Estimates of new onset of covid-like illness, symptomatic population, and testing rates

Note: This report has not yet undergone formal peer review

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Summary

Using the FluTracking survey data for 2021 up until the week ending 29 August, 2021, we can estimate the weekly incidence (new onset) of COVID-19-like symptoms within different age groups and different parts of the country. We use this to produce an estimate of the newly symptomatic population, and combine this with current testing data (up until 1st September) to estimate how many people with new onset of symptoms (in the past 7 days) would have been tested for COVID-19 through time.

- Weekly incidence rates for *any two or more COVID-19-like symptoms* (CLI2+) in the week ending 29 August, 2021 was 6.7% for under 5s, 3.1% for 5-19 year olds, 3.3% for 20-64 year olds, 1.9% for 65+.
- Weekly incidence rates for *any one or more COVID-19-like symptoms* (CLI1+) in the week ending 29 August, 2021 was 7.1% for under 5s, 4.8% for 5-19 year olds, 5.7% for 20-64 year olds, 3% for 65+.
- New onset of illness, especially among pre-school and school age children has seen a large drop. This matches the declines seen in earlier Alert Level changes when schools were closed (Alert Level 3 and 4).
- Despite the drop in testing seen in many regions, the lower incidence of illness still produces high symptomatic testing rate estimates in Auckland Region DHBs across all age bands except under 5s. A number of the approaches used to calculate this find testing rates up to 100%.

These estimates have a number of caveats. First, we are assuming that the weekly incidence (new onset of symptoms) estimated from the FluTracking survey is representative across a number of different communities. Secondly, we assume that all tests without an entry in the National Contact Tracing System (NCTS) database are seeking a test due to covid-like symptoms. Finally, we assume that people seeking tests for symptoms would have had new onset of symptoms within the past 7 days (although we test the sensitivity to this last assumption in section 3.2.2). In future it would be worth using more detailed information on the reason for seeking a test, including the symptoms people seek tests for, and the time from symptom onset to seeking a test. Unfortunately this data is not available yet.

1. Calculating incidence (new onset) of covid-like illness

We use responses to the weekly FluTracking survey to estimate the **incidence** of COVID-19-like and influenza-like symptoms each week. The six symptoms asked about are: cough, fever, sore throat, shortness of breath, runny nose, and loss of taste or smell. We note that the FluTracking survey has added the symptom 'headache' to the list they ask about. For now we have removed this from the list of symptoms, to enable consistency with past weeks' estimates.

We calculate incidence for two categories of symptom severity: *CLI1+*, if a respondent indicates any one or more of the included covid-like symptoms; and *CLI2+*, if they indicate two or more covid-like symptoms. For estimates of the COVID-relevant symptomatic population we use CLI1+, which meets the Ministry of Health advice to seek a COVID-19 test, and CLI2+, which allows us to be slightly more discerning given that many non-infectious illnesses (allergies, asthma, etc) can cause some of the symptoms in the survey.

The key adjustments we make to the incidence calculations used by MoH for the online FluTracking reports are:

1. we define new covid-like case definitions, instead of 'Cough and Fever' (Influenza-like Illness);
2. we adjust for reporting bias by considering only responses where the participant had consistently responded for a number of weeks prior;
3. we weight responses by age to account for the under- and over-representation of different age groups in the survey participants;

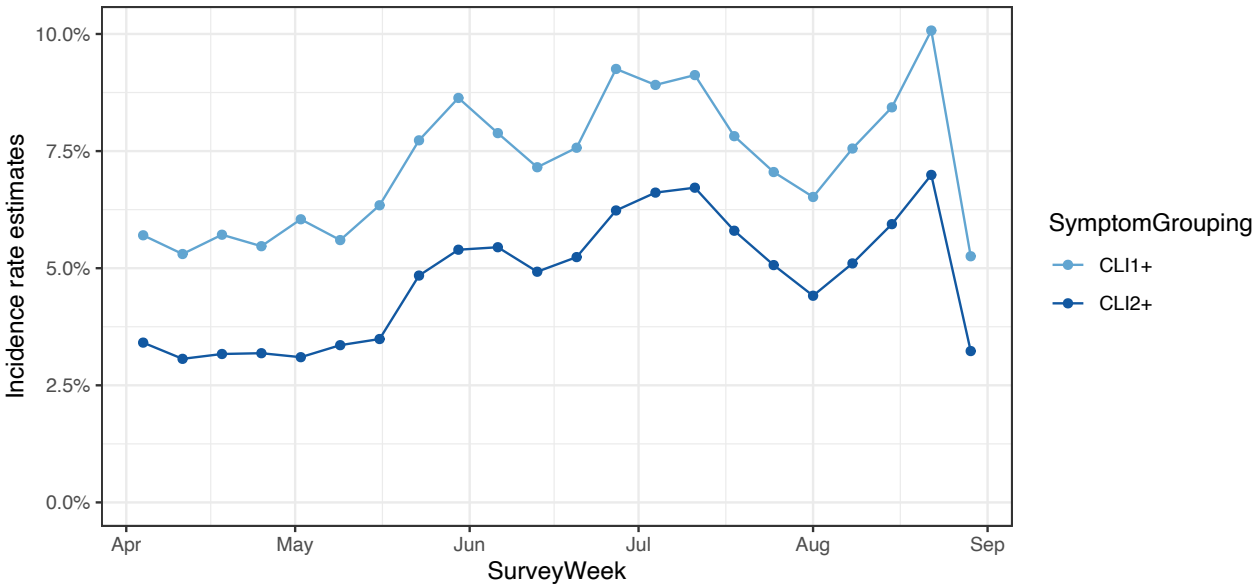
The number of consistent responses varies through the year for the FluTracking survey, with around 45,000-50,000 per week at the moment. In order to have a large enough sample that estimates don't jump around week to week depending on whether the one person in a given age group and postcode got sick, we use the postcodes to determine the DHB of respondents. We then aggregate the DHBs up to grouped estimates for the four groups: "Auckland Region DHBs", "Wellington Region DHBs", "Rest of North Island DHBs", and "South Island DHBs". For ages we use the age bands <5, 5-19, 20-64, and 65+. All incidence estimates used for estimating symptomatic populations are at the level of these four DHB groups, and these four age bands.

FluTracking also includes information on ethnicity. However, the low number of responses in any category other than the options "European" and "NZ European", means we are not able to investigate differences in covid- and flu-like symptoms for different ethnic groups.

