

# Root Cause Analysis Report

## National Contact Tracing Solution Date Timestamp Issue

October 2020 – Final

### Executive Summary

The root cause analysis (RCA) review process is complete. A principle approach guides the process:

- Thoroughness - a review of all possible causes is required.
- Fairness – participation of those involved.
- Efficiency – the time to complete the RCA is consistent with the significance of the issue being investigated.
- Independence - investigation independence reduces the impact of bias and ensure impartiality.

This issue has occurred within a new service set up to support the Ministry of Health's response to COVID-19. The recommendations are presented as draft because they are prepared without full understanding of the current operating environment of the wider COVID-19 Directorate.

The recommendations are prepared to address the risks associated with the underlying issue and the probability of its reoccurrence. The recommendations reflect the Ministry's value of Kaitiakitanga.

1. Acknowledge the commitment of NITC staff and partners to secure as soon as possible a resolution to the issue.
2. Formally recognise and celebrate the commitment of the teams that is the hallmark of CMMI Level 1.
3. Recognise the inherent process and systems risks associated with the assessment of capability maturity aligned to CMMI Level 1 with activity underway to reach Level 2.
4. Promptly progress NITC capability maturity level/s by securing enough resource and expertise to establish a system-based QMS framework including an acceptance testing approach for NCTS. The objective is to mitigate system risks to an acceptable level including the risk of diminished trust and confidence in the Ministry's response to COVID-19.
5. Promptly assess staff development and training needs to match NCTS business requirements, identify any skill or training gaps for existing staff, and analyse the benefit of a targeted workforce development plan and if required a supporting recruitment plan.
6. Promote with NITC staff and partners timely communication of a concern or issue; consider adopting a structured approach such as the RACI or RASCI matrix to safeguard individual commitment to a culture of continuous quality improvement.

*Kaitiakitanga*

*Ka mua, ka muri*

The past is clearly visible, but the future is not

The future comes out of the past

The only constant is change

## Process

A root cause analysis (RCA) is a comprehensive term encompassing a collection of problem-solving methods used to identify the underlying or fundamental cause for a non-conformance to a standard or a quality problem. The term 'root cause' refers to the precise point in a causal chain where a corrective action or intervention is required to prevent recurrence. In general, an RCA is completed soon after an issue is resolved. The RCA assumes there is no obvious human error and no previously identified concern on professional practice and or personal conduct.

To support the RCA a table top review has been conducted. This involved a review of associated documents, discussion with relevant staff and additional technical advice was sought.

The timeframe scope of the review is the operating period of National Investigation and Tracing Centre (NITC)<sup>1</sup> to the time of the incident from 18 March to late September 2020 ie, six months.

## About National Contact Tracing Solution (NCTS)

- NCTS is an information technology (IT) solution to support case investigation, management and contact tracing. It's a single national platform to be accessed by PHUs, NITC and Healthline. NCTS enables management of cases, contacts and clusters.
- NCTS monitors the performance of the system and help identify trends at a regional and national level. All data related to COVID-19 cases and close contacts will be entered and securely stored in the solution.
- NCTS is an adaptation of Salesforce. Salesforce is a customer relationship management platform operating as software as a service (SaaS). The Ministry contracted Deloitte as the platform developers.
- Since NCTS was stood up on 6 April 2020, several enhancements have been made, including integration with EpiSurv, border health requirements and the NZ COVID Tracer Application (App).
- The Contact Tracing Data Management Overview is outlined in Appendix One - Diagram 1.
- The purpose of the data monitoring platform is to create a curated data layer across all data sets involved in Contact Tracing. This enables the Ministry's end-to-end Monitoring Framework for COVID-19 Cases.
- The NCTS data monitoring platform is a solution that has been configured using Amazon Web Services (AWS) data management services to support the collection, transformation and presentation of individual case related data to support reporting and monitoring national contact tracing services for the COVID-19 response.
- The NITC routinely publish data on ten system performance indicators using data from three distinct sources; EpiSurv (case notification), Éclair (for laboratory results) and the NCTS (for all case and contact tracing management records). EpiSurv and Éclair data is recorded in Local Time (Pacific/Auckland).
- Amazon Athena<sup>2</sup> is used as the query tool for reporting from the three sources of COVID-19 case related data.
- A Qlik Sense Application (Qlik App) was developed to enable hourly reporting. The Qlik App went live in mid-August 20.

