

New Zealand's COVID-19 Surveillance Plan

19 May 2020

Version 4.1

Executive summary

This document sets out the overall approach to surveillance of COVID-19 in New Zealand, as one of the core pillars of the overall strategy of disease elimination. National COVID-19 surveillance systems operate to provide information about the characteristics of the disease in New Zealand and the effectiveness of the response.

This plan sets out the current aims and objectives, key surveillance activities and areas of ongoing development. As we learn more about the nature of COVID-19 and understand more about our response capabilities, then aspects of the surveillance system will adapt in order to address emerging questions and priorities. The framework of key surveillance questions and the specific information products to address them are summarised below.

In addition to the two broad areas of core infectious disease surveillance covered by the key questions shown here, there is an important area of analysis focussed upon understanding the wider health impacts of the response beyond the direct consequences of COVID-19. Delays in access to health care during lockdown periods will have consequences for the treatment of a range of conditions, and there is great potential for this to exacerbate inequity in health outcome for high risk populations, including Māori and Pacific people. The non COVID-19 health impacts are important but lie beyond the scope of this plan. Analysis of these issues will be a wider responsibility of intelligence and insights teams across the Ministry of Health and the health sector.

Key category areas and questions for COVID-19 surveillance system		Information products
1. Understanding the disease	What are the characteristics of the current disease in Aotearoa?	Case characteristics in person, place and time, inequities, disease severity and risk factors, source and transmission dynamics, molecular epidemiology, patient outcomes in primary and secondary care
	What is the degree of likely undetected disease?	Testing coverage and reasons for testing, cases with unknown source, syndromic surveillance trends, rates and characteristics of cases detected through targeted and sentinel testing, predicting disease trends and transmission dynamics
	Is there an emerging new disease outbreak in the population?	Case source and transmission dynamics, SARI & community sentinel surveillance trends, HealthStat, case detection via novel methods
	What is the level of past infection in the population?	Prevalence of detectable immunoglobulin to SARS-CoV-2
	COVID-19 impacts	Cases, hospitalisations, deaths, comparison to expected levels (hosp and deaths), post-discharge morbidity
2. Are the public health strategies effective and equitable?	Border measures	Numbers, compliance data, cases after quarantine or in those exempt, capacity to manage arrivals
	Case and contact management	Timeliness of case & contact identification & isolation, numbers of contacts per case, number of secondary cases.
	Physical distancing and contact measures	Prevalence of behaviours, aggregated data on human movement (eg traffic patterns, cellphone data)
	Populations and settings at high risk of infection, onward transmission, or poor outcomes	Performance measures of Infection control systems in health care and other high-risk settings, cases of transmission in high risk settings/people. Targeted testing of populations with high risk or consequence of infection.

Evidence and insights from the data-processing stage will be packaged into surveillance products for different audiences. All analyses will be broken down by ethnicity, and NHI-based prioritised ethnicity will be used as the standard for analysis. A number of existing products have been generated during the initial phase of the pandemic, and are now evolving into output that is more suitable for the longer term COVID-19 response:

Output	Status at May 2020
Daily update on cases and testing	Being revised. Expanded version soon available in dashboard form. Case data also available on the ESR dashboard. Moving towards consolidating reporting from multiple different sources.
Ministry of Health updates summarising key descriptive epidemiological information on the pandemic and response.	Have been produced on a manual basis, and require a production system
ESR Weekly intelligence reports	In place
Mandated reporting to international bodies.	In place
Interactive platforms making data available to both internal and external audiences.	ESR dashboard provides interactive access to descriptive case epidemiology, outbreaks, international epidemiology, and national syndromic surveillance trends. This will be further developed to be consolidated in one place, along with products being developed by Data and Digital with the Ministry of Health which will coordinate with ESR. Public facing access to information to be further developed with specialist science communication advice, privacy advice, and in discussion with external stakeholders.
Stand-alone reports on specific topics in greater depth as required.	As needed. Cluster reports and other reports focussed on supporting the response generated by ESR and the Ministry of Health.
Ad hoc information requests	Being responded to by COVID-19 Intelligence

Key roles in implementing this plan are:

The Ministry of Health, which owns this plan and is responsible for Tiriti partnership in the governance of the plan, as part of the overall COVID-19 response. The management of the plan sits with the Health Intelligence Team in the Ministry of Health COVID-19 Response Hub, in consultation with the Office of the Director of Public Health, the Communicable Disease Team, the Population Health and Prevention Directorate, the Māori Insights Team, the Pacific Insights Team, and ESR as a lead provider of surveillance to the Ministry. The Chief Science Advisor, and the management of the Technical Advisory Group and subgroups both sit within the Ministry of Health COVID-19 Response Hub.

