

Undergraduate Thesis Prospectus

Pushing Time Forward: A Clock to Inspire Fascination in Nuclear  
Physics

(technical research project in Mechanical Engineering)

Protecting the Patients: Fighting Against Overprescription of Opioids

(sociotechnical research project)

by

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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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STS advisor: Peter Norton, Department of Engineering and Society

## **General Research Problem**

*How can the number of drug overdose deaths in the United States be reduced?*

Over the past several years, the United States has seen the rate of drug overdoses skyrocket. The prevalence of opioids as both illicit drugs on the street as well as prescribed medication greatly influenced this rapid rise. With the inherent duty to serve the people of America, the government along with many health organizations have sought to halt this trajectory via policy and research. Groups such as the National Institutes of Health (NIH) have conducted research on the profound impacts of opioid painkillers prescribed post-surgery and found that over the past 20 years the number of opioid prescriptions increased by 300% (Reuben, 2015).

Drug overdoses also affect the youth of America drastically. UCLA Health conducted a study on the teen death rate due to drug overdoses (Friedman, 2022) . During the COVID-19 pandemic, the number of teen drug overdoses deaths increased dramatically, mostly due to the presence of illicit fentanyl in counterfeit drugs purchased from unreliable sources. The youth of America faces the highest rates of drug-related deaths when compared to the overall population, a situation in dire need of change.

## **Pushing Time Forward: A Clock to Inspire Fascination in Nuclear Physics**

*How can students be inspired to scientific exploration?*

The technical problem my capstone group will approach this semester is how to design and construct a cloud chamber clock. A cloud chamber is a box that uses supersaturated alcohol vapor to illuminate the travel of radioactive particles. The chamber heats isopropyl alcohol from

elevated reservoirs in the top and then cools them down at the face of a cold plate to achieve the desired effect. This project will incorporate a clock into the cloud chamber that will ideally inspire future generations to scientific exploration. My group consists of Julian Lee and Luca Campbell. Our project is under the MAE department with Gavin Garner as our advisor.

The cloud chamber clock presents itself as a challenging design problem to allow our group to exercise our skills as mechanical engineers to design and build a contraption that has never been built before. The goal of this project is to not only illuminate subatomic particles from radiation for students and intrigued persons but to also represent the skill and professionalism of mechanical engineers at UVA. The methods with which we will bring this project together include ideation followed by computer-aided modeling that will lead into hands-on manufacturing and prototyping to create a final product, ideally to rest in the Mechanical Engineering Building at UVA. This cloud chamber clock will be present for functional use as a timekeeper for students as well as an inspiration to explore the complexities of the world around us.

### **Protecting the Patients: Fighting Against Overprescription of Opioids**

*How do organizations fight overprescription of opioids as medication in the United States?*

The problem of excessive prescription of opioid medications is exceedingly prevalent in the United States health system. In *Annals of Surgery*, Thiels (2017) showed significant overprescription of opioids to patients recovering from elective surgeries. This study found that over 80% of the participating patients were prescribed more than the recommended amount of

opioid-based painkiller medication. In response, several organizations are seeking a solution to this epidemic by fighting against prescription of opioid medications.

### *Related Research*

In the area of opioid management, a research paper by Robin Cantor addresses the public and private response to the opioid crisis in America (Cantor, 2021). Cantor analyzes different groups responses to opioids in widespread use via risk signals over the course of the past several decades. In her research, she found that many large federal agencies such as the DEA, FDA, and CDC were inconsistent in their response to heightened risks involving opioid prescriptions. These agencies were not able to advise and regulate local health departments in their role of providing access and oversight to patients requiring addictive medications. Other researchers have also investigated the different ways in which participant groups have fought for change in health care. One such researcher, Randall Hudspeth (2019) found that boards of nursing primarily focus on assisting with provider education to reduce the number of opioid prescriptions. White, Perrone, Watts, and Malm (2021) found that the collaboration between social groups, police, and researchers provided an avenue of fighting prescription drug addiction by presenting treatment with Narcan. One final group of researchers, Cochran, Hruschak, DeFosse, and Hohmeier (2016) found that the literature published by pharmacy groups has a significant impact in the reduction of opioid prescriptions. These papers all attempt to understand the social interactions between organizations involved in presenting a solution to the opioid epidemic in America.

### *Major Participants*

The primary participants in this research project consist of professional organizations advocating for greater regulation and pharmaceutical companies responsible for producing

opioid-based medications. One professional organization, the American College of Emergency Physicians is urging lawmakers to propose legislation that heightens the requirements for prescribing opioids in pain management situations (ACEP, n.d). Tied to their role in the opioid epidemic, ACEP's declared mission is to, "serve as the leading advocate for emergency physicians, their patients, and the public." To be able to aptly advocate for emergency physicians, ACEP has an inherent stake in fighting against misconduct and poor treatment in the form of opioid overprescription.

University of Pennsylvania's Leonard Davis Institute of Health Economics, another professional institution, prioritizes research into the social effects of healthcare, which has a distinct interest in the economics surrounding opioid prescription and care for those suffering from substance use disorders (Perrone, 2022). This interest serves their greater mission "to achieve effective and efficient health care" via research into important issues in the realm of health care. The American Medical Association is a participant group who cares deeply about the opioid epidemic as their entire mission is to support the medical profession in their care for patients and those suffering with a substance use disorder (Harris, 2020). A fourth participant in this fight is the NIH, National Institutes of Health. They are similar to UPenn's Leonard Davis Institute in their use of research to bring light to problems in healthcare (Phillips, 2017). The NIH, a federal agency, is also backed by their governmental protocol to serve the greater interest of the people, ensuring their primary interest in defending people over monetary gain.

Another set of participants in this project are the pharmaceutical companies responsible for producing addictive medications. One such company is Cardinal Health, producer of opioid-based medication in the US, has made an effort to also take a stand against misuse of prescribed specialty drugs. Cardinal Health is participating in a country-wide settlement that will provide 46

of the 50 US states with monetary support for patients suffering from opioid addiction, whilst also providing data from their company to aid in fighting against pharmaceutical fraud (Cardinal Health, 2022). The other pharmaceutical company with heavy influence on the opioid epidemic is Purdue Pharma. In response to heavy pressure to monitor diversion of opioid medications from proper channels in medication towards addictive behavior, Purdue Pharma has set up monitoring programs to attempt to ensure drugs stay within proper uses (Purdue Pharma, n.d.). It should be noted that these pharmaceutical companies primary motive is to make a profit by selling drugs to health departments regardless of the outcome. However, given the immense political pressure to respond to the opioid epidemic, it is in the best interest of these pharmaceutical companies to adhere to the regulations set in place as well as setting up programs to ensure proper usage of their drugs, ideally reducing the number of lawsuits in the future.

Both groups of participants have significant interest in reducing the number of opiate prescription medication overdoses. Combining each of the groups missions, the overall goal of protecting the people of the United States is evident in the desire to fight against overprescribing addictive medications.

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