TENTO™
HEALTH

Digital Health Passport

White Paper

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("CPE") Circle Pass Enterprises

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Challenges

Viruses exist only to propagate. To copy themselves. To do so effectively, they depend on the behaviour of their hosts.

Viruses are barely living organisms. They are small, simple but exceedingly effective at hijacking cells and turning them into factories that pump out more copies of itself - virus shedding.

Over 1.5 billion years[1], viruses have become highly evolved to do the same task. Despite our vastly greater intellectual capacity, it is far more difficult for people to act with the same singular purpose. Discord is magnified between countries with differing strategies, beliefs and approaches. As the virus continues its unrelenting march upward despite lockdowns, the need for coordinated action grows.

To date, all of the lockdowns and measures have only succeeded in keeping both the spread of the virus and the number of deaths linear instead of exponential (see below[2]). If, as many believe, the true infection rate is significantly underreported[3], even assuming that 10 times more people have been infected than the reported numbers, the virus has only infected < 1% of the world's population (7.5b / 250m = 0.003) yet it has had an unprecedented negative impact.

[1] Cosmos Magazine - What came first?
[2] Bing Covid statistics
[3] Evaluating massive underreporting

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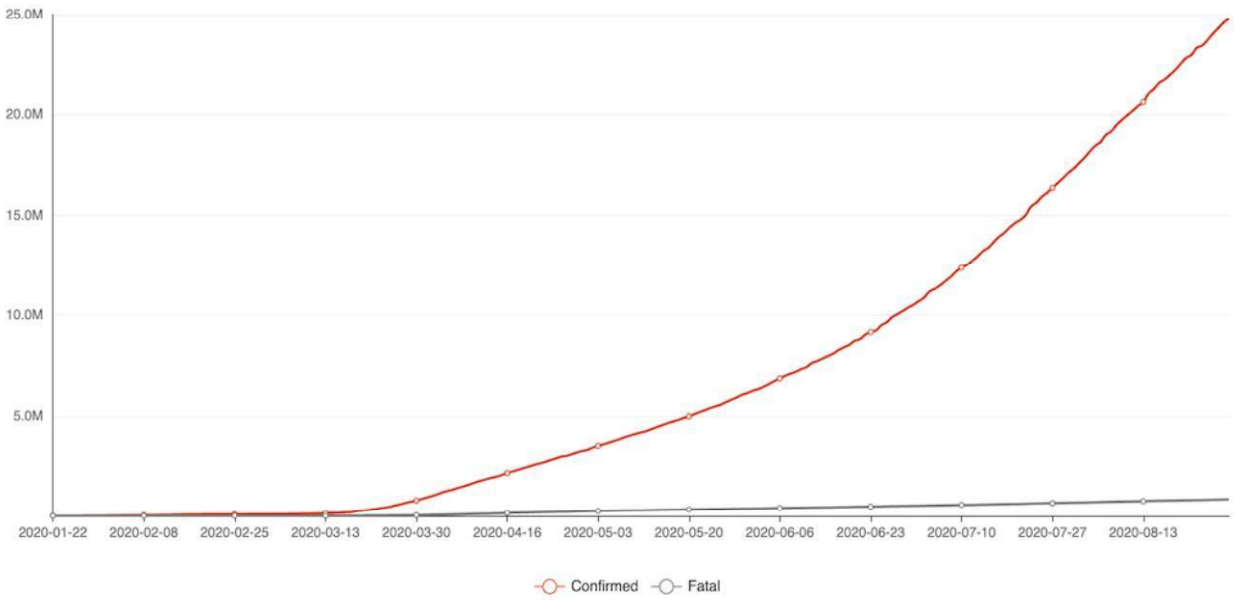
Spread over time



Hurdles to achieving Herd Immunity

Herd Immunity makes it harder for the virus to spread when a large enough proportion of the population is either acquired immunity through vaccination or having antibodies after recovering from previous infections. There are some major hurdles that will delay this scenario:

1. **Vaccine Hesitancy**
   There is a vibrant *Anti-Vax* movement[4] that is emboldened by large social media platforms and messaging apps. They allow wild conspiracy theories[5] about vaccines to reach more people than ever before. There will be massive, coordinated pushback against vaccination. Mandatory vaccination measures will face strong resistance[6].