The Ministry of Health's COVID-19 Information Governance Group has overall responsibility for the governance of information specifically collected or used as part of the COVID-19 response over and above the routine collection and use of information in the Ministry of Health.

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1 Background

New Zealand's national COVID-19 surveillance systems operate to provide information about the characteristics of the disease in New Zealand, the effectiveness of the response, and on the wider impacts of the epidemic, in order to inform national and local strategic and operational responses. New Zealand is currently pursuing an elimination strategy that aims to eradicate or minimise cases of COVID-19 from New Zealand to a level that is manageable by the health system, until a vaccine becomes available to achieve population-level immunity. Achieving this goal requires a comprehensive surveillance system that collects, collates and analyses data on the disease, the effectiveness of the response, and on the wider impacts of the epidemic.

As Aotearoa New Zealand's response continues and the goal of very low or no transmission within the country is achieved, the surveillance system will continue to monitor cases and transmission dynamics. It will broaden further to include more sensitive and timely measures to indicate the risk of re-emergent disease and assess non-COVID health consequences that need mitigation. Should elimination fail and we move to a mitigation strategy, the surveillance system requirements will have to adapt to a different set of response priorities.

Surveillance has a specific role to play in monitoring the equity of health outcomes for populations with high risk during the COVID-19 epidemic, and in informing effective responses that will avoid inequitable outcomes. Previous pandemic responses have preferentially benefited non-Māori, and failed to protect whānau, hapū, iwi and Māori communities from the worst outcomes. The Crown's obligations under Te Tiriti requires applying the principles of Tino rangatiratanga, Equity, Active protection, Options and Partnership. Surveillance is both a key tool for effecting aspects of these principles, and a check on how effectively they are applied.

High priority populations with elevated risk of harm during the COVID-19 pandemic include:

- Māori
- Pacific peoples in New Zealand, with specific and diverse needs
- older people, especially those over 70 years
- people with long-term conditions
- people with disabilities
- people with mental health conditions
- people living in residential facilities (e.g., aged residential care facilities, hostels, university accommodation or Department of Corrections facilities), and
- refugees and migrant community members.

This plan is a living document that sets out the current aims and objectives, key surveillance activities and areas of ongoing development. As we learn more about the nature of COVID-19 and understand more about our response capabilities, then aspects of the surveillance system will adapt in order to address emerging questions and priorities.

2 Aims and objectives

The COVID-19 surveillance system aims to provide timely, equitable and reliable intelligence (information for action) about key aspect of the disease in New Zealand, the local and national response, and broader impacts, to support strategic and operational decision making and actions. The ultimate goal of this is to optimally promote and protect the health and wellbeing of the people of Aotearoa New Zealand during the global COVID-19 pandemic.

To fulfil this role, the surveillance system must bring together data from a range of sources to produce information which is integrated and tailored to the specific questions which need to be addressed to enable well-informed actions at various stages of pandemic management. In the context of a continuously evolving understanding of SARS-CoV-2, its direct and indirect impacts, and effective mitigation and prevention strategies, the surveillance system will need to continue to evolve to meet changing information needs. The following aims and objectives provide the current framework for surveillance planning to fulfil the national strategic goal of COVID-19 elimination but may necessarily change. The understanding and mitigation of inequitable consequences of COVID-19 cuts across all surveillance aims:

Aim 1: To understand the burden of COVID-19 disease and SARS-CoV-2 infection in the New Zealand population in order to inform the COVID-19 response

Objectives:

- to understand who is at risk of COVID-19 and how infection is spread.
- to identify the impact of COVID-19 on specific population groups
- to detect new disease early
- to assess the degree of undetected infection
- to understand population immunity to SARS-CoV-2

Aim 2: To assess the effectiveness and equity of public health strategies to control the disease in order to inform the COVID-19 response

Objectives:

- to assess the effectiveness and equity of public health measures at the Border
- to assess the effectiveness and equity of case and contact management
- to assess the effectiveness and equity of infection prevention and control measures
- to assess community acceptance and adherence to control measures
- to assess health system capacity to manage COVID-19 and non-COVID-19 health needs

