Field Epidemiology
IN ACTION

Case Study

Public Health Surveillance

Contents

Note: If this case study includes any technical terms which you may not understand, refer to the Field Epidemiology in Action reference guide which provides general epidemiology definitions. The Field Epidemiology Reference Guide document is available at: https://www.fieldepiinaction.com/reference-guide.

If you wish to explore the topics covered in this case study, there is an eLearning course on public health surveillance on the Field Epidemiology in Action website: https://www.fieldepiinaction.com/basics-of-public-health-surveillance

All people, places and scenarios contained in this case study are fictional.

1

Background

You are a Public Health Officer and newly graduated FETP fellow in the Alphabet Islands, a small tropical island country. The country has six main provincial islands (named Alpha, Bravo, Charlie, Delta, Echo, and Foxtrot), and hundreds of smaller, sparsely populated islands spread over a large geographic area in the Western Pacific region.

It's Monday, 4 July 2022. Today you start a new job as assistant national syndromic surveillance focal point! You've worked very hard to deserve this promotion, and you're eager to help further strengthen the public health surveillance system in your country.

Your office is at the national Ministry of Health, which is located in the capital city on a hillside overlooking the ocean, on the largest island by geographic size and population (Alpha Island).

Your supervisor is Simone, the senior National Public Health Surveillance Officer in the Ministry of Health, Surveillance Branch. Under Officer Simone's guidance, it will be your responsibility to manage the country's surveillance system for influenza-like illness (ILI), and other clinical syndromes (1).

Officer Simone congratulates you on your new position, then immediately starts a briefing about the responsibilities and challenges of your new job.

Figure 1 A depiction of a rural seaside village on Bravo Island, in the Alphabet Islands

Officer Simone says:

There are six sentinel sites collecting surveillance data for ILI syndrome in the Alphabet islands – one on each of the six major islands. These sites are located in the provincial capital hospitals on the three larger islands of Alpha, Bravo and Charlie; or at the provincial community health centres on the three smaller islands of Delta, Echo and Foxtrot.

The Ministry has been conducting national ILI surveillance for several years now. But recently, the COVID-19 pandemic put a lot of strain on our health system which has limited resources, laboratory testing capacity and staff. When the pandemic started in early 2020, the Government of the Alphabet Islands introduced several public health restrictions to prevent the spread of COVID-19 in our country. These included hygiene and physical distancing measures, movement restrictions between islands, and the international border was closed for almost two years, during 2020 and 2021. Now that the border is open again and trade and tourism is resuming, things are slowly starting to return to normal.

We've seen a significant increase in syndromic surveillance signals for ILI this year so far, compared to 2020 and 2021 – but we're not sure what exactly this means! Some of the increase is due to COVID-19, but what about influenza virus? There used to be a clear seasonal pattern of increase in ILI presentations during the southern hemisphere winter months, between April and August each year. This is typically a busy tourist season, when we receive a lot of visitors from overseas. Some of these tourists bring respiratory illnesses with them. This didn't happen in the past two years, so I think we need to better understand what is happening this year.

I'm worried that the changing data patterns will cause us to miss important signals about the burden of seasonal ILI or outbreaks of other respiratory diseases. Our provincial immunisation coverage rates against COVID-19 are still rather low, especially in rural areas. So, there are several groups of people at risk of severe respiratory illness, especially if they are very young, elderly or have underlying risk factors like diabetes or cardiovascular disease. I'm worried we might miss large outbreaks in these groups.

Your first task will be to examine the current system and ILI syndromic data received weekly from the six sentinel surveillance sites, then report back about some of your findings, challenges and any recommendations to improve the system (3).

Please remember that any ideas you develop should build upon the established data collection mechanisms, reporting pathways, and response procedures that our provincial health workers are already familiar with.

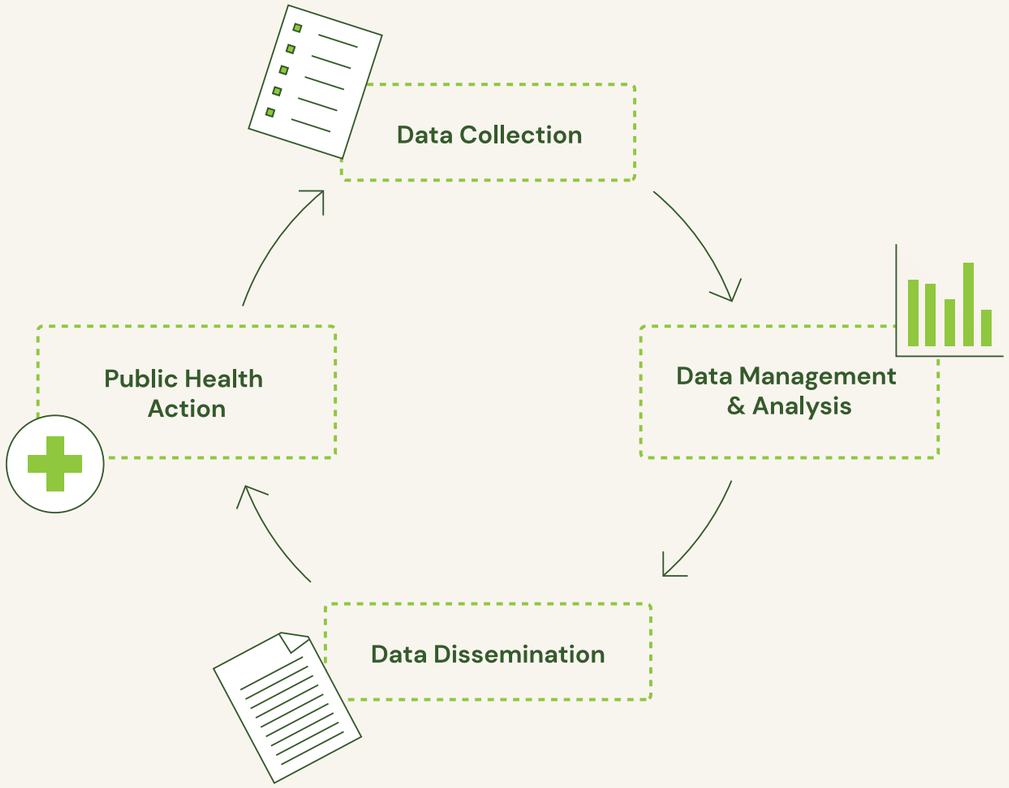
Let me know if you have any questions. Good luck!

