

VEO, WP9&10: Identification of barriers and lessons learnt in the development and implementation of tools to fight SARS-CoV-2 questionnaire

1. From which sector does your institute primarily belongs to?

- Research Institute/University
- Government agency
- Private sector
- NGO
- Other

2. What type of scientific tool have you applied to SARS-CoV-2?

- Diagnostic
- Sequencing
- Epidemiological/ statistical analyses
- Modelling/ risk assessment
- Laboratory (*In vitro*) experiments
- Animal experiments
- Vaccine/ drug trials
- Other

3. Further info on tool:

For example material being sampled / sequence; outputs of analyses etc. Include reference if possible.

4. What is the main purpose of your tool?

- Patient diagnosis
- Outbreak monitoring
- Outbreak control
- Fundamental research
- Vaccine/ treatment development
- Other

Elaborate how it supports COVID-19 response.

5. What data and /or depositories were used in the development of your tool?

- A. National epidemiological data
- B. International epidemiological data
- C. National laboratory data
- D. International laboratory data
- E. VEO hub
- F. GISAIID
- G. Etc.

Please provide further information regarding which data sets.

6. Speed

at which the tool was developed / deployed for SARS-COV2?

- A. 0-3 days
- B. 3-7 days
- C. 7-14 days
- D. >14 days

7. Cost of development/deployment of the tool?

- A. Low (<10k)
- B. Medium (10-100k)
- C. High (100-500K)
- D. Very high (>500k)

8. Impact of the tool on the control of SARS-COV2 during the current pandemic; high, medium low.

- High: Results directly used by Govt to inform control policy
- Medium: Results indirectly used by Govt to inform control policy
- Low: Results not used by Govt to inform control policy

9. Impact of the tool on the control of SARS-COV2 in a future pandemic; high, medium, low.

- High: Results directly used by Govt to inform control policy
- Medium: Results indirectly used by Govt to inform control policy
- Low: Results not used by Govt to inform control policy

10. Availability of tool / material / outputs to others in VEO consortium.

- Yes
- No

11. Availability of tool / material / outputs to others outside the VEO consortium.

- Yes
- No

12. If yes to Q11, how can the tool / material / outputs be accessed?

- A. Code on GITHUB
- B. Sequences on GISAIID
- C. Etc. etc.
- Etc.

13. For each tool, what are the lessons learnt for next pandemic?

Tool	Lessons Learnt
Insert tool	
Insert tool	
Insert tool	
Insert tool	

14. Are there barriers to applying this tool? (Not only for activities within VEO, but also within your organization) e.g. access to data, sharing of samples.

Insert tool	Choose an item.
Insert tool	Choose an item.
Insert tool	Choose an item.

Insert tool	Choose an item.
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15. Provide details of the barriers on the following points:

<i>How it hampered the application of the tool?</i>	
<i>Were the barriers for accessing (from whom/where?) or sharing (at which level?) data/materials?</i>	
<i>Which type of barrier? (e.g. institutional policies, EU regulation, political issues, ethical standards)</i>	
<i>Please, specify the barriers for the type of data/materials/output.</i>	

16. For each tool, do you see any possible ways of addressing these barriers (i) within or (ii) outside VEO?

- Yes – within VEO
- Yes – outside VEO
- Yes – within & outside VEO
- No
- Don't know

<p>If yes, are these:</p> <ul style="list-style-type: none"> • Technical solutions (e.g. protection mechanisms) • Policy/legal solutions (e.g. standardization of policies, legal reforms) <p>Please provide further details.</p>

DEFEND[®]

COVID DEFENDER

A next generation intelligent contact tracing application

The OPPORTUNITY

One of the reasons that Singapore has less than 1700 cases of COVID (as of April 8, 2020), despite not imposing a lockdown until April 7, is that they implemented contact tracing very rigorously. They also deployed a contact tracing app, *Trace Together*, to automate the process, a brilliant first attempt: Once someone tested positive, the app contacted those exposed during the previous two weeks and instructed them to get tested. Singapore's actions will likely result in a fatality rate an order of magnitude lower than other countries, and because the design is tuned to fit Singaporean culture, *this approach will not work in many other countries.*

