Metaverse Health Systems: Whitepaper

Version 0.0
2022/03/14

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Summary

Metaverse Health Systems is an open-source, EVM-compatible project with the goal to provide the primitives needed to build a digitally native health system.

Foreword + Context

I'm a health professional, a physiotherapist, to be exact. So why am I writing a whitepaper for a web3 project, like I'm some sort of developer?

Because web3 let me 😜

A cheeky statement which understates the cultural and technological shift that is happening.

I also like first principles and levers (thanks @naval + @balajis). I quickly came to realize that my time is valuable, and that there are always too many patients and not enough time. I decided I would rather have a small percentage share in helping a lot of others provide health care. The lever I chose was web3.

I don't expect this to be the best, or even a popular, solution to the coordination failures most health systems suffer from. I'm no developer. I just want to set the idea free. So others can iterate on it and improve it. And who knows? Maybe, one day, I can be content knowing that I had the smallest part in improving health systems.

I believe health systems can be fundamentally improved by web3 technologies.

I believe we can create a positive sum solution to the multiplayer coordination game that is our global health system.

This is a call to arms for anyone interested in building this with me.

Let's heal the world.

Yours in kindness,
@LourensLinde

Introduction

Health systems as a public good, regardless of location, are seen as a drain on a nation's financial resources. In contrast, an effective health system should contribute to a nation's economic output through the maintenance of a population's health. An effective health system is analogous to a distributed autonomous organization; smaller entities interacting with one another, each under its own power, but orchestrated into a complex system acting towards one goal.

Improvements in technology now allow for the creation and digital representation of distributed autonomous organizations (DAOs). Such organizational patterns are surprisingly prevalent in society today, although they may not identify as a DAO because of their off-chain nature. Blockchains provide the needed primitives to sustain such digital representations effectively. At the same time, we are seeing the creation of cryptocurrencies, NTFs and DeFi protocols; inventions which were unthinkable a decade ago.

The advent of smart contracts has allowed for systems design through the framework of regenerative cryptoeconomics, which uses economic and game-theoretic concepts to design incentives with the aim to provide positive-sum outcomes to multiplayer coordination games.

Problem Statement

Health systems are abstractions of the complex, health-related interactions between entities. The World Health Organization divides health systems into the following components: governance, financing, workforce, products and technologies, information systems and service delivery. An exhaustive outline of the WHO approach to health systems is beyond the scope of this whitepaper and can be found here. Representing a health system in such a way is convenient for analysis, measurement and research, but does not, in a general sense, provide an up-to-date, comprehensive view of a health system.

In the digital age it becomes difficult to accurately model such systems where the different components have no digitally appropriate representation. In addition, complex systems obfuscate inefficiencies between different components. Systems wherein the components themselves have internal inefficiencies compound the external inefficiencies. Determining the performance of a health system component is usually based on lagging indicators; determining the real-time state of a health system is (currently) near impossible.

A public good, such as a health system, creates an environment where there is an inherent bias towards self-interest without regard for the whole (the “free-rider” problem). The coordination failure is readily apparent in many health systems. But because the participants have incomplete information and no reliable method to coordinate, a suboptimal result is achieved.

The field of decentralized health may be a subset of decentralized science (DeSci). MHS uses economics and game-theoretic concepts to design novel mechanisms to solve for the multiplayer coordination failures experienced in health systems. The hope is to enable the creation of a positive-sum system.

To summarize: health systems are opaque, multi-player coordination games, which can be partially digitally expressed, but the state of which cannot be accurately determined at any one point in time. Consequently, coordination failure leads to inefficiencies and a net-negative effect on a population; a population which funds the public good, but does not realize the positive-sum result thereof.

Metaverse Health Systems

The Metaverse Health Systems protocol is a collection of open-source, EVM-compatible contracts and organizational processes which, when used together, provide the needed primitives for composable, digitally native health systems built on economic and game-theoretic principles. The MHS protocol is to be developed, maintained and supported by a healthDAO; a community-run, ImpactDAO with the goal of improving the health of all people.

Implementation

The health entity is a foundational primitive in the proposed system. A health entity, in the MHS protocol, is defined as any token holder that has a health-related interaction with another token holder. A health-related action is a transaction between token-holders on an EVM-compatible blockchain that has the goal, even indirectly, to improve the health of others. This allows any actor, from a single health professional to larger administrative organizations to form part of the system. Health entities will be covered in the open-source document maintained by the healthDAO. The scope of a health entity is broad by design. The system should optimize for the public good. As with quadratic funding mechanisms, small contributions from a more granular network should outweigh more concentrated contributions from larger actors.