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<sup>1</sup> Initially NITC was known as the national close contact service. The name changed as the service scope and purpose changed.

<sup>2</sup> Amazon Athena aka Athena is an interactive query service that makes it easier to analyse data using standard SQL.

## Background

1. On 22 September the National Investigation and Tracing Centre (NITC) identified that since 18 August 2020, contact tracing indicators related to timeliness were not adjusted to the Local Time (Pacific/Auckland). This meant an additional 12 hours were included in the time period when reporting on seven of the ten reporting metrics. Contact tracing indicators are outlined in Appendix Two – Diagram 2.
2. The performance indicators measure the aggregated performance of the close contact and investigation service. The indicators are not prepared to track the journey of an individual COVID-19 case and their close contacts. As such the implications of a defect or an error does not affect the quality of the NITC services or the service providers. Of importance the defect did not cause harm to any person with COVID-19.
3. An accepted 'always' software requirement is compliance to an agreed time zone (in most cases local time) and preferred language ie, to develop a product that will meet local business requirements. Is it important to note that NCTS internal tracking clocks were always correct and accurate; the issue arises when combining Salesforce data with other system's data in the raw layer.
4. Coordinated Universal Time or UTC<sup>3</sup> is a time standard used across the world. The Salesforce software used by the National Contact Tracing Solution (NCTS) records time and date fields in UTC. The UTC timestamp<sup>4</sup> is identified by a trailing 'z' code<sup>5</sup> added at the end of the time and date fields. For accurate monitoring and reporting in the New Zealand context the timestamp needs to reflect New Zealand (NZ) standard time (+12 hours).

What was the issue?

A defect was identified in the raw data layer where the source Salesforce date and time data fields were not recorded in the original Salesforce format. The conversion removed a trailing 'z' from the datestamp which identifies the time zone UTC plus zero hours aka Zulu time. In other words, UTC without the trailing z code remains UTC.

This is not in line with the business requirement of the data management layer to reflect local time, nor was it apparent to the data user.

Because of this defect it was not possible for the data user to identify in the raw or curated data layer which dates were in UTC or local time (Pacific/Auckland), and where date times received from external systems are in local time. This resulted in reporting errors across the COVID-19 monitoring framework as the data calculations assumed that all dates were local time.

Therefore, reporting of the indicator was not adjusted for local time (Pacific/Auckland). The exclusion of the 'z' code effectively added an additional 12 hours to a denominator sourced from NCTS data and used in calculating the result for seven of the 10 performance indicators.

5. Although the preliminary investigation quickly identified the technical cause and the necessary fix was completed by 28 September, a further investigation for possible system related root cause/s is outlined below.
6. This review will assess why this defect was not picked up until NITC transitioned from an intensive and time-consuming manual reporting process to hourly reporting on the Qlik App.

<sup>3</sup>Coordinated Universal Time (UTC) is the primary time standard by which the world regulates clocks and time. It is within about 1 second of mean solar time at 0° longitude and is not adjusted for daylight saving time. It is effectively a successor to Greenwich Mean Time (GMT).

<sup>4</sup>A timestamp is a sequence of characters or encoded information identifying when a certain event occurred, usually giving date and time of day, sometimes accurate to a small fraction of a second.

<sup>5</sup>The z code stands for zulu code and indicates an offset of zero (0) hours from UTC

