

Blockchain Technology to Disrupt Electronic Medical Records One 18 Wheeler at a Time...Surprise, ROI +545%!!



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Business Plan Prepared for:
Meharry Medical College: School of Dentistry

March 13, 2019

Prepared by Johns Hopkins University MBA/MSF students:
Amr Alhuraibi, Zihan Bai, Jennifer Ghelardini, Jesse Masear, & Mohamad Mohamad

Advisors:

Professor of Finance Dr. Jim Kyung-Soo Liew

Professor of Finance/Blockchain Jose Arrieta

Meharry Medical College:

Dean School of Dentistry Dr. Cherae M. Farmer-Dixon, DDS MSPH, FACD

Senior VP for Health Affairs and Dean School of Medicine Dr. Veronica T. Mallett MD, MMM

Senior VP Institutional Advancement Mr. Patrick Johnson

Senior VP Executive Director Dr. Dexter Samuels Ph.D.

Senior VP General Counsel and Corporate Secretary Dr. Ivanetta Davis-Samuels J.D.

Dean School of Graduate Studies and Research Dr. Maria de Fatima Lima Ph.D.

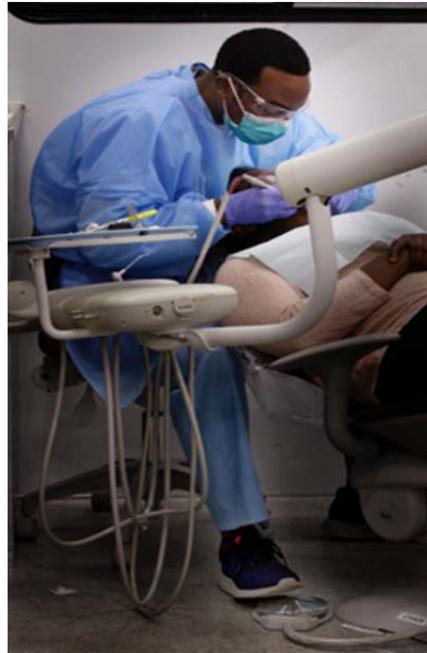
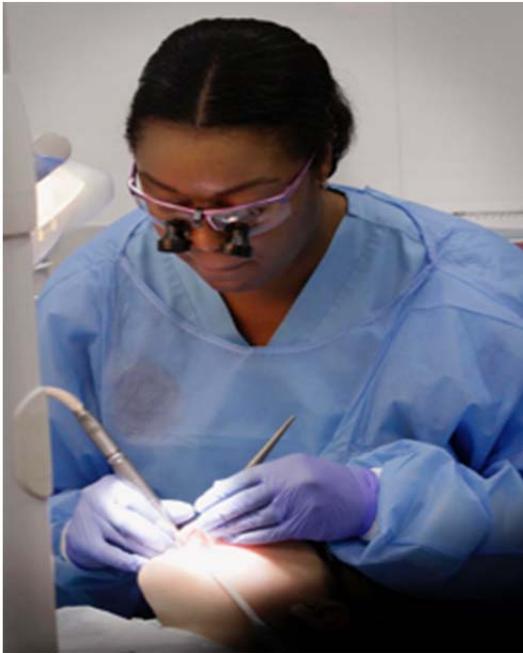
Senior Advisor to the President on Technology Amy Adrande M.S., PMP

Special Thanks to our Technical Advisors:



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Executive Summary

“True to its heritage, the Meharry Medical College School of Dentistry exists as a center of excellence to improve the oral health and overall healthcare of minority and underserved communities, with special emphasis on providing opportunities for African Americans, other people of color and individuals from disadvantaged backgrounds by; sustaining an excellent learning environment that promotes inter-professional collaboration, humanistic patient centered care, community service, and research that fosters the elimination of health disparities.”(Meharry, 2019)

In line with this mission statement, Meharry Medical College School of Dentistry provides treatment for youths eligible for Medicaid, age 10-17 years old and seniors 60+ years old through the use of a mobile dental clinic in Tennessee.

Problem:

There are roughly 2.2 million patients without access to dental care in Tennessee (Tennessean, Apr14). In Tennessee there is only 1 dentist for every 1,400 patients. Many people do not have access to a dentist within a 30-minute radius. How can Meharry School of Dentistry College use this mobile unit to provide dental care in an efficient and cost-effective manner? What more, how can Meharry scale up their operations to the level of self-sustainability?

Solution:

In order to treat more patients, we can increase the reach of Meharry Mobile Dentistry Clinic and increase the efficacy of the clinic. We recommend Meharry Dental Colleges to implement an information recordation process that incorporates wireless tablets with biometric identification, patent pending Blockchain EMR integration, and optimized scheduling.

Using this solution Meharry Medical College School of Dentistry can achieve an **ROI of 545%**. The subsequent present value of this solution is over **\$5.411 million**. ROI is calculated using cash flow analysis over 10-year period and with a discounted rate of 10% (average market return). The terminal value is calculated using a perpetuity, assuming a growth rate of 2% to match inflation (See Appendix).

Supporting Evidence

The initial investment needed for this ROI is \$992,341:

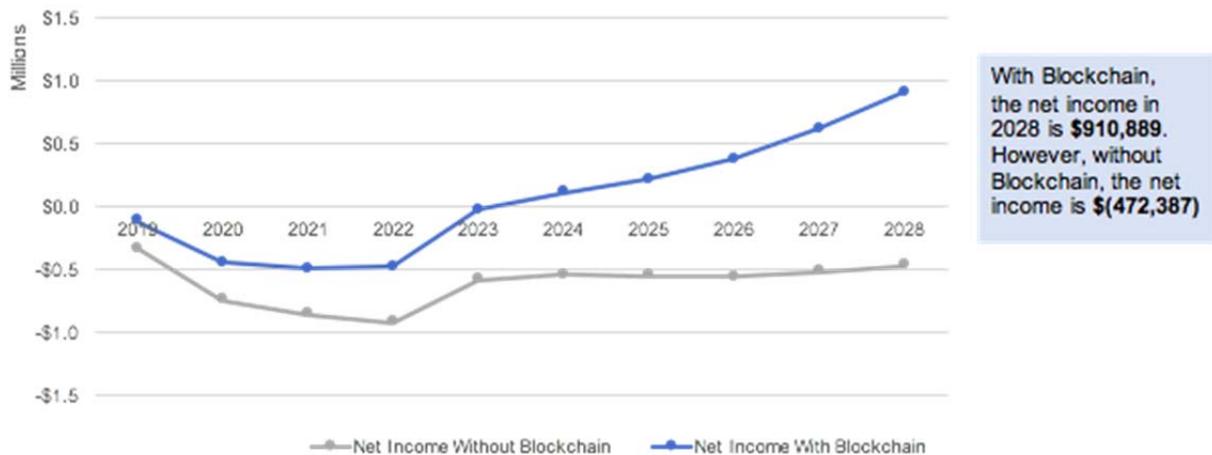
PV of Program Cash Flows:	\$5,411,679	Rate of Return:	10%
PV of Investment Required:	\$992,341	Growth Rate:	2%

ROI

$$\frac{\text{Value of Expected Revenue}}{\text{Required Investment}} = \frac{\$5,411,679}{\$992,341}$$

545%

Net Income Comparison



The main drivers of the return revolve around the technology solution offered:

1. Due to efficiencies created from patient identity-validation, Blockchain security and electronic data recordation; mobile units can serve more patients, generating additional income of \$93,728 in year one, and steadily increasing that figure to \$313,638 by the end of the forecasted time horizon.
2. The data-monetization processes we recommend will add additional revenue of \$20,400 starting year 2. These revenues will increase to around \$979,976 in year 10. This includes data derived from existing patient record information currently existing in Meharry's ecosystem. Data is

monetized through a subscription, or pay-per-use model, which allow users access to data through Meharry’s research Blockchain terminal.

The subscription model assumes client institutions pay \$20,000 a year for an access point that grants them entry into the Blockchain grant database. We assumed that in the period of 10 years we would get 18 institutional clients. Each client would have 5 access points in a 10-year period. In total we would sell 41 access points throughout the 10-year time horizon.

The graphs below demonstrate the revenue and cost model throughout the next 10 years. Costs flatten in year 2020 with no expenditure on new trucks, while revenues grow exponentially so does growth in data sales and operating efficiencies. This dynamic is demonstrated in the graphs below (all calculations can be found in the Appendix).