Health entities are represented by an ERC-721 token. Each token represents a health entity and must have the following attributes:

- An unsigned integer (uint32) representing the type of health entity holding the token. The type in this context can be anything from a health professional's speciality to a large health administrator's specific focus.
- A health identifier represented as a bytes32 variable. This variable is a Keccak256 hash of the health entity's credentials and the statutory body in compact JSON format:
  {"governingBody":"ZA: HPCSA","healthId":"PT0119350"}

The hash allows a client to verify the credentials without storing the raw data on the blockchain. The credentials should already be public domain, but there is no reason to expose participants unnecessarily. This value can be changed by an assigned address as governed by the healthDAO (the Auditor).

- A verified property, expressed as a simple boolean value, to indicate that the health entity has been verified by another health entity. Verification is lost on transfer to another address and must be re-applied for.
- A sponsor address, which tracks the address that sponsored the health entity to verified status.
- An active property, expressed as a boolean value, indicating if a health entity can participate in the network. True by default, can only be set to false by the governing healthDAO through an Auditor address.
- An unsigned integer (uint32) that tracks the health entity's reputation points (RP). RP is gained for participating in the MHS protocol and can be lost through misbehavior or abuse.

The MHS: Heal Token (HEAL) is an ERC-20 token; it is a utility token that is to be used within the MHS ecosystem. The token supply is not capped and the emissions schedule is variable. Tokens are earned for various actions within the ecosystem. Initially, tokens are earned for verifying other health entities. RP earned by a health entity is a product of the interaction's base-reward and the reputation multiplier of the health entity. The primary use for HEAL is as an incentive for participation within the MHS protocol.

As different types of interactions can exist between health entities the incentives (both the base reward and reputation multiplier) can be shifted as the goals of the project change. These two properties, base reward and reputation multiplier, are the main mechanisms that control HEAL emission and are governed by the healthDAO.

Token Economics

The primary coordinating incentive mechanism for the ERC-721 token holder is the reputation points (RP) that accrue for qualifying interactions (e.g. verifying credentials).

A health entity token, as an ERC-721 token (or NFT), can be sold on the open market. As soon as the NFT is sold it loses its verification, meaning it must apply to have its credentials reverified and participate in the protocol, but transfer of the NFT does not impact the accumulated RP.

In the same way a doctor may build up a practice where their brand/name becomes a valuable intangible asset, the RP becomes a quantifiable asset which enhances the value of a health entity NFT when sold. The RP becomes a significant modifier to earning HEAL when participating in the protocol - a quality which may fetch a premium on the open market and which rewards hodlers and frequent contributors.

There is no initial distribution of the HEAL token. Retroactive public goods funding can be decided on by the healthDAO, but shouldn't be decided on by the author. A fair launch is needed for a fair ecosystem.

The healthDAO sets the Base Reward and the RP Multiplier for each defined health interaction. The first interaction is restricted to verifying health entities. A higher base reward is expected to incentivise greater activity towards the underlying interaction. The RP Multiplier is expected to incentivise continued participation in daily activities by creating a mechanism to fine-tune the HEAL earnings. In addition, as the range of incentivized activities expand, it may be beneficial to direct more seasoned (i.e. higher RP) participants to more complex interactions through increased RP Multipliers.

Qualifying activities earn HEAL on a per transaction basis. The HEAL, as a utility token for use within the MHS ecosystem, should be claimable (not airdropped). HEAL accrues to an NFT, which adds another incentive layer to the MHS token economics.

Conclusion

The whitepaper is a living document. The protocol, in this version, is incomplete. It is the author's firm belief that the protocol shouldn't set out to create a digital analogue of current health systems. The preferred approach is to set the primitives free and see how the environment reacts and, maybe, iterates on it. The primitives discussed allow for the health care implementations like health dapps that enable payments for services, or patient control of data, or health professional login to dapps. More importantly, it allows for the system to be expressed as a sum of all the health-related interactions on the blockchain, providing a real-time view of the entities in the system.

Feel free to come poke around in the project's GitHub folder. Interested in helping? Send an email to lourens@dao.health