

Exploring Discrepancies: Analyzing Electronic Medical Records Data Against Direct Observations

Understanding the Effect of Real Time Location Systems (RTLS) on Nurse Workloads and Retention Rates In Healthcare Systems

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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I. Introduction

With the disruptions caused by the COVID-19 pandemic, healthcare has seen many changes to its operations in an effort to continue to provide high quality patient care. These changes have shown that there is still a long way to go to improve the resiliency and efficiency of such environments while also supporting the complex needs of patients, nurses, and doctors. One technology with the capability of improving patient care and provider experiences is Real Time Location Systems (RTLS), which use a variety of methods to accurately determine an asset or individual's location. RTLS technology records time based data through the use of Radio Frequency Identification (RFID) tags, which can be incorporated into nurses' badges (Jones, 2014). The following paper will discuss the capabilities of RTLS technology in two separate components, a Technical Project and a STS Project.

The Technical Project is focused on understanding and improving patient flow in the University Physicians Primary Care Clinic (UPC) in the UVA Health System. Professor Robert Riggs of the UVA Systems & Information Engineering Department will mentor a team of students for this project. The team of students and I will be going in person to observe the movements of nurses and patients throughout the fall of 2023, to better understand the structure of patient appointments and clinic's most pressing needs. Additionally, we will be validating the data we've received from UPC's RTLS with data from our own observations. This project will culminate in both a presentation to the clinic in spring of 2024 and a paper for the Institute of Electrical and Electronics Engineers Systems and Information Engineering Design Symposium conference in the spring.

The STS project will apply the idea of healthcare design improvements to reduce feelings of stress and burnout in healthcare professionals, particularly nurses. This project will use the

Social Construction of Technology framework and the Feminist Critique framework to explore how RTLS technology can be used to increase retention rates and promote more desirable working conditions for nurses in healthcare. The beginning stages of the STS project will be completed in the fall of 2023 and the paper will be finalized in spring of 2024. The technical and STS projects are interconnected as they both aim to better understand the limitations and drawbacks of healthcare, while determining what improvements can be made from both an efficiency and human-centric perspective.

II. Technical Project

The COVID-19 pandemic had significant impacts on the healthcare system, with the effects of its disruption still felt today. Issues such as increased patient demand, staffing shortages, and risk of infectious exposure have forced many healthcare institutions to restructure aspects of their organization to ensure patients receive high quality care. The UVA Health system, known for providing excellent care across their various facilities, is attempting to optimize their patient flow process to address this industry-wide issue. Specifically, the UPC, my client for this project, has faced challenges with the timing and management of their patient intake. Appointments frequently exceed their scheduled times, creating a domino effect for subsequent appointments in the day. Additionally, they are experiencing high nurse turnover and are frequently understaffed, which inhibits their capability to correct the aforementioned domino effect. Furthermore, the fact that their primary patient population consists of elderly patients and patients with mobility issues also impedes their ability for quick patient intake. To better accommodate these factors when determining patient and provider scheduling, the UPC tasked us with analyzing data collected through an electronic medical records (EMR) system called

Epic Systems and providing UPC with recommendations for how to optimize the flow of patients they receive.

Epic Systems is a software that utilizes RFID technology for recording data on healthcare workers and patient visits. At the UPC, their nurses and doctors use badges containing RFID tags to log into desktop computers throughout the clinic and access patient medical charts and information. The computers are fitted with a device that reads the unique identification information contained in each nurses and doctors' RFID tags using radio waves, so a quick tap of their badge to the reader allows them to log in to the patient's chart seamlessly (Department of Homeland Security, 2022). Epic Systems then records timestamp data of when these logins and logouts occur and creates metrics to quantify patient visits, along with recording the manually inputted medical data.

To achieve our goal of optimizing patient flow and scheduling processes in the clinic, the research team will use data validation techniques to analyze the EMR data from Epic and make recommendations. The first step is introductory meetings which will facilitate the team's familiarity with UPC processes, goals, and standards. Following this, team members will observe the UPC clinic in scheduled increments of two hours, noting when and where appointment milestones occur to create a dataset used for validating the data in the larger EMR dataset. Once the EMR dataset is understood and the necessary variables solidified, the team will begin modeling patient flow and observing pain points to make recommendations using R, Excel, and Tableau. The phases of this project are twofold: the first phase will consist of in-person observations and data collection at the clinic, and the second will consist of data validation, modeling, and final recommendations.

III. STS Project

The state of healthcare in the United States is an important issue, especially in the wake of the COVID-19 pandemic. Many concerns and challenges which were previously minor have been dramatically exacerbated by the devastation and uncertainty created by the pandemic. One notable issue with the potential to cause a catastrophic domino effect is the current and future shortage of nurses in healthcare. Nurses “make up the largest section of the health profession” (Haddad, 2023, p. 1), and are necessary in all stages of patient care. In order to ensure healthcare patients are receiving adequate care, it is paramount that nurses are supported with not only the proper medical resources, but also the proper staffing resources. Facilities without the proper patient-to-nurse ratio can lead to problems for both the nurses employed by the facility and the patients in their care. Hospitals with far more patients than nurses staffed (patient-to-nurse ratio) can cause “nurses [to] experience burnout, dissatisfaction, and the patients [to experience] higher mortality and failure-to-rescue rates than facilities with lower patient-to-nurse ratios” (Haddad, 2023, p. 6). One method to combat this shortage of nurses is to address their feelings of stress and burnout to increase retention by incorporating technologies to not only assist them with their daily workloads, but also to assess the everchanging scheduling needs of each individual facility. Therefore, for my STS project I will be analyzing the incorporation of Real Time Location Systems technology in healthcare facilities to address the research question: how has Real Time Location System technology affected nurse workloads, and how might this technology impact issues such as staffing shortages and nurse burnout?

