From: Rob Fyfe s9(2)(a)
Sent: Monday, 6 July 2020 2:41 PM
To: Murray Scott
Cc: Mike Bush [DPMC]
Subject: Re: Sewage Covid-19 Testing BBC

Interesting challenge! R

Rob Fyfe
The People Shop *26 Minnehaha Avenue, Takapuna, Auckland 0622, New Zealand*
s9(2)(a)

From: Murray Scott s9(2)(a)
Date: Monday, 6 July 2020 at 1:36 PM
To: "'Mike Bush [DPMC]'" <mike.bush@DPMC.govt.nz>, Rob Fyfe s9(2)(a)
Rodney Jones s9(2)(a)
Subject: RE: Sewage Covid-19 Testing BBC

Ahhh. Looks like you folks are well ahead of the curve. I see that it was in our papers last month.
https://www.stuff.co.nz/national/health/coronavirus/121921096/coronovirus-sewage-testing-could-stop-covid19-outbreaks

I also see a few international medical papers are recently published suggesting it is a good lead indicator. One attached.

But to do **localised testing** for a whole city like Auckland or Wellie is a huge logistical task. May be offer a $100k prize for a working model of an autonomous, robotic, self-propelled, RFID communicating, "poo sniffing" drone. Some engineering student will have a technology answer somewhere in his garage.

Murray

From: Mike Bush [DPMC] <Mike.Bush@dpmc.govt.nz>
Sent: Monday, 6 July 2020 1:03 PM
To: Murray Scott s9(2)(a) 'Rob Fyfe' s9(2)(a) Rodney Jones
s9(2)(a)
Subject: RE: Sewage Covid-19 Testing BBC

[UNCLASSIFIED]

Hi Murray
We are currently looking at this. Any ideas kindly appreciated.
Best regards
Mike

From: Murray Scott s9(2)(a)
Sent: Monday, 6 July 2020 12:15 pm
To: 'Rob Fyfe' s9(2)(a) Mike Bush [DPMC] <Mike.Bush@dpmc.govt.nz>; Rodney Jones s9(2)(a)
Subject: Sewage Covid-19 Testing BBC

The Police already know how to do this sort of testing right? BBC article says it can give a 10 day heads up, potentially. I saw it in the Nature e-mail brief.
https://www.bbc.com/news/science-environment-53257101 [bbc.com]

I follow the NZ wastewater drug testing data as an economic lead indicator for certain economic sectors. Although we only have three years of quarterly data.
https://www.police.govt.nz/about-us/publication/national-wastewater-testing-programme-quarter-4-2019 [police.govt.nz]

Murray

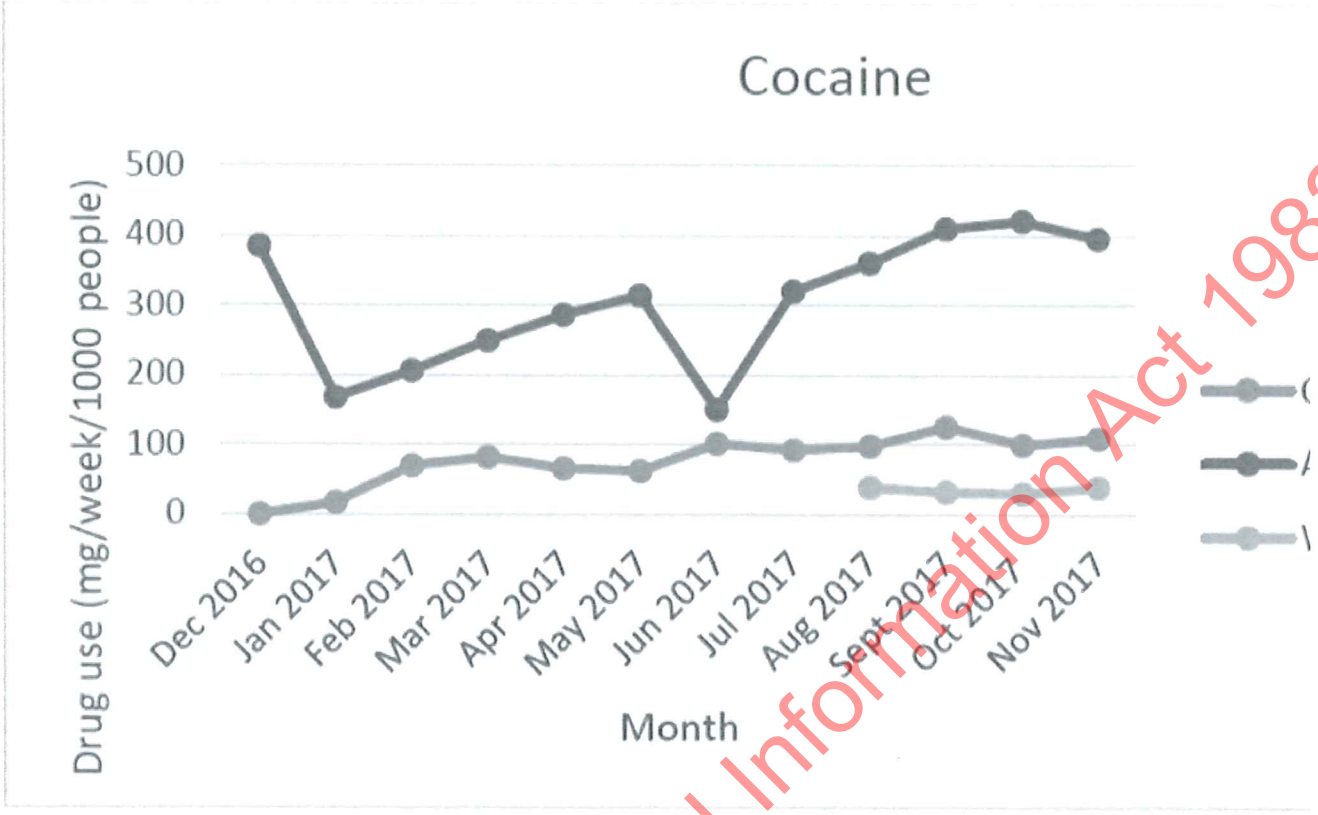
From: Murray Scott
Sent: Friday, 9 March 2018 4:05 PM

www.stuff.co.nz/national/99310594/wastewater-drug-testing-shows-cocaine-on-the-rise-in-auckland-high-meth-use-in-whangarei [stuff.co.nz]
www.police.govt.nz/news/release/wastewater-testing-and-rataora-trial-informs-enforcement-and-treatment [police.govt.nz]

Testing Site: Auckland	June 2017	July 2017	August 2017	Total Gı
Methamphetamine	620	629	583	
Cocaine	36	77	87	
a-PVP	Not detected	Not detected	Not detected	
MDMA	85	153	136	
Heroin	Not detected	Not detected	Not detected	

Population: 240,000 *Not detected means the concentration of the drug or metabolite ir*

Figure 5 Cocaine use for the week sampled in December 2016 to Nove



From: Ann-Marie Cavanagh <Ann-Marie.Cavanagh@dia.govt.nz>
Sent: Friday, 3 July 2020 2:22 PM
To: John Ombler [DPMC]; Mike Bush [DPMC]
Cc: Paul James; Nigel Prince; Jayne Conaghan
Subject: CovidCard: Implementation Options and Next Steps [SEEMAIL]

Dear John and Mike,

Ahead of the meeting next week and on behalf of the GCDO, I would like to respond and comment on the paper you received from Rob Fyfe, Sam Morgan and Alastair Grigg on the 30th June. We were aware of some of these concerns being expressed by Sam and Alastair and knew they were preparing a paper for discussion. We were unaware this was going to be distributed wider without the opportunity to comment.

The early draft we saw did not have the commentary around the relationship with opening the Border and tone was more direct towards the Public Service. We agree the programme needs to proceed at pace given the significant lead times of development, procurement, manufacture and delivery. We also agree with the risk of delay to approval processes through an election and Christmas period.
Since the inception of the CovidCard idea, the role of the card has moved substantially from improving the contact tracing process at Levels 4 & 3 to being an insurance policy and augmenting contact tracing processes to maintain the Level 1 status.

While the letter states a high level of confidence in the solution we agree that this must be independently validated through the current peer review process. The GCDO recognises this is a substantive financial investment and there are also significant policy positions that are still to be landed.
Our consistent feedback to the PPP team has been to enable these decisions to be made we need to ensure the following three points are validated:

1. **Technical Validation**

   We need independent validation of the Card System Design including performance, battery life, memory, robustness and backend processing. This review will also cover Security architecture, hardware and firmware design. This review is currently being undertaken by the Defence Technical Agency with input from the PPP team.

2. **Contact Tracing Business Validation**

   Assuming technical validation is confirmed. The objective of this validation is to agree the value of the information provided from the end to end solution connects into the existing Ministry of Health Contact tracing process and can reduce the time to identify, contact and then action 'close and casual' contacts of a COVID 19 positive case.

   For the CovidCard to succeed it requires senior business acceptance by the Ministry of Health on the use and efficiency of the information in the contact tracing process. This has been, and will continue to be a challenge for the GCDO to facilitate alignment and agreement between the parties.

3. **Epidemiological Validation**

   On the assumption the technology works and contributes to a step change improvement, it is proposed where possible to model the epidemiological impact (contribution of managing the R value of the pandemic) based on the time reduction to contact trace close contacts. This work is being commissioned via the NCMC to Professor Shaun Hendy.

It is proposed to be able to inform Ministers on the results of the three reviews by the end of July. The programme will always be high risk. Assuming the solution is validated on all three points the acceptance and use by the community is fundamental to success. A substantive campaign will be required to promote the society use of the

card rather than assuming a compliance driven strategy. We are aware that the PPP team have engaged widely with union, iwi and business groups eliciting support for the card concept. We believe market research on public sentiment is factored into the next stage.
From the governmental perspective there are still several key policy, investment and operational accountability decisions still to progressed after the solution has been validated.

s9(2)(g)(i) In parallel to reviews we are engaging with MBIE on their agency taking over from the GCDO and becoming the implementation agency. This will require MBIE to progress the Policy, Financial, Procurement, and Service Delivery Establishment roles.

s9(2)(g)(i)

Ngā mihi

Ann-Marie

Ann-Marie Cavanagh | Deputy Government Chief Digital Officer
Te Kōtui Whitiwhiti | Digital Public Service Branch
Te Tari Taiwhenua | The Department of Internal Affairs
Direct Dial: +64 4 494 0620| Extn: 5620 | s9(2)(a) | ann-marie.cavanagh@dia.govt.nz
45 Pipitea Street, Thorndon | PO Box 805, Wellington 6140, New Zealand | www.dia.govt.nz
Te Tari Taiwhenua
Internal Affairs

From: Rob Fyfe s9(2)(a)
Sent: Monday, 6 July 2020 5:42 PM
To: Mike Bush [DPMC]
Cc: John Ombler [DPMC]; Brook Barrington [DPMC]; ^Parliament: Rajesh Nahna; Brian Roche
Subject: Re: Follow-up to Sustaining Elimination with CovidCard and Enhanced Digital Contact Tracing,

Follow Up Flag: Flag for follow up
Flag Status: Flagged

Thanks Mike.

As an input into those discussions, from my perspective this has implications that are much broader than the Card and the work DIA has done to date. What the paper is advocating is an early detection and rapid response system, of which CovidCard is a key component, but there are implications across MoH, Legislation, quarantine, DHB's, MSD plus possibly others and based on what I observed during the project there were significant challenges with DIA engaging and leading this as a cross Government initiative.

Please don't hesitate to sing out if you'd like any further detail.

Ngā mihi ... Rob

Rob Fyfe
The People Shop *26 Minnehaha Avenue, Takapuna, Auckland 0622, New Zealand*
s9(2)(a)

From: "Mike Bush [DPMC]" <Mike.Bush@dpmc.govt.nz>
Date: Monday, 6 July 2020 at 5:17 PM
To: Rob Fyfe s9(2)(a)
Cc: "John Ombler [DPMC]" <John.Ombler@dpmc.govt.nz>, "Brook Barrington [DPMC]" <Brook.Barrington@dpmc.govt.nz>, "^Parliament: Rajesh Nahna" <rajesh.nahna@parliament.govt.nz>, Brian Roche s9(2)(a), Sam Morgan s9(2)(a) Ali Grigg s9(2)(a) Leon Grice <leon.grice@police.govt.nz>
Subject: RE: Follow-up to Sustaining Elimination with CovidCard and Enhanced Digital Contact Tracing,

[UNCLASSIFIED]

Kia ora Rob

Thanks for the email, we have a meeting tomorrow with DIA to discuss this further. We will come back with a formal response shortly.

Ngā mihi,

Mike Bush [DPMC]
Operations and Planning Lead
DPMC COVID-19 Operations Centre

Email: mike.bush@dpmc.govt.nz

From: Rob Fyfe s9(2)(a)
Sent: Tuesday, 30 June 2020 4:03 pm
To: Mike Bush [DPMC] <Mike.Bush@dpmc.govt.nz>
Cc: John Ombler [DPMC] <John.Ombler@dpmc.govt.nz>; Brook Barrington [DPMC] <Brook.Barrington@dpmc.govt.nz>; ^Parliament: Rajesh Nahna <rajesh.nahna@parliament.govt.nz>; Brian Roche s9(2)(a) Sam Morgan s9(2)(a) Ali Grigg s9(2)(a) Leon Grice <leon.grice@police.govt.nz>
Subject: Follow-up to Sustaining Elimination with CovidCard and Enhanced Digital Contact Tracing,

Hi Mike, I'm conscious almost a month has passed since we published the paper: *Sustaining Elimination with CovidCard and Enhanced Digital Contact Tracing,* and while we have had some encouraging feedback, we have not yet had any indication of whether the Government is interested in pursuing this proposal, subject to the independent review underway, or how Government would proceed.

Given the timelines involved in implementation and the risk they we loose access to key personnel, involved in the project to date, I have attached a follow-up email from Sam, myself and Ali Grigg (the programme director for the proof of concept trial) outlining how we see the options and imperatives for progressing.

We would value some more formal feedback and direction as soon as possible, on how/if Government would like to proceed.

Many thanks … Rob

Rob Fyfe
The People Shop *26 Minnehaha Avenue, Takapuna, Auckland 0622, New Zealand*
s9(2)(a)

From: Simone Hurley [DPMC] s9(2)(a) on behalf of John Ombler [DPMC] <John.Ombler@dpmc.govt.nz>
Sent: Friday, 3 July 2020 2:42 PM
To: Mike Bush [DPMC]; Heather Peacocke [DPMC]; Nicola Simmonds [DPMC]
Subject: FW: Re-engaging NZ with the world - a paper from Koi Tu: The Centre for Informed Futures
Attachments: Re-engaging NZ with the world July 2020.pdf

Team,

Essential reading.

John

From: Brook Barrington [DPMC] <Brook.Barrington@dpmc.govt.nz>
Sent: Friday, 3 July 2020 12:35 PM
To: John Ombler [DPMC] <John.Ombler@dpmc.govt.nz>; Cheryl Barnes [DPMC] <Cheryl.Barnes@dpmc.govt.nz>
Subject: FW: Re-engaging NZ with the world - a paper from Koi Tū: The Centre for Informed Futures

[UNCLASSIFIED]

Dear Both

This is a short and useful contribution. Worth a read.

It sets out a range of strategic questions to be answered, while at the same time acknowledging that now is not the time for a reconsideration of our existing Elimination/border strategy. Rather, any such reconsideration should occur "at some point" (and most likely after the election).

I would especially draw your attention to paragraphs 4 ("What solutions should we consider....") and 5 ("Ultimately, these questions....") on page 3 of the report, as well as paragraph 2 on page 4 ("While we may have limited options....").

Answering the questions posed in these paragraphs could, I think, efficiently form a basis of an in-house piece of strategic thinking, which might then be used to inform a wider discussion when the time is right.

If you agree, and assuming that you don't already have something underway, I wonder if there might be merit in setting up a small and in-house tiger team to work up a draft think-piece over the next four weeks, focused on the questions that are posed in the piece (and any others that strike you)?

Views welcome.