The DEFENDER Solution

What will work in the US, and possibly Europe as well, is the *COVID Defender* solution, which provides more than a simple contact tracer. It is a complete, next generation framework for personal infection risk management and pandemic response. Its advanced capabilities include:

- Contact tracing through both social contacts and location tracking
- Spatio-temporal risk analysis with an innovative dosimeter user experience
- Enhanced privacy protection
- Integration with EHR and HIE systems
- Advanced optimization to generate actionable recommendations for reducing personal infection risk using the metaphor of a social proximity risk dosimeter

The system is based on patient-anchored, universal health record system using open standards that enables individual empowerment, and combines this with a powerful command center dashboard system to assist public health officials in detecting and managing community infection risk. This Phase I functionality is available for pilot testing immediately.

Phase II functionality will be released once antibody testing becomes widely available. Building on new standards from the W3C, we will leverage Verifiable Credentials (VC) to enable digital certificates for immuno-status – with continuous monitoring of re-infection – to enable the optimization of logistics for safe socioeconomic reactivation of economies. Also we'll provide a model for international travel supporting Known Traveler Digital IDs.

Phase III is the Pandemic Preparedness Kit (PPKit), a fully decentralized version of the app to support government health agencies. This will enable grassroots participation in pandemic response and will assist in managing personal infection risk while also crowdsensing potential new pandemics in a manner that facilitates increased governmental transparency. It will also validate the important concept that intelligent risk management apps do indeed amplify herd immunity.

Leveraging CLINICAL TRIAL methods

Just like vaccines, this kind of software requires rigorous testing. Our approach is to use qualified clinical research methodology to insure that pilots deliver verifiable data. Our CRO partner has managed more than 30 Phase I-IV trials, and is the developer of the world's first blockchain based clinical trial records system. Scientific in-vivo testing will enable new research efforts like detecting asymptomatic super-spreaders by analyzing their "wake" as they move through the social graph.

LICENSE and COST INFO

This is an open source project. There will be costs associated with localization, customization, configuration and installation of software and training systems. We will also offer grants for emerging economies.

About US

Our singular team of entrepreneurs, engineers, and scientists includes leading experts in epidemiology, virology, clinical research, UX design, software engineering, venture capital, and Agile innovation methodology. Our primary virology expert is Dr. [Eric Topol](#), one of the world's top experts on coronaviruses. Our AI/data science team is led by Dr. Fred Glover, who has authored over 500 published articles and 8 books in the fields of AI and mathematical optimization, and is the winner of the John von Neumann Prize.

NEXT STEPS

We are seeking strategic partners, cities and countries seeking to pilot the software and solution, funding sources, software developers, cheerleaders, and volunteers who want to make a difference.

Please contact: [\(10\)820-1000](#) @futurelab.ventures



FEATURES

Phase I Features

- Contact tracing through both social graph and location tracking
- Multiple windows for spatiotemporal risk, cumulative risk timeline, contact maps
- Realtime dosimeter and cumulative risk metrics for the day/week/month
- Actionable timers for each contact
- Dynamic risk maps powered by spatiotemporal risk prediction algorithms
- Digital Journal to track health status
- Enhanced privacy functionality
- HIPAA compliance EHR/HIE Interop
- Verified news channel from DOH
- WFH integrated dashboards
- Clinical research framework

Phase II Features

- Digital credentials for immuno-status to support the full pandemic lifecycle and to power socioeconomic reactivation
- Continuous re-infection tracking
- Support for international travelers
- AI chatbot to assist low tech users
- Research project to test detection of asymptomatic super-spreaders
- Economic restart optimization