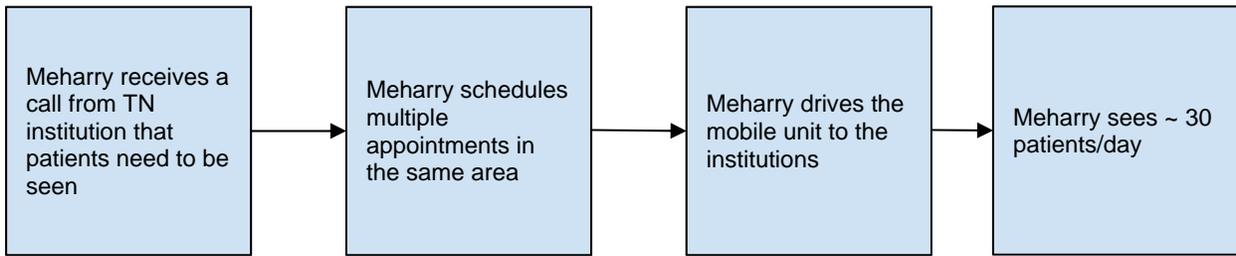
The net income summary below outlines the main revenue and cost line items:

Year	2019	2020	2021	2022		2027	2028
Operational Revenue	\$406,154	\$414,277	\$676,100	\$948,230		\$1,332,447	\$1,359,096
Effeciency-Driven Revenue (BC)	\$93,728	\$95,602	\$156,023	\$218,822		\$307,488	\$313,638
Data-Driven Revenue	\$0	\$20,400	\$41,616	\$84,897		\$726,429	\$979,976
Total Revenue	\$499,882	\$530,279	\$873,739	\$1,251,949		\$2,366,364	\$2,652,709
Truck Purchase Cost	\$0	\$400,000	\$400,000	\$400,000		\$0	\$0
Blockchain Implementation and maintainance	\$204,000	\$146,880	\$149,818	\$152,814	● ● ●	\$168,719	\$172,093
Salaries	\$307,000	\$313,140	\$641,053	\$922,360		\$1,314,789	\$1,341,085
Miscellaneous and Depreciation	\$71,921	\$78,293	\$147,503	\$223,340		\$228,803	\$188,952
Total Cost	\$582,921	\$938,313	\$1,338,373	\$1,698,514		\$1,712,311	\$1,702,131
Net Income	\$ (83,040)	\$ (408,034)	\$ (464,634)	\$ (446,565)		\$654,052	\$950,579
Incremental Cash Flow	\$ (65,706)	\$ (391,420)	\$ (395,422)	\$ (324,768)		\$718,539	\$960,889
PV of Cash Flow	\$ (65,706)	\$ (355,837)	\$ (326,795)	\$ (244,003)		\$335,204	\$5,314,884
Present Value of Program	\$5,411,679						
Present Value of Investment	\$992,341						

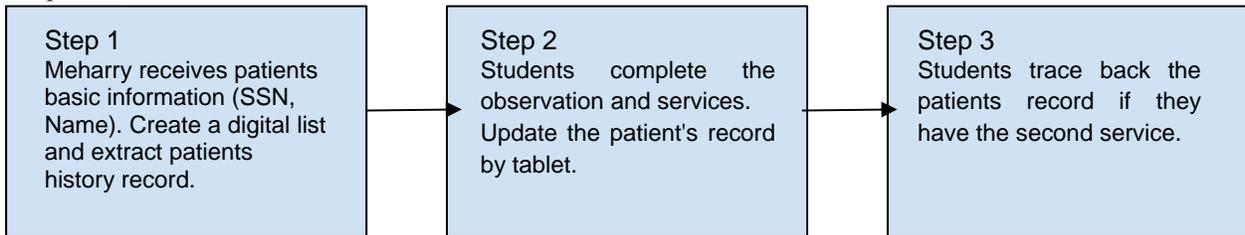
The Mobile Dental Clinic would not be able to cover scaling operational costs as they are unsustainable. This was proven in previous projects that have since failed. As the program scales, net operating income is consistently negative. The value of the technology solution is demonstrated by neutral net operating income at year 5 (2023) and positive net operating income going forward. Figure 5 shows the net income of the project with and without the solution:

Process Flow Diagrams

Current:



Proposed:



Description of Current Operations & Proposed Processes

Current Patient Encounter:

Currently, Meharry's Mobile dental Unit serves various residences throughout Tennessee to treat underserved youths. The process for a typical patient encounter starts with contact from a state sponsored institution. Law requires that a resident have a dental appointment administered within 60 days of arrival. Meharry is given the name, date of birth, and social security number of the patient who is then entered into their electronic health records (EHR) Axion. Meharry sees an average of 30 patients per day during the 7 days/month that the truck is operational. During the appointment the procedure is documented on paper forms but practitioner and later entered into the EHR. When the mobile unit arrives back to Meharry, patient records collected from that trip are entered manually into Axion at a rate of 15 minutes/patient. This task is delegated to the students whom are on the mobile unit during the examination.

Proposed Process:

Using Blockchain technology embedded on a tablet, students, and senior dentist will biometrically identify patients using fingerprint scanning. The patient's information will populate on the tablet and will be accessible for the appointment. The students, assistants and senior dentists will enter the information pertaining to the appointment such as conditions treated, treatment applied and follow up appointment information. This data will be cached on the tablet remotely and securely for upload on Meharry's cloud based EMR using a secure VPN. This digital process will allow easily retrievable immutable information to be accessed at any time due to the nature of Blockchain technology described below.

Marketing

To market this new solution, more research needs to be conducted. We feel this concept is going to revolutionize the industry. The research that needs to be conducted pertains to those that are willing to adopt a similar data structure to provide the sharing capabilities needed to make this concept a reality. Healthcare networks, research hospitals, medical device companies and pharmaceutical companies will find the organization and accessibility of medical records extremely valuable.

We must also keep in mind the purpose of this mobile unit; to serve patients that would not have access to proper dental care without the mobile unit. If we can use marketing to spread our idea the resulting financial support will allow Meharry School of Dentistry to provide more care to more people.

Conclusion

The introduction, integration, and implementation of this solution into Meharry's EMR ecosystem shows significant and sustainable ROI. We project an ROI of 545% from the integration of Blockchain technology over a 10 year time horizon. The breakeven point of this project occurs in year 5 due to the non-recurring one time capital expenses in year 2, 3, & 4 that are required to scale the fleet to 4 units in order to serve the desired patient population. Combine this with the projected revenue from monetizing the index accessible data within Meharry's ecosystem ROI is enhanced. We also show that without the efficiencies afforded by this solution, the project shows a negative ROI and will fail due to the required reinvestment each year. For these reasons we strongly recommend that Meharry invest in this solution.

Supporting Research

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Technology

Wireless Tablets

To accommodate record digitization, we recommend acquiring five wireless tablets per mobile unit. The use of wireless tablets is to facilitate the data upload to the cloud through a private VPN. This is accomplished whenever the unit is in a cell service in the coverage area. With the expansion of Meharry's intended coverage area this will provide a more efficient data collection process that is currently in place. This makes the data immediately accessible through the server and does not require Wi-Fi to do so.

There is the option to use the tablets with a digital pen/pencil so practitioners can handwrite the information. Technology is available to transpose handwriting to type.

An additional and very important benefit from keeping the records on tablets is the availability of biometric authentication. Practitioners and patient identity can be verified using fingerprint scanners available on modern tablets. This ensures that only credentialed practitioners get access to the database and patients are easily verifiable even without a physical identification card after the initial visit. Instant identity verification will cut back on patient admittance time. Mike Boyd from CNBC's "On the Money" suggests that adding biometric identification can save as much as ten minutes per customer, as exemplified in airline experimentation (Sutter, Feb15).

As technology becomes more advanced, the price of tablets decreases. According to Statista.com the average price of a tablet in 2019 is \$593.53 (Engler, N.J., Mar19). We propose attempting to partner with Microsoft, Apple, IBM, or Computers with Causes to acquire the tablets for no cost. IBM Health Corps was created to assist new healthcare initiatives through providing hardware and software support. To participate in this program we would have to build our blockchain platform on IBM's Hyperledger Fabric (IBM Health Corps, Mar19). 'Computers with Causes' allows non-profits to set up wish-lists of computers and tablets, where consumers can donate their used electronics to charity (Statisa, Mar19). This is an option after we can ensure each device is wiped clean.