BB

From: Megan Stunzner s9(2)(a) **On Behalf Of** Peter Gluckman
Sent: Friday, 3 July 2020 7:18 AM
To: info@informedfutures.org
Subject: Re-engaging NZ with the world - a paper from Koi Tū: The Centre for Informed Futures

Tēnā koutou

Today Koi Tū: The Centre for Informed Futures is publishing a paper calling for an inclusive conversation about a cohesive national 'reconnection strategy' to re-open New Zealand's borders.

The authors, Former Chief Science Adviser to the Prime Minister Sir Peter Gluckman, former Prime Minister the Rt Hon Helen Clark and former Air New Zealand CEO Rob Fyfe, say hard conversations are needed about the right time for New Zealand to re-engage with the world – and how.

The trio joined forces to co-author a conversation paper, *Re-engaging New Zealand with the world*, with expert input from epidemiologist Sir David Skegg and digital contact tracing expert Dr Andrew Chen.

New Zealand needs an adaptable and pragmatic strategy to safely reopen the country and allow increased border flow to sustain our economic future. It will not be too dangerous to start opening New Zealand in the near future if we have the right processes in place.

The argument that we can persist with total elimination until vaccination in place has a limitation. Vaccination will be most unlikely to provide total protection.

The paper offers possible solutions such as establishing an intensive testing regime prior to departure and after arrival for travellers from low-risk countries, adjusting quarantine methods for low-risk entrants and perhaps allowing universities to provide quarantine for their international students from such low risk countries.

It also says we need to reframe how New Zealand views the "elimination strategy" of no cases at all, to one that is in line with how many epidemiologists define it – which is reducing case-transmission to a "predetermined very low level".

The paper also calls for New Zealand to develo and adopt a much more effective automatic contact tracing system which will be very valuable as travel opens up.

Taking the knowledge of the pandemic's evolving behaviour into account, the authors say we must prioritise exploring the ways in which we can more completely re-engage with the world. While that any such relaxation is clearly some weeks away , not the least because of the complexities of the election cycle, we need now to be thinking through when and how we might do so.

Sincerely
Peter

Sir Peter Gluckman ONZ KNZM FRSNZ FMedSci FRS
University Distinguished Professor
Koi Tū: The Centre for Informed Futures
Chair; International Network for Government Science Advice
President-Elect; International Science Council

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www.informedfutures.org
www.ingsa.org

EA: Megan Stünzner s9(2)(a)

Conversation Paper

RE-ENGAGING NEW ZEALAND WITH THE WORLD

Sir Peter Gluckman, Rt Hon Helen Clark, Rob Fyfe

July 2020

THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

KOI TŪ:
THE CENTRE FOR
INFORMED FUTURES

In any complex and prolonged crisis, a transparent and adaptive strategy is needed. This has never been more obvious than in the COVID-19 pandemic. Just after COVID hit our shores, initial discussions centred on adopting a "flattening the curve" strategy. This involved accepting there would be some influx of disease, but by using behavioural and hygiene measures, viral transmission would be slowed and our hospital system would not be overloaded, as was being seen in northern hemisphere countries.

But soon after cases started appearing, a clear shift in strategy was made – sometimes expressed as "keep it out, stamp it out". In epidemiological terms, elimination of the virus became the goal. For New Zealand, adopting that strategy was scientifically plausible, as we had a low number of infections and could use our island geography. But it required huge effort and sacrifice by all New Zealanders – the burden of which will continue to echo for many years. With the border closed, it would then be a case of effective testing, contact tracing, and isolation to eliminate the virus. Through very good messaging, particularly helped by the 'bubble' metaphor and relying on the country's inherent social cohesiveness, the lockdown was a spectacular success. But in that success there are also challenges.

It is now clear the messaging around the state of contact tracing, personal protective equipment (PPE) and the management of isolation were not always accurate and that there were deficiencies in the system. Trust is essential for a government in handling any crisis, especially when civil cooperation is required over a long time, and this is not helped by obfuscation. Indeed, in recent times that trust has been weakened by revelations of quarantine and tracing failings, and reassurances proving to be less certain than first claimed, with much remedial action required. Nevertheless, we've achieved our goal of being almost certainly free of community spread.

The public has shown remarkable forbearance and support for the sacrifices of lockdown. But people's anger at process breakdowns was to be anticipated, given the early phase of the pandemic, during which most of us enjoined in a collective and cohesive blitz mentality, had passed. This is entirely as we would expect our emotions to evolve as we transition through a prolonged crisis.

To many epidemiologists, elimination means the reduction to zero of an infection in a defined geographical area. But as epidemiologist Sir David Skegg noted in his advice to the Epidemic Response Committee before lockdown was imposed, many others in the epidemiological community pragmatically define elimination as the reduction of case-transmission to a predetermined very low level. These distinctions may appear subtle, but they become critical in our collective thinking about the path ahead. The former creates an expectation of keeping the virus out absolutely and indefinitely and that even one case coming in could be seen as a failure. The latter accepts that cases will occur and that processes need to be in place to ensure community spread is not established. Given the nature of the virus, the former definition is impossible to sustain unless we are prepared to continue aggressive and foolproof testing and quarantine at the border for a long time.

As smugglers have known for centuries, border controls are never foolproof. We do better than most because of our geography and a long experience in biosecurity, but human failures will occur, and at some time a case will break through. Universal quarantine for arrivals, aggressive testing, and contact tracing remain our main protection.

Further, defining a strategy for locking down is relatively easy (although requiring much sacrifice), one for reopening to the world is harder. Much depends on what is happening in other countries. From the moment of going into lockdown, work was needed on defining a strategy and the processes that would be required to move past total quarantine. Any such strategic analysis must be transparent and preferably developed through a collaborative process, because whatever is done will change the risk landscape significantly. Many stakeholders continue to be at the mercy of such decisions, and those stakeholders are not just businesses, they are indirectly every New Zealander.

Therefore, we need to be thinking about defining our longer-term strategy. Is New Zealand prepared to hold itself in its state of near-total isolation for the indefinite future? Even opening the Trans-Tasman bubble looks further away than it did a month ago with resurgent community spread in at least one Australian state. The hoped-for early links with Singapore have similarly evaporated. Are there Pacific countries that we could now open up to with green lanes? Some other countries are starting to create green lanes, but they have not adopted the elimination strategy. The latter places higher expectations on the system.

While we pin our hopes on a vaccine, it could be much further away than the hype suggests. Can we afford to wait out another year, two years, or even more in almost total physical isolation? And at what cost? This is not just affecting tourism and export education, but also the many ways in which New Zealand projects and leverages its place in the world.

On arrival, everyone is quarantined for 14 days, then tested around days 3 and 12. However, even that has not been foolproof, requiring tougher actions to make it more robust. Then there is the problem of volume management. With more flights resuming, more Kiwis are returning home. Among them are those who were trapped overseas by the virus, but now others who have been away much longer are choosing to come home because of our relative safety. As more flights open up, the flow could become a flood. How will we manage? Will returning New Zealanders need to reserve a place in quarantine before arrival? And who among them should bear the cost of quarantine or part of it?

What solutions should we consider over the longer term? For example, could we develop a regime of approved tests – both antigen and RNA-based – before departure? This could be combined with rapid testing on arrival, then a shorter quarantine for those from low-risk countries. Could we develop better protocols for managed self-isolation for low-risk entrants? Could we allow long-term tourists, business travellers, and tertiary students in on such a basis? Could universities quarantine offshore students wishing to return? Volume management and cost must be the primary reasons for not doing so now. Do we need to balance that against the priority of non-resident New Zealanders wanting to come home? These are difficult, value-laden ethical and legal questions, but they need to be asked. To what extent is the political cycle affecting necessary discussion and decisions?

Ultimately, these questions have been and will remain about risk management and communication. At what point will New Zealand accept less than absolute elimination? Such a goal is likely unrealistic over a long term. Even if a highly protective vaccination is developed, it may not provide absolute protection and coverage will not be absolute, so cases will always occur. Actuarial calculations might allow protocols to be established that could mean shorter quarantine or even self-isolation for some. Of course, any such loosening without protections increases the risk of the virus appearing in the community, but there are possible ways through that. What about mandatory tests every day or second day and a shorter quarantine for people from low-risk countries who want to enter?

Any change from current practices would require highly effective, high-speed contact tracing supported by quarantine of first- and second-degree contacts and would need to be carefully piloted. What incentives are needed so that people cooperate as the pandemic drags on over the next year or more? How can we maintain or introduce hygiene practices that economies like Taiwan have used effectively throughout the outbreak?

The costs of failing to develop an effective automatic tracking system may come to haunt us. Any simpler border system will meet public expectations and public-health needs only if track, trace and isolation are rapid and effective. The costs of the COVID-card-type methodology are small compared with the costs of continued complete lockdown. If we required such a tracing system for all incoming passengers and provided a large number of New Zealanders had adopted it, then we would have more alternatives, at least for low-risk entrants. Singapore introduced a similar card this week. There are other systems that could be used. The Google/Apple joint development using a cellphone's embedded Bluetooth technology has progressed to overcome many of the earlier objections and is being introduced in some countries. However, some limitations remain, including technical challenges associated with repurposing phones as proximity devices, giving sufficient visibility over the performance of the system to public health officials. Any such system relies on voluntary compliance.

The ethical arguments against such technologies have perhaps been overstated in their generalisation. Yes, there are apps that might provide private information to third parties or governments, but Google, Uber, and many others already have access to that information on almost everyone with a smartphone. The Bluetooth systems proposed do not automatically provide information to anyone. The Government could quickly establish an independent oversight mechanism to approve download of the data. Failure to even start discussions towards seeking societal approval for use of these technologies further reduces our options.

While we may have limited options, we do need a transparent process towards developing a reconnection strategy. Do we continue as we are now indefinitely, relying on strict quarantine and a giant moat? Even with current controls, the number of cases at the border will likely grow as more New Zealanders drift home. Do we need to start exploring alternative strategies that might at the appropriate time allow increased border flow, thus allowing more of New Zealand to flourish? And when would that be? What would be the criteria? The internet and video conferencing can take us only so far. We will need face-to-face contact if we are to maintain and grow the flow of goods and services into New Zealand.

This country needs its global connectivity. We have gained significant advantage through our stringent lockdown and early elimination of the virus allowing the domestic economy to reactivate. But we will rapidly progress to a position of relative disadvantage if our trading competitors are able to engage with our customers and suppliers in ways that are not possible for us. The alternative would be to remain in a state of effective national isolation, which could even last into 2022 or beyond. That may be our best option now, but that won't always be the case, and we need at least to explore alternatives.

Of course, we want to keep the virus out. The elimination strategy has worked, but at some point we'll need to reconsider the balance of objectives. The pandemic continues to evolve. The decisions needed will be best removed from the politically charged environment of an election season and therefore it would be premature to reach conclusions. In any event there is still too much viral uncertainty.

But we do need to start a process that is evidence-based, using a breadth of transparent inputs to explore the options. Taking the knowledge of the pandemic's evolving behaviour into account, we must prioritise exploring the ways in which we can more completely re-engage with the world.

ACKOWLEDGEMENTS

This paper was peer reviewed by Sir David Skegg. We thank him for his insights.

Dr Andrew Chen provided advice on contact tracing.

From: Mike Bush [DPMC] <Mike.Bush@dpmc.govt.nz>
Sent: Wednesday, 10 June 2020 9:31 AM
To: Brook Barrington [DPMC]; John Ombler [DPMC]
Subject: RE: A strategy to avoid lockdown in response to future COVID19 outbreaks in New Zealand [UNCLASSIFIED]

Hi Brook
I spoke with Rob yesterday to let him know and he was pleased with our response.
Mike

Sent with BlackBerry Work
(www.blackberry.com)

From: Brook Barrington [DPMC] <Brook.Barrington@dpmc.govt.nz>
Date: Wednesday, 10 Jun 2020, 8:16 AM
To: John Ombler [DPMC] <John.Ombler@dpmc.govt.nz>, Mike Bush [DPMC] <Mike.Bush@dpmc.govt.nz>
Subject: RE: A strategy to avoid lockdown in response to future COVID19 outbreaks in New Zealand

[UNCLASSIFIED]

Colleagues

A follow-up to the email sent below.

John: In the assessment process, I would appreciate you seeking the views of Paul James and Juliet Gerard.

Mike: Grateful if you could get in touch with Rob and let him know that we are taking the papers as serious contributions and will engage with them seriously once we have completed the above quick assessment.

Many thanks.

BB

From: Brook Barrington [DPMC]
Sent: Monday, 8 June 2020 6:52 PM
To: John Ombler [DPMC] <John.Ombler@dpmc.govt.nz>; Mike Bush [DPMC] <Mike.Bush@dpmc.govt.nz>
Subject: FW: A strategy to avoid lockdown in response to future COVID19 outbreaks in New Zealand

[UNCLASSIFIED]

Gents

Rob and company have produced two substantive documents, which we need to take seriously.

The idea of an end-to-end system is not new (the ANZLF and the Roche report are also working in some of the same space, as are the officials' processes that are underway). Nor are the ideas relating to mandate, oversight and seamless operationalising. Indeed, we are possibly ahead of them on some of this. But we do need to assess the paper, form a view, and then formally engage with Rob.

Ditto on the COVIDcard.

John: I would be grateful if you could set up a formal process by which AoG assesses the two papers, advises the three of us, after which we should respond to Rob. We should aim to provide Rob with some initial feedback this week, please.

Many thanks. Brook

From: Rob Fyfe s9(2)(a)
Sent: Monday, 8 June 2020 3:10 PM
To: Mike Bush [DPMC] <Mike.Bush@dpmc.govt.nz>; Brook Barrington [DPMC] <Brook.Barrington@dpmc.govt.nz>; John Ombler [DPMC] <John.Ombler@dpmc.govt.nz>
Cc: Sam Morgan s9(2)(a) Brian Roche s9(2)(a) Leon Grice s9(2)(a)
Subject: Re: A strategy to avoid lockdown in response to future COVID19 outbreaks in New Zealand

Many thanks for sharing the strategy paper last week Mike, I look forward to any feedback.

I thought it also worthwhile sharing this more detailed paper: 'Sustaining elimination with *CovidCard* and enhanced digital contact tracing 5 June 2020', which takes the outcomes and learnings from the *CovidCard* trial and outlines how a wearable Bluetooth LE technology, such as the *CovidCard*, combined with a more effective contract tracing system, could satisfy the challenge outlined in the paper we shared last week.

During the course of the work on the *CovidCard*, there has been significant interest in the potential of wearable Bluetooth LE technologies from outside New Zealand and we have had ongoing interaction with the Singaporeans, who have determined that Phone apps aren't effective for tackling Covid19 and are now investing significant resource in a wearables strategy, and we have had an ongoing dialogue with teams working in Australia and the UK.

This paper has been produced by the private sector group to help inform the work being undertaken, not just here in New Zealand, but by teams and countries around the world that are trying to solve the Covid-19 contact tracing challenge.

Again, Sam and I would welcome any comments or feedback.

Many thanks ... Rob

Rob Fyfe
The People Shop *26 Minnehaha Avenue, Takapuna, Auckland 0622, New Zealand*
s9(2)(a)

From: "Mike Bush [DPMC]" <Mike.Bush@dpmc.govt.nz>
Date: Friday, 5 June 2020 at 8:07 AM
To: Rob Fyfe s9(2)(a) "Brook Barrington [DPMC]" <Brook.Barrington@dpmc.govt.nz>, "John Ombler [DPMC]" <John.Ombler@dpmc.govt.nz>
Cc: Sam Morgan s9(2)(a) Brian Roche s9(2)(a) Leon Grice

s9(2)(a)

Subject: RE: A strategy to avoid lockdown in response to future COVID19 outbreaks in New Zealand

[UNCLASSIFIED]
Morning Rob

Thank you for your collective work on this important subject. I am forwarding this to Brook and John and I will discuss with them once they have had an opportunity to consider it.
Best regards
Mike

From: Rob Fyfe s9(2)(a)
Sent: Thursday, 4 June 2020 10:34 pm
To: Mike Bush [DPMC] s9(2)(a)
Cc: Sam Morgan s9(2)(a) ; Brian Roche s9(2)(a) Leon Grice s9(2)(a)
Subject: A strategy to avoid lockdown in response to future COVID19 outbreaks in New Zealand

Dear Mike,

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Many thanks ... Rob

Rob Fyfe
The People Shop *26 Minnehaha Avenue, Takapuna, Auckland 0622, New Zealand*
s9(2)(a)

From: BELCHAMBER, Vanessa
Sent: Friday, 12 June 2020 2:55 PM
To: CAMERON, Rebekah; Mike Bush [DPMC]; BINKS, Elizabeth; SIM, Murray; BOYLE, Brendan; GRICE, Leon
Subject: The Herald - Robs article (if you dont have Herald Premium)

COMMENT:

The Prime Minister has effectively cold-shouldered top businessman Rob Fyfe, who worked without pay for eight weeks as business liaison at the peak of the Covid-19 crisis.

