Redesigned Intravenous Cannulation Catheter

(Technical Paper)

The Social and Technical Factors of Intravenous Insertions and the Construction of Social Groups

(STS Paper)

A Thesis Prospectus Submitted to the

Faculty of the School of Engineering and Applied Science

University of Virginia – Charlottesville, Virginia

In Partial Fulfillment of the Requirements of the Degree

Bachelor of Science, School of Engineering

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Fall, 2019

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Introduction

The insertion of a peripheral intravenous cannulation catheter line, more commonly referred to as an IV, is typically one of the first invasive procedures a medical practitioner performs on a patient. Almost half of the patients receiving an IV will have to have the procedure repeated in order for a successful IV line to be accessed (IV Catheters, 2000). Repetition of this invasive procedure to obtain a successful line can be distressing for patients and could possibly insinuate the start of a patient's distrust in medical practitioners and the institution of healthcare (Cooke, 2018). The aim of the technical portion of this paper is to redesign the IV insertion protocol and technology to increase the likelihood of sticking a successful IV line on the first attempt.

The relevancy of the science, technology, and society portion is to reveal the social factors constructing the need to redesign an IV insertion technology, and to evaluate the extent a new technology's success depends on societal and technical factors that hold stake in healthcare advancement. The social construction of technology theory will be utilized in this paper as a framework to describe the social groups holding stake in healthcare to interpolate the point of stabilization among these later defined social groups, in respect to a new IV insertion protocol. Furthermore, a Strong Programme ideology is considered to discern the success of a technology as a result of stabilization of social groups or as a result of supremacy of technology. To validate these frameworks of thinking, an historical analysis of previously introduced technologies within healthcare will be evaluated similarly and critiqued against current understandings of the reasons behind the respective technologies' success.

This thesis aims to answer questions such as: what happens to those who from a young age who had a bad experience with a regular protocolled blood draw, vaccination, or the injection of numbing medicine at the dentist? Do they harbor a conditioned distaste, mistrust, or fear of standard healthcare interventions? It is common for people to avoid going to the dentist because they know or understand the discomfort and pain associated with the visit, perhaps the same phenomenon occurs with IV's. If this is true, what is to happen with those who are consisted "hard sticks"? How does the inconsistency within IV insertion practices marginalize hard sticks from healthcare and society?

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Need for Improving First Pass Rates of Intravenous Cannulation

Approximately 90% of all patients admitted for hospital care receive a kind of IV therapy during their hospital stay (Cooke,2018). Of those receiving an IV line, studies show that 40% of adult patients require more than one attempt to open a line, and that number increases to 64% in a pediatric patient population (Cooke, 2018). Medical practitioners are often blamed for an unsuccessful first pass, as 89% of surveyed patients after receiving an IV-line insertion reported that the most influential factor for a successful first pass is dependent on the capabilities of the medical practitioner performing the procedure (Cooke, 2018). The distrust in the capabilities of medical practitioners opens the door for a new technology to emerge aimed at reducing the level of skill needed of a medical practitioner to successfully insert an IV line.

Currently many medical practitioners utilize simple methods, such as a warm compress, application of a tourniquet, mild agitation (slapping/flicking) of the vein to increase the likelihood of a successful first pass (Dudrick, 2006). These methods are applicable to most patients however, many older patients have thin, fragile, skin that cannot withstand the rigor of these methods without injury (Dudrick, 2006). In attempt to create vein visualization methods applicable to a larger patient population, technologies such as ultrasound, near infrared, and transillumination methods have been incorporated into healthcare to increase the visualization of veins for those considered 'hard sticks' (2018). These methods are expensive, require new technological experts to operate the machine, and are often only used in healthcare facilities as a protocol for escalation as a last resort, making for a time-consuming protocol (2018). Both the simplistic and technologically driven methodology are aimed at the idea to increase visualization, but do not approach other associated reasons for a failed IV insertions.

Aims of Technical Project

Refinements and modifications to the design of the intravenous cannulation catheter are necessary to improve first pass rates without the use of expensive and time-consuming imaging technology. While many current technologies focus on locating the vein and vasodilation, their inaccessibility and ineffectiveness in certain 'hard stick' patients could be addressed by a single

device that helps to visualize, localize the vein, and guide the needle all while reducing the inflicted pain, discomfort and anxiety experienced by a patient.

