INVESTIGATING MOBILE MESSAGING IN HEALTHCARE ORGANIZATIONS: A SENSEMAKING PERSPECTIVE

Research-in-Progress

Zhenbin Yang
Department of Information Systems
National University of Singapore
13 Computing Drive
Singapore 117417
zhenbin@comp.nus.edu.sg

Atreyi Kankanhalli
Department of Information Systems
National University of Singapore
13 Computing Drive
Singapore 117417
atreyi@comp.nus.edu.sg

Boon-Yuen Ng
Department of Information Systems
National University of Singapore
13 Computing Drive
Singapore 117417
ngby@alumni.nus.edu.sg

Kee Kiat Koo
Department of Information Systems
National University of Singapore
13 Computing Drive
Singapore 117417
keekiat.koo@alumni.nus.edu.sg

Abstract

Hospitals are adopting advanced messaging systems to facilitate communication among healthcare personnel with the aim of improving patient care. However, users face various challenges in employing these systems, with serious consequences of miscommunication. Nevertheless, past studies on healthcare messaging systems tend to be descriptive with a lack of theoretically grounded and empirical validated research to explain their nature of use. Motivated thus, we study the usage patterns of a web-based messaging system (WMS) in the context of a public hospital. Using media synchronicity and sensemaking theories, we explain how healthcare personnel on the move use WMS to make sense of their work for achieving a shared understanding for patient care. Through a preliminary content analysis of the WMS messages during a month, our results showed salient differences in the usage patterns of different user groups and for different kinds of sensemaking. The study’s potential contributions and future plan are discussed.

Keywords: web-based messaging system, healthcare personnel, content analysis, IS use, sensemaking, media synchronicity
Introduction

Communication and coordination problems are known to negatively affect patient care. Such issues are the root cause for two-thirds of preventable adverse events in hospitals (O’Leary et al. 2010). With the expectation that information systems can help improve the situation (Runyon et al. 2009), hospitals are beginning to adopt advanced messaging systems to support timely communication among healthcare personnel. For instance, there is increasing deployment of web-based messaging systems (WMS) that allow hospital personnel to send messages via a web portal and receive them via the same portal or SMS (Cheng et al. 2009). WMS offer users several advantages such as a more convenient and faster form of communication (Runyon et al. 2009), though these systems may also pose challenges such as increased work interruptions (Scholl et al. 2007). As WMS become more prevalent, research is needed to investigate how these systems can be used effectively in hospitals.

In this regard, most studies on healthcare messaging systems were conducted in the medical informatics domain and tend to be descriptive in nature without the use of theories to predict and explain observed patterns of use (e.g., Guerrero et al. 2009; Nguyen et al. 2006). The lack of theoretically grounded empirical research on healthcare systems has led researchers to comment that behavioral models are needed to understand how interpersonal elements of care delivery could be embodied better in these systems (Avison & Young 2007). Researchers have also called for studies in this area to understand the impact of WMS for healthcare professionals (Karpati et al. 2009). Further, prior studies have focused mainly on listing the benefits of different communication technologies (e.g., mobile phones, alphanumeric pagers) (Jen et al. 2007; Locke et al. 2008).

However, there is less understanding of how these messaging systems directly impact communication tasks within a hospital. Specifically in the case of WMS, it remains unclear to what extent these systems can be an effective communication tool for healthcare professionals to develop shared understanding. This is a salient issue since patient care requires frequent communication among several parties such as physicians, nurses, and administrative staff, who may not remain at one location over the course of their work. With WMS, healthcare professionals have a flexible medium for knowledge transfer, with SMS at the receiving end. However, SMS may be less suitable for complex tasks with a high amount of interaction because of its informal nature and inherent message length limitations (Ryoo & Koo 2010). Also, different user groups have varying task and communication requirements. Without identifying the types of communication processes that can be best facilitated by WMS, healthcare professionals may not be able to reap the expected system benefits. Therefore, there is a need to enhance understanding of how WMS is used for communication of various kinds of messages among different groups of healthcare personnel.

