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# Exploring Contradictions in the Use of Mobile Technology by Multidisciplinary Healthcare Teams

Pamela Spink
*Monash University*, Pamela.Spink@monash.edu

Frada Burstein
*Monash university*, frada.burstein@monash.edu

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**Pamela Spink**
Monash University
pamela.spink@monash.edu

**Frada Burstein**
Monash University
frada.burstein@monash.edu

## Abstract

*Modern healthcare is predominantly delivered by a multidisciplinary health care team (MHCT). MHCTs in hospitals have shown to improve health outcomes through enhanced communication and improved patient satisfaction. Mobile technology is increasingly being used in healthcare to provide quality care to patients. Healthcare professionals are embracing mobile technologies, as evidenced by substantial research contributions. This study is extending recent research into the use of mobile technology by a MHCT using Activity Theory as a theoretical lens. The current research focusses on exploring the contradictions that emerge as a result of the use of mobile technologies by the MHCTs. Based on data collected from four cases, this study reveals some significant contradictions focusing on the tool dimension; more specifically, i) Personal device Vs. Professional device ii) Flexibility of the device Vs. Restricted access iii) Anywhere, anytime Vs. Drawing boundaries.*

**Keywords**

Mobile technology use, Multidisciplinary healthcare teams, Activity Theory contradictions

## Introduction

Multidisciplinary care is an integrated team approach to health care in which professionals from different disciplines such as medicine, nursing, and allied health collaboratively discuss options and make decisions regarding treatment and care plans for patients. A team can be composed of members from different disciplines depending on the type of care and medical specialties required (Ellingson, 2002). Research has shown that team-based approaches in healthcare delivery besides improving the quality of care to patients (Reiss-Brennan et al., 2016), also benefit the healthcare professional in understanding care plans for patients (O'Leary et al., 2012). For the multidisciplinary health care team (MHCT) to function effectively, make timely decisions, and render quality care, consistent, reliable, and up to date, information exchange channels are imperative. Communication, coordination, and collaboration are critical for an MHCT to effectively share essential information amongst its team members that enable sound decision making. MHCTs in hospitals have shown to enhance communication, improved patient satisfaction, and decreased the length of stay, thereby improving health outcomes (Epstein, 2014). Hospitals use different types of devices to communicate, and these devices that establish clinical communication should be capable of transferring information quickly, accurately, effectively, and efficiently.

Mobile technologies are being increasingly used in the health care sector. The use of Personal Digital Assistants (PDAs), smartphones, and tablet PC has enabled doctors, nurses, and allied health professionals to deliver quality care to patients through improved communication. Literature has revealed a substantial contribution of research in the area of mobile technology use by various healthcare professionals at an individual level. Study as to how doctors use smartphones (Nerminathan et al., 2017), or nurses use ipads (Vilstrup et al., 2017) as well as adoption studies (Zhang et al., 2010). However, there is limited research regarding mobile technology use by multidisciplinary healthcare teams in hospitals and the contradictions

of its use. We argue that before any adoption study can take place, it is worthwhile to understand how mobile technologies are being used by the MHCT and how unraveling the contradictions can help determine its use.

Prior research on the use of smartphones in a MHCT has shown to increase efficiency and communication in the team (Wu et al., 2010), the findings were further supported by (Lo et al., 2012). A recent study on the use of mobile technology in a multidisciplinary healthcare team has used Activity Theory (AT) (Engestrom, 1987) as a lens to explore the factors of use and challenges faced by the MHCT (Spink & Burstein, 2020). While the main focus of this study was understanding how, why and for what purpose the MHCT use mobile technologies and the factors that influence its use, the current research makes use of their findings to explore the tensions or contradictions that emerge in the MHCT as a result of the use of this technology. It must be noted however, that due to the page limit constraints, this study will focus only on some of the major contradictions emerging due to the tool. This paper begins with the synthesis of literature on the use of different types of mobile technologies by healthcare professionals at an individual level; the use of mobile technology in a multidisciplinary healthcare team, healthcare studies that have used AT as a lens and contradiction studies to answer the research question "What are the major contradictions in the use of mobile technology by a multidisciplinary healthcare team?". Next, the case study methodology is described, followed by a discussion of findings and concludes with contributions, limitations, and future direction of the research project.