Aim 3: To understand the indirect impacts of COVID-19 and non-COVID-19 health needs

Objective:

- to assess indirect health and broader impacts of COVID-19, and any impact on health equity

Aims One and Two are core infectious disease surveillance functions, with primary responsibility lying with Public Health Intelligence within the Ministry of Health, and ESR as a key partner for infectious disease surveillance and control. Aim Three is a broader question which lies outside core infectious disease surveillance activity and will require health services analysis expertise from a range of perspectives, particularly including Māori, both within and beyond the Ministry of Health. This plan focusses on Aims One and Two, while noting that the non COVID-19 impacts of the response present a risk to equity of health outcomes, particularly for high risk populations including Māori and Pacific people and will be the focus of dedicated work to monitor and respond to inequity in such impacts.

Many sources of information contribute to multiple objectives within the framework of surveillance objectives. For example, risk-based testing for COVID-19 case-finding contributes to understanding the impact of COVID-19 on specific population groups, to managing emerging infection in communities that face the highest risk, and to understanding how effective and equitable New Zealand's elimination strategy has been. This plan is oriented around the surveillance objectives and questions and sets out activity contributing to each of those objectives, acknowledging that in some places this duplicates reference to key surveillance activity.

In order to meet these surveillance objectives, data will be analysed by ethnicity wherever feasible. Ethnicity information derived from the National Health Index will allow analysis by prioritised ethnicity, in accordance with best practice in presenting ethnicity information in Aotearoa.

3. Aim one: understanding the disease

Objectives:

- to understand who is at risk of COVID-19 and how infection is spread
- to identify the impact of COVID-19 on specific populations
- to detect new disease early
- to assess the degree of undetected infection
- to understand population immunity to SARS-CoV-2

3.1 What do we need to know

Enhanced surveillance measures will vary over the course of the COVID-19 pandemic, as New Zealand moves from a period of active case finding to rule out significant undetected disease into a period of ongoing surveillance to ensure rapid detection of emerging disease transmission in the population. This will still include testing for undetected disease in some groups, particularly those at higher risk and with lower health care access for symptomatic testing.

Throughout the response, reporting of the characteristics of COVID-19 in Aotearoa New Zealand will continue to be a fundamental part of the surveillance system. This will include reporting of case notification data, including demographics (age, sex, ethnicity, and area level deprivation), geographic location and source of disease. Source of disease will be reported not only in terms of epidemiological linkage but also in terms of reason for testing, in order to evaluate the effectiveness of surveillance methods. It is important to distinguish between people who are tested in CBACs and primary care because they have symptoms meeting the case definition, those who are asymptomatic but tested because they are contacts, those who are tested as part of hospitalized SARI testing, and those tested as part of risk based asymptomatic community testing without contact history.

The ongoing COVID-19 testing strategy is a key underpinning for future surveillance. As New Zealand moves into a phase of low COVID-19 prevalence randomised asymptomatic testing will have limited utility, with a low chance of finding undetected disease. The testing approach towards case finding will be risk based rather than random, with a focus on escalating levels of testing in high risk populations in response to flags, such as the discovery of a new case with unknown source of infection. Risk factors considered in targeting such testing will consider: populations with increased risk of infection; populations with more severe consequences of infection; and populations with poorer access to health care where there is a risk of under surveillance from symptomatic testing. This approach will leverage off existing syndromic surveillance, including the Influenza Like Illness surveillance system, which will also contribute to flags for increased risk-based testing. Comprehensive testing, and equity of access to testing services when needed, will be core to ensuring that surveillance is effective for all populations.

Efforts to improve the quality of the data will be ongoing and will include linkage to NHI records to ensure that the quality of ethnicity data is understood. Using this case information and linked contact information it will be possible to better understand the transmission dynamics including the incubation period and the serial interval, as well as the severity and equitable impact of disease in the Aotearoa New Zealand context. This information can be examined over time and compared to international experiences and will be used to refine New Zealand's case definition, testing and case management criteria.

