

**MEASURING JAW DISTRACTION LENGTH VIA POSITION-AWARE  
SCREWDRIVER**

**THE RISING COST OF HEALTHCARE'S IMPACT ON AMERICAN AMBULANCES**

An Undergraduate Thesis Portfolio  
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By

Sarah Schroter

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## **SOCIOTECHNICAL SYNTHESIS**

The rising costs of healthcare and health insurance in the United States have caused a decline in ambulance usage by Americans. Many insurance companies refuse to sign contracts with ambulance agencies, making all ambulances ‘out of network’ for patients, ultimately forcing patients to pay for life-saving emergency care. This manipulative practice is known as “surprise billing” and is done by insurance agencies in many different aspects of healthcare. Maxillomandibular distraction osteogenesis is a surgical procedure used to correct a deformed jaw. However, most health insurance companies refuse to cover the procedure, which costs between \$6,000 and \$12,000, by classifying it as a cosmetic procedure, leaving patients with an exorbitantly large bill for a procedure they medically need to have.

Maxillomandibular distraction osteogenesis is typically performed on infants, and improves their ability to breath, chew, swallow, speak, sleep, and cosmetically improves their appearance. Many physicians consider this surgical procedure an absolute necessity for children born with micrognathia and retrognathia, both of which occur in 1 in 1600 births. The procedure involves fracturing the jaw, and slowly separating the fractured bone ends, allowing osteogenesis, bone growth, to occur. This ultimately lengthens the jawbone. Currently, there is no way for surgeons to accurately measure how far this bone growth is allowed to occur. The technical project is centered around creating a smart screwdriver that can be used to calculate the fracture displacement of the jawbone in real time.

This smart screwdriver would ultimately allow surgeons to reliably measure the bone’s growth while the procedure is occurring. The screwdriver’s components, its circuitry and housing, were designed in tandem. The circuitry consists of an arduino nano, an accelerometer, and an organic light-emitting diode (OLED) display. The software that the circuitry operates on

was developed in C++ and utilizes many open-share libraries. The screwdriver housing was developed via computer animated design (CAD) and was 3D printed using acrylonitrile butadiene styrene (ABS) plastic. In testing, the screwdriver has proved successful at determining the angle it's been rotated and then converting the angle rotated into distance the fractured bone ends have been separated, however final statistical analysis of the data collected still needs to be performed.

The immediate question the science, technology, and society (STS) project investigates is how the high cost of healthcare and health insurance in the United States has impacted ambulance usage rates by Americans using a social construction of technology, where ambulance treatment and transport is the technological artifact. It was found that the rising costs of healthcare and insurance have caused a decline in American usage of ambulances. This investigation utilized newspaper articles, medical journals, along with federal and state legislative policies to conclude that ambulance usage was on the decline due to the exorbitant cost of insurance and healthcare.

It was found from the SCOT investigation and analysis that on average 25% of Americans refuse medical care because they cannot afford it. In 2017 alone, 32% of millennials avoided seeking healthcare due to the cost. The cost of healthcare in the United States has an average increase of 5.26% annually and the cost of health insurance increases by 3-5% each year as well, while the federal minimum wage has remained stagnant since 2009. These cost increases have made obtaining healthcare in general more difficult for Americans. This cost increase is further compounded in cases of emergency, with the ambulance costs alone averaging \$450 per insured patient, and can be thousands of dollars for an uninsured patient. 71% of ambulance transports result in a patient being a victim of surprise billing by their insurance agency, and are

responsible for a large portion of their ambulance bill. Coupling the cost of an ambulance with an emergency room bill, which averages \$1,389 per patient, most Americans simply cannot afford to have a medical emergency. To avoid suffering the cost of these medical bills and potential surprise bills, at least a quarter of Americans have refused ambulance care during a medical emergency.

The cost of healthcare and health insurance in the United States is too high for the average American to afford and has resulted in Americans avoiding seeking out treatments for injury and illness. While there are state and federal laws that attempt to prevent surprise billing from occurring, they are currently ineffective for the majority of emergency health treatments and need to be reformed.

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STS advisor: Catherine D. Baritaud, Department of Engineering and Society

### **PROSPECTUS**

Technical advisor: Jonathan Black, M.D., Department of Pediatric Plastic Surgery;

STS advisor: Catherine D. Baritaud, Department of Engineering and Society