

Development of Reliable Drive System for Medical Ultrasound Imaging
(Technical Paper)

The War on Drugs: A Sociopolitical Analysis
(STS Paper)

A Thesis Prospectus
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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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Prospectus

Introduction

Within the healthcare industry, numerous advances have been made in the last decade to identify problems and apply innovation to meet the need of the individual. One gap that exists within the health community is unguided epidural injections, where doctors have little to no guidance when inserting needles into the lower back for procedures (Dhansura et al., 2015). The other extreme end exists where fluoroscopy or computed tomography (CT) scans are taken to guide the needle, but these procedures are costly and inaccessible to many institutions (Wagner, 2004). Rivanna Medical is working to create an intermediary for interventional needle procedures into the bone. The primary goals of this technical project are to develop an actuator, test fixture, and reliable acoustic coupling system that will be implemented in the ultrasonic imaging product, and to evaluate product reliability with the test fixture.

While the health community utilizes innovation to improve quality of life for the individual, government bodies utilize legislation, but with politically charged motives. In the 1970's, President Nixon launched a "War on Drugs" campaign to reduce drug distribution and usage (Barber, 2016). In the decades to come, the United States would attempt to enforce their drug policies, yet drug use continued to rise, with the consequences from the initial push of the war on drugs reflected in modern society. Despite a seemingly worthwhile cause to eradicate drugs from the streets, most drug policies have been racially motivated, with attempts to mass incarcerate minorities (Earp et al., 2021). This sociotechnical report analyzes various legislation regarding the War on Drugs to unveil the motives behind each decision, as well as analyze how these have been used to mass incarcerate minorities, and how those have drastically devastated families and communities in America today.

Technical Topic – Medical Ultrasound Imaging

The lumbar spine, also known as the lower back, consists of five vertebrae separated by discs and is surrounded by nerves, muscles, ligaments, and blood vessels. The lumbar spine provides mobility and support for the entire body, and thus faces high loads of pressure and stress, resulting in lower back pain (*Spine Structure & Function*). Epidural injections are a common treatment for lower back pain, where a needle is inserted into the epidural space of the lower spine and steroids are released to relieve pain. However, injections into the lower spine region are commonly performed unguided with no imaging technology, where the physician is trained to feel the patient's spinal anatomy and determine the site of puncture (Gupta & Gupta, 2015). Approximately 38% of unguided epidural injections are done incorrectly, and require multiple injection attempts, leading to patient discomfort (Karmakar et al., 2009). On the other end, guided injections can be performed with the use of fluoroscopy or computed tomography (CT) scans, where X-ray images can be obtained of the lumbar spine region and the physician has full visualization of the region (Dietrich et al., 2019). However, these procedures take time and expose the patient to radiation, and many institutions lack access to the expensive equipment needed to perform these scans.

Rivanna Medical is working to create an intermediary device between unguided and guided injections, which provides the ultrasound guidance to match clinical need while also being cost-effective. As opposed to CT scans, where the patient must lie down and go through the machine, this device can be transported and readily used in any room, without exposing the patient to radiation. Ultrasound imaging works by transmitting sound waves into the body and capturing the waves that echo back, resulting in varying intensities depending on the boundary they run into. Different structures, such as bones and tissue, have differing densities, and will

absorb or reflect sound waves at different rates, resulting in a gradient of intensities being recorded by the probe (Chan & Perlas, 2011). Sound waves have difficulty being transmitted through air due to its high density, resulting in scattered waves. Ultrasound gel is used to remedy the boundary between the ultrasound probe and the skin boundary, serving as a medium to minimize contact with air and better transmit waves (Casarotto et al., 2004).

The purpose of this technical project is to aid in the development of the ultrasound device and develop a reliable acoustic coupling system to ensure transmission of waves into the body. Another goal is to evaluate product reliability of the test fixture and ensure function over the product's lifetime. This project will be completed in conjunction with three other team members, where roles are split amongst hardware lead, software lead, quality lead, and project manager. Through these various roles, the team will work together to create, test, and develop parts and function of the ultrasound device, with the anticipated outcome of a functional device to be sold on the market.

STS Topic – The War on Drugs

In 1971, President Richard Nixon began the crusade against drugs, famously coined the War on Drugs, declaring drug abuse as “public enemy number one.” This movement was largely inspired by the rise of recreational drug usage in the 1960's with the goals to eradicate illegal drug use and distribution, increase federal intervention for drug enforcements, and reform prison sentencing for drug-related crimes (Fornili, 2018). As part of federal intervention, the Drug Enforcement Agency (DEA) was created in 1973 under Nixon to tackle drug usage, specifically aimed at dealing with smuggling from Mexico, as well as creating a single institute responsible for handling drug-related issues (Golub et al., 2015).