Motivated thus, we investigate WMS use to determine which types of messages are better supported through these systems for different groups of users. As achieving a coherent understanding among healthcare personnel is essential for effective patient care, the sensemaking theory is a suitable perspective to understand how WMS can facilitate this process. Specifically, we aim to explain if WMS is better suited and used for contributing knowledge (sense-giving), seeking knowledge (sense-demanding), or for surfacing incongruencies (sense-breaking) for making sense of different user groups’ work. Our study seeks to answer the following research questions “RQ1: Which types of sensemaking messages will hospital personnel use WMS more or less for? RQ2: What are the differences in the message usage patterns of WMS for physicians, nurses, and administrative staff?” To address the questions, our study will make use of actual WMS data logs instead of self-reported usage. A preliminary analysis of the message contents can help us understand the actual usage of WMS by various parties and for which types of communication the system is more suited. In future, the study will be extended to examine the effect of WMS usage on communication performance and subsequent impacts on patient care.

Conceptual Background

Use of communication media has mainly been viewed from the perspective of media choice theories such as media richness theory (Daft & Lengel 1984), social presence theory (Short et al. 1976), and the more recent and improved media synchronicity theory (Dennis et al. 2008). In this section, we first review the media synchronicity theory with the aim of characterizing the synchronicity of WMS and its suitability for different types of communication processes. Subsequently, we review sensemaking theory that can be
used to understand how different kinds of sensemaking can be supported through the WMS medium. We suggest that based on the synchronicity of WMS, the medium will likely support certain kinds of sensemaking better than others.

**Media Synchronicity Theory**

Media synchronicity theory (MST) aims to address the shortcomings of previous theories in explaining the use of new media (DeLuca & Valacich 2006). Media synchronicity is defined as the extent to which a communication medium can enable individuals to work together on the same activity at the same time (Dennis et al. 2008). The theory proposes that performance depends on the fit between communication processes and synchronicity of the medium. Specifically, MST breaks tasks down into two separate communication processes i.e., conveyance and convergence (Ryoo & Koo 2010). *Conveyance* involves the transmission of fresh information between two or more parties so as to allow the recipient to create a mental image of the issue being discussed. Receivers may need more time to process the information by possibly reading the same material a few times to successfully achieve understanding in such communication. *Convergence* involves the discussion of each individual’s interpretation of the situation so as to obtain a common understanding. When performed at a group level, this process requires regular but typically small chunks of interaction and debate among individuals so as to reach a consensus.

In terms of synchronicity and process fit, as convergence processes require more turn taking and interaction, MST proposes that high synchronicity media such as face-to-face communication will be more suitable. On the other hand, low synchronicity media such as email will yield higher performance for conveyance processes as individuals need time to process and formulate a mental image of the issue. Based on a comparison with other communication media discussed by Dennis et al. (2008), we propose that due to the asynchronous nature of WMS, the medium can be considered as having low synchronicity. This, in turn, can determine the kinds of sensemaking messages appropriate for WMS.

**Sensemaking Theory**

Sensemaking theory has been applied to understand diverse IS phenomenon such as the use of virtual worlds (Berente et al. 2011) and challenges in distributed work (Vlaar et al. 2008). Sensemaking is a process of social construction in which organizational members attempt to interpret and explain cues from the environment that leads to the enlistment of action (Maitlis 2005). It is particularly important in situations that demand coherent shared understanding among relevant stakeholders that enables collective action (Weick et al. 2005). It can explain communication processes of individuals who do not reside in a single location during the course of their work, and how shared understanding can be achieved (Vlaar et al. 2008). Thus it is relevant to our study in a hospital setting where effective patient care necessitates frequent communication among several caregivers to achieve a common understanding, even when the parties are distributed.