## Step 1: Define the problem

### Problem One: Defect in software development

7. The identified cause of the problem is the defect<sup>6</sup> in the software.
8. In mid-June when business acceptance testing was completed it was assumed that the UTC datetime included the 'z' code in the raw and curated data. The trailing 'z' code was described as essential in the NCTS data requirements although the z code needs to be removed from the data string when curated data is queried via Athena.
9. Athena is the query tool used by the NITC report team. The lack of the 'z' code meant the reporting team was unaware they needed to adjust the indicators affected ie, reports prepared with data from the NCTS and one other data source.
10. The objective of the Qlik App development was to achieve close to real time reporting with hourly updates on performance across the system. The Qlik App changed the reporting baseline from a result measured within a 24-hour period to a result measured within an hour. In the context of this issue, the result was confounded by plus 12 hours<sup>7</sup> added to the reporting denominator for seven of the 10 indicators.
11. Another objective of introducing the Qlik App was to improve the responsiveness of NITC because the performance indicators measures the aggregated timeliness of engagement with COVID-19 people plus close contacts and their comparative progress across the disease & contact tracing pathway.
12. As such a comparison between previous reports and the new reports would demonstrate improved granularity as the time for each date was to the hour; previously it was to the 24-hour day. Because of the Qlik App it was expected the actual performance would shift ie, the performance would improve or worsen because of improved accuracy.
13. When checking the new results, the NCTS reporting team preparing the close contact and border health indicators reports observed unexpected variance in the results. The team proposed it was linked to data from NCTS being in UTC time and not local NZ time. The team sought to confirm the matter of concern as an issue. And as noted above, on 22 September NITC identified the issue and a response plan was implemented.
14. The timestamp defect was not known to the NCTS reporting team therefore from this date the results for seven of the 10 performance indicators were incorrect. From the 18 August reports were released for the 10 performance indicators available via the Qlik App. The affected performance indicator reports have now been re-issued with corrected results.

Problem statement: There was a standing defect in quality of the source data related to the date timestamp that adversely affected the reliability of the performance indicator reports released from 18 August till the time the reporting was paused to allow the fix to occur.

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<sup>6</sup> Defect is an imperfection or deficiency in a work product where it does not meet its requirement or specifications

<sup>7</sup> Due to NZ daylight saving time from 29 September 20 the time offset is + 13 hours

Problem Two: Software development occurs in flight

15. The COVID-19 close contact service did not exist till 18 March 2020. The national close contact service stood up NCTS on 6 April 2020. Since this time NITC with Deloitte the solution developer has overseen a series of enhancements to NCTS including extension for border health, integration with EpiSurv and the Qlik App.
16. In simple terms NCTS developments progresses across a standard work flow:

**Business need > Business requirement > Data requirement > Developer enhancement > Testing > Acceptance**

17. The focus of the RCA is the quality of NCTS data management as the issue has diminished trust and confidence with report reliability on the NITC performance indicators. A fundamental business need is the preparation of timely and reliable reports.
18. In mid-June business acceptance testing of data sourced from NCTS was conducted and produced a gap analysis. From this activity a list of issues was identified and addressed by Deloitte. The absence of the UTC 'z' code to the date timestamp to match Athena's query tool requirements was not identified. No other business or user testing analysis occurred after this time.
19. As a result of the investigation into the background to this issue it was found the 'z' code was absent since the time the NCTS platform was stood up. Further when responding to the issue, the developer acknowledged there was no user expectation of the need to modify timestamp dependent on NCTS data prior to reporting on performance indicators.
20. The reporting team attempted a fix with a workaround on the Qlik App. A fix of this kind may have addressed the specific reporting issue, but it would not have isolated the underlying timestamp issue or resolved the defect. Assuring the quality of the reporting inputs depends on a balance of timely and targeted quality assurance (QA) activity to assure adherence to appropriate development procedures and processes to prevent product defects, and quality control to detect and correct product defects.
21. A quality management system (QMS) <sup>8</sup> is necessary to assure the quality of NITC close contact service provision including NCTS as a critical business enabler. A NCTS testing strategy or approach can fulfil this function with a testing plan across the product work flow ie, a testing plan can incorporate the developer's quality assurance activity to evidence comprehensive coverage and support shared risk mitigation actions in partnership with the developer.
22. In general terms the function of testing strategy or a testing approach to plan, design and execute tests, analyse, monitor and control in order to evaluate the quality of the developer's work products such as match to requirements, user story<sup>9</sup>, design and code.
23. The extent of quality related testing activity can be matched to the business's appetite for risk. Within a strategic approach risk base testing<sup>10</sup> includes timely notification to the business owner for critical decision-making including acceptance sign off or highlighting an issue that may affect the trust and confidence and or reputation of NITC.

Problem statement: The business acceptance testing did no detect the defect.

<sup>8</sup> A quality management system (QMS) A formal system that documents the structure, processes, roles, responsibilities and procedures required to achieve effective quality management. It is aligned with an organisation's purpose and strategic direction.

