



Creating a Value-base Healthcare System through Goal Achievement, Transparency, Security & Automation

Decentralized Healthcare Marketplace - Connecting People, Processes & Machines

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Version 1.11

IOT + Blockchain + AI
The OS of Healthcare

Abstract

Helix³ is a next-gen healthcare platform that rewards members for consolidating data and achieving health and wellness goals. We bring meaningful use to the members data through various modules designed to improve patient value, security and access control. By bringing together secure and connected data, a goal achievement system, and a marketplace for healthcare products and services, we are creating the foundation of a new and improved healthcare ecosystem.

Our secure platform, built on blockchain technology, ensures data breaches are a thing of the past by using advanced encryption, cryptography, and de-identifying techniques. This enables the consolidation of health data (patient partials, fit devices, medical devices) that will be leveraged for support AI, deep learning, and other innovations. It also shrinks the scope of an attack to a single record, significantly lowering the target value.

The goal achievement system is powered by FitFlows, which have a defined goal, activities to achieve the goal, and different milestones to measure goal progress. The achievement of each milestone is rewarded with tokens that can be spent in the the Helix³ healthcare marketplace, or at the healthcare provider much like a loyalty rewards program.

Members can get support building their FitFlows from healthcare providers that can help support the successful achievement of the goals by defining activities, milestones, and funding rewards. Members can view FitFlow provider ratings, reviews, and an automatically calculated goal achievement rating, and eventually be guided to better health through personal recommendations and FitFlows.

In the Helix app, users can use their health and activity data to earn rewards from goal sponsors and FitFlow providers. Rewards are provided in Helix Tokens (HLX) and can be spent on health related products and services in our marketplace.

At the center of the platform is the ever growing Helix Twin. The Helix Twin consolidates health information including EMR data, activity records and 3rd party verified measurement into a single pane of glass that is used to create optimal FitFlows, personalized for our members. Helix Twin organizes and automatically updates its record through our integration framework. This enables seamless interoperability between all parties interested in lowering the risk and cost of poor health.

Our mission is to bring the healthcare industry together in a meaningful way, creating more patient value across the healthcare ecosystem which provides better care to billions of people around the world. By improving overall health and bringing automation and improved controls to health management, Helix³ aims to reduce the trillions of dollars in healthcare waste globally and improve quality of life.

This white paper will explore some of the problems with the current healthcare system and our proposed solution.

Welcome to the OS of Healthcare

Abstract

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Legal Disclaimer:

There are risks and uncertainties associated with Helix³ and/or the Distributor and their respective businesses and operations, the HLX tokens, the HLX Initial Token Sale, token generation event and the Helix³ platform (each as referred to in this Whitepaper). You can find a description of the risk related to the Token Sale under the section 'Legal', which should be read carefully.

This Whitepaper, any part thereof and any copy thereof must not be taken or transmitted to any country where distribution or dissemination of Token Sale or Initial Coin Offering like the one described in this Whitepaper is prohibited or restricted. The HLX tokens are not intended to constitute securities in any jurisdiction. HLX tokens are a utility token and cannot have a performance or a particular value outside the Helix3 Platform. Therefore this Whitepaper cannot constitute a prospectus or offer document for investment in securities. This Whitepaper does not constitute or form part of any opinion on any advice to sell, or any solicitation of any offer by Helix3 Technologies, Inc. to purchase any HLX tokens or give any advise in any investment decision.

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Forward looking statements: There may be statements in this whitepaper that are considered forward looking initiatives, future products and could be changed if necessary.

Please make sure you have fully read and understand the language written in the legal statement at the end of this whitepaper.

Please note this whitepaper is constantly evolving to improve the overall outcome and success of Helix3 Technologies, Inc. We make periodic changes to this document and will make the updated version available in replace of previous iterations when needed.

1.0 Introduction

The healthcare industry is in a state of disarray where data is silo'd, information exchange is paralyzed by regulations and security, and the desired outcomes are not being achieved.

It's hard to believe all the inefficiencies and security vulnerabilities in the current healthcare system of fragmented data. However, when you look at the current situation, the healthcare system is designed in a centralized way, which creates vulnerabilities and single points of failure.

The US spends 17.1% of GDP on healthcare, that's over \$3 trillion per year and growing. For comparison, the global mobile advertising market (that's the market that gives companies like Facebook or Google pretty much all their valuation) is about \$100+ billion per year, the global handset market is \$400+ billion per year.(1) There doesn't seem to be a lack of funding. So, why haven't things changed?

Germany spends 11.3% of GDP on its healthcare system (and everyone is insured throughout his or her whole life), Switzerland spends 11.7% of GDP, France 11.5%, Japan 10.2%. In fact, you won't find another developed country that spends more than 11-12% of GDP on healthcare.

If you plot this against life expectancy, people in the US die earlier than in all those countries I just listed, and we somehow manage to spend 50-100% more on healthcare per GDP than any other developed nation, and still leave 10% of our population uninsured. Right now, you see the incredible inefficiencies of our healthcare system today. (1)

Issues with the way health data is managed and how transactions are orchestrated in the healthcare industry is a problem that leads to even bigger problems - (Fraud, security vulnerabilities, and inaccessibility).

While patients are looking for increased value, there is pressure to spend more quality time (lower re-admittance) and follow rigorous process to document the details. These goals are polar opposite in the constructs of the current system of transactions.

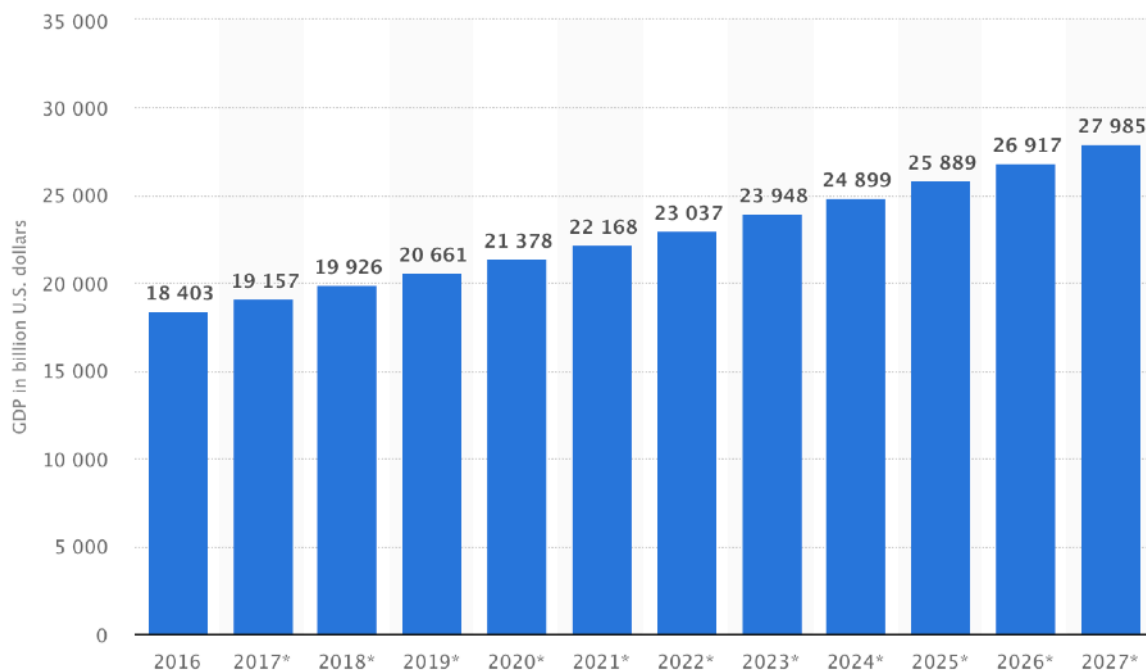
The end result is an inordinately high level of administration behind every physician. It's estimated that there are 16 full-time employees for each physician in the system many of which are manually processing claims, entering data, and ensuring regulatory compliance.

The healthcare ecosystem needs to transition to a decentralized and secure system that focuses on seamless interoperability and better patient care, while reducing administration, security and compliance burdens.



It's Time to put the Patient at the center of Healthcare 2.0 The State of the Healthcare Industry

Information is the heart of the healthcare system. Analyzing how information is exchanged between all stakeholders exposes many negative feedback loops that result in poor patient care and costs



that are spiraling out of control. Healthcare spending is expected to reach 20% of the US GDP by 2025.

[source](#): Statista

We believe that there are three key symptoms that indicate the poor overall health of the system:

- 5 conditions cause almost 2/3rds of the deaths in the US alone (900,000/yr [\[PC26\]](#))
- The threat of cyber security is putting patient data at risk (Millions of records in 2017 alone [\[PC11\]](#))
- The costs related to fraud, duplication, and administration create significant financial burdens (Estimated \$5.5 Trillion by 2025 [\[PC27\]](#))

2.1 Wellness and Patient Care:

“Five things kill more people in the United States than anything else: heart disease, cancer, lung disease such as emphysema and chronic bronchitis, stroke and unintentional injuries such as those on roads or caused by medication overdoses” -CNN [\[PC1\]](#)

Many of these chronic illnesses have proven methods of prevention. Left out of these reports are preventable deaths due to medical error. Johns Hopkins Medicine defines this as death due to:

- An error in judgment, skill, or coordination of care
- A diagnostic error
- A system defect resulting in death or failure to rescue a patient from death
- A preventable adverse event

In their letter to the CDC, John Hopkins Medicine highlighted that the US government and private sector spend vast amounts of money on heart disease and cancer research and prevention, and calls for similar investment in technology research that addresses the above issues.

In an analysis performed by the Common Wealth Fund [\[PC2\]](#), a few things stand out.

- The overall US population has poorer health than other countries
- Life expectancy has worsened in recent year for some populations.
- People all over the world are living with age-related disabilities and chronic disease
- 21% of adults age 18-64 have at least two of the five common chronic conditions.

Its not because the US isn't trying either. The US ranked 5th overall in Care Process which covers Preventative Care Measures, Safe Care, Coordinated Care, and Engagement and Patient Preferences.

The reality is that on the surface, healthcare systems like the US appear to be making the short-term experience more positive, but the longer-term health care outcomes indicate that the level of what is done, needs to be risen to the level of how its done.

Not all medical error can be solved, or the top five causes of death; however, any step that can positively impact either should be explored.

2.2 Cyber Security:

Vulnerable healthcare systems are major targets for malicious actors. The healthcare networks of the world are established as silos in centralized data centers. This creates single points of failure across the industry.

A visit to a new provider typically requires a patient to complete a paper questionnaire that is manually entered into a computer to be stored electronically, and then filed away at a later time.

If a person sees 20 different doctors, specialist, hospitals in their lifetime, there are now 40 copies of a patient's health records and often some financial information (co-pay and insurance), none of which are under the control of the patient.

The repetition of duplicate records at every different provider creates an enormous attack surface (ie. points of entry) for hackers. The security of a person's data is limited to that of the weakest link in the chain of records, either physical or digital. In one instance, a single stolen hard drive containing over 1 Million records was stolen 2017^[47], a reminder of the scale of the problem. Each one of these records can contain enough information to impersonate the patient for financial gain.

