Rapid Audit of Contact Tracing for Covid-19 in New Zealand

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Executive summary

Rapid case detection and contact tracing, combined with other basic public health measures, has over 90% efficacy against COVID-19 at the population level, making it as effective as many vaccines. This intervention is central to COVID-19 elimination in New Zealand.

New Zealand needs to anticipate a 'new normal' of local transmission and small clusters without alert level four restrictions, with the potential for one or more very large outbreaks over the next two years. Examples, such as the church outbreak in Korea, which reached over 4000 cases in just over two weeks, show how COVID-19 outbreaks can expand very quickly. However even large outbreaks can be brought under control without lockdowns if the public health response is ready and adequate.

The capacity of the 12 Public Health Units (PHUs) in New Zealand is the primary factor limiting New Zealand's ability to scale up its case management and contact tracing response to Covid-19. In March the workload of PHUs exceeded their capacity to conduct rapid contact tracing on occasion, even though case numbers were less than 100 per day. Expansion of the Public Health Unit workforce is an urgent need.

The 'National close contact service' (NCCS) hub has been operational since 24 March. The NCCS was established in the Ministry of Health, together with a technology solution (NCTS), to perform contact tracing at times of high demand for PHUs. It is a scalable initiative underpinned by high quality technology. It is currently used by PHUs in a narrow set of circumstances. With better triage of referrals and protocols this could be expanded further. There are also difficulties in finding contacts that need to continue to be addressed. The NCCS is an impressive service especially considering it has been established in just weeks. However it is not a suitable nor desirable system for managing all contacts. The NCCS also has limited use in certain important situations, such as in the event of a large complex cluster or specific scenarios that require intense involvement of Medical Officers of Health.

At the present time the only centrally visible performance indicators relate to the completion of tracing for contacts referred to the NCCS. However this does not capture the upstream events that impact the timeliness of contact tracing, like case referral processes and testing times. Nor does it capture contact tracing activity in PHUs. Measuring performance indicators to drive improvement is an urgent priority. This report proposes a set of indicators for this purpose.

At the time of writing the Ministry of Health and local developers are building a smartphone app to assist with contact tracing. As it is not yet completed and a number of key aspects are under consideration, it cannot be meaningfully evaluated. Near instantaneous notification of contacts following case diagnosis is promising from a public health perspective, but other elements of the process of case assessment, testing and notification will still need to be optimised. High levels of uptake will also be required to achieve impact.

Recommendations

1. The Ministry of Health should expand the capacity of Public Health Units (PHUs) to isolate Covid-19 cases and trace their contacts three to four fold for as long as Covid-19 remains a public health threat. Some of this additional capacity should include contact tracing teams that can move from one PHU to another according to need.

2. The Ministry of Health should develop a Covid-19 outbreak preparedness plan that includes how to rapidly scale case identification and contact tracing and regain control. The plan should specify the task-shifting arrangements between PHUs and NCCS and any additional resource required to deal with up to 1000 cases per day while maintaining high performance.

3. The Ministry of Health should develop a system that monitors the case-isolation and contact tracing process from end-to-end in the NCCS and PHUs. Recommended key performance indicators are listed in the appendix. Of these 17 indicators, 3 are critical, 3 are urgent, 10 are high priority and 1 is moderate priority. Ability to measure these indicators in real-time should be proven.

4. The NCCS and its providers must ensure close contacts in home quarantine are contacted every day to monitor for adherence to isolation and to assess for the development of symptoms.

5. The NCCS and Medical Officers of Health should collaborate to better define referral protocols and triage systems, especially with respect to more complex or high-risk contacts.

6. The Ministry of Health should give PHUs access to the NCTS in order to retain visibility of contacts traced by the NCCS.

7. The Ministry of Health should engage with PHUs to determine if the NCTS could be suitable, with modification, as a single national contact information system.

8. The Ministry of Health should rapidly complete development of a smartphone app to assist contact tracing and pilot it in New Zealand. Evaluation of the app should include assessing the proportion of contacts identified by the app who develop covid-19, as well as other relevant parameters in the appendix.