Simply adding the tablets will eliminate duplicate data entry will save marked time on patient sign-in. This results in 750 additional hours available to dentists, assistants, and administrators while the mobile unit is active (see calculation in appendix 1).

Biometric Identification

The most significant process improvement that will give validity to the introduction of Blockchain is the immutable nature of data in this new environment. This is the backbone of some significant assumptions in this new process. To accomplish this task the identification and validation at the source is vital. To accomplish this unquestionable validation process to insure the integrity of the data within the Blockchain we need to establish 100% assurance that the patient receiving treatment is the patient receiving the Medicaid funding.

Currently Meharry Medical College School of Dentistry uses the date of birth, social security number, and name of the patient for identification. While this can be valuable in the current process, the possibility of fraud may exist. We propose using biometric identification via fingerprint identification to insure that

patient receiving the care is the patient receiving the Medicaid reimbursement. This serves a number of purposes. However, the most vital purposes is to influence the actual reimbursement costs associated with delivering treatment.

The most common argument against an increase in reimbursements rates is waste. This is something that comes from both sides of the political aisle. However, with undisputed identification and the ability to prove actual costs, there is very little argument against increasing reimbursements to the actual proven costs.

To insure validation and verification of patients we are recommending fingerprint identification of patients. The addition of this level of security will insure the integrity of the data data and assist in the assurance of those designating reimbursements that funds are going to the patient assigned to those funds.

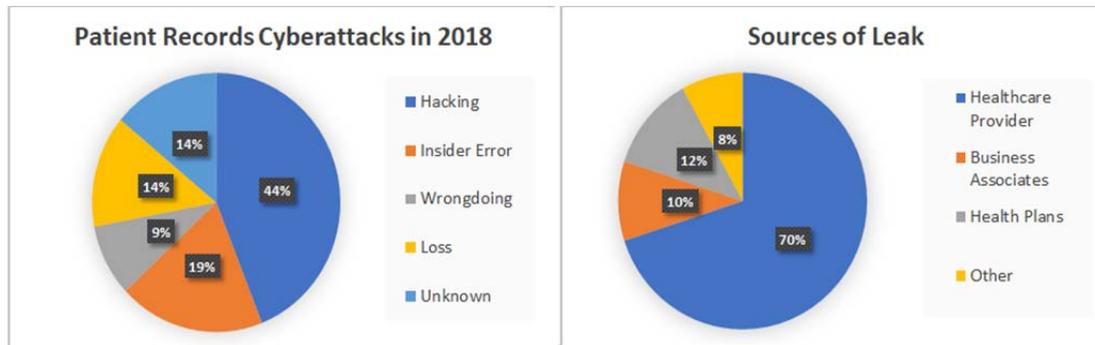
Blockchain Integration

The use of tablets, combined with Blockchain, will save time by eliminating repetitive data entry. The cryptographic potential of Blockchain eliminates security issues and data loss. This is vital due to HIPPA regulation. The risk of data loss becomes a non-issue.

Security

In 2014, the FBI warned healthcare companies that hackers were interested in their data. Later, the government created bitcoin to catch criminals engaging in illicit activity. This threat has only intensified in the following years (Finkle J, Aug14) with most cyber-attacks in the healthcare industry starting in 2015 when over 100 million records got hacked, according to IBM (TechTarget, Mar19). A report from Cybersecurity Ventures predicts that in 2019 businesses will be hit with ransomware attacks every fourteen seconds resulting in \$11.5 billion in losses (TechTarget, Mar19). According to the 2018 Protenus Breach Barometer Report, 15+ million patient records were compromised in 503 cyberattacks in 2018 (Freeze, D, Oct18). Of these 44% was due to hacking, 28% due to insider error or wrongdoing (19% to error and 9% to wrong-doing), 14% due to loss and 14% is unknown (Freeze, D., Oct18). This shows us that while there is an increase in malicious hacking attempts geared towards healthcare records, there is still an unacceptable percentage of patient data breached to error. The average cost of a healthcare security breach is \$10 million (TechTarget, Mar19).

The Breach Barometer report points out that patient data leaked from 70% from the healthcare provider, 10% from business associates, 12% from health plans and 8% from other (Freeze, D, Oct18). It also notes 89/503, roughly 18% of the data breaches occurred from paper records (Freeze, D, Oct18).



The cost of a healthcare data breach in 2018 is alarming, but maybe even more unsettling is that it took on average 255 days to detect the data breach, with some taking as long as four years to uncover (Freeze, D, Oct18). This is especially disconcerting when there is one healthcare data breach per day since 2016 (Freeze, D, Oct18).

In addition to paying ransom figures, hospitals and healthcare providers lose revenue when they are unable to function due to loss of access to patient records and reorganizing records after a breach (Protenus, Feb19).

One reason healthcare data is so attractive to hackers, is that the data obtained- social security number, birthday, etc. cannot be changed, resulting in double the price of a credit card number- roughly \$100/ name and social security number on the black market (Protenus, Feb19).

Carl Wright from TrapX Security Inc. stated that cybersecurity in “healthcare is at least five years behind (CDW, June18).”

Enigma CEO, Guy Zyskind describes a current problem in data encryption:

Currently, there’s really no option for computing over encrypted data in the market. The result is that we can only encrypt data at rest (i.e. while being stored on disk) or in-transit (sending over the wire), but not in-use. This means that when we process data, in whatever way or form, we end up decrypting it. This poses the usual risks associated with data breaches — an attacker with access to a system can see the plain-text data (Costofabreach, Feb19).

While these facts are startling, there are preventative measures that Meharry can take to guard against and prevent future attacks. We suggest utilizing a private Blockchain structure to organize patient records. Operating on a private, permissioned Blockchain will ensure that only those with credentials are able to access the data, ensuring data control for Meharry. Adding biometric identification, such as fingerprint scanners, is another added form of security.

Data

Data Integrity and Transparency

In addition to heightened security features, the Blockchain will make all patient records immutable securing them against data breach due to loss. This reduces time lost due to searching for a patient record, and missing, incomplete or incorrect records. Blockchain and biometric identification would ensure that practitioners have the proper credentials, compliant with HIPAA to view and edit patient data (Dickson, B., Dec16).

In a 2018 interview with FierceHealth Optimum engineer Mike Jacobs stated "The Blockchain could or should be used as a means of tracking whose record is accessed and who is supposed to have access to a record." If linked with providers and government agencies, Blockchain can also provide price and payment transparency, which will eliminate lag time in insurance pricing disputes and present an even playing field for patients. This is optimal since HIPAA does not cover payment information (Dickson, B., Dec16).

Incomplete or incorrect records result in payment delays and multiple lost hours for claims management. This can delay Medicaid reimbursements that are the primary source of funding for the mobile unit. Blockchain can help eliminate this, allowing more speedy reimbursement process. Additionally, inaccurate information for referrals results in delays as well (Managed, Jan17).

University of Minnesota professor's research that projects 30-40 percent of medical bills contain errors. A report from the Medical Billing Advocates of America estimates that as many as 80 percent of all medical bills include incorrect information. Another study from NerdWallet found that about 50 percent of the Medicare claims they examined involved some type of inaccuracy. The errors include: edits, CCI issues (inappropriate coding), unbundling (billing for multiple procedures covered by one comprehensive code), MUE errors (medically unlikely edits and other (i.e. Incorrect Data Entry) (Lamontagne, C., Oct14).

According to a 2017 report from enterprise systems company, Unit4, the average office worker spends 69 days completing repetitive tasks, resulting in \$5 trillion lost global productivity (Mishchenko, A, Jun18). About \$2.1 billion is lost in the healthcare space due to hospitals, doctors, and insurers doing repetitive administrative tasks (Magowan, K., Oct18). The *Harvard Business Review* estimates that the US economy loses \$7.4 billion a day for these same repetitive tasks (Ayyar, K., Sept18). In Meharry's specific situation, we estimate that by utilizing a Blockchain application we can save them 750 hours/year that can be spent treating patients (See Appendix).