This is why HIPAA in the US provides strict guidelines for in-scope providers and payers to create layers of security around their information. Some examples are:

- Data at rest (storage) is expected to be encrypted
- Network based access control is expected to prevent unauthorized devices
- Data transfers (data in motion) is expected to be encrypted
- Changes that are applicable to protecting data at rest and motion are expected to be documented.

Fines for non compliance have been as high as \$4.8M dollars in the case of New York-Presbyterian Hospital and Columbia University Medical Center in 2010^[48]. Costs to test for and remediate compliance violations can cost upwards of \$40,000, and need to be repeated yearly to ensure continuous compliance. In addition to fines, some companies are paying identify theft protection^[49] for all members who's records have been breached to help protect their reputation in the marketplace.

By creating financial pressure to keep networks protected, the networks are forced into silos limiting the ability for providers to exchange information as needed. It is a cycle that can only be rectified with an underlying architectural change.

A popular solution to this problem, is to move towards centralized or cloud storage. Cloud providers deploy complex security solutions, have redundant data centers to protect the data and make it highly available, and have generator backup, fire suppression, redundant power and UPS battery backup among other resiliency capabilities. This allows state of the art technology to be applied to larger sets of data, mitigating most of the physical security risks.

The problem with centralized storage was brought to light with the recent Equifax data breach^[49]. The centralized storage contained names, Social Security numbers, birth dates, addresses, and in some instances, driver's license numbers for 145.5 Million people affected by the breach. In 209,000 cases, credit card numbers were also exposed.

Applying this to healthcare, Epic Systems Corporation says its softwares holds the medical records of 54% of patients in the United States (190 Million worldwide). As more and more of these records move to centralized cloud storage, the attack target becomes more attractive to cyber attackers. Access to a single administrator account grants access to a very profitable data repository.

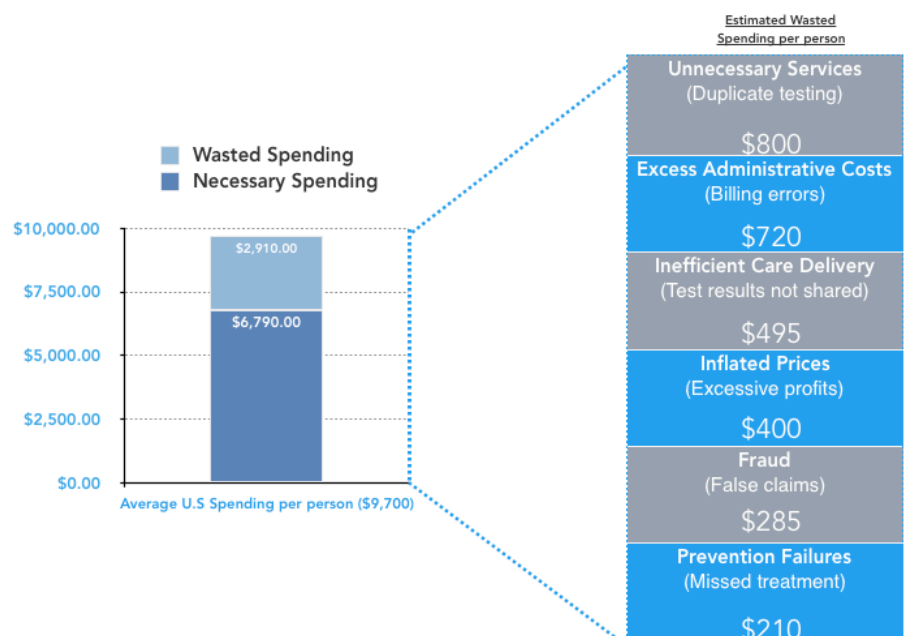
Meaningful Use Stage 3, which is a CMS requirement for Medicare and Medicaid reimbursement, will also contribute to duplication of records by requiring providers to allow their patients to access their EHR data through the patient's app of choice. While this is meant to facilitate sharing and innovation, the result will be more duplicate copies of patient health information stored by each new application a patient uses, increasing the attack surface.

2.3 Waste in Healthcare Spending:

According to Donald M. Berwick and Andrew D. Hackbarth^[92], the following categories of waste exceeds 20% of total health care expenditures.

- Over-treatment
- Failures of care coordination
- Failures in execution of care processes
- Administrative complexity
- Pricing failures
- Fraud and abuse

Helix believes the root of this problem is in the process of how patients, providers, and payers exchange and validate information. In today's system, the patient is not the owner of their information. Providers and payers



transact with each other, using the patient's information, without real-time approval. To combat potential consumer risks, regulations and checks and balances are implemented which are slowing the pace of innovation.

To illustrate the scale of the problem just in administrative complexity in the system, in 2013, the ratio of doctors to non-doctor staff was 1:16^[50]. Of the 16, only 6 were nurses or general practitioners. The remaining 10 were administrators spending time on manual activities like submitting and resolving claims, gaining prior approvals, transcribing data, and faxing records. Administrative costs in the U.S. healthcare system consume well over \$300 billion annually^[51], or nearly 15 percent of all healthcare expenditures by some estimates.

Fraud estimates range from \$68-320B of healthcare spending, most of it undetected. Just this year, the US government accused 400 health care providers of healthcare fraud in the order of \$1.3 Billion^[51].

The first line of detection is placed on patients requiring them to review their bills for correctness, when they could be dealing with serious health issues. Even a patient in good health would never understand which ICD-10 codes are acceptable for the services delivered, or how many units of which medications they received.

Closing Thoughts

Decisions are only as good as the information you have to make them on. The current healthcare system is not equipped to securely store patient data and allow transactions using the information to be controlled properly leading to poor overall outcomes.

The focus needs to be shifted towards achieving better patient outcomes, increasing participation in preventative measures, and leveraging secure data storage and controls to reduce waste.



Helix Platform Overview

The OS of Healthcare

Helix³ is a platform that offers a secure way for the healthcare industry to exchange value, streamline workflow and gain deep insights across a global ecosystem

The 4 Core areas of Value

Security:

By design Helix³ is built leveraging advanced encryption, 2-factor authentication and immutability of records. All transactions and data storage are facilitated through a fully distributed network using blockchain technology.

Interoperability:

One of the biggest road blocks in the healthcare industry is interoperability and integrating systems. Currently most systems are silos and don't 'talk' to each other. This leads to fragmented data, duplicate records and inefficiencies. We believe that integration is key. Helix³ supports a RESTful API framework and follows HL7 standards. Our goal is to seamlessly interconnect the fragmented pieces of the healthcare industry. This will enable a more efficient workflow for providers and payers. All of this leading to a much more valuable patient experience.

Transparency:

Often times, errors that take place between providers and payers are due to a lack of transparency. Helix³ provides a platform for these organizations to access data as a single source of truth.

Insight:

From advanced analytics to precision medicine, the Helix³ platform supports a wide range of applications using deep learning services through the Tensorflow framework. Applications built on the platform can help gain valuable insights into the data across the Helix³ network.

3.1 Health and Wellness Data

Introducing Helix³ Digital Twin

Store, manage & exchange health + genome data

Earn digital HLX tokens for achieving health & activity goals

Redeem product & services for HLX tokens in the marketplace

Don't have an account yet? Sign up [HERE](#)

Helix Twin

Each participant (human or machine) on the Helix³ platform will establish a digital twin ("Helix Twin") to manage the health and wellness information they create or own.. This interface offers the holistic picture of the current and historical status of a members health.

All participants in the ecosystem interact with each other using their Helix Twin. Each registered user is assigned a unique identity on the platform through the Helix Twin interface. All transactions on the Helix³ platform are facilitated through the users personalized digital self, and events recorded in a distributed ledger.

As members connect additional data sources, the helix twin protects the data and standardizes access to the data. This data brings together all the pieces of the puzzle required to provide the most accurate prescription for living a long and healthy life.

Members will have access to the following information and resources, built on this data, in our app:

1. **Medical Records:** History of all medical records from birth to last recorded appointment
2. **FitFlow Dashboard:** A summary of a members challenges, FitFlow progress, and activity
3. **Genome Data:** Partial or complete genome data with useful insight through third party services
4. **Clinical Research:** Keep track of on going research projects to monetize user data
5. **Health Insurance:** Healthcare coverage details for an easy way to access
6. **Helix Wallet:** Send/receive HLX tokens while proving storage of HLX tokens with the platform
7. **Healthcare Marketplace:** Dynamic data marketplace for participants to transact with each other
8. **Settings:** Configure Helix Twin settings, connect and sync IoT devices, whitelist of approved apps or users etc...

Benefits of the Helix Twin

Members will be able to take their health and wellness data with them when they travel. As long as the member has access to a computer or their smart phone app, they can exchange information about allergies, activities, medications, medical history, and so on to ensure providers in silo'd areas can still offer value to the member.

With a larger, consolidated data set, specific medications can be prescribed based on deep analytics that match success rates with others that match our members's health history. Preventative plans can also be developed based on matching success rates of others like the member. These recommendation can include which FitFlows worked best, and highest rates FitFlow Providers in a members area.

The ever-evolving digital record is connected to a 'smart contract' and API's which trigger a function of collecting member information into an encrypted node, storing the information into a distributed database and data lake, and enabling access control of the data by the patient/member.

Permission-based access to the data must be validated by the owner using a private key and 2-factor authentication. The data is collected from existing EMR/HIM systems using (HL7 standards), IoT medical/fitness devices and manual input of a validated user.

3.2 FitFlow Goal Achievement System

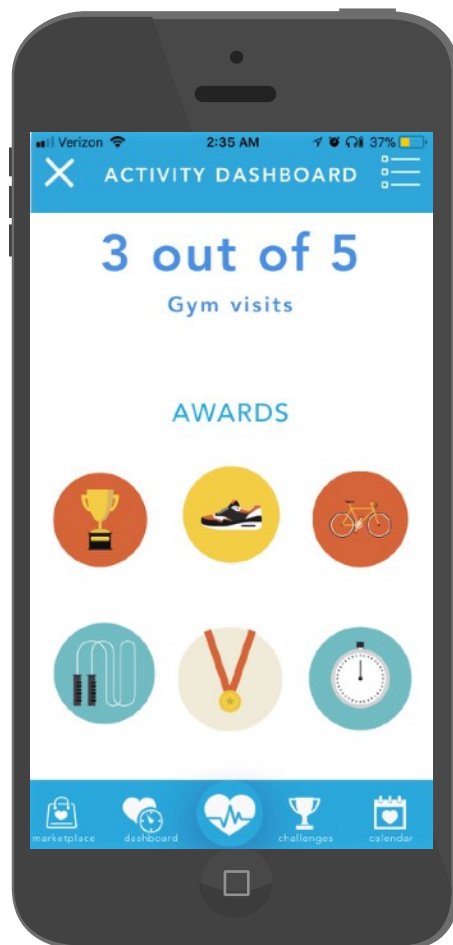
Helix³ is changing the game by introducing our FitFlow Goal Achievement System. Ready Player 1!

We are enabling every wellness program and health service provider to set goals, build a customizable plan for every member, and motivate through rewards and accountability. Individuals can also set personal goals and find providers in our marketplace that will help them achieve their goals or participate in FitFlow Challenges.

The plan is laid out using activity cards that record member activity, and achievement cards measuring progress towards achieving the goal.

