Automating Prostate Cancer Diagnosis to Improve Healthcare Efficiency

ENGINEERING HONORS PROGRAM
UNIVERSITY OF MICHIGAN

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Introduction & Context

Hundreds of billions of dollars are wasted in healthcare in the US every year due to inefficient spending. It is without a doubt that in the US, healthcare is incredibly inefficient, costing a lot of money for the average American and not getting people the proper care. There are three main reasons for this: **(1) administrative issues and wasted time spent with doctors and nurses, (2) doctors following outdated protocols - there is a lack of standardization for doctors and protocols for specialty treatments are constantly changing, making it hard to keep up, and (3) unnecessary procedures.**



One area that particularly struggles with these challenges is prostate cancer diagnosis. Currently, patients take a PSA at their yearly check in, and, depending on their doctor, will get very different recommendations for next steps. This often leads to either poor follow up for concerning scores or referrals to a Urologist and a following prostate biopsy - a $2,000 procedure that is unnecessary 75% of the time and has a high false negative rate.

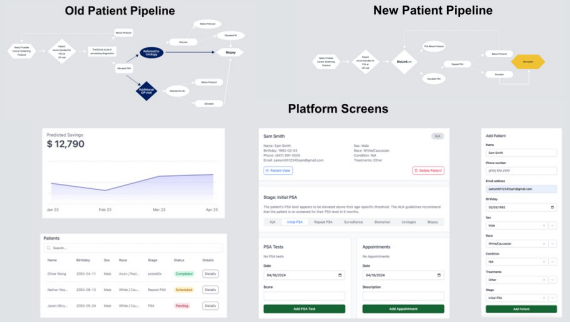
Recently, there has been an increased interest in cost effective healthcare, partly due to the rise in ACOs or Value Based Care Organizations. ACOs are a conglomerate of health groups (e.g. hospitals, general practitioners) that parter with insurance companies to provide the best care. Insurance companies designate a budget for the ACO, and every dollar not spent below that budget gets split between the insurance company and the ACO, thus promoting cost effective healthcare. As this model grows, it is increasingly important to find solutions to reduce unnecessary costs.

Proposed Solution & Methodology

Our solution is a software platform with both a physician and patient facing dashboard. In this platform, we included relevant health and demographic information on each patient in regards to prostate cancer screening. Ultimately, to resolve the prior inefficiencies, we built an all-in-one solution for prostate cancer diagnosis which reduces wasted doctor visits and incorporates modern protocols - which in turn reduces unnecessary biopsies. The main functionality includes: **(1) algorithmic recommendations for next steps, (2) patient tracking and analytics dashboard, and (3) the incorporation of intermediary biomarkers.**

We implemented the protocol from the American Urology Association (AUA) guidelines that turn into a decision tree for moving patients along the screening process. We coded up a platform that allows doctors to input their patients info and then automatically receive recommendations on next steps based on the AUA guidelines. We also designed a data analytics dashboard to track how patients are moving through the protocol and record important information such as spending and performance. In the future, we will compare these KPIs with similar metrics of how doctors are currently approaching prostate cancer screening to see if we made any significant improvements.

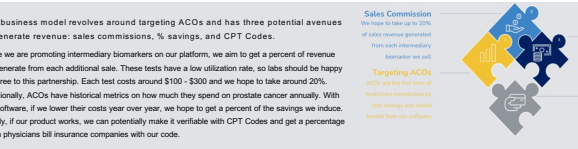
Our tech stack contains (1) AWS Amplify to manage different user pools, API calls, authentication, and send reminders, (2) Python and Typescript for the backend and the data analytics dashboard and to implement the AUA guidelines, (3) React for front end components, and (4) a graphSQL database. Some additional features we included are: (1) an education page for more information with links attached, (2) scheduling, (3) communication, (4) doctor verification, and (5) warnings for failing to follow the procedure.



Business Model & Tangential Products

Our business model revolves around targeting ACOs and has three potential avenues to generate revenue: sales commissions, % savings, and CPT Codes.