Phase III Features

- Pandemic Preparedness Kit
- Contact tracing-as-a-service for DOH

"Emerging technologies such as those presented by the COVID Defender consortium will be a key component of contact tracing strategies in the global fight to control the novel coronavirus. Sophisticated privacy preserving mechanisms will facilitate necessary mass user adoption, this technology holds tremendous potential for disease containment."
- Dr. Arnold Monto, globally recognized epidemiologist, past president of the American Epidemiological Society, the 2009 recipient of the the Alexander Fleming Award of the Infectious Diseases Society of America for lifetime achievement.

futurelab



COVID Defender: Privacy-preserving contact tracing through verifiable credentials and spatiotemporal smartphone tracking

PROBLEM CONTEXT

How to contain re-occurring outbreaks in a non-disruptive way?

Society should prepare for re-occurring outbreaks of COVID-19 as long as effective vaccines and/or therapeutics are unavailable for widespread (prophylactic) treatment. Effective containment is vital for outbreak control, but difficult to achieve without significant social-economic disruption.

**Effective containment depends on**

Timely diagnosis of infected individuals, and tracing of their social contacts to enable isolation of all involved individuals.

**Diagnostic testing is limited**

Reliable and rapid diagnostic tests are only limitedly available*. Countries are now stockpiling diagnostics to be able to supply their GPs and other healthcare practitioners.

**Contact tracing is time-intensive**

Contact tracing is very time-intensive. According to the European CDC it would take about 100 person-hours to trace the contacts of a single COVID-19 case.

* According to FINDdx.org and the ECDC, there are now 10 rapid SARS-CoV-2 antigen detection tests with CE-IVD approval for the European market, including assays by Coris BioConcept NV (Belgium), SD Biosensor Inc. (South Korea), Shenzhen Bioeasy Biotechnology Co. Ltd. (China).



OUR APPROACH

Intelligent contact tracing to support COVID-19 containment

The technologies are available to develop a smartphone application and an underlying infrastructure architecture to facilitate and accelerate contact tracing in a way that preserves individual privacy.

Features of this COVID Defender application include:

**Location tracking**

Automatic spatiotemporal tracking of users through a smartphone application.

**Privacy-preserving storage and computation**

Working with pseudonymous decentralized identifiers (DIDs), verifiable credentials, and a Trusted Execution Environment (TEE).

**Linked diagnostic outcomes**

Outcomes of diagnostic testing by healthcare professionals (HCPs) are attributed to user DIDs.

**Interoperability between different contact tracing apps**

Overcoming fragmentation through our SafeTrace API that enables privacy-preserving data transfer between systems.

**Signaling users**

Informing users who have been in close proximity to diagnosed cases (spatio-temporal overlap).

**Targeted risk assessment**

Surveying at-risk users (e.g. those who might have been in close proximity to cases) to assess and monitor risk of infection.

**Targeted instructions**

Instructing suspected new cases e.g. to self-isolate or to come in for diagnostic validation by a HCP.

**Web-based dashboard**

Overview of selected metrics for permitted entities (e.g. HCPs, public health authorities, municipalities, employers).



Use case example



Competitive analysis

The COVID Defender application improves on available and announced solutions by building on a decentralized identity system that offers universal interoperability and assures long-term security and privacy. Our project partners combine these principles with algorithmic spatiotemporal risk prediction capabilities, working with advanced AI optimization technologies.

TraceTogether

Singaporean; First-generation solution with significant privacy issues; Gained 600K downloads in first 3 days.

The Shield / Hamagen

Israeli; First-generation contact tracer; Tracking based on tower triangulation; Data stored locally on users' smartphones; Locations of officially diagnosed patients are disclosed to smartphones.

PEP-PT

Pan-European Privacy Preserving Proximity Tracing app; Joint initiative (130 European researchers) to develop apps that log encrypted proximity history of users.

geoHealthApp

German; Uses phone's location function to determine contact with infected persons; User data is stored decentralized on the blockchain, but not clear how. Relies on crowdfunding (€2057 obtained since 4 April)

Stopp Corona

Contact journaling app by Red Cross Austria. Requires users to connect their phones when in close proximity. Users are given a universally unique identifier (UUID). 130,000 downloads

LUMC COVID Radar

Dutch; Questions users about symptoms and behavior; Matches answers to postal codes; No contact tracing. Users able to view and filter summarized data. 5-year data retention for government and academic research.