## Literature Review

As this research sits in the area of multidisciplinary healthcare team's use of mobile technology and its contradictions, this section presents a review of relevant research encompassing these areas. We intend to highlight the importance of communication amongst healthcare professionals using mobile technology and some theoretical and practical aspects of AT and its suitability as a theoretical lens for this research.

### *Mobile technology use at the individual level*

Communication is a critical component of the health care process. Sharing patient information with another facility, or a group of doctors, nurses specialists, effective communication is the key. Inadequate communication has often been a leading cause of serious medical errors (Kohn, 2000). Given the mobile nature of healthcare professionals, access to patient information is highly critical for them to make a useful and timely decision. Mobile technology has proved beneficial in accessing and sharing information, anytime, anyplace, while clinical systems are said to provide the right information about the right patient at the right time (Bardram & Bossen, 2005). Handheld computers (or Personal Digital Assistants) offer increasing support to physicians for scheduling, accessing drug references, patient data, and storage and billing (Burnard, 1995; Helwig & Flynn, 1998). With technological improvements over PDA, tablet computers are used as remote radiological image review and teleconsultation device (John et al., 2012). In addition to the mobile devices used by the healthcare professionals, “apps', an essential feature of the smartphones, play an important role particularly in physicians' lives making it a useful tool at the point of care and clinical communication (Mosa, Yoo, & Sheets, 2012), health monitoring and decision support (Oscar, 2013). All these studies presented a comprehensive landscape of the use of mobile technology at an individual level. So, can this technology support a MHCT in a similar way?

### *Mobile technology use in a multidisciplinary healthcare team*

Healthcare professionals are embracing smartphones for the delivery of patient care and help change behavior, better health outcomes, and lower healthcare costs. Smartphones have been used in an intervention program by Bashi et al. (2018) to study post-discharge management of patients with Acute Coronary Syndrome (ACS) using a multidisciplinary focus group. The multidisciplinary group consisted of cardiologists, nurse practitioners, clinical nurses, research scientists, and a physiotherapist. Findings revealed that the smartphone-based intervention is likely to motivate the patients, thereby improving patients' health outcomes following discharge. A pilot project conducted by Cockerham (2009) on the use of tablet computers on patient care rounds with a multidisciplinary team consisting of oncology physicians, nurses, social workers, and medical and pharmacy students proved to enhance patient care through timely

administration of therapy. He identified some limitations of the use of tablet computers on long rounds such as the weight of the tablet computer, battery power, and wireless access.

The use of smartphones for collaborative work is further evidenced in the study conducted by Wu et al. (2010), who have evaluated the use of smartphones in an internal medicine ward at the Toronto General hospital, by resident doctors and nurses. Smartphones were perceived by the nurses as increasing efficiency and communication. The survey study used was not formally assessed and validated; further objective evaluation was necessary to determine if this intervention improves efficiency and, more importantly, quality of care. The findings of this study were further backed up by Lo et al. (2012), who conducted qualitative research using smartphones at a General Internal Medicine ward at two teaching hospitals in North America, for improving collaborative care delivery among healthcare providers. Findings suggest that Smartphone technology creates a flexible communication environment and allows high accessibility, thereby enhancing professional interactions within an acute context. This study, however, does have its limitations due to the fact that it is based on a single data source. As the authors suggest, greater generalization could be achieved if studies were undertaken in a different context using multiple data sources to investigate how communication technologies are used from different perspectives (Lo et al. 2012). Recent research on the use of mobile technology in a multidisciplinary healthcare team has identified the factors of use and the challenges taking into account a wide variety of mobile technologies to include PDAs, smartphones, ipads (Spink & Burstein, 2020). Their research focused on understanding who, how, why, and for what purposes the MHCT uses mobile technology. This current study builds on their research to uncover the tensions or contradictions of its use.

