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# TOKENOMICS – The Economics of the NRN token

## A Position Paper on the NEURON network

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# 1 Introduction

The biological profile of the near future will be consumer-controlled, AI-powered and data-centric. It will be algorithmic rather than symptomatic, bottom up rather than top down, quantitative rather than qualitative. The decentralization of Medicine is in full swing.

## 2 The Participant will see you now and why we are not using the word “patient”

We are not using the word "patient" (we use participant <sup>1</sup>) in this position paper for three reasons:

- We believe that the future of healthcare is going to be n=1, where everyone is a participant in their own medical trial and this medical trial is only part of a bigger whole, wherein the whole world becomes one Deep Data Trial.
- We believe that healthcare is becoming a continuous function and not a discrete one (healthy-unhealthy period transitions).
- We no longer believe that people who suffer from disease and their loved ones are happy with being patient and waiting for a Kafkaesque <sup>2</sup> healthcare system.

## 3 Deep Data Trial Ecosystem

We propose a new type of trial: the Deep Data Trial. Deep Data Trials are deep research studies involving volunteers whom we call participants. Volunteering to participate in a Deep Data Trial is one of the ways a participant can contribute to helping themselves and others in the development and change of behaviors. Participants choose to participate in a trial for various reasons. Some desire to help others by advancing medical science; where a treatment is not fully effective in relieving the symptoms of the condition, while some may just want to experience receiving investigational data prior to it being peer reviewed. They offer both another hope for other participants, whilst contributing to the advancement of medical science for future participants. A diagram is shown in Figure 1.

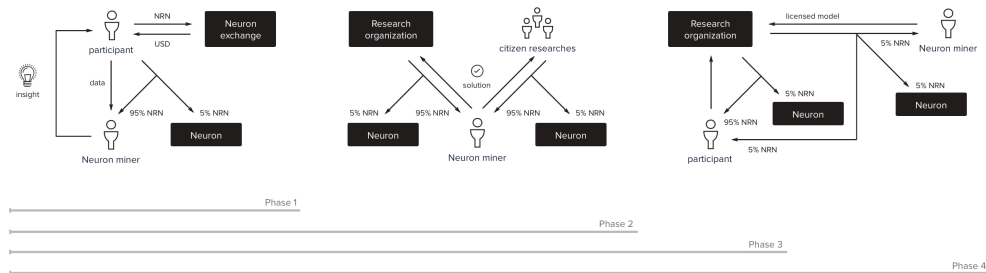


Figure 1: Deep Data Trial Ecosystem

### 3.1 Parties

- **Participant** – We are using the metaphor of a clinical data trial
- **RO** – Research organizations, which can be participants who unite under a common goal for a clinical data trial, or organizations/corporations

<sup>1</sup>Eric Topol, The Participant will See You Now, tweet 28 February 2015: <https://twitter.com/EricTopol?lang=en>

<sup>2</sup>Kafka died a patient at 41 from starvation. He was editing "A Hunger Artist" on his deathbed.

- **Neuron Miner** – Data scientists

### 3.2 Phases

- **Phase 1:** Participant data collection (deep phenotyping)
- **Phase 2:** Broadcasting the trial to recruit other volunteer participants in a RO (an ad hoc research Organization that is put together by participants). They formulate the proposal and offer the bounty (prize) to the community of Neuron miners (data scientists). NEURON Miners are modeling and clustering the data and the competition prize (bounty) is awarded and a data report is published to the group or individual participant. Individuals go to their respective health providers with the model or act in group (RO) looking for validation.
- **Phase 3:** The data owners will be able to opt-in to the network to put up their data for sale
- **Phase 4:** When the model is validated clinically, the group of volunteers open sources the model for the advancement of science and/or decides to license the results to academia, pharma, insurance etc.)

### 3.3 Participant Categories

- Participants who want to do a Deep Data Trial
- Participants who are collecting the data for family members or friends who are no longer able to do it themselves (citizen doctors)
- Participants who have been awarded a data grant because they are suffering from a mysterious disease, a rare illness or a genetic enigma
- Participants who do not have health insurance
- Participants who live in a region or country where access to medical knowledge is sparse but who have a smartphone
- ROs: Individuals grouped under a common banner in order to do a clinical trial together; or, research organizations which are looking for organic, unbiased and precisely segmented, anonymized, enriched datasets from a diversified group of participants.
- Corporations that manage their own health insurance risks and want to bring in AI and data driven healthcare to reduce their exposure to expensive and/or unavailable therapies conducted by humans.

## 4 Phase 1: AI-protocol to deconstruct medical records

The current electronic medical records (EMR) are a legacy. They are low-entropy carriers<sup>3</sup> that live in a high-context culture and we want to see them replaced by high-entropy carriers in a lower-context culture<sup>4</sup>. Qualitative, small-data, gut feelings should make way for quantified biological studies or deep data trials. This will enable participants to better understand health, and to later evolve towards machine-aided auto diagnosis. The approach reduces randomness in therapies, increases transparency in care and gives accountability back to the participant, where it belongs.