Shareability

This is perhaps the most important benefit from placing the data to a blockchain. With more participants on the network, the network effects will be amplified. Insurance providers, specialists and government agencies, with permission and verification, will receive instantaneous access to patient records. This will cut back on time lost interacting with patients, searching for and faxing medical records.

Currently, healthcare data is siloed based on the organization due to regulatory reasons. The use of Blockchain presents the platform to integrate this data and work together. This also presents an opportunity for mutual benefit. Usage and shareability are the hallmarks of this technology and will allow institutions to mutually benefit from their indexable data.

What's more, it has been regarded that "Better data sharing between healthcare providers means a higher probability of accurate diagnoses, more effective treatments, and the overall increased ability of healthcare organizations to deliver cost-effective care (IBM Healthcare, Oct17)." The basis of this business plan has been the feasibility of financially providing proper dental care to a severely underserved population. What we forget is the impact of the actual care the patients are receiving. This is life changing event for most of these patients. This must be first and foremost the purpose of this project.

Medical Advancement

In addition to allowing access to Blockchain to Meharry practitioners, specialists, government agencies and insurance agencies, there is much to be gained from sharing data with medical research institutions, like Johns Hopkins University and additional partner universities and colleges.

Of the NIH 2016 Research highlights, 6/8 highlights came from universities (Gillies, T., Dec18). According to Rush University, collaboration is what drives innovation and medical research (NIH, Jan17).

Patient Empowerment

Medical Record Retrieval - Consumer makes initial inquiry: To start, consumers call their provider's office to figure out how to send their records to another health care provider (or get their own copy). Consumer requests the records: usually, this means filling out an authorization form. Consumers might have to go online, download the form, print it, and then mail or fax it in. Or they may need to go to the records request office and fill out a form in person. Occasionally, health care practices ask consumers to write a letter authorizing release of their records. Consumer waits: This is a bit of a black hole for consumers — they're often in the dark about how long the process takes (up to 30 days under HIPAA) or when they can expect to hear back (MIT, Aug16).

Granting patients access to their own health records allows them to work with a provider of their choosing regardless of insurance plan (this is ignoring additional financial costs). Patients will also be aware of their treatments and procedures. Apple and the US Veterans Association are initiating a program where Veterans will have access to their medical records on their cell phones. Apple's VP of technology, Kevin Lynch said "For veterans, we think it's going to be very empowering (Ollove, M., Aug18)."

Demand for Blockchain Networks

Due to the large amount of compromised healthcare, there is great demand for the use of Blockchain in the healthcare industry (Communicatehealth, Jun17). According to a report from Black Book Market Research, October 2017, 29% of hospital executives have a working knowledge of Blockchain technology and 19% of hospital executives and 76% of insurance companies were interested in or in the process of executing Blockchain technology within their organization (Mayo, Mar19). Microsoft launched the Coco Platform in 2017 to create uniformity among systems to enhance the network effects. IBM released a similar solution on their Hyperledger platform called Helios (HITInfrastructure, Aug17). Humana, United Healthcare, Optum, MultiPlan and Quest Diagnostics are creating a Blockchain pilot to share data (Virtualhealth, Feb19).

Competition

Mid-South Mission of Mercy sees roughly 2,000 patients over a period of two days each January. They estimate to provide \$1M in free services to those in need (CAQH, Feb19).

Christian Mobile Dental Clinic began in 2007 and since then has seen over 12,000 patients and provided over \$4M in free or reduced services at churches to those who will listen to their gospel (Mid-South, Mar19).

Wallace Mobile Healthcare, Inc. 501(c)(3) provides basic healthcare, screenings, and wellness education to underserved communities (Ingram, L., July18).

Christ Community Dental Center and Church Health Dental Clinic in Memphis provides affordable dental care to Memphis residents (Bellevue, Feb19) (ChristCommunity, Feb19).

Colgate Bright Smiles, currently offers nine state-of-the art, mobile dental vans provide children ranging from three to 12 years of age all receive free dental check-ups, treatment referrals (if needed), and learning materials

District Mobile Dental, is a Gaithersburg, Maryland based concierge oral healthcare company providing on demand in-residence dental services in Maryland, Virginia and the District of Columbia, with a specific focus in caring for older adults and those with disabilities.

Tennessee State University Dental Hygiene Clinic: Dental Hygiene students provide the oral health care services under the direct supervision of licensed dental hygienists and dentists.

Partners

Currently Meharry is working with the US government, the United Methodist Church and the Elgin Foundation to provide dental care to the underserved population of institutionalized youth. Meharry will start to serve adults aged 60+ in the near future.

America's Dentists Care

America's Dentists Care will donate a 100-foot or 40-foot dental clinic trailer to treat patients in underserved areas. Additionally, they provide support on how to start a free clinic as well as how to recruit volunteer support. Meharry could set up a clinic in rural Tennessee and then use funds to transport patients to and from the clinic. This could be a great way to treat additional patients before Meharry purchases more mobile dental clinics (Churchhealth, Feb19).

Uber/Lyft

Meharry could partner with Uber and/or Lyft once a year - they provide transportation to and from the clinic in exchange for goodwill publicity. Last year Uber launched UberHealth where they provided free rides to patients, paid for by the doctors offices, going to and from health appointments (ADCF, Feb19). Currently it appears that UberHealth is not free to the patient, but the same cost of Uber transportation. According to www.Uberhealth.com, UberHealth offers their API's and data for healthcare research. It sounds like the perfect partnership.

Education Partners

Massachusetts Institute of Technology, (MA) - MIT released a white paper along with Beth Israel entitled *A Case Study for Blockchain in Healthcare: "MedRec" prototype for electronic health records and medical research data* (Day, J.A., Dec16). With their interest in healthcare and Blockchain, we hope they would want to collaborate.

University of Maryland, (MD) - UMD operates WellMobile, a mobile clinic, that provides "primary and preventive care to underserved" communities in Maryland (UMD, Mar19).

Johns Hopkins Medicine, (MD) - Care-A-Van is operating in select locations offering primary care, blood testing, immunizations and education on various health-related topic.

Harvard Medical School, (MA) - The Family Van provide healthcare for underserved and alienated communities in Boston. They run a sister project, Mobile Health Map, which provide information about Mobile Health Clinics locations nationwide and function as a hub for research communities. This program help mobile health units measure their impact and contribute their data to study the impact of the mobile health sector as a whole (Potential partner to expand the Blockchain network and customer to buy data).

Cleveland Clinic (OH) - Mobile Stroke Unit offer a service to shorten the time between the onset of a stroke-like symptoms and the delivery of needed drugs. They function mainly in Cuyahoga County, Cleveland. The unit is equipped with a CT scan that is wirelessly connected to the brick-and-mortar clinic, where it is deciphered and analyzed. Unit is integrated in the 9-1-1 system for optimal delivery. Institute and donors are oriented towards research the effect of mobile health care delivery (Potential partner for sharing data) (Cleveland Clinic, Feb19).

Mayo Clinic, (NY) - Currently is exploring technology integration into healthcare through Telehealth, which uses digital information and communication technology to offer/use healthcare services remotely.

This is a prime partner due to the significant of data they generate and we could work together in integrating their database into our Blockchain hyperledger (Mayo Clinic, Feb19).

Stanford Lucile Packard Children's Hospital (CA) - With a return visit rate, the Teen Van offer expert care and compassion to patients that rely solely on the program for healthcare. The program has been functioning since 1996, and would be a great partner for sharing expertise and data.

Potential Community Partners

Educators Use current educators with public schools, teaming with Meharry student, to educate the youth populations in hopes of changing current public misconceptions into dental care

Local & Non-Local Dentists: Host oral health drives and hang promotional materials in their clinics so their patients will be aware of our program. Awareness can result in 1) donations, 2) suggestions for state institutions to work with, 3) government official awareness. Oral health drives can help Meharry acquire 1) dental supplies (tooth brushes, tooth paste, floss, fluoride), 2) healthy, sugar-free snacks, 3) funding.

Grocery stores - Host supply drives for 1) dental supplies (toothbrushes, toothpaste, floss, etc., 2) sugar-free snacks, and education on healthy eating.

Farmers - Donate fruits and vegetables to the state institutions vs high sugar alternatives as well as assist in setting up community gardens at the institutions so students can grow their own healthy foods.

