OpTrak: Tracking Opioid Prescriptions via Distributed Ledger Technology

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ABSTRACT

This article describes the structure and functionality of OpTrak, a decentralized app implemented using the Ethereum blockchain that targets the opioid epidemic currently plaguing the United States. Over-prescription and distribution of opioids cost the national healthcare system over $78 billion every year. Problems persist in every stage of the process, from doctors prescribing the medication to the pharmacists fulfilling prescriptions. These problems arise from a combination of factors, including lack of accountability, transparency, and reliability in the current prescription drug monitoring programs. This work provides three key contributions to research on a technical approach to mitigate the opioid epidemic. First, the authors pinpoint key problems in the current opioid prescription system. Second, they propose an integrated approach for addressing the problems by leveraging distributed ledgers, focusing on blockchain technology. Third, the authors describe the structure and functionality of OpTrak that allows a consortium of care providers to exchange patient prescription data securely.

KEYWORDS
Blockchain, Data Sharing, Ethereum, Healthcare, Interoperability, Opioid Epidemic, Opioids, Prescription Drug Monitoring Programs

INTRODUCTION

Emerging Trends and Challenges

It is widely known that the United States (US) is in the midst of an opioid epidemic. Opioids are a class of drugs that consists of heroin, as well as legal pain relievers like oxycodone, hydrocodone, codeine, and morphine. Pain relieving opioids can be safe when prescribed for the right reasons and duration. These opioids can easily be misused, however, due to the production of euphoria and the relief of pain. Due to these effects, regular use (even through valid prescriptions) can yield dependence and addiction. In turn, the abuse of pain relievers often leads to overdose and death (National, 2018).

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Every day in the United States, over 115 Americans die after overdosing on opioids (CDC/NCHS, 2017). Moreover, the DEA states that up to 80% of heroin addictions begin with the misuse of prescription opioids (Bresnick, 2017). By calculating the costs of healthcare, addiction treatment, lost productivity, and criminal justice involvement, The US Centers for Disease Control and Prevention estimates that prescription opioid misuse has a total economic burden of $78.5 billion per year on the United States (CDC/NCHS, 2017).

Many efforts are attempting to address this crisis, as shown by The Drug Supply Chain Safety Act (DSCSA) (Center, 2013), the establishment of the President’s Commission on Combating Drug Addiction and the Opioid Crisis (Madras, 2018), and numerous prescription awareness campaigns (CDC, 2017). Unfortunately, the current prescription tracking system in the US lacks the technical infrastructure to address this crisis effectively. In particular, the prescription opioid marketplace is rife with data hoarding, doctor shopping, provider ignorance, vulnerable and centralized data, and over-prescription (Laxmaiah, 2012).

Attacking the opioid crisis in the US requires an approach to prescription monitoring that not only makes prescriptions safer, but also incentivizes providers to write fewer prescriptions. Providers today are economically incentivized to prescribe opioids to patients. As a result, providers often spend less face-time with patients, thereby lowering costs associated with patient treatment, while increasing their financial returns. Similarly, pharmacies today are incentivized to produce and distribute opioids because the more opioids sold, the greater their revenue, which also increases shareholder value.

Patients themselves are also incentivized to consume opioids. For example, physical therapy in the treatment of pain can be extremely frustrating and filled with disappointment. Opioids provide short-term relief, though they often lead to patient addiction (Van, 1999). This self-reinforcing cycle can be ameliorated by a technical approach that realigns incentives for providers, pharmacies, and patients.

**Our contribution**

The OpTrak decentralized app (DApp) that tracks opioid prescription using distributed ledger technology. To provide a technical platform for more effective sharing of opioid-related activities, we have developed OpTrak, which is a distributed ledger technology (DLT)-based DApp designed to operate within a networked consortium of healthcare professionals. OpTrak allows a trusted network of stakeholders (e.g., hospitals and pharmacies) to store opioid transaction records in a secure and accountable manner. By securely disseminating knowledge that a prescription has been filled by a patient, OpTrak helps remedy various problems in the current US opioid system, such as lack of communications between providers causing duplicated opioid orders of the same patient (Goldman, 2017).

Opioid data in OpTrak is shared with the networked consortium in a secure fashion with no single point of failure that could corrupt the entire system. Healthcare professionals, such as providers and pharmacists, are incentivized to participate in the consortium through access to data that will increase the quality and transparency of care. In turn, proper analysis of this data enables patients to receive care that is more appropriate to their condition(s).

OpTrak can also create personalized logs for each individual patient to help them identify past prescription activities. These logs can help steer patients away from the dangers of opioid addiction by encouraging them to adopt more effective long-term treatment actions. For patients who have genuine needs for opioid prescriptions, OpTrak helps make a safer marketplace.

**Paper Organization**

The remaining of this article is organized as follows: the Background and Challenges section describes the context of our work on opioid tracking via blockchain. The Structure and Functionality of OpTrak section describes the design and implementation of a prototype OpTrak DApp we developed using the Ethereum blockchain platform. The Addressing Key Opioid Misuse Challenges via OpTrak section presents key considerations we applied when developing our OpTrak DApp to address each of the challenges facing current opioid prescription tracking systems. The Related Work section compares
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