More details on the incidence calculation method are given at: https://www.tepunahamatatini.ac.nz/2021/09/20/flutracking-incidence-calculation-methods/

1.1 National level

Figure 1: National level incidence estimates

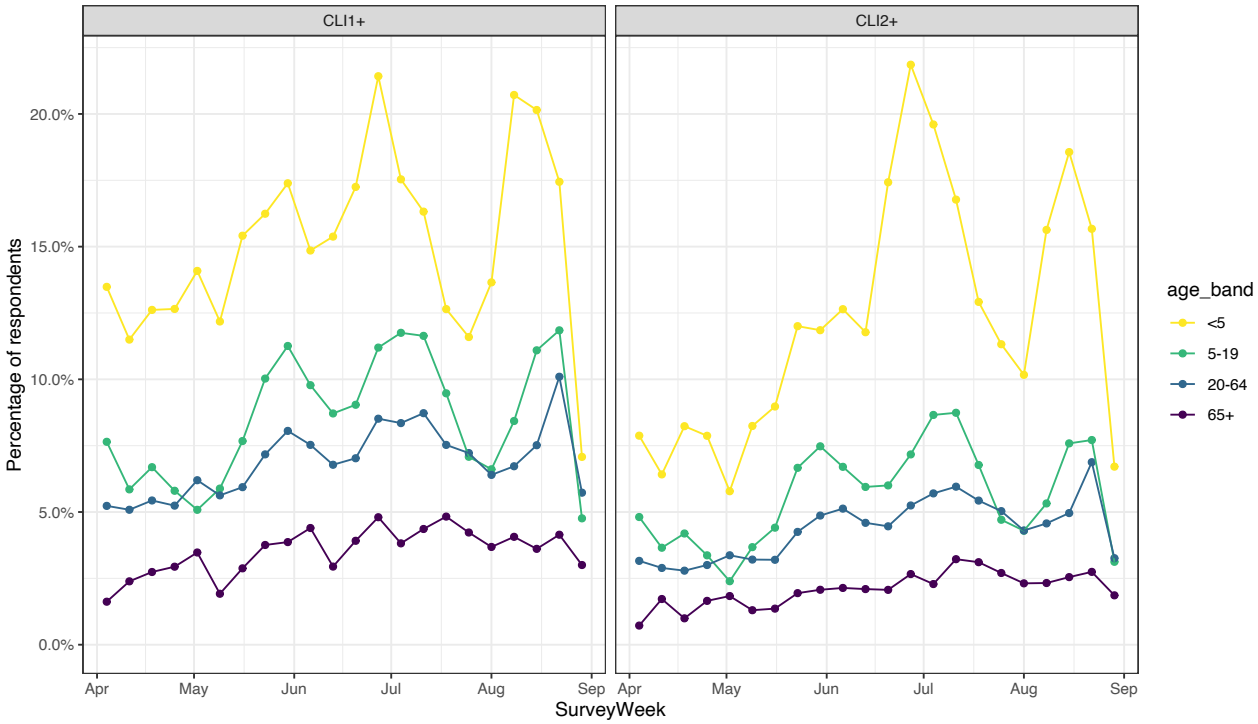


Looking at the incidence estimates since April (Figure 1), we can clearly see the winter 'cold' season and the dip late July following school holidays. We can now see a large drop in the first week of Alert Level 4, as expected from past years.

1.2 Differences with age

A substantial proportion of new incidents are in younger children, especially under 5s. In Figure 2 we look at the incidence by age bands (selected to roughly line up with preschool, school, working age, and retired age groups).

Figure 2: National level incidence estimates by age bands



In Figure 2 we can see the large decrease due to the Alert Level change is clearly evident in all age groups.

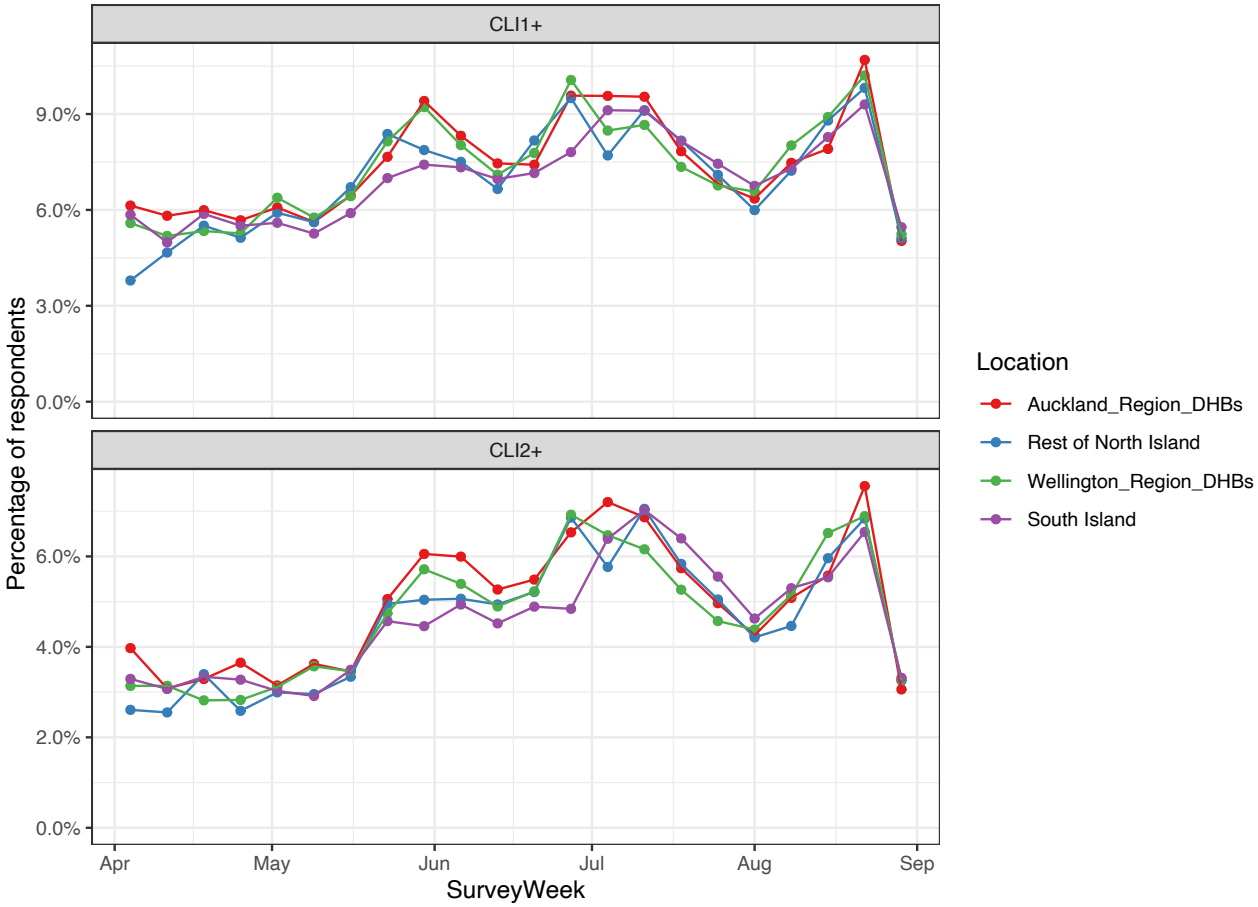
Under 5s have the highest rates of new onset of symptoms, especially in the CLI2+ (two or more covid-like symptoms) case definition. We can see the sharp rise in illness in under 5s from June onwards. This is likely linked to the RSV surge that caused the neonatal and paediatric capacity issues in hospitals and ICUs in June and July. There is a drop in late July for under 5s and school age children, which coincides with the school holiday period.

