Undergraduate Thesis Prospectus

Needle Stabilization Device for Paracentesis Procedures

(technical research project in Biomedical Engineering)

Care of the Whole Patient: The Competing Interests That Shape Personal Caregiving in U.S. Hospitals

(sociotechnical research project)

by

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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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General research problem

How may hospital procedure be improved to help patients?

State-of-the-art professional medical care can be impersonal. Guided by a value of objectivity, conventional practice has tended to favor professional detachment, and even skepticism about patients' self-reports. Medical technology, though indispensable, may divert caregivers' attention from the human patient in favor of the patient's digital surrogate, the "iPatient" (Verghese, 2011). Successful medicine is successful care of the whole person; expert attention to the body to the neglect of the person may work to the disadvantage of both (Verghese et al., 2011). Patients' mental health is important to their physical health; in extreme cases a patient receiving expert physical care to the neglect of their mental wellbeing may lose the will to live; this, in turn, may become a contributing cause of death (Leach, 2018). As caregivers, physicians attend to whole patient. For this purpose they need the best that medical technology has to offer, but they must never permit it to let the iPatient supersede the human patient (Altringer, 2010; Verghese et al., 2018).

Needle Stabilization Device for Paracentesis Procedures

In paracentesis (drainage of bodily fluid) procedures, how may the needle be stabilized and post-paracentesis leakage be prevented?

This technical project is being conducted in the Biomedical Engineering Department under the guidance of Dr. Neeral Shah from the UVA Hospital. It is a Capstone project that does not involve project collaborators. In paracentesis procedures, a needle is inserted into the abdomen to facilitate the drainage of ascites (fluid in the body) (Thomsen et al., 2006). During the procedure, the needle does not always remain stable in place for the duration of the

procedure. If the needle does not remain stable throughout the procedure, there can be consequences for the patient such as irritation or a laceration to the peritoneal organs that causes internal bleeding and/or additional leakage of ascites through the hole that is left behind at the end of the paracentesis when the catheter is removed. These are complications that can potentially endanger the patient and make a physician's job more difficult during the procedure. By stabilizing the needle with a medical device, these potential dangers and worries for a physician are dealt with prior to the procedure.

This project seeks to create a device to stabilize the needle during the procedure, and if possible, seal the hole left behind after the procedure. This device must be able to adhere to damp human skin. This device would be the first to be used in this manner, as there currently do not exist any medical devices used in paracentesis procedures for needle stabilization. When this problem occurs, doctors jury-rig a solution, usually by using a roll of gauze or bandage to prop the needle up and fight against potential drooping or movement. Using a bandage in this manner creates unnecessary waste and takes supplies that may have been better used elsewhere in the hospital. It is not a very sustainable method and it is not completely secure as the bandage has no adhesion to the skin, meaning it too could slip or become unstable during the procedure. This device, by correcting for the issue of needle stabilization before it becomes a problem, will help to simplify the procedure for doctors making it safer and easier for both patient and physician.

This device will be 3D modeled and then 3D printed. The design for the device has been iterative, taking into account the needs of the doctor and patient during the procedure while also accounting for ease of use and ease of printing. Once the design has been modeled and approved, it will be printed and tested. The first stage of testing will be on the conductors of the project, to ensure that the device can adhere to damp human skin and hold a needle (not inserted) in place.

If these basic steps are not met, the device design will be updated and reprinted until they are met. If this step is reached in the scope of the project, IRB approval will be sought to begin clinical trials. The metrics for success to be considered are: ease of use for operator, safety for patient (adhesive is non-irritant), and functioning sufficiently to replace current techniques (stabilizes needles as well as or better than current techniques).

The goal for the end of this experiment is to have a working prototype. This may not include clinical testing within the scope of the Capstone project. This project seeks to have a prototype that can adhere to damp human skin and stabilize a needle. Completing at least this goal, will ensure that in the future clinical testing can be completed. If clinical testing is completed during the project, then the next step for the future will be getting the device out to doctors who can use it by either finding a company to manufacture it or by releasing the design for people to 3D print themselves.

Care of the Whole Patient: The Competing Interests That Shape Personal Caregiving in U.S. Hospitals

How are patient advocates, medical personnel, and hospitals competing to determine how best to attend to the emotional needs of the conscious patient?

Sound patient care is care of the whole patient. Most patients expect personal care from physicians, including attention, for example, to emotional distress. In a survey of patients, Brody et al. (1997) found that 63 percent of patients considered physicians' responsiveness to emotional distress at least somewhat important; 30 percent considered it extremely important.

In their efforts to receive comprehensive, personal care, patients have allies in the form of patient advocacies. But because some such advocacies are funded by hospitals or by other sources in the healthcare sector, their commitment to patients is subject to other influences (Rose

et al., 2017). In hospitals, healthcare-associated infections (HAIs) have proliferated; 1 in 31 hospital patients had one or more HAI (CDC, 2020). Some hospitals advise physicians to limit close contact with patients; such directives may obstruct the physician-patient relationship (Mehrotra et al., 2013). Direct engagement with patients to determine their health has grown difficult with time and technological advancements in the medical field, but remains an important aspect of overall patient care (Verghese et al., 2011). The care setting is a factor in patient wellbeing; hospitals can promote patient wellness through the design of care spaces (Altringer, 2010).

Social groups are competing to influence the norms of patient care, including personal care. Participants include informal caregivers, such as family members (Shorofi et al., 2016), physicians ("Communication," 2008), nurses (CNUO, 2020; "Comfort Measures," 2010), hospital administration (Crowley, 2017), and patient advocacy organizations (NPAF, n.d.). Caregivers and patient advocacies are patients' allies. Physicians and hospital administrators must balance competing responsibilities, including duties to the patient's physical condition, the patient's emotional wellbeing, other patients' needs, insurance requirements, and even the risk of lawsuits. Nurses spend much of their time directly interacting with patients. But nurses' patient loads and their many other responsibilities often compete for their time.

These social groups take a stand on the aspects of patient care that are most important to achieving their goals. Citing research findings (Shankaran et al., 2017) to support its position, the Patient Advocate Foundation favors financial support programs to improve patients' quality of life and to reduce stress, which can help patients' health (PAF, 2018). Sarann Kraushaar sought medical assistance for her atrial fibrillation after discovering her current treatment was insufficient. Her doctor's personal care, Kraushaar says, promoted her healing. "Before I met Dr.

Calkins, I felt tired, depressed and couldn't live my life to the fullest. My AFib was greatly impacting my quality of life…Now, I feel great and have no limitations." Dr. Calkins "is always there when I need him" (JHM, n.d.). The Mayo Clinic claims its core values include, "treating patients and family members with sensitivity and empathy" and serving "the well-being of the whole person, respecting physical, emotional and spiritual needs" (Mayo Clinic, n.d.). According to the American Nurses Association, sufficient nurse-patient ratios promotes "improved patient outcomes and greater satisfaction for both patients and staff"; overloading nurses "affects patient care and overall outcomes" (ANA, n.d.). One internal medicine physician argues that as hospitals grow larger and shift power to administrators, procedural work "wastes time and pulls doctors away from what they are trained to do, doctoring," at a cost to patient care (Medimentary, 2020).

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