<sup>9</sup> User story is a user or business requirement consisting on one sentence expressed in the everyday or business language which is capturing the functionality a user needs, the reason behind it, any non-functional criteria and including acceptance criteria.

<sup>10</sup> Risk based testing is the engagement, selection, prioritisation, and use of testing activities and resources are based on corresponding risk types and risk levels (informed by the appetite for risk)

### Problem Three: Quality Assurance

24. Business acceptance testing is not an end in itself; it is one quality assurance activity in a suite of interactive QA actions aligned to a comprehensive strategic approach.
25. As NITC business needs grew NCTS was developed at pace. The business needs grew in response to the rapidly escalating need to contain COVID-19 in New Zealand. The growth was not linear; rather there was exponential growth as the scope of NITC accountability and NCTS functionality changed to match the requirements of New Zealand's COVID-19 response. For example, the extension to NCTS to include border health and the expansion of its use by the twelve public health units (PHUs). As such it is reasonable to observe NCTS time and resources were required to complete iterative change to the high availability<sup>11</sup> IT platform in a pressured operating environment.
26. Managing this scale of change in the absence of a fully a mature operating environment is challenging. Defects and mistakes can be expected and NITC has not matured to the level where a systematic approach to quality has been established. A capability maturity model<sup>12</sup> is one framework for appraising the process and capability maturity of the organisation.
27. The Capability Maturity Model Integration model (CMMI) is used to provide guidance for developing or improving processes that meet the business goals of an organization. A diagram of CMMI is attached in Appendix Three. As stated by CMMI Institute "The maturity level or capability level of an organization provides a way to characterize its capability and performance. Experience has shown that organizations do their best when they focus their process improvement efforts on a prioritized and manageable number of practice areas at a time."
28. A mature system will afford reasonable protection and evidence an acceptable level of capability to safeguard against system or enabler defects, as well as human error and mistakes affecting the system performance. The maturity of NITC and NCTS are inextricably linked by purpose and time. At the time of preparing this report and in accordance with the CMMI model the NITC and NCTS capabilities are assessed as Level 1 with activity underway to reach Level 2.
29. A risk-based approach to QA can inform the level of investment required to progress to a satisfactory level of capability maturity. At a minimum the investment should be to a level to prevent a repeat of a situation the same or like this issue. As noted, human error and mistakes can occur when the system has not developed capability with a strategic approach to business processes and a quality framework.
30. For a wider context to this issue there is direct relevance with the World Health Organisation (WHO)'s approach to quality to achieve patient safety. The WHO states "Traditionally, the individual provider who actively made the mistake (active error) would take the blame for such an incident occurring and might also be punished as a result. Unfortunately, this does not consider the factors in the system that led to the occurrence of error (latent errors). It is when multiple latent errors align that an active error reaches the patient."

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<sup>11</sup> High availability (HA) is a characteristic of a system which aims to ensure an agreed level of operational performance, usually uptime, for a higher than normal period. For example, hospitals and data centres require high availability of their systems to perform routine daily activities. Availability refers to the ability of the user community to obtain a service or good, access the system, whether to submit new work, update or alter existing work, or collect the results of previous work. If a user cannot access the system, it is – from the user's point of view – unavailable. Generally, the term downtime is used to refer to periods when a system is unavailable.

<sup>12</sup> The Capability Maturity Model was originally developed as a tool for objectively assessing the ability of government contractors' processes to implement a contracted software project.

31. The WHO supports a system approach to quality and explains this by stating “Humans are guarded from making mistakes when placed in an error-proof environment where the systems, tasks and processes they work in are well designed. Therefore, focusing on the system that allows harm to occur is the beginning of improvement, and this can only occur in an open and transparent environment where a safety culture prevails. This is a culture where a high level of importance is placed on safety beliefs, values and attitudes and shared by most people within the workplace.”
32. It is recognised that a commitment to staff development is vital in fostering a high level of staff satisfaction and supports staff retention in a positive workplace culture. In relation to the last six months NITC’s work has produced a significant level of unique business knowledge; NITC is exposed to the risk of loss even with low staff turnover, as such professional development is a benefit to NITC capability. NITC can enhance capability building by engaging staff with quality improvement principles and supporting their individual contribution to develop a culture of quality.

Problem Statement 3: Product testing did not occur within a quality assurance framework.