Given the large difference in illness incidence by age, we will keep age bands separate for the majority of our estimates.

1.3 Differences with location

In Figure 3 we look at the difference in incidence estimates in different parts of the country. To enable us to have a larger sample of responses, we group this by regions of most interest in the current outbreak, that is: the Auckland Region, the Wellington Region, the rest of the North Island, and the South Island.

Figure 3: Incidence estimates by DHB groupings

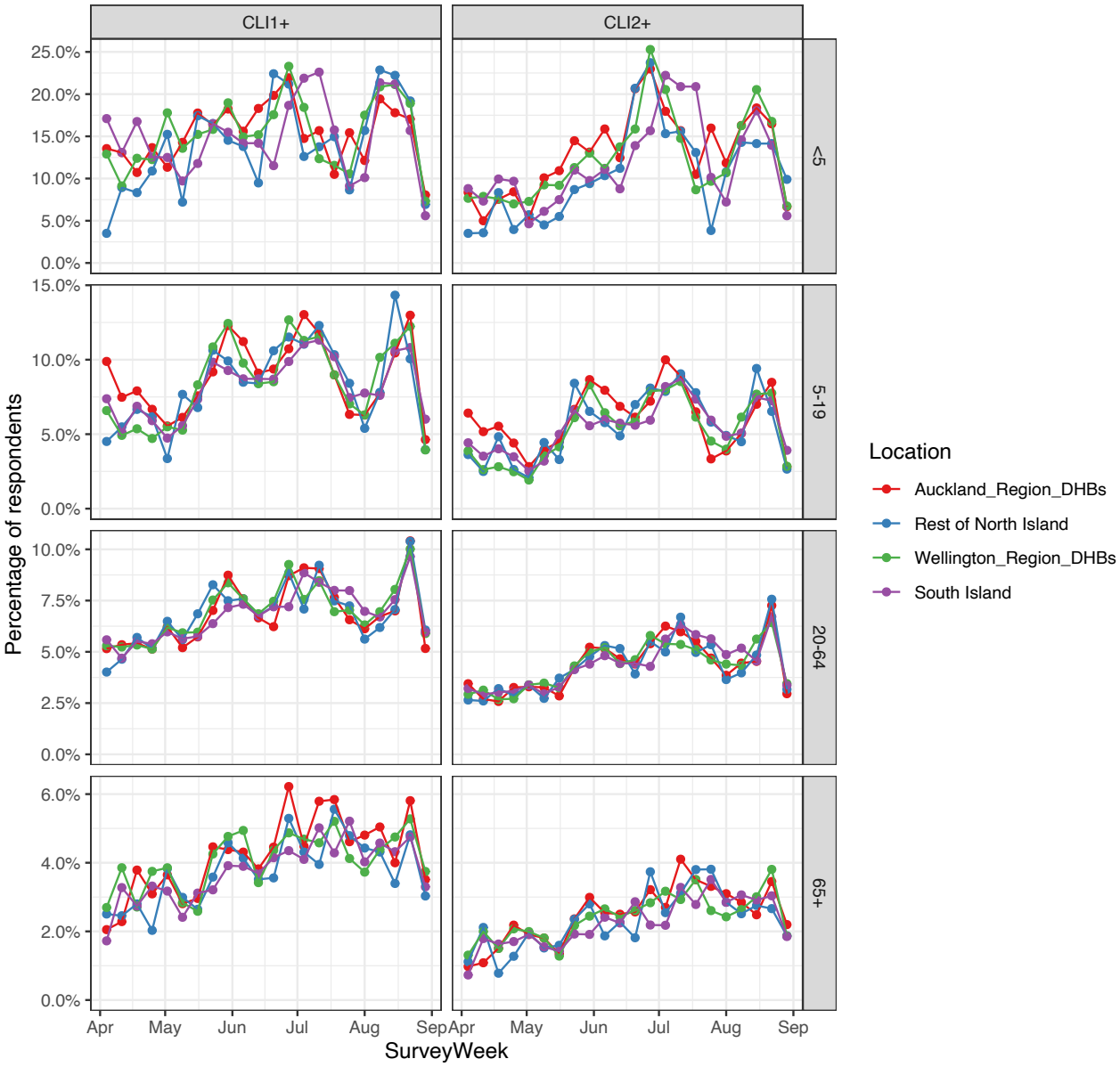


We do not see any consistent differences in different parts of the country since April. But if we look back to earlier in the year or last year, we see clear differences between Auckland and the rest of NZ when Auckland was in Alert Level 3 and the rest of the country was in Alert Level 2 (see https://www.tepunahamatatini.ac.nz/2021/09/20/flutracking-incidence-calculation-methods/ for more information). Being in higher Alert Levels reduces the number of cold and flu-like illnesses that children bring home from school. We see a similar effect in the school holidays (Figure 2).

1.4 Estimates by age and location for use in estimating symptomatic population

We finally calculate incidence by location (four DHB groupings) and (four) age bands, shown in Figure 4. These are the estimates that we will use for the estimations of the symptomatic population, and for testing rates, and are listed in Table 1 for the past two weeks.

Figure 4: Incidence estimates by DHB groupings and age bands. Aggregating DHBs up to 6 groupings of interest



In addition to having higher incidence of illness, younger children are much less likely to get tested for covid. They are also much less likely to get severe symptoms if infected with covid. For testing rate related estimates, we will focus on the age bands over 5.

2. Testing data

We receive a dataset of the number of tests processed daily, broken down by DHB, Age (in 5 year age bands), Prioritised Ethnicity (Māori, Pacific, Asian, and Other), whether the person is in the NCTS database as a known contact, and location of test (here we select just the categories: "GPs and other primary health" and "CBACs and pop-ups").

Important caveats

One key thing to note is that we don't have information from the point of getting a test as to the reason for a test.

Table 1: Incidence rate estimates by DHBgroupings and age bands for the past 2 weeks