That's a lot of information to take in!

You clearly have a big task ahead to help Officer Simone understand the ILI syndromic surveillance signals. Thankfully, as a trained field epidemiologist, you recall the definition of public health surveillance: the ongoing, systematic collection, analysis, interpretation and dissemination of health-related data for public health action (4).

You also recall that broadly speaking, the surveillance cycle (loop) consists of the following four key components:

Figure 2: The key components of the public health surveillance cycle.



To help you better understand the existing system, including its strengths and weaknesses, you decide to start by reviewing the surveillance system objectives and the ILI syndrome case definition.

2

Surveillance objectives

You recall that a surveillance objective is a statement about what the system is trying to achieve.

Officer Simone provides you with the Ministry's document called the *Operational Guideline for Syndromic Surveillance in the Alphabet Islands*, which clearly defines the three primary objectives of the national ILI syndromic surveillance system:

Objectives of the Alphabet Islands ILI syndromic surveillance system:

- To provide early warning of outbreaks and other important public health events, so that immediate action can be taken and health impacts minimised;
- To monitor ILI surveillance data trends, including if ILI signals are above or below the calculated threshold, to enable early detection of clusters of ILI or outbreaks of respiratory disease; and
- To strengthen the Alphabet Islands' capacity to comply with international obligations under the International Health Regulations (IHR 2005) (5) which includes early detection and outbreak investigation, and immediate notification to WHO of events or outbreaks of potential international importance.

You identify the key themes outlined in the surveillance objectives:

- Regularly monitor ILI trends for signals;
- If a signal exceeds the threshold, investigate further;
- Follow up to identify any ILI clusters or outbreaks or respiratory illness early;
- Communicate your findings to the decision makers who need to know;
- Take immediate action to minimise the public health impacts; and
- Comply with international reporting obligations of notifiable disease events to the World Health Organization (WHO) under the IHR (2005).

Knowing the system's objectives is very helpful - you now understand the regular tasks to be performed in your new job.

Next, you need to understand what influenza-like illness (ILI) syndrome means. Again, thankfully this information is clearly defined in the Ministry's operational guideline as a syndromic case definition.

Case definition for influenza-like illness (ILI) syndrome:

A sudden onset of fever (defined as temperature above 38°C) **AND** Cough

You notice that the case definition for ILI is quite broad, and basically covers any respiratory illness causing fever, plus a cough. This syndrome of clinical symptoms could be caused by several organisms or exposures, including:

- Viruses, e.g. influenza virus, the virus that causes COVID-19 (SARS-CoV-2), respiratory syncytial virus (RSV), and many others;
- Various bacterial respiratory infections (e.g., diphtheria caused by the bacterium, *Corynebacterium diphtheriae*);
- Other possible, but rarer causes of ILI syndrome include parasitic and fungal infections, toxic exposures or even allergic reactions.

Next, you need to understand more about how the current system works, specifically the type of surveillance that's being conducted.

3

Types of surveillance

To understand more about the types of public health surveillance being conducted, you again refer to the Ministry's Operational Guideline for Syndromic Surveillance in the Alphabet Islands.

The guideline explains there are two main types of public health surveillance conducted in the Alphabet Islands:

Indicator-based surveillance

Indicator-based surveillance is the regular, systematic collection, monitoring, analysis and interpretation of structured data.

This is the structured, routine collection, analysis and reporting of data on specific diseases or syndromes by designated people, based on case definitions.

The Alphabet Islands has a sentinel, syndromic surveillance system.

Sentinel surveillance means a sample of surveillance sites that contribute reports to the system. Sentinel sites were chosen due to geographical location on each major island, diagnostic capacity and available staff. Due to being a sample of sites, the data are not representative of the entire population, but are an indicator of what is happening with syndromes under surveillance in the Alphabet Islands.

Syndromic surveillance is based on identifying cases by using a case definition of clinical signs and symptoms rather than a laboratory diagnosis. This means that identifying cases can be rapid as it is based on clinical signs and symptoms that can be done quickly at a clinic, rather than needing to wait for a laboratory confirmation.

Health clinics on each island collect data about patients presenting with, influenza-like illness (ILI), which gets regularly reported (weekly) to a provincial syndromic surveillance focal point on each of the six main islands. The provincial syndromic surveillance focal point then sends the data on to the National Ministry of Health, Surveillance Branch.

Data are sent through every week and regularly analysed to see if the number of people with ILI is higher than normal. If there are more people with ILI than what is expected (exceeding the threshold), this is considered an ILI signal alert.

The Ministry will then take action, and will try to verify if there really is a cluster or an outbreak. If patients have a specimen collected which is tested at a laboratory for a respiratory illness, that may also be called laboratory-based surveillance.

Event-based surveillance

Event-based surveillance is the rapid, organised collection of information about an event that potentially poses a threat to public health.

An **event** might be an outbreak, or any other situation that creates a potential public health risk, e.g. unusual disease patterns, animal disease die-offs, or environmental contamination events like chemical spills.

A public health event may also include outbreaks, injuries or illnesses associated with natural disasters like floods, mud slides, typhoons or volcanic eruptions. This may result in large-scale population displacement (e.g. when many people are housed in crowded in temporary shelters), and increased risk of water-borne, vector-borne, or respiratory illness outbreaks.

Reports can come through formal channels such as health care workers or they can be informal (e.g. community reports, media, rumours). The information provided in a report is unstructured and the reports can be made at any time (even after work hours).

Next, you need to understand more details about the system's data collection and data management processes.

4

Data collection

You recall data collection means that health related information is collected about people with disease.

Data collection in surveillance systems can be active or passive. Passive surveillance is the regular reporting of disease data by health care providers based on a known process. It relies on patients presenting to health facilities who then meet a case definition to be entered into the system. Active surveillance is surveillance by actively going out to find new cases. This means the Health Ministry takes the initiative to contact health providers, visits health facilities, reviews patient records and talks with health staff. It can also be health workers going into community to systematically try to find cases by going house to house.