Sensemaking involves the reciprocal interaction between knowledge seeking, meaning ascription, and action (Weick 1995). It entails an iterative engagement in three types of acts i.e., sense-giving, sense-demanding, and sense-breaking, to allow individuals to make sense of their tasks and their environment, increasing the likelihood that congruent understanding will emerge (Gioia & Chittipeddi 1991; Maitlis & Lawrence 2007). *Sense-giving* is the process of providing explanations in the hope of influencing the sensemaking and meaning construction of others (Maitlis and Lawrence 2007; Weick 1995). It involves framing and disseminating visions and beliefs to others to influence their interpretation and lead them to a preferred redefinition of reality. Sense-giving thus includes offering descriptions and explanations (Vlaar et al. 2008). For instance, on noticing changes in the condition of a patient, nurses may attempt to convince a physician to take appropriate actions for patient care.

*Sense-demanding* involves individuals proactively seeking relevant knowledge from others, rather than being reactive, so as to reduce uncertainty. This includes clarifying one’s views and explanations with others and performing inquiries or asking questions in the hope of achieving new insights into problems. Consistent with this view, researchers have suggested that individuals should resist making assumptions especially when communication is unclear to avoid inaccurate interpretations (Cramton 2001). For example, nurses may attempt to clarify the problem with the physician in charge of the patient when things appear to be out of order. *Sense-breaking* involves the reframing of previously held conceptions
and redirecting coworkers to different ideas (Vlaar et al. 2008), causing individuals to reconsider their point of view by the destruction or breaking down of meaning (Pratt 2000). People engage in sense-breaking when they believe that others hold incongruent or undesirable views of reality that may lead to adverse and disjointed action (Maitlis and Lawrence 2007). Sense-breaking can take the form of individuals offering others contradictory evidence, or highly negative evaluations of their work. For example, a physician may reprimand a nurse if he/she thinks that the nurse have acted wrongly.

In this study, we will use sensemaking theory to understand communication patterns among different groups using WMS in a hospital. Specifically, we will categorize WMS messages based on the types of sensemaking highlighted above.

**Sensemaking and MST Communication Processes**

We aim to derive a correspondence between sensemaking message categories and convergence and conveyance processes in MST in order to understand which kinds of sensemaking messages are better supported by WMS. As *sense-giving* involves an individual providing descriptions and explanations with the aim of influencing the views of another, it is likely to involve mainly conveyance communication where sufficient knowledge needs to be transmitted over the medium so that a sound decision can be made. In our study, sense-giving involves informative messages for the management of interdependence of tasks or messages that provide situational awareness such as the health status of patients.

*Sense-demanding* generally involves requesting specific information needed for the performance of work activities. The sending of these messages is motivated by the need to reduce task uncertainty, which directs the attention of the recipient to a specific situation that needs to be clarified. As a few rounds of discussion may be required for the communicating parties to clarify their views, sense-demanding should involve mainly convergence communication as task uncertainty is reduced over the course of the interaction. *Sense-breaking* involves opposing and reshaping the opinions of others which may require interaction so as to come to a common understanding. It consists of explanations that accelerate the process of obtaining a shared understanding by highlighting the need for changing previously held misconceptions. Therefore, sense-breaking should involve mainly convergence communication.

**Hypotheses Development**

As described above, sense-giving involves mainly conveyance communication processes as individuals need time to process and create a mental image of the knowledge obtained. In contrast, sense-demanding and sense-breaking involve mainly convergence communication processes as individuals discuss and reshape their mental models to achieve a common understanding. Convergence communication should take place using high synchronicity media as intense interaction is required (Dennis et al. 2008). Thus, as a low synchronicity medium, WMS is expected to better facilitate conveyance (sense-giving) than convergence (sense-demanding and sense-breaking) communication processes. Therefore, we hypothesize that hospital personnel (physicians, nurses and administrative staff) will use WMS more for sense-giving as compared to sense-demanding and sense-breaking messages.

