

**Thesis Project Portfolio**

**Enhancement of the Intravenous Cannulation Catheter**

(Technical Report)

**Cyclical Marginalization of Social Groups in Triage Systems**

(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science

University of Virginia • Charlottesville, Virginia

In Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

**Lindsay Carlesi**

Spring, 2020

Department of Biomedical Engineering

## **Table of Contents**

Sociotechnical Synthesis

Enhancement of the Intravenous Cannulation Catheter

Cyclical Marginalization of Social Groups in Triage Systems

Prospectus

## Sociotechnical Synthesis

Intravenous (IV) cannulation is a procedure common to admitted patients, with about 90% receiving intravenous therapy in some form. Of those, 40% of adults require a second attempt at a successfully getting an IV line, these patients being labelled as “hard sticks”. Denying hard sticks non-equivalent health care options, as compared to “easy sticks” based on their condition, decides these patient’s fates prematurely. People have recognized this inconsistency and have subsequently developed technology to increase the likelihood of sticking a patient correctly. Ultrasound technology is most commonly seen in a clinical setting, especially within the University of Virginia’s hospital. Infrared imaging devices, topical anesthetics, and distraction techniques for children have also been added into a medical practitioner’s toolbox but are rarely sought out or implemented into hospital treatment protocol. (NIR, 2018) The University of Virginia hospital has put in place a two-attempt limit to gain IV access in the case of “hard sticks”. If a medical practitioner does not gain access in the two allowed attempts, the protocol for escalation is that medical practitioner must call upon a more experienced medical practitioner or call down the IV team who utilizes an ultrasound machine.

However, such expensive machinery, are not purchased to allow a ratio equivalent with the patient demand. On top of cost, the highly technical ultrasound devices require specially trained medical professionals, again limiting the accessibility of ultrasound devices. Thus, some patients are still denied adequate quality of care, or the devices are used as unintended. The creation and implementation of these devices and protocols have led to new bioethical issues. How do you decide when to use an expensive, highly technical device, and on which of the many patients waiting for treatment gets it first?

The aim of the technical portion of this paper is to develop a to create cost-effective devices that could be seamlessly added to the current IV cannulation process and increase first pass rate.

Through the constraint discovery process of the technical project, it became apparent that despite the aim of the project, a solution will never be suitable for all patient types. In attempt to create new devices focused to alleviate the health disparity created by the original technology, further groups are excluded. Patient treatment becomes specialized by patient type in order to best treat the situation. In other words, select social groups are included in the design and others are not. The patients who are not designed for in the system have to jump through larger hoops to get equivalent care.

This pattern discovered during the design process, led to relation between medical device design and the social construction of technology (SCOT) theory. SCOT is focused around the dynamic needs of social groups and how technology is developed to reach a point of stabilization among the groups. Often times because of the many social groups holding weight in an issue, multiple solutions to many versions of one problem are created. The purpose of this analysis is to understand how the selection process of one solution hinders the progress of another social group due to the lack of an all-encompassing solution. Thus, the aim of the STS research paper is to analyze how the cyclical nature of SCOT impacts the patients within the medical field.

Rather than analyzing the medical field as a whole, the triage system was chosen for this analysis as it is representative of a healthcare process where all patient types are subjected to the system. IV insertions are similar in that the procedure is so common it sees a large variety of patient demographics with various treatment defining characteristics, symptoms, and past medical histories. A triage system is used by healthcare practitioners to determine which patients should

receive treatment and care first, based on their clinical status, the prognosis of disease, and available resources. (Baciu, 2017) Triage systems are most commonly used in emergency departments or urgent care centers where a large volume of patients with various conditions arrive to be treated making the order of patient intake difficult. Algorithms have been designed to optimize patient health and reduce cost to both patients and care facilities. However, one should question if this system is biased or if the system of knowledge is designed to exclude certain patient groups?

The inability to address all patient type variations creates care inequity in a healthcare. The reason for this inequity may be the resultant of a conscious or implicit bias. No matter the reason for marginalization, the cyclic production of problems still seems to exist. This portfolio is designed to address the unmet clinical needs within IV insertions, but also to understand on a large scale the constant need for innovation.