Officer Simone explains that the sentinel syndromic surveillance system on Alphabet Islands is mostly passive surveillance. The health clinics on each island fill out a form each week documenting the number of people with ILI and other syndromes. The data from the previous week's form are then sent to the provincial surveillance focal point every Tuesday morning in a text message.

Figure 3: Example of a syndromic surveillance form completed weekly at provincial health clinics.

Alphabet Islands Syndromic Surveillance System

Weekly tally sheet

Location reporting:_____

Epi week:_____

Date of report:_____

Syndrome	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Total Cases
Acute flaccid paralysis								
Acute fever and rash								
Acute watery diarrhoea								
Influenza-like illness								
Prolonged fever								
Unexpected event								

Usually, the text message has a basic format with weekly counts of cases by syndrome type, e.g. acute flaccid paralysis (AFP); acute fever and rash (AFR), Acute watery diarrhoea (AWD), Influenza-like illness (ILI), Prolonged fever (PF), or Unusual/ unexplained health events (UE).

Example weekly text message sent by a rural health clinic on Delta Island:

```
EPI WEEK 24
AFP: 0
AFR: 2
AWD: 7
ILI: 4
PF: 1
UE: 0
```

Officer Simone continues to explain that the national surveillance focal point collates (combine and organise) and analyses the data from all the provincial island sentinel sites. You expect to receive the syndromic data from surveillance focal points by lunch time every Tuesday.

If the number of cases reported in a week (the **surveillance signal**) exceeds what is expected (the **threshold level**), then you need to coordinate with the provincial health authorities to verify the signal and if necessary, launch an investigation.
The **ILI threshold level** is calculated by averaging the previous five years' weekly ILI notifications data.

Officer Simone says:

Remember, whichever method the sentinel sites use for counting their syndromic cases, it is important that it still be possible to identify individual patients, so that an outbreak investigation can be carried out when necessary.

This is because the syndromic diagnoses provide very little information, and if you detect a rise in ILI cases exceeding the threshold level, the sentinel sites need to go back to their patient register books to get more information for your investigation.

You realise that effectively performing this task involves a lot of responsibility!

Next, you need to review the principles of **data management** to ensure that your monthly syndromic surveillance reports are accurate, and shared on time with the senior decision makers and local health staff who work so hard to collect the data every week.

5

Data management

Data management is an important element of ensuring that ongoing, accurate, and timely information is available for decision makers to act on to minimise public health impacts.

Data management means the **transfer** (entering), **collation** (combining and organising) and **cleaning** of data in a central database (like an Excel linelist, Microsoft Access database, or other database, e.g. district health information software system DHIS2) (6).

Officer Simone says:

You'll receive the ILI syndromic data from the provincial surveillance focal points on a weekly basis, every Tuesday.

The focal points from the larger islands usually send their data in an Excel spreadsheet. The focal points on the smaller islands sometimes send their data in a text message. If you don't receive the data promptly, it may be best to phone the focal points to check if there are any problems. Sometimes there's no electricity or mobile phone reception, or surveillance focal points may be on sick leave. If data are not being received, it's important to understand why – e.g. is it being appropriately collected at all? Sometimes the data are not sent by the sentinel site focal point on the island for various reasons. Sometimes the same data are accidentally sent more than once. It is your responsibility to manage the database with appropriate data entry, data cleaning, and quality control.

5.1 Data Cleaning

Data cleaning involves regularly checking the data you receive for completeness and accuracy, and fixing any obvious errors (e.g. duplicate records), and following up on incomplete or incorrect information. This is also called data quality control (QC).

It's now Tuesday, 19th July 2022, the beginning of the third week in your new job.

By lunch time, you've received several text messages and Excel files containing notification data from the six sentinel site surveillance focal points in Alphabet Islands.

Today, you notice something unusual in the text message data received from **Charlie Island** for epi week 27 (10-16 July 2022). There were 25 cases of ILI being reported!

By examining the previous 5-year average data, you notice that you'd normally expect the number of weekly ILI notifications from Charlie Island for epi week 27 to be at or below 15 cases per week (the threshold level for action).

```
SYNDROMIC SURVEILLANCE,
CHARLIE ISLAND:
EPI WEEK 27
AFP: 0
AFR: 10
AWD: 7
ILI: 25
PF: 1
UE: 0
```

A weekly ILI count of 25 ILI cases is 1.66 times more than what you'd expect (15 cases). You wonder, does this increase in ILI cases require an investigation? Is this an outbreak?

You decide to call the surveillance focal point on Charlie Island to ask for an Excel line list of the cases to be sent through for further analysis. A couple of hours later, you receive an Excel file containing details of the 25 notifications that were reported by Charlie Island. The surveillance focal point on Charlie Island informs you that some of the ILI cases were tested using RDT kits and were positive for COVID-19. There is a confirmed case definition for people who tested positive for COVID-19 and the rest were probable cases that uses the surveillance case definition.

You start by examining the line list data dictionary, to better understand the variables for which data had been collected.

Figure 4: Data dictionary of line listed data sent by Charlie Island.

Variable	Variable type	Variable description	Variable options
Case_ID	Categorical	Unique case identifier	Sequentially assign case number, ILI, ILI2, etc.
Case_classification	Categorical	Case classification status	Probable | Confirmed | Unknown | no_data
Last_name	Categorical	Last name	E.g. Jones | O'Neill | no_data
First_name	Categorical	First name	E.g. Peter | Emily | no_data
Age_years	Numeric	Age in years	E.g. 0 (if < 1 year-old) | 5 | 10 | 21 | Unknown | no_data
Sex	Categorical	Biological sex	Male | Female | Unknown | no_data
Island_name	Categorical	Name of island	E.g. Alpha | Bravo | Unknown | no_data
Occupation	Categorical	Type of occupation	E.g. Road worker | Farmer | Office | School | Unemployed | no_data
Onset_date	Date	Date of sympom onset	dd/mm/yyyy | Unknown | no_data
Fever	Categorical	Did the case experience fever?	Yes | No | Unknown | no_data
Cough	Categorical	Did the case experience cough?	Yes | No | Unknown | no_data
Sore_throat	Categorical	Did the case experience a sore throat?	Yes | No | Unknown | no_data
Specimen	Categorical	Was a clinical specimen collected for a diagnostic test?	Yes | No | Unknown | no_data
Test_type	Categorical	What type of diagnostic test was performed?	NA, if no test | RDT | PCR | Culture | Serology | Unknown | no_data
Test_result	Categorical	Was a laboratory test result received for ILI?	COVID-19 | Influenza A(H3) | RSV| Diptheria | No pathogens detected | Unknown | no_data