Additional Sources of Revenue

Medicaid Proofing

In the state of Tennessee, the maximum Medicaid reimbursement rate for a dental patient encounter is \$110. This is mandated to cover the diagnosis and treatment of oral care. Unfortunately, this is not what is required for each patient. Rather than a standardized amount, the cost should be dependent on the treatment needed.

Common arguments against increasing these Medicaid reimbursement rates are proving that the increases are need and will be used for the true care of patients. Historically there has not been a mechanism to ensure that the dollars spent are reaching patients in an efficient manner.

The use of Blockchain and immutable data can solve this problem. The very nature of Blockchain's cryptographic potential will allow institutions to prove dollar costs for treatment without the potential for waste.

The most important component of this process is the identification of patients. With the use of a biometric identification process we can essentially eliminate potential patient fraud in this process. This is the most important aspect of using Blockchain. Having an irrefutable source of treatment cost using the cryptologic capabilities of Blockchain can insure that the monies required to treat patients is the actual cost of treating patients.

This is a repeatable process that can be evaluated at any time. Should regulators require an audit of what the true cost of a patient encounter, the use of Blockchain is able to deliver without the potential for fraud. At any time indexed data within the Blockchain can be accessed to insure costs equal reimbursements.

Putting patient EHR on Blockchain would have a privacy and security effect. There would be one true copy of each record in one place, making it easy to control the follow of and access to data. Due to the technology's architecture, Blockchain offers a secure way to store data.

Blockchain Healthcare Platform

It is expected that the global blockchain industry will reach a \$60 billion valuation by the year 2024 (Wallacemobile, Feb19), and healthcare being the most hacked industry, it makes sense that several healthcare organizations would like to move their data to a Blockchain program (Office, 2017).

We anticipate it to cost \$60,000 - \$80,000 to build the blockchain. This number is based off estimates from SoKat.co software engineers. Due to the sensitivity of the data and necessity of HIPAA compliance, we strongly discourage cutting costs by hiring offshore talent. The average hourly rate for a blockchain engineer is \$55/hour and the average salary of a Blockchain engineer is \$96,545, according to paysa.com and \$79,985 according to Glassdoor.com.

We anticipate cost recuperation to occur rather quickly, compared to investments of the same amount - for example in real estate or in the stock market- where it takes almost a decade to return your initial investment.

Blockchain Systems

We recommend franchising the system and setup of our completed project to other dental colleges as an additional revenue stream for Meharry. There are some pilot programs, such as the Center for Biomedical Blockchain (Engler, N.J., Feb19), but no working models (VirtualHealth, Feb19). Since there are currently no working systems (VirtualHealth, Feb19), we anticipate this to be an easy sell. All parties will benefit from the shared data.

Data for Research

1. Unlimited Access- We suggest charging \$25,000 for annual unlimited access for research institutions and organizations to access Meharry's data after speaking with Research Professor Jim Liew at Johns Hopkins University.
2. Pay-per-use - We suggest a pay-per-use option for researchers and institutions that do not need annual access to data. The rate we suggest is \$1,500.

Venture Capital

Due to the nature of medicine in Tennessee there are a significant number of private practices that operate in the hospital systems. This has caught the interest of Private Equity and Venture Capital firms looking to capture the consistent cash flow a practice generates on a yearly basis.

Grants

Secure additional grants. Examples from the CDC below:

- <https://www.grantsolutions.gov/gs/preaward/previewPublicAnnouncement.do?id=63272>
- <https://www.grants.gov/web/grants/search-grants.html>

Solicit donations from national oral health brands, national dental foundations, Tennessee Foundations, individuals, pharmaceutical companies, medical device companies, etc.

Look into receiving funding from the School Based Dental Prevention Program (SBDPP) which provides sealants on school-aged children (Black, Mar19).

NIH Data Sharing Requirements:

When applying for certain Grants the applicant must understand the data sharing requirements of the application. To collect the data and silo it in a permissioned database may not result in a favorable grant approval. There are requirements for the sharing of collected data when a grant is awarded. The requirements for data sharing are vital for this project to be transcending.

For example, the NHI requires a data sharing agreement that is put in place prior to any grant approval (NIH, Mar19).

Future Monetization of Data

The use of Blockchain in conjunction with Meharry's database will allow Meharry to fundamentally change the framework and delivery of care to patients. With organized immutable data held on their database, Meharry now has the ability to integrate with other institutions surrounding patient care in order to insure the delivery of care is state of the art.

Meharry will also allow data to be used for research purposes. The ability of Meharry to access patient records quickly due to potential AI algorithms will allow researchers to test theories in really time. Unfortunately the current method of gathering information requires a significant amount of time and money to be spent gathering the information for research studies.

Donation Projections

If you can partner with 100 dentistry offices across the state to offer to round up their costs to the nearest dollar and donate the change to Meharry, we estimate that from this funding alone Meharry can raise 100 clinics x \$0.50/patient x 25 patients/ day x 156 days/year = \$195,000 year in \$0.50 donations.

We estimate that if you follow this business plan we believe that you will add an additional \$10MM in NPV going forward.

Marketing and Public Relations for the Program

Total Addressable Market (TAM) (From Wallethub)

1.3 million Medicare beneficiaries in Tennessee

Uninsured children: 4.4%

Uninsured adults: 11.14%

National

Uninsured children: 5%

Uninsured adults: 9.93%

Community Outreach and Education

Currently Meharry is not participating in community outreach and education through the mobile dental clinic.

In line with the Tennessee Oral Health Plan and the Meharry Medical College mission statement and vision, we suggest the following community outreach and education initiatives:

- Dental health presentations showing how to properly brush and floss teeth and presenting the damaging effects of sugary foods and tobacco to the teeth.
- Pamphlets, posters and other POS to be displayed in the institution cafeterias emphasizing the importance of oral health, how to brush and floss teeth and the damaging effects of sugar and tobacco to the teeth.
- Toothbrush drive: Partner with national brands to ensure the underserved population has a new toothbrush every three months.
- Sugar-free initiative: Partner with a national snack or beverage brand to provide sugar-free and low-sugar alternatives to the underserved population.

Marketing Initiatives

- *Meharry Smiles* campaign
 - Create brochures of children smiling to highlight Meharry accomplishments community partners - grocery stores, local dentist offices, pediatrician offices, local government offices, state fairs. These brochures will have a form so friends can send tax-deductible contributions to Meharry.
 - Create merchandise to sell to promote the program- t-shirts, koozies, baseball hats, etc. where donors receive a gift with donation and the gift will act as additional advertisements.
 - Host a dinner where proceeds benefit Meharry.

Publications

- PennWell's *RDH Graduate*

Program Expansion

Truck Expansion

We suggest the purchase one truck/year over the next four years. Since the program only operates during the academic school year - ten months/ year- we believe scaling one truck at a time is an appropriate rate of increase to expand the program across Tennessee. We were told four trucks is the optimal amount of trucks to cover all three of the main regions in Tennessee with an extra truck - East, West and Middle.

Currently the TennCare Medicaid program only covers dental care for youths aged <18 and the elderly aged 60+. Until legislation changes this is the population that we need to focus on. We hope that in the future this program will address all adults.

Once this model is proven in Tennessee, we hope that other states will be able to utilize the same process and framework.

Data Expansion Plan

The first phase of data sharing will just be between Meharry and Johns Hopkins University. We hope to grow this program at a rate of five research universities a year, as a very conservative estimate.

In addition to sharing data with universities, we anticipate that insurance companies and pharmaceutical companies would also be interested in purchasing data for research purposes.

Data Framework System

Since there is currently no universal blockchain network in the healthcare industry, we plan to sell our framework to hospitals, insurance providers, government agencies and research institutions.

Artificial Intelligence Models

One of the most significant benefits of having the data on a blockchain is being able to build predictive models on top of the data.

Effects on Insurance Industry

The models used to predict risks, and insurance premiums currently used by actuaries use older data. We expect that with data we can perform real-time risks assessments. This will make each risk assessment current up-to-the-minute. Knowing real-time risk assessment can create more accurate insurance premiums which will save significant money in the long-run.

Meharry Mobile Clinic

Mobile unit:

The mobile unit is a 65-foot semi trailer that houses 5 dental bays. There are also x-ray and autoclave capabilities within the unit. It is powered by a diesel generator and carries its own water for procedures. When in transport, a driver is hired to hook on to the unit and transport it to the next location.