**H1:** Hospital personnel will use WMS more for sending sense-giving than sense-demanding messages

**H2:** Hospital personnel will use WMS more for sending sense-giving than sense-breaking messages

Although sense-breaking and sense-demanding both involve mainly convergence communication, familiarity with the work environment and communication medium may induce individuals to use WMS more for sense-demanding than sense-breaking. This is because individuals may encounter more challenges if they were to sense-break (e.g., resolve conflicts) via a low synchronicity medium as compared to sense-demanding. Specifically, such usage may result in a deterioration of relationships if it is not handled with care (DeVito 2009). Thus, we hypothesize that hospital personnel (physicians, nurses and administrative staff) will use WMS more for sense-demanding than sense-breaking.

**H3:** Hospital personnel will use WMS more for sending sense-demanding than sense-breaking messages

Both inpatient and outpatient care require frequent communication and coordination among several parties such as physicians, nurses, and administrative staff. Nurses are often stationed within hospital wards or clinics with tasks such as medication administration and patient monitoring. Administrative
staff also play an important role to ensure smooth hospital operations by performing tasks such as sending meeting and appointment reminders. Physicians, unlike nurses and administrative staff, usually do not remain at one location over the course of their work. As a result, physicians often have to rely on nurses to provide them with updates of their patients and administrative staff to provide coordination support, which implies the need for both nurses and administrative staff to send more sense-giving messages to physicians with WMS. Therefore, we hypothesize

**H4:** Nurses will use WMS more than physicians for sending sense-giving messages

**H5:** Administrative staff will use WMS more than physicians for sending sense-giving messages

As physicians are the ultimate decision-makers in patient care (e.g., deciding which medicine to administer to the patient and in what quantity), it is likely that both nurses and administrative staff will ask physicians more questions than vice versa to obtain a decision. As such knowledge seeking for clarification from physicians signifies a proactive action of nurses and administrative staff to reduce any uncertainty that needs to be resolved, we expect that both nurses and administrative staff will send more sense-demanding messages with WMS than physicians. Therefore, we hypothesize

**H6:** Nurses will use WMS more than physicians for sending sense-demanding messages

**H7:** Administrative staff will use WMS more than physicians for sending sense-demanding messages

As noted above, physicians are regarded as the final decision-makers in the domain of patient care. When nurses or administrative staff send either sense-giving or sense-demanding messages to physicians, it will often require a response with a decision. Although some responses from physicians are likely simple decisions or acknowledgments, it can be expected that more messages will require a response that involves reframing or challenging previously held conceptions of nurses or administrative staff. On the other hand, nurses and administrative staff are less likely to challenge physicians’ views. Thus, we hypothesize that physicians will send more sense-breaking messages than nurses and administrative staff.

**H8:** Physicians will use WMS more than nurses for sending sense-breaking messages

**H9:** Physicians will use WMS more than administrative staff for sending sense-breaking messages

**Research Methodology**

To test our hypotheses, we conducted content analysis of logged messages in the WMS in a hospital setting. As a positivist research method, it has been widely used to obtain objective description of content in social science research (Krippendorff 1980). For example, researchers have used it to analyze text relating to advertisements, chat messages, and online customer feedback (Pavlou and Dimoka 2006).

**Hospital and System Background**

Hospital A (name anonymized to protect confidentiality) is a comprehensive healthcare provider organization that also serves to educate medical, nursing and dentistry students. It has more than 1000 beds and serves as a general medical center in providing subsidized tertiary healthcare for its patients. The authors were approached by the hospital management to study the usage patterns of WMS. The WMS at Hospital A is primarily used to support clinical messaging among hospital personnel with the aim to improve patient care and to replace the use of pagers. All employees including nurses and administrative staff in the hospital are given individual accounts for the web portal which they can use to contact others through asynchronous services, i.e., SMS. The system allows users to search for other personnel in the web directory and to send messages out to a selected group of people. For example, users can send messages to the doctor on duty for the day, without the need for the user to find out who the doctor is. The system however imposes a maximum limit of 160 characters per message as is common in SMS.