Following the initial push for drug reform, the next big movement sparked in the 1980's under Ronald Reagan's administration, where a large number of incarcerations and severe penalties were seen for drug-related crimes. Under Reagan, the focus shifted to prosecution and criminalization of offenders, as seen under the Comprehensive Crime Control Act of 1984 as well as the Anti-Drug Abuse Act of 1986, which both strengthened mandatory minimum sentencing policies (*Reagan's National Drug Strategy, Omeka Beta Service*). These policies later faced heavy criticism as they led to mass incarcerations of primarily black Americans, based on the allocation of longer prison sentences on the distinction of crack cocaine, which was predominantly used by black Americans, versus powder cocaine, which was predominantly used by white Americans (Yeh).

Each piece of legislation appears to have the same core value of reducing drug usage in America, yet when looking back, the social implications of the legislation has caused more harm than good. This sociotechnical report analyzes how legislation has been used as a political technology to exacerbate the War on Drugs and adversely impact black Americans in the United States. Political theorist Langdon Winner first introduced the notion of political technology in his piece "Do Artifacts Have Politics?" where he discusses the relationship between technology and power in society and distinguishes two ways in which artifacts can have power. First, Winner outlines how technology "becomes a way of settling an issue in a particular community," showing how the process of technological development determines the politics associated with the artifact. Second, Winner defines the phrase of "inherently political technologies," where these technologies strongly correlate with particular kinds of political relationships (Winner, 1980). This framework highlights how technology can be used to maintain order, increase authority and privilege, and change power relationships within society.

The idea of political technology has been widely accepted in society, seeing as those behind the artifacts have malicious or ulterior social intent. However, German professor of sociology Bernward Joerges offers a rebuttal in his piece “Do Politics Have Artefacts?” where he specifically comments on the example of how Robert Moses’ bridges of Long Island Parkway were not inherently politic. Winner provides an example of how Moses presented “social-class bias and racial prejudice” by deliberately creating low-hanging overpasses to prevent busses from passing, which were predominantly used by low-income and minority groups. Joerges comments that Winner failed to assess all of the factors, stating that Moses was not intending to be political, but was limited by state laws, and that the effect of the artifact may be political, but the outcome was not intended by the designer (Joerges, 1999). Despite the criticism, Winner’s perspective on political technologies remains widely accepted.

Winner identifies technology as a physical artifact, but the implications of his framework can be broadly applied. This report identifies legislation as the technological artifact, and will analyze how legislation has been utilized as an inherently political technology with the motive to racially alienate minority groups. This research strives to identify motives behind each legislation and compare the outcomes, specifically how minority communities have been targeted for mass incarceration, and how those racially-motivated policies still have impact today. By understanding the impact of the past, current legislators can work towards fair prison laws to provide justice to the families that have been disrupted.

Research Questions and Methods:

How has legislation been used as a political technology to exacerbate the War on Drugs for minorities in United States?

To answer the research question presented, a thorough literature review will be conducted to identify sources that discuss the War on Drugs. For background information, literature regarding each administration will be assessed to identify how each President handled the War on Drug and what their motives and primary concerns were, and policy analysis will be performed to analyze what legislation was passed under their term. Literature review will also be conducted to understand public sentiment at the time of each administration, and what outside factors influenced policy decisions. Once the background is set, further analysis will be conducted to scope the relationship between race and politics, and how scholars in the field link drug policies with race and mass incarcerations. To support the claims, statistics will be collected to observe trends in incarceration rates based on data from the 1970's until 2020's, as well as data linking drug usage and non-violent crime rates linked with imprisonment to highlight injustice.

Conclusion:

In conjunction with Rivanna Medical, the technical deliverable aims to aid development of an intermediary medical ultrasound device to provide guidance to physicians when performing epidural lumbar spine injections. Once completed, the goal of the device is to be marketed and sold to physicians, hospitals, and institutions to provide imaging guidance. Future goals include elaborating the use of the ultrasound device on different sections of the body, providing mobility. The aim of the STS deliverable is to analyze how legislation has been used as a political technology to exacerbate the War on Drugs and marginalize communities of color, leading to mass incarcerations and disruption of communities that can still be seen today. The goal is to provide a thorough investigation of how legislation has been utilized as a racially motivated

weapon, with the anticipated outcome of identifying trends and motives, and identifying how politics are closely tied with socioeconomic impact.

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