NA= Not applicable; RDT= Rapid diagnostic test; PCR= polymerase chain reaction; RSV= Respiratory syncytial virus

You now examine the data of these 25 notifications more closely, and notice that some of the record entries have incomplete data, and that some also appear very similar. For example, some entries have the same name, and/or the same occupation, age or onset date, which suggests it may actually be the same person! Other entries are incomplete, e.g. the symptom onset date or symptoms fields are missing. For other rows, the **Specimen** field says 'Yes', but then the **Test_type** data is missing.

It seems there is some additional data cleaning needed here! For example, you notice what looks like several possible duplicate entries or missing data, showed in the coloured boxes below.

Figure 5: Highlighted example of duplicate or incomplete record entries in line listed ILI data for Charlie Island.

Case_ID	Case_ classification	Last_ name	First_ name	Age_ years	Sex	Island_ name	Occupation	Onset_ date	Fever	Cough	Sore_ throat	Specimen	Test_ type	Test_ result
ILI1	Confirmed	Clark	Brian	29	M	Charlie	Taxi driver	10-Jul-22	Yes	Yes	Yes	Yes	RTD	COVID-19
ILI2	Confirmed	Clark	Briann	29		Charlie	Taxi driver		Yes			Yes	RTD	COVID-19
ILI3	Probable	Felix	Gulliver	18	M	Charlie	Farmer	11-Jul-22	Yes	Yes	No	Yes	RTD	COVID-19
ILI4	Confirmed	Boston	Liam	27	M	Charlie	Shop owner	11-Jul-22	Yes	No	Yes	Yes		
ILI5	Confirmed	Johnson	Joseph	18	M	Charlie	Road worker	12-Jul-22	Yes	Yes	Yes	Yes	RTD	COVID-19
ILI6	Confirmed	Joshua	Andrew	24	M	Charlie	Office	12-Jul-22	Yes	Yes	Yes	Yes	RTD	
ILI7	Probable	Bell	Clara	30	F	Charlie	Farmer		Yes	Yes	No	No	NA	NA
ILI8	Confirmed	Joshua	Andrews		M	Charlie	Office	12-Jul-22	Yes			Yes	RTD	COVID-19
ILI9	Probable	Vairama	Evon	14		Charlie	School	12-Jul-22	Yes			Yes		COVID-19
ILI10	Probable	Vairama	Yvonne	14	F	Charlie	School		Yes	No	Yes	No	RTD	COVID-19
ILI11	Probable	Bell	Claire	18	F	Charlie		13-Jul-22	Yes	Yes	Yes	Yes		
ILI12	Probable	Bell	Claire		F	Charlie	Farmer		Yes				RTD	
ILI13	Probable	Cooper	Mark	9	M	Charlie	School	13-Jul-22	Yes			Yes		
ILI14	Probable	Thomas	Peter	30	M	Charlie	Farmer	12-Jul-22	Yes	Yes	Yes	No		
ILI15	Probable	Brown	Benedict	37	M	Charlie	Shop owner	13-Jul-22	Yes	No	Yes	No		
ILI16	Probable	Bell	Klare	18	F	Charlie	Farmer		Yes					COVID-19
ILI17	Probable	Grey	Thomas	23	M	Charlie	Farmer	13-Jul-22	Yes	Yes	No	No	NA	NA
ILI18	Probable	Peters	Venice	12	F	Charlie	School	13-Jul-22	Yes	Yes	Yes	No	NA	NA
ILI19	Probable	Cooper	Marckus	9		Charlie	School		Yes	Unknown	No	Yes	RTD	
ILI20	Probable	Cooper	Marcus		M	Charlie	School	13-Jul-22	Yes					COVID-19
ILI21	Probable	Vanama	Walter	0	M	Charlie	Infant	14-Jul-22	Yes	No	Yes	No	NA	NA
ILI22	Probable	White	Stephen	7	M	Charlie	School	16-Jul-22	Yes	Yes	Yes	No	NA	NA
ILI23	Probable	Jupiter	Basil	15	M	Charlie	Farmer	16-Jul-22	Yes	No				
ILI24	Probable	Jupiter	Basil		M	Charlie		16-Jul-22	Yes	Unknown	Yes	No	NA	NA
ILI25	Confirmed	Green	Solomon	73	M	Charlie	Retired	17-Jul-21	Yes	Yes	Yes	Yes	RTD	COVID-19

So, how to clean these data?

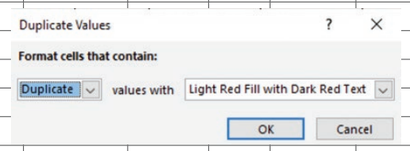
The easiest way may be to start with the case names, to look for duplicate entries.

You follow the steps to check for duplicates using Excel.

1. Copy the spreadsheet and rename it as the clean version.
2. In the clean tab, use the 'Conditional Formatting' command to highlight cells that are duplicates for 'Last_name'.

Figure 6: Using the 'Conditional Formatting' function in Excel to highlight duplicate data in a variable column.

