Redesign of Positioning Board for Portable Imaging

The Effect of Technology on Human Error

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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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Introduction

If human error in healthcare was a disease, it would be the third largest cause of death in the United States (Bindra, Sameera, & Rath, 2021). Whether it be resulting from the work of board-certified physicians, nurses, or even radiological technologists, human error has a prevalent impact on the way patients are treated and the quality of care they receive within the hospital. To join the battle against human error, I aim to produce a device that lowers the probability of it occurring within the Department of Diagnostic Imaging at the University of Virginia Medical Center. I am tasked with designing and constructing a new positioning board to lift patients from the cushioning of a hospital bed during portable lateral X-ray imaging that includes an alarm whenever it is forgotten under a patient. This would be used to prevent unnecessary injury or discomfort to patients caused by the board's presence.

While doing so, I intend to use Thomas P. Hughes's Technological Momentum Theory to research the social and technological pitfalls of the Vanderbilt University Medical Center within the 2017 RaDonda Vaught incident. Vaught was convicted of negligent homicide because of the critical human error of accidentally administering a 75-year-old patient with a paralyzing drug that eventually led to their death (Oung, 2022). Both projects not only bring awareness to the way human error affects patient experience and safety, but they will also offer solutions to combat this basic human deficiency which is so often overlooked. Because the challenge of human error within the biomedical setting is sociotechnical in nature, it requires attending to both its technical and social aspects to accomplish successfully. In what follows, I set out two related research proposals: a technical project proposal for developing this improved design of a portable imaging positioning board and an STS project proposal for examining the effect of technology on human error in the Vanderbilt University Medical Center Incident of 2017.

Technical Project Proposal

To combat human error in the hospital setting, I will design a solution to a specific problem within the Department of Diagnostic Imaging at the University of Virginia Medical Center. When a patient requires an X-ray and is immobile, radiological technologists are trained to use a portable machine that can be utilized at the bedside. However, problems arise when taking lateral images because cushions of the bed cave upward under the weight of the patient and obstruct the machine's line of sight. To initially combat this, the department used a code board (used to provide a rigid surface to perform chest compressions on) to lift the patient out of the bed during these cases. This simple design included just a rigid plastic board with handles. This iteration did not change until around twenty years ago when the board was forgotten under a patient for the entirety of a weekend after its use. This caused severe bed sores for the patient who later died during the same visit although it is unknown if these injuries were the main cause. This highlighted how easy the device was to forget about after the procedure was completed. Since then, the department added bright yellow upholstery to wrap the original board and make it more noticeable by caretakers. This design has been used ever since but still creates problems with human error and forgetfulness. The board is still forgotten under patients for extended periods of time and the numerous methods used to combat this have mostly all failed at consistently alerting caretakers of its presence. Along with this, the outer covering includes materials such as Velcro that makes the device incredibly difficult to thoroughly sanitize between uses (*Design for Manufacturing*, n.d.).

Without a new design, the positioning board will continue to be forgotten under patients which poses a great risk for both comfort and safety within the in-patient environment. The innovation of this device will provide caretakers with a greater ease of use while still maintaining

the boards intended purpose of providing a clearer line of sight for lateral portable X-ray imaging. Furthermore, the new design will provide patients with a more hygienic stay at the hospital, especially in the aftermath of a global pandemic. To achieve these, I propose a design that uses audible alarms that can effectively alert caretakers of the board's presence under the patient. This technology would either use pressure sensing or an automatically pressed button to start a timer that would account for the average time for the imaging process to take. This ensures efficiency and decreases the likelihood of human error causing problems. The device will also me made of hygienic materials and smooth surfaces. This will allow the device to be cleaned between uses to prevent the spread of disease and infection.