Current mobile unit staffing:

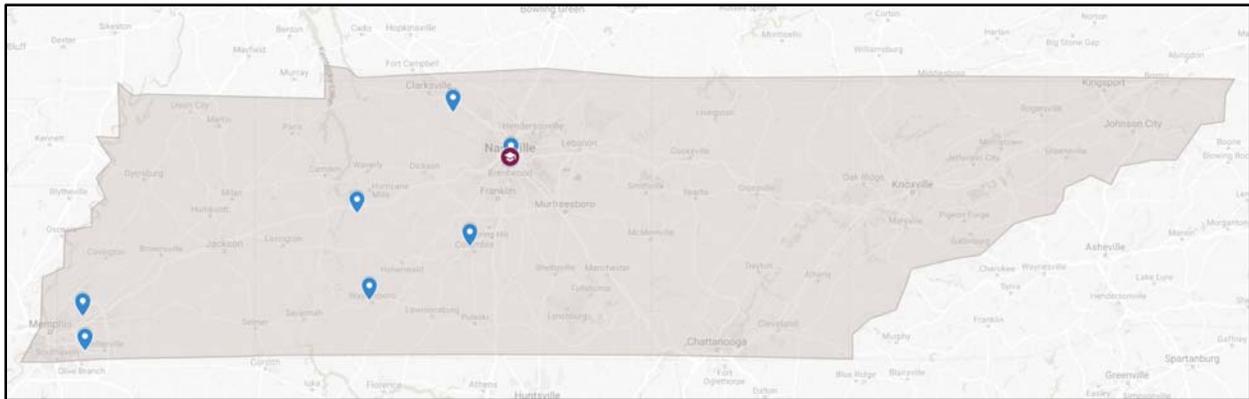
- The mobile unit is staffed with seven (7) individuals:
- (1) senior dentist
- (4) dental students
- (2) dental assistants.
- (1) manager that oversees the daily operations of the mobile unit
- (1) driver paid on a contract basis

Current list and description of centers visited

Center	Description	Address	Distance to Meharry
Compass Intervention Center	Addiction Treatment Center	7900 Lowrance Road, Memphis, TN 38125	208 mi.
Youth Villages: Barlett Campus	Helping emotionally and behaviorally challenged children	7410 Memphis Arlington Rd, Memphis TN 38135	195 mi.
Natchez Trace Youth Academy	Residential Treatment Facility; cognitive behavioral treatments; all-male; ages 12-17	415 Seven Hawks Lane Waverly, TN 37185	74 mi.
Oak Plains Academy	Foster Care from children with therapeutic needs	1751 Oak Plains Road Ashland City, TN 37015	40 mi.
Hermitage Hall	Specializes in helping children who	1220 8th Avenue South	4 mi.

	had traumatic experiences	Nashville, Tennessee 37203	
Wayne's Half-Way House	Half-way house for youth males who exit the state custody program	942 Andrew Jackson Dr. Waynesboro, TN 38485	104 mi.
Middle TN Juvenile Detention Center	Juvenile Inmates	1272 Lawson White Dr, Columbia, TN 38401-1609	49 mi.

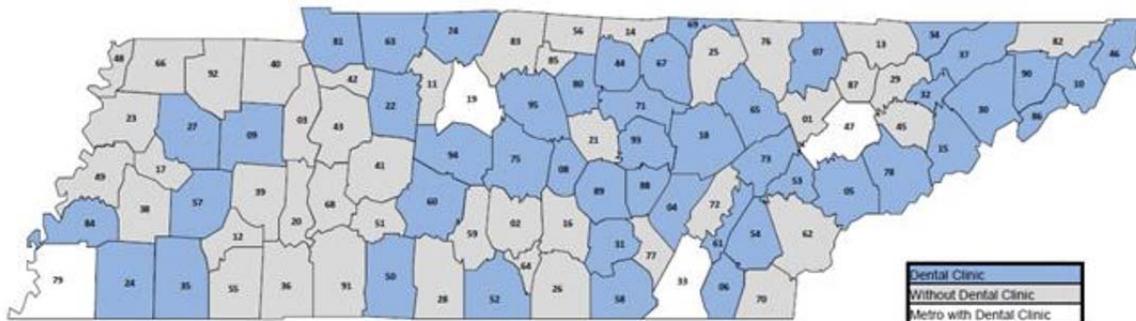
Map of centers serviced by the mobile dental clinic:



Dental Clinics in Tennessee

The map below shows the amount of TN public Health Dental Clinics from the Tennessee Department of Health, updated May 20, 2017.

Figure 2 – Tennessee Public Health Dental Clinics



Calculation of Costs

Current

Current cost of the Data Science institute at Meharry Medical College is \$1.35MM per year. They have a 3 year contract. The costs include, real-time data ingestion, all things data management, storing the data,

cybersecurity, data encryption, and personnel costs. The portion associated with Meharry School of Dentistry accounts of 30% of this annual cost or \$405,000.

The data is organized and accessible through search algorithms and manual search. To index and maintain this data for rapid access would cost \$180,000. This figure include hot and cold storage costs as well as maintenance spending.

Meharry's data sharing policy specifically states that all data is never to leave the Meharry ecosystem in its physical form. However, access this information will be permissioned on a subscription basis. To insure Meharry's costs associated with data storage and access are satisfied we need to make assumptions of the number of users that will request access. For this purpose, we will assume a linear growth model, peaking at 17 users after year 10.

Calculation of cost savings

Mobile unit practitioners are recording patient data multiple times - first when a patient gets admitted to an institution, second to paper while on the mobile unit, and then third entering the data into a computer.

Digitizing this information so student practitioners only have to enter the information once can save roughly 450 minutes of entering information into the computer, roughly 7.5 hours/ day of repetitive data entry work, or 750 hours/ annual program. This figure is based on the estimate of seeing thirty patients/day, entering data for 15 minutes/patient and the program duration of 100 days/year.

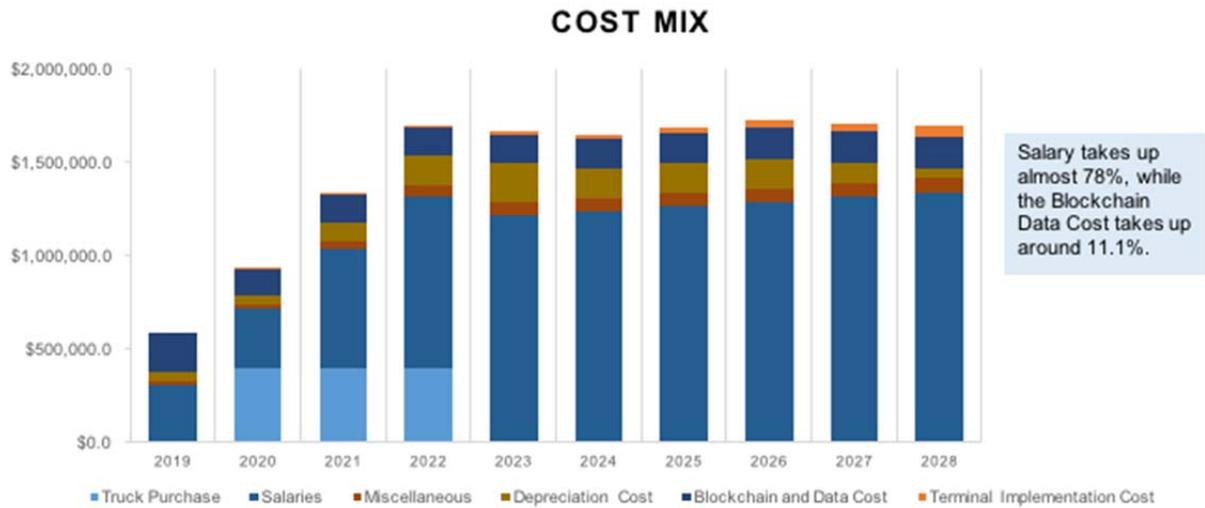
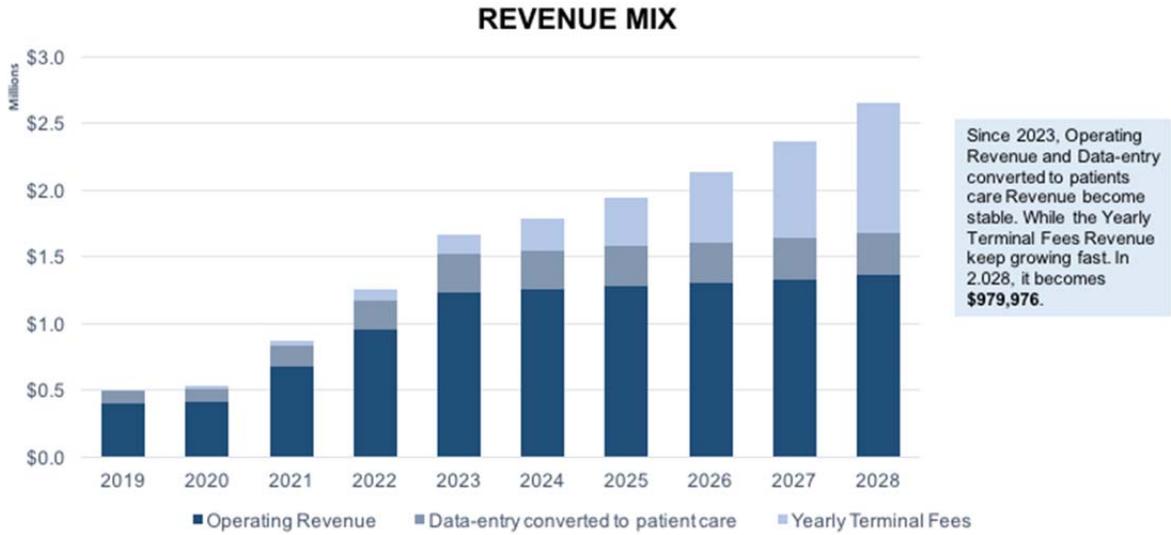
Oral Health