### *Activity Theory (AT) theoretical and practical research*

Activity theory, according to Engestrom, helps understanding dialogues, multiple perspectives, and interaction of activity systems (Engestrom, 1987). It captures all aspects of an activity system to better understand the nature of the activities. AT is characterized by principles such as hierarchical structure, object-orientedness, internalization/ externalization, tool mediation, and development (Kaptelinin et al., 1997). Activity analysis has been applied to build activity-aware systems, i.e., systems that are able to recognize both context and the user. Badram and Doryab (2011) have demonstrated the application of activity theory through two cases. One, a higher-level activity, analyzing the work at a hematology department and another case analyzing a specific operational activity on a more detailed level of actions and operations. Furthermore, AT has been applied in healthcare studies to investigate different activities such as examining and diagnosing (Engestrom, 2000), information management practices in maternity care network (Hakkinen & Korpela, 2007) and explaining collaborative technology use (Riechert et al. 2016).

An essential feature of activity systems is the principle of "contradictions." According to Engeström and Sannino (2010), "..contradictions are the driving force of transformation. The object of an activity is always internally contradictory. It is these internal contradictions that make the object a moving, motivating, and future-generating target.." (p. 5). Identifying contradictions in an activity system can help practitioners and administrators to tackle the root causes of the problem. Engestrom's study of a children's medical care in Helsinki brought to light a number of disturbances identified as cost, overlaps, and discoordination of care (Engestrom, 2000). Addressing contradictions in the initial stages of system analysis and the design of a health information system can improve specific processes. Sadeghi et al. (2014), have analyzed the patient discharge process in two care units of a large hospital using the Activity-Oriented Design Method (AODM) to highlight the need to address documentation, organizational and process issues as needed improvement in the discharge planning process. Additionally, Reichert et al. (2016) have analyzed the chemotherapy administration process, a complex and collaborative process using AT to uncover the contradictions in the activity system. This research study extends recent research by Spink & Burstein (2020) in utilizing the principle of contradictions to uncover the barriers and opportunities for better use of mobile technology by MHCTs.

## Research Design

This research employed a multiple-case, interpretive design, an approach more suited for extension of theory and cross case-analysis (Benbasat, 1987).

## *The case study context*

The case study organization chosen for this research is a large Australian public hospital providing leading-edge specialist services as well as tertiary teaching. Four multidisciplinary teams, from significant units of the hospital - Radiation Oncology, Colorectal Surgery, Gastro Unit, and the Intensive Care Unit, participated in the research. A multidisciplinary team (in this research) comprises at least one physician, one nurse, and one allied professional. Table 1 summarizes the details of the multidisciplinary healthcare team (MHCT).

| **Case 1 - A** | | | **Case 2 - B** | | |
|---|---|---|---|---|---|
| Participant | Role | Gender | Participant | Role | Gender |
| A1P | Physician | Male | B1P | Physician | Male |
| A2P | Physician | Male | B2P | Physician | Female |
| A3N | Nurse | Female | B3P | Physician | Female |
| A4AP | Radiation T | Male | B4N | Nurse | Female |
| A5AP | Radiation T | Male | B5AP | Pathologist | Female |
| **Case 3 - C** | | | **Case 4 – D** | | |
| C1P | Physician | Male | D1P | Physician | Male |
| C2N | Nurse | Female | D2P | Physician | Female |
| C3N | Nurse | Female | D3N | Nurse | Male |
| C4AP | Pharmacist | Female | D4AP | Dietician | Female |

**Table 1. Multidisciplinary healthcare team participants demographics**

## *Conceptual framework*

Activity Theory (AT) has been chosen for this study, as the contextual emphasis of Activity Theory and the framework is highly appropriate for qualitative and interpretive research that explores how organizations understand and meet the challenges by analyzing and providing deep and rich understandings of complex dynamic settings such as health care context. Activity theory (AT), started in the 1920s by Lev Vygotsky, is a framework been widely used in human-computer interaction, education, and information systems, to mention a few. It helps to understand the relationship between humans and tools with other influences within a social setting. It stems from the notion that human "activity" has a purpose, and it is carried out through a set of "actions" using "tools." This theory is suited for understanding the use of technology, with applicability in a wide variety of settings, contexts, and approaches (Murphy & Rodriquez, 2008). The fundamental assumptions that underpin activity theory are i) knowledge is mediated through tools, and ii) the basic unit of analysis is what's defined as an activity. Tools mediate between the subject and the object, the subject refers to the important actors in a particular activity at whose perspective we want to look from, and the object is essentially the objective to be achieved. The second-generation AT (Engestrom, 1987) was popularized in the west by Engestrom in the 1970s. It builds on the first, adding the collective notion of activity, the "collective activity system" that when activities are undertaken, several rules are implicit or explicit that will influence the way in which that activity occurs. There is also a community of actors who are involved, and the other element or component is the division of labor, which refers to who does what so how the activity is divided. The second-generation AT has been used in this study to explore contradictions in the activity system of a MHCT's use of mobile technology.