On May 18, Fyfe wrote to Jacinda

Fyfe confirmed to the Herald that three weeks on the Prime Minister has yet to acknowledge his letter.

Nor has Ardern thanked him for the leadership he and his private-sector team brought to organising vital personal protection equipment for frontline health staff, ventilators and a world-class contact tracing app to cover clear inadequacies within the New Zealand health system.

"It was surprising," was Fyfe's comment.

He has clearly been frustrated by the opacity of the Wellington bureaucracy and saw that his ability to add value was diminishing as government officials returned to work during alert level 2.

Irrespective of what appears to be a prime ministerial cold shoulder, Fyfe says his offer remains to continue to assist Ardern with the challenges that Covid-19 will bring for years to come.

He had earlier written to Ardern in mid-April congratulating her on the success of her leadership and the importance of building an effective Covid-19 early detection and rapid response system so New Zealand could operate successfully in a global environment where the coronavirus might not be constrained for four or five years.

A project team from Fyfe's Prime Sector Group led by businessman Sam Morgan has developed a Bluetooth-enabled CovidCard to enhance digital contact tracing so that New Zealand can open its borders earlier with a higher degree of certainty that any incidental migration of the coronavirus into New Zealand can be stamped out quickly.

Fyfe remains concerned that the current government Covid-19 system - which is reliant on either signing into business places or scanning QR codes - is not up to the job.

The project team put a paper up to DPMC boss Brook Barrington on June 5. This has since been conveyed to Ardern and Finance Minister Grant Robertson.

Fyfe remains extremely concerned that the significant competitive advantage that New Zealand has achieved through tackling the virus will be squandered if further steps are not taken.

He told the Herald he has recommended five priorities: The need for New Zealand to adopt new social norms - including distancing; an intelligent virus-free border; daily health check-ins to drive detection at the earliest sign of symptoms; a high-speed and high-accuracy testing system for the Covid-19 virus; and a system for instant tracing and rapid isolation of close contacts of those affected.

He has recommended to Ardern that the Government invest in and retain a central operational leadership unit with accountability to drive delivery of all elements of this early detection and rapid-response system, with clearly defined, agreed and measurable performance.

Fyfe's letter was copied into Robertson, with whom he says he had a "very good interaction" during his sojourn in Wellington.

The Prime Minister's Office referred questions to the All of Government Covid response team, which has been contacted for comment.

From: BELCHAMBER, Vanessa
Sent: Friday, 12 June 2020 2:49 p.m.
To: HARTLEY, Samantha s9(2)(a)
Subject: Thank you :)

https://www.nzherald.co.nz/business/news/article.cfm?c_id=3&objectid=12339397

Vanessa Belchamber

NCMC COVID-19 Operations Command Centre

s9(2)(a)

Also note, the views expressed in this message may not necessarily reflect those of the New Zealand Police. If you have received this message in error, please email or telephone the sender immediately

From: Rob Fyfe s9(2)(a)
Sent: Monday, 8 June 2020 5:51 PM
To: Mike Bush [DPMC]
Subject: Re: A strategy to avoid lockdown in response to future COVID19 outbreaks in New Zealand

Follow Up Flag: Follow up
Flag Status: Flagged

Thanks Mike, although it's a bit long it's a relatively easy read and very compelling ... R

Sent from my iPhone

On 8 Jun 2020, at 17:01, Mike Bush [DPMC] <Mike.Bush@dpmc.govt.nz> wrote:

Cheers Rob
II will have a read tonight and be in touch tomorrow.
Mike

From: Rob Fyfe s9(2)(a)
Sent: Monday, 8 June 2020 3:10 pm
To: Mike Bush [DPMC] <Mike.Bush@dpmc.govt.nz>; Brook Barrington [DPMC] <Brook.Barrington@dpmc.govt.nz>; John Ombler [DPMC] <John.Ombler@dpmc.govt.nz>
Cc: Sam Morgan s9(2)(a) Brian Roche s9(2)(a) ; Leon Grice s9(2)(a)
Subject: Re: A strategy to avoid lockdown in response to future COVID19 outbreaks in New Zealand

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I thought it also worthwhile sharing this more detailed paper: 'Sustaining elimination with *CovidCard* and enhanced digital contact tracing 5 June 2020', which takes the outcomes and learnings from the *CovidCard* trial and outlines how a wearable Bluetooth LE technology, such as the *CovidCard*, combined with a more effective contract tracing system, could satisfy the challenge outlined in the paper we shared last week.

During the course of the work on the *CovidCard*, there has been significant interest in the potential of wearable Bluetooth LE technologies from outside New Zealand and we have had ongoing interaction with the Singaporeans, who have determined that Phone apps aren't effective for tackling Covid19 and are now investing significant resource in a wearables strategy, and we have had an ongoing dialogue with teams working in Australia and the UK.

This paper has been produced by the private sector group to help inform the work being undertaken, not just here in New Zealand, but by teams and countries around the world that are trying to solve the Covid-19 contact tracing challenge.

Again, Sam and I would welcome any comments or feedback.

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s9(2)(a)

From: "Mike Bush [DPMC]" <Mike.Bush@dpmc.govt.nz>
Date: Friday, 5 June 2020 at 8:07 AM
To: Rob Fyfe s9(2)(a), "Brook Barrington [DPMC]" <Brook.Barrington@dpmc.govt.nz>, "John Ombler [DPMC]" <John.Ombler@dpmc.govt.nz>
Cc: Sam Morgan s9(2)(a) Brian Roche s9(2)(a) Leon Grice s9(2)(a)
Subject: RE: A strategy to avoid lockdown in response to future COVID19 outbreaks in New Zealand

[UNCLASSIFIED]
Morning Rob

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Best regards
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From: Rob Fyfe <rob.fyfe@thepeopleshop.com>
Sent: Thursday, 4 June 2020 10:34 pm
To: Mike Bush [DPMC] <Mike.Bush@dpmc.govt.nz>
Cc: Sam Morgan s9(2)(a) Brian Roche s9(2)(a) Leon Grice s9(2)(a)
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<image001.png>

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Subject: Re: A strategy to avoid lockdown in response to future COVID19 outbreaks in New Zealand
Attachments: Sustaining elimination With CovidCard v1.0[8].pdf

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s9(2)(a)

Sustaining elimination with *CovidCard* and enhanced digital contact tracing.

5 June 2020

Authors and contributors:
Sam Morgan, Dr Tim Chambers, Dr Andy Anglemyer, Rob Fyfe, Alastair Grigg, Chris Teeling, Alexander Fala, Dr Dean Armstrong, Paul Scott, Bain Hollister.

Document version: 1.0

1. Purpose

In mid-March 2020, a group of private sector individuals (the Private Sector Group) joined together to assist the Government with the COVID-19 response under the co-ordination of Rob Fyfe, who was based inside the National Crisis Management Centre alongside former Police Commissioner Mike Bush.

The Private Sector Group has been working alongside the Government Chief Digital Officer (GCDO) to explore the possibilities of a dedicated Bluetooth hardware device, the *CovidCard*, to augment and accelerate contact tracing efforts. The purpose of this document is to report back on the findings of these efforts.

This document details work undertaken to:

- Design a dedicated wearable (the *CovidCard*), including the initial hardware and embedded software (firmware), with the design objectives of accurately recording close contacts and minimising the detection of false positives.
- Conduct robust real-life trials of *CovidCard* to confirm the accuracy of identifying "close contacts" and "casual contacts", as clinically defined.
- Determine the potential impact that *CovidCard* can have on reducing the transmission rates of the virus under different scenarios, through accelerated isolation of close contacts.
- Evaluate costs and timelines for the manufacture and distribution of cards in volumes necessary for population-wide deployment.
- Determine the effort and investment required to build the software platforms to support a card scheme and to integrate close contact data into core contact tracing systems.
- Consult with and solicit feedback from international groups working on similar projects and local stakeholders, including Iwi, Pasifika, Union leaders, government officials and Members of Parliament and Cabinet.
- Identify key risks and considerations for a national roll out.

CovidCard exists within a system of policies, operational management and other tools and should be considered as such. A detailed assessment of existing contact tracing capabilities is not within the scope of this document. Consideration has been given to the wider strategic context into which the *CovidCard* might be deployed.

2. Executive summary

The New Zealand Government has chosen a COVID-19 strategy of elimination. The closing of our border to the majority of travelers, and the Level 4 lockdown were our primary available tools to effect this strategy. These measures were very effective and we now see a rapid return to normalised social settings and an end to social distancing.

COVID-19 is now globally endemic, with over 6 million reported cases[1], and may remain so for years to come. As a globally connected trading nation, the economic and social impact of an elimination strategy are severe. It is not certain that such an approach is economically and politically sustainable over the longer term.

Estimates vary, but between 35% and 62% of COVID-19 infections are understood to occur before symptom onset and the delays intrinsic to manual contact tracing - from initial symptoms to presenting for a test, to getting the result, to identifying, contacting and isolating close contacts - mean that the secondary cases have already both become infectious and, in most cases, finished their virus shedding cycle before they are isolated.

A strategy that relies solely on New Zealand's ability to rapidly test and trace, absent enforced social distancing and a closed border, is simply not credible. It will not prevent the spread of the virus should it arrive again in New Zealand unless changed fundamentally.

The border is effectively closed, with mandatory 14 day quarantine for all arrivals. The Government is yet to articulate any longer term strategy with regard to the border but we consider there to be just three options:

1. **Keep the border closed and persist with a strategy of elimination.** This strategy will impose significant economic costs for an indefinite period.

2. **Open the border and accept a strategy of suppression.** This strategy would likely see us oscillate between levels of mandated and voluntary social distancing. Alert Level 4 would be avoided as best as possible. This strategy implicitly accepts some level of infections.

3. **Open the border while maintaining a strategy of elimination.** This approach is not considered viable with our existing capabilities. An open border will inevitably result in infected persons entering New Zealand and lockdowns would be required to continue with an elimination strategy.

[1] https://www.who.int/emergencies/diseases/novel-coronavirus-2019 (2nd June 2020)

Sufficiently upgraded tools can reduce the time between a positive test result and the isolation of close contacts by 3-4 days and also enable the timely isolation of second-order contacts, which is considered near impossible with existing tools and therefore generally not considered at all. Such an approach may enable a strategy to extinguish limited outbreaks and sustain elimination. Without an upgraded approach, we are left to choose between an indefinitely closed border or a shift to a strategy of suppression should the virus inevitably arrive again. Any strategy that assumes the virus will not make it through the border again, in fullness of time, does not appear a sensible strategy.

Upgrading our tools with digital contact tracing

Digital contact tracing has typically been considered in the form of an app. The Singaporean approach (TraceTogether) and the Apple/ Google Exposure API are the most notable app frameworks. The required rate of compliant adoption for any digital contact tracing technology is in excess of 60%[2]. A compliant adoption rate of 40%, which is well beyond that achieved by any contact tracing app globally thus far, would still only detect 16% of encounters. The goal for any digital contact tracing initiative really needs to target coverage of 80% of the most high risk encounters - bars, restaurants, public transport, private parties etc.

We do not consider it possible for a voluntary app to reach the requisite levels of compliant adoption or, therefore, have any impact on contact tracing efforts or the spread of COVID-19. Our existing digital apps - the NZ COVID Tracer app - including the planned future roadmap, are almost certain to achieve nothing with regard to slowing the virus. Promoting solutions that so obviously don't work is damaging because it erodes our future ability to drive adoption tools that can be effective.

Singapore has abandoned apps and is now progressing a wearables strategy, very similar to that proposed with *CovidCard*.

CovidCard

CovidCard is a dedicated hardware device which performs much the same function as an app, but can potentially achieve the necessary levels of compliant adoption across broader segments of society. *CovidCard* is designed to be worn on a lanyard around the neck, for both easy compliance monitoring in venues where it might be required, but also to enable optimal device function.

CovidCard would enable close contacts to be immediately notified and asked to self-isolate and could immediately provide contact details of close contacts to contact tracing teams. Four days, on average, can likely be saved between potential exposure and isolation, thus reducing tertiary infections. Downloading the cards of close contacts would also enable rapid isolation of second-order contacts which we consider a necessary further step if elimination is the goal.

[2] World Health Organisation 18 May 2020 - Digital proximity tracking technologies.

Our research and development efforts, including field-trials, demonstrate that a high-functioning contact tracing system that utilised *CovidCard* could:

1. Accurately identify 90% of close contacts[3] with false positives[4] estimated at around 10% in a wide variety of environments.

2. With high adoption and effective isolation procedures, substantially reduce the number of secondary cases and drive the effective reproduction number below one in conjunction with other public health response measures.

3. Maintain New Zealand's Elimination Strategy in the event of a COVID-19 outbreak, even with significantly relaxed border settings, if combined with recursive contact tracing (the isolation of second-order contacts).

4. Help address health inequities by protecting at-risk populations with limited access to technology (smart phones, mobile service or internet) and healthcare.

5. Be ready for distribution at population scale in around 6 months. *CovidCard* is not able to be used as a reactive solution - it must be deployed in advance of any outbreak.

We consider the primary project risks to be:

- The requirement for ~80% compliant adoption in situations of elevated risk suggests that, in addition to effective national marketing and community outreach programmes, some level of Government mandating will be required for higher risk venues and events.

- Any device must exist in a system of policies, procedures, and tools. Achieving the desired results with the *CovidCard* will require modified contact tracing processes to reflect the new tools - if contact tracers continue to work as before, the results will be the same as before.

- New Zealand's highly devolved health system, including having our contact tracing efforts rooted in the regions, may not easily or universally adapt to an upgraded approach. We do not believe the Ministry of Health could deliver a project of the complexity of *CovidCard* and they may struggle to drive the necessary change into regional contact tracing efforts.

- *CovidCard* needs to be deployed before it is needed, at a time where case numbers and public concern for COVID-19 will likely be at an ebb. It will take strong political commitment

[3] Clinical definition of a close contact is someone encountered within 2 metres for over 15 minutes.
[4] Close contacts who are wrongly identified as meeting the clinical definition of being within 2 metres for 15 minutes in total.

to achieve population scale deployment of a device that is required to enter public places such as bars, restaurants, and concerts, under such a scenario.

We found very strong support for the initiative when seeking feedback from various community groups, including Iwi, Pasifika health leaders, Union leaders and business leaders. The primary concerns expressed were to do with privacy, security and the use of data. Concerns have been technically addressed but clear communication will be the key to addressing these objections.

The operating environment has changed dramatically in just the last few weeks as the acute concern about COVID-19 has waned and attention shifts to business as usual and the upcoming election. Our work has been motivated by an expectation that New Zealand will inevitably see a further incursion of COVID-19 and that test and trace, under normal social settings, cannot possibly prevent the rapid spread of this particular virus. If it could, we could open the border.

The fully scoped cost of the project and first year of operation is estimated at just under $100m.

Recommendations

1. That *CovidCard* is considered for population wide deployment in advance of relaxing border settings, particularly to countries where COVID-19 levels are above zero.
2. That recursive contact tracing is considered alongside *CovidCard* as a way to enhance the effectiveness of contact tracing. We consider recursive contact tracing to only be achievable with the assistance of digital contact tracing technology.
3. That further modelling work is conducted to quantify the degree to which *CovidCard* is able to slow the spread of COVID-19, over and above manual contact tracing, both including and excluding recursive contact tracing.
4. We recommend that further work, including large-scale field trials only proceed alongside in-principle support for a population-wide deployment.