Introduction

On 9 April 2020 I met with Ministry of Health Officials and National Close Contact Service workers and interviewed Medical Officers of Health by telephone. This report summarises my findings and makes recommendations for improvements to contact tracing to control Covid-19 in New Zealand.

Contact tracing and Covid-19

Contact tracing is the identification and isolation of people who have been exposed to an infectious case, to prevent onwards transmission from the contact to others. The contact tracing system is the final part of a process that begins with someone who is ill with Covid-19, called an index case. The index case becomes ill and infectious, is assessed and tested, isolated and if they test positive their close contacts are traced and quarantined. The contacts of probable cases are also traced and quarantined. Contact tracing is a key preentive measure for covid-19 and is recommended by the World Health Organization (1).

Ideally, contact tracing promotes good clinical management of the contact who is at risk of developing Covid-19 and who might need testing and medical care, as well preventing further disease transmission. Contact tracing is a well-established public health process that is routinely performed in public health units (PHUs) in New Zealand. In practice PHUs are often simultaneously managing index cases and their contacts in an integrated way, as they will usually share households, workplaces or social networks.

This case-identification and contact tracing system has been a key component of successful control of Covid-19 in countries like Singapore, where contact tracing led to detection of more than half of Covid-19 patients (2). Transmission models show Covid-19 outbreaks could be controlled through this system provided tracing is fast enough (3). Indeed, rapid case contact management, when used with other basic public health measures, has over 90% efficacy against Covid-19 disease at a population level (4), which makes it as effective as any vaccine that might be developed.

Specific characteristics of Covid-19 make contact tracing more effective than for influenza. Firstly the time from a person being exposed to Covid-19 to developing illness is longer (5-6 days) meaning there is time for contact tracing to occur. Secondly, it appears easier to identify Covid-19 cases who transmit the infection, as unlike influenza, there is as yet no evidence that asymptomatic cases transmit the disease (5). This means contact tracing is a important activity to achieve elimination or 'stamp out' covid-19 when case numbers are low. It also means contact tracing and other public health measures can control outbreaks, as has been demonstrated in China(6) and South Korea. This ability to reverse outbreaks through public health measures is has led the World Health Organization Director General to characterise plans to abandon or relax public health measures in the face of an outbreak as "wrong and dangerous" (7). In other words our contact tracing system needs to be suitable for moderate case numbers or clusters as well as outbreaks.

Description of the current system

New Zealand's communicable disease control system is highly devolved with 12 Public Health Units (PHUs) taking responsibility for case and contact management as well as the monitoring and evaluation of this work. PHUs are staffed by public health nurses, health

protection officers and Medical Officers of Health who are public health medicine specialists experienced in communicable diseases control. Their routine work includes contact tracing for illnesses like tuberculosis, and during outbreaks of diseases like measles and mumps. The type of information system used for outbreaks varies across different PHUs and ranges from basic excel templates through to purpose-built clinical systems. In February and early March 2020, PHU staff were involved in aspects of border control as well as case management and contact tracing to control Covid-19. Many cases were returned travellers who had taken domestic flights, meaning the contact tracing workload was extremely high. As case numbers rose in March it became apparent that the workload would exceed the capacity of many PHUs.

A hub, called the 'National Close Contact Service' (NCCS) was established in the Ministry of Health to coordinate centralised contact tracing. In this new model PHUs continue to receive notifications of new confirmed or probable cases from laboratories and clinicians. PHUs experiencing heavy workloads can choose to divert parts of the workflow to the NCCS. PHUs inform the case of their result, arrange their home-isolation and identify close contacts. Close contacts who live with the index case are managed by the PHU. Other contacts can be transferred to the NCCS for tracing. These lists of close contacts, which take various forms, are forwarded to the NCCS either via entry into REDCap (an existing web-based database used by some Public Health Units), secure file transfer, or email. The NCCS has developed a 'finding service' that seeks contact information from various health and other government datasets. NCCS staff call close contacts and advise they are contacts of a Covid-19 case and obtain the contacts' agreement to quarantine (commonly called self isolation).

The NCCS started operations using manual processes on 24 March 2020. A national contact tracing technology solution (NCTS) was developed, piloted on the 27 March and used to process all calls from 6 April. This cloud-based platform repurposes case management software designed for the National Screening Unit, called the National Screening Solution. The platform stores case and contact details linked by exposure events, and supports contact management. It provides links to existing health information sources, primarily for sourcing contact details and the unique identifier from the National Health Index. Training in use of the new system for the contact tracing process was completed for all 200 NCCS users on 6 April.