Health Conditions Related to Oral Health

- Gum disease increases the risk of head and neck cancer. - AAOSH
- Diabetes and bleeding gums increases your risk of premature death by 400-700 percent. - American Academy for Oral Systemic Health
- People with gum disease are twice as likely to die from stroke. - Mayo Clinic
- Gum disease increases pancreatic and kidney cancer by 62%. - Harvard
- 93% of people with gum disease are at risk for diabetes. - AAOSH
- The Surgeon General reports that 80+% of Americans have gum disease. - AAOSH
- Tooth decay affects half of US adolescents age 12-15. - CDC
- 25% of adults age 65+ have gum disease. - CDC
- 25% of US adults 65+ have lost all of their teeth.- CDC
- 7,800+ adults, mostly older, die from mouth and throat cancers a year. - CDC
- Asthma puts you at risk for dental conditions. 24 million Americans have asthma.- CDC
- Tooth decay is the most common chronic disease for adolescents aged 12-19 years. - CDC
- Is there a link between Alzheimer's and poor dental hygiene. - Mayo Clinic

Financial Calculations

- Revenue mix and Cost mix:



- Comprehensive income statement with cash flow valuations and required investment calculations:

Income Statement With Blockchain Solution										
Year	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Mobile truck (optimal)	1	1	2	3	4	4	4	4	4	4
Total Working Days	5	5	8	11	14	14	14	14	14	14
Work days per year per truck	100	100	100	100	100	100	100	100	100	100
Average patients per bay/care giver	7	7	7	7	7	7	7	7	7	7
Patient per day	37	37	59	81	103	103	103	103	103	103
Average charge per patients	\$110	\$112	\$114	\$117	\$119	\$121	\$124	\$126	\$129	\$131
Operating Revenue	\$406,154	\$414,277	\$676,100	\$948,230	\$1,230,975	\$1,255,595	\$1,280,707	\$1,306,321	\$1,332,447	\$1,359,096
Data-entry converted to patient care	\$93,728	\$95,602	\$156,023	\$218,822	\$284,071	\$289,753	\$295,548	\$301,459	\$307,488	\$313,638
Number of Terminals (incremental)	0	1	2	4	7	11	16	23	31	41
Yearly Fee per Terminal	\$ 20,000	\$ 20,400	\$ 20,808	\$ 21,224	\$ 21,649	\$ 22,082	\$ 22,523	\$ 22,974	\$ 23,433	\$ 23,902
Yearly Terminal Fees	\$0	\$20,400	\$41,616	\$84,897	\$151,541	\$242,898	\$360,372	\$528,395	\$726,429	\$979,976
Total Revenue	\$499,882	\$530,279	\$873,739	\$1,251,949	\$1,666,587	\$1,788,245	\$1,936,626	\$2,136,175	\$2,366,364	\$2,652,709
Truck Purchase	\$0	\$400,000	\$400,000	\$400,000	\$0	\$0	\$0	\$0	\$0	\$0
Blockchain Implementation cost	\$60,000	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Driver Salary	\$56,000	\$57,120	\$116,525	\$178,283	\$242,465	\$247,314	\$252,260	\$257,306	\$262,452	\$267,701
Senior professor	\$125,000	\$127,500	\$260,100	\$397,953	\$541,216	\$552,040	\$563,081	\$574,343	\$585,830	\$597,546
Mobile manager	\$54,000	\$55,080	\$114,610	\$116,903	\$119,241	\$121,626	\$124,058	\$126,539	\$129,070	\$131,651
Assistant (2)	\$72,000	\$73,440	\$149,818	\$229,221	\$311,740	\$317,975	\$324,335	\$330,821	\$337,438	\$344,187
Terminal Costs	\$0	\$6,000	\$6,000	\$12,000	\$18,000	\$24,000	\$30,000	\$42,000	\$48,000	\$60,000
Maintenance & Operation	\$1,500	\$1,530	\$3,121	\$4,775	\$6,495	\$6,624	\$6,757	\$6,892	\$7,030	\$7,171
Medical Miscellaneous	\$9,231	\$9,415	\$15,366	\$21,551	\$27,977	\$28,536	\$29,107	\$29,689	\$30,283	\$30,889
Operational Miscellaneous (gas)	\$7,857	\$8,014	\$16,349	\$25,014	\$34,019	\$34,700	\$35,394	\$36,102	\$36,824	\$37,560
Depreciation Cost	\$53,333	\$53,333	\$106,667	\$160,000	\$213,333	\$160,000	\$160,000	\$160,000	\$106,667	\$53,333
Data-Base and Blockchain Cost (Hot)	\$36,000	\$36,720	\$37,454	\$38,203	\$38,968	\$39,747	\$40,542	\$41,353	\$42,180	\$43,023
Data-Base and Blockchain Cost (Cold)	\$144,000	\$146,880	\$149,818	\$152,814	\$155,870	\$158,988	\$162,167	\$165,411	\$168,719	\$172,093
Total Cost	\$618,921	\$975,033	\$1,375,828	\$1,736,717	\$1,709,324	\$1,691,650	\$1,727,701	\$1,770,455	\$1,754,491	\$1,745,154
Net Income	\$ (119,040)	\$(444,754)	\$(502,089)	\$(484,768)	\$(42,737)	\$ 96,695	\$ 208,925	\$ 365,719	\$ 611,873	\$ 907,555
Net Income Ratio	\$ (0)	\$(1)	\$(1)	\$(0)	\$(0)	\$ 0	\$ 0	\$ 0	\$ 0	\$ 0
Valuation Calculation										
Period	\$ -	\$ 1	\$ 2	\$ 3	\$ 4	\$ 5	\$ 6	\$ 7	\$ 8	\$ 9
Cash Flow	\$ (65,706)	\$(391,420)	\$(395,422)	\$(324,768)	\$ 170,596	\$ 256,695	\$ 368,925	\$ 525,719	\$ 718,539	\$ 960,889
Terminal Value										\$11,571,330
PV Multiple	\$ 1	\$ 1	\$ 1	\$ 1	\$ 1	\$ 1	\$ 1	\$ 1	\$ 0	\$ 0
PV	\$ (65,706)	\$(355,837)	\$(326,795)	\$(244,003)	\$ 116,520	\$ 159,387	\$ 208,249	\$ 269,777	\$ 335,204	\$ 5,314,884
Project w BC Value	\$ 5,411,679									
Initial Investment and ROI Calculation										
Investment (grant)	\$65,706	\$355,837	\$326,795	\$244,003	\$0	\$0	\$0	\$0	\$0	\$0
Investment needed today	\$992,341									

Operations Assumptions	
65	min/patient assumption
8	Hours/day
5%	Growth in data rev.