2. **Freeriding Problem**
   [quote]*Individuals who lack immunity, particularly those who choose not to vaccinate, free ride off the herd immunity created by those who are immune*[end-quote][7]. When sufficient numbers of people that are not immune intersect, significant outbreaks can recur between those individuals.

[4] New Map Reveals Distrust in Health Expertise Is Winning
[5] Here's what Bill Gates has to say about those Covid-19 vaccine conspiracy theories
[6] Australia rules out mandatory immunisations
[7] Herd Immunity

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3. **Mutations and Reinfection**
   A person in Hong Kong contracted SARS-CoV-2 twice[8]. The RNA from both infections were sequenced and found not to match. SARS-CoV-2 has many mutations[9], which may become a factor in limiting the protection offered solely by antibodies.

4. **Vaccine Fragmentation**
   With 172 countries racing to develop vaccines[10], the levels and quality of clinical validation will inevitably vary. As more vaccines are eventually deployed, it is also inevitable that the level of trust and respect that countries will have of each others' vaccines will vary greatly. This mistrust[11] of one country's vaccine by another can already be seen with the Sputnik V vaccine developed in Russia. Furthermore, there could be mistrust within the same country[12] or of pharmaceutical companies.

[8] First Covid-19 reinfection documented
[9] Geographic and Genomic Distribution of SARS-CoV-2 Mutations
[10] 172 countries and multiple candidate vaccines
[11] Russia's coronavirus vaccine
[12] 1 in 2 Russian Doctors Distrust New Coronavirus Vaccine – Poll

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Coordinated Action

SARS-CoV-2 is unlikely to be the last global pandemic the world will face[13]. We must adapt. When we work together, humanity is capable of great things. But dealing with the current health emergency faces significant headwinds of misinformation, lack of universal acceptance of the threat among the public and a paucity of coordinated action.

100 CEOs have signed a letter to the G7 urging greater global coordination[14] to save the struggling Travel & Tourism sector:

- Airlines including *British Airways, Emirates, Etihad, Jet2, WestJet and Virgin Atlantic*
- Hotels including *Accor, Hilton, Hyatt, InterContinental, Mandarin Oriental, Marriott, and Radisson*
- Travel companies including *American Express, Carlson Wagonlit, Expedia, TUI and Uber*

They advocate four main measures, two of which this white paper will focus on:

1 **Wearing a mask**

2 **Testing and contact tracing**
We need governments to invest and agree on extensive, rapid, and reliable testing, ideally with results available in as quick as 90 minutes, and at a low cost, before departure and/ or after arrival (symptomatic and asymptomatic would-be travellers), supported by effective and agreed contact tracing tools. The application of one or multiple tests, with the second after five days, will help to isolate infected people.

3 **Quarantine for positive tests only**

4 **Reinforcing global protocols and standardise measures**
The adoption of global health and safety protocols will help rebuild traveller confidence and ensure a consistent, coordinated and aligned approach of the travel experience in addition to significantly reducing the risk of infection. We also support the Public Health Corridor Concept which promotes a clean and safe end-to-end journey.

[13] 10 Infectious diseases that could be the next pandemic
[14] Letter to the G7

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The Need for Testing

> Testing is necessary to identify and limit risk. This is essential to avoid repeated start/stop restart of operations.

Without testing, passenger transport companies import risk between locations. Regardless of cleaning measures on vehicle and departure stations, untested passengers will carry a level of infection risk that is dependent on factors such as:

- Mean infection levels at the origin
- Actual infection status and viral shedding
- Days into the infection, if they are positive
- Being symptomatic/asymptomatic. Fever alone is not a reliable indicator[15].
- Being a superspreader[16]
- Age[17]
- Mask wearing (enforced/voluntary)
- Adherence to social distancing in the days before travel

Repeated lockdowns become necessary with outbreaks that can quickly escalate by importing cases[18]. Test-based screening is the only effective way to reduce the number of imported cases. Without it, every inbound passenger represents an unknown risk - a risk that is compounded for every passenger. Classic Probability[19] means that the chance of importing 200 untested passengers is 200 times higher than importing 1 untested passenger. No matter how small the chance is, the compound risk of restarting operations without a testing regime increases until a carrier eventually transports positive cases. Transporting multiple positive cases per flight is possible[20]. SARS-CoV-2 has wreaked havoc with large outbreaks on everything from cruises[21] to aircraft carriers[22]. The economic and operation impact can be reduced with a structured testing programme before setting sail.