Traditionally collecting medical data is difficult. We help participants aggregate their medical data in an app, which will pull additional data from sources such as external medical institutions, wearables, OTC testing facilities and GUI-based life logging apps. The NEURON application layer is doc.ai, an entertaining hybrid of natural language and faceted search. In our UX, most questions and answers are predicted- most of the time it's multiple choice, but if participants do have to type something out, they'll have autocomplete to help them.

<sup>3</sup>George Gilder, *Knowledge and Power: the Information Theory of Capitalism and How It Is Revolutionizing our World*. A low-entropy carrier is predictable, a high entropy carrier has surprising insight.

<sup>4</sup>These concepts were first introduced by the anthropologist Edward T. Hall in his 1976 book *Beyond Culture*. According to Hall, messages exchanged in a high-context culture carry implicit meanings with more information than the actually spoken parts, while in low-context cultures, the messages have a clear meaning, with nothing implied beyond the words used. Hall, Edward, T. *Beyond Culture*. Anchor Books (December 7, 1976). ISBN 978-0385124744

Old Medicine	New Medicine
Population-Based One-Of, Doctor's Office Doctor Ordered Data Doctor's Notes, Unshared Information Owned by Doctors and Hospitals Expensive, Big-Ticket Tech Data Limited	Individualized Real-Time Streaming, Real World Patient Generated Data Our Notes, Patient Edited Information Owned by Rightful Owner Cheap Chips, Moore's Law Panoromic

Table 1: Eric Topol on Twitter (link)

According to Jeremy Howard, the key characteristics of good datasets are that they have <sup>5</sup>:

1. Longitudinal Information
2. Conditions, Treatments and Recommendations (such as doctor's notes)

NEURON will start from scratch to allow participants to construct their own deep data profile. It extracts medical information about them via pictures of lab results, through downloading records and test results from portals and apps, or by guiding them through a self-reported stacked decision tree. This part of the AI will be free; participants will not need NRNs (currency of NEURON) to get access. However, if they want predictions on the spot, they will be able to purchase them with a small NRN payment.

#### 4.1 Inclusion Project

No currency will be charged and costs will be waived for special categories in the Inclusion Project. The Inclusion Project will whitelist special case participants and award them a data grant for data collection, premium features and for data science.

Inclusion Project categories may include:

- participants suffering from a mysterious disease
- participants suffering from a rare illness
- participants suffering from a genetic condition
- participants who do not have health insurance
- participants who live in a region or country where access to medical knowledge is sparse but who have a smartphone

*These categories are illustrative and subject to future detail and change.*

#### 4.2 Deconstructing Medical Records

We are designing a system that will allow participants to easily think about, store and add to their medical records. The digest of medical records is depicted in Figure 2. The data will be decentralized and storage will happen on-device, be it a tablet, smartphone or computer.

**Timing:** 6 months after closing of the ICO we hope to have the AI system operational in pilot (scalability testing) on top of the Ethereum Blockchain. Tokens should be released shortly after that.

#### 4.3 Phase 1 Planned Tokenomics

- Income from participants who buy premium versions (for example, instantaneous prediction and advice)
- System tokens awarded to the developer community to stimulate the ecosystem
- Negotiations to have shares in the economics of partner tokens

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<sup>5</sup>Jeremy Howard, NEURON- Research Directions

## Deconstructing (and demythologization) the Medical Record

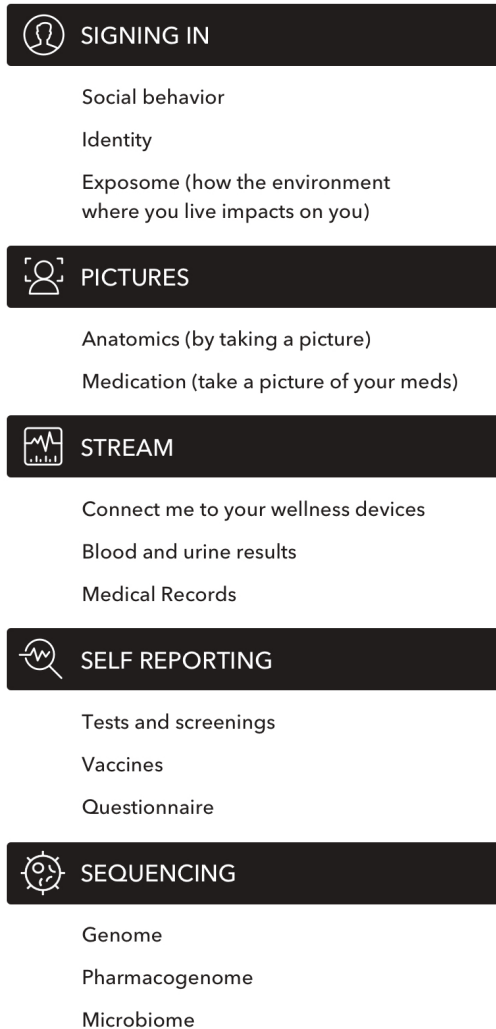


Figure 2: Deconstructing the Medical Record

## 5 Phase 2: A Community for Predictive Modeling

NEURON enables the owners of the deep data quantified biology profile on the network to broadcast a competition very much like Kaggle and offer a bounty. This bounty will be quoted in NEURONS. The participant will have already structured data and will need to formulate a description of the problem.