**Data Collection**

The WMS implemented in Hospital A logs all messages sent and stores them in a database. Additionally, all healthcare personnel working in the hospital have been informed that these messages are recorded and may be retrieved and viewed at the discretion of the management. The data for this study was obtained from the message logs recorded in the database after obtaining necessary approval. As the WMS has been
used in the hospital for a few years, the usage patterns should have reached an equilibrium state. After consultation with the hospital’s management, it was decided to analyze messages exchanged through the WMS in one month that does not coincide with major holidays in which a substantial number of employees may go on leave. Our initial data consists of a total of 70,949 usable messages from more than 2000 personnel, which came with information on message threading and time stamps.

**Content Analysis Procedures and Reliability**

The content analysis method was used to confirm causal relationships, as in previous studies (e.g., Chatterjee et al. 2009; Seddon et al., 2010). For the content analysis, we closely followed a five-stage approach guided by prior work in this area (Lacity & Janson 1994; Lombard et al. 2002). Specifically it involves (1) Codebook development and data preparation, (2) Coding constructs, (3) Calculating continuous construct’s value (not applicable in our study as we are using categorical units instead of continuous values), (4) Preparing data for analysis, and (5) Hypotheses testing. In addition, to ensure intra-coder reliability, we required coders to re-code 10% of their data (Pavlou and Dimoka 2006). As our data set is large, we adopted a split half technique where coders independently code a subset of messages after reliability is established (Neuendorf 2002).

As recommended in previous research (Krippendorff 2004; MacQueen et al. 1998), a codebook was developed so as to ensure that all coders consistently follow a similar set of instructions in their coding. The various coding categories in the codebook are summarized in Table 1 below. To avoid the reuse of individuals who are involved in deriving the codebook, we employed a different group of coders to test the finalized codebook. This study used three coders where Coder 1 was one of the authors of this paper, while Coders 2 and 3 were two doctoral students who were blind to the objectives of the study and recruited for this research. To reduce subjectivity in coding, the data set was split into two parts with the first part coded by Coders 1 and 2, while the second part was coded by Coders 1 and 3 for reliability.

<table>
<thead>
<tr>
<th>Category</th>
<th>Definition</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sense-giving</td>
<td>Process of providing explanations in hope of influencing the sensemaking and meaning construction of others</td>
<td>wd62b3 patient complain of pain over the back puncture site. was given panadol @ 1300 hrs with no relief. kindly order additional pain medicine</td>
</tr>
<tr>
<td>Sense-demanding</td>
<td>Process of proactively seeking relevant knowledge from others so as to reduce uncertainty</td>
<td>wd78b16, so is patient confirmed for discharge today/ or still KIV? still need omeprazole upon discharge?</td>
</tr>
<tr>
<td>Sense-breaking</td>
<td>Involves the reframing of previously held conceptions, causing individuals to reconsider their point of view by the destruction or breaking down of meaning</td>
<td>I have already ordered that medicine just now. You should always check before you ask us to do something.</td>
</tr>
</tbody>
</table>

Reliability implies that the observations must be stable and consistent when coded by different people over time (Krippendorff 2004). In a content analysis study, it is recommended that researchers consider key types of reliability i.e., stability and reproducibility (Krippendorff 2004). Stability concerns itself with reproducing the same results by the same person at different time. Known as intra-coder reliability, stability measures the number of mistakes by a coder due to carelessness in his work. To measure intra-coder reliability, coders are required to randomly re-code a pre-defined amount of data. Reproducibility measures the degree to which two or more coders independently agree on a coding decision given similar instructions under varying conditions. Known as inter-coder reliability, the measure ensures that coding instructions are clear and the decision is indeed sound and hence helps ensure validity in a study.