## Step 2 Additional Information

### 1. Timeline

As a record of completeness an incident timeline has not been prepared to assist the RCA.

### 2. Source of information

- Situation Report prepared by Deloitte
- Data Management & Monitoring Report Test Plan and Summary – NCTS Test Lead
- NITC information from Astrid Koornneef, NITC Group Manager
- International Software Testing Qualifications Board Glossary
- 2020 American Society for Quality Terms & Definitions
- Discussions with Eddie Gray, Technology Director Population Health, Ministry of Health
- Incident response team briefs
- International Software Testing Qualifications Board Syllabus: Certified Tester Foundation Level
- NCTS Data Platform for Contact Tracing Monitoring Design Document

## Step3: Identify possible causal factors

This issue occurred in a snapshot of time and the possible casual factors reflect the operating environment in which the issue occurred. They do not reflect individual behaviour or action. The following factors may have contributed to the root cause of the issue. The possible causal factors also support the assessment that in accordance with the CMMI model NITC and NCTS capability is Level 1 with activity underway to reach Level 2.

In no priority order and as they relate NITC enablers, systems and processes:

### 1. Process

Managing change at pace which impacted on:

- Not enough time to check business needs to all data requirements
- Limited full record keeping of agreements on business needs, business requirements
- Not enough time to preserve, repeatedly transfer business and developer knowledge
- Not enough resource with the necessary skill to support all change and quality assurance related processes
- Little time to complete enough staff and contractor induction
- A challenging operating environment to keep QA processes front of mind



## 2. System

Rapid development of the system and:

- Individual or group assumptions made with little time to check and recheck
- The business needs altered with rapidity to achieve exponential steps in the first six months of operating
- Little inbuilt system resilience to consistently perform at a high level within the context COVID-19 and its impact on the lives of New Zealanders (including the staff working in or with NITC or NCTS)
- Existing system and monitoring functions could not be adapted to detect system and process issues such as non-conformity to business requirements
- In context of the pressure to perform and the time available, it wasn't possible for NCTS reach an accepted level of performance with supporting processes

## 3. Governance

Meeting the business design needs while establishing adequate monitoring and oversight at pace such as:

- Experiencing time and resource constraints with limited resource to support governance 'line of sight' activity over the effectiveness of the system enablers, partner functions and key relationships
- Accountability and relationship forums to guide service, system and enabler planning & design were completed at pace
- Consolidating accountability structure, roles and functions could not be prioritised due to the pressure to achieve business goals

### **Step 4: Identify root causes**

A three-legged RCA method<sup>13</sup> was applied to identify the root cause of the issue.

The three legs of the RCA are:

#### 1. Direct cause

The immediate reason and cause/s that lead to the non-conformity is:

- a. A defect in NCTS production phase.

#### 2. Detectability

The process controls that failed or not in place to detect the non-conformity:

- a. The business acceptance testing did not detect the defect.

#### 3. System Cause

The core programme policies, procedures, processes and overall governing system that allowed the problem/s to occur and go undetected:

- a. NITC approach to quality assurance acceptance testing is not established.
- b. A system-based approach to quality and culture is not established.

### A Related Finding

- a. There was no person directed error either by commission or omission identified in this RCA.

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<sup>13</sup>A targeted RCA method to solving persistent and/or a systemic problem



## Step 5: Recommended solutions

The following recommendations are presented as draft for consideration by the Ministry and NITC leadership:

1. Acknowledge the commitment of NITC staff and partners to secure as soon as possible a resolution to the issue.
2. Formally recognise and celebrate the commitment of the teams that is the hallmark of CMMI Level 1.
3. Recognise the inherent process and systems risks associated with the assessment of capacity maturity aligned to CMMI Level 1 with activity underway to reach Level 2.
4. Promptly progress NITC capability maturity level/s by securing enough resource and expertise to establish a system-based QMS framework including an acceptance testing approach for NCTS. The objective is to mitigate system risks to an acceptable level including the risk of diminished trust and confidence in the Ministry's response to COVID-19.
5. Promptly assess staff development and training needs to match NCTS business requirements, identify any skill or training gaps for existing staff, and analyse the benefit of a targeted workforce development plan and if required a supporting recruitment plan.
6. Promote with NITC staff and partners timely communication of a concern or issue; consider adopting a structured approach such as the RACI or RASCI matrix<sup>14</sup> to safeguard individual commitment to a culture of continuous quality improvement.