3. Background

3.1. New Zealand's Elimination Strategy

New Zealand is pursuing an elimination strategy for COVID-19. On 9 May 2020, the Ministry of Health's COVID-19 Public Health Response Strategy Team published *Case and contact management: monitoring and reporting to achieve and sustain elimination of COVID-19.*[5] This document considered how COVID-19 elimination would be operationalised:

> *COVID-19 elimination will be achieved through three key systems:*
>
> - *management of cases and contacts to stop onward transmission from identified cases*
> - *physical distancing and hygiene measures to stop onward transmission of undetected cases*
> - *border controls to prevent seeding of new clusters from outside the country*

Effective border controls presently involve a 14-day mandatory quarantining period in a Government managed facility at significant cost to the New Zealand Government. New Zealand is now experiencing largely normalised social settings, meaning there is limited physical distancing. The remaining plank of the strategy is the management of cases and contacts.

The MoH document comments further:

> *Currently, the intense physical distancing measures implemented at Alert Level 4 are acting as a strong safety net for cases not detected at the border and the case and contact management system. If the intensity of physical distancing decreases (by de-escalating to Alert Level 3 or by a decrease in compliance), this lowering of protection will induce a critical reliance on effective case management (including detection) for stopping existing transmission and any new transmission associated with a 'leaky' border.*

The characteristics of COVID-19 are such that existing contact tracing, absent the intense physical distancing under Alert Level 4 and with an open border, would be unable to prevent COVID-19 from spreading largely unchecked once community transmission occurred. It is simply not possible to identify, contact and isolate all close contacts fast enough to prevent further transmission.

Elimination is not considered compatible with an open border as it would lead to regular Level 4 lockdowns to preserve elimination. Opening the border, with existing contact tracing tools, would entail a transition to a strategy of suppression.

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5 https://www.health.govt.nz/system/files/documents/publications/covid-19-case-and-contact-management-monitoring-and-reporting-to-achieve-and-sustain-elimination-of-covid-19-9may2020.pdf

The Government has not articulated any longer term strategy with regard to the border or these considerations as at time of writing. However, the status quo is maintaining a strategy of elimination and means the border would be closed for an indefinite period, with all arrivals required to quarantine for 14 days. The most likely catalyst for a broad reopening of the border would be the wide deployment of a vaccine. Vaccine timelines are uncertain and it is prudent for New Zealand to plan on the basis that it might take several years or not come at all.

3.2. The existing manual contact tracing process

Contact tracing in New Zealand is largely decentralised with 12 Public Health Units (PHUs) being responsible for the public health management of notifiable diseases. The Public Health Unit is notified following a positive laboratory result and the "case" is contacted to:

- Conduct interviews to establish timelines of exposure and determine the infectious period, and establish links to prior cases, clusters or travel, and to identify close contacts.
- Identify attendance at events and places that are higher risk or associated with substantial numbers of 'casual' or 'close' contacts (e.g. aged residential care, hospitals, learning institutions, primary care, workplace, flights, transport, gatherings such as church or community events).
- Provide public health management advice (i.e. direction to isolate), education, and identify welfare or cultural needs.

Information from interviews is predominantly paper-based. A "case report form" is submitted for every case to the national ESR EpiSurv platform and some PHUs have their own IT solutions to manage the investigation of cases and contacts.

Following the interview, the PHU traces 'close contacts', provides self-isolation advice and monitors these persons regularly for symptoms. The PHU also provides advice to institutions and the public in higher risk situations around management of 'casual contacts' (e.g. flights).

Since COVID-19, there have been some modifications to this process, including establishment of the National Close Contact Service (NCCS) and the National Contact Tracing Solution - an IT platform that can be used by PHUs (although is not mandatory and some PHUs have chosen not to use it) and the Ministry of Health to manage cases and contacts. The NCCS is a Ministry of Health service that aims to help find the contact details of close contacts and high-risk casual contacts (e.g. flights). The NCCS is available at the request of PHUs for the management of individuals or clusters. These two initiatives were necessitated by rapidly increasing COVID-19 cases and multiple complex clusters, which rapidly exceeded the capacity of PHUs.

The risk of widespread transmission is reduced by shortening the time between symptoms appearing and the isolation of close contacts, such that those infected spend their infectious period

away from others they may infect. Failure to comprehensively isolate close contacts in a timely manner results in ongoing chains of infection. This is particularly important for cluster management as otherwise second or third generation spread can be missed.

Key to the success of contact tracing is the speed at which contacts can be traced. New Zealand is aiming to trace 80% of close contacts within four days of a positive test result. It is highly unlikely this standard is achievable under normal social settings if there is community transmission.

As identified in the above Contact Tracing Audit[6] :

- As New Zealand moved to Alert Level 4 on 25 March nationwide daily case numbers ranged from 70-86 and many PHUs were at or beyond their capacity to manage cases and contacts, even with increasing support from the newly established NCCS.
- Between 2 and 8 April the average time from referral to instructing a contact to isolate was 2.3 days.
- Only 60% of contacts could be easily reached by phone, either because of incorrect contact details in the National Health database or because calls from the NCCS went unanswered.

During lock down, contact tracing was significantly simplified as the majority of close contacts were typically within the case's bubble or essential workplace. This is supported by the Ministry of Health's contact tracing metrics which state for the period of:

- Between 13 April and 27 April there were 75 cases with 270 close contacts (avg 3.6 contacts)[7].
- Between 13 April and 11 May there were 141 cases with 351 close contacts (avg 2.5 contacts)[8].

This indicates that for the period 28 April - 11 May there were just 66 new cases with only 81 close contacts, an average of just 1.2 contacts per case. Prior to Level 4 each case had around 30 close contacts.

Identifying and notifying close contacts of confirmed cases is much more challenging at lower Alert Levels, because people frequently can't remember who they have been in contact with; people may

[6] https://www.health.govt.nz/system/files/documents/publications/contact_tracing_report_verrall.pdf

[7] https://www.health.govt.nz/system/files/documents/pages/2020.05.01_national_close_contact_tracing_metrics_13-27_apr_v1.0_-_publish.pdf

[8] https://www.health.govt.nz/system/files/documents/pages/national_close_contact_tracing_metrics_13_apr_-_11_may.pdf

not tell tracers everywhere they have been (wilful deception); and accurate contact details for close contacts are unavailable.

The degree to which contact tracing and the isolation of potentially infected close contacts helps break a chain of transmission depends on the time elapsed between the index case being infected and the isolation of contacts. The key levers to speeding this up are based on:

- The time elapsed before someone is tested.
- The time to return a test result.
- The time taken to complete contact tracing.

For technology to augment and accelerate manual contact tracing, it needs to more rapidly identify close contacts (known and unknown) and provide contact tracers with contact details as fast as practicable. Technology may also enable systems to automatically message probable close contacts, instructing them to self-isolate while awaiting contact from contact tracers.

3.3. Manual contact tracing cannot stop COVID-19

Ferretti et al[9] determined that "controlling the epidemic by manual contact tracing is infeasible." This is reinforced by a number of other modelling studies (Plank 2020; Hinch, 2020; Vaithianathan 2020) and the realities of countries around the world opting for economically crippling lockdowns, even those with more mature contact tracing systems, public health capacity and pandemic preparedness than New Zealand.

A strategy that relies solely on New Zealand's ability to rapidly test and trace, absent enforced social distancing is simply not a credible strategy to prevent the spread of the virus.

Between 35% and 62% of infections are understood to occur before symptom onset and inefficiencies in the manual contact tracing system result from a number of delays from the onset of symptoms:

- A delay from the onset of symptoms to access to a test (2 days).
- A delay from access to a test to receiving test results (2 days).
- A delay from notification of positive test to informing close contacts (2-4 days).
- A delay from notification to isolate to full isolation (1 day).

The combined impact of these delays mean that the secondary cases have already both become infectious and, in most cases, finished their virus shedding cycle before isolation.

[9] https://science.sciencemag.org/content/368/6491/eabb6936.abstract

Figure 1, adapted from Vaithianathan (2020), provides a visualisation of the cumulative increase of cases transmitted by first-order close contacts from the day the index case develops symptoms. For example, for R_0=3.4, we would expect ~1 new infection from first-order contacts (i.e., tertiary case) before the index case even showed symptoms. Based on the cumulative delays cited above, we can see there is limited capacity of the current manual contact tracing system to substantially impact the number of secondary infections under normal social conditions (R_0 =2.5).

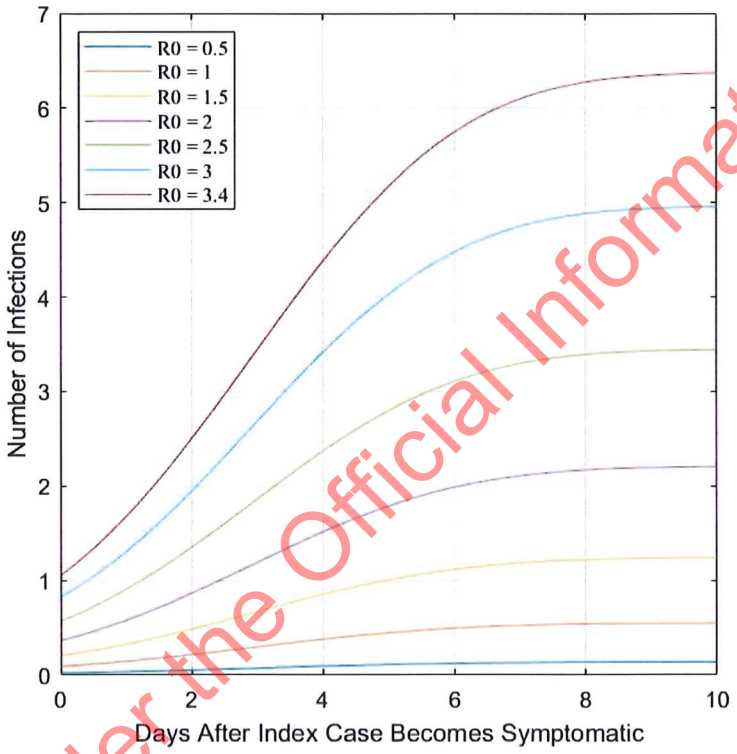

Figure 1. Expected Infections transmitted by First Order Contacts to Second Order Contacts (tertiary cases) Compared to Time Since Index Case Becomes Symptomatic. Adapted from Vaithianathan (2020).

It should also be noted the cited delays are optimistic estimates as many are based on contact tracing capacity during periods of low caseloads (e.g. Alert levels 3 and 4) and often exclude metrics from cases where symptom onset cannot be defined, biasing results towards lower values (when symptom onset cannot be defined it is likely due to longer delays in contact tracing performance metrics).

Manual contact tracing is too slow to identify and isolate close contacts based on virus transmission characteristics and the delays in key contact tracing performance metrics. It is simply not possible for manual contact tracing to maintain New Zealand's elimination strategy in the event of a major

outbreak or indeed with any numbers of cases continually coming across the border, without border quarantines or nationwide social restrictions (e.g. full or partial lockdowns).

3.4. The promise of digital contact tracing

Many countries are investigating and deploying technology solutions to augment and accelerate manual contact tracing.

For the purposes of this paper, 'digital contact tracing' refers to a smartphone app or device that is able to detect and record close contacts[10] through detecting the corresponding app or device of the close contact using Bluetooth LE technology.

Discussion of other possible means to locate people and their close contacts (GPS, cell towers, Wi-Fi networks, etc) are not in scope of this paper, but generally considered not particularly effective in the New Zealand context.

Digital contact tracing technology can accelerate contact tracing because a list of close contacts and their contact details can be made available immediately following a positive test result. This data can be used to notify potentially exposed persons immediately (with a text message) and to make the job of manual contact tracers much faster, more efficient and scalable.

Presently, close contacts only consist of those persons that the interviewee is able (and willing) to recall. Our own trials, and wider literature (see section on Health Case, later in this document), shows significant inaccuracies in the recall of encounters, including their nature (touch or no touch) and duration.

Three technology approaches, all based on Bluetooth LE technology, are emerging:

- Apps built on top of the Apple/ Google Exposure Notification API.
- Apps that are custom-built, typically by Governments, such as Singapore's TraceTogether.
- Dedicated hardware devices: *CovidCard*.

By far the most important metric is the level of compliant adoption of any of these technologies. This is covered separately further in this document.

"Compliant adoption" is defined as a user having the technology on their person and operating as designed. There are many barriers to compliant use, particularly with apps. Apps don't work if Bluetooth is disabled (by the user or the operating system to conserve battery) or if the app is not loaded by the user following a restart of their phone, for example.

[10] The clinical definition of which (in New Zealand) is defined as being within 2 metres for 15 minutes.

3.5. Compliant adoption

Digital contact tracing relies on very high levels of compliant adoption, particularly in places where transmission of COVID-19 is a risk. Even seemingly impressive levels of compliant adoption are inadequate to have a material impact on stopping COVID-19. Digital contact tracing technology is subject to a "network effect" where the value of the network increases at the square of its number of participants.

Recording encounters between people relies on both persons using the technology. If only 40% of people are compliant adopters, 60% of their encounters will be with people without the technology. Only 16% of encounters would be recorded at 40% adoption (40% * 40% = 16%). Modest levels of compliant adoption render digital contact tracing technology ineffective.

Rates of compliant adoption of over 60% are considered necessary for digital contact tracing to be effective[11]. We believe 60% compliant adoption is almost impossible for an app and no country has remotely achieved that level of compliant adoption.

Singapore's celebrated TraceTogether app, managed to get around 25% of the population to download it, but only half of all users (~12% of the population) were compliant adopters. Meaning only 1.5% of contacts are able to be recorded. At last count, 1.4m downloads had resulted in approximately 6 additional contacts being contributed to manual contact tracing efforts.

The table below illustrates the challenge for apps:

% of population who download the app	10%	20%	40%	60%	80%
Compliant adoption @ 60% (n)	6%	12%	24%	36%	48%
Contacts recorded (n^2)	**0.36%**	**1.4%**	**5.8%**	**13%**	**23%**

We have seen no evidence that apps can meaningfully contribute to manual contact tracing efforts which is largely the result of rates of compliant adoption.

3.6. Equity considerations

It is not enough to have high levels of adoption overall. We must also achieve high levels of adoption amongst sub-communities, especially in those communities most at risk or more likely to be in overcrowded living conditions. Failure to achieve high levels of compliant adoption of any digital contact tracing technology risks the virus gathering momentum undetected in those communities.

[11] World Health Organisation - Considerations for COVID-19 digital contact tracing https://apps.who.int/iris/handle/10665/332200

Any solution should be able to be adopted to high levels regardless of ethnicity, age, socio-economic level, the type of phone you have or your ability to use it. If any community has low levels of adoption, it would impair our ability to slow the spread of the virus. This situation occurred in Singapore, where migrant workers were effectively excluded as a result of the smartphone app approach taken and this is where a new wave of the disease took hold.

In New Zealand, people living in high deprivation, the elderly and Māori suffer health inequities (Sheridan 2011). These same populations are also at the greatest risk of COVID-19 infection or developing severe COVID-19 symptoms (James 2020). Further, lower detection in these populations is likely to result in more severe outbreaks owing to lower detection capacity than in the general population.

Existing COVID-19 response measures may drive inequities or disproportionately affect at-risk populations. For example, the current app-based solutions such as the NZ COVID Tracer app are likely to exacerbate these inequities as at-risk populations have limited access to smartphones and may live in areas with low connectivity (Digital Inclusion Research Group). While the lockdown may have disproportionately benefited these populations from a COVID-19 infection perspective, it has worsened existing economic and other health inequities (e.g. Rheumatic fever). The Government cannot pursue COVID-19 response measures that may exacerbate health inequities caused by established systematic problems in the health system. For Māori, this would represent a failing to uphold the principles of Te Tiriti o Waitangi.