[15] Don't rely on temperature screening products
[16] Superspreader
[17] Children often carry more coronavirus
[18] Germany cases raise concern of second wave
[19] Classic Probability
[20] Cases on TUI flight from Zante to Cardiff
[21] Serious mistakes made by Australian Authorities
[22] Covid-19 aboard French Aircraft Carrier

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High-risk destinations where outbreaks are particularly impactful include:

- Indigenous and/or remote communities. Tourism, by its nature, brings people into these communities.
- Offshore drilling
- Places with a large older demographic within the population
- Populations with poor healthcare
- Remote islands
- Ships of any size on long-duration cruises, long-haul cargo routes

Intelligent Borders

Whether some people believe or don't believe in the virus, its transmissibility, or even in the merit of certain preventive measures like masks, no one can dispute the severe impact that containment measures have. The economic impact alone is enough to implement new movement regimes that are fit-for-purpose and sustainable.

Lockdowns are a powerful tool in curtailing the momentum of transmission. Yet, they come at a staggering economic cost. An unsustainable cost that, when combined with politicians and civilians who reject the draconian measures, leads to premature reopening when the "curve has not yet flattened". When the scale of the outbreak is not out of control across an entire country, it sometimes makes more sense to lockdown only those areas/states/cities that have high infection rates. This is more sustainable in the medium term as the areas of each country with low infection rates can continue to function while containment measures are calibrated.

Partial lockdown requires highly configurable systems that are able to facilitate travel based on allowing city-pairs or regions.

The testing measures and test-result assurance form part of a framework for safely restarting travel without reversion to country-wide shutdowns as the de-facto measure.

Dynamic Border Management

Country-to-Country arrangements (called *Travel Bubbles*, *Travel Corridors*) add a layer of operational complexity but allow staged restarts of travel. *Travel Corridors* are sometimes volatile because they depend on a shifting "r" number[23] - the Reproduction Rate of the virus or a measure of how many people, on average, one infected person goes on to infect.

The **Tento Health Passport** is a fundamental part of allowing borders to be more dynamic and responsive to changes made as a result of increasingly real-time data being used to drive government or state-level decisions. The **Tento Health Passport** is a decision-support tool for interstate as well as international

[23] R Number

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travel.

This proposed solution will help stabilise traffic flow during SARS-CoV-2 disruption; providing a useful template for handling future pandemics proactively. Reshape the permission to travel in minutes:

- Trust/mistrust types of tests
- Real-time: latency of test results and configuration changes measured in seconds
- Permit/prohibit outbound travel or admission based on test results

Establishing Travel Corridors

In order to support, the solution can be deployed regionally when adopted by multiple partner countries. Acting as a *Standard*, it facilitates the portability of test data (controlled by the traveller) between totally decoupled systems. The system is capable of being run as with independent back-ends or within a secure multi-tenant cloud environment.

The solution is designed to integrate with existing local systems including Immigration, using IATA One ID [24] principles. Instead of moving personal data between systems, a token is shared between multiple partners during the traveller's journey. The flexibility to customise and integrate is fundamental to wide adoption by multiple independent jurisdictions. Integration also makes it possible to feed large numbers of tests and results, enabling enterprise scalability.

The system is ready to be deployed into multiple countries now

Travel Corridors can be quickly established by adopting this solution. Startup will be achieved within weeks; with guaranteed project success against a standard scope. A Pilot Project can be rapidly established among multiple partners (countries/states/organisations) to prove the solution in active use.

Tento brings years of knowledge of interfacing with legacy systems globally and decades-old communication protocols. Its open approach to integration and cooperation makes it the ideal partner for bringing disparate systems and countries together quickly.

[24] IATA One ID

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Testing Strategy

Not only does the **Tento Health Passport** provide test-result assurance for SARS-CoV-2, its multi-disease architecture also future-proofs your border control.

Which do you believe is safer? A flight from a high-risk country where everyone is tested? Or a flight from a lower-risk country where no one is tested?

Gain the ability to insist on testing before point-to-point departures and have confidence in the integrity of those tests and their results. This information can form part of the passenger's authority to travel. Testing before departure reduces the total amount of imported risk that needs to be managed at the destination.