3.2 Existing surveillance activities

Notifiable disease surveillance

The national notifiable disease surveillance system adapted early to enable local and national monitoring of cases and clusters of COVID-19 in New Zealand. This was enabled by a change to the Health Act Schedule 1 list of notifiable diseases, the development of COVID-19 case definitions, the establishment of COVID-19 case reporting to the national notifiable disease database, EpiSurv, data collection alignment with WHO international reporting requirements, and the establishment of SARS-CoV-2 diagnostic testing capability and direct electronic notification of results from diagnostic laboratories to EpiSurv and local Medical Officers of Health. This system allows the progressive enhanced targeting and expansion of case investigation and detection through changes to the case definition in conjunction with strategies to enhance healthcare access to people with acute respiratory illnesses and particularly vulnerable population groups (e.g. tailored public health messaging, deployment of Community Based Assessment Centres and Mobile Testing Units).

Intelligence from this system identifies key demographic characteristics of COVID-19 in New Zealand, illness severity, risk factors for disease, the sources of infection and how disease is spreading. Whole Genome Sequencing of SARS-CoV-2 is being used to track genetic changes in the virus as it is detected in cases in New Zealand and compared with viral genomics overseas. This assists with outbreak investigations including source attribution, and with understanding the effects of different strains in New Zealand. Enhanced international surveillance of COVID-19 events, ongoing review of emerging scientific evidence and risk assessments, also contribute to informing the evolving understanding of COVID-19 in New Zealand.

Syndromic, sentinel and event-based surveillance

Surveillance of patients presenting with Acute Respiratory Infection (ARI) and Influenza-like Illness (ILI) syndromes in the community, and with Severe Acute Respiratory Infection (SARI) in hospitals supports the early detection of emerging COVID-19 in New Zealand. Enhanced syndromic surveillance systems have been implemented, including enhanced event based surveillance of local ARI and ILI outbreaks (reported to local Medical Officers of Health, recorded on EpiSurv, and including targeted testing for COVID-19 and influenza), and expansion of HealthStat (GP ILI consultation monitoring) to increase the sensitivity of ILI surveillance to detect local increases in community ILI activity, from the original 99 to 380 GP practices in second week of May.

The expansion of HealthStat has been implemented with prioritisation of the recruitment of practices with greater Māori, Pacific, more socio-economically deprived enrolled populations, and increased representation in major centres for international travel arrivals, seasonal workers and tourism. It needs to be taken into account that given COVID-19 and the related response, previous baselines may not apply. Healthline ILI related calls and FluTracker ILI/ARI surveillance provides other methods to monitor community trends. However, these have limitations as an early warning system in that they are variably subject to biases (e.g. demography-related for both, and, for Healthline, COVID-19 response related, media influence on health seeking behaviours etc). Sentinel SARI surveillance at Auckland DHB and Counties Manukau DHB hospital respiratory wards expanded early from the sentinel ICU SARI surveillance which runs year-round. Case detection among hospitalised SARI cases across the country is currently facilitated by the COVID-19 case definition.

Testing

The Ministry of Health is providing guidance for the risk-based prioritisation of COVID-19 molecular diagnostic testing. This applies to people who meet the case definition, contact management, and through population sampling.

A national repository for clinical test results has been developed and managed by ESR to collate all negative and positive COVID-19 test results from clinical laboratories around New Zealand. This will facilitate data management and analysis through the surveillance systems which utilise diagnostic testing data and inform surveillance performance measures including population coverage and equity, for example through linkage to key demographic characteristics via the NHI.

Modelling

The principal quantitative modelling is being conducted by Te Pūnaha Matatini (TPM), with data provided from a range of government agencies to allow modelling of networks, and the analysis of scenarios for the effectiveness of Alert Levels as well as different characteristics of the underlying disease. Case information is provided to TPM researchers to support this work.

3.3 Additional surveillance activities

Syndromic and sentinel surveillance

With the arrival of the influenza and other common acute respiratory illnesses season, possible further waves of COVID-19, and finite testing resources, there may be necessary refinement of the case definition and more targeted and sentinel testing, with greater reliance on syndromic surveillance to facilitate that.

- The non-specific clinical picture of COVID-19 requires that community based systematic surveillance monitor ARI in keeping with the current COVID-19 case definition, and systematically sample from those not being tested under the national case definition should this be narrowed.
- Options for sentinel virological community ILI/ARI surveillance are under development in the context of continuously changing community patient care flow as a result of the COVID-19 response.