FitFlows allow a goal and challenges to be sponsored by government programs, employers, PCPs, insurance companies, merchants, marketplace participants, or an individual themselves.

Benefits of FitFlow Goal Achievement System:



- **Employers:** Employers can issue activity challenges such as “Walk for 30 minutes, 3 times a week, for 12 weeks”, “get your flu shot”, or “record 10,000 steps, every day for a year” and reward their employees with HLX tokens for the successful completion.

We find that workplace wellness programs can help contain the current epidemic of lifestyle-related diseases, the main driver of premature morbidity and mortality as well as health care cost in the United States.

Soeren Mattke, Lead Author of the [Rand Report](#)

- **Health Insurance Providers:** The same reason employers would issue challenges, insurance providers will have a great interest in the FitFlow Challenges and Rewards. Lifestyle contributes to Health Risk Level which impacts Chronic Disease, contributing to a higher health care costs.
- **Associations:** There are many sponsored government programs that are aimed at educating people on the health and wellness. Education does not always mean a change in action. With FitFlow challenges, Heart and Lung associations can reward participants with HLX for challenges like “quit smoking for a year” or “10,000 steps every day for a year”.

- **Tournaments and Events:** Activities such as 5k runs, marathons, Walk for a Cure, and other sporting events like tournaments or organized leagues can offer HLX rewards for participation.

This creates a differentiator in this space by offering more options for event participants to get what they want with their rewards. In addition to participation rewards, additional rewards can be offered for the results. For example, a race can reward the 1st through 3rd place finishers, in different age groups, and sexes.

- **Merchants:** Merchants can find a targeted user audience for their products and services, and accept HLX tokens for a limited trial. FitFlow providers also receive a turn-key loyalty program when issues challenges that must be completed by them, or at their facility.

How does it Work?

As members of the Helix³ platform perform activities, they are recorded in activity cards. In order for the activity to be recorded, they must check-in with a 3rd party verifier. A 3rd party verifier can be the a reception desk at a gym, or the check-in station at a 5k race.

Check-in can also be performed by groups of 3 or more Helix members who check-in with each other before performing an activity.

Once the check-in occurs, the activity card records vitals from a smart device like AppleWatch, Fit-Bit, or exercise machine into the Activity Card where it is stored to be submitted towards challenges.

Members then apply the activities towards their customized FitFlow, proving participation in the challenge, and potentially earning participation rewards.

Challenges are controlled by the issuer to determine if it can be entered into once or multiple times. The issuer also funds the challenge on creation, setting a maximum payout and participation limit, ensuring all participants will be paid upon successful completion. Issuers have the option to top of a challenge at any time to keep it alive, or re-vive it with HLX tokens after it has expired.

Challenges are rewarded in HLX which can be spent in the marketplace. The marketplace contains merchants and service providers that accept HLX for their products and services.

Marketplace items can include massages, fit devices, fitness club memberships, race entrance fees, chiropractic assessments, etc. As the platform grows, more and more marketplace participants with innovating products and services will be recruited and join to reach our large user base.

Helix³ will provide Helix Premium items to help stimulate the marketplace. These marketplace items will be raffle draws where users pay HLX, or submit activity cards to enter into the draw for a chance to win the item. Raffle items will related to health and wellness such as healthy meals, AppleWatches, Smart Scales, full year gym memberships and others based on customer feedback.

Since HLX Rewards are based on tokens... they never expire like many other programs. The choice available is also much larger than any typical rewards system and all support additional health and wellness. Who doesn't like a good massage after working out for a while.

In many loyal programs, you select the redemption you want, and wait 3-5 weeks for the card to be given to you. With FitFlow challenges and milestone rewards, HLX tokens are given instantly and can be spent immediately in our marketplace.

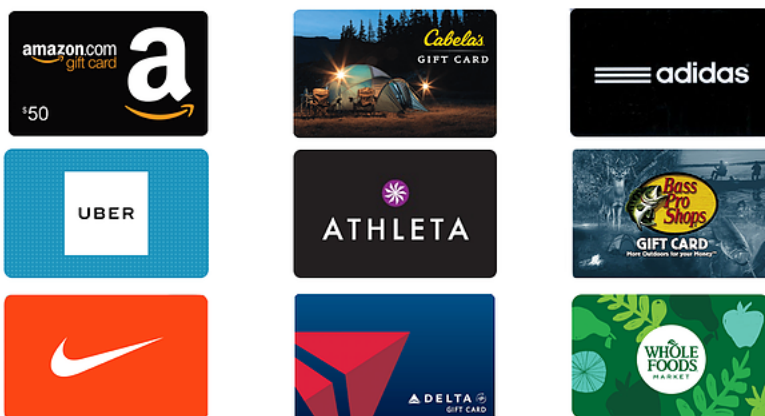
Types of Challenges:

A challenge will typically fall into two different categories. Exercise and Wellness. The challenge consists of a goal, a method of verification, and HLX token amount for successful completion.

- **Exercise Challenges:** The success of an exercise challenges can be determined by defining a combination of calories burned, steps taken, heart-rate, length of session, frequency of sessions, and number of sessions of a period of time, and weight as proof of health.
- **Individual Challenges:** Allows members define a goal and pay their reward into the challenge. Helix³ holds the payment in escrow until the individual achieves the goal. Individual challenges follow the same proof of health as Exercise Challenges.
- **Pay-to-Play Challenges:** Pay to play are a special kind of FitFlow challenge were friends put up their own tokens and define the rules of payment. This is great for pick-up games of golf for instance, where all parties track the score and at the end of each 9-holes, the lowest score gets a the pool of HLX.
- **Wellness Challenges:** Activities like getting a yearly physical, vaccines, flu shot, and so on can be verified as they are performed. As these activities are performed by a provider, they are logged as activity by the participants, allowing them to be submitted as proof of health. Weight loss goals can be measured at the provider's office or through a smart scale that updates the participants records.

3.3 Helix³ Health and Wellness Marketplace

The Helix³ platform interface provides access and tools for users to interact and exchange value between others on the network.



The marketplace will offer Groupon-like functionality for *beauty and anti-aging products, fitness and mind + body exercise and health eating, nutrition and weight loss merchants.*

Member can also use the marketplace to find providers that will design FitFlows that help measure and reward their progress towards their goals.

A third option for users to spend their HLX tokens is towards gift cards. The Helix3 marketplace will offer cards from over 50 health and wellness friendly retailers.

A final option enables Helix3 members to enter drawings for health and wellness related merchandise using their HLX tokens. This is a great opportunity for innovative new products to introduce these products to a market focused on improving their quality of life.

Automation Through Smart Contracts

Transactions on the Helix³ marketplace platform are automated through smart contracts. When a user wants to transact with another member they can simply log on to the platform and search for products & services offered by healthcare participants. Once a service or product is found, the user can engage with the other members smart contract. The platform uses 2 factor authentication, private key and encryption to secure every transaction that takes place.

Payments

The Helix³ Platform improves on the foundational layer by facilitating payment transactions directly through the system. Users can pay for healthcare products and services using the HLX token as a secure and fast way to pay or be paid.

By design Helix³ makes sure all participants involved have a realtime view into the transaction. Our goal is to have all healthcare related payments settled in seconds.

Future modules on the Helix3 platform will focus on claims reimbursement through benefits providers. Generally, these payments involve the patient, provider, insurer and a clearing house to authorize the claim and payout the required funds for the medical product or service. This process creates friction, delays and unnecessary intermediaries to get involved.

By leveraging the Helix Cortex Integration Framework, the claims process can be entirely automated by leveraging data from medical devices combined with patient and provider authorization. Through automation, duplication, fraud, and administrative burden can be reduced.

Ratings System

Trust is an important part of any community especially when it involves your money, health and well being. By design the Helix³ platform has a built in user based rating system. This allows all participants to leave a ratings score based on their experience. Each users rating will evolve over time as they transact in the Helix marketplace.

An added benefit of the Helix3 platform is that each FitFlow provider can be rated automatically by the platform based on their goal achievement success and their members ability to follow the plan.



Almost 18% of total GDP was spent on health care last year. This comes out to about \$3.4 trillion. However, this money is largely spent on a highly inefficient system. It is thought that close to \$1 trillion of that figure could go to wasted spending.

4.1 Market Opportunity:

We've set a goal to make the platform, first and foremost, about better health and wellness for people. While others are primarily focused on solving the problems in reactive healthcare, we are taking a more preventative approach by promoting better habits and behaviors through our Goal Achievement System.

"The next trillion dollar industry globally, the Health & Wellness market space is dominated mostly by beauty and anti-aging product sales at \$679 billion, followed by fitness and mind + body exercise (\$390 billion) and health eating, nutrition and weight loss sales (\$277 billion)."[\[MO01\]](#)

Driving health, wellness and a new operating system for healthcare are three key participants:

- **Merchants:** In "the Groupon of Healthcare", merchants can list one-time purchase items, accept HLX tokens as payment, and gain the opportunity to earn the clients business. As merchants collect HLX, they can create their own challenges and use the HLX to pay rewards as a FitFlow Provider.

The marketplace also includes a collection of health conscious gift cards from vendors like Atheta, Amazon, Nike, and Whole Foods for premium members of the platform. As the marketplace grows, more products and services will be offered. Product listings and transaction provide revenue to Helix³.

- **FitFlow Providers:** FitFlow providers are merchants who build FitFlows (activities, milestones, and rewards) for members and fund the rewards for the member. FitFlow Providers typically require a member to perform the activities at the provider premise, which a trial membership may be available for purchase with HLX in the Helix Twin app. Transaction fees created revenue for Helix³

- **Sponsors:** Sponsors are those who issue individual challenges that would support health initiatives (Heart, Diabetes, Lungs). For example, a benefits provider could post a FitFlow Challenge that would reward tokens for quitting smoking for 10, 30, 60 days, and then on the year anniversary. American Heart Association can offer rewards for lowering cholesterol.

Sponsors use third party medical verification to validate goal achievement opening the door for Healthcare Providers to join the ecosystem. Helix³ members will have incentive to connect their patient portals for increased HLX rewards potential.

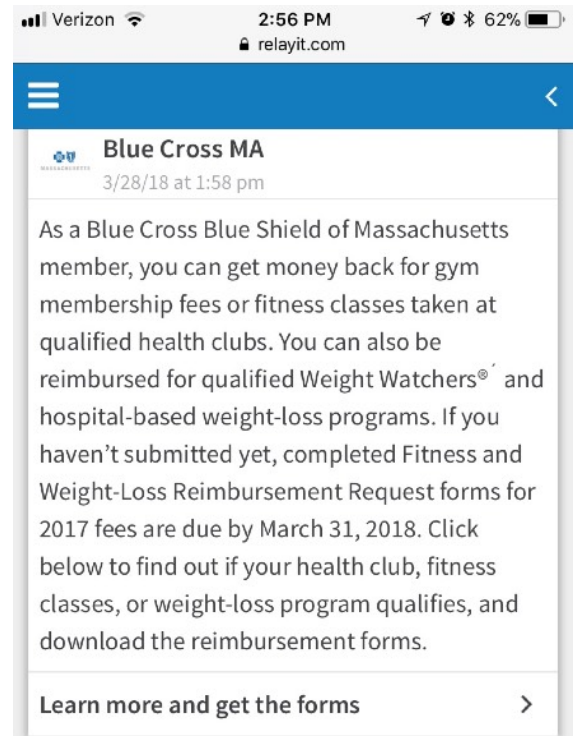
Each of the three participants create a supply and demand for HLX tokens within the ecosystem. People get active to avoid top chronic illnesses, sponsors lower claims reimbursements, and merchants/FitFlow providers have new ways to address a targeted audience. It's a win/win for everyone.