Be able to react to emerging pandemics and effectively manage the restart from this unfolding pandemic, supported by reliable data. Because there is currently no standard, the landscape will contain competing solutions. We intend to enable interoperability and provide cross-system functionality, where possible. This depends on the security (encryption) and openness of any competing solution. The overarching aim is to increase convenience for the passenger at the same time as increasing data accountability to those that need to verify it.

The **Tento Health Passport** supports the bulk-import externally held test results and can be extended to contain other information.

Affordability is the key to wide adoption, especially in populous countries with limited financial resources. The usage-based business model reduces fixed, upfront financial commitment in the difficult commercial landscape. The solution can either be Cloud-hosted by CPE or locally hosted within each participating country. The solution is fully mobilised allowing for use in airports, rail stations, sea ports, road checkpoints as well as any remote location where there is Internet coverage. It is not restricted to PCs and fixed points.

Use Outside of the Transport Vertical

Even though this has not been discussed, the Digital Health Passport enables other industries to restart with the confidence of screening and accountability. This avoids stop/starts and provides a higher safety threshold. Large-scale screening **and being able to trust the result** detects the vast majority of cases, leaving a manageable workload for Contact Tracing to be used as an effective secondary tool for controlling the pandemic.

The Tento Health Passport could also be used before allowing check-in to hotels or access to sensitive facilities.

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Features

Feature	Description
Multi-test administration	Store different tests in the wallet along with different, varying results.
Socially Distanced Scanning	QR codes can be scanned at a safe social distance through clear plexiglass.
Supports active Test Types	Compatible with the results of any type of active test: ○ Rapid Tests (LAMP, Antigen, saliva-based supplied by Tento) ○ RT-PCR
Antibody Test Results	Supports IgG/IgM test results for reference.
Direct Upload of Tests	Batch results can be uploaded to the platform to save on data entry and remove the likelihood of manual transcription errors.
Secure delivery of results	Eliminates paperwork with cryptographically hashed and encrypted data. Tamper-proof. Eliminates "person-in-the-middle" attacks.
Rapid Results	Health Passport updated with the latest results within seconds of publication by the Tester. Results delivered internationally.
Repeated Tests	Built to handle multiple tests. Maintains a history of previous results, even though only the last test result is valid. This full test lifecycle management allows the traveller to maintain their own historical profile.
Simple Decision Support	The simplified *Red/Green* Health Status of each traveller is derived by an algorithm based on configurable criteria set by each jurisdiction. This logic preserves independence in the decision making process.
Detailed Test Results	In addition to simple boolean data, multi-page documents can optionally be stored against each test result, allowing for certificates and detailed scientific data to support contextual examination and deeper auditing.
Ephemeral Barcodes	To thwart attempts to copy or forge data, QR codes are ephemeral and continually change every 30 seconds. Because they are only valid for a short time window, it is not possible to try to fake the information within that short period of time.
Built on Blockchain	A truly decentralised solution built on robust blockchain architecture.
Real-time Reporting	Analyse and manage usage data
Vaccine Compatibility	Forward-compatible with large-scale, multiple vaccination scale-up and rollout.

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Not an Immunity Passport

CPE does not advocate the use of Digital Health Passports as an *Immunity Passport*. Travellers may still have sufficient viral load and be shedding viruses even though they have begun to develop antibodies. At the time of writing, it is theoretically possible to be infected with more than one strain of SARS-CoV-2 and not enough is known about the strength, duration or scope of naturally acquired antibodies. Protection could last as little as 6 months[25].

Therefore, it is recommended to consider the presence of antibodies as information to be viewed in the context of current viral shedding, rather than an exclusive indicator of immunity.

Digital Trust

Being able to trust the source and integrity of the result is as important as doing a test in the first place.

Data is encrypted during transport and at rest. Just as importantly, PKI (Public Key Infrastructure) is used for encryption, ensuring the receiving party can trust that data originated from the expected sender. Fraud is eliminated within the scope of the system

SARS-CoV-2 tests are only as dependable as:

- The verifiability and accountability of the entity carrying out these tests and the results
- The preservation of the original results that were originally committed to the Health Passport
- The absence of opportunities for bad actors to tamper with the result or forge it outright
- The verified identity of the Health Passport Holder

These concerns take on more importance when tests done at the origin are outside the visibility and control of the destination, which has increased reliance on the integrity of the result being maintained. Trust provides the foundation for international testing before departure. A real-time system makes Rapid Testing immediately before departure practical to implement and run.