We tested the Holsti Agreement index for stability and Krippendorff’s Alpha for reproducibility (Holsti 1969; Pavlou and Dimoka 2006). Consistent with previous IS research, we adopted a minimum threshold of 0.70 for Krippendorff’s Alpha and 0.90 for Holsti’s intra-coder reliability (Pavlou and Dimoka 2006). All intra-coder and inter-coder reliability indices exceeded the thresholds, as shown in Table 2.
Table 2. Reliability Measures

<table>
<thead>
<tr>
<th>Category</th>
<th>Holsti Agreement Index (Coder 1)</th>
<th>Holsti Agreement Index (Coder 2)</th>
<th>Holsti Agreement Index (Coder 3)</th>
<th>Krippendorff’s Alpha (Coder 1 and 2)</th>
<th>Krippendorff’s Alpha (Coder 1 and 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sense-giving</td>
<td>0.93</td>
<td>0.99</td>
<td>0.93</td>
<td>0.78</td>
<td>0.89</td>
</tr>
<tr>
<td>Sense-demanding</td>
<td>0.94</td>
<td>1</td>
<td>0.90</td>
<td>0.84</td>
<td>0.86</td>
</tr>
<tr>
<td>Sense-breaking</td>
<td>0.96</td>
<td>1</td>
<td>1</td>
<td>0.74</td>
<td>0.90</td>
</tr>
</tbody>
</table>

Data Analysis and Results

The WMS implemented in Hospital A is highly utilized with more than 70,000 messages exchanged in the month of study. We collated the number of messages for each user and dyad group based on our initial data. Physicians sent the most messages (25597 or 36.08% of messages), while administrative staff sent fewer messages (23611 or 33.28% of messages). Of the three user groups in our study, nurses sent the least messages (17698 or 24.94% of messages). The remaining few user groups (e.g., allied health) sent messages infrequently (4043 or 5.70% of messages) and were not included in our study.

We also collated the messages based on sensemaking categories from the coding results. The analysis reflected that hospital personnel used the system mainly to send messages for sense-giving (46018 or 64.86% of messages) and sense-demanding (9320 or 13.14% of messages). However, a small portion of messages are used for sense-breaking (1850 or 2.61% of messages). The remaining messages (13761 or 13.40% of messages) were not included in our analysis because they were not relevant for our hypotheses (e.g., for social purposes). Eventually, 53,145 messages were used for hypotheses testing.

Hypotheses Results

SPSS 17.0 was used for the hypotheses testing. Hypotheses H1 to H3 were tested with a paired samples t-test (Rubin 2009) as they are derived from a sample that is related to one another (dependent sample). For these hypotheses, the coding data is separated into their respective user groups, with the number of sense-giving, sense-demanding, and sense-breaking messages sent between a sender and a receiver. Results for this group of hypotheses are presented in Table 3. All hypotheses were found to be supported.

<table>
<thead>
<tr>
<th>Hypotheses</th>
<th>Description</th>
<th>T-value</th>
<th>P-value</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1</td>
<td>Sense-giving &gt; Sense-demanding</td>
<td>2.689*</td>
<td>0.017</td>
<td>Supported</td>
</tr>
<tr>
<td>H2</td>
<td>Sense-giving &gt; Sense-breaking</td>
<td>2.707*</td>
<td>0.016</td>
<td>Supported</td>
</tr>
<tr>
<td>H3</td>
<td>Sense-demanding &gt; Sense-breaking</td>
<td>2.589*</td>
<td>0.021</td>
<td>Supported</td>
</tr>
</tbody>
</table>

An independent samples t-test (Rubin 2009) is used to test the hypotheses H4 to H9 as they are separated into their respective groups (categorical data) in accordance to the hypotheses (independent sample). Results of the analysis are presented in Table 4. All hypotheses were found to be supported except H5.

Discussion and Expected Contributions

A total of eight out of nine hypotheses in our study were supported. By analyzing messages as part of the sensemaking framework, we found general support for the media synchronicity theory for both convergence and conveyance communication processes (H1, H2 and H3). Specifically physicians, nurses, and administrative staff tend to utilize WMS for communication tasks that are high in conveyance (sense-giving) as compared to tasks that are high in convergence (sense-demanding and sense-breaking). This suggests that WMS is most useful for supporting communication processes that involve sense-giving, while it is less useful for messages involving sense-breaking. A likely explanation for the low usage of WMS for sending sense-breaking messages is because it may result in misunderstanding and deterioration in human relationships due to the medium’s low synchronicity.
Table 4. Results for Hypotheses Testing (H4 to H9)