Case _ID	Case_ classification	Last_ name	First_ name	Age_ years	Sex	Island_ name	Occupation	Onset_ date	Fever	Cough	Sore_ throat	Specimen	Test_ type	Test_ result
ILI1	Confirmed	Clark	Brian	29	M	Charlie	Taxi driver	10-Jul-22	Yes	Yes	Yes	Yes	RTD	COVID-19
ILI2	Confirmed	Clark	Briann	29		Charlie	Taxi driver		Yes			Yes	RTD	COVID-19
ILI3	Probable	Felix	Gulliver	18	M	Charlie	Farmer	11-Jul-22	Yes	Yes	No	Yes	RTD	COVID-19
ILI4	Confirmed	Boston	Liam	27	M	Charlie	Shop owner	11-Jul-22	Yes	No	Yes	Yes		
ILI5	Confirmed	Johnson	Joseph	18	M	Charlie	Road worker	12-Jul-22	Yes	Yes	Yes	Yes	RTD	COVID-19
ILI6	Confirmed	Joshua	Andrew	24	M	Charlie	Office	12-Jul-22	Yes	Yes	Yes	Yes	RTD	
ILI7	Probable	Bell	Clara	30	F	Charlie	Farmer		Yes	Yes	No	No	NA	NA
ILI8	Confirmed	Joshua	Andrews		M	Charlie	Office	12-Jul-22	Yes			Yes	RTD	COVID-19
ILI9	Probable	Vairama	Evon	14		Charlie	School	12-Jul-22	Yes			Yes		COVID-19
ILI10	Probable	Vairama	Yvonne	14	F	Charlie	School		Yes	No	Yes	No	RTD	COVID-19
ILI11	Probable	Bell	Claire	18	F	Charlie						Yes		
ILI12	Probable	Bell	Claire		F	Charlie							RTD	
ILI13	Probable	Cooper	Mark	9	M	Charlie						Yes		
ILI14	Probable	Thomas	Peter	30	M	Charlie						No		
ILI15	Probable	Brown	Benedict	37	M	Charlie						No		
ILI16	Probable	Bell	Klare	18	F	Charlie	Farmer		Yes					COVID-19
ILI17	Probable	Grey	Thomas	23	M	Charlie	Farmer	13-Jul-22	Yes	Yes	No	No	NA	NA
ILI18	Probable	Peters	Venice	12	F	Charlie	School	13-Jul-22	Yes	Yes	Yes	No	NA	NA
ILI19	Probable	Cooper	Marckus	9		Charlie	School		Yes	Unknown	No	Yes	RTD	
ILI20	Probable	Cooper	Marcus		M	Charlie	School	13-Jul-22	Yes					COVID-19
ILI21	Probable	Vanama	Walter	0	M	Charlie	Infant	14-Jul-22	Yes	No	Yes	No	NA	NA
ILI22	Probable	White	Stephen	7	M	Charlie	School	16-Jul-22	Yes	Yes	Yes	No	NA	NA
ILI23	Probable	Jupiter	Basil	15	M	Charlie	Farmer	16-Jul-22	Yes	No				
ILI24	Probable	Jupiter	Basil		M	Charlie		16-Jul-22	Yes	Unknown	Yes	No	NA	NA
ILI25	Confirmed	Green	Solomon	73	M	Charlie	Retired	17-Jul-21	Yes	Yes	Yes	Yes	RTD	COVID-19



Next, you examine each of these rows with the same last name entries more closely, from top to bottom.

By examining the other data in these rows (e.g. age, sex, occupation, onset date, etc.), you are able to determine that these entries are most likely duplicates of the same people! You will verify this with Charlie Island's surveillance focal point later.

Next, you use the data from the duplicate entries to complete the blank fields for each row in the line list, where possible. This results in a line list data set with all possible fields completed, but with several duplicate entries still remaining.

Figure 7: The line list with all missing data fields completed, but with duplicate entries remaining.

Case _ID	Case_ classification	Last_ name	First_ name	Age_ years	Sex	Island_ name	Occupation	Onset_ date	Fever	Cough	Sore_ throat	Specimen	Test_ type	Test_result
ILI1	Confirmed	Clark	Brian	29	M	Charlie	Taxi driver	10-Jul-22	Yes	Yes	Yes	Yes	RDT	COVID-19
ILI2	Confirmed	Clark	Brian	29	29	Charlie	Taxi driver	10-Jul-22	Yes	Yes	Yes	Yes	RDT	COVID-19
ILI3	Probable	Felix	Gulliver	18	M	Charlie	Farmer	11-Jul-22	Yes	Yes	No	Yes	RDT	COVID-19
ILI4	Confirmed	Boston	Liam	27	M	Charlie	Shop owner	11-Jul-22	Yes	No	Yes	Yes	NA	NA
ILI5	Confirmed	Johnson	Joseph	18	M	Charlie	Road worker	12-Jul-22	Yes	Yes	Yes	Yes	RDT	COVID-19
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ILI14	Probable	Thomas	Peter	30	M	Charlie	Farmer	12-Jul-22	Yes	Yes	Yes	No	NA	NA
ILI15	Probable	Brown	Benedict	37	M	Charlie	Shop owner	13-Jul-22	Yes	No	Yes	No	NA	NA
ILI16	Probable	Bell	Claire	18	F	Charlie	Farmer	13-Jul-21	Yes	Yes	Yes	Yes	RDT	COVID-19
ILI17	Probable	Grey	Thomas	23	M	Charlie	Farmer	13-Jul-22	Yes	Yes	No	No	NA	NA
ILI18	Probable	Peters	Venice	12	F	Charlie	School	13-Jul-22	Yes	Yes	Yes	No	NA	NA
ILI19	Probable	Cooper	Marcus	9	M	Charlie	School	13-Jul-21	Yes	Unknown	No	Yes	RDT	COVID-19
ILI20	Probable	Cooper	Marcus	9	M	Charlie	School	13-Jul-22	Yes	Unknown	No	Yes	RDT	COVID-19
ILI21	Probable	Vanama	Walter	0	M	Charlie	Infant	14-Jul-22	Yes	No	Yes	No	NA	NA
ILI22	Probable	White	Stephen	7	M	Charlie	School	16-Jul-22	Yes	Yes	Yes	No	NA	NA
ILI23	Probable	Jupiter	Basil	15	M	Charlie	Farmer	16-Jul-22	Yes	No	Yes	No	NA	NA
ILI24	Probable	Jupiter	Basil	15	M	Charlie	Farmer	16-Jul-22	Yes	Unknown	Yes	No	NA	NA
ILI25	Confirmed	Green	Solomon	73	M	Charlie	Retired	17-Jul-21	Yes	Yes	Yes	Yes	RDT	COVID-19

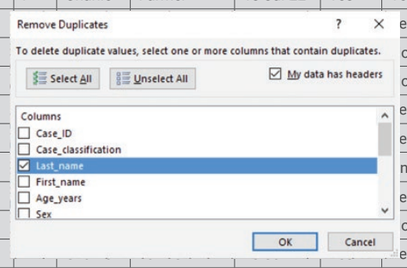
Next, use the Remove Duplicates function in Excel.