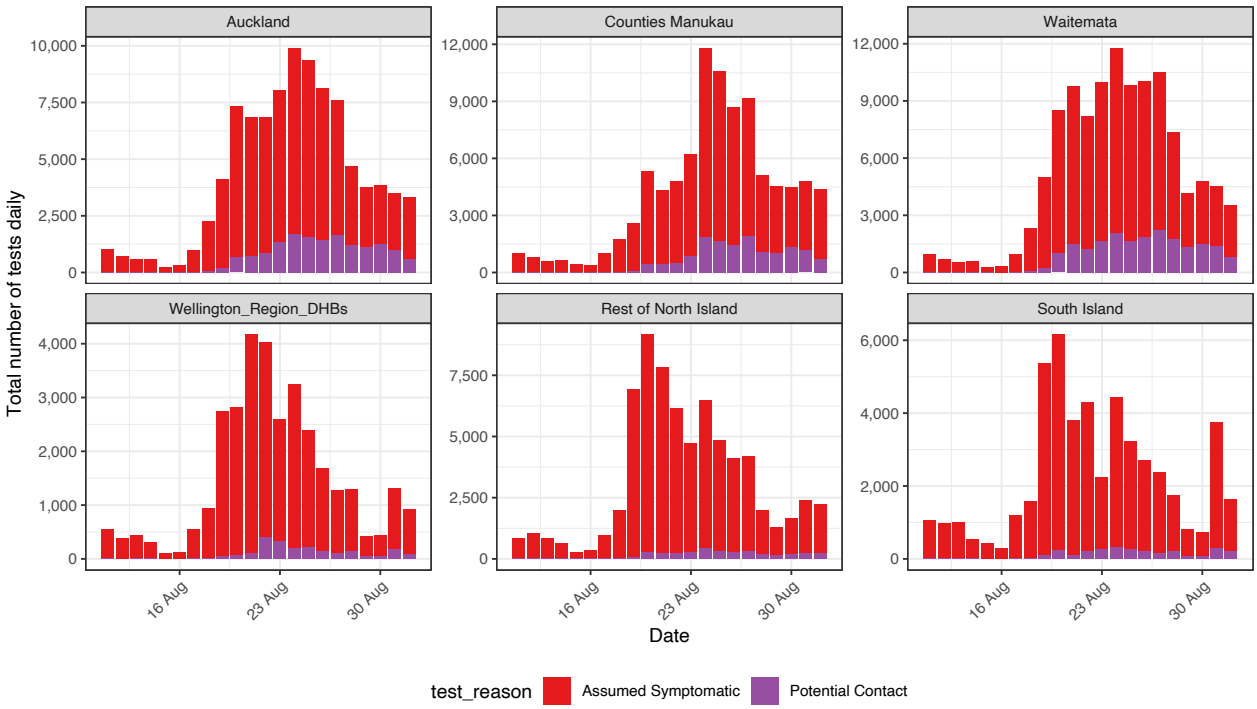
WeekEnding	Location	age_band	Responses	Weekly Incidence Estimate CLI1+ (%)	Weekly Incidence Estimate CLI2+ (%)
2021-08-29	Auckland_Region_DHBs	<5	360	8.1	6.7
2021-08-22	Auckland_Region_DHBs	<5	358	17.0	16.5
2021-08-29	Rest of North Island	<5	101	6.9	9.9
2021-08-22	Rest of North Island	<5	99	19.2	14.1
2021-08-29	Wellington_Region_DHBs	<5	341	7.3	6.7
2021-08-22	Wellington_Region_DHBs	<5	328	18.9	16.8
2021-08-29	South Island	<5	286	5.6	5.6
2021-08-22	South Island	<5	287	15.7	13.9
2021-08-29	Auckland_Region_DHBs	5-19	1917	4.6	2.8
2021-08-22	Auckland_Region_DHBs	5-19	1911	13.0	8.5
2021-08-29	Rest of North Island	5-19	654	4.0	2.7
2021-08-22	Rest of North Island	5-19	656	10.1	6.5
2021-08-29	Wellington_Region_DHBs	5-19	1937	3.9	2.8
2021-08-22	Wellington_Region_DHBs	5-19	1943	12.2	7.8
2021-08-29	South Island	5-19	1827	6.0	3.9
2021-08-22	South Island	5-19	1803	10.8	7.2
2021-08-29	Auckland_Region_DHBs	20-64	8137	5.2	3.0
2021-08-22	Auckland_Region_DHBs	20-64	8101	10.4	7.3
2021-08-29	Rest of North Island	20-64	3134	6.1	3.2
2021-08-22	Rest of North Island	20-64	3128	10.4	7.6
2021-08-29	Wellington_Region_DHBs	20-64	9214	5.9	3.4
2021-08-22	Wellington_Region_DHBs	20-64	9221	10.0	6.4
2021-08-29	South Island	20-64	8293	6.0	3.4
2021-08-22	South Island	20-64	8305	9.6	6.7
2021-08-29	Auckland_Region_DHBs	65+	2863	3.5	2.2
2021-08-22	Auckland_Region_DHBs	65+	2892	5.8	3.5
2021-08-29	Rest of North Island	65+	1802	3.0	1.9
2021-08-22	Rest of North Island	65+	1783	4.8	2.7
2021-08-29	Wellington_Region_DHBs	65+	3600	3.7	1.9
2021-08-22	Wellington_Region_DHBs	65+	3610	5.3	3.8
2021-08-29	South Island	65+	4009	3.3	1.9
2021-08-22	South Island	65+	4014	4.8	3.0

We are using the NCTS database to determine which tests are related to known exposure events, but a number of the people seeking tests may know that they have been exposed due to Locations of Interest or other information before being officially 'contacted' by MoH and entered into the NCTS database. There may also be people seeking a test who are not contacts, and don't have symptoms. We have no way of excluding these people.

We also don't have information about whether the tests are repeat tests in the same person or not. This will probably only be a factor for close contacts who are required to have 2-3 tests over the space of two weeks.

2.1 Test reasons

Figure 5: Test numbers per day in DHB groupings



In Figure 5 we plot the daily test counts, split into six different DHB groupings. These are the same as the four used earlier, but with the three Auckland Region DHBs separated out. Looking at this data we can clearly see the massive surge in tests that occurred after the new outbreak was detected. The tests for 'Potential Contacts' are the tests that (as of 02 September) had an entry in NCTS for the current outbreak.

Nationwide, the dataset includes 429,701 tests that have been done in total between between 18 August-01 September 2021 (inclusive). This is made up of 371,306 tests with no match in the NCTS database, and 58,395 tests which do have a match in the NCTS database. This tracks closely with the numbers being announced in the MoH press releases, so we are confident the categorisation is working reasonably well, and the number of repeated tests in close contacts is not playing a major role yet in biasing our contact test data yet.

2.2 Testing related to symptoms

We make the assumption that all tests without a match in the NCTS dataset are seeking a test due to having covid-like symptoms. This is not going to be quite accurate, especially in Auckland where a number of close contacts are self-identifying and seeking a test before being entered into NCTS. Some of this will become more accurate through time, as the contact tracing catches up. But for now we just acknowledge that the number of symptomatic tests is likely an over-estimate. It should be mostly accurate in areas of the country with very few contacts though.

In Figure 6 we plot the proportion of people who have been tested for COVID-19 over the 7 day period from

25 August to 01 September, 2021 inclusive. We split this out by age band, ethnicity, and DHB. Here we see strong testing rates in the Pacific community across the motu.

Figure 6: Estimated ethnicity and age testing proportions for symptomatic testing.
From 26 August-01 September, 2021 inclusive.