We also understand the importance of data security and reducing waste, so the platform is designed from the ground up to support permission based access, automation, deep learning, and AI in addition to integrating with other EHR platforms and data sources. Read the Future Use Cases section of this whitepaper to understand the long term vision for Helix3

The Helix Twin app itself provides and additional source of revenue for Helix³. Members who have the free version will be able to fully interact with the application and marketplace, but there will be some restrictions on premium level content and how activity cards can be submitted towards challenges. The premium version of the app will be available on a subscription basis with in-app purchases.

As the platform modules are developed, providers, researchers, and pharma will connect to the platform increasing compute and storage capabilities as they contribute their data. Attaching to the platform will be governed by a subscription service that receives discounts or penalties based on the level of computer and storage provided, versus offered. The subscription fee will have multiple tiers, with a basic tier offering permission based access to only their patients. A premium service will provide access to de-identified data from permitting members. The subscription will be paid in fiat or HLX, with a 20% discount when using HLX.

Members are incentivized in HLX to share their de-identified data, creating a vast resource of health and wellness data which will drive additional research and innovation participants to the ecosystem.



4.2 Product Development and Go to Market:

Helix3 is positioning itself as a data consolidation platform that brings meaningful use to the information. We are taking a different approach than most of the other blockchain healthcare products in that we will be focusing on consumer and enterprise applications.

This is the first time in history, that this amount of data is available to use, which supports out end goal of data consolidation, and meaningful use.

To get there, we will launch an app, called Helix. The app will be available for iOS and Android phones. The app will allow users to connect their fit devices, and patient portals. The data will be synchronized with Helix, and a more secure copy of data will, over time, be transferred to the Helix app.

Revenue Opportunity: Premium App + In-App Purchases

To incentivize users to connect devices and patient portals, Helix will reward participants for specific tasks. This will also help stimulate the market with HLX tokens.

To make Helix useful to our members, we will also include a goal achievement system called FitFlow. FitFlows allow users to pick goals from a list of sponsors, and be rewarded for achieving them. Goals can be losing weight, running a race, lowering cholesterol, quitting smoking, and anything else that can be confirmed using a 3rd party data source, or verified activity.

Initially, Helix3 will focus on goals that can be verified by fitness devices, and sponsor the first 2 goals. Run a 5k, and 10,000 steps, 5 of 7 days a week, for 2 months.

Revenue Opportunity: Sponsorship+ Premium Listing Fees

To create a marketplace for members to spend their HLX, Helix will focus on the business development of FitFlow Providers and Coupon Merchants.

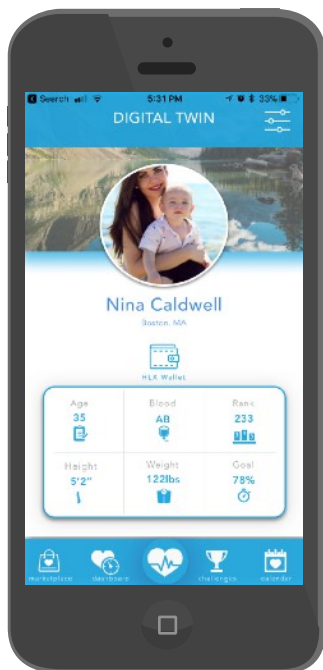
FitFlow Providers are merchants who will build a plan with the member to achieve their goals, and fund milestone and/or goal achievement rewards. To create a merchant for initial members, Helix3 will offer a "Run a 5K" FitFlow and fund the HLX rewards.

Coupon Merchants offer discounts and trials for health related product, in exchange for HLX tokens., much like Groupon does. While Helix3 builds out our merchant business, Helix3 will offer on-line gift cards for over 50 health related retails in the US in exchange for HLX.

Revenue Opportunity: Transactions + Premium Listing Fees

Release Plan:

The platform will be released in 3 major phases over the next 18-24 months.



1. Release 1.0 (Q1, 2019): Enable the Wellness challenges by releasing patient portal integration and expand the Goal Achievement System. Added functionality included:

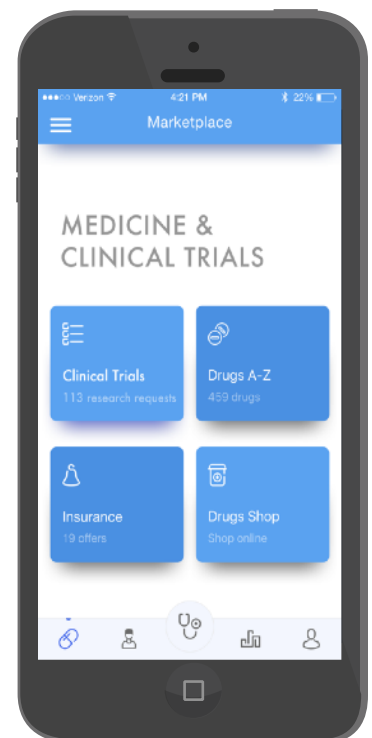
- Connect fit devices, track activity to *Activity Cards*, and apply them towards a single Helix3 sponsored goal
- Apply activity cards towards a single Helix3 sponsored challenge.
- Use HLX token rewards to purchase gift cards in the *Helix3 Marketplace*.
- Use of testing results to be collected from patient portal and be used as measurements of goals.
- Goal setting functionality that will add activity plans and milestone measurements to the existing challenge based rewards.
- Upgrades to the UI will include posting challenges, goal setting, and Fit-Flow plans builder.

2. Release 1.5 (Q2, 2019)

- Introduction of Pay-to-Play challenges where groups of people fund a challenge pot and split the winnings based on an agreed upon result.
- Minor releases to incorporate user feedback

3. Release 2.0 (Q1, 2020): In this expansion phase, we will add more connected device types and patient portals, increasing access to more and more data. Goals of this release are to:

- Collect more data around activities, goals, and lab testing.
- Learn the best FitFlow plans to achieve goals and begin personalized recommendations on FitFlow activity and milestones based on others success.
- Expand data collection to more medical grade wearables enabling controlled clinical trials.
- API module for a major EMR/EHR provider bringing permission based access and enhanced security to an existing workflow tool.





Future Helix³ Participants

5.1 Providers

Value-based care is top of mind for all Healthcare Providers today. The inability to exchange information in a timely manner will result in poor patient value ratings which can lead to lower reimbursements.

ACHE's yearly report put financial challenges as the #1 challenge across 383 CEOs:

Medicaid reimbursement has some strong implications based on the level of care they provide. Hospitals and doctors offices need streamlined processes for administering patients to ensure they meet value-based guidelines while as a large percentage of the population ages.

With the Helix³ platform, providers can apply automation to high labor tasks, and shift their resources to tasks that improve the patient experience and health results.

With Helix³, the following examples are possible:

- **Preventative Healthcare Plans:** By setting goals and achievements, providers help drive the outcome of patient wellness. Their patients then go to the marketplace or build their FitFlow through challenge participation, perform verified activities, and the provider measures progress at future check-up sessions, or pre-ordered tests.
- **Full Cost Disclosure:** Information about plan benefits is tied to the Helix Twin. A patient can request the coverage information using their plan details, and the prescribed medical procedure before approving the transaction.

- **Automated Claims:** Information Claims are programmed into smart contracts that pull the required information directly from the Helix Twin to complete the claim. Workflow logic in our Apps can ensure conditions are met before submission.
- **Self Check-in:** Patients visiting a doctor can login into the Helix³ App to confirm attendance to the visit. Check-in information can be provided before the patient arrives or viewed directly from the Helix Twin if permission is provided.
- **Enhanced Diagnosis:** The Helix Twin can contain far more information than is available today. Apps providing enhanced diagnostics for people and doctors will be built around the multi-dimensional data. Using deep learning technologies, Helix can help analyze large data sets to come to a more personalized and accurate diagnosis.
- **Educational Resources:** Based on the patients entire healthcare information consolidated in the Helix Twin, provides can direct patient specific educational materials to meet meaningful use stage 3 requirements.

In order to achieve full reimbursement, providers must meet CMS guidelines for meaningful use:

- Use computerized provider order entry (CPOE) for medication, laboratory and radiology orders
- Generate and transmit permissible prescriptions electronically
- Use clinical decision support to improve performance on high-priority health conditions
- Provide patients the ability to view online, download and transmit their health information
- Incorporate clinical lab-test results into certified EHR technology
- Use secure electronic messaging to communicate with patients on relevant health information

With Helix³'s IoT integration, automating many of the repetitive services will be possible, freeing providers to handle more advanced functions, more patients, and increase value time.

The Helix³ platform also returns patient data to the custodianship of the patient themselves, reducing HIPPA requirements. Since the data is not stored by the provider, regulations become redundant. The Helix³ platform is design with HIPPA compliance in mind, and the scope of an attackable record is limited to a single user at a time.

5.2 Payers (Health Insurers)

Payers bear a large portion of the financial burden caused by inefficiency in the healthcare system. The better the population health is, the less payouts need to be made. Payers will be a primary sponsor of FitFlow Challenges that promote health and wellness. Things like quitting smoking, losing weight, and minimum activity levels can be verified by a third party, and rewards providing for achieving the goals. Rewards can be early and often in the start to motivate participants, and become less frequent but more rewarding after longer periods of time of maintenance. In addition to better health, as modules are built out by Helix³ and the community, excessive administration caused by failed claims and prior authorization will can be reduced, increasing the human resources available to support their patients. Using Smart Contracts to automate the workflow, significantly improves accuracy and reduces manual labor.

Payers also bear an added burden when duplication is introduced into the system. Tests are often duplicated when the results cannot be shared freely. A recent study, implementing a CDST (clinical design support tool) eliminated 11.790 duplicate tests over the course of a 2 year period (2011-2012).

5.3 Government

From Medicare to Medicaid to population health and regulation. Helix³ enables the government to get permission-based access to valuable healthcare data. This will help the government with regulation and provide a more efficient healthcare system overall. HLX Token Overview

There is a tremendous amount of value exchanged throughout the healthcare systems of the world. Unfortunately, the current state of the industry is centralized, fragmented and silo'd. So it's hard to capture better value for our communities. We believe that the HLX token can bring all participants together on the platform providing a common ground to seamlessly transact with each other on a shared, distributed network.

The HLX token operates as a required mechanism to access and transact on the Helix³ platform. HLX follows the ERC20 standards and will be fully compatible with the Ethereum blockchain.



6.1 Token Utility & Function

The HLX token is a core piece of the Helix³ technology. There are 3 main utilities that the HLX token holds:

1. **Rewards** - HLX tokens are earned through health and wellness activities. These tokens provide incentive for our members as they achieve sponsor goals or FitFlows. The tokens can be spent on a variety of health related products and services available in our marketplace.
2. **Transactions** - The Helix³ platform and healthcare data marketplace bring in various participants across the ecosystem. Every transaction on the system requires the transaction to be facilitated in HLX tokens. As products and services are posted for use in Helix, premium features can be unlocked using HLX tokens.
3. **Validity** - The HLX token helps validate the integrity of the platform by functioning as a supporting validator of information through the exchange of services or products. Exchange of tokens is stored using distributed ledger technology.