Engestrom describes contradictions as "historically accumulating structural tensions within and between activity systems" (Engeström, 2001, p. 137) and "the motive force of change and development" (Engestrom & Miettnen, 1999, p.9). Contradictions are tensions or inconsistencies in an activity system causing changes

or imbalances in the activity or the people (Blin & Munro, 2008) however; they are necessary for an activity system for change and development. Engestrom identifies four levels of contradictions in an activity system (Figure 1) primary contradictions, those that emerge within the elements or components of the activity system 2) secondary contradictions – those that occur between the different elements or components 3) tertiary contradictions - occur when a culturally more advanced activity within the central activity of interest introduces a more advanced object or motive and 4) quaternary contradictions - are those that occur between two activity systems.

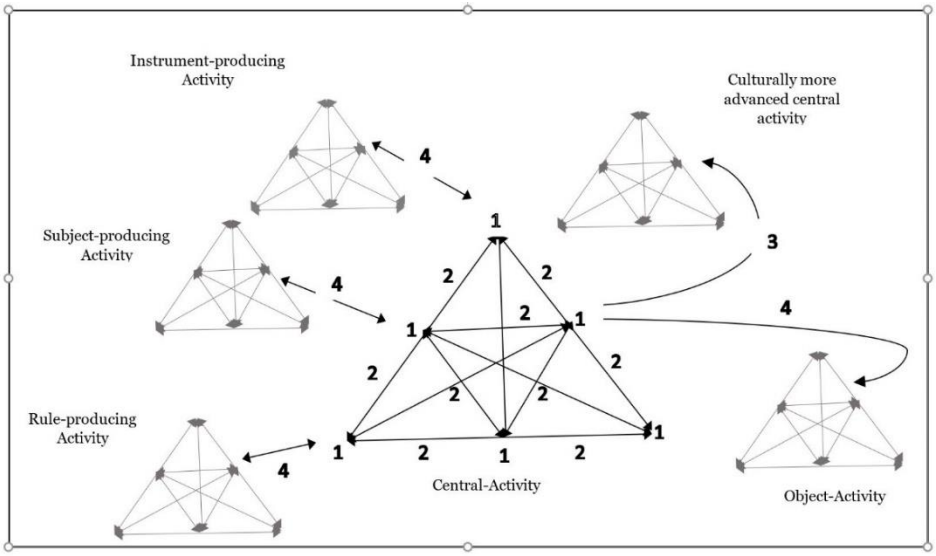


**Figure 1 – Four levels of contradictions in an activity system (Engestrom, 1999)**

### *Data collection and analysis*

This research studied four cases. This number was sufficient to attain data saturation (Yin, 1994). Data was collected through face-to-face interviews as the primary source and document analysis. Face to face interviews lasted approximately 30-40 minutes. Participants were chosen using purposive sampling, followed by a snowball technique. This technique was more suitable as the research required teams comprising of at least one physician, one nurse, and one allied professionals working in the same team. Interviews were semi-structured, and questions were formulated based on the theoretical concepts from Activity Theory. Working together in the team denotes that participants were familiar with the care delivery of a particular patient they dealt with and, as such, shared their experiences in response to the interview questions. Data collected was analyzed using NVivo11 software and thematic analysis. Emerging themes were identified, and a coding structure was developed using the deductive approach (Miles & Huberman, 1994). Thematic analysis was employed to reduce data further. Themes were reviewed to ensure coherency and meaning within data in themes while maintaining distinctions between the theme. Ethics approval for this study was obtained, and explanatory statements were sent to the chosen participants.