<table>
<thead>
<tr>
<th>Hypotheses</th>
<th>Description</th>
<th>T-value</th>
<th>P-value</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sense-giving</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H4</td>
<td>Nurses &gt; Physicians</td>
<td>3.286**</td>
<td>0.001</td>
<td>Supported</td>
</tr>
<tr>
<td>H5</td>
<td>Admin &gt; Physicians</td>
<td>0.982</td>
<td>0.326</td>
<td>Not supported</td>
</tr>
<tr>
<td>Sense-demanding</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H6</td>
<td>Nurses &gt; Physicians</td>
<td>3.077**</td>
<td>0.002</td>
<td>Supported</td>
</tr>
<tr>
<td>H7</td>
<td>Admin &gt; Physicians</td>
<td>0.3935***</td>
<td>0.000</td>
<td>Supported</td>
</tr>
<tr>
<td>Sense-breaking</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H8</td>
<td>Physicians &gt; Nurses</td>
<td>9.98***</td>
<td>0.000</td>
<td>Supported</td>
</tr>
<tr>
<td>H9</td>
<td>Physicians &gt; Admin</td>
<td>7.978***</td>
<td>0.000</td>
<td>Supported</td>
</tr>
</tbody>
</table>

* p < 0.05; ** p < 0.01; *** p < 0.001

By comparing the usage of WMS by each group according to the sensemaking framework, we found support for hypotheses H4 to H9 with the exception of H5. Although we predicted that administrative staff would send a higher number of sense-giving messages than physicians, the results did not support this hypothesis. One possible reason is due to the high number of sense-giving messages that physicians sent to other personnel in their team for coordinating patient care. However, although administrative staff sent a higher number of sense-giving messages than physicians mainly for administrative coordination, the difference was low. Therefore, this can explain why administrative staff did not send significantly more sense-giving messages than physicians.

**Expected Theoretical and Practical Contributions**

By studying the usage patterns of WMS, we achieve a better understanding how the system can facilitate different types of communication for various user groups. Although past research in healthcare messaging systems has focused mainly on the communication system used and the interaction between physicians and nurses (Locke et al. 2008), we found that such systems are also commonly used by other parties (e.g., administrative staff). Our study demonstrates the usefulness of MST in explaining the suitability of new media such as WMS for different types of communication processes. In addition, our study shows the relevance of sensemaking theory in a healthcare setting where little is known of how individuals who are not collocated can achieve shared understanding for patient care. By integrating key concepts of MST and sensemaking together, our findings show that a low synchronicity medium can also support some tasks that are high in convergence (sense-demanding). This synergy serves as a basis for developing theory to investigate the appropriateness of new media for different types of sensemaking messages, and how a medium such as WMS can facilitate shared understanding.

As the main aim of implementing messaging systems is to facilitate communication in hospitals, this study serves to highlight which group of users (physicians, nurses, administrative staff) send more of each type of message, and what type of communication processes are better facilitated by WMS. In general, the high number of messages sent with WMS suggests that it is useful to support communication processes among healthcare professionals, especially for physicians who usually do not remain at one location over the course of their work. Our findings also highlight several limitations of the system. For instance, users may need to be reminded to be more careful when sending sense-breaking messages with WMS to avoid misunderstandings. Therefore, the use of WMS should be seen as a complement to other forms of communication rather than as a substitute. Nevertheless, in spite of the limitations of WMS, the system can be seen as an effective way for healthcare personnel to communicate several kinds of sensemaking.

**Conclusion and Future Plan**

There are two main limitations in the current study. First, our data set is from a single hospital and hence our results need to be generalized with caution. Second, our study is based on a single month of data, even though it is deemed to be a typical month. In future, we intend to analyze data from other hospitals that implement WMS and over longer periods of time to increase the generalizability of our findings. Also, content analysis can be complemented by other methodologies such as surveys to study communication outcomes. Thus, in the next phase of our study we plan to employ a survey and objective data to analyze communication performance based on the fit suggested above and the impact of WMS on patient care.
References