Other Incentives: Insurance and benefits programs can offer member incentives using HLX tokens (eg. check-ups, exercise). Members can purchase products and services on the Helix³ Marketplace

6.2 Standards (ERC20)

The Ethereum token standard[24] (ERC20) is used for Ethereum smart contracts. Developed in 2015[25], ERC-20 defines a common list of rules that an Ethereum token has to implement. These standards will be implemented in the development of the HLX token.

6.3 HLX Token Generation & Distribution

This token generation event will provide wide access to patients, providers and other network participants.

Role of Token: Helix³ platform access (full production version) and enabling transactions of data between users to facilitate healthcare products and services.

Symbol: HLX

Type: ERC20

Supply: 888,000,000

For Public Sale: 399,600,000

Emission Rate: No new tokens will be created

Price: 1 HLX token = \$0.08 equivalent of ETH and/or BTC and/or LTC

Accepted Currencies: ETH, BTC, LTC

Private-sale Period: April 2, 2018 - June 30, 2018

Bonus: 30% tokens

Private soft-cap: \$1.5 million USD equivalent of ETH and/or BTC and/or LTC

Private Hard-cap: \$5 million USD equivalent of ETH and/or BTC and/or LTC

TGE Period: Oct 1, 2018 - Nov 16, 2018

Bonus: 20% tokens, -5% per week

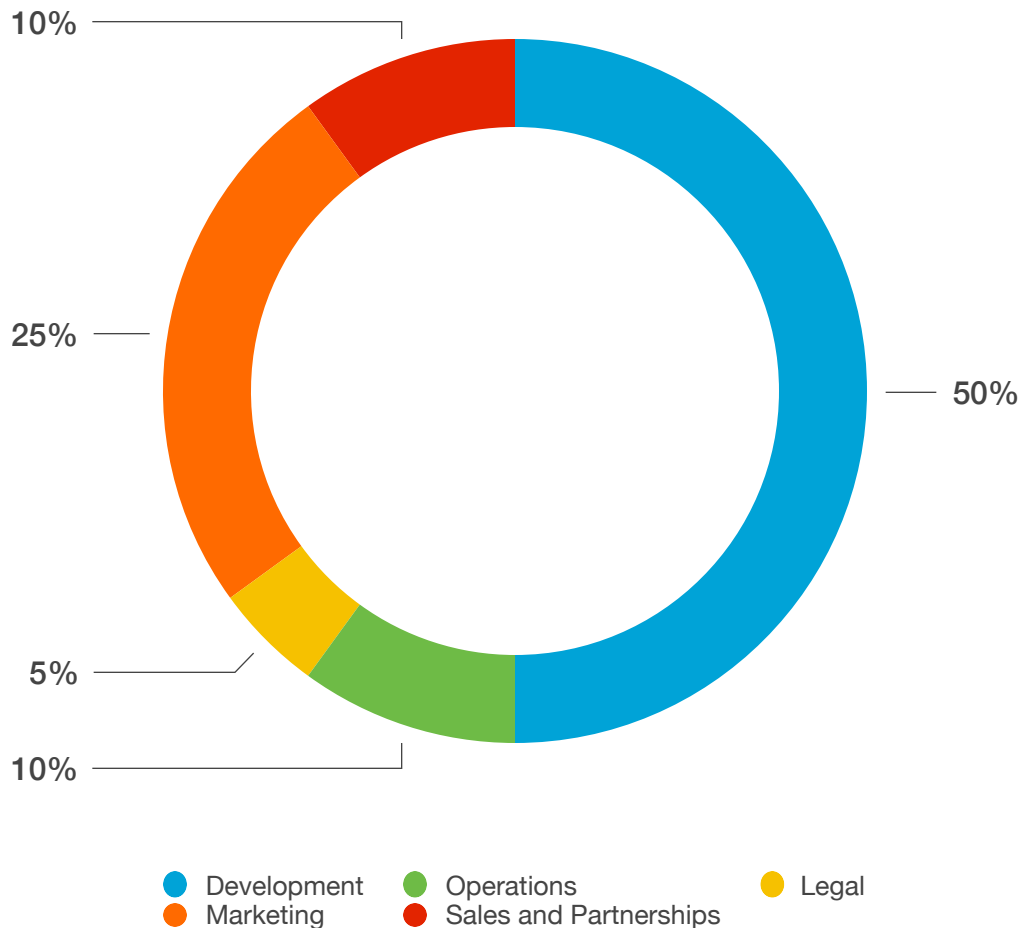
Minimum goal: \$3.5 million USD equivalent of ETH and/or BTC and/or LTC

Maximum goal (Hard Cap): \$31 million USD equivalent of ETH and/or BTC and/or LTC

Please note: Any remaining tokens (not sold), which are allocated to the token generation event participants will be burned at the conclusion of the main token generation event.

6.4 HLX Token Proceeds Allocation

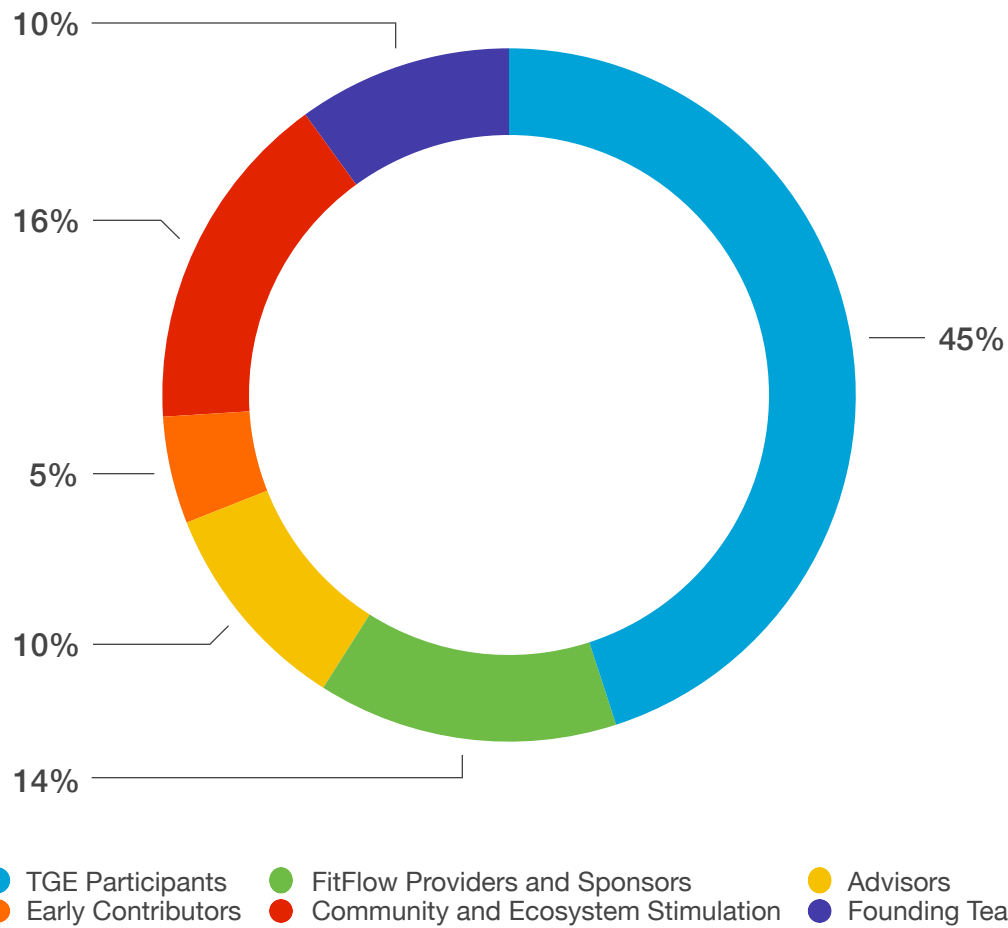
Our proceeds distribution model covers 6 main areas to build towards the long term success of Helix³.



HLX Token Generation Event Distribution

The chart below displays how we plan to distribute the HLX tokens in a public token generation event ('TGE'). The goal of this distribution model is to strategically spread HLX tokens across the public for future access on the Helix³ platform.

In order to achieve success, we want to make sure tokens are readily available for users to gain access and transact on the platform. HLX tokens will be initially available on our dedicated TGE website (web URL will be announced within 48 hours of the TGE start time).



More details on the pre-sale, bonuses and general information on the token generation event will be made available through a separate website www.helixtoken.com. Until more information is provided this site might redirect to the main Helix³ page.

Help us create the worlds first global healthcare OS
IoT + Blockchain + AI

Contact us for more information



Helix³ Architecture Details

Core Technology Components:

The Helix³ components consist mainly of three (3) components:

- **Helix³ Blockchain Sync Server (BSS)** acts as the bridge between the blockchain and the various participants on the network. This virtual server works on top of the Ethereum blockchain. It provides a foundational layer of the Helix³ platform to transact with digital ‘Helix Twin’ data and smart contracts through decentralized applications (Dapps).

Three services are part of the BSS:

- **Ethereum VM** enables Helix³ to run decentralized code on a trusted and proven blockchain. Additionally EVM, smart contracts make transfer and settlement of value simple and tamper resistant. Helix³ is using Ethereum for business logic, creating seamless sharing of data in a trusted way.
- **IPFS Node** allows Helix³ to store large files in a distributed file system. Helix³ is using IPFS to store all static files or any UI element in addition meta information of events is stored in IPFS.
- **BigchainDB Node** is a decentralized database that stores encrypted user assets. Being a decentralized database, BigchainDB is complementary to decentralized processing technologies like Ethereum Virtual Machine, and decentralized file systems like IPFS.

- **IEGN** (Intelligent Edge Gateway Node) is a specialized hardware device that sits on premise at provider networks. It integrates with IOT medical devices to securely gather data at the edge. The IEGN operates a full **IOTA** node to facilitate the device identification management, encrypted data throughput and edge analytics.
- **Helix³ Cortex** is an Integration framework consisting of various specialized API's that help inter-connect the Helix³ platform components and third party healthcare systems, devices or applications.

Helix³ will be home to various different healthcare related 'decentralized applications' (DAPPS). The first Dapps available on Helix³ will be the FitFlow Goal Achievement System tightly integrated with patient portal data.

7.1 Decentralized Data Structure

Helix3 is built on an encrypted and distributed database. All nodes build a consensus network allowing for maximum security and transparency. Data is securely exchanged amongst participants through smart contracts and stored on an immutable blockchain ledger.

A blockchain[1][2][3] is a continuously growing list of records, called blocks, which are linked and secured using cryptography.[1][6] Each block typically contains a hash pointer as a link to a previous block,[6] a timestamp and transaction data.[7] By design, blockchains are inherently resistant to modification of the data.

blockchain is "an open, distributed ledger that can record transactions between two parties efficiently and in a verifiable and permanent way." [8] For use as a distributed ledger, a blockchain is typically managed by a peer-to-peer network collectively adhering to a protocol for validating new blocks. Once recorded, the data in any given block cannot be altered retroactively without the alteration of all subsequent blocks, which requires collusion of the network majority.