The *CovidCard* could address health and economic inequities. First, the *CovidCard* does not require any level of technical expertise so it is user friendly for people unfamiliar with technology or smartphones. Second, the CovidCard is not reliant on existing communications infrastructure such as mobile networks or internet connectivity. Third, it is envisioned the CovidCard will come at no cost to individuals, removing the direct financial barrier. Fourth, the CovidCard could enable targeted lockdown (with recursive contact tracing) so there will be a limited economic impact on most people. Fifth, the development, testing and implementation of CovidCard is being conducted in partnership with Māori to ensure the solution is responsive to Māori, is compliant with principles of Māori data sovereignty and uploads Te Tiriti o Waitangi principles.

3.7. Trust, security and privacy

The concerns voiced during our consultations were mostly focused on privacy, security and the use of data. We consider it critical to adoption that any solution is designed to ensure limited data is collected, use of data is limited, and that once COVID-19 is no longer a threat, data is deleted.

Trust in any solution will be critical to adoption and must be at the centre of how these systems are designed. Data governance is an important aspect and Maori have specifically asked for both early engagement and involvement in considerations around data governance. More generally, New

Zealanders do not wish to be tracked, to see any erosion of their civil liberties, to have their data matched with other agency data, or to see excessive data collected by the Government.

3.8. Bluetooth contact tracing apps

Most custom apps are designed to integrate with contact tracing efforts. A positive test ideally results in the contact details of close contacts being made available immediately to centralised contact tracing efforts. This contrasts with a "notification-based" approach which would simply notify close contacts, but not health authorities, that they have been exposed to someone who has tested positive. We refer to this approach as "notification-based".

An approach that seeks to integrate with contact tracing efforts has been observed in many countries, including Singapore and Australia, but no national app deployment has achieved the necessary levels of compliant adoption to contribute to manual contact tracing efforts. Australia's app, with some 6 million downloads, had only found one additional close contact at last report.

One critical issue has been the inability for these integrated apps to work reliably on iPhones. Singapore has stopped developing the TraceTogether application and is now focussed on developing a wearable device similar to *CovidCard*.

3.9. A notification-based approach: Apple and Google's Exposure API

Apple and Google have partnered to build a system that will be common across almost all smartphones (iOS and Android) which is designed to assist in fighting COVID-19. Specifically, they have created common APIs (Application Programming Interfaces) on their iOS and Android phone operating systems which Government approved apps can access. The system is known as the "Exposure Notification API".

The underlying technology is Bluetooth based and allows a user's phone to detect the proximity of other phones. It is built within a highly secure architecture to ensure the highest levels of privacy and security. Apple and Google have effectively built what is becoming the only global standard and while it is being embraced by some countries, it is being rejected by others.

The key function of the Apple/ Google approach is to notify close contacts of a positive case. While initially seeming promising, the primary concerns with the Apple/ Google approach are:

- The service is defaulted OFF on iPhones and can only be enabled once an approved Government app is installed on the phone. The compliant adoption levels will therefore likely be similar to any other app, which is well below the level required to contribute to manual contact tracing efforts.
- It is voluntary for users to notify close contacts, then voluntary for those close contacts to notify Public Health Authorities, and voluntary for those exposed to self-isolate. Close

contacts are notified in an anonymous way, so won't know how they might have been exposed, further reducing the likelihood that they will self-isolate.

The Apple/ Google solution is highly secure and impressive from a technical design perspective and we consider the Apple/ Google approach to potentially be of some incremental value in countries where manual contact tracing is not the local approach.

The inability of the current Apple/ Google solution to integrate into Government contact tracing efforts and the fact it is highly unlikely to gain the necessary levels of compliant adoption makes it highly unlikely to materially add to New Zealand's approach to fighting COVID-19.

3.10. Wearables and interoperability with apps

The *CovidCard* is an example of a wearable device that operates similar to an app, using Bluetooth Low Energy to exchange messages with other devices. It may be desirable to have wearables and apps interoperate, providing users with the ability to choose either approach and increasing overall compliant adoption levels closer to the required 60% or greater.

Choosing this approach introduces some new risks, such as making it more difficult to assess or enforce compliance - checking that the app is installed and running as intended rather than simply sighting a wearable. We haven't considered these issues of compliant usage in detail. We have considered whether it is technically feasible to have wearables and apps interoperate.

The key challenge pertains to iPhones, which do not operate reliably for Bluetooth contact tracing apps outside of the Apple/Google Exposure API. Specifically, Apple phones cannot be relied upon to advertise their presence to other phones unless the app is open and running in the foreground - which is highly unlikely to be the case under normal use.

The Apple/Google Exposure Notification System is contrary to New Zealand's approach to contact tracing, in that it anonymously notifies close contacts that they have been exposed and relies on them to voluntarily notify the public health authorities. We consider it prima facie unsuited to use as part of augmenting and accelerating contact tracing.

At a technical level, the security model of the Apple/Google system is such that the tracking messages (Bluetooth advertisements) of phones are unable to be reconciled with a user. As *CovidCard* is not a network connected device, it is unable to integrate with the Apple/Google API. We do not consider it technically possible to effectively integrate hardware with the Apple/Google Exposure Notification system.

It is, however, technically possible to have wearables like *CovidCard* interoperate with Android phones when running a customised app such as Singapore's TraceTogether protocol. This approach is being considered by the Singaporean Government. We consider that an approach that allows users to choose apps if they have the right phone, or hardware if they don't, would create

confused messaging and compromise our ability to achieve required levels of combined compliant adoption.

3.11. The NZ COVID Tracer app

On 20 May, the New Zealand Government launched the NZ COVID Tracer application. As at 29 May, 446,000 had registered to use the app. The focus of the application is for people to maintain an "electronic diary" to track their movements by scanning QR codes of the places they visit.

A voluntary app approach that relies on users and businesses to participate, launched before QR codes were available at premises, was always going to fail. As at 29 May, some 480,000 QR codes had been scanned, an average of 1.07 scans per registered user. We do not consider the NZ COVID Tracer app, or the future roadmap for this app, to have any prospect of materially contributing to contact tracing efforts or the slow of the spread of COVID-19 under any conceivable circumstance.

The promotion of various COVID-19 solutions by the Government to people and businesses that so obviously don't work will not contribute to public health efforts and are considered counterproductive to the adoption of future technologies that might.

4. CovidCard Project Findings

4.1. Overview

CovidCard is a Bluetooth Low Energy (Bluetooth LE) device with the dimensions of a credit card. It is designed to be worn on a lanyard around the neck when you are in environments where people congregate. This includes public transport, workplaces, bars, restaurants, gyms, hospitals, large gatherings and events. Openly wearing a *CovidCard* contributes to easily assessing and enforcing compliant use, as required. Wearing it under clothing does not impact the function of the card.

Each *CovidCard* is registered to an individual. Minimal personal details consisting primarily of cardholder's contact details would be stored in a database administered by a dedicated Crown Entity established for the purposes of administering the card. Keeping data independent of other Government databases is considered a critical plank to establishing public trust and confidence in the scheme.

CovidCard detects and records close contacts using Bluetooth LE and stores this data securely on a person's card. No contact data is automatically stored in the cloud or elsewhere and only 21 days of close contacts will be stored. Cards do not track user location as they do not contain GPS capability.

Each *CovidCard* is both advertising its presence and scanning for the presence of other *CovidCards*. Algorithms on the card assess the radio signal strength (the RSSI) and accelerometer outputs over the duration of the encounter to accurately identify close contact events.

The current clinical definition of a close contact is an encounter of 15 minutes within 2 metres of the contact. Additionally, cards would record "casual contacts" who do not fit the definition of a close contact and a list of these could also be provided to contact tracers.

The RSSI value alone is not able to reliably determine precise distances, even with homogenous and specifically calibrated hardware. Our field trials provide high confidence that a combination of inputs can accurately determine close contacts and minimise false positives.

CovidCard makes contact tracing faster, more accurate, and more scalable if effectively integrated with existing contact tracing efforts. The main benefits of *CovidCard* are:

- Close contacts could be identified, independently of whether the case can recall the encounter, broadening the comprehensiveness of the close contacts.
- Close contacts could be notified immediately by text message, asking them to self-isolate.
- Contact details of close contacts could be made immediately available to contact tracers for all close contacts and casual contacts, accelerating the speed with which close contacts can be isolated.
- Recursive contact tracing is made possible, but would require the cards of first-order close contacts to be retrieved to enable this.

Success of *CovidCard* relies on detecting a high proportion of the high-risk encounters that occur within a population. High-risk encounters typically take place inside, at places such as bars, restaurants, at church services, at large events, or on planes or public transport. It is envisaged that *CovidCard* would need to be required to be worn in such settings to be effective.

CovidCard must be deployed in advance of any second wave of COVID-19. Otherwise, by the time we distributed cards to everyone we would have already had our second Level 4 lockdown and would have been moving down the Alert Levels again. While *CovidCard* could play a role with essential workers during a Level 4 lockdown, lockdown alone can control the spread of the virus in the wider community. The time when *CovidCard* should be deployed will likely be characterised by complacency in the community regarding COVID-19.

CovidCard is designed as a temporary solution for COVID-19. The battery on the device will only last around 12 months. Deploying *CovidCard* in New Zealand in advance of relaxing border restrictions is likely the time when *CovidCard* is able to deliver the greatest value as this will be a time of elevated risk.

Singapore is actively working on a similar solution to CovidCard and opportunities exist to establish an interoperability standard between our efforts.

4.2. Testing and field trials results

The *CovidCard* project team has undertaken a program of field trials and product testing to support the development of the core technology (card hardware and algorithms), and to determine the accuracy and efficacy of a Bluetooth LE card to enhance manual contact tracing.

This work commenced with a small-scale field trial conducted May 7-12th in Nelson Hospital using a "Prototype 0" version of the *CovidCard*. This was followed by a series of closed and controlled scenario tests conducted May 14-29th in the Waikato region. These tests used "Prototype 1" cards which could be updated, enabling iterative card embedded software (firmware) development. These closed tests simulated common interactions across a range of scenarios including an office environment, a cafe/restaurant, a construction site, taxi/Uber trips and a house party/social function. The tests have provided a strong real-world dataset to support the evaluation of the *CovidCard's* contact identification performance relative to a robust observed reality (ground truth), derived through a combination of video capture and detailed trial observer records.

This evaluation essentially determines whether the *CovidCard* can accurately identify events meeting the current clinical definition of a "close contact" (within 2 metre distance for 15 minutes in total).

The key metrics resulting from the evaluation are:

- Recall: a measure of the percentage of actual "close contact" events that the *CovidCard* was able to identify.

- False positive rate: a measure of the percentage of the *CovidCard*-reported "close contact" events that did not meet the clinical criteria in the observed reality.

The overall *CovidCard* system includes both on-card and server-side algorithms. The on-card firmware algorithms must achieve high levels of recall to minimise false negatives and will provide additional contextual information to support server-side processing. These algorithms need to also operate within the memory and battery lifetime constraints of the card. Once shipped, card software is unable to be updated.

The server-side component of the *CovidCard* system further filters, refines, categorises, and prioritises the contact list, resulting in information tailored to enhance manual contact tracing efforts. Server-side software can be improved over time to better fit the needs of the contact tracing process, including updating clinical definitions or categorisations of types of contacts.

Our initial evaluations are focused on the recall performance of the *CovidCard* hardware and firmware. As noted above, we seek to maximise recall performance so our evaluation is deliberately biased against the *CovidCard*: our observed reality is absolute and highly precise (recorded with minute or sub-minute accuracy) in comparison to human recall of the last 7 days or so, as manual contact tracing requires[12].

Nonetheless, our provisional results show that the prototype *CovidCard* can achieve strong recall performance averaging at 90.3% over all trials.

[12] Manual contact tracing in NZ goes back to 2 days before symptom onset.

Additionally, "close contact" false positive rates for the on-card algorithms are encouragingly low and largely meet the definition of a "casual contact" (being any other contact who has had exposure but does not meet the clinical definition for a "close contact"). We expect these "casual contacts" will be further deprioritised and categorised as such in server-side processing, resulting in an estimated 'close contact' false rate of around 10%.

Overall, these initial results give us strong confidence that the *CovidCard* system will be capable of generating an accurate digital record of close contacts that can be used to augment and accelerate manual contact tracing processes.

The next stage of product development would involve one or more large-scale field trials using a production candidate version of the *CovidCard*. The large-scale trials would ideally include simulated contact tracing scenarios involving the relevant regional contact tracing centre to identify the extent that *CovidCard* might make to manual contact tracing.

Given the potential public profile of any large scale field trials, we recommend these only proceed under the current project structure if the Government intends to proceed with the recommended nationwide *CovidCard* programme. In the event the Government chooses not proceed, then these large-scale field trials could be reframed as a research project run independently by Otago University, with the trial findings published for the benefit of other Governments and private sector organisations developing Bluetooth LE hardware devices for enhanced contact tracing.

4.3. Card security and privacy

Security and privacy are critical to adoption and success of the *CovidCard,* and have been addressed comprehensively in the design. Only information necessary for the purposes of COVID-19 contact tracing is gathered or stored and information is envisaged as only downloadable from the card if the cardholder consents at the time of testing.

No personal information is ever electronically stored or printed on a *CovidCard.* Each *CovidCard* has a unique 12-digit serial number and corresponding QR code laser etched onto the card. The card also has a signature strip for the cardholder to write their name, alias or other identifier to avoid it being inadvertently swapped with another card in their household or workplace. The serial number of each *CovidCard* is associated with the contact details of its cardholder as part of the card registration process and stored in a secure central register. This central register would be disconnected from any other Government agency databases, including that of the Ministry of Health.

Once a card is activated, transmissions would change regularly and would be pseudonymous, meaning the card serial number would not be revealed or able to be derived. Regularly changing the data transmitted means cards cannot be tracked or used to remotely detect the presence of a given

cardholder. The changing pseudonymous identifiers would only be able to be resolved by the approved authority.

CovidCard has no notion of location as it does not use GPS or have a network connection. Cards simply receive and record properly-formed transmissions from other nearby cards and use this information to help determine close or casual contacts. Records of other cards are retained on the card, not on any phones, computers or servers elsewhere, for a maximum of 21 days.

CovidCard has a non-rechargeable battery with a typical 12-18 month battery life. Once the battery is depleted contact records are lost and become irretrievable as records are encrypted using a key held in volatile memory which is lost if power is lost. At that point, cards are recycled or disposed of.

As a part of the project, the *CovidCard* security architecture has been submitted for initial review by the National Cyber Security Centre (NCSC), who have expressed satisfaction with the approach taken whilst noting the need for final overall review in the context of a broader card deployment and usage model.

4.4. Card manufacture and supply chain

Two preferred *CovidCard* hardware manufacturing providers have been engaged in the prototype development project:

- **Fenda**: Shenzhen Fenda Technology Co. Ltd., based in Shenzhen, China, engages in the design, manufacture, and sale of household and personal care electric appliances. Fenda has manufactured 4,000 *CovidCards* for the large scale field trials, to our hardware specification and with our prototype firmware.

- **Minew**: Shenzhen Minew Technologies Co., Ltd., also based in Shenzhen, China, designs, manufacturers and sells IoT devices. The initial small scale hospital trial and Waikato-based testing used an existing Minew BLE Beacon card with early prototype firmware loaded on the card.

Both manufacturers are capable of producing tooling and scaling up card hardware manufacturing to meet our large-scale card volume and supply timeframes. Supply of key electronics components have been assessed by both manufacturers and (as of the time of this report) there is adequate component stock available. Alternatives for some components have also been identified to provide further supply chain redundancy. Supply of hardware components may be adversely affected if other large countries pursue hardware based contact tracing solutions.

If *CovidCard* proceeds, we recommend awarding a card manufacturing contract to one or two providers. Prepayments would be required to complete tooling and to secure component supply and manufacturing production capacity.

4.5. Distribution

Achieving mass adoption to achieve sufficient coverage of high-risk encounters would require both a national marketing and distribution campaign, as well as usage to be mandated in high risk settings.

Population-wide campaigns have been successfully executed for general elections and censuses. In the 2017 General Election, 1.2m advance votes were taken in the two week advance voting period, with a further 1.3m votes taken on election day. Nearly 500,000 enrolments were also updated with 300,000 of those made during a 6 week campaign.