## Discussion of Findings

Spink & Burstein (2020) have identified the type of tasks and characteristics of the roles of the MHCT as important factors in understanding how they use mobile technology. The MHCT use mobile technology spontaneously for communication, in a restricted manner for data management and find potential use for the technology. Using the activity system (Table 2), this section will unravel the “contradictions” in the activity system to answer the research question, “What are the major contradictions in the use of mobile technology by a multidisciplinary healthcare team?”.

| **Concepts** | **Meaning** | **Themes** |
|---|---|---|
| Subject – who are involved in the activity? | The multidisciplinary health care team – Physicians, nurses, and allied professionals who might use mobile technology. | Subject Task types<br>Clinical<br>Non-clinical<br>Subject characteristics<br>Level of mobility<br>Level of responsibility<br>Level of experience<br>Nature of work |
| Object of the activity | The purpose of the activity and what they want to achieve – improved health outcomes | Quality care |
| Tool - used to carry out the activity | The type of mobile technology – Computer on wheels (COWs), Personal Digital Assistants (PDAs), Laptops, Smartphones, and tablet | Spontaneous<br>Restricted<br>Potential |
| Rules- Are there rules and regulations governing the activity? | Policies and guidelines governing tasks performed by the MHCT | Policies and procedures in tasks |
| Outcome | Outcome of the objective of the activity – quality care. | Efficiency, effective and timely decision making |
| Division of labor – who is responsible for what? | Individual and shared tasks of the Multidisciplinary health care team | Responsibilities of physicians, nurses and allied professionals |
| Communities– individuals directly or indirectly involved in the tasks | MHCT's involvement directly or indirectly in the community/organization external to their organization | Medial centers, health services, and health administrators |

**Table 2. Activity system – Use of mobile technology by a multidisciplinary healthcare team**

Contradictions in an activity system can occur at four levels namely, within each component of the activity for example within the tool (the dual nature of the tool), between components for example between the subject and tool; those that occur when a culturally more advanced activity within the central activity of interest introduces a more advanced object or motive and those that occur between two activity systems. Since the focus of this research is on how the MHCT uses mobile technology, we focus specifically on the tool and identify some of the major contradictions i) Personal device Vs. Professional device, Flexibility of mobile technology Vs. Restricted access, Anywhere, anytime Vs. Drawing boundaries.

### *Personal device Vs. Professional device*

When the participants were asked questions about the different tasks that were performed using mobile technology and questions about the mobile device, their responses, the participants report:

> "*The smartphone is like, if I didn't have it, I would not be able to function in life. Yep. So I used my mobile, like my smartphone or the mobile phone, to call other units. To call my own team would be the second thing to communicate something that's happening in Emergency, for example, [D2P].*

> *"There is no policy about this. But people use mixed; we only have two phones. Some staff has a phone that is provided by a director and most of us only have our own phones. So I would use my own device. I would bring my own phone to work because it is more convenient for me to be contacted on my own phone rather than and more efficient than being dependent on having to get that…" [D3N].*

> *"I'm not exactly aware if the hospital does have a formal mobile device policy with regards to--with regards to personal devices. It's all personal. Why don't I hesitate to use it? There's no other way you can get by. You know, there's no other ability to communicate in the twenty-first century without having a mobile device. So, the very least, it's my phone and my calendar" [C1P].*

> *"So with all of the team we've actually got a group, a WhatsApp group as well for the IBD team and its called XXXX, so that's a good way to communicate with everyone to make sure everyone's on board with the plans and you don't have to repeat yourself all the time" [C4AP].*

Reflecting on these quotes, while focusing on the tool, we contend that the inherent primary contradiction is apparent in the "tool" due to its pervasive nature to function as both a personal as well as professional device (Wiredu, 2007). The participants do not hesitate to use their own devices for work-related tasks, specifically for communication. On the one hand, there seems to be no clear policies that allow them to use their personal device, yet they believe they cannot carry out their task efficiently without the mobile device. This contradiction provides an insight into "how" they use the mobile device in a "spontaneous" manner. This contradiction in the tool itself leads to other secondary contradictions when the participants start using the tool. Mobile devices provide a lot of benefits for the healthcare providers; however, with some unintended consequences blurring organization control and personal control (Sorensen et al., 2011)