Blockchains are secure by design and are an example of a distributed computing system with high Byzantine fault tolerance. Decentralized consensus has therefore been achieved with a blockchain.[9] This makes blockchains potentially suitable for the recording of events, medical records,[10]

[11] and other records management activities, such as identity management,[12][13][14] transaction processing, documenting provenance, or food traceability.[15]

The initial release of Helix³ will use the Ethereum blockchain as a 'business logic' layer in the technology stack. Smart contracts, authentication, validation and HLX token transactions/storage.

Ethereum is an open-source, public, blockchain-based distributed computing platform featuring smart contract (scripting) functionality.[2] It provides a decentralized Turing-complete virtual machine,

the Ethereum Virtual Machine (EVM), which can execute scripts using an international network of public nodes. Ethereum also provides a cryptocurrency token called "ether", which can be transferred between accounts and used to compensate participant nodes for computations performed.[3] "Gas", an internal transaction pricing mechanism, is used to mitigate spam and allocate resources on the network.[2][4]

7.2 Database & File System

As an information consolidator, the Helix Twin needs to be stored in a database like structure that behaves like existing databases while providing maximum levels of security, interoperability, and scalability.

To achieve these goals Helix³ chose to create a distributed database paired with distributed storage. Each provides ledger capabilities, with the ability to limit access to the data. Both also provide high levels of security based on the distributed nature of the storage and consensus.

The Helix³ database and file system has the following characteristics:

- HTTP APIs and Web- Socket Event Stream for business logic and integration
- Immutable recording of transactions
- Existing database logic for streamlined development
- Highly secure and tamper-proof
- Data replication to mitigate loss or corruption.

Asset Creation:

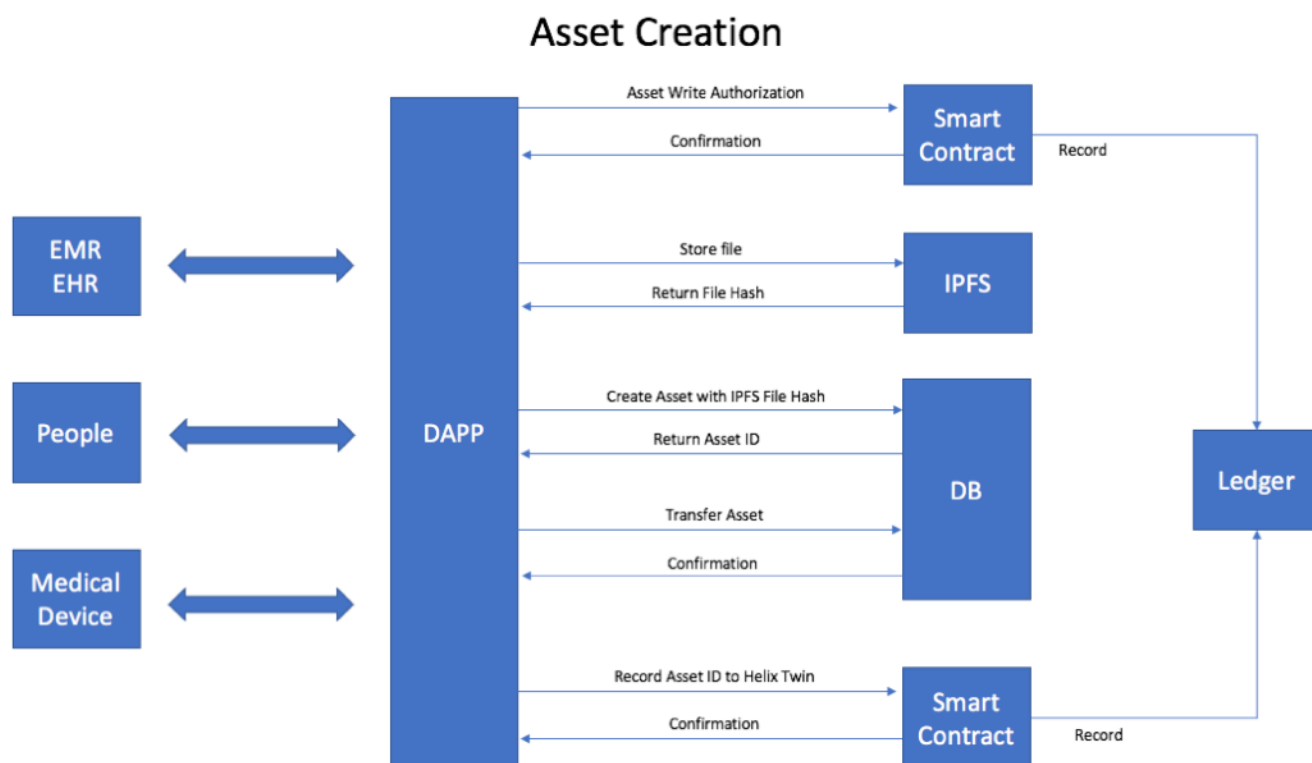
Every record related to a patients medical history, will be created as an asset inside the BlockchainDB. Assets owned by a specific user, will make up what is the Helix Twin.

In order to maintain an immutable record of history (provenance,) an asset will first be created by the service provider and then transferred to the Helix Twin. Through revision history, we maintain the source of origin, and track every change to an asset. Some assets (ePHI) will be created and owned by the Helix³ member ensuring ownership, control, and security.

Assets can be of many different types, each of which is defined in each entry:

- HealthKit Data
- Patient Visit Record
- Allergies
- Imaging Results
- Blood work
- Genome
- HL7

- Patient Identity
- Patient protected Information (SSN, Policy Number)
- Vitals



Each asset type will have a 1024 character description field to provide additional details, in addition to a category.

In the case of large file attachments, an IPFS hash (AssetLoc) will be included in the Asset Record. The Business logic at the Dapp level will control which asset types retrieve the IPFS or local storage.

Sample Asset Header

AssetID: Unique id in the system
 AssetOwner: public key of the Helix Twin owner
 AssetCreator: Helix twin public key of the creator
 AssetType: 32 bit code to describe an asset type
 Asset Description: 1024 characters for meta data and tagging
 AssetLoc: IPFS hash for remote storage
 AssetCreationDate: timestamp
 Asset TransferDate: timestamp
 AssetCategory:

Permission Based Access Control:

Interacting with assets will be performed by various participants in the system.

- Helix Twin
- Pharmacy
- Research
- PCP
- Physician
- Surgeon
- Alternative Medicine
 - Chiropractor
 - Acupuncturist
- Merchant

To control how each of these users interact with information we will grant permissions based on who the asset originator is, or what the role of the asset originator was at the time of creation.

This is to allow certain participants of the same type to have read only access to content created by related roles.

Participant Type	Asset Owner	Asset Creator	Level
Helix Twin: Patient/Member	Self	Self	Create/Edit/Read/Transfer/Approve/Delete
	Self	Other	Read
	Other	Self	Delete
	Other	Other	Permission Based Access
Physician, Surgeon, PCP, Pharmacy	Self	Self	Create/Edit/Read/Transfer/Approve/Delete
	Self	Other	Read/Approve
	Other	Self	Read
	Other	Role != Research, Merchant	Read
	Other	Other	Permission Based Access
FitFlow Providers and Merchants	Self	Self	Create/Edit/Read/Transfer/Approve/Delete
	Self	Other	Read/Approve
	Other	Self	Read
	Other	Other	PBA

For the most part, the Helix Twin owner will be the creator of the *patient protected data*, *patient identity* assets, and other manually entered assets. Since they are the originator and the owner, they have full access to these files, and are the only one who can edit or view the assets by default.

All other data will be originated by other participants or connected devices, then ownership transferred to the Helix Twin. Since the owner is not the originator, there is no ability to edit or delete the asset. The user can only read, and approve others to read the asset.

Once an asset is transferred to a new owner, it can still be read by the originator. This is to support compliance and process requirements.

For participant types other than the Helix Twin, there is a third dimension of permission that is hard coded to ensure full sharing of patient information. Helix³ will check if the current user role matches the originator's role to improve sharing.

For example: Physicians, surgeon, hospitals, and specialist could read any asset originated by each other: however, they would not be able to read researcher and merchant originated data. The reverse is also true.

In all other cases, the owner of the asset must grant approval to view any asset they own.

The HelixID functions as a verified identity and custodian of personalized data assets. Provenance of records, and any transactions with it are recorded in an immutable log, which can never be deleted or changed. All data is encrypted and tamper proof. This brings an unprecedented level of trust and transparency into the healthcare system. All users on the platform interact digitally through their personal Helix Twin interface.

Data at Rest and in Motion Security:

All transactions with the Helix Twin are recorded in a public ledger. The ledger of transactions itself can never be modified. To ensure a transaction is valid and from a trusted source, multiple computers calculate a hash of the transaction record and compare the result.

Through a technique called voting, computers build a consensus on the correct hash and the transaction is written into the chain. Voters are selected randomly from a decentralized list of voting eligible nodes.

Eligible nodes requires a proof of stake that will be forfeited if the voting node is detected as a bad actor. A bad actor is any node that attempts to manipulate data in the ledger or the database. Voting nodes will be part of a provider or payers subscription fee to the system, ensuring no single entity can control, or manipulate the BFT consensus process.

Bad actors are immediately removed from the blockchain system and the proof of stake is lost. The primary purpose of this type of database is to ensure integrity of the platform, however it serves as a

strong deterrent to many hackers. The first attempt to tamper with the platform carries a financial cost. Every failed attempt after that requires more proof of stake (cost) eventually making tampering cost prohibitive.

All assets in the Helix³ platform are encrypted (SHA-256) and protected by cryptographically secured data models. Assets are de-identified to facilitate an additional layer of "security through obscurity" into the platform.

All communication within the platform and with external applications are encrypted using SSL encryption (HTTPS).

Combining de-identified data and the provider only storing the HELIX ID of the patient ensure that data at rest is always in the control of the asset owner.

HIPPA requirements do not regulate patient owned data (out of scope), however Helix³ delivers the same level of security required of the in-scope providers, while shrinking the scope of attack to a single record.

BigchainDB

The BigchainDB software is one component of the Blockchain Synchronization Server (discussed elsewhere in this whitepaper) which resides on provider and payer premises.

The differentiator in choosing BigchainDB was its ability to scale horizontally. In other words, the more servers and storage you add to the system, the greater its capacity. Adding BigchainDB to our BSS allows the platform to automatically scale as it grows.

[Read the complete BigchainDB whitepaper.](#)

IPFS (Interplanetary File System)

The actual contents of large assets are stored in a distributed file system that is optimized for big data ensuring a scalable system. IPFS was chosen based on its successful integration with BigChainDB in addition to its distributed nature.

Distributed storage ensures that no single physical device has all the information required to reconstruct meaningful information. Distributed file systems are not new. They are what most peer to peer (P2P) sharing programs are built on.