Community assessment and testing for COVID-19 during the first epidemic wave has been conducted in Community Based Assessment Centres (CBACs) and in general practice. A flexible system for standardised data collection and systematic and targeted sampling to cover both GP and CBAC based presentations is under development. This includes a community Healthlink reporting system to enable 1) direct electronic notification (of suspected COVID-19 and other priority notifiable disease cases) from community (GP/CBAC) Practice Management Systems to Medical Officers of Health via EpiSurv based on a previously successfully piloted system, and 2) active sentinel surveillance sampling of ARI/ILI similar to the seasonal eILI GP sentinel surveillance system. It is important to be able to monitor both influenza and COVID-19 activity.

Further enhanced community syndromic surveillance to monitor ARI/ILI presentations to GPs and CBACs using text mining is also under development. Other novel data including over the counter medicine sales, and prescription data are non-specific and have limited utility in the near term over and above routine syndromic surveillance.

Further test development and strategies

Serological SARS-CoV-2 antibody tests are being developed in New Zealand to identify previous infection and facilitate contact tracing and outbreak control. Work by the New Zealand Microbiology Network and others to understand the performance of serological tests, and molecular diagnostic tests in different settings (e.g. diagnostic via population studies), is ongoing. Seroprevalence surveys are under consideration and may play a greater role if COVID-19 becomes widespread to identify where and whether herd immunity exists.

Testing for SARS-CoV-2 in wastewater is being considered as a novel approach to potentially identify otherwise undetected infection in communities to prompt further investigation.

4 Aim two: are public health strategies effective and equitable?

Objectives:

- to assess the effectiveness and equity of public health measures at the Border
- to assess the effectiveness and equity of case and contact management
- to assess the effectiveness and equity of infection prevention and control measures
- to assess community acceptance and adherence to control measures
- to assess health system capacity to manage COVID-19 and non-COVID-19 health needs

4.1 What do we need to know

Border measures

The introduction of new cases through the border is the most likely reason for failure of Aotearoa New Zealand's elimination strategy. All arrivals into Aotearoa New Zealand by commercial air flight are now required to quarantine for 14 days at a designated facility.

There are however exceptions, such as arrivals by air crew, and arrivals by other means such as private vessels. We must be able to:

- monitor the numbers of arrivals and their COVID-19 status (no infection, new infection and possibly past infection), including those who go into quarantine and those who are exempt.
- detect and monitor cases among those who are at risk of border exposure because of their employment (such as port workers, airport staff, or those supporting quarantined people).
- monitor how quarantine works to minimise risk of transmission, in particular the acceptability and compliance by those in quarantine. Equity in this context needs to take into account whether compassionate reasons for traveling are taken into account in the way quarantine is managed.
- monitor the timing and results of any COVID-19 tests, and any cases and contacts.

Indicators of failure will include any onward transmission from an imported case, any cases (and onward transmission) in those exempt from quarantine, and any cases, imported or linked to importations which are diagnosed after the quarantine period. Any cases in those at high risk of border exposure because of their employment will also represent a failure to protect these groups.

Case and contact management

The central function of case and contact management is to detect and interrupt transmission chains. Monitoring and reporting therefore needs to be optimal to ensure that weak points in the control system are swiftly identified and remediated and to ensure that equity is central to control.

The case and contact management will involve widespread testing of close symptomatic contacts who have been exposed to the case and possibly close asymptomatic contacts where they are at high risk.

In order to understand whether access to testing is equitable, ethnic-specific testing rates must take into account ethnic-specific infectious disease risk. Ethnicity coverage of testing will be monitored, and feedback provided to front line services should gaps appear in testing rates.

A framework for monitoring the effectiveness of contact tracing has been developed on the basis of independent advice, and data are now available that allow the performance of the public health system to be monitored as it responds to a symptomatic presentation, through to testing and isolating close

contacts. Contact tracing is an ongoing workstream of continuous performance monitoring and improvement. Establishing the effectiveness of contact tracing for different communities, and especially for Māori and Pacific people, will be an important component of monitoring the equity of the effective public health response to COVID-19.

Control measures relying on communities and individuals

An understanding of adherence to individual and community-based behavioural recommendations (e.g. social distancing) and variation by age, ethnicity and region is essential to optimise the response. The inclination as well as the ability to adhere to recommendations over time may change in different subsets of the population. These variations and how they change over time must be tracked and analysed so that corrective interventions can be targeted and made most useful.