In a questionnaire conducted on 15 medical practitioners within the University of Virginia Hospital, it was found that rolling veins was considered one of the most difficult patient conditions, and that angle of needle insertion among medical practitioners vary largely. The angle of insertion and the prevention of veins rolling are the focus of our capstone project. In order to address the patient comfort and angle of IV insertion, we will attach a bubble level to the current standard cannulation catheter. To address the problem of veins rolling, we have modeled a vein-stabilizing device to attach to an armband with two 'depressors' to pull the skin on either side of the vein. Overall, we have designed and started to model a new kit, containing our two devices, to aid in IV cannulation

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Relevant STS Frameworks

The need to develop a redesigned IV protocol, most aligns with the social construction of technology (SCOT) theory. This theory stands on the three basic tenants: knowledge is constructed and not innate, relative social groups form interpretations from this knowledge, and a point of stabilization among these social groups is reached (Pinch, 1984). By assigning this theory to the historical development of the need for a redesigned IV, a comparison of other socially constructed technologies can be used to analyze the to what extent the new technology's success depends on societal and technical factors holding stake in healthcare advancement.

In this analysis it maybe be expected that in attempt to argue the reasons behind technologies success is a result of the superiority of the introduced technology. This ideology aligns with that titled Strong Programme. This theory argues that the best technologies, from a scientific standpoint, find success as well as offer the best outcome for society (Strong Programme). Thus, this prospectus stands to implement research that analyzes how technology, science, and knowledge forms from the stabilization of stake holding groups within a particular field and to what extend the dynamic individual aims of these groups define the constraints for successful implementation of innovation.

Scientific, Technological, and Societal Factors Entwined within Intravenous Cannulation

As mentioned previously, the aim of this portion of the paper is to analyze the social factors that have, over time, influenced the need to redesign an IV insertion technology. The social factors in control over the technological and scientific development of IV insertions can be outlined by the relevant social groups defined by SCOT that hold stake in a healthcare setting: the patient, medical practitioner, healthcare facility, medical device company, etc. Each of these groups formulate their own interpretation of an event facilitated by this role society assigned to them.

IV insertion is one aspect that overlaps between all of the previously listed groups. Patients want to better their own health with as little cost as possible, economic and/or physical, while medical device companies, healthcare facilities and medical practitioners want to facilitate healthcare while maintaining a functioning budget and keeping individual people, whether it be patients, workers, business partners, happy. The need for a redesigned IV insertion process, and even the developments of helpful techniques like tourniquets and ultrasound technology, came about as the relevant group's aims reached a point of stabilization. Current practices allow for the IV insertion procedure to be economically favorable for all of the groups involved, time efficient, and minimally invasive.

However, as time progressed the aims of these groups have changed. Patients desire a protocol with less pain, medical practitioners desire more confidence in ability to complete the procedure, healthcare companies want to have the best standards of care all while relying on patient perception. Medical device companies want their devices to be bought by health care organizations to appeal to the desires of patients and needs of an efficient healthcare organization. Perhaps what defines the success of a technology is not the acceptance by certain groups but instead the supremacy of the technology its self. Some argue that the current IV technology offers the safest and most sterile way of inserting an IV, perhaps that is why medical practitioners use it, not because of invasivity or work flow constraints.

Research Implementation

To analyze how technology, science, and knowledge is formed from the stabilization of stake holding groups, different fields of science, including medical, will be looked at to historically analyze the development of the technology, science, and knowledge to understand the justifications and bases that emerging technology find success. The analysis will take the form of

identifying the three tenants of social construction of technology theory: knowledge is constructed, social groups have holdings, and a point of stabilization among the groups is reached.

From here, analysis will continue by identifying how social groups play into the definition of success within the specific field of science for technological advancements. Specific fields to be analyzed include circumcision practices, medicalization of mental illness, webcam tracking algorithms…etc. The significance to be gained by this study is to understand how social groups construct current issues by introducing new technology to solve previous issues. From here, a model can be generated to uncover how the development of new technologies will marginalize new groups, generate new problems to tackle, fashion new barriers for people to overcome, eliminate jobs and produce new markets, all by the creation and introduction of new knowledge, science, and technology.

This study allows insight into how liability can be transferred from medical practitioner to device, all backed by scientific study constructed by society itself. It poses questions such as how is marginalization of people a continuous cycle, and who is to blame when technology fails.

Conclusion

Attempting to redesign IV insertion protocol by creating new scientific and technological advancements available to medical practitioners, patients, and healthcare systems as a whole, creates the question of what new problems arise after implementation. This prospectus stands to initiate research that analyzes how technology, science, and knowledge develops from the three tenants of social construction of technology, yielding stabilization of stake holding groups. This prospectus argues that technological constraints that define technological success are constructed from the social construction of technology, ultimately to understand how these constructs marginalizes new social groups and generates new problems for society.

Word Count : 1805

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