Three major benefits of IPFS are:

- Helix Twin encrypted assets are well protected from damage
- File transfer speed is greatly improved regardless of geography
- Self scaling as more nodes added

IPFS, much like other P2P platforms, creates copies of files as they are used. The copies are already encrypted ensuring patient privacy, and are then distributed closer to the patient or consumer. When a request to view the file is sent, IPFS returns a copy from the nearest location.

Now, if a patient needs to be treated by a specialist or get a second opinion, files will already be nearby, reducing dependency on the global internet for access to the data itself. This translates to a very responsive platform scaling to millions of users.

The **Helix³** platform needs to scale to 1000s of Petabytes of data in the future which is seen in the big data trends in recent years. Storage will need to grow as more and more users join the platform.

IPFS is the second component of the blockchain synchronization server ensuring the platform storage grows as participants are added. Every BSS will be scaled to provide capacity for the patients or members insuring a self scaling platform.

[Read IPFS white paper](#)

5.2 Multi-factor Authentication

Multi-factor authentication (MFA) is a method of computer access control in which a user is granted access only after successfully presenting several separate pieces of evidence to an authentication mechanism – typically at least two of the following categories: knowledge (something they know), possession (something they have), and inherence (something they are).[40][41]

Two-factor authentication (also known as 2FA) is a method of confirming a user's claimed identity by utilizing a combination of two different components. Two-factor authentication is a type of multi-factor authentication.

The use of multiple authentication factors to prove one's identity is based on the premise that an unauthorized actor is unlikely to be able to supply the factors required for access. If, in an authentication attempt, at least one of the components is missing or supplied incorrectly, the user's identity is not established with sufficient certainty and access to the asset (e.g., a building, or data) being protected by multi-factor authentication then remains blocked. The authentication factors of a multi-factor authentication scheme may include:

- some physical object in the possession of the user, such as a USB stick with a secret token, a bank card, a key, etc.
- some secret known to the user, such as a password, PIN, TAN, etc.
- some physical characteristic of the user (biometrics), such as a fingerprint, eye iris, voice, typing speed, pattern in key press intervals, etc.[42]

Helix³ uses various advanced techniques to keep user access safe. Providers and patients both use multi-factor authentication when accessing the Helix³ system.

Members and Merchants: Through a specialized hardware wallet, a private key is held on the device which is required to access the Helix³ platform. The device itself is locked with a pin that must be manually typed in on the physical device.

Patients: Patients are not required to have a specialized hardware wallet to hold their private key. Instead, they access a web or mobile based application. Access to the user's account requires a 4 to 6 digit passcode and validation through Google Authenticator.

7.3 RestfulAPI & Integration

The path to successful adoption will require a phased approach to rolling out the Helix³ platform.

- **Phase 1** - Integration with Apple Health Kit, Fitbit and other consumer based fitness/healthcare hardware.
- **Phase 2** - Integrating with medical grade equipment and legacy machines. Additionally, we will integrate with existing EHR systems.
- **Phase 3** - Development of open API and SDK for third party developers to build out applications on top of the Helix³ platform.

All phases will rely heavily on APIs to provide access to the platform. An application program interface (API) is a set of routines, protocols, and tools which specify how software components should interact. They can also be used to create graphical user interfaces.

In the Helix³ platform, APIs are the glue between the different layers in the technology stack. The Helix Cortex integration framework brings it all together.

- BigchainDB uses APIs to connect 'Helix Twin' data into the IPFS storage system.
- Ethereum uses APIs to interact with the Helix Twin data in the BigchainDB.
- Applications interact with the 'BSS' using APIs to interact with the Helix Twin

Helix³ APIs will be developed using the RESTful API Framework, supporting HIPAA level encryption for data in motion. The RESTful API will also authenticate the connecting machine using multi-factor authentication.

CMS (Centers for Medicare and Medicaid Services), which defined the Meaningful Use Incentive program rules, is now in stage 3 which has some basic requirements:

1. The patient (or the patient-authorized representative) is provided timely access to view online, download, and transmit his or her health information; and
2. The provider ensures the patient's health information is available for the patient (or patient-authorized representative) to access using any application of their choice that is configured to meet the technical specifications of the API in the provider's certified EHR technology (CEHRT)

Failure to meet these requirements results in a 3-4% penalty for which every provider must comply in 2018.

In phase 1, Helix³ will enable patients to populate their data from various EMRs directly from our platform, using HL7 standards and custom APIs.

To meet stage 3 requirements, all EMR software providers will need to expose an API into their software to allow 3rd party applications present the information, and share it with other providers. Helix³ will leverage these APIs to achieve 80% coverage of EMR platforms in 2018-2019.

Phase 2 APIs will focus on integrating existing healthcare medical equipment (eg. MRI, Dialysis Machine) into the Helix³ platform, enabling them to interact directly with the patient, payer, and provider. Helix³ connected devices can be used to build additional automation, thereby reducing administration and errors.

The Intelligent Edge Gateway Node is a device that will be placed in close proximity of the medical equipment. It will collect assets from a medical device, perform some processing, and control the interaction with the Helix3 platform and its participants.

The IEGN will perform a proxy function by supporting protocols used to transfer information and translating to the APIs used in the Helix³ platform. Any APIs that are developed to support legacy equipment can be integrated directly into IoT medical devices which can automate much of the administration surrounding the workflow they support.

Helix³ will release integration capabilities so other healthcare applications can interact with the Helix Twin data. This will enable the marketplace and innovation for next-gen healthcare applications.

7.4 Smart Contracts & Automation

A smart contract is a computer protocol intended to facilitate, verify, or enforce the negotiation or performance of a contract. Smart contracts were first proposed by Nick Szabo in 1996.[38]

Computer code can be embedded into the contract to automatically execute contractual clauses, fully self-executing, self-enforcing, or both.

Smart contracts are deterministic exchange mechanisms controlled by digital means that can carry out the direct transaction of value between untrusted agents.[39] They can be used to facilitate, verify, and enforce the negotiation or performance of economically-laden procedural instructions and potentially circumvent censorship, collusion, and counter-party risk.

In Ethereum, smart contracts are treated as autonomous scripts or stateful decentralized applications that are stored in the Ethereum blockchain for later execution by the EVM. Instructions embedded in

Ethereum contracts are paid for in ether (or more technically "gas") and can be implemented in a variety of Turing complete scripting languages.[17]

Automation is a key to reducing the administrative burden in the healthcare platform. Creating a consolidated location for patient data in the Helix Twin and connecting people and machines, the Helix³ platform enables workflow and service automation.

The vehicle for automation is the Ethereum platform, and more specifically, Dapps, smart contracts and oracles. Dapps control how information is presented to the user, smart contracts control how patients and providers exchange information and oracles pull data from other sources. All of this data is accessible in the Helix Twin.

Passing attributes from the Dapp to the Smart contract and vice versa will enable the creation of many different workflows

4 key attributes of a smart contract :

- Execution is logged into an immutable ledger
- Support IF, THEN logic to test conditions during execution
- Smart contracts have transaction costs, and can involve transferring ownership of an asset.

Every view or change to the Helix Twin attributes is recorded in a ledger that can never be changed. This is where the blockchain offers extreme value. The ledger is public, so tampering is easily detected, and even attempting to change the contents of an existing entry, would require an extremely high level of computation, not readily available to any single attacker today.

With each step of the workflow controlled by the Dapp using the appropriate smart contract, and all read and writes recorded to the ledger, strict compliance to best practices or regulation can be attained.

The contract automatically validates a condition and determines whether the asset should be transferred to a new owner, or remain with the current owner. The condition will always be enforced, with the exact same parameters, making smart contracts perfect automation vehicles.

From an automation prospective, smart contracts will also run other smart contracts. One can think of a workflow consisting of multiple tasks. The workflow can be programmed into a smart contract, with the individual steps in the workflow being performed by other smart contracts.

The ability to automate workflows using smart contracts, combined with access to a consolidated view of healthcare data, will create a platform for innovative applications, known as Dapps (Decentralized Apps).

Dapps can be expanded to deep learning, artificial intelligence, population health management, and self-service apps supporting wellness and preventative care.

7.4 Deep Learning Framework

Deep learning (also known as deep structured learning or hierarchical learning) is part of a broader family of machine learning methods based on learning data representations, as opposed to task-specific algorithms. Learning can be supervised, partially supervised or unsupervised.[20]

Some representations are loosely based on interpretation of information processing and communication patterns in a biological nervous system, such as neural coding that attempts to define a relationship between various stimuli and associated neuronal responses in the brain.[21]

Deep learning architectures such as deep neural networks, deep belief networks and recurrent neural networks have been applied to fields including computer vision, speech recognition, natural language processing, audio recognition, social network filtering, machine translation, bioinformatics and drug design[22], where they have produced results comparable to and in some cases superior[23] to human experts.[24]

We see many different applications that could leverage these deep learning capabilities. From advanced analytics to next generation drug design. All the data in the world doesn't matter unless you can make it meaningful. In other words it's data that makes an impact.

Machine learning is closely related to (and often overlaps with) computational statistics, which also focuses on prediction-making through the use of computers. It has strong ties to mathematical optimization, which delivers methods, theory and application domains to the field. Machine learning is

sometimes conflated with data mining,[20] where the latter subfield focuses more on exploratory data analysis and is known as unsupervised learning.[25], [24]

Machine learning can also be unsupervised[14] and be used to learn and establish baseline behavioral profiles for various entities[35] and then used to find meaningful anomalies.

Within the field of data analytics, machine learning is a method used to devise complex models and algorithms that lend themselves to prediction; in commercial use, this is known as predictive analytics. These analytical models allow researchers, data scientists, engineers, and analysts to "produce reliable, repeatable decisions and results" and uncover "hidden insights" through learning from historical relationships and trends in the data.[16] Helix³ helps gather data and make it useful. Predictive analytics can enable providers, payers, drug manufactures and other participants to can gain deep insight through this method of analyzing massive data sets. TensorFlow is an open-source software library for dataflow programming across a range of tasks. It is a symbolic math library, and also used for machine learning applications such as neural networks.[19] It is used for both research and production at Google, often replacing its closed-source predecessor, DistBelief.

TensorFlow was developed by the Google Brain team for internal Google use. It was released under the Apache 2.0 open source license on November 9, 2015.[16],[20]

TensorFlow is Google Brain's second generation system. Version 1.0.0 was released on February 11, 2017.[22] While the reference implementation runs on single devices, TensorFlow can run on multiple CPUs and GPUs (with optional CUDA and SYCL extensions for general-purpose computing on graphics processing units).[23] TensorFlow is available on 64-bit Linux, macOS, Windows, and mobile computing platforms including Android and iOS.

TensorFlow computations are expressed as stateful dataflow graphs. The name TensorFlow derives from the operations that such neural networks perform on multidimensional data arrays. These arrays are referred to as "tensors".

The Helix³ platform will support the Tensorflow framework and include deep learning functionality within our Dapps. This will also enable third party developers to easily build these capabilities into other Dapps on the platform.

7.5 Medical Device Integration & Management

Adherence to standards ensures interoperability within a network of medical devices. In most cases, the clinical environment is heterogenous; devices are supplied by a variety of vendors, allowing for different technologies to be utilized. Achieving interoperability can be difficult, as data format and encryption varies among vendors and models.[42] The following standards enable interoperability between connected medical device.