Aggregated mobile phone data may provide ancillary information but are not suitable for the granular analysis of the population which will ensure equity in health outcomes. Analysis of mobile phone data collected for the purposes of contact tracing may prove useful if data privacy and sovereignty can be resolved and public engagement assured.

The results of syndromic surveillance can provide information about the spread of influenza-like illnesses and the spread of these conditions provides information on changing contact patterns. Specific ability to identify changes across all subsets of the population ensuring equity is required.

Populations and settings at high risk of infection, onward transmission, or poor outcomes

A risk-based approach to surveillance targets those in the population most likely to be exposed, those where the consequence of infection is high because of the health outcome for individuals or the impact on the response capacity, those who are less likely to access testing if infected and/or those with a high risk of onward transmission. The Ministry of Health has provided guidance to District Health Boards on testing for high risk populations, and this programme of testing has been established across New Zealand.

Those most likely to be exposed include people with COVID-19 symptoms. However, during the coming winter (flu) season these symptoms may become even less specific, and the case definition may need to be adapted.

There are groups in the community that are at higher risk of being exposed to COVID-19. These higher risk groups include:

- health care workers and other staff working at health facilities, including aged residential care facilities
- essential workers in workplaces where there has been a case
- staff in quarantine hotels
- international airline crew
- international travellers
- tourism industry workers
- police working in areas with a higher incidence of confirmed cases, and
- migrant workers

There are also groups where there is a high consequence of undetected transmission with a risk of exposure that may change according to the local case prevalence, including:

- Māori, Pacific people, and people in communities with high deprivation, crowded housing, and barriers to access to healthcare
- backpacker hostels, and
- prisons.

In addition, there are specific settings that require special attention due to poor health outcome in case of infection and high risk of onward transmission (e.g. aged-related residential care).

4.2 Existing surveillance activity

Border information

Information is collected from Border Operations, who administer border quarantine and isolation. Positive test results are collected via EpiSurv, as part of the wider disease notification system.

- Data on arrivals (Immigration)
- Numbers of airline passengers quarantined
- Case data from EpiSurv (travel, occupation incl. location, settings)

Targeted surveillance of frontline staff at border-related settings: this includes in particular those employed at isolation stations and international airline crew. Aside from messaging to report any degree of clinical signs, testing of asymptomatic people in these groups is part of the current Testing Approach to Eliminate COVID-19.

Case and contact management information

Contact tracing information is brought together from existing contact tracing information systems operated by Public Health Units, and data from the National Close Contact Service. This is combined with data from EpiSurv and laboratory testing information in order to generate a range of metrics on contact tracing and cluster management. This data is used both operationally to manage cluster outbreaks, and as a management tool to monitor the timely performance of contact tracing, and the effectiveness of contact tracing for different communities. Data can be analysed by ethnicity.

Physical distancing and contact measures

A survey is already in the field focussed on population knowledge, understanding and practice, powered to detect differences by age and ethnicity, including questions on the numbers of close contacts, physical distancing and mask wearing that can be used to understand current practice and monitor change. This is part of the wider New Zealand Health Survey process.

Health system capacity

The core public health capacity issue is the effectiveness of the contact tracing function. This is monitored as part of a set of independently advised metrics that have formed a basis for developing information about contact tracing and the pathway of a person presenting with symptoms from testing to diagnosis and follow and isolation of close contacts.

The capacity of the health system to respond to COVID-19 more broadly has been monitored on the basis of reports from individual DHBs, advising on the availability of inpatient beds, intensive care beds and ventilators. The capacity of primary health care services is not monitored on a routine basis but is the subject of regular updates with representatives of those services.

4.3 Additional surveillance

In progress

- Continue to optimise ILI surveillance (HealthStat extension, Flutracker membership, and GP text mining); an assessment of the use of CBAC as part of the ILI surveillance is carried out (CBAC data and virological testing).
- The integration of case data with contact tracing datasets in order to inform contact tracing performance metrics.
- The effectiveness of apps to support contact tracing is being assessed.

5 Outputs of the surveillance system

5.1 Surveillance question set

The current set of surveillance questions are summarised below, with a more detailed set of questions provided in Appendix One. These underpin the specific outputs of the surveillance system. This set of questions is current at May 2020, but COVID-19 surveillance questions will need evolve to align with policy changes, progression of the pandemic, and emerging understanding of the disease.