The NCCS call centre is staffed by workers from a variety of professional backgrounds trained in the use of standardised scripts to guide their conversations. The call centre staff provide the close contact with self isolation advice and complete a health and welfare check. Clinical supervision is available on site by experienced Registered Nurses who can also escalate clinical questions to Public Health Medicine Physicians in the Ministry of Health. Contacts with more complex health questions are advised to contact their primary care provider for advice. Telephone translation services are also available. Following a call from the NCCS the person's information is referred to Healthline for follow up calls, on day seven and day 14 of the isolation period. Healthline checks on the people self-isolation and their health and wellbeing. They will place additional calls if there are reasons for concern. This differs from the standard practice in PHUs, which is daily calls or sometimes text

messages in order to ensure both adherence to quarantine or the early testing and confirmation of Covid-19 in the contact.

Initially, the timeliness of the process was poor. For, example between 2 and 8 April the average time from referral to instructing a contact to isolate was 2.3 days. However this likely reflected the staff training and software changes that were occurring at the time. At the time of my audit the main remaining quality concern was that only 60% of contacts could be easily reached by phone, either because of incorrect contact details or because people choose not to answer calls from an unidentified number. Linkages between the National Health Index and other health datasets were being established to address the first problem. Planned improvements include changes to have outbound calls show a local number as the caller, rather than the current mix of four digit numbers. If the person attempts to return the missed call an explanatory text message will be sent, and by the end of April, missed outbound calls will soon be followed by a text message.

The Medical Officers of Health I interviewed were broadly supportive of the concept of a 'hub' and agreed the NCCS could be an important part of measures to deal with the intense workload they faced in the last half of March. However, they were cautious about diverting contact tracing to the NCCS in many situations, because once they did they lost visibility of the outcome for the contact. The types of situations where that were felt to be best managed at the PHU level included:

- contacts who themselves have lots of contacts (currently these are mostly essential workers), because if the contact developed Covid-19 a new larger contact investigation could be required.
- medically complex people including rest-home residents who cannot not be adequately assessed by a call centre.
- transmission in institutional settings such as aged residential care or schools requires a high level of stakeholder engagement by a local public health official who is across all aspects of the situation.

For a greater proportion of contact tracing to be diverted to the NCCS, Medical Officers of Health would need to have access to the NCTS to be confident that the contact is traced in a timely way. This is particularly important for cluster management as otherwise second or third generation spread can be missed. Clusters that spread across multiple PHUs would also be visible. PHUs would also need to be confident that the frequency of follow up was appropriate for higher risk contacts. These areas need to be discussed further between PHUs and NCCS and appropriate triage processes and protocols refined. The underlying technology (NCTS) will also enable delegation of a case to the NCCS but this process will need to be very carefully defined, as cases need clinical care and are the highest risk group with respect to transmission.

At the time of my audit the NCCS was working to establish clinical governance structure and an equity plan.

System capacity and ability to scale

PHUs are indispensable for the public health response to Covid-19. As described above, only portions of their workload can be safely transferred to the NCCS even with better protocols guiding this process. When New Zealand moved to alert level 4 on 25 March, many PHUs were at or beyond their capacity to manage cases and contacts, even with increasing support from the newly established NCCS. During that week, nationwide daily case numbers ranged from 70-86. Some PHUs have since expanded their contact tracing workforce on a temporary basis – drawing on staff normally involved in vaccination and school programmes – but this is unlikely to be sustainable once routine public health work recommences when the level 4 alert is lifted. Even these temporary increases are insufficient for the likely future workload. The capacity of PHUs is the primary factor limiting New Zealand's ability to scale up its case management and contact tracing response to Covid-19.

The NCCS model and its underlying technology is designed for scaling up and has had some experience of moderately high volumes. On 1 April, 701 contacts were traced by the NCCS. A suitable flexible workforce is being sought for the coming months. This service will be an important component of a scalable system that can be accessed by PHUs on an as-and-when needed basis.