### *Flexibility of the mobile device Vs. restricted access*

> "*We cannot really use technology as flexibly as we could. That also extends to our difficulty sometimes to seeing results. I might want to look at someone's results to follow up on a letter that I receive to follow upon some results. Well, I have to sort of ring and gain access to their result as I was not the ordering doctor. [A2P]".*

When the participants start interacting with the tool, secondary contradictions emerge. The physicians who held multiple roles were more mobile traveling across locations. This entitled them to have access to mobile devices provided by the organization, or they were able to purchase with allocated funding. While the devices were provided in order for them to be able to access information from anywhere, to perform their tasks, they were not able to gain timely access due to regulations concerning privacy and confidentiality. In a way, the healthcare team is enabled by technology but disabled by law, which could probably be more dangerous due to lack of timely access to information. This contradiction helps understand that the MHCT use mobile technology in a restricted way. According to Engestrom, these secondary contradictions of the activity are the moving force behind disturbances and innovations, and eventually behind the change and development of the system (Engestrom & Miettnen, 1999, p.9).

### *Anywhere, anytime Vs. Drawing boundaries*

> *"The difficulty is that we see no boundaries now. Some of our colleagues don't respect boundaries and expect that you should be contacted 24/7" [A2P].*

> *"But it also affects me in my real life, time management balance and boundaries of when is it appropriate to respond and when is it not appropriate to respond. And a good example is recently I received an email, a photo from a patient, two o'clock in the morning. And I had a conscious conversation with myself that it's 2 o'clock Saturday, no, it was Sunday morning. I'll respond on Monday. I won't respond immediately." [B4N].*

> *"And the same goes conversely for team members, giving a text at ten o'clock at night saying, what do you think on AB and C and D, you're a clinician, so I'm not responding at ten o'clock at night, there is no need. This can wait till the morning" [B4N].*

> *"I guess the fact that it can ring nonstop, and sometimes I think being on a busy unit and a busy hospital a lot of people rely on you to be with your phone 24/7 and for you to be accessible for that whole time you're with when that's not always possible" [D2P].*

Tasks in healthcare are highly interdependent and necessitate actions to be taken at particular locations,

times, and by and for specific individuals. Mobile technology allows the MHCT to communicate and keep track of each other from any place & anytime anywhere. This very characteristic of reliably being able to be contacted anytime creates tensions in the form of work-life boundaries and has blurred the boundaries between work and non-work (Scheepers et al., 2006).

### *Contributions*

The increasing complexity of patient conditions and treatments demand care delivery by MHCTs. Importantly, communication between healthcare professionals need to be consistent and reliable. Communication dependent activities that impact the quality of care, such as coordination of care, transitions across the hospital, follow up after discharge, can be enhanced using mobile technologies. The wide accessibility to mobile devices by the healthcare professionals and the hospital setting with rich details seemed to complement the proposed research to explore the contradictions in the use of mobile technology by a MHCT. This study has empirically explored the contradictions that emerge in the use of mobile technologies by a MHCT in an Australian hospital. The principle of contradictions has helped understand not only the "Who does what" in an activity system, but also the "how." So "who does what and how," in the activity system is explained. The findings can inform the organization to deploy bring your own mobile device (BYOD) strategies, and also, they understand the potential issues associated with the deployment.

## Conclusions

This study was carried out to explore the contradictions that emerge in the use of mobile technologies by a MHCT using activity theory as a lens. This study extends a recent study that explored the factors of use and challenges faced by MHCT. Based on the findings of the four cases and using AT, some major contradictions were uncovered. The primary contradiction starts with mobile technology itself. The pervasive nature of the device functioning both as a personal as well as a professional device. This inherent contradiction has led to other secondary contradictions such as flexibility of the device versus restricted access, anytime, anywhere versus drawing boundaries. These contradictions help understand how the MHCT uses mobile technology in a spontaneous, restricted, and potential way. Insight into this has provided an opportunity for the case study hospital to think of strategies and policies in regards to mobile technology use.

### *Limitations and further research*

In this qualitative study, we explored the contradictions on the use of mobile technology by a MHCT; we focused only on some of the significant contradictions that emerged with the tool as the focus. There could be other secondary contradictions due to the interaction of different elements of the activity system. Another limitation is that the findings are based on data collected from one organization. Future work involves data collection to validate the results by a follow-up survey with the participants.

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