All surveillance questions should be analysed by ethnicity unless fundamental data limitations do not allow this. Principles of equitable use of data and information including data sovereignty and equal explanatory power will to be built into COVID-19 surveillance collection, analysis and reporting, with transparency and timeliness. The balance between privacy rights and public health also will be explicitly considered.

Key category areas and questions for COVID-19 surveillance system		Key category areas and questions for COVID-19 surveillance system
1. Understanding the disease	What are the characteristics of the current disease in Aotearoa?	Case characteristics in person, place and time, inequities, disease severity and risk factors, source and transmission dynamics, molecular epidemiology, patient outcomes in primary and secondary care
	What is the degree of likely undetected disease?	Testing coverage and reasons for testing, cases with unknown source, syndromic surveillance trends, rates and characteristics of cases detected through targeted and sentinel testing, predicting disease trends and transmission dynamics
	Is there an emerging new disease outbreak in the population?	Case source and transmission dynamics, SARI & community sentinel surveillance trends, HealthStat, case detection via novel methods
	What is the level of past infection in the population?	Prevalence of detectable immunoglobulin to SARS-CoV-2
	COVID-19 impacts	Cases, hospitalisations, deaths, comparison to expected levels (hosp and deaths), post-discharge morbidity
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	Physical distancing and contact measures	Prevalence of behaviours, aggregated data on human movement (eg traffic patterns, cellphone data)
	Populations and settings at high risk of infection, onward transmission, or poor outcomes	Performance measures of Infection control systems in health care and other high risk settings, cases of transmission in high risk settings/people. Targeted testing of populations with high risk or consequence of infection.

5.2 Analysis and interpretation

Optimal performance of the COVID-19 surveillance system requires decision makers to have rapid access to evidence that is generated from a complex data environment. Analysis and interpretation includes:

- Descriptive analyses reporting numbers, proportions, and distributions by person, place and time; outputs are usually in the form of tables or graphs, including plotting the epidemic curve; maps are an intuitive way to explore geographical distributions, genome data, and contact patterns.
- Quantitative epidemiology is focused on answering a carefully-formulated question. A variety of techniques can be employed and will be explored. This includes the exploration of scenario tree modelling to assess the degree of confidence that SARS-COV2 is absent from a population. We expect that these will be developed iteratively and reviewed and refined by peer review and interaction with the EpiTAG, internal and external discussion.
- Mathematical modelling of pandemic and response scenarios is a particularly useful tool to explore options for control. Mathematical modelling is largely being conducted by Te Pūnaha Matatini, to which the Ministry of Health surveillance function has a direct link.

These analyses are used to generate evaluative indicators including data quality, intervention fidelity of control measures, and a view of the equity of implementation and impacts, as well as reporting on the pandemic itself.

Analysis is conducted by a range of contributors. ESR perform key analyses on a regular basis, and analytical teams within the Ministry of Health will also conduct some of the analyses required to address this plan. This will involve the Ministry of Health Māori Insights and Pacific Insights teams in specifying analyses, generating results, and in advising on the generation and distribution of information for their communities of interest.

Regular monitoring reports will be produced in as automated a manner as feasible, but a number of surveillance products, such as the design and conduct of a serology study, lend themselves to specific analyses conducted on a one off or intermittent basis.

5.3 Information for managing the response

Key information will be available to agencies involved in aspects of managing the response:

Early warning of emerging outbreaks

- New case incidence and source of infection
- Surveillance testing in high risk populations
- Syndromic surveillance and sentinel testing
- Potentially: sewage testing

Management of clusters and outbreaks

- Case and contact information
- Contact tracing performance
- Genomic analysis of virus isolates
- Analysis of transmission patterns

Changing Alert Levels

- Analysis of transmission patterns
- Regional analysis of transmission patterns and risks
- System performance and capacity information

Addressing COVID-19 response impacts

- Consequences of deferred care
- System performance and capacity information

5.4 Other dissemination

Because of the demands of the broad scope and rapid (in some cases near-real-time) reporting, analyses and reporting will be automated as much as possible. Transparency of reporting is important and unless there are contraindications, data should be widely available.

