Thesis Project Portfolio

Design of an Elbow Joint Reduction Trainer for Dislocation Management

(Technical Report)

An Exploration of Health Literacy Measurements and How They Can Protect the Rights of Patients

(STS Research Paper)

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Executive Summary

As medical education continues to improve for doctors, it is important to review the health education of patients and how this can impact their overall health outcomes. A dislocated elbow is hardly life threatening, and the treatments for it are fairly low risk and can easily be performed by a specialist. However, there is the problem that a patient might not have the knowledge necessary to make the choices that are best for them because they do not have the necessary education, and it can be resource intensive to get the patient to understand the situation they are in to a degree that would be considered comprehensive. In fact, anywhere from one quarter to one half of patients might not have the level of health literacy needed to navigate their injury. By reducing the amount of risk inherent in a procedure, the amount of potential damage that might happen to a patient can be minimized if they make a decision that is not well informed. In essence, the goal is to reduce the weight of the patient's decision. It is easier to reduce the risk of a procedure through training than it is to improve patient understanding because the latter is so connected to education, which is a systemic issue that is hugely complex and difficult to solve.

The technical project focuses on the development of a trainer that simulates the reduction, or relocation, of a dislocated elbow joint. The driving force behind the need for this development is that orthopedic specialists and athletic trainers do not have a good way of practicing the techniques they use to reduce a joint. Many of their first interactions with a dislocated joint are with a patient that currently has a dislocation. While the procedure to put an elbow back in place is fairly easy, it can be very painful when done incorrectly. Before beginning to make virtual models, we first discussed some of the common techniques that are used in reducing an elbow joint with orthopedic specialists. The doctors told us that the key

movement for reducing an elbow is simultaneously pulling the forearm down as well as out, as the bone of the upper arm needs to get over what is essentially a hill of bone on the forearm. The trainer we eventually created was modelled very similarly to a real human elbow, except there were grooves in the forearm where the upper arm was meant to sit when in the dislocated position. We presented this design to doctors and they thought it replicated the needed motion well, and that it would be very useful in an education setting.

My STS research focused on how health literacy is measured in a clinical setting, and if any of the tests are useful for establishing if a patient can understand their treatment well enough to give meaningful informed consent. In my exploration of health literacy, I found that of the three tests that I reviewed, the Health Literacy Questionnaire, the Test of Functional Health Literacy in Adults, and the Rapid Estimate of Adult Literacy in Medicine, only one of them was particularly comprehensive, and that one also measured for a lot categories that were not necessary for assessing a patient's understanding of treatment options. As for the other two tests, the methods for measuring health literacy were either lacking or outright inadequate, and neither really tested for the aspects of the generally agreed upon definition of health literacy. I also made the determination that any of these tests is tied more to general education and reading comprehension than any particular medical understanding. With regard to withholding consent because of a deeply held belief, most of the cases are fairly similar to each other, and the main problem is that there's not much a doctor can do to convince a patient to take a course of action against their beliefs. The only exception to this is when a parent is making a choice on behalf of their child, a court will sometimes take the choice out of the parents' hands if they feel that the child is being endangered.

I think that the work I did on the technical portion of my project was very well done. All of the doctors my group has spoken to had numerous positive reviews of the prototype we presented, and the company that we worked with has been pleased with the results. Having a very well put together model makes me feel like the project has been a great success. We have received some input from doctors about some additions we should make, so that would be a good jumping off point for anyone who want to continue working on it. As far as the STS research goes, I feel that I hit several unforeseen roadblocks that required me to adjust my approach and framing of my question. I knew going in that health literacy was not a very clearly defined concept, and part of my objective was to refine the definition. I did not expect the tests to be so poor and so hard to get access to, which was surprising to say the least. The next step in this research would be to examine the rest of the common methods used to assess health literacy, and then try to pick parts of various tests to create a test that is more focused on medical knowledge than general reading comprehension.