Each data scientist will need to be provided with a rich analytical environment. It should show them information about the problem they've been asked to solve, as well as how to access the data. The sandbox should not be given external internet access so that the data cannot be easily copied, and data scientists will sign a legally binding data usage agreement to not use the data for any other purpose.

Once the project is complete, the sandbox will be deleted and they will lose access to their data, although they may be allowed to upload data to their own libraries through a special upload-only folder.

Neuron will have resources to help frame the competition and anonymize the data. Participant data scientists (called NEURON Miners) experiment with different techniques and may either compete against each other, or cooperate with each other to produce the best models, through processes such as:

1. Data cleaning
2. Exploratory data analysis
3. Creating a validation set
4. Building a model
5. Analyzing and validating the model

### 5.1 Example Flow

1. The applicant, or RO, prepares the data in a sandbox and adds a description of the problem.
2. Neuron miners experiment with different techniques and compete against each other to produce the best models.
3. After the deadline passes, the applicant pays the bounty (prize money) in NRN in exchange for "a worldwide, perpetual, irrevocable and royalty free license" to use the winning solution developed.
4. Submissions are scored immediately based on their predictive accuracy relative to a hidden solution file and summarized on a live leader-board.

**Timing:** 6 months after NEURON will be operational the NEURON Miners community is expected to be online.

### 5.2 Phase 2 Planned Tokenomics

- Income from NEURON Miners who are awarded the bounty
- Income from all parties in NEURON who broadcast proposals to NEURON Miners

## 6 Phase 3: BIO Wallet

The data owners will be able to opt-in to the network to put up their data for sale. The data will be anonymized and encrypted.

### What is the added value for participants?

1. **Information asset.** Participants would control of their own medical data, across all their visits to different institutions and departments, as well as their own collected information (such as from wearables and self-reported data).
2. **Financial asset.** The investment in health becomes an asset class. They can sell their data or part of their data.
3. **Knowledge Asset.** The AI will notify its owner of medical breakthroughs all over the world related to certain condition, or clinical trials that are underway either by academia, pharma or ROs on the network.
4. **Ecosystem asset.** For many, there is an intangible value in knowing how their data and their investment in their health helped others. Often overlooked, this an overlooked, this asset may be the prime non-capitalistic and collective mover of the whole ecosystem.

**Timing:** 12 months after the NEURON Network will be operational the BIO wallet is planned to be online.

## 6.1 Phase 3 Planned Tokenomics

- Income from ROs who want to purchase buckets of segmented data and pay NEURON
- Income from Participants who sell data to ROs and pay NEURON

## 7 Phase 4: A Healthcaser Blockchain

Allowing participants to control their own medical data, and giving data scientists the opportunity to solve pressing medical problems, is a powerful idea. But it's only the tip of the iceberg. We believe, the bigger opportunity comes when the models are continually improved, and eventually all combined. Each data scientist's engineering steps can be saved and made available to future researchers, with compensation when their approaches are re-used. In addition, their pre-trained model activations can be automatically brought into new models to see if they add predictive power.

By reusing pre-trained models, we leverage the benefits of combining data across all datasets, with fewer logistical and privacy challenges.

This may also provide an effective way of tackling rare diseases and pediatric diseases, where there is only a small amount of data. Pre-trained models will be used to analyze the data in those situations. Very simple models with few parameters can be used to combine them.

**Timing:** Planned for 24 months after NEURON is operational.

### 7.1 Phase 4 Planned Tokenomics

- Income from ROs who want to buy a license to the data and models of previous competitions

## 8 Conclusion – disrupting the concept of a doctor

In the near future, we, the participants will decide on our own health care. We will manage risks and how many bills we pay. We will decide how much we sleep and how much we eat. We will decide whether we take action or not. We will have greater control over our health than ever before.

The doctor shouldn't spend most of his/her time to fill in forms for patients' insurance companies in order to keep our records. They're not accountants and they were not trained for this. They shouldn't have to have homework after we leave. We deserve more attention from our doctors, but they deserve more time to dedicate to us. Both of us deserve smart machines, because sometimes it takes an impartial third party to fix something. A silicon outsider may renew the relationship between doctor and participant.

## 9 Legal Disclaimers

*This is a position paper that expresses opinions only. It also contains forward looking statements, including statements relating to the expected development of DOC.AI's network, business and broader vision, the completion of various phases in the envisioned future ecosystem, the issuance and utility of NRN tokens, and basically every other matter this paper discusses. These statements are not guarantees of future performance and undue reliance should not be placed on them. They involve known and unknown risks and uncertainties that may cause actual performance or events to differ materially from those expressed or implied by such forward-looking statements. See the "Risk Factors" section of DOC.AI's private placement memorandum. DOC.AI undertakes no obligation to update forward-looking statements, except as required by applicable law.*

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