Even if the public health response to Covid-19 is improved through better surveillance and quarantine of returned travelers, the risk of further transmission remains, especially when level 4 restrictions are lifted. It is highly likely that there will be multiple instances of community transmission needing case management and contact tracing at intervals and across the country for the next year and beyond. To avoid regular nationwide returns to level 4 restrictions, PHU capacity must be increased. PHUs need the capacity to confidently manage cases and clusters through a combination of case isolation, contact tracing and potentially targeted restrictions on movement. If cases can be quickly identified and isolated and contacts quickly notified and quarantined then we have the potential to slow or stop transmission without widespread social disruption.

There is also a threat of a large outbreak, as experienced in many other countries even those with strong public health systems. For example, the Shincheonji church outbreak in Korea in late February/early March rose to over 4482 cases in less than 3 weeks (8). Such situations pose a challenge for planning because exponentially increasing demand will need to be met in a short period of time. Case isolation and contact tracing remain effective against Covid-19 even during large outbreaks. Therefore as a matter of preparedness there must be a plan to rapidly scale PHU and NCCS capacity to manage up to 1000 new cases a day if needed, while maintaining the essential performance quality to minimise the chances of transmission beyond identified case contacts.

Smart phone contact tracing technology

The primary way in which smartphone technology could support contact tracing is through Bluetooth detection of close contact between people's smartphones and, if one is later found to be a case, instantaneously notifying contacts of their exposure and the need to self-isolate. There is also the potential to use QR-codes to 'check in' to high traffic settings like

public transport or cafes. This latter function has received less attention but seems particularly important as many clusters appear to arise from transmission in closed crowded environments (9,10).

Together, these features could identify contacts that would be missed by manual methods due to poor recall or anonymous contacts in a crowded venue. The time from case diagnosis to contact isolation could also be reduced. At the time of writing the Ministry of Health and local developers are building a smartphone app to assist with contact tracing. As it is not yet completed and a number of key aspects are under consideration, it cannot be meaningfully evaluated as part of this audit.

However, it is possible to comment on some aspects of the public health impact of whatever product is developed. First, it needs to be available quickly, piloted and continuously improved. Second, potential impact will not be realised unless it is acceptable to a large proportion of the population and enjoys high uptake. Less than a fifth of the Singaporean population downloaded the tracetogether app in ten days, which, assuming random mixing, means only 1 in 25 exposures will be captured by the app and public health impact will be negligible. Third, an app will also only produce incremental improvement in the time to isolate contacts as many other steps are involved and need to be managed, as described below. Fourth, an app cannot replace the option to interact with a real person as many contacts will develop illness, have welfare needs, or face issues with accessibility.

The monitoring and evaluation for a contact tracing app needs to consider the same parameters as the system as a whole, detailed below. In particular, the proportion of contacts identified by the app who develop illness should be closely followed, in case the app identifies too many low risk people and adjustments are necessary.

Reporting requirements

An effective high-quality contact tracing system for Covid-19 will have the following characteristics:
- Scalable – able to respond to exponential growth in case numbers
- Fast – contacts should be placed in isolation quickly.
- Effective – contacts will adhere to the self-isolation direction and onwards transmission from contacts will be rare
- Equitable – high performance across age and ethnicity
- Acceptable – to contacts and PHUs

A monitoring system is required to ensure the contact tracing system achieves these characteristics, and if not corrective action is taken quickly (2). A strength of the NCTS is that it allows tracking of the timeliness and completeness of contact finding and tracing (from the time of referral to the NCCS). However, the crucial measurement for contact tracing success is the time from case symptom onset to contact isolation. Data on this measurement was not available during my audit because the current monitoring system will not provide visibility of the upstream events relating to case management. The time taken to be assessed clinically, tested and notified of results should be considered components of

a single system, and measured and managed accordingly. This will require information systems that make some clinical, laboratory and PHU processes visible at a single point within the Ministry of Health. Contacts traced through PHUs, with their various different contact information management systems, will also need to be captured.

The NCTS links case and contact data and has excellent reporting functions. Extending use of the NCTS to PHUs, with appropriate support for implementation and adjustments, would offer a high quality data system for improving performance.