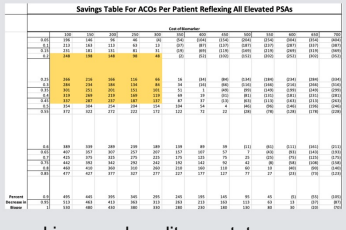
Since we are promoting intermediary biomarkers on our platform, we aim to get a percent of revenue we generate from each additional sale. These tests have a low utilization rate, so labs should be happy to agree to this partnership. Each test costs around $100 - $300 and we hope to take around 20%. Additionally, ACOs have historical metrics on how much they spend on prostate cancer annually. With our software, if we lower their costs year over year, we hope to get a percent of the savings we induce. Finally, if our product works, we can potentially make it verifiable with CPT Codes and get a percentage when physicians bill insurance companies with our code.



After talking to potential customers, many mentioned the need for a modern cognitive assessment solution. While we are obtaining clients and trying to acquire funding for legal and cybersecurity assistance, we have begun building out a potential solution. Our assessment aims to beat traditional tests by allowing patients to take it at a higher frequency and using AI to evaluate their performance, thus tracking the smallest deviations in cognitive function. We are still building this out, but sign up for our waitlist on the QR code to the right.

Objective & Data Analytics

The goal of this project is to automate and implement modern protocols for prostate cancer diagnosis. We aim to increase efficiency of this process by eliminating wasted doctor visits, providing active recommendations, referring intermediary biomarkers, democratizing medical information, and reducing costs.



The primary objective is to facilitate cost effective and improved quality prostate cancer screening through software and automation. Part of this project, however, was also to identify the efficacy of these intermediary biomarkers - blood/urine tests - in reducing the amount of unnecessary biopsies. Due to the complexity of this task and requirement of tracking large data over years, we narrowed this scope down to focusing on projections instead. Using data from the CDC and NIH, we created an expected value cost breakdown for a patient using our system vs the incumbent.

Obstacles & Milestones

After intensive development, we learned the healthcare industry is incredibly difficult to enter. We hoped to continuously iterate on our product based on customer feedback, but faced many logistical challenges in our ability to launch. Some of these included: (1) HIPAA and patient data concerns, (2) the necessity for legal expertise, and (3) data acquisition. These first two issues require funding and scrutiny by external organizations, and a failure to do them could result in huge legal issues for the future. Outside of the technical and business issues, it is also hard to acquire users. Doctors are busy and typically older people, so they are unwilling to adopt a new platform unless the value is clearly outlined.

That being said, we did accomplish small wins. Not only did we build an extensive platform in such a short time, but we navigated a new entrepreneurial endeavor and overcame some of the obstacles above. We did a beta test in Mexico due to less regulations and saw an increase in patients getting prostate checks with our platform. Additionally, we participated in a small screening event with PCEC to onboard and get users accustomed to our platform.

Conclusion & Future Work

Through thorough research, we discovered a huge problem in the healthcare industry's lack of modern technology. Not only does the US have one of the worst costs per patient out of any other country, but the quality of care varies greatly with each physician. Much of our medical practices are outdated with doctors following old protocols and not using new tests that can lower costs for their patients. This was incredibly prevalent in our work with prostate cancer diagnosis, and we found that an all encompassing software platform with modern algorithms and intermediary biomarkers implemented is a viable solution. While it is difficult to gain customer adoption, we believe that a platform with multiple protocols would see large success.

In the future, we hope to do exactly that by expanding beyond prostate cancer into other diagnosis processes such as lung cancer and cardiology. In the meantime, however, we need to resolve the data acquisition issue of getting patient information on our platform. Our current workaround solution includes manual entry and doctor verification, but we are exploring potential integration with labs, cascade coding, web scraping EMRs, and joining FHIR servers. Additionally, in the near future, we have begun talks about a pilot launch in the states with eight clinics and a revenue sharing contract with another healthcare company. While we are still early, this project has been incredibly rewarding in culminating all of my technical skills from the past couple of years into a meaningful mission and has drastic potential to make a huge impact in healthcare.