Highlight all the cells in the linelist;

Use your mouse to navigate as follows: Data > Remove Duplicates > Unselect All > tick the boxes for: My data has headers and Last_name > click OK.

Figure 8: Using the 'Remove Duplicates' function in Excel to remove duplicate rows in a variable column.

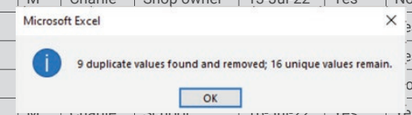
Case_ID	Case_ classification	Last_ name	First_ name	Age_ years	Sex	Island_ name	Occupation	Onset_ date	Fever	Cough	Sore_ throat	Specimen	Test_ type	Test_result
ILI1	Confirmed	Clark	Brian	29	M	Charlie	Taxi driver	10-Jul-22	Yes	Yes	Yes	Yes	RDT	COVID-19
ILI2	Confirmed	Clark	Brian	29	29	Charlie	Taxi driver	10-Jul-22	Yes	Yes	Yes	Yes	RDT	COVID-19
ILI3	Probable	Felix	Gulliver	18	M	Charlie	Farmer	11-Jul-22	Yes	Yes	No	Yes	RDT	COVID-19
ILI4	Confirmed	Boston	Liam	27	M	Charlie	Shop owner	11-Jul-22	Yes	No	Yes	Yes	NA	NA
ILI5	Confirmed	Johnson	Joseph	18	M	Charlie	Road worker	12-Jul-22	Yes	Yes	Yes	Yes	RDT	COVID-19
ILI6	Confirmed	Joshua	Andrew	24	M	Charlie	Office	12-Jul-22	Yes	Yes	Yes	Yes	RDT	COVID-19
ILI7	Probable	Bell	Claire	18	F	Charlie	Farmer	13-Jul-22	Yes	Yes	Yes	Yes	RDT	COVID-19
ILI8	Confirmed	Joshua	Andrew	24						es	Yes	Yes	RDT	COVID-19
ILI9	Probable	Vairama	Yvonne	14						o	Yes	No	RDT	COVID-19
ILI10	Probable	Vairama	Yvonne	14						o	Yes	No	RDT	COVID-19
ILI11	Probable	Bell	Claire	18						es	Yes	Yes	RDT	COVID-19
ILI12	Probable	Bell	Claire	18						es	Yes	Yes	RDT	COVID-19
ILI13	Probable	Cooper	Marcus	9						nknown	No	Yes	RDT	COVID-19
ILI14	Probable	Thomas	Peter	30						es	Yes	No	NA	NA
ILI15	Probable	Brown	Benedict	37						o	Yes	No	NA	NA
ILI16	Probable	Bell	Claire	18						es	Yes	Yes	RDT	COVID-19
ILI17	Probable	Grey	Thomas	23	M	Charlie	Farmer	13-Jul-22	Yes	Yes	No	No	NA	NA
ILI18	Probable	Peters	Venice	12	F	Charlie	School	13-Jul-22	Yes	Yes	Yes	No	NA	NA
ILI19	Probable	Cooper	Marcus	9	M	Charlie	School	13-Jul-21	Yes	Unknown	No	Yes	RDT	COVID-19
ILI20	Probable	Cooper	Marcus	9	M	Charlie	School	13-Jul-22	Yes	Unknown	No	Yes	RDT	COVID-19
ILI21	Probable	Vanama	Walter	0	M	Charlie	Infant	14-Jul-22	Yes	No	Yes	No	NA	NA
ILI22	Probable	White	Stephen	7	M	Charlie	School	16-Jul-22	Yes	Yes	Yes	No	NA	NA
ILI23	Probable	Jupiter	Basil	15	M	Charlie	Farmer	16-Jul-22	Yes	No	Yes	No	NA	NA
ILI24	Probable	Jupiter	Basil	15	M	Charlie	Farmer	16-Jul-22	Yes	Unknown	Yes	No	NA	NA
ILI25	Confirmed	Green	Solomon	73	M	Charlie	Retired	17-Jul-21	Yes	Yes	Yes	Yes	RDT	COVID-19



Finally, you have a cleaned line list, with all duplicate entries removed and missing fields filled! You notice that the cleaned line list now contains only 16 entries, not 25 as before.

Figure 9: The final cleaned and de-duplicated line list with n=16 record entries.

Case_ID	Case_ classification	Last_ name	First_ name	Age_ years	Sex	Island_ name	Occupation	Onset_ date	Fever	Cough	Sore_ throat	Specimen	Test_ type	Test_result
ILI1	Confirmed	Clark	Brian	29	M	Charlie	Taxi driver	10-Jul-22	Yes	Yes	Yes	Yes	RDT	COVID-19
ILI3	Probable	Felix	Gulliver	18	M	Charlie	Farmer	11-Jul-22	Yes	Yes	No	Yes	RDT	COVID-19
ILI4	Confirmed	Boston	Liam	27	M	Charlie	Shop owner	11-Jul-22	Yes	No	Yes	Yes	NA	NA
ILI5	Confirmed	Johnson	Joseph	18	M	Charlie	Road worker	12-Jul-22	Yes	Yes	Yes	Yes	RDT	COVID-19
ILI6	Confirmed	Joshua	Andrew	24	M	Charlie	Office	12-Jul-22	Yes	Yes	Yes	Yes	RDT	COVID-19
ILI7	Probable	Bell	Claire	18	F	Charlie	Farmer	13-Jul-22	Yes	Yes	Yes	Yes	RDT	COVID-19
ILI9	Probable	Vairama	Yvonne	14	F	Charlie	School	12-Jul-22	Yes	No	Yes	No	RDT	COVID-19
ILI13	Probable	Cooper	Marcus	9	M	Charlie	School	13-Jul-22	Yes	Unknown	No	Yes	RDT	COVID-19
ILI14	Probable	Thomas	Peter	30	M	Charlie	Farmer	12-Jul-22	Yes	Yes	Yes	No	NA	NA
ILI15	Probable	Brown	Benedict	37	M	Charlie	Shop owner	13-Jul-22	Yes	No	Yes	No	NA	NA
ILI17	Probable	Grey	Thomas	23							No	No	NA	NA
ILI18	Probable	Peters	Venice	12							Yes	No	NA	NA
ILI21	Probable	Vanama	Walter	0							Yes	No	NA	NA
ILI22	Probable	White	Stephen	7							Yes	No	NA	NA
ILI24	Probable	Jupiter	Basil	15	M	Charlie	Farmer	16-Jul-22	Yes	Unknown	Yes	No	NA	NA
ILI25	Confirmed	Green	Solomon	73	M	Charlie	Retired	17-Jul-21	Yes	Yes	Yes	Yes	RDT	COVID-19