In closing the RCA was not possible without the timely assistance and advice from many people including Ministry's NITC team, contractors and Deloitte's staff.

The reviewer is Christine Nolan, Quality Manager National Screening Unit

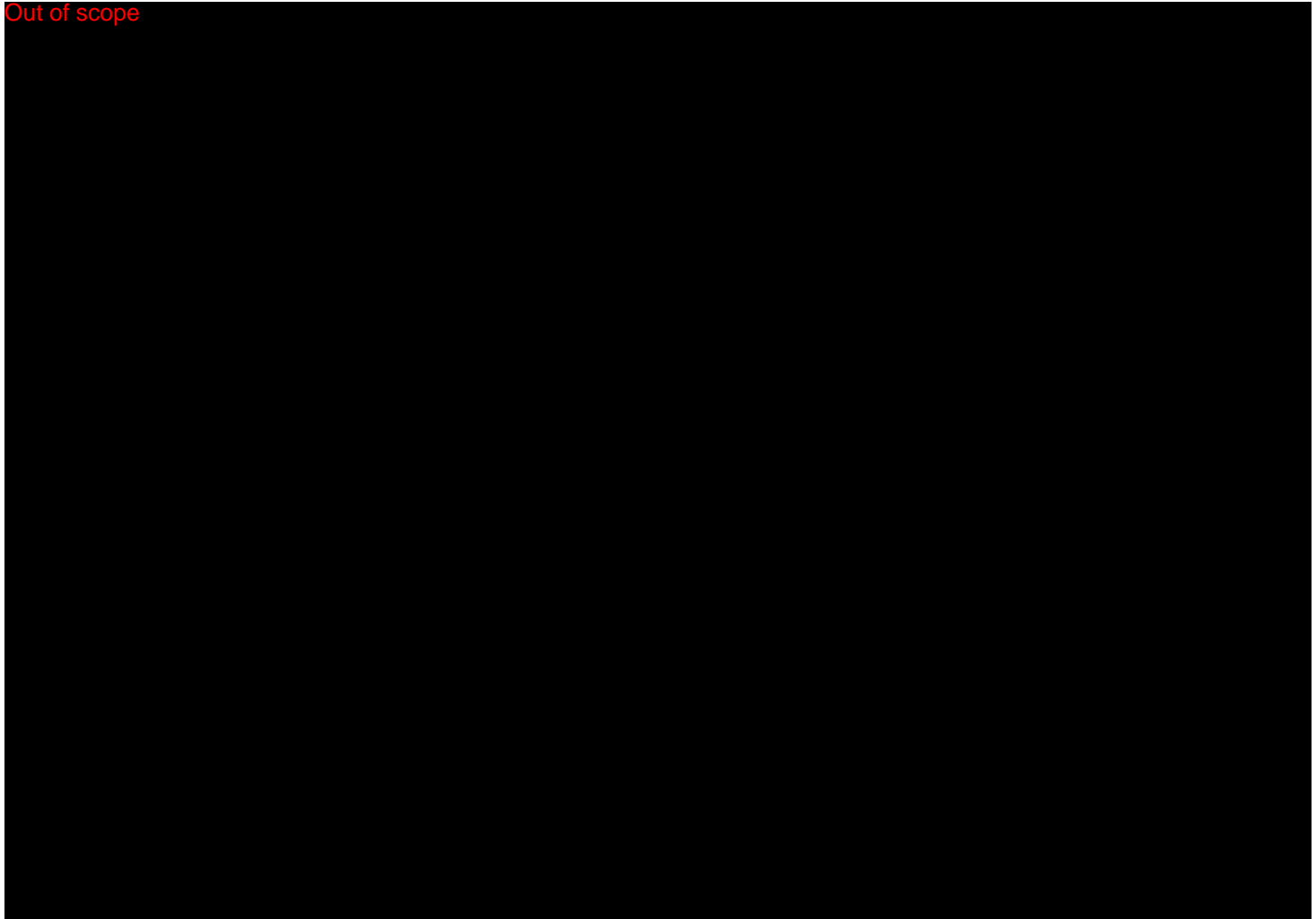
The RCA report style and limitations are outlined in Appendix Four.