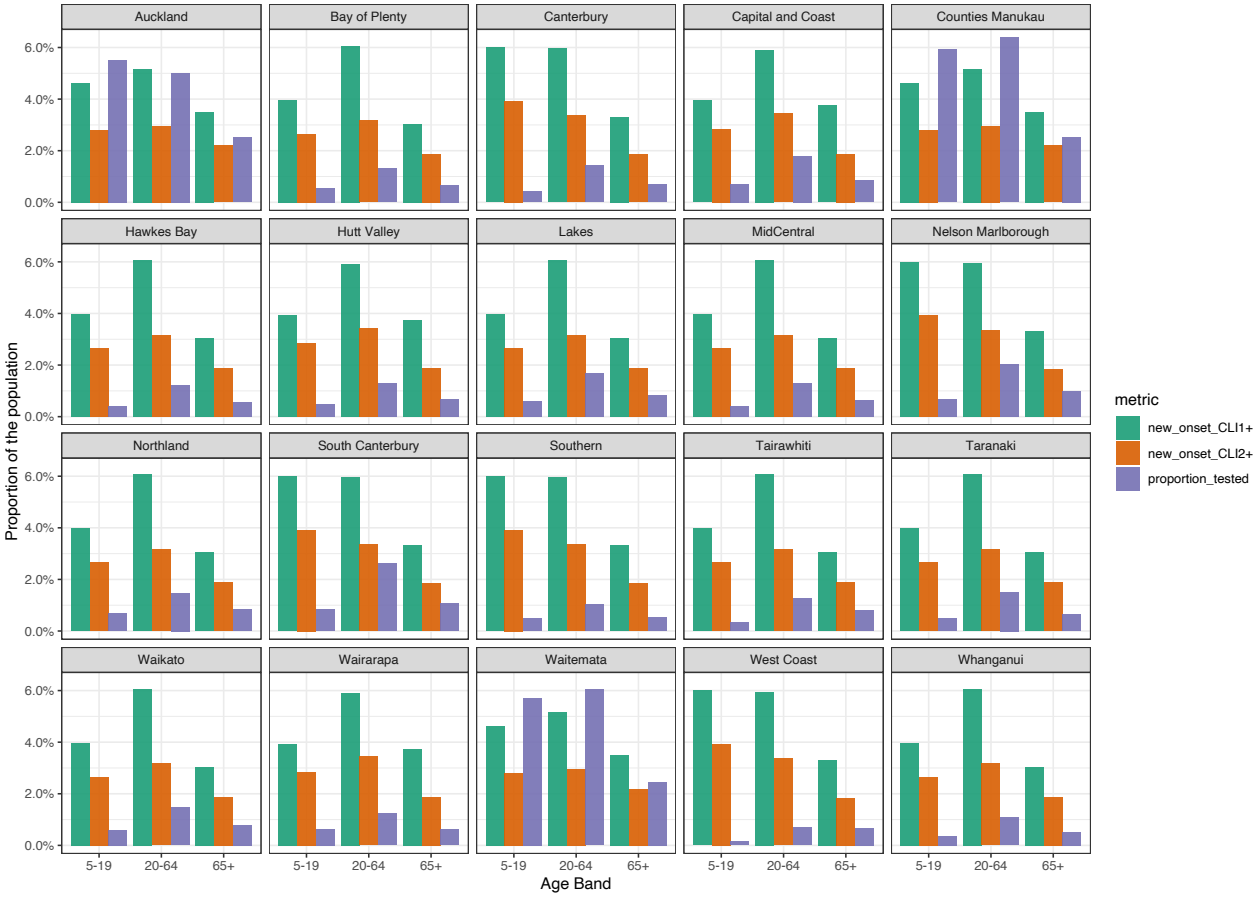
The next question is how this proportion seeking testing, which we assume to be due to symptoms, relates to our estimates of new onset of covid-like symptoms in a given week (Table 1).

3. Combining symptomatic testing counts with weekly symptom incidence estimates

3.1 Comparing weekly testing rates with weekly symptom incidence rates

First we simply use the weekly new incidence estimates from the week ending 01 September, 2021 to estimate the number of people (in each DHB and age band) who would have new onset of symptoms in that week, and compare it to the number of tests over the 7 day period from 25 August to 01 September, 2021 inclusive (Figure 7). In addition to having high incidence, younger children are much less likely to get tested for covid, but also much less likely to get severe symptoms. For testing rate related estimates, we will focus on the age bands over 5.

Figure 7: Symptomatic testing rates compared to weekly symptom incidence estimates.
For the week 26 August to 01 September, 2021 inclusive.



Here we can see that in the Auckland Region DHBs the number of tests (purple 'proportion_tested' bars) are as high, if not higher, than the proportion with new onset of symptoms. This may be in part due to the fact that people would initially be getting tested for illnesses with symptom onset before last week. An upper bound on this might be to consider the last two weeks of new onset of symptoms. This would effectively more than double the green and brown bars ('new_onset_CLI1+' and 'new_onset_CLI2+') because of the higher incidence of symptoms two weeks ago.

3.2 Estimating the symptomatic population and how many have been tested through time

A more nuanced way to consider the new onset of illness and window of time that someone would seek a test, and compare this to the test numbers through time. We do this by building a model where we explicitly estimate these numbers through time. First we estimate the number of people with new onset of symptoms each day; we do this using the FluTracking incidence estimates smoothed through time (rolling mean, with a 10 day window), and add them to our *symptomatic population who might seek a test* total each day. We then set a time window after symptom onset where people would seek a test, `n` days, and look back that many days to decide how many people to remove from the *symptomatic population who might seek a test* total each day.

In order to estimate the number of symptomatic people who have been tested we then look at the same time frame seeking a test (`n` days from symptom onset) and count up how many symptomatic tests have been done in that time using a rolling window. This means that tests on a specific day are not explicitly allocated to a symptomatic person who would already be symptomatic by then, but it should at least match similar estimates calculated from weekly estimates/counts. A more advanced age (of illness) structured model could be used, but that is future work.

3.2.1 Results using a time window of 7 days Figures 8a-d show the estimated number of newly symptomatic people (within the last 7 days) and how many of those haven't been tested, through time for both symptom case definitions by DHB and age band.

Figure 8a: Symptomatic Population estimates and estimates of untested population, by age band and Auckland DHBs. Testing data up to 01 September, 2021
FluTracking data up to week ending 29 August, 2021

Red bars show daily test numbers.
We only consider new onset within the past 7 days, and assume people wouldn't seek testing after 7 days.
CLI1+ considers incidence for any one or more COVID-like symptoms,
CLI2+ considers incidence for any one or more COVID-like symptoms.