You send the cleaned line list back to the surveillance focal point on Charlie Island, who confirms that these data are indeed correct.

The surveillance focal point explains that the previous numbers reported by text message occurred because of miscommunication in the provincial hospital, resulting in different officers adding data from the same case entry forms to the line list without first checking the data.

You can now see that even though the original numbers were high, and you were worried it could be an outbreak, it was actually a data reporting issue! It's a good lesson to remember to always carefully inspect and interpret the data.

Now that your data management tasks are complete, it's time to move on to more detailed data analysis.

6

Data analysis

Data analysis is used to summarise, describe, and interpret surveillance data.

The ILI surveillance data are regularly analysed to see if there is something different compared with normal trends. These data are used to develop the monthly surveillance report which is sent to all sentinel surveillance focal points and the Ministry's Senior Management. If something unusual is detected, that provides information for public health action.

Through data analysis, graphs and tables can be created to provide an overview of the surveillance data.

6.1 ILI trends analysis

It's now Tuesday, 2 August 2022.

You've already completed the first month in your new job as assistant national syndromic surveillance focal point!

You've been regularly managing and analysing the ILI syndromic surveillance data you've received every Tuesday from the six provincial sentinel surveillance focal points for the past four weeks.

By lunchtime, you've received the weekly ILI notification data from all six provincial surveillance focal points.

It's now time to generate the national ILI line graph for your first monthly surveillance report, by collating the provincial data by epidemiological week for the 2022 year-to-date (YTD), and comparing that to the established **ILI threshold.**

The ILI threshold is calculated by averaging the previous five years' weekly ILI notifications data. You start by looking at the data from January to July of this year, namely **epidemiological weeks (Epi weeks)** 1 to 30.

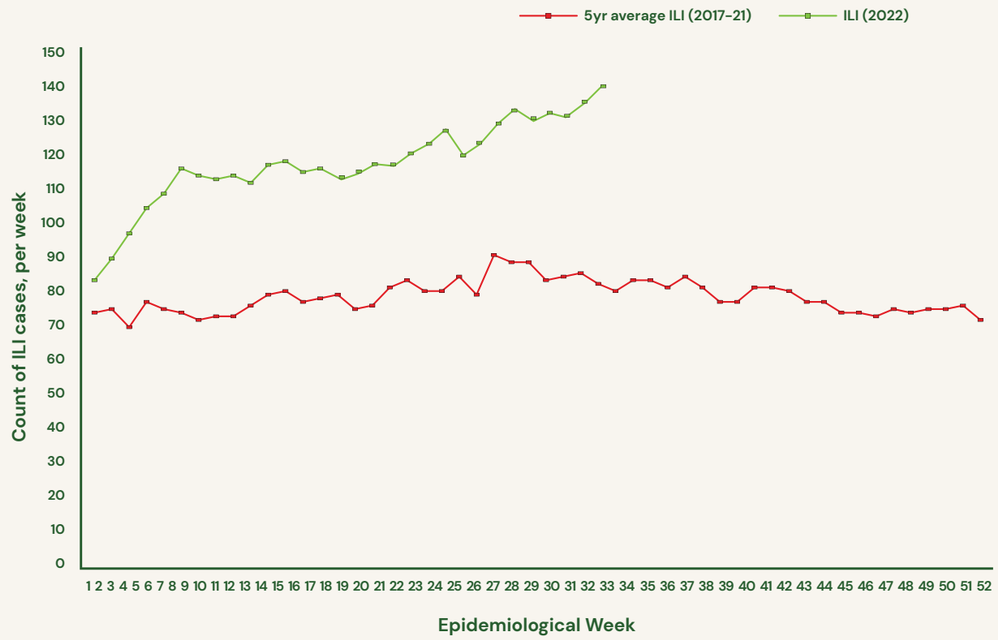
Epidemiological weeks

Epi weeks are 7-day periods typically counted to start on a Sunday, and ending the following Saturday. By looking at the calendar, you determine that in 2022, Epi week 1 started on Sunday 02 January, and Epi week 30 ended on Saturday 30 July. So, you now have complete data for the 30 epi weeks starting on Sunday 02 January, and ending on Saturday 30 July 2022 with which to prepare a line graph.

6.1.1 National ILI trends analysis

Using the ILI notifications data, you use Excel to create a line graph showing weekly ILI notifications between January and July 2022, compared to the previous five-year average (2017-2021).

Figure 10: National influenza-like illness notifications, by epidemiological week, Alphabet Islands, 2017-2022



But wait, something in these data looks very strange indeed!

If your analysis is accurate, syndromic ILI notifications from January to July 2022 have been trending very much higher than the 5-year average trend all year, and is therefore continuously exceeding the threshold for action!

Surely, the ILI situation cannot be that bad - is there some kind of major national respiratory illness outbreak going on? This is quite worrying, so you decide to ask your supervisor for some advice.

Thankfully, Officer Simone is experienced and very helpful, and reminds you of the background briefing she provided on your first day in the job.