A campaign to distribute the *CovidCard* would be a significant undertaking, comparable to the enrollment update and advance voting activities undertaken by the Electoral Commission. Experience gained from general elections and the census suggest success would require four key components: (1) a mass-market advertising campaign; (2) an online channel where people can register for a card to be mailed to them; (3) an 'over the counter' channel, involving physical station set-up in high traffic areas, such as shopping centres and supermarkets; and (4) a proactive community engagement campaign for communities that are harder to reach (e.g. Maori, Pasifika, Ethnic Communities). After a short planning period, these streams of work could be executed in 8-12 weeks. Opportunities may exist to use employers as a means of distribution also.

Marketing messages will materially influence adoption and social acceptance. A combination of messages that appeal to a sense of community ('We're all in this together') and individual motives ('Get notified if you're exposed so you can protect your loved ones') are likely to drive greater acceptance than government mandate, particularly in Maori and Pasifika communities with their strong values around the collective. Any campaign will also need to address potential objections to the campaign, including privacy protections, and practical information on how to obtain and use the card.

Many New Zealanders are expected to respond favourably to an appeal by the Prime Minister supported by a mass-market campaign, but mandatory usage of *CovidCard* in some settings would likely be required to reach adoption targets (bars, nightclubs).

Social acceptance may be subdued while case numbers are low but deployment must necessarily take place in advance of any second wave. Mandated usage could be required only once risks increase, such as when border controls are relaxed or triggered by an increase in Alert Levels as first cases are identified. It is not envisaged that mandating should occur where denied entry could lead to harm (e.g. medical care, public transport).

Confused messaging from the Government around using various apps, scanning QR codes, keeping diaries, or completing registers when entering venues, etc remains a risk to people's receptivity to the promotion of *CovidCard.*

4.6. Service delivery platform and systems

A high level design of the proposed operating models and systems to support the *CovidCard* has been completed. It is proposed that a separate Crown Entity be established under independent governance to administer the scheme and keep data independent of other Government databases. A decision to proceed should be followed by rapid implementation. The organisation could be discontinued once COVID-19 is no longer considered a special threat to New Zealand. The design and establishment of an entity will be further defined by the Government following a decision on whether to proceed.

Aspects of the operating model will need to be delivered via commercial contacts with specialist third parties, including providers for:

- **Core Service Delivery Platform,** to develop and operate the core technology solution. The core Service Delivery Platform has been designed,and high level estimates of the software development effort and delivery timelines are contained in this document. The Service Delivery Platform can support the three channels identified - online orders, phone orders, and over-the-counter - with a consistent underlying management system.

- **Fulfilment,** providing card warehousing, card printing, packaging and fulfilment. This provider would also manage returns.

- **Contact Centre,** providing customer support and onboarding by phone.

In addition to supporting distribution, the Service Delivery Platform would include customer support and manage the secure download of card information, providing a categorised list of close contacts to the core contact tracing systems currently operated by the Ministry of Health.

High level processes have been defined and the supporting system architectures for a robust, secure, scalable platform have been developed to support the six key solution elements in Figure 2.

1. Card Registry List of all cards and person contact details.	**2. Card Data Escrow** Securely store retrieved card contact data. Integrated with contact tracing systems.	**3. Card Website** Website where users register to receive a card, edit their details, or order a replacement.
4. Secure Download App Used by health workers to download card data pending a test result.	**5. Contact Centre Team & Platform** Integrated systems used by the contact centre team to answer queries within agreed service levels.	**6. Fulfilment House & Platform** The solution used by the outsourced fulfilment centre to send cards to customers.

Figure 2. Key elements of the Service Delivery Platform

The key risk identified is the delivery timeframes that are implied by building pandemic software during a pandemic. Key mitigations of this risk include taking a multi-team approach and early build of a minimum viable product or MVP.

Contact centre costs will be impacted by the exact mix of service channels (online, phone, over-the-counter) for card issuance and ongoing support. The key external dependency will be integration with the Ministry of Health's National Contact Tracing Solution and with PHUs for the uploading of card data at the time of testing. Any recursive contact tracing will require the physical retrieval of the cards held by close contacts, in order for those cards to also be uploaded.

A brief Privacy Assessment was completed for the Service Delivery Platform. The solution holds limited personal data which is not connected to any national register. Uploaded card data is stored encrypted and held separately to personal data. Authorised access of close contacts data would only be available through the Ministry of Health systems following a positive test result.

Security considerations include the separation of components, limited access to systems, design and security patterns, and GCSB and 3rd party audits. Implementation is outlined as part of the proposed phases and timeline and more information is available in appendices.

4.7. Using data for disease surveillance and research

For each case, *CovidCard* would provide lists of close contacts and casual contacts, per clinical definitions. It could also provide a long list of other contacts not making this threshold. These contacts could be anyone detected by the card over a minimum threshold.

This data could provide the ability to map connections between cases that are linked by casual contacts or the lower threshold contacts, which are likely an order of magnitude greater in number. The ability to link cases through intermediary contact events may contribute to the understanding of how the virus is spreading, and perhaps link it to specific events or venues.

Figure 3, illustrates three different *CovidCards* with positive results have a number of close or casual contacts. While some close contacts are shared between two *CovidCards*, there are also close contacts shared by all three, indicating a possible common event or location.

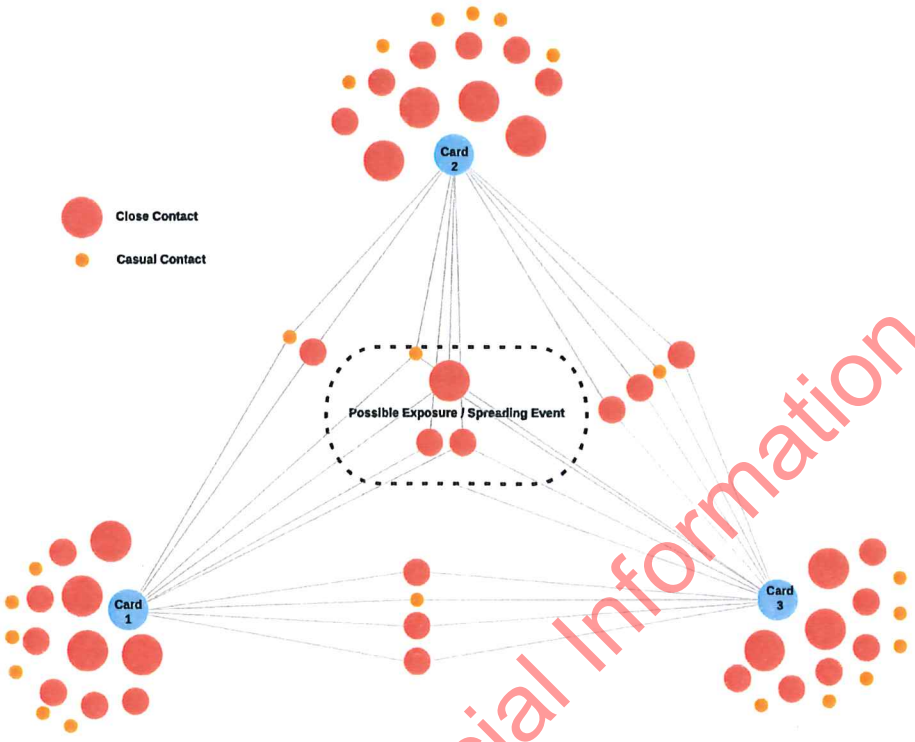

Figure 3. Network relationship diagram based on *CovidCard* data

4.8. The Health Case: Assessing impact on the spread of COVID-19

This section investigates the possible impact that *CovidCard* might have on the spread of COVID-19 and the results we might expect assuming target levels of adoption are able to be achieved.

We have chosen not to present our own preliminary models given how sensitive (and potentially controversial) models are with a wide array of assumptions required, including: virus transmission dynamics, tracing efficiencies, isolation efficiencies, the number of pre-symptomatic infections, any delay from symptom onset to testing, technology adoption rates, the country context, the assumed R_{eff} value and much more.

CovidCard should be evaluated against its ability to meaningfully slow the spread of COVID-19. An ongoing Cochrane Review of digital contact tracing solutions identified multiple modelling studies that can inform the evaluation of the *CovidCard* (including Kucharski 2020; Ferreti 2020; Hinch 2020; Plank 2020; Grice 2020; Vaithianathan 2020). Three of these studies focus specifically on the New Zealand context (Plank 2020; Grice 2020; Vaithianathan 2020).

The three areas that *CovidCard* can claim to improve on within existing systems are:

1. Increasing the total number of clinically relevant close contacts identified.
2. Reducing the time elapsed between symptoms presenting and the isolation of first-order contacts.
3. Enabling recursive contact tracing, the isolation of second-order contacts.

Increasing the total number of clinically relevant close contacts identified

The full extent to which contacts are missed by manual contact tracing efforts is not well understood. In New Zealand, the current manual contact tracing system has been able to track up to 50% of self-reported known close contacts within 7 days, with the target of reaching 80% of self-reported known close contacts within 4 days. Modeling efforts assume a high percentage of close contacts will be traced (also referred to as tracing fraction), ranging from 75% (Ferretti 2020) to 95-100% (Kucharski 2020 and Hinch 2020), while others (Vaithianathan 2020) illustrate the impact of a range of percentages of contacts traced (25-100%). Importantly, there is a difference between assumed tracing fractions (percentage of all close contacts, known or unknown, traced) and realized tracing fractions (percentage of self-reported known close contacts ultimately traced).

One UK study (Keeling, 2020) estimated that only 61% of a person's close contacts were known to the individual. Additionally, the researchers estimated 15% of all primary cases would generate at least one secondary case that cannot be identified. By augmenting the manual contact tracing system, which focuses on self-reported known close contacts, and adding close contacts not recalled or unknown to the case, the *CovidCard* could bridge the gap between these two tracing fraction constructs and increase the total number of clinically relevant close contacts identified.

Further illustrating the limitations of relying solely on self-recall of close contacts, prior research has compared the number of close contacts identified via self-recall with close contacts identified using digital solutions (Leecaster 2016; Mastrandrea 2015; Smieszek 2014). Three (Leecaster 2016; Mastrandrea 2015) to 10 times (Smieszek 2014) more close contacts can be expected to be identified using sensors or digital solutions when compared to self-report data.

Under ordinary social conditions, people have meaningful and clinically relevant interactions with other people everyday, and many of these interactions would not be captured in current manual contact tracing systems.

Reducing the time elapsed between symptoms presenting and isolation of first-order contacts, the 'first-order tracing delay'

Close contacts of index cases are often referred to as first-order contacts and the "close contacts of close contacts" are referred to as second-order contacts. Currently, the Ministry of Health aims to

identify 80% of known self-reported close contacts within 4 days of case notification. Reducing the delay to isolate first-order close contacts is often one of the main objectives of modelling studies. Modeling studies which have reported assumptions regarding the time from case notification to isolation of first-order contacts, use a 2 day lag-time (Ferretti 2020 and Plank 2020).

The *CovidCard* has the potential to reduce this lag-time from notification of a positive test to the isolation of the first-order close contacts (tracing delay). Upon notification of a positive test, all first-order close contacts would be automatically notified of their exposure and instructed to self-isolate while awaiting contact from contact tracers. Though the Ministry of Health target is 80% of known self-reported close contacts to be traced within 4 days, approximately 44% of close contacts are currently traced within 4 days.

Figure 4, provides a visualisation of the potential benefit of digital contact tracing compared to manual contact tracing based on a reduction in the tracing delay. Depending on key assumptions, digital contact tracing could reduce the tracing lag by up to 3 days, which in turn could prevent a larger fraction of tertiary cases than manual contact tracing would.

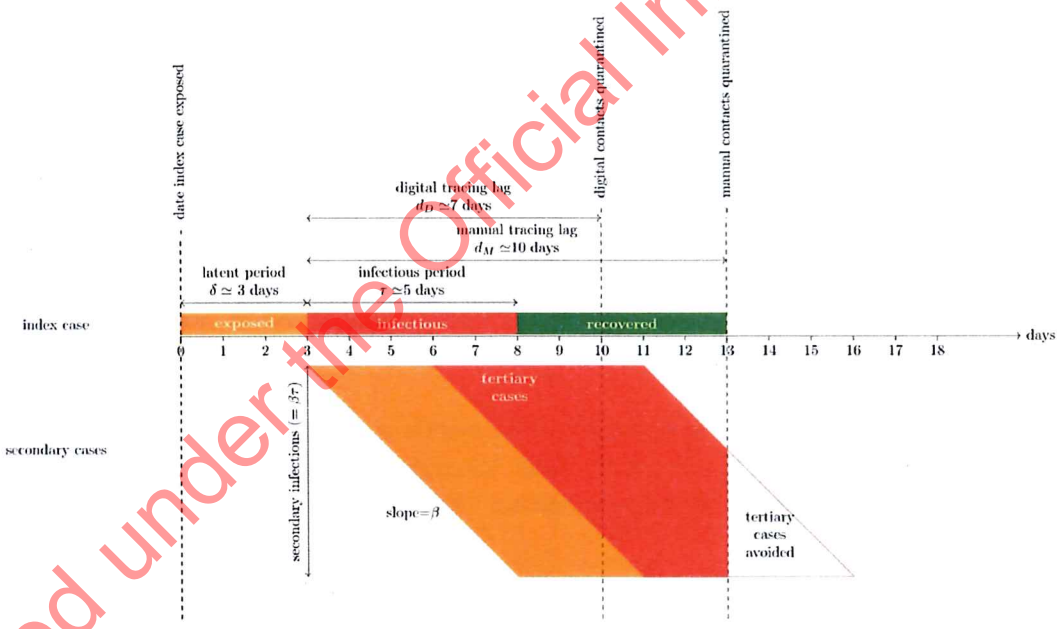

Figure 4. Potential benefit of digital contact tracing

A direct impact of reducing the tracing lag is the reduction in secondary cases and R_{eff}. The impact of reducing the tracing delay through digital contact tracing has been estimated to reduce R_{eff} by 44-55% (Kucharski 2020; Plank 2020; Ferretti 2020). However, these same studies, and others (Hinch 2020), also show that reducing the first-order tracing delay is insufficient to reverse the epidemic growth without substantial social distancing restrictions. However, some (Ferretti 2020; Grice 2020; Vaithianathan 2020; Kucharski 2020) have found that digital contact tracing, together

with large uptake of the digital solution, ranging from 50% (Vaithianathan 2020) to 92% (Plank 2020) and optimistic testing and isolation assumptions, could push the R_{eff} below one.[13] In sum, reducing the first-order tracing delay would substantially reduce R_{eff}, but may not push it below one without additional social restrictions or recursive contact tracing.

Recursive contact tracing, isolating second-order contacts

We consider the rapid identification of second-order contacts to potentially be the most impactful feature of *CovidCard*. In addition to isolating first-order close contacts of the index case, the second-order contacts could also be notified to self-isolate. Although second-order contacts may have been infected, the majority would not have yet become infectious - effectively cutting the chain of transmission. We consider the timely isolation of second-order contacts not possible without *CovidCard*.

The added advantage of second-order contact tracing is reducing the dependency on the fixed characteristics of the contact tracing system that cause major delays: the delays between exposure to first symptoms, from first symptoms to getting tested, from getting tested to getting a test result.

Recursive contact tracing is practiced elsewhere. In mid-April, the Chinese city of Harbin, for example, chose a strategy to quarantine and test both close contacts and the "close contacts of close contacts"[14]. Recursive contact tracing would enhance a strategy of elimination or suppression. Recursive contact tracing, enabled by *CovidCard*, effectively makes it possible to implement a highly targeted quarantine.

To our knowledge, only one study (Hinch 2020) has modelled the impact of isolating second-order household contacts. They found that even under the most pessimistic assumptions of epidemic growth, recursive contact tracing could prevent a lockdown. *CovidCard* would obviously enable recursive contact tracing to reach beyond the household.

To enable second-order contacts to be traced with *CovidCard*, the cards would need to be retrieved from the close contacts of the index case, following which the contact details of second-order contacts would be available to contact tracers.

If each index case has 30 first-order close contacts, and each first-order contact also has 30 close contacts (the second-order contacts), then you might be isolating some 900 people when you discover a single case of COVID-19. If ~8% of first-order contacts are infected (with an R_{eff} = 2.5 and 30 contacts), and ~8% of second-order close contacts of secondary cases were also infected, then only 0.64% of second-order close contacts might be infected, or just 6 of the 900.