Date: October 2020

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<sup>14</sup> A responsibility assignment matrix to describe the participation by various roles in completing tasks or deliverables for a project or business process. It's used for clarifying and defining roles and responsibilities in cross-functional or departmental projects and processes.

RACI: Responsible, Accountable, Consulted, Informed or RASCI: Responsible, Accountable, Supported, Consulted, Informed

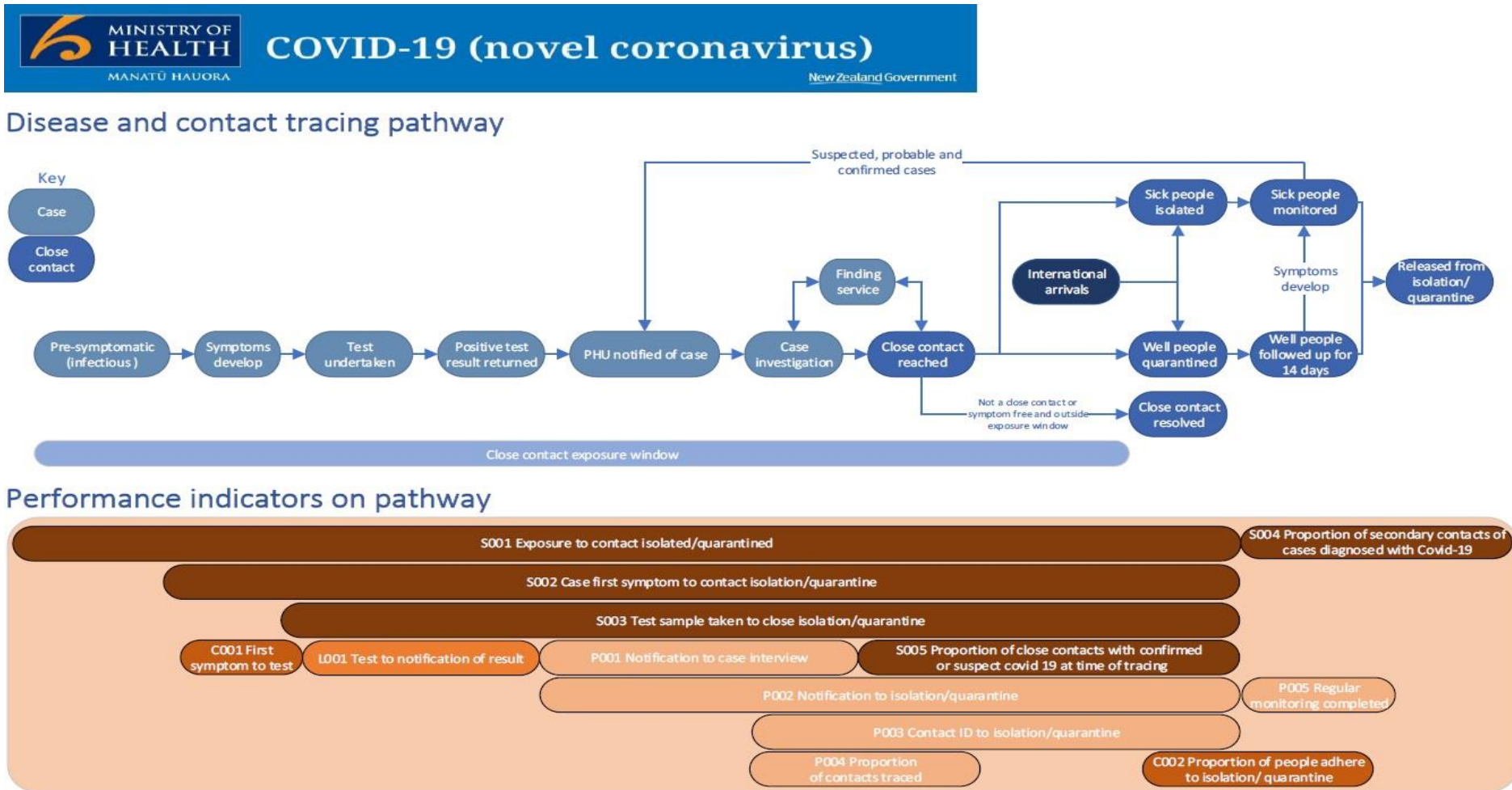


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<sup>15</sup> National Screening Solution Amazon Web Services