Project partners



Triall combines blockchain and document-processing capabilities with thorough understanding of the clinical research (data) management landscape.



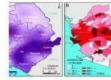
Enigma's SafeTrace API enables privacy-preserving data transfer, storage, and computation between different apps and systems.



The **W3C Credentials Working Group** is a community of technology standards developers focused on decentralized identity systems for enhanced digital security and privacy.



FutureLab develops technology solutions and collaborations in the blockchain and AI domain.



Quantum Bridge Analytics develops high-resolution spatiotemporal risk prediction algorithms using advanced AI optimization technologies.



COVID Defender Testimonial

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Emerging technologies such as those presented by the **COVID Defender consortium** will be a key component of contact tracing strategies in the global fight to control the novel coronavirus. Versions of this approach have already demonstrated their value globally, but issues of privacy have made some to question their general usefulness.

Sophisticated privacy-preserving mechanisms are key for widespread and secure implementation, and will facilitate necessary mass user adoption. With large user bases, this technology holds tremendous potential for disease containment.”

Joint testimonial



Arnold S. Monto, M.D.

Professor, Epidemiology
Professor, Global Public Health
Thomas Francis Jr. Collegiate
Professor of Public Health
University of Michigan
School of Public Health

Dr. Arnold Monto is a **globally recognized epidemiologist** and **one of the most renowned influenza experts** of our time. He is a **past president of the American Epidemiological Society**, the **2009 recipient of the of the Alexander Fleming Award** of the Infectious Diseases Society of America for lifetime achievement, and the **2012 recipient of the Charles Merieux award** of the National Foundation for Infectious Diseases.



Ab D.M.E. Osterhaus, PhD

Director, Research Center for
Emerging Infections And
Zoonoses
Hannover University of
Veterinary Medicine (TiHo)
Emeritus Professor, Virology
Erasmus University Rotterdam

Dr. **[10/20]** is a **leading and award-winning virologist** and is rated among the **Top 3 of most influential coronavirus experts** globally. He is **known throughout the world for his work on SARS and H5N1**, which was instrumental in combatting outbreaks like SARS, MERS, and avian influenza. He has (co-)authored over 1300 peer-reviewed papers, **cited 70,000 times**, and holds an **H index of >110**.



Phased development



Funding requirements





Follow our project at [INSIGHTS.TRIALL.IO](https://www.insights.triall.io)



securing health, wellbeing and economy

Privacy-proof diagnostic passports
for safe socioeconomic reactivation

Problem context

How to restart socioeconomic activities in a safe and secure way?

Social distancing efforts are putting economies to a standstill. Communities around the globe are looking for ways to safely return to work and school. Now reliable immunity tests are being introduced, a potential solution is to test for antibodies and give immunity passports to those who test positive. However, we still know little about immunity to SARS-CoV-2, its duration and scale, and collecting immunity data about individuals comes with significant privacy risks.

Our approach

Privacy-proof diagnostic passports

The ViroSure Diagnostic Passport system complements contact tracing solutions. Only in combination, contact tracing and personal diagnostic credentials can coordinate safe socioeconomic reactivation. ViroSure therefore partners with an international consortium that is developing COVID Defender (See next slide): a platform that enables to integrate available contact tracing solutions by offering privacy-preserving means for data storage, exchange, and computation.

- Time to Production Version: 2 weeks
- Funding Requirements: €200 000



Privacy and compliance first

Privacy is the hallmark of the ViroSure system. Data is stored in a secured cloud environment that meets the highest EU privacy and security standards. Personal access is based on multi-factor and biometric authentication.



Selective disclosure

Passport holders are given complete control over who is able to view their credentials, and to which extent. Holders can generate unique links, enabling restricted viewing by permitted third-parties within a certain time window. Viewing events are logged for complete auditability.