A proposed set of reporting requirements is included as an appendix to this report. The target specified for time from index case symptom onset to isolation is based on two recent modeling reports (3,11). This is likely to need to be revised as more becomes known about the incubation period and by investigating instances of transmission from close contacts to third persons that occur in New Zealand.

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Appendix. Recommended reporting system for Covid-19 contact tracing

Reporting requirement	Proposed performance indicator	Interpretation	Remedial action if target not met	Priority
System capacity – number of cases able to have contact tracing completed/ day, overall and by PHU	To scale up to 1000 cases and their contacts within 5 days	This relates to the threshold at which physical distancing measures are introduced/reduced.	Expansion of PHU and NCCS capacity.	Critical
Proportion of contacts quarantined within 4 days of symptom onset of index case (*or exposure to index case*)	>80%	Too slow means onwards transmission will have already occurred.	Improve time from case symptom onset to sampling, sampling to PHU notification of result and time from contact isolation to isolation.	Critical
Time from case symptoms onset to test, stratified by ethnicity	<2 days in 80%	Late detection delays case isolation and potentially increases number of contacts	Raise awareness to promote early presentation Adjustment of case definition to emphasise early symptoms	High
Time from sampling of suspected case to test result (*at least PHU notification of positives*)	<24 hours in >80%	Slow turn-around times delay in case isolation and contact tracing.	Adjustment to sample transport or laboratory analysis processes	Urgent
Time from PHU notification of case to contact identification	<24 hours in >80%	Delays case isolation and contact tracing.	Increase PHU capacity, use of smartphone apps, digital or manual 'check in' to venues	High
Time from contact identification to isolation	<24 hours in 80%	Timeliness of contact tracing will prevent onwards transmission	Increase contact tracing capacity at PHU or NCCSor smartphone app. Or explore additional data sources for contact details.	Urgent
Number and distribution of close contacts per case **Characteristics of contacts** *e.g. age, sex, ethnicity, occupation, exposure setting*	No target	This information required under various physical distancing settings to understand system capacity	N/A	High

Reporting requirement	Proposed performance indicator	Interpretation	Remedial action if target not met	Priority
Proportion of suspected cases who should have a test, who have a test done *(per case definition – though still elements of discretion in CD)*	>90%	Low rate means cases won't be detected or isolated.	Increased availability of testing centres. Audit of referral processes	High
Proportion of identified contacts who are traced, stratified by household or other contacts and ethnicity.	>80%	Failure to complete contact tracing increases the likelihood of onwards transmission.	Review systems for interviewing case. Options for use of other govt datasets	Critical
Proportion of contacts with confirmed or suspected covid-19 at time of tracing	<20%	High rates means testing, notification and tracing process are too slow.	Improve time from case symptom onset to sampling, sampling to PHU notification of result and time from contact identificaton to isolation.	Urgent
Proportion of contacts with covid-19 over follow-up	No target but understanding this parameter important as informs whether contact definition is appropriate.	If high definition of close contact maybe too restrictive, if low definition may not be restrictive enough.	To inform definition of close contact.	Moderate
Proportion of contacts adhering to quarantine	>90%	Poor adherence risks onwards transmission from contacts.	Improve advice on quarantine, increase frequency of checks, use quarantining apps.	High
Proportion of contacts of covid-19 positive contacts who become covid-19 positive	<1%	This is a sign of failed contact tracing or isolation.	Improve time from case symptom onset to sampling, sampling to PHU notification of result and time from contact isolation to isolation.	High
Timeliness of reports	In real time	Enables continuous quality improvement.	Assess ability to develop real-time reporting into national contact tracing solution	High
Accuracy of reporting	proof of accuracy required	Poor accuracy on these KPIs impairs decision making especially with respect to social distancing interventions.	Audit	High
Turnaround time for a change to any policy related to case contact management system	< 5 days	Enables continuous quality improvement.		High

Reporting requirement	Proposed performance indicator	Interpretation	Remedial action if target not met	Priority
Acceptability	>80% of PHUs find the practice acceptable >80% of cases and contacts find the practice acceptable			High

Priority: Critical>Urgent>High>Moderate

Abbreviations: PHU: Public health unit; KPI Key performance indicator; N/A: Not applicable.