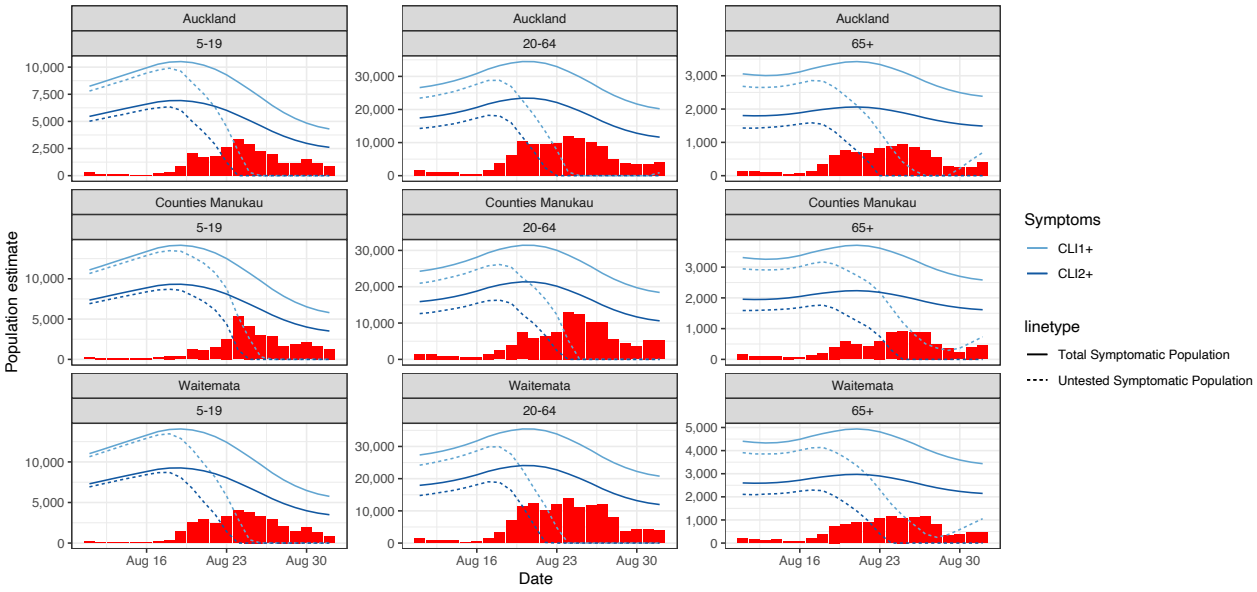


Figure 8b: Symptomatic Population estimates and estimates of untested population, by age band and Wellington DHBs. Testing data up to 01 September, 2021
FluTracking data up to week ending 29 August, 2021

Red bars show daily test numbers.
We only consider new onset within the past 7 days, and assume people wouldn't seek testing after 7 days.
CLI1+ considers incidence for any one or more COVID-like symptoms,
CLI2+ considers incidence for any one or more COVID-like symptoms.

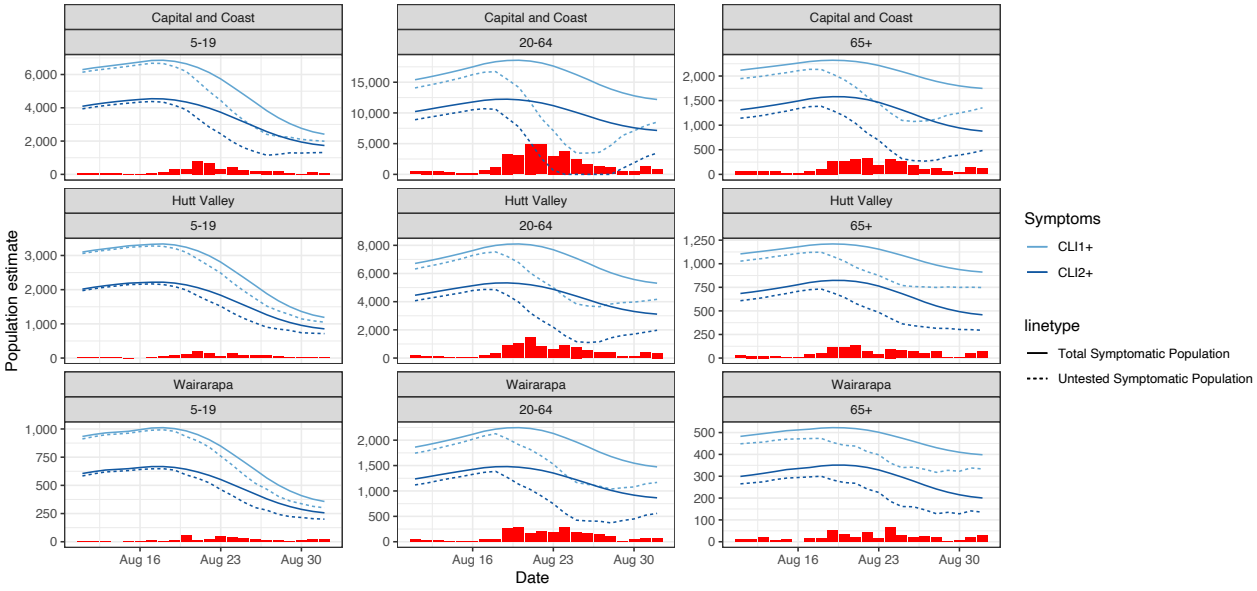


Figure 8c: Symptomatic Population estimates and estimates of untested population,
by age band and Rest of North Island DHBs. Testing data up to 01 September, 2021
FluTracking data up to week ending 29 August, 2021

Red bars show daily test numbers.
We only consider new onset within the past 7 days, and assume people wouldn't seek testing after 7 days.
CLI1+ considers incidence for any one or more COVID-like symptoms,
CLI2+ considers incidence for any one or more COVID-like symptoms.