The process of developing this device will involve researching materials and methods to decide upon the best course of action. The device will then be modeled in a CAD program to visualize dimensions, and this file will be formatted for 3D printing during production. To develop the most important feature on this device, a knowledge of basic circuitry and coding must be used. This would be utilized to create a button or pressure sensor activated timer and audible alarm. This technology would have to be embedded into the board itself to make a smooth surface and prevent any damage to the technology. The material that this board will be made of will be researched and produced to balance hygiene and the stress of a patient's weight. When evaluating the success of the device, there are many features that would have the be tested. For the alarm feature, the success would have to be measure upon subjective thresholds of patient and caretaker satisfaction. As far as the board itself, it would be tested on its ability to fit within the outer covering bags and for its ability to hold the weight of a patient at a variety of parts of the body. This will be tested for any cracking and/or deformity under the prolonged

force of the heaviest patient's heaviest body part, the thorax ("ExRx.net: Body Segment Data," 2012).

STS Project Proposal

In 2017, nurse RaDonda Vaught made a crucial mistake in the Vanderbilt University Medical Center when administering medication to a 75-year-old patient. Instead of giving the patient Versed to calm them for an MRI, she administered Vecuronium, which resulted in the patient's death (Kelman, 2022). During the incident, she had to override safety features within the medical center's automatic dispensing cabinet (Lusk et al., 2022). Many current approaches to this case focused on the fact that it set a precedent that nurses can be prosecuted for their actions within the hospital system (Collins & Burke, 2022). This is understandable considering that the ruling overlooks the malpractice safeguards caretakers have been protected by for a long time and allows nurses to be punished for their lack of production in the workplace. However, regarding the abuse of a technological pitfalls during this case, there have been little to no focus upon the automatic disposal cabinets lack of safeguards. Some have investigated VUMC's carelessness in their organization of this technology, but none have focused on the technology itself (Short, 2022). This overlooks the role that technology had within the case itself and its inability to protect the patient from the human error of the caretakers.

When examining the case from a broad perspective, it is apparent that the largest social impact of this incident is the conviction of RaDonda Vaught for negligent homicide. However, to dismiss the technical problems within the Vanderbilt University Medical Center would do this case a disservice because of its multidimensional problems. Although this being a momentous decision in the courtroom shows the social impact of this incident, choices originally made within the design of the automatic dispensing cabinet make this case technological as well.

Through adopting this perspective, I aim to shed light on the problems that occurred way before the incident occurred that had a part to play in the death of a 75-year-old patient. Therefore, through deeper research into the case and the study of social frameworks, I intend to show that the designers of the technology used within the incident are just as responsible for not accounting for common human error within the healthcare setting.

When analyzing this case, I will draw upon the Technological Momentum Theory developed by Thomas P. Hughes. This framework explains that specific technologies were first created by designers to fix specific problems, but as time ensues, the technology itself becomes the shaper of societal norms and the way people interact with each other (Hughes, 2009, pp. 141–149). When first implementing the technology used within the incident, it was less likely to allow for such accidents to happen, however the medical center later changed the settings within the technology and made the two drugs easier to confuse (Lusk et al., 2022). The cabinet was originally shaped by the way the nurses worked around the hospital, but as time passed, the technology began to shape the way nurses handled medications with negligence and carelessness. Even though these protections were in place, the fatal flaw in the technological system was the ability for nurses to override the safeguards of drug prescription in times of rush and emergency (Paterson, Manning, Schmidt, & Provine, 2022). This feature was originally designed by engineers to prevent fatalities during codes and emergencies. However, this override being available to nurses to use during relatively normal times within the system is an unacceptable flaw and needs to be studied. Through further study, I aim to research this feature being readily available to nurses to use in stable conditions and the way that the workplace culture at the Vanderbilt University Medical Center shaped the way that this technology was utilized and modified.

Conclusion

Within both my technical and STS project, I expect to challenge the currently held beliefs on human error within the healthcare system. When designing a new product to be used for the positioning board, the audible alarm will allow for both patients and nurses to feel safer within the in-patient setting when dealing with diagnostic imaging. This will provide a more reliable reminder to caretakers to remove the positioning board from under a patient after imaging to prevent further harm. Within the STS project, I aim to use the Theory of Technological Momentum to analyze the role technology played in the 2017 Vanderbilt University Medical Center Incident where an accident involving an automatic drug dispensing cabinet resulted in the death of a patient. This will provide valuable insight into the social and technological factors involved within cases of human error. Through these two projects, I aim to highlight technology's role in preventing human error in healthcare and therefore promote a safer and more comfortable environment for all patients.

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