Evidence and insights from the data processing stage will be packaged into surveillance products for different audiences. A number of existing products have been generated during the initial phase of the pandemic, and are now evolving into output that is more suitable for the longer term COVID-19 response:

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Daily update on cases and testing	Being revised. Expanded version soon available in dashboard form. Case data also available on the ESR dashboard. Moving towards consolidating reporting from multiple different sources.
Ministry of Health updates summarising key descriptive epidemiological information on the pandemic and response.	Have been produced on a manual basis, and require a production system
ESR Weekly intelligence reports	In place
Mandated reporting to international bodies.	In place
Interactive platforms making data available to both internal and external audiences.	ESR dashboard provides interactive access to descriptive case epidemiology, outbreaks, international epidemiology, and national syndromic surveillance trends. This will be further developed to be consolidated in one place, along with products being developed by Data and Digital with the Ministry of Health which will coordinate with ESR. Public facing access to information to be further developed with specialist science communication advice, privacy advice, and in discussion with external stakeholders.
Stand-alone reports on specific topics in greater depth as required.	As needed. Cluster reports and other reports focussed on supporting the response generated by ESR and Ministry of Health.
Ad hoc information requests	Being responded to by COVID-19 Intelligence

A more detailed public dissemination plan will be developed to complement this work, with input from key stakeholders on the information they seek for a variety of purposes.

6 Roles

The Ministry of Health

The ownership of this Surveillance Plan sits with the expanded Ministry of Health Executive Leadership Team for COVID-19. The expanded Ministry of Health ELT is responsible for the Tiriti partnership in governance over the surveillance plan, as it is with other aspects of the COVID-19 response.

The management of the plan sits with the Health Intelligence Team in the Ministry of Health COVID-19 Response Hub, in consultation with the Office of the Director of Public Health, the Communicable Disease Team, the Population Health and Prevention Directorate, the Māori Insights Team, the Pacific Insights Team, and ESR as a lead provider of surveillance to the Ministry. The Chief Science Advisor, and the management of the Technical Advisory Group and subgroups both sit within the Ministry of Health COVID-19 Response Hub.

The Ministry of Health's COVID-19 Information Governance Group has overall responsibility for the governance of information specifically collected or used as part of the COVID-19 response over and above the routine collection and use of information in the Ministry of Health. This information governance group will have responsibility for considering issues of governance and data sovereignty over surveillance information, while respecting the principle of being as transparent with information as possible.

Environmental Science and Research

ESR is responsible for coordinating national, real-time notifiable disease surveillance and data analysis, so case and transmission patterns throughout New Zealand can be monitored. ESR also develops and operates non-notifiable disease surveillance systems including syndromic surveillance of acute respiratory illnesses. ESR plays a central role as the national public health reference laboratory, undertaking diagnostic and reference testing including genetic analysis of COVID-19 strains. The surveillance teams operate EpiSurv, the national disease database, and other national information systems. ESR liaises with Public Health Units on behalf of the Ministry of Health to support national surveillance and applied epidemiological investigations. ESR provides data to the Ministry of Health including case and testing data, analysis of transmission patterns, contact tracing information and phylogenomics. ESR provides intelligence reports to the Ministry of Health and Public Health Units on key features of COVID-19 epidemiology. ESR also disseminates surveillance information into its dashboard, which has public and public health sector facing elements, and will continue to be developed further.

The surveillance system has interfaces with:

District Health Boards

DHBs both provide key elements of surveillance information to aggregate to a national picture and are consumers of surveillance information to support their response. Much of their key information is available from local sources, although guidance on surveillance testing is being provided nationally. DHB roles include:

- The operators of Public Health Units and responsible for key elements of the front-line public health response, including notification, contact tracing and investigation of outbreaks.
- Responsible for operationalising COVID-19 assessment and testing (both diagnostic and surveillance testing) in partnership with PHOs.

- Responsible for commissioning or providing clinical treatment of COVID-19 cases in primary care and hospital settings.
- The bodies with overall responsibility for the health of their district populations, and therefore tasked with addressing the indirect health consequences of the COVID-19 response.

Primary Health Organisations

PHOs are a source of valuable surveillance information, particularly on the population being assessed for COVID-19. Some PHOs have developed their own COVID-19 intelligence functions to allow them to allocate resources effectively at a very localised level. PHO roles include:

- delivering the clinical care for the majority of COVID-19 cases
- much of the COVID-19 testing, both diagnostic and surveillance testing, whether conducted in general practice, CBAC or other community settings
- responding to demands for urgent care if deferred care increases health need, and
- maintaining the continuity and capability of primary care services under circumstances of fluctuating demand.