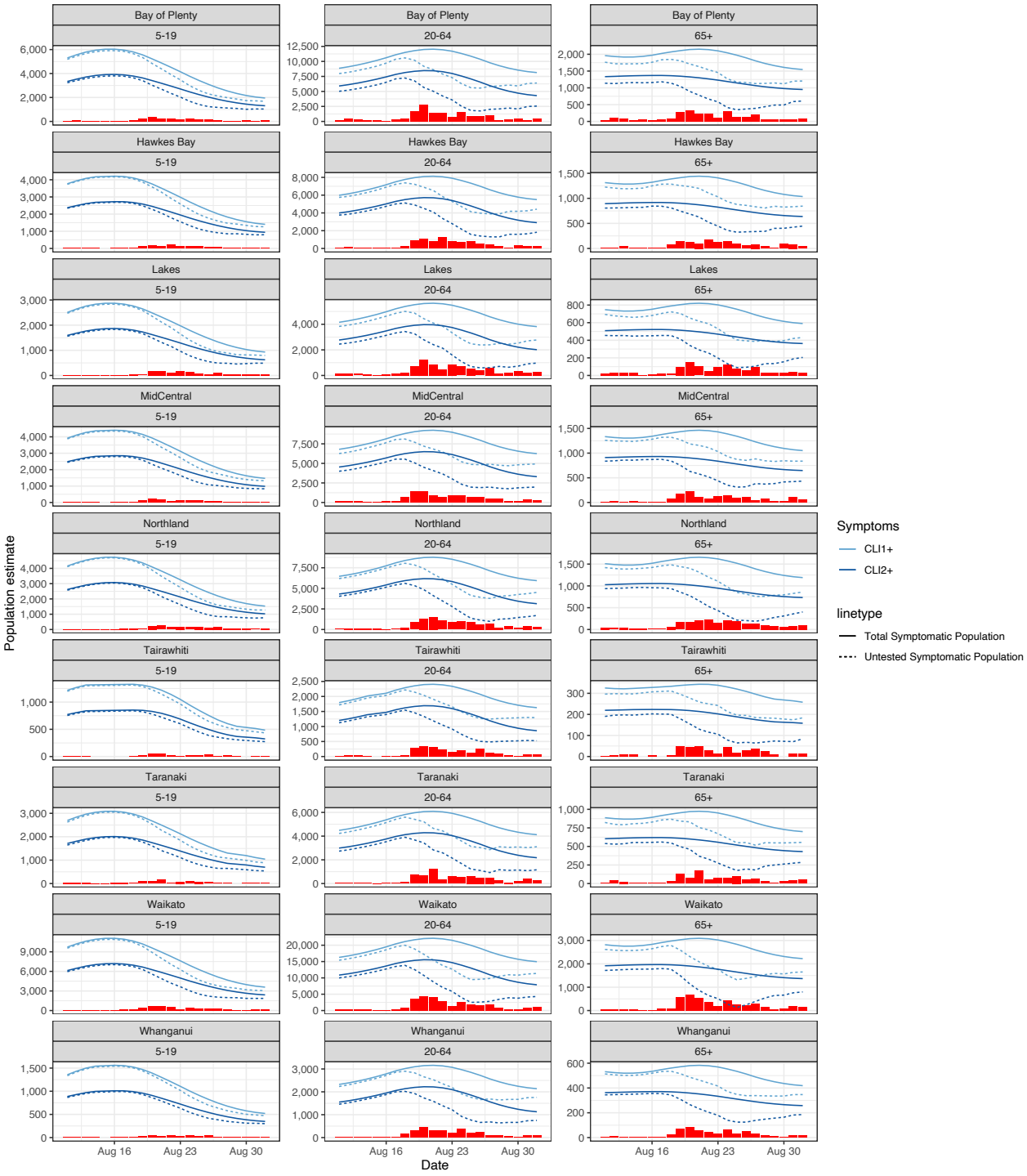
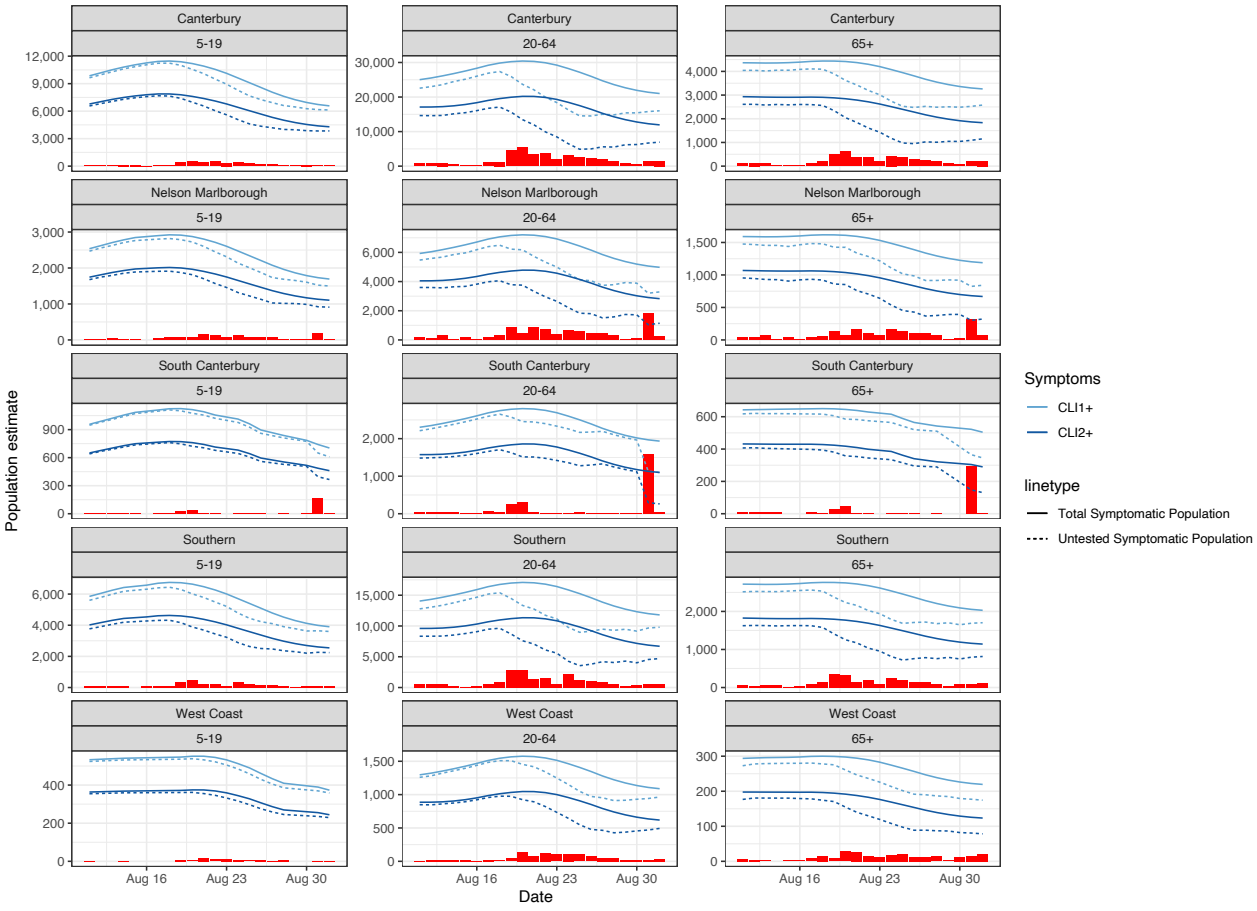


Figure 8d: Symptomatic Population estimates and estimates of untested population,
by age band and South Island DHBs. Testing data up to 01 September, 2021
FluTracking data up to week ending 29 August, 2021

Red bars show daily test numbers.
We only consider new onset within the past 7 days, and assume people wouldn't seek testing after 7 days.
CLI1+ considers incidence for any one or more COVID-like symptoms,
CLI2+ considers incidence for any one or more COVID-like symptoms.



Note: there is an issue in South Canterbury and Nelson Marlborough, where a number of tests were only entered into the system on August 31st.

Using a 7 day time window since symptom onset, and CLI1+ and CLI2+ symptom definitions, we produce estimates of current (01 September, 2021) symptomatic testing rates for different age bands and DHBs (Table 2). We also aggregate these age bands up to a single figure for each DHB (Table 3), but emphasise that this is biased by the high incidence and low testing in under5s.