Integration with diagnostic testing

A secure web portal allows for easy registration of tested individuals by accredited healthcare professionals. Individuals and blood samples are linked through unique ViroSure identifiers.



Permitted epidemiological analyses

Test outcomes are stripped from personally identifiable information, and loaded into a secure central database environment. Unique access links are provided for permitted (e.g. government) entities to facilitate near real-time aggregate analyses.

Technology stack



Back end

- Node.js
- JWT tokens
- PostgreSQL / MongoDB as database technology
- Jest as testing framework
- Sentry for debugging



Front end

- Figma and Sketchapp for responsive designs
- React JS as modular development framework
- ANT design as functional UI framework
- GraphQL client API
- JWT tokens for industry-standard security
- Jest as testing framework



Next steps

Integrating diagnostic passports and contact tracing

For apps to be effective in their aim to coordinate socioeconomic reactivation, *population-wide coverage is key*. However, the current rush of app development projects risks to result in a highly fragmented landscape of siloed solutions. A pressing need for interoperability can be predicted. The international COVID Defender consortium delivers on this need, building on pioneering work in decentralized identity and access management systems. The project aims at an infrastructure for universal interoperability that also assures long-term data security and privacy.

COVID Defender Testimonial

"Emerging technologies such as those presented by the COVID Defender consortium will be a key component in the global fight to control the novel coronavirus. Sophisticated **privacy-preserving mechanisms** are key for widespread and secure implementation, and **will facilitate mass user adoption**. With large user bases, this technology holds tremendous potential for disease containment.*

— Prof. Arnold S. Monto, MD



Dr. Arnold Monto is a **globally recognized epidemiologist** and **one of the most renowned influenza experts** of our time. He is a **past president of the American Epidemiological Society**, the 2009 **recipient of the of the Alexander Fleming Award** of the Infectious Diseases Society of America for lifetime achievement, and the 2012 **recipient of the Charles Merieux award** of the National Foundation for Infectious Diseases.



Privacy-preserving location data storage and computation

COVID Defender offers an API that connects to a privacy-preserving storage service and Trusted Execution Environment (TEE).



Universal interoperability

To link systems and applications, COVID Defender offers a universally resolvable decentralized public key infrastructure (DPKI) that involves decentralized identifiers (DIDs) and verifiable credentials.



Spatiotemporal risk analysis

Advanced mathematical optimization algorithms (AI) are run in the TEE for high-resolution spatiotemporal risk prediction.



Global and individual monitoring and reporting

Privacy-preserving risk heatmaps are generated based on aggregate data, by running computational outcomes through a mapping user interface. In addition, users are able to generate private risk reports.



Team & Partners

ViroSure unites expertise in emerging database technologies, immunology, and Life Sciences IT



(10)(2e)

Theoretical physicist, 30 years' experience in database tech. Founder of Splendid Data, TopSystems, Oxio Energy and others. Boardroom advisor in IT and Finance.

(10)(2e)

Patent-holding innovator and serial entrepreneur with over 25 year experience in IT ventures, including a joint venture with British Telecom.

(10)(2e)

CTO, software developer and agile development leader. Recent winner of the Italian Hackathon.

(10)(2e)

Renowned clinical immunologist, former Head of the Department Clinical and Tumor Immunology, Erasmus Medical Center.

(10)(2e)

Experienced executive in the Life Sciences & Health domain. CEO of CR2Q, Triall, Herakles Life Sciences. 17 years' experience in the management of clinical development programs.

(10)(2e)

PhD candidate and management consultant in Medical IT and innovation management. Head of Product Design for Triall.



Splendid Data (NL)

Enterprise service provider with over 20 years of experience in designing and implementing complex database environments.

SPLendidDATA.COM



Triall (NL)

Combines privacy-preserving identity and access management capabilities with thorough understanding of the clinical research (data) management landscape. Dutch partner in the COVID Defender consortium.

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