- CEN ISO/IEEE 11073* enables the communication between medical devices and external information systems. This standard provides plug-and-play interoperability between devices, and facilitates the efficient exchange of data acquired at the point of care in all care environment.
- IEEE 802.11 a/b/g/n are standards for implementing a wireless local area network (WLAN) in 2.4 GHz and 5 GHz frequency bands, utilizing the same basic protocol.

Regulatory organizations and industrial associations, such as Integrating the Healthcare Enterprise (IHE) initiative and Continua Health Alliance, are working towards standardized vendor-neutral device integration systems.[43] The IHE provides a single set of internationally harmonized medical device informatics and interoperability standards as a unitary reference point for the industry. The IHE collaborates with Continua Health Alliance regarding data exchange protocol and device specializations.[44]

The IHE Patient Care Device (PCD) Technical Framework Volumes 1-3 defines the established standards profiles, such as the integration, transaction and semantic content profiles respectively for

complete, enterprise-wide integration and interoperability of health information systems.[46][47][48] Several profiles have applications in medical device connectivity including the following:

[DEC] Device Enterprise Communication - supports publication of information from point-of-care medical devices to applications such as clinical information systems and electronic health record systems, using a consistent Health Level Seven version 2 (HL7 v.2) messaging format and device semantic content or DICOM profile.[49]

[ACM] Alarm Communication Management - ensures the right alarm with the right priority to the right individuals with the right content.[46]

[DEC-SPD] Subscribe to Patient Data - supports a filtering mechanism for data transaction.[46]

[PIV] Point-of-care Infusion Verification - supports communication of a 5-Rights validated medication delivery / infusion order (from Bar Code Medication Administration (BCMA) system, also known as Barcode Point of Care (BPOC) system, to an infusion pump or pump management system[45]

[RTM] Rosetta Terminology Mapping - is based on the ISO/IEEE 11073 semantic standards converting vendor specific terms into harmonized standard terms. It uses a set of tools (Excel spreadsheets & XML files) to map the proprietary semantics communicated by medical devices to a standard representation using ISO/IEEE 11073 semantics.[44]

[IDCO] Implantable Device – Cardiac – Observation (IDCO)* profile - specifies a mechanism for transmission, and processing of discrete data elements and report attachments associated with cardiac device observations.[48]

Hospitals have many different makes and models of medical devices. Each department has different types of devices, and rarely does an entire hospital run on the same brand device. Because of the large number of devices, and the varying formats that data is exchanged (RS-232, HL7, Bluetooth, WiFi), Medical Device Integration software has become a critical component to integrating this vital patient data.

With the Helix³ platform, providers can connect with virtually any device via HL7, Serial (RS-232), Bluetooth, WiFi, etc., and data can be shared across any other software platform within a hospital network through the Helix³ Cortex integration framework. This allows hospitals to continue to use their older devices, in a more modern setup.

All data transport on the Helix³ platform uses advanced encryption and multi-factor authentication to ensure data is private and secure.



Future Use Cases

Below we outline several use cases that will be built out as modular applications on the Helix³ platform. We will also incentivize a development ecosystem for third party developers to build applications as part of the community.

Clearly, there are many advantages of embedding intelligence, automation, trust & transparency into our healthcare networks using blockchain, IoT and deep learning technologies. This combination saves tremendous amounts of time by accelerating transactions in a trusted & verifiable way, while being able to extrapolate data and make it useful. Manual efforts and transaction times can be reduced from days to near instantaneous.

We aim to remove costs by reducing overhead and eliminating unnecessary intermediaries and workflows through powerful applications built on the Helix³ platform. This will eliminate additional layers of complexity, embedding these capabilities digitally into smart contracts, some of these costs could disappear completely. Blockchain is an immutable, security rich and transparent shared network, providing each participant end-to-end visibility based on their level of permission.

Helix³ brings together all participants in the healthcare industry and provides a trusted platform to transact with one another. Ultimately the collective elements that are brought together by the marketplace participants will create a next generation operating system for the healthcare industry as a whole.

Below are just some examples of specific use cases that will drive the future of healthcare.

8.1 Master Patient Index & Longitudinal Records

Helix³ provides a platform to help solve the problem health systems have when their data sets get mismatched, or the problem of duplicate records. Under the current system, there are 20 different ways you can enter date-of-birth.

Another challenge is that this information is centralized with a single trusted source, which contributes to the issues with how we are approaching MPIs today.

Even within organizations, error rates for being able to successfully identify or integrate a file are 25 percent; outside the walls, they're 50 or 60 percent.

Longitudinal health records are a major gap with no good solutions available today. Currently, most of us go to our primary care roughly 54 percent of the time we engage with the healthcare system. The other 46 percent (of clinicians) doesn't have a complete view of our health history. We need a clinical summary, view into what's going on with that patient: labs, treatments, diagnoses. Then we need a way to dive deeper into the records and gain more insight.

Helix³ brings all healthcare records onto a decentralized database and puts the control in the hands of the patient (owner of their data). This is all manageable through the Helix Twin interface. All records from birth to present day are synced up with the system and organized chronologically. This gives the full picture of a patient's health record and provides a more personalized and valuable experience. These records are updated in realtime as events take place.

8.2 Revenue Cycle & Fraud Prevention

A shared, trusted data ecosystem has as many financial benefits as clinical ones. Both payers and providers can leverage Helix³ as the basis for more stable and predictable revenue cycles.

Helix³ offers the ability to create validated identities for members of the network, accurately record tamper-proof transactions and sync all participants involved automatically through smart contracts. This Enhances security and transparency and may also drastically reduce the amount of fraud that slips through the defenses of public/private payers. When entities must have current and authenticated identities before a transaction is approved, the ability to push suspect claims through the reimbursement process is diminished.

Payers with access to a patient's complete medical record and all of the individual's approved providers would be more able to identify suspect claims or payment requests that do not match the patient's documented conditions or normal care habits. This data would only reveal relevant "permission based" access from the data owner.

Helix³ supports the tensor flow framework to run advanced analytics applications for proactive monitoring of patterns that could inform fraud detection systems that rely on machine learning to continually improve their sensitivity, allowing payers to avoid the costly "pay-and-chase" situation.

The system can make it easy to maintain a benefits database, determining patient insurance and ensuring accuracy. Roughly 6 percent of all claims are denied because of incomplete or incorrect information. Helix³ could help by updating the information continuously and distributing it to the decentralized network.

8.3 Claims Adjudication

Automated adjudication means being able to automatically take a claim and decide whether it's going to be paid or denied without manual intervention. 80 percent of claims are done this way. But claims are getting a lot more complex, and more importantly there's error and fraud already in that 80 percent.

Helix³ makes sure all transactions are transparent to the stakeholders involved. This level of end to end visibility is governed by automatically executing "smart contracts".

8.4 HIPAA and PCI Compliance

Today providers hold the burden of managing patient healthcare records. Even worse this is done in a centralized silo that leaves records extremely vulnerable to cyber attack. It's nearly impossible to be HIPAA compliant with the current systems. It requires a lot of resources to keep up with.

Helix³ can securely shift management and control of records back to patients. The network uses decentralized database, advanced cryptography and automated smart contracts to facilitate each transaction. The patient can manage their own records and choose who they share data with. From a HIPAA perspective, data is stored according to HIPAA compliance standards; however, since data is not owned by anyone except the patient, data at rest requirements along with much of the cyber security expenses can be reduced or even eliminated.

8.5 Clinical Research

One of the challenges with clinical research studies are the manual and inefficient ways to recruit candidates for research programs. Additionally, once they have the data, it must be extrapolated.

The Helix³ platform adds a layer where pharmaceutical companies can create a smart contract and broadcast it out to the marketplace to collect candidates.

Data and information is automatically de-identified and made available by users on a permission basis. Researchers in clinical trials, would love having access to this wealth of data that currently locked up in silos.

Once data is compiled and associated with a HelixID, participants can choose to submit their information for medical research and be compensated for it directly. This scenario enables a more streamlined approach to research while giving the user an opportunity to monetize their data.

8.6 Population Health Data

In addition to one-on-one improvements for individual patients, Helix³ has the potential to change the way population health management is conducted.

Users on the platform can access de-identified health data in realtime. This information can be filtered based on numerous criteria.

For example, users can track a seasonal flu based on region. Then the user can look at historical flu data in that area and leverage the deep learning capabilities to help predict future spread and effects on the local population.

8.7 Automated Patient Check-in

When a patient typically goes to a provider for care, they are usually asked to fill out a few paper forms and then sit in the waiting area. This applies to scheduled appointments and ER care.

With Helix³, a patient can automatically 'check-in' through their digital identity on the platform (mobile app). When a patient arrives to an appointment, the doctor can get a notification that their patient is in route and what the ETA would be. At the same time a smart contract will route the patients medical chart and make it available to the doctor. By the time the patient arrives, all necessary "paper work" is completed, automatically by the Helix³ network.

8.8 Communications & Telehealth

Helix³ enables patients to communicate with the healthcare providers through video and text. Remote appointments can be scheduled and conducted from anywhere in the world. With Helix³ integrating with medical IoT devices, patients can have vitals monitored from the comfort of their home. All while a doctor can communicate back with their patient and help them in the most convenient way.

8.9 Emergency Transport

Increasingly connected devices are making their way into the healthcare system. This is no different for ambulances and other emergency transport services. Each of these vehicles can also be a connected IOT device that generates and communicates data.

With Helix³ emergency vehicles are considered an asset that provides a service. For example, a patient needs emergency response and an ambulance is dispatched. As soon as the ambulance is in route, location data is transmitted to the hospital notifying them of an incoming patient. The patient data is automatically collected from the digital ID (Helix Twin) and shared with the hospital's doctors in the ER. By the time the patient is at the hospital, all necessary data is analyzed for maximum value based care.



Legal

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General information

In order to fund the development of the Helix³ platform and ecosystem, the HLX token will be sold to the public for future access, in exchange for crypto assets like BTC (Bitcoin), ETH (Ethereum), LTC (Litecoin).

The HLX token is a digital key, which will allow the user to access the service provided by the Helix³ platform. Users that intend to purchase HLX Tokens are subject to the acceptance of the General Terms & Conditions. The HLX token does not have the legal qualification of a security, since it **does not** give any rights to dividends, interests, shares or voting privileges through Helix³.

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The purchaser of HLX tokens undertakes that she/he understands and has significant experience of cryptocurrencies, blockchain systems and services, and that she/he fully understands the risks associated with the crowd sale as well as the mechanism related to the use of cryptocurrencies (incl. storage of tokens). Helix³ Technologies, Inc. shall not be responsible for any loss of HLX tokens or situations making it impossible to access HLX tokens, which may result from any actions or omissions of the user or any person undertaking to acquire HLX tokens, as well as in the case of hacking attacks.

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Governing law and arbitration

The participants in the Helix³ TGE acknowledges and accepts that the Helix³ token offering operation is taking place within a U.S legal environment that is still under development. The Parties agree to seek at least two rounds of professional mediation and then negotiation on an amicable settlement prior to bringing any legal action. All disputes arising with the whitepaper provided, shall be resolved by arbitration in accordance with the US law. The arbitration panel shall consist of one arbitrator/mediator only. The seat of the arbitration shall be Boston, MA USA. The arbitral proceedings shall be conducted in English.

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