Table 2: Testing rate estimates by DHB and age bands

Date	DHB_name	age_band	Percentage tested CLI1+	Percentage tested CLI2+
2021-09-01	Auckland	<5	25.9	31.1
2021-09-01	Auckland	5-19	100.0	100.0
2021-09-01	Auckland	20-64	95.5	100.0
2021-09-01	Auckland	65+	70.9	100.0
2021-09-01	Bay of Plenty	<5	10.2	7.3
2021-09-01	Bay of Plenty	5-19	14.0	20.9
2021-09-01	Bay of Plenty	20-64	21.4	40.5
2021-09-01	Bay of Plenty	65+	22.1	36.0
2021-09-01	Canterbury	<5	8.9	8.9
2021-09-01	Canterbury	5-19	6.8	10.4
2021-09-01	Canterbury	20-64	23.8	41.8
2021-09-01	Canterbury	65+	20.9	37.1

Table 2: Testing rate estimates by DHB and age bands *(continued)*

Date	DHB_name	age_band	Percentage tested CLI1+	Percentage tested CLI2+
2021-09-01	Capital and Coast	<5	8.5	9.2
2021-09-01	Capital and Coast	5-19	17.4	24.2
2021-09-01	Capital and Coast	20-64	30.2	51.5
2021-09-01	Capital and Coast	65+	22.6	44.9
2021-09-01	Counties Manukau	<5	29.6	35.6
2021-09-01	Counties Manukau	5-19	100.0	100.0
2021-09-01	Counties Manukau	20-64	100.0	100.0
2021-09-01	Counties Manukau	65+	71.5	100.0
2021-09-01	Hawkes Bay	<5	6.3	4.6
2021-09-01	Hawkes Bay	5-19	10.0	15.0
2021-09-01	Hawkes Bay	20-64	19.6	37.2
2021-09-01	Hawkes Bay	65+	18.4	30.0
2021-09-01	Hutt Valley	<5	9.3	10.1
2021-09-01	Hutt Valley	5-19	11.7	16.3
2021-09-01	Hutt Valley	20-64	21.6	36.7
2021-09-01	Hutt Valley	65+	18.0	35.8
2021-09-01	Lakes	<5	7.4	5.3
2021-09-01	Lakes	5-19	14.5	21.7
2021-09-01	Lakes	20-64	27.4	51.9
2021-09-01	Lakes	65+	26.8	43.5
2021-09-01	MidCentral	<5	5.8	4.1
2021-09-01	MidCentral	5-19	10.2	15.2
2021-09-01	MidCentral	20-64	21.2	40.1
2021-09-01	MidCentral	65+	20.4	33.1
2021-09-01	Nelson Marlborough	<5	12.1	12.2
2021-09-01	Nelson Marlborough	5-19	11.4	17.5
2021-09-01	Nelson Marlborough	20-64	33.8	59.6
2021-09-01	Nelson Marlborough	65+	29.2	51.9
2021-09-01	Northland	<5	10.4	7.4
2021-09-01	Northland	5-19	16.7	25.0
2021-09-01	Northland	20-64	24.0	45.6
2021-09-01	Northland	65+	27.7	45.0
2021-09-01	South Canterbury	5-19	13.5	20.6
2021-09-01	South Canterbury	20-64	43.3	76.1
2021-09-01	South Canterbury	65+	31.5	54.9
2021-09-01	Southern	<5	9.9	10.0
2021-09-01	Southern	5-19	7.8	11.9
2021-09-01	Southern	20-64	17.0	29.9
2021-09-01	Southern	65+	16.1	28.6
2021-09-01	Tairawhiti	<5	10.7	7.9
2021-09-01	Tairawhiti	5-19	10.3	15.4
2021-09-01	Tairawhiti	20-64	20.5	38.8
2021-09-01	Tairawhiti	65+	28.7	46.8
2021-09-01	Taranaki	<5	6.6	4.7
2021-09-01	Taranaki	5-19	15.2	22.7
2021-09-01	Taranaki	20-64	24.7	46.7
2021-09-01	Taranaki	65+	20.6	33.5
2021-09-01	Waikato	<5	9.5	6.8
2021-09-01	Waikato	5-19	15.1	22.5
2021-09-01	Waikato	20-64	24.0	45.5
2021-09-01	Waikato	65+	25.6	41.7
2021-09-01	Wairarapa	<5	9.3	10.2
2021-09-01	Wairarapa	5-19	15.7	21.8
2021-09-01	Wairarapa	20-64	20.8	35.4
2021-09-01	Wairarapa	65+	16.3	32.4
2021-09-01	Waitemata	<5	24.3	29.2
2021-09-01	Waitemata	5-19	100.0	100.0
2021-09-01	Waitemata	20-64	100.0	100.0
2021-09-01	Waitemata	65+	69.3	100.0

Table 3: Testing rate estimates by DHB for all ages

Date	DHB_name	Percentage tested CLI1+	Percentage tested CLI2+
2021-09-01	Auckland	88.6	92.4
2021-09-01	Bay of Plenty	19.3	30.3
2021-09-01	Canterbury	19.2	31.5
2021-09-01	Capital and Coast	26.0	41.9
2021-09-01	Counties Manukau	89.5	90.1
2021-09-01	Hawkes Bay	16.7	26.3
2021-09-01	Hutt Valley	18.6	29.7
2021-09-01	Lakes	23.4	36.7
2021-09-01	MidCentral	18.1	28.6
2021-09-01	Nelson Marlborough	27.4	45.1
2021-09-01	Northland	22.1	34.5
2021-09-01	South Canterbury	34.7	59.0
2021-09-01	Southern	14.6	23.9
2021-09-01	Tairawhiti	18.4	28.5
2021-09-01	Taranaki	21.1	33.3
2021-09-01	Waikato	21.5	33.7
2021-09-01	Wairarapa	18.3	29.4
2021-09-01	Waitemata	89.2	90.2
2021-09-01	West Coast	10.7	17.4
2021-09-01	Whanganui	16.2	28.7

Table 2: Testing rate estimates by DHB and age bands *(continued)*

Date	DHB_name	age_band	Percentage tested CLI1+	Percentage tested CLI2+
2021-09-01	West Coast	<5	7.9	8.6
2021-09-01	West Coast	5-19	4.0	6.1
2021-09-01	West Coast	20-64	11.5	20.2
2021-09-01	West Coast	65+	20.5	36.5
2021-09-01	Whanganui	5-19	9.2	13.8
2021-09-01	Whanganui	20-64	17.7	33.5
2021-09-01	Whanganui	65+	17.2	27.9

3.2.2 Sensitivity to 7 day assumption In the estimates produced so far, we only consider people with new onset of symptoms within the past 7 days, and we assume that all people seeking a test would have had symptom onset within the past 7 days. In the initial stages of the outbreak, when we had been seeing low testing rates in the previous weeks, we expect that a number of the people seeking tests may have had symptoms for more than 7 days. In Figure 9 we extend the time since symptom onset out to 10 or 14 days. This acts as a rough sensitivity analysis for this approach.

In general, the total symptomatic population increases when the time window increases, but that the total number of tests is also over a longer period. In this case (decreasing incidence rates and decreasing test numbers), we find that the estimates of the proportion of the symptomatic population who have been tested is lower for 10 and 14 day time windows in the initial stages of the outbreak, but that the 7 day time window picks up decreasing test numbers sooner in the latest week. This is seen in the 65+ age group most clearly.

Figure 9: Estimated proportion of the symptomatic population tested in Auckland Region DHBs, based on different case definitions, and different Time Windows after symptom onset