The field of nursing includes a diverse range of individuals to consider when addressing this question. Some nurses are seasoned veterans who have been working in healthcare for a majority of their lives, while others are just entering the workforce. Some seasoned nurses go on

to become nurse coordinators or clinic managers as well, using their prior experience to ensure facilities run smoothly. The younger, less experienced nurses are especially relevant to this project, as not only are they the future of the workforce, as the older nurses begin to retire from the profession, making them the primary concern of nurse retention, they are also the nursing demographic that has been most affected by the high workloads due to the pandemic (Martin, 2023, p. 2). These three social groups, experienced nurses, inexperienced nurses, and clinic managers, are the primary relevant social groups for my project. These social groups were identified for their presence in the patient flow process of the UPC and similar facilities, their association with each other, and their direct usage of the current RTLS technology in healthcare. The less relevant social groups that I will be leaving out of this analysis are doctors, patients, receptionists, and executives. This is notable because it places the emphasis of a healthcare process on the nurses instead of the patients. This is reasonable because patients do not have any direct contact with the nurses' RTLS technology or any control over the scheduling and staffing of healthcare facilities. They are tangentially affected by the technology due to its effect on nurses; however, the patients themselves never directly touch this technology in their appointments.

The STS project will use the Social Construction of Technology framework to assess how EMR systems in conjunction with RTLS support nurses while also accommodating their patients' needs. Developed by Pinch and Bijker (1984), the Social Construction of Technology framework lends itself to these relationships between social groups. This framework will be helpful when conducting research and interviews with the nurses and clinic managers from the Technical Project. Additionally, the Feminist Critique framework will be employed in my project because women make up 86% of all nurses (Day, 2021; Åsberg & Lykke, 2010). This framework

will explore the intersection of gender roles and technical sciences, and bring an important sociological perspective to the challenges facing nurses today.

My timeline for researching the effects of RTLS technology on nurses is to start by conducting a comprehensive literature review on the current retention rates and mental health statistics on nurses in the pre and post-pandemic United States, as well as the historical and current state of RTLS systems in healthcare. Understanding the current states of nurses' relationships with this technology will be completed by the end of January 2024. This research will allow me to formulate questions for ethnographic research. I will then conduct this ethnographic research at the UPC where my technical project took place by the end of February. I would seek to gain knowledge on the first hand experiences the clinic nurses have with their current RTLS and RFID system, as well as any past experiences they've had at other clinics and facilities. These interviews will provide valuable insight into my primary social groups and allow me to finalize my STS thesis by May 2024.

IV. Key Texts

One source that I will be using to assess the current methods employed for scheduling providers in healthcare outside the UPC is a piece published by the American Urological Association called *Provider Scheduling to Maximize Patient Access*. This piece was written by Jennifer M. Lobo, S. Ayca Erdogan, Bjorn P. Berg, Hyojung Kang, Matthew B. Clements, Stephen H. Culp, and Tracey L. Krupski. As the title suggests, This piece discusses the use of creating an optimization model to reduce the variability in the number of doctors or providers scheduled on a given day and what that schedule looks like. The primary purpose of this piece is

to summarize the current methods for improving healthcare scheduling and determine their appropriateness for integration into UPC and beyond.

The second key text, published by the National Library of Medicine, is titled *Examining the Impact of the COVID-19 Pandemic on Burnout and Stress Among U.S. Nurses*. This piece, written by Brendan Martin, Nicole Kaminski-Ozturk, Charlie O'Hara, and Richard Smiley, discusses common issues faced by the nursing workforce and how those issues are projected to affect the future of nursing. This piece's primary purpose is to gain an understanding of nurses' workloads during and after the COVID-19 Pandemic, as well as examine the psychological effects of healthcare workloads on nurses.

This text ties into the first text, as data is necessary for building and testing models. Published by Wiley Online Library, the research paper *Can Real Time Location System Technology (RTLS) Provide Useful Estimates of Time Use by Nursing Personnel* details methods of capturing this time centric data. The primary purpose of this paper is to summarize the components of RTLS technology and to provide insight into the incorporation of this technology in a healthcare setting.

Finally, regarding the texts surrounding the retention rates of nurses in healthcare, the piece *Nursing Shortages*, by Lisa M. Haddad, discusses seven key factors that contribute to the nursing shortage, as well as the detrimental effects of a reduced nursing workforce. This source will be useful when discussing how to improve nurse retention rates. Additionally, this source is relevant as it examines the use of technological advances as potential solutions for the nurse shortage, and how different nurse demographics respond to these technological advancements.

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