## APPENDIX TWO

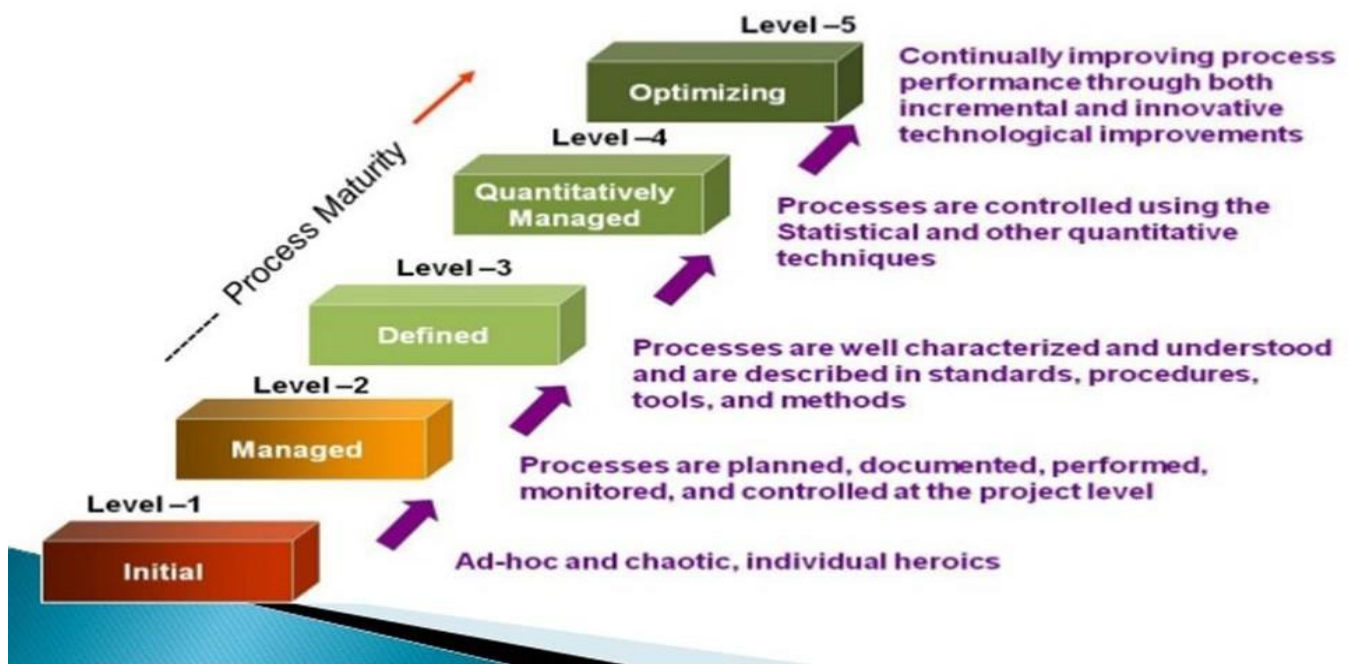
Diagram 2: Disease and Contact tracing Pathway with Performance Indicators



APENDIX THREE

Capability Maturity Model Integration (CMMI) - sourced from CMMI Institute

### CMMI Maturity Levels



## APPENDIX FOUR

### RCA Report style and limitations

#### Style

- The IS terms used in this report are all drawn from the *Standard Glossary of Terms used in Software Testing Version 3.4*
- The body of the report is prepared in the passive voice to link and balance the flow of information and to avoid statements of blame.
- This is a table top review. There were no formal interviews with the participants or minutes taken.

#### Limitations

- The reviewer has no training or expertise in Information System development, testing or use.
- The RCA has drawn reference from the named reports and material as it relates to the RCA only.
- The RCA report is not prepared to update the previously released material or related reports.
- It is assumed the reader of the RCA report has a working knowledge of the Ministry's COVID-19 response and contemporary knowledge of the COVID-19 accountability structure, role and functional responsibilities, enablers and support processes.
- Any gaps or errors in the report are the reviewer's own.