversation is better than computation, Journal American Medical Informatics Association, 7,277-286, 2000.

[11] Leape LL, Bates DW, Cullen DJ, Cooper J, Demonaco HJ, Gallivan T, Hallisey R, Ives J, Larid N, Laffel G. Systems analysis of adverse drug events. JAMA. 1995;274(1):35-43.

[12] Kaushal R, Shojania KG, Bates DW. Effects of computerized physician order entry and clinical decision support systems on medication safety: a systematic review. Arch Intern Med 2003;163:1409-16.

[13] Bates DW, Teich JM, Lee J, Seger D, Kuperman GJ, Ma'Luf N, Boyle D, Leape L. The impact of computerized physician order entry on medication error prevention. J Am Med Inform Assoc 1999;6:313-21.

[14] Balas EA, Weingarten S, Barb CT, Blumenthal D, Boren SA, Brown GD. Improving preventive care by prompting physicians. Arch Intern Med 2000;160:301-8.

[15] Hunt DL, Haynes RB, Hanna SE, Smith K. Effects of computer-based clinical decision support systems on physician performance and patient outcomes: a systematic review. JAMA 1998;280:1339-46.

[16] Ash JS, Berg M, Coiera E. Some Unintended Consequences of Information Technology in Health Care: The Nature of Patient Care Information System-related Errors

[17] Health Care. U.S. Bureau of Labor Statistics. 2008. Available from: http://www.bls.gov/oco/cg/cgs035.htm

[18] Lee D. Developing Effective Communication. University of Missouri Extension. 1993. CM109.

[19] Steven Shkaminski. Communication Models. Transamerica SBC. 2002. Available from: http://www.shkaminski.com/Classes/Handouts/Communication%20Models.htm

[20] Foulger D. Models of Communication. Brooklyn College. 2004. Available from: http://foulger.info/davis/research/unifiedModelOfCommunication.htm.

[21] Cook R. Models. Loyola College in Maryland. 2003. Available from: http://cm203.loyola.edu/pdf/models.pdf

[22] Dowdell, EB. Pediatric Medical Errors Part 1: The Case A Pediatric Drug Overdose Case. Pediatric Nursing. 2004. Vol 30. No. 4.

[23] Agency for Healthcare Research and Quality. AHRQ WebM&M: Case & Commentary. Surgery/Anesthesia. May 2009. Available from: http://www.webmm.ahrq.gov/case.aspx?caseID=201

[24] Agency for Healthcare Research and Quality. AHRQ WebM&M: Case & Commentary. Medicine. April 2009. Available from: http://www.webmm.ahrq.gov/case.aspx?caseID=199

[25] Agency for Healthcare Research and Quality. AHRQ WebM&M: Case & Commentary. Surgery/Anesthesia. October 2008. Available from: http://www.webmm.ahrq.gov/case.aspx?caseID=187

[26] Agency for Healthcare Research and Quality. AHRQ WebM&M: Case & Commentary. Medical Informatics. October 2004. Available from: http://www.webmm.ahrq.gov/case.aspx?caseID=79

[27] Weeks W, Bagian JP. Developing a culture of safety in the veterans health administration. Eff Clin Pract. 2002;3(6):270-276.

[28] Karlsen K, Hendrix TJ, O'Malley M. Medical Error Reporting in America: A changing Landscape. Q Manage Health Care. 2009;18(11):59-70.

[29] Parker J, Coiera E. Improving Clinical Communication: A view from Psychology. AMIA. 2000, p:453-461.

[30] Pope, B. B., Rodzen, L., & Spross, G. (2008). Raising the SBAR: How better communication improves patient outcomes. Nursing, 38(3), 41-43.

[31] Cullen DJ, Sweitzer BJ, Bates DW, Burdick E, Edmondson A. Leape LL: Preventable adverse drug events in hospitalized patients: a comparative study of intensive care and general care units. Crit Care Med 1997, 25:1289-1297.

[32] Gong Y, Zhu M, Li J, Turley JP, Zhang J. Clinical communication ontology for medical errors. Studies in Health Technology & Informatics. 2007;129(Pt 2):1007-11.

Address for correspondence

Saif Khairat, MS.
706 CS&E Building. University of Missouri. Columbia, MO. 65201, USA.
Email: sekfz5@mail.missouri.edu.