[25] Immune Responses

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Privacy

> Travellers retain control of their data at all times. They choose what to share, when and with whom.

If a traveller does not want to share their data, it will not be shared. They initiate the sharing event and they choose which items will be shared with every scan. This puts them in total control of their data. Sharing events are logged within the back end and within the Passport App itself. Decentralised architecture avoids the creation of a monolithic data store.

CPE will not track the movements of anyone that uses the Health Passport App while they are using the App. Not now. Not ever.

Locations, where the barcode is shared by the User and read by the Authenticator Service, are logged in the User's App; visible to them in their own usage logs. The system complies with GDPR regulations for Data Security.

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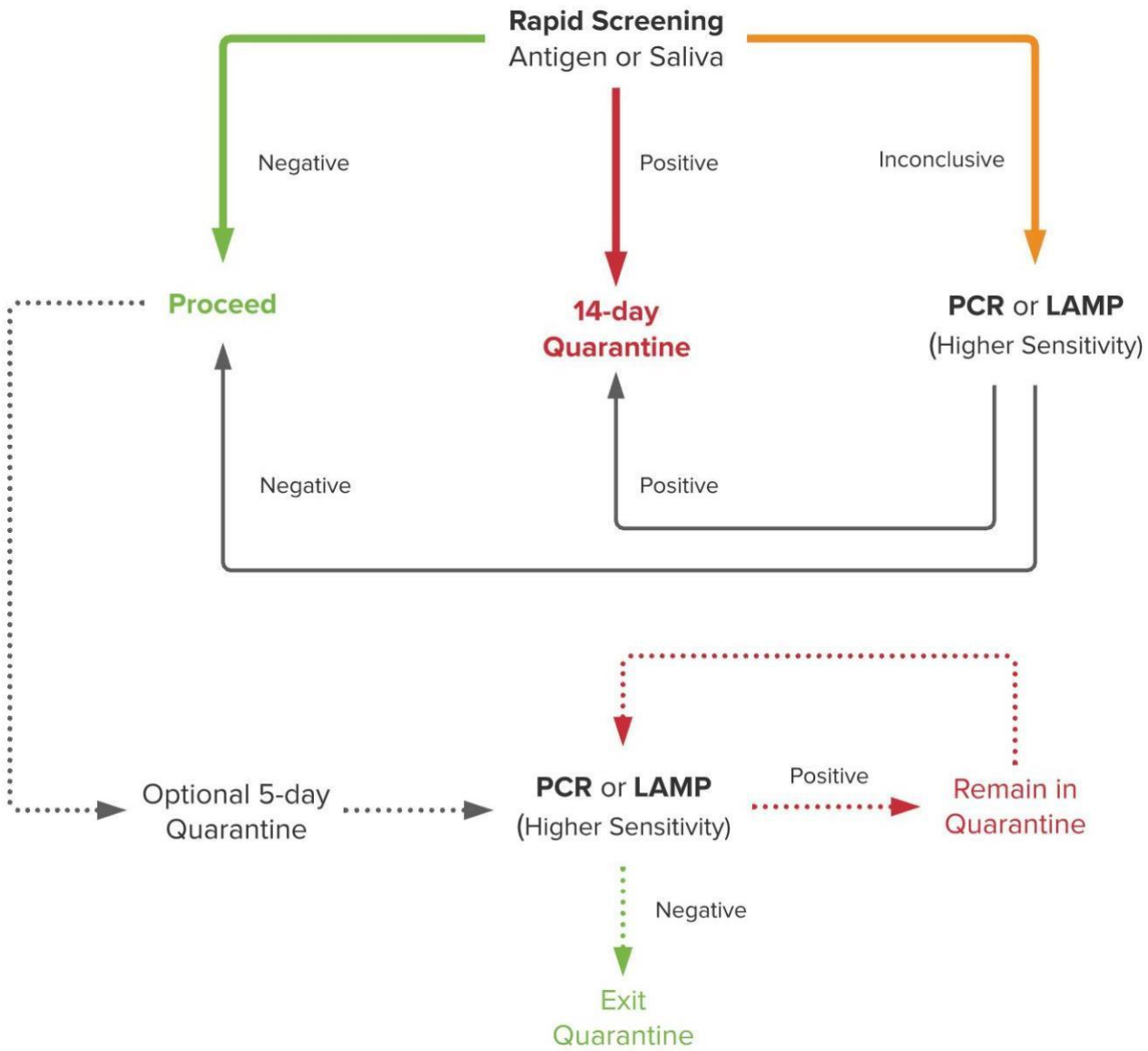
How the Solution Works