[13] Refer to Section 8: Supporting Documentation section for papers/models.

[14] https://www.reuters.com/article/us-health-coronavirus-china-harbin/chinese-city-tightens-coronavirus-travel-curbs-in-biggest-outbreak-idUSKCN22409D

4.9. Risks and mitigations

Risks	Mitigation
Compliant adoption levels must be over 60%. Any digital contact tracing technology is only effective at very high levels of compliant adoption, estimated at over 60% and ideally over 80%, in places where high-risk encounters are likely.	Effective marketing messaging is critical, particularly to address core concerns of privacy and security, but it is expected that some level of Government mandating will be required in areas of particular risk to achieve the full benefits.
Lead times to deployment. Deploying *CovidCard* will take 5 months, meaning it needs to be deployed in advance of any outbreak or opening of the border.	*CovidCard* is best deployed in advance of an outbreak or the opening of the border, which is expected to dramatically increase the risk of importing cases of COVID-19. *CovidCard* implicitly requires a strategy which considers COVID-19 as an ongoing threat to New Zealand's health and economy.
Specific use required. *CovidCard* needs to be worn visibly to be optimally effective both for social signalling, ease of enforcement, and operation of the Bluetooth radio. We have modelled our work based on *CovidCard* being worn on a lanyard around the neck. Burying the *CovidCard* in a handbag or similar may reduce the operating efficacy of the device.	Marketing and social signalling should reinforce optimal use. Future form factors could include wristbands.
Confused Government messaging. The Government continues to provide inconsistent messaging and advice on what New Zealanders should do with respect to technology and continue to promote solutions that are prima facie ineffectual.	A clear and consistent communications strategy is required. Minimising the other technology that is promoted will assist in adoption and reduce confusion.

4.10. Proposed phasing and indicative timeline

Programme implementation is a 6 month period, phased to achieve a population wide roll out in the shortest practical time frame. This is illustrated in Figure 5, and has three phases:

- Phase one, "Design & Plan" is one month in duration.
- Phase two, "Build and Readiness", is executed over four months and includes establishing the service delivery platform, manufacturing and landing cards, and preparing for fulfillment and distribution. Marketing and communications streams are executed in parallel.
- Phase three, "Rollout" involves 4 - 6 weeks of nationwide distribution.

Establishment of the entity to manage and operate the service is also part of Phase One, with leadership in place, Phase Two support resources and processes are established, ensuring the entity is operational prior to the completion of the rollout.

Any large scale field trials are not reflected in the timeline, as they are the final stage of the *CovidCard* product development project.

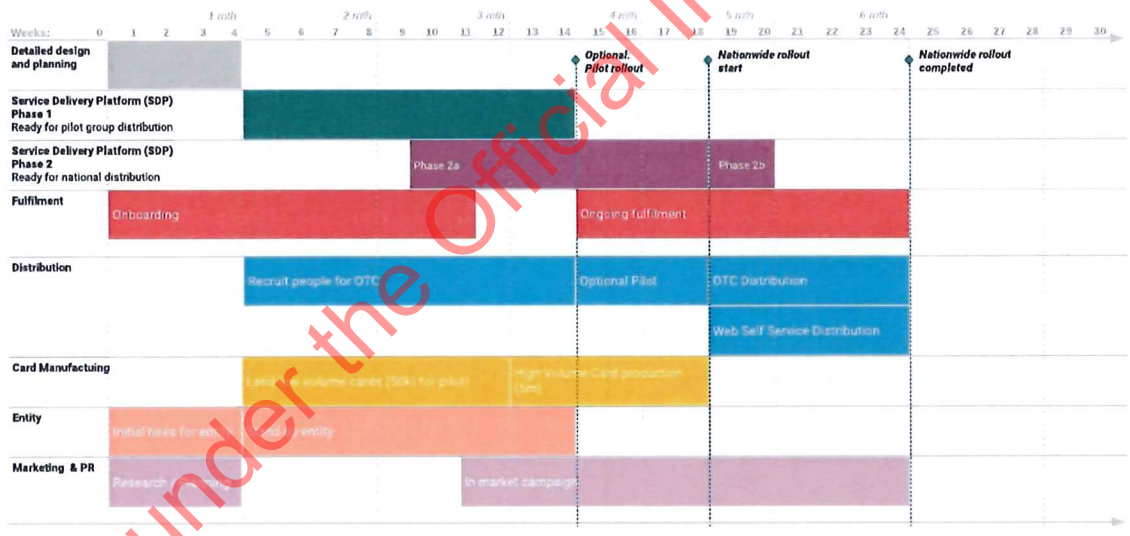

Figure 5. Implementation indicative phasing and timeline

4.11. Cost estimates

The indicative cost estimates below are based on a whole of population rollout for cards that would last 12 months. Cards are not rechargeable and the battery life of cards is 12 months. Cards would need to be replaced to provide coverage for a second year. We have provided cost estimates for this also.

Project - Design, Build, Rollout		Estimate
1.	Entity establishment (5 FTE)	$1.5 million
2.	Phase One: Design and planning; Early service delivery platform iteration; Marketing and brand research; and card trial.	$4.5 million
3.	Card manufacturer (c.3.9 million *CovidCards*)	$37 million
4.	Service delivery, service desk and card streams	$7 million
5.	Service desk to support rollout	$3 million
6.	Go-to-market and distribution (including direct and over the counter channels)	$12 million
7.	Marketing and PR	$5 million
8.	Project contingency	$7 million
	Total Project	**$77 million**
Ongoing Service Year 1		
1.	*CovidCard* Operational Entity	$3 million
2.	Lost/damaged card replacement (30% year 1 card churn = 1.2m cards)	$14 million
3.	Support for service delivery platform and contact center	$4.5 million
	Total Year 1	**$21.5 million**
Total Implementation, rollout and operate for 1 year		**$98.5 million**
Ongoing Service Year 2 (if required)		
1.	*CovidCard* Operational Entity	$3 million
2.	Support for service delivery platform and contact center	$4.5 million
3.	Manufacture 4.6 million cards. Covers replacement due to battery life and lost/damaged cards.	$44 million
4.	Market and distribute replacement cards nationally	$10.5 million
5.	Contingency	$2 million
	Total Year 2	**$64 million**

5. Consultation

Various stakeholders have been engaged as part of soliciting feedback during the development of the *CovidCard*, including:

- Various Ministers - Ardern, Robertson, Clark, Little, Shaw, Martin, Faafoi.
- Representatives of the Iwi Chairs Forum.
- The Council of Trade Unions.
- The Pacific Health Response to COVID-19.
- The Privacy Commissioner.
- The Government Communications Security Bureau (and, in particular, the National Cyber Security Centre) who were involved with the design and development of the solution.

Overall, there was broad support for the approach. The primary concerns relate to concerns about out-of-pocket costs, privacy, data security and the risk of Government misuse of any information - such as linking the data to other Government databases - IRD, MSD, Police, etc.

5. Conclusions

New Zealand lacks the advanced technologies and broader social license of other Governments battling COVID-19 (China, South Korea, Taiwan). With our existing technology, manual contact tracing is simply not fast enough or scalable enough to materially slow the spread of COVID-19 under normalised social settings with an open border, so the border remains closed.

Following extensive work, we have not gained any confidence that voluntary contact tracing apps can meaningfully augment and accelerate contact tracing as they simply cannot reach the required level of compliant adoption.

We are however confident that *CovidCard* could achieve the necessary level of adoption, if some degree of Government mandating accompanied it for places that are higher risk. We have confirmed the approach is technically viable and can be manufactured and distributed to the necessary levels of scale. Our trials and product development work give us confidence that *CovidCard* can detect over 90% of close contacts (relative to empirical observations, not flawed human recall) in a wide variety of simulated social settings. We have confidence that, allowing for server-side processing of data before providing contact details to contact tracers, that we could get false positives below 10%.

Manufacturing and distributing cards will take the better part of 6 months and provide just one year of *CovidCard* national coverage for an estimated cost of nearly $100m, assuming no co-payment by cardholders. The economic costs of lockdowns are measured in the tens of billions of dollars.

Opening the border, to countries other than the small number with zero COVID-19, will create a period of elevated risk and seems the best timing for a tool like *CovidCard*, which is designed as a temporary intervention to last only 12 months. Additional cards would need to be deployed to do a second year, if that was deemed necessary.

CovidCard must be distributed in advance of when it is needed and is not something that can be rolled out quickly in an emergency - the flood defences need to be built before the flood. Achieving the required level of adoption is expected to require a significant investment in a national marketing effort and a strong Government support to achieve.

We are unaware of any potential tool that is available in the New Zealand context, aside from mandatory social distancing, that holds the potential to reduce the growth rate of the virus below zero.

6. Recommendations

We recommend:

1. That *CovidCard* is considered as a tool for population wide deployment in advance of relaxing border settings, particularly before allowing arrivals to New Zealand from countries where COVID-19 levels are above zero.
2. That recursive contact tracing be considered, in conjunction with *CovidCard,* as a way to significantly enhance the effectiveness of contact tracing and sustain elimination. We consider timely recursive contact tracing to not be possible without *CovidCard*.
3. That further modelling work is conducted to quantify the degree to which *CovidCard* is able to slow the spread of COVID-19, over and above manual contact tracing, both including and excluding recursive contact tracing.
4. That an economic analysis is completed to determine the economic benefits of *CovidCard*.
5. That further work, including large-scale field trials, only proceed alongside in-principle support for a population-wide deployment.

7. Supporting Documentation

The following papers/models support analysis in this report.

#	Paper/Model	Description
1.	WHO advice on digital contact tracing	Interim Guidance 18 May 2020 World Health Organisation - "Ethical considerations to guide the use of digital proximity tracking technologies for COVID-19 contact tracing"
2.	Kucharski 2020	"Effectiveness of isolation, testing, contact tracing and physical distancing on reducing transmission of SARS-CoV-2 in different settings" Preprint academic paper focusing on modelling digital contact solutions, Location: UK
3.	Ferreti 2020	"Quantifying SARS-CoV-2 transmission suggests epidemic control with digital contact tracing". Academic paper published in *Science* modelling the benefits of digital contact tracing. Location: UK.
4.	Hinch 2020	"Effective Configurations of a Digital Contact Tracing App: A report to NHSX" A commissioned report for the National Health Service Technology (NHSX) modelling the effectiveness of various digital contact tracing solutions. Location: UK.
5.	Plank 2020	"A model of COVID-19 case isolation and contact tracing in New Zealand" Unpublished modelling of different contact tracing scenarios using the Te Punaha Matantini (TPM) model. Location: NZ
6.	Grice 2020	"The effect of social distancing, isolation and digital contact tracing on COVID-19". A technical report examining the effectiveness of digital contact tracing. Location NZ
7.	Vaithianathan 2020	"Digital Contact Tracing for COVID-19: A Primer for Policymakers". Working paper targeted at policymakers outlining the case for digital contact tracing. Location: NZ
8.	Keeling 2020	"The Efficacy of Contact Tracing for the Containment of the 2019 Novel Coronavirus (COVID-19)". Preprint academic paper focusing on efficacy of contact tracing efforts, Location: UK
9.	Leecaster 2016	"Estimates of Social Contact in a Middle School Based on Self-Report and Wireless Sensor Data". Academic paper published in PLoS ONE showing the results of a comparative study of sensor and self-report logs with regards to close contacts, Location: USA
10.	Mastrandrea 2015	"Contact Patterns in a High School: A Comparison Between Data Collected Wearable Sensors, Contact Diaries and Friendship Surveys". Academic paper published in PLoS ONE discussing results of a study comparing different methods of collecting information regarding close contacts, Location: France
11.	Smieszek 2014	"How Should Social Mixing Be Measured: Comparing Web-Based Survey and Sensor-Based Methods". Academic paper published in BMC Infectious Diseases showing the direct comparison of close contacts as determined by a wireless sensor device and web based surveys, Location: USA

12.	James, A., Plank, M.J., Binny, R.N., Hannah, K., Hendy, S.C., Lustig, A. and Steyn, N., 2020.	A structured model for COVID-19 spread: modelling age and healthcare inequities. medRxiv.
13.	Sheridan NF, Kenealy TW, Connolly MJ, Mahony F, Barber PA, Boyd MA, et al.	Health equity in the New Zealand health care system: a national survey. International Journal for Equity in Health. 2011;10(1):45.
14.	Digital Inclusion Research Group. Digital New Zealanders	Digital Inclusion Research Group. Digital New Zealanders: The Pulse of our Nation. Wellington (NZL); 2017

Supporting project deliverables.

#	Document	Description
1.	Card Hardware Assignment Reports	Assignment report including card hardware, firmware and secure download app technical specifications, card security specification, and card testing reports
2.	DEL04: *CovidCard* Phase One Report.	Otago University Small Scale Nelson Hospital Trial Study Report. Analysis and results from the initial field trial conducted to evaluate early prototype card performance and usage.
3.	Distribution and Adoption Report	Analysis of population wide distribution options to drive adoption and proposed viable approach.
4.	Service Delivery Platform Assignment Report	Card Service Delivery platform (SDP) analysis and design including distribution channels, card registry, technical architecture, security and privacy. Process flows include interfaces to contact tracing systems.

From: Mike Bush [DPMC] <Mike.Bush@dpmc.govt.nz>
Sent: Thursday, 4 June 2020 4:35 PM
To: Rob Fyfe; CAMERON, Rebekah
Cc: GRICE, Leon
Subject: RE: Contact Tracing Strategy

[UNCLASSIFIED]

Hi Rob
Agreed.
I have just had JO take a read of the document prior to sending it to him. He's very comfortable to receive it, comfortable with the content and rec, and happy to send it on.
Can you re-email me the document with an email header giving a short intro and rec. I will then on-forward to Brook and John.
Best regards
Mike

From: Rob Fyfe s9(2)(a)
Sent: Thursday, 4 June 2020 2:08 pm
To: Mike Bush [DPMC] <Mike.Bush@dpmc.govt.nz>; CAMERON, Rebekah s9(2)(a)
Cc: Leon Grice s9(2)(a)
Subject: Contact Tracing Strategy

Hi Mike, Bex

This is the clean version of the contact tracing strategy. My thinking is that the most appropriate way to present it to John Ombler and Brook is for it to arrive via you Mike so that I ensure I am staying within the 'guide-rails' if I then refer to it in a conversation with Grant Robertson (if that opportunity arises).

Does that make sense to you Mike ... I haven't implied it has your endorsement but more signalling that I am attached to you in the context of my role.

Brian Roche has reviewed the paper and is happy with it as well.

Thanks ... R

Rob Fyfe
The People Shop *26 Minnehaha Avenue, Takapuna, Auckland 0622, New Zealand*
s9(2)(a)

To: John Ombler, All of Government COVID-19 Response
Brook Barrington, CEO, Department of Prime Minister and Cabinet

Via: Mike Bush, OCC lead, DPMC

Cc: Brian Roche

From: Rob Fyfe
Sam Morgan

Date: 3 June 2020

After Wave 1.0: How to stay out of Lockdown in a COVID19 world

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Background

SARS-CoV-2 was first identified in Wuhan, China in November 2019 and has now become a global pandemic.

Once the virus arrived in New Zealand, our public health system and measures were insufficient to slow the spread of the virus and our case numbers. By mid-March, our confirmed cases were growing on a similar trajectory to the early stages of the outbreak in Italy.

On March 23rd New Zealand had closed our borders to all but returning New Zealanders and entered Level 4 lockdown, effective quarantining approximately 5 million false positives in an effort to reduce the base reproduction rate of the virus below one and setting us on a path to elimination.

We are now approaching 2 weeks with no new reported cases but, as the Prime Minister has stated publicly, notwithstanding our achievements here in New Zealand, we should not lose sight of the fact that we remain in the midst of a global pandemic.

While there is hope that a vaccine may be discovered, initial estimates of 18 months are now being viewed as overly optimistic by many commentators. To be prudent, we should plan for living with SARS-CoV-2 for the foreseeable future, if not permanently, and establish our health, social and economic settings accordingly.