Storage Costs	
20%	Hot Storage
80%	Cold Storage

10%	RR
2%	Growth
2%	Inflation
2.5	Diesel price
375	Gas price

- Comprehensive income statement and valuation of the program without the blockchain solution:

		Income Statement Without Blockchain Solution									
Year		2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
As assumptions	Mobile truck (optimal)	1	1	2	3	4	4	4	4	4	4
	Total Working Bays	5	5	8	11	14	14	14	14	14	14
	Work days per year per truck	100	100	100	100	100	100	100	100	100	100
	Average patients per bay/care giver	8	8	8	8	8	8	8	8	8	8
	Patient per day	36.9230769	36.9230769	59.0769231	81.2307692	103.384615	103.384615	103.384615	103.384615	103.384615	103.384615
	Average charge per patients	\$110	\$112	\$114	\$117	\$119	\$121	\$124	\$126	\$129	\$131
revenue	Operational Revenue	\$440,000	\$448,800	\$732,442	\$1,027,249	\$1,333,556	\$1,360,228	\$1,387,432	\$1,415,181	\$1,443,484	\$1,472,354
Total Revenue		\$440,000	\$448,800	\$732,442	\$1,027,249	\$1,333,556	\$1,360,228	\$1,387,432	\$1,415,181	\$1,443,484	\$1,472,354
Variable cost	fixed cost	truck	\$0	\$400,000	\$400,000	\$400,000	\$0	\$0	\$0	\$0	\$0
	Driver Salary	\$56,000	\$57,120	\$116,525	\$178,283	\$242,465	\$247,314	\$252,260	\$257,306	\$262,452	\$267,701
	Senior professor	\$125,000	\$127,500	\$260,100	\$397,953	\$541,216	\$552,040	\$563,081	\$574,343	\$585,830	\$597,546
	Mobile manager	\$54,000	\$55,080	\$114,610	\$116,903	\$119,241	\$121,626	\$124,058	\$126,539	\$129,070	\$131,651
	Assistant (2)	\$72,000	\$73,440	\$149,818	\$229,221	\$311,740	\$317,975	\$324,335	\$330,821	\$337,438	\$344,187
	Maintenance & Operation	\$1,500	\$1,530	\$3,121	\$4,775	\$6,495	\$6,624	\$6,757	\$6,892	\$7,030	\$7,171
	Medical Miscellaneous	\$9,231	\$9,415	\$15,366	\$21,551	\$27,977	\$28,536	\$29,107	\$29,689	\$30,283	\$30,889
	Operational Miscellaneous (gas)	\$7,857	\$8,014	\$16,349	\$25,014	\$34,019	\$34,700	\$35,394	\$36,102	\$36,824	\$37,560
	Depreciation Cost	\$53,333	\$53,333	\$106,667	\$160,000	\$213,333	\$160,000	\$160,000	\$160,000	\$106,667	\$53,333
	Database Cost	\$400,000	\$408,000	\$416,160	\$424,483	\$432,973	\$441,632	\$450,465	\$459,474	\$468,664	\$478,037
Total Cost		\$778,921	\$1,193,433	\$1,598,716	\$1,958,183	\$1,929,489	\$1,910,448	\$1,945,457	\$1,981,166	\$1,964,256	\$1,948,075
Net Income		\$ (338,921)	\$ (744,633)	\$ (866,274)	\$ (930,934)	\$ (595,902)	\$ (550,220)	\$ (558,025)	\$ (565,985)	\$ (520,772)	\$ (475,721)

Operations Assumptions	
60	min-patient assumption
8	Hours/day
5%	Growth in data rev.

- Calculations of the increased number of patients seen due to technology efficiencies:

Data-entry converted to patient care

Assumption:

1. average saved time per patients after BC 15 min
2. Average work days per year for 7 location 100 days
3. Average appointment time 65 min

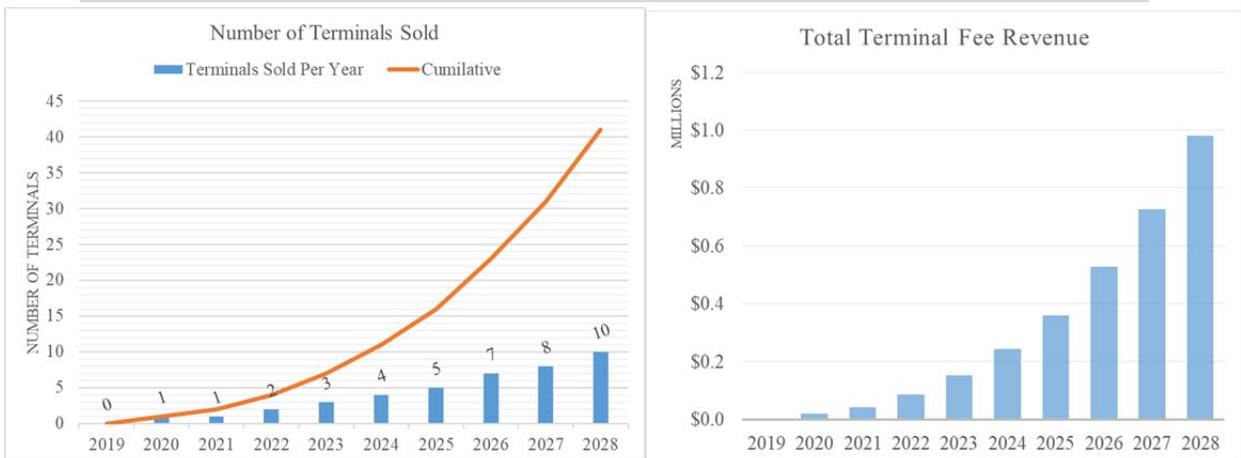
Year	Average charge per patient	Patients Per	The time saved per patient	# of added patients per day	revenue increased
2019	110	37	553.8461538	9	\$93,728
2020	112	37	553.8461538	9	\$95,602
2021	114	59	886.1538462	14	\$156,023
2022	117	81	1218.461538	19	\$218,822
2023	119	103	1550.769231	24	\$284,071
2024	121	103	1550.769231	24	\$289,753
2025	124	103	1550.769231	24	\$295,548
2026	126	103	1550.769231	24	\$301,459
2027	129	103	1550.769231	24	\$307,488
2028	131	103	1550.769231	24	\$313,638

- Terminals Sales calculations:

Terminals Sale Calculations

Years	Incremental: # of Inst./ Terminals Per Inst.	0	1	1	1	2	2	2	3	3	3	Term. /Year
2019	1	0										0
2020	0	0	1									1
2021	1	0	0	1								1
2022	0	0	1	0	1							2
2023	1	0	0	1	0	2						3
2024	0	0	1	0	1	0	2					4
2025	1	0	0	1	0	2	0	2				5
2026	0	0	1	0	1	0	2	0	3			7
2027	1	0	0	1	0	2	0	2	0	3		8
2028	0	0	1	0	1	0	2	0	3	0	3	10

Year	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Terminals Sold Per Year	0	1	1	2	3	4	5	7	8	10
Cumulative	0	1	2	4	7	11	16	23	31	41
Yearly Fee per Term.	\$20,000	\$20,400	\$20,808	\$21,224	\$21,649	\$22,082	\$22,523	\$22,974	\$23,433	\$23,902
Total Fee Rev	\$ -	\$20,400	\$41,616	\$84,897	\$151,541	\$242,898	\$360,372	\$528,395	\$726,429	\$979,976



- Calculations of Depreciation:

Depreciation Calculations

Period	6									
Cost	\$400,000									
Salvage	\$ 80,000 20%									
Dep/period	\$ 53,333									
Year	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Truck 1	\$ 53,333	\$53,333	\$ 53,333	\$ 53,333	\$ 53,333					
T 2			\$ 53,333	\$ 53,333	\$ 53,333	\$ 53,333	\$ 53,333	\$ 53,333		
T 3				\$ 53,333	\$ 53,333	\$ 53,333	\$ 53,333	\$ 53,333	\$ 53,333	
T 4					\$ 53,333	\$ 53,333	\$ 53,333	\$ 53,333	\$ 53,333	\$53,333
Dep Cost	\$ 53,333	\$53,333	\$106,667	\$160,000	\$213,333	\$160,000	\$160,000	\$160,000	\$106,667	\$53,333

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