Example Screening Flow

Every jurisdiction has its own testing regime. The flow below allows for scalability and high throughput. Antigen Testing is not overly sensitive and is therefore less likely to erroneously detect people with extremely low viral load. Some countries elect to have a second testing 5 days after the initial test.

Any flow with multiple tests could result in changing statuses. The Tento Health Passport will be able to handle the complex scenario illustrated below. The initial Rapid Screening test could be administered remotely. Extraction-to-Result time could be as low as 35 minutes with tests provided by CPE.



Process

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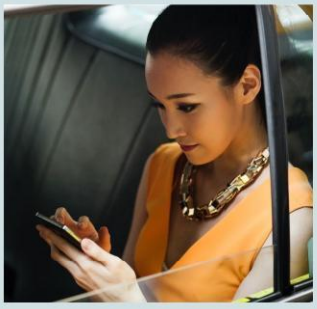
There are four main entities involved:

- The **Traveller**/passenger/user
- The **Tento Digital Health Passport** - the container for test results
- The **Clinician** - the person or body carrying out these tests
- The **Authenticator** App - used by Immigration Officers, agents or anyone else that needs to read the Health Passport



Install Health Passport on Mobile Phone

- ↳ Free download from the Apple App Store or the Google Play Store
- ↳ Registers with email and phone number
- ↳ [Optional] Profile validated by external service
- ↳ Their **Digital Health Passport** joins the platform ✔

The Health Passport stores all of the user's test results. Although these can be viewed, they can never be manipulated by the user.

Clinic / Health Authority Opens Account

- ↳ Secure account created
- ↳ Entity ("Clinician") authorised to carry out tests
- ↳ Clinician authorised to commit results to Passport
- ↳ The **Clinician** joins the platform ✔

Although new, simple rapid screening tests can be administered by anyone, a **Trust Chain** must be established so only authorised entities can commit results to the Health Passport. This increases accountability and prevents untrusted people from doing tests and committing fake results.

Associate Clinician ⇹ Patient ⇹ Test

- ↳ Clinical scans the Digital Health Passport from their Application
- ↳ Associate the patient's Digital Health Passport
- ↳ Geolocation of the test location recorded for auditing

The association of the Clinician to the Patient and the Test about to be performed is essential in continuation of the **Trust Chain**. The aim is to replace paperwork and manual processes as much as possible during the association process.

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Health Practitioner administers Test

- ↳ Different types of tests supported: RT-PCR, Antigen, Antibody
- ↳ The barcode of the test (if there is one) is scanned
- ↳ Entering a reference code creates a data bond between the test and patient

All types of current and emerging tests such as saliva-based tests can be administered and recorded. The platform is test-agnostic.

Results

- ↳ Output from different machines can be integrated with the platform
- ↳ Transfer of results can be automated or semi-automated
- ↳ Rapid tests can feed directly into the platform
- ↳ Detailed clinical data can be added ✔

The transfer of data from thermal cyclers is dependent on its capabilities. This can be file export and upload, barcode scanning, cloud integration (if the cycler has a cloud platform).

Data seamlessly updated in Digital Health Passport

- ↳ Result automatically updated in Digital Health Passport
- ↳ Traveller is notified about their updated test status
- ↳ Traveller does not have to take any action
- ↳ Traveller cannot manipulate or influence the Clinician's result

The Health Passport stores all of the user's test results. Although these can be viewed and results are updated in real-time, they can never be manipulated by the user.

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User chooses what to share

- User retains control of their data
- They choose what to share, when and with whom
- Specially configured QR code is generated
- Ephemeral barcode changes continually

User chooses data elements from a simple pick list of fields. This way, they control what is divulged to the various parties that scan the QR code.

Authenticator scans QR Barcode

- Seamless transfer of Test Result data
- Secure and trustworthy
- Minimises errors and paperwork
- Eliminates fraud

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