Planning for Living with SARS-CoV-2

The social and economic sacrifices that New Zealanders made during Level 4 lockdown have given us much needed time to bolster our public health system in preparation for future waves of SARS-CoV-2 with: increased national reserve stocks of PPE, increased ICU bed capacity, increased testing capability, enhanced contact tracing capabilities and enhanced quarantine, self-isolation, social distancing and personal hygiene protocols.

Our understanding of the virus continues to evolve and we continue to see significant variation in reported data from country to country. Based on data accumulated by the CDC in the USA, up until April 29,2020, (https://www.cdc.gov/coronavirus/2019-ncov/hcp/planning-scenarios.html) the CDC estimate the characteristics of the virus to be;

Basic reproduction number (Ro)	2.5
Symptomatic case fatality ratio	0.004
Symptomatic case fatality ratio (age 0-49 years)	0.0005
Symptomatic case fatality ratio (age 65+ years)	0.013
Percentage of infections that are asymptomatic	35%
Mean time for symptom onset	6 days
Percentage of transmission occurring prior to symptom onset	40%
Infectiousness of asymptomatic individuals relative to symptomatic individuals (assumed by the CDC)	100%

Future waves of infection continue to present material health risks for New Zealanders due to the combination of:

- the infectiousness of this disease,
- the high proportion of asymptomatic and mildly symptomatic infections,
- the high proportion of transmission occurring before symptom onset,
- the delays in New Zealanders presenting for testing and receiving their test results, and
- our contact tracing capability which is still not fit for purpose in tackling SARS-CoV-2

These characteristics make it especially difficult for traditional test, manual contact trace and quarantine responses to keep pace with the speed at which this virus spreads under normal social settings.

In the event we relax our social distancing and gathering restrictions currently in force at Level 2 and allow increased non-quarantine travel across our borders, it is unlikely that the improvements we have made in our test, trace and quarantine capability will be sufficient to avoid New Zealand being forced back into some level of lockdown to halt the spread of future waves of the virus.

The current elapsed time of between 12-14 days for 44% of first generation contacts of an originating case to be traced (despite very low case numbers) is largely ineffective and allows for up to 4 generations of infection to occur. With an average of 30 contacts to be traced for each contact at each generation this generates 27,000 potential contacts to be traced from the one originating case.

To successfully defend against the threat of future waves of infection we must significantly accelerate the elapsed time to trace 80% of first and second generation contacts to within 7-8 days from the time of infection of the originating case.

Our Strategic Options

Whilst the Government has committed to, and is on track to achieve, a strategy of elimination[1] of SARS-CoV-2, the Government has not yet communicated how it will sustain a strategy of elimination under normalised social settings and, at some point, reduced border restrictions.

[1] A report from Australia's leading research universities ("The Group of Eight") produced a preliminary definition of elimination: "In practice this would mean no new SARS-CoV-2 cases linked to community transmission or unknown sources of infection over two incubation periods since the time of the last known community acquired case, provided a highly sensitive early detection, case and contact tracing and management surveillance system is in place".

The experience in New Zealand and internationally has shown that population-level quarantining is highly effective in suppressing the spread of the virus, but this is not a viable medium or long term strategy. The social license the Government currently enjoys will dissipate rapidly in the face of increased social, economic and secondary health hardship from repeated ,lockdowns.

The New Zealand economy, and our sense of place in the world, is highly dependent on being globally connected. Pressure is growing to allow people to move more freely across our borders, but reducing border restrictions increases the risk that we will reintroduce the virus to New Zealand. Once border restrictions are reduced we consider it almost certain that SARS-CoV-2 will re-enter New Zealand before a vaccine is deployed, given the disease is globally endemic. It is a matter of informed and prudent risk management to plan for the probability of these future outbreaks.

It is essential that a coherent, aligned and responsive strategy, supported by quality, real time information is in place to eliminate any future outbreaks as soon as they emerge. New Zealanders and New Zealand businesses need clarity of this strategy so they in turn can align their plans with the national strategy for eliminating future waves of SARS-CoV-2.

There are three strategic options available to us. Not choosing an option inevitably leads to choosing option 1 or 2:

Option 1

Keep the border closed and persist with a strategy of elimination	The border remains effectively closed, with 14 day government quarantine on arrival mandatory. "Travel bubbles" may be enabled in time, but only with countries that have also achieved elimination. Under a closed border, reinfections should be infrequent, but will occur occasionally, and should we detect cases of community transmission we would again move to Level 4 and quarantine 5 million people. It is expected that, under this strategy, Level 4 lockdowns are inevitable, perhaps once or twice per year. It is expected that the Government will lose the social license to impose Level 4 lockdowns after two or three more of them as the economic and social cost is extreme. Under this scenario, the economic cost of an effectively closed border is severe.

Option 2

Open the border and accept a strategy of suppression	Suppression does not aim for zero cases but rather oscillates between different levels of social distancing and permitted gatherings and business activities on an ongoing basis. Under suppression, our threshold for moving into Level 4 lockdowns would be much higher than under an elimination strategy.

	This strategy could allow the border restrictions to be relaxed enabling some commerce, trade and leisure travel to and from New Zealand. Demand for travel would be dramatically less than prior levels. We would attempt to minimise any importation of SARS-CoV-2 with rapid testing of passengers pre-embarkation and so forth. Such tests, as yet, are only partially effective. We would see some level of continual infections (and elevated fatalities when compared to the elimination option) but our goal would be to keep the case load below the level at which it might overwhelm our health system. The economic and social cost of this approach, while less than option 1, is still very significant as the population is unable to go about their social and economic lives with confidence.

Option 3

Open the border while maintaining a strategy of elimination	This approach would require that we commit to significantly upgrading our capabilities to respond to outbreaks. Even with the best possible early detection and rapid trace and isolate system of 2 days from symptom onset (for 80% of contacts traced) we would still need selective use of recursive contact tracing (the isolation of the close contacts of close contacts) given the incidence of pre-symptomatic transmission. This option requires a broadened social license, more rules, a higher level of social compliance and enforcement, enabled by education and policies to support early presentation for testing, expanded access to testing, accelerated processing of tests and accelerated contact tracing enabled by digital technologies, Option 3 would require a significantly increased investment into our strategy of test, trace and isolate.

Our belief is that neither option 1 or 2 are viable strategic options for New Zealand – we must prepare for further infections and significantly upgrade our capabilities. Repeated, lockdowns and long term closure of our borders under option 1 will debilitate the health of our nation on every level and the guaranteed increase in fatalities under option 2 offers no equivalent guarantee of improved economic or social outcomes.

We conclude that New Zealand has rightly chosen to be one of the first countries in the world to pursue an elimination strategy. But if we are to sustain this strategy for the long term, while staying out of lockdown and enabling our borders to reopen to some degree, it is essential we invest now in the early detection, rapid response and effective quarantine system to support this strategy.

Designing an effective system for early detection and rapid response

We do not presently have the capability to open our borders, without an inevitable return to a Level 4 lockdown. The strategy of test, trace, isolate is correct, but our tools are too slow to keep up with the spread of the virus, which will inevitably lead to borders being closed once more and a Level 4 lockdown being reimposed.

One of the challenges presented by SARS-CoV-2 is the high incidence of pre-symptomatic transmission and those with mild symptoms which makes it difficult to slow the spread under normal social settings. In essence we are already racing to catch-up once symptoms appear.

We must have much greater ambition in designing our early detection and rapid response system to effectively eliminate limited outbreaks of SARS-CoV-2. This is much more than a public health initiative – it is a 'freedom' strategy to enable a confident and open society, which is able to interact with the rest of the world whilst sustaining an elimination strategy.

Key elements of an effective system are as follows:

- We propose that the primary performance target should be 80% of first generation contacts traced within 2 days of symptoms appearing (vs 44% of contacts being traced within 9 days currently). There are three key enabling workstreams that support this goal;
    - Education and access to testing
    - Speed of test processing and returning test results
      Instantly advising probable close contacts and, where appropriate, second order close contacts to self-isolate

- Our contact tracing systems, teams, and processes are manual, centred in the regions and are designed for localised outbreaks of notifiable diseases - measles, rheumatic fever, acute gastroenteritis or food poisoning and are difficult to scale above low numbers of cases. It is essential that the contact tracing system is coordinated at a national level using consistent tools, data, performance targets and flexible staffing that can be mobilised against a cluster anywhere in the country.

- It is essential that all close contacts are quarantined and that the quarantine is effective and enforced, with minimal disincentives such as negative impacts on one's employment situation or remuneration in the longer term.

- With accurate contact tracing and better understanding of the virus lifecycle, it is likely that the duration of quarantine/self-isolation will be able to be reduced.

We don't believe that health, economic and social outcomes need to be trade-offs. Rather, an elimination strategy, supported by a 'fit for purpose' system to enable early detection and rapid response, coupled with an effective quarantine system, can allow our society and economy to function relatively normally while protecting public health.

Upgrading our technology tools

We have significant scope to improve the performance of our current contact tracing and isolation systems. However, we will need to invest in key enabling technologies to achieve the ultimate performance targets and to stay out of Level 4 lockdown, while opening our borders, reducing social distancing and increasing the freedom of people to congregate;

Specific tools to deploy include:

1. An SMS-based Daily Health Check-in which encourages people to get tested at the earliest possible appearance of symptoms and provides valuable insights into population and postcode level symptomicity.

2. Improved access to testing and accelerated test processing (both serological or PCR)

3. Population scale surveillance testing

4. Digital contact proximity technology deployed and adopted on a population wide basis, to be used especially in places where people congregate

5. Effective enforcement of quarantine/self-isolation.

There has been much talk about Bluetooth technologies. Done well, such tools can accelerate contract tracing, allowing instant messaging of close contacts of a positive case and early quarantine. Our trial of the Bluetooth card is already showing that the Bluetooth technologies are identifying a significant number of close contacts not recalled during traditional interviews. Timely isolation of second-order close contacts, if required, is only possible in a timely manner with such technology.

There is some risk of identifying false positive contacts when using Bluetooth proximity devices. Given we were prepared to quarantine 5 million false positive New Zealanders at home during Level 4 lockdown for 5 weeks, the risk of quarantining a modest number of false positive close contacts using Bluetooth proximity technologies for up to 48 hours (until phone interviews remove them from the close contact set) appears to be an acceptable inefficiency given the significant benefit these technologies provide.

A dedicated wearable device for contact tracing, together with clear instructions on when such a device must be worn, is considered the only option to detect the necessary proportion of risky close contacts. We have seen plenty of evidence now that a smartphone based approach will not achieve the necessary level of adoption.

A dedicated wearable, such as the CovidCard, cannot be deployed fast enough in response to an outbreak - it would need to be deployed to the population in advance of an outbreak, perhaps in conjunction with the opening up of the border which will be a time of heightened risk.

The basis on which you would deploy CovidCard would be that we want an open border, that SARS-CoV-2 is likely to be with us for a few years and that there is no vaccine imminent. What may seem a far-out idea in the current period where the general population consider the virus vanquished will be something obviously needed once we are on our second, third or fourth Level 4 lockdown.

Recommendations

Creating the operational capabilities to enable early detection and rapid response for SARS-CoV-2 is the highest value infrastructure investment that New Zealand can make over the next 6 months if we are to thrive in a world where SARS-CoV-2 is globally endemic.

Yet with every day of zero new cases, the sense of urgency and ambition across Government dissipates, as does any sense of crisis amongst the population at large. We remain just as vulnerable as we were before the first wave and we expect subsequent waves to arrive with little notice.

Many countries that thought they had SARS-CoV-2 under control, and relaxed their defences, only to see the virus re-emerge. The evidence suggests that winter is a higher risk period and past pandemics have been characterised by multiple waves over multiple years.

In our view, neither the Ministry of Health, nor the 20 DHB's can alone develop the necessary early detection, rapid response and effective quarantine system to respond to future outbreaks and prevent Level 4 lockdowns. The issues we face over the period until we have a vaccine go well beyond the somewhat narrow issue of health.

We recommend a modification to the approach adopted to date with an appropriate agency assigned, and funded, with accountability for designing and operationalising the early detection, rapid response and effective quarantine system that will support a credible strategy of elimination, while enabling people to move freely and in a safe way within New Zealand and across our borders.

This system will be a key enabler of a well-functioning, connected community and economy in a world that will likely see New Zealanders living with SARS-CoV-2, for a number of years yet.

From: Mike Bush [DPMC] <Mike.Bush@dpmc.govt.nz>
Sent: Thursday, 28 May 2020 7:07 PM
To: Rob Fyfe; Brian Roche
Cc: Sam Morgan
Subject: RE: Strategic rational for enhancing our COVID19 early detection and rapid response system [UNCLASSIFIED]

Hi Rob
I am in support of the paper, particularly the summary under "Recommendations"

For your information I have again pushed for a "technology" work stream under the sponsorship of Paul James, with coordination provided from the OCC. Ashley however believes current arrangements suffice.
I will meet with Paul in the next few days as I understand he supports our proposal.

Best regards and our thanks to you and Sam for the work.

Mike

Sent with BlackBerry Work
(www.blackberry.com)

From: Rob Fyfe s9(2)(a)
Date: Thursday, 28 May 2020, 3:41 PM
To: Brian Roche s9(2)(a)
Cc: Sam Morgan s9(2)(a) Mike Bush [DPMC] <Mike.Bush@dpmc.govt.nz>
Subject: Re: Strategic rational for enhancing our COVID19 early detection and rapid response system

Hi Brian,

If we can get your feedback in the next day or so plus some input Sam will have from the clinical/epidemiological team, we can then finalise the paper and use it as a basis for engagement with Julia earlier next week.

We are starting to see countries set their timelines for opening up their borders to non-citizens and for quarantine free passage from 'green' (low risk) countries. This will see pressure emerge here in New Zealand to relax our borders settings ... which presents unique challenges for New Zealand if we have achieved elimination.

Inevitably we will have active cases come across the border and our ability to detect these cases and have highly effective contact tracing and quarantine will be essential if we are to sustain our elimination strategy.

So there is some real urgency in getting alignment on this strategy .... given the implementation timeline For a Covid card type technology is realistically shaping up as a 4-5 month timeline.

R

Sent from my iPad

On 28/05/2020, at 10:57, Brian Roche s9(2)(a) wrote:

Thanks Rob

I'll have a read if it and get back to you.

I spoke to Julia yesterday and she's up for a meeting with s at some stage to suit.

Cheers

Brian

Sent from my iPhone

On 27/05/2020, at 3:56 PM, Rob Fyfe s9(2)(a) wrote:

Hi Brian, Mike

This is the latest state of a paper that Sam and I have been crafting which lays out the strategic rationale for why a significantly enhance early detection, rapid contract tracing and effective quarantine system is essential to New Zealand's elimination strategy.

The idea is that once we've got this nailed we would send it to John Ombler and Brook with the endorsement of both of you and then, if supported by them, flow it through to Grant and Jacinda.

Appreciate any thoughts on both the paper and the process we're proposing.

R

Rob Fyfe

The People Shop *26 Minnehaha Avenue, Takapuna, Auckland 0622, New Zealand*
s9(2)(a)

From: John Walsh <John.Walsh@mpi.govt.nz>
Sent: Wednesday, 13 May 2020 9:35 PM
To: Rob Fyfe
Cc: Mike Bush [DPMC]; BOYLE, Brendan
Subject: RE: Many thanks

Thanks Rob. I will get my team to do an update for them first thing in the morning and share back through you

Cheers

John

From: Rob Fyfe s9(2)(a)
Sent: Wednesday, 13 May 2020 5:16 PM
To: John Walsh <John.Walsh@mpi.govt.nz>
Cc: Mike Bush [DPMC] <Mike.Bush@dpmc.govt.nz>; BOYLE, Brendan <Brendan.Boyle@police.govt.nz>
Subject: FW: Many thanks

Hi John,

Just following up from the EMA forum I participated in – almost 900 attended.

The EMA gave a presentation before I spoke – Slide 3 talks to the requirements for contract tracing dependent on whether you are operating at 1 or 2 meter separation … they have been running multiple of these forums over the last couple of days sharing this message.

R

Rob Fyfe

The People Shop *26 Minnehaha Avenue, Takapuna, Auckland 0622, New Zealand*
s9(2)(a)