> "Ah yes – I can see why you're alarmed!
>
> It's true that we use the five-year average of weekly ILI notifications as our threshold for action. But remember, due to the COVID-19 pandemic, the years of 2020 and 2021 were very unusual indeed. All the public health interventions, movement restrictions and border closures to prevent COVID-19 meant there was also very little transmission of other respiratory illnesses in the Alphabet Islands. So, the ILI trends for those two years were very much below the typical average.
>
> I recommend that you disaggregate (separate) the previous years' ILI data by year of notification, to show the average ILI notifications in the five years before the COVID-19 pandemic started (2015–2019), and place the ILI data for 2020–21 on a separate line.
>
> Then compare that to the ILI notifications for 2022. That may provide a clearer picture of what's going on with ILI signals in 2022, compared to recent years."

Of course!

You recall that 2020 and 2021 had far fewer ILI notifications than usual, meaning that if these years are included in the ILI threshold calculation, it brings the calculated five-year average down a lot. This will result in the ILI threshold for action being too low, which would make the syndromic surveillance system far too **sensitive** - meaning signals would be continually exceeding the threshold for action. This may prompt unnecessary public health investigations, which would not be a good use of the Ministry's limited human, financial and laboratory testing resources.

You follow Officer Simone's advice to redraw your graph with the 2020–21 ILI data separated out.

To disaggregate the data and calculate five-year threshold averages, you examine the weekly ILI notification counts by year, for the seven-year period from 2015 to 2022. To obtain the five-year average weekly ILI threshold for the period 2015–2019, you calculate the mean by using the Excel formula: '=Average()', to highlight the cells for the years 2015 to 2019.

DATEVALUE | =AVERAGE(A2:E2)

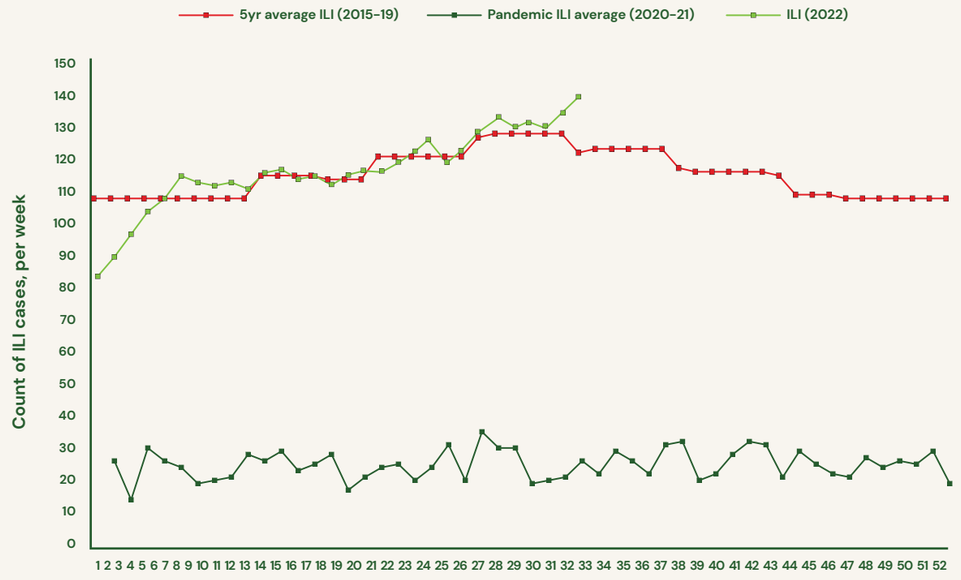
	A	B	C	D	E	F	G	H	I
1	2015	2016	2017	2018	2019	2020	2021	5yr average ILI threshold (2015-19)	5yr average ILI threshold (2017-21)
2	109	112	110	108	108	25	25	=AVERAGE(A2:E2)	75
3	109	112	110	108	108	27	27	109	76
4	109	112	110	108	108	15	15	109	71

To obtain the average weekly ILI threshold for the period 2020–2021, you calculate the mean by using the Excel formula: '=Average()', to highlight the cells for the years of 2020 and 2021.

Government of the Alphabet Islands: Ministry of Health

The information is now starting to make much more sense!

Figure 11: National influenza-like illness notifications in 2022 compared with pre-pandemic 5-year average and pandemic average, by epidemiological week, Alphabet Islands, 2015-2022.



Based on your reworked line graph, you can interpret the following information:

- Looking at the pre-pandemic five-year ILI average (2015-19), you can see the seasonal pattern of increase in ILI notifications during the southern hemisphere winter months between April and August each year that Officer Simone talked about.
- You notice that average ILI notifications in 2020 and 2021 were indeed much lower than in previous years. In fact, the average weekly ILI notifications for those two years were only about one-fifth (20%) to one quarter (25%) of what they were before the COVID-19 pandemic. You also notice that there was no seasonal variation, because the line remains comparatively even over the course of those two pandemic years.
- You see that ILI notifications for 2022 are indeed quite high, having increased rapidly in the first few weeks of the year to remain at, or just slightly below or above the threshold for action.
- Finally, you notice that there's been a consistent national **ILI signal above the five-year average** in the past six weeks. This is a cause for concern, and you'll need to examine the data more closely to determine what may be happening.

You decide to look at the ILI trends at provincial island level, to determine why these signals have been exceeding the national threshold for the past several weeks. Is it because of high rates of COVID-19 transmission on some islands, or is something else going on? Are there high ILI signals on all the islands, or only on some?

You continue your ILI trends analysis to examine the provincial island-level data more closely.

6.1.2 Provincial islands trends analysis

You recreate the national ILI trend graph for each of the six sentinel surveillance sites, to help you form some ideas about what may be happening, and where it is happening (hypothesis generation). You again disaggregate (separate) the 2020-21 data out for each sentinel surveillance site.

By examining the provincial-level data line graphs, you can interpret the following information:

- The weekly ILI counts and calculated thresholds differ between the islands.
  - This likely reflects differences in ILI transmission rates and population size on the different islands, differences in human mobility and commercial activity, as well as the capacity of health facilities that make up the sentinel sites.
  - For example, on average the number of weekly ILI notifications is much higher on the three larger islands (Alpha, Bravo & Charlie), compared to the smaller three islands (Delta, Echo and Foxtrot).
- Across all six islands, there is a consistent pattern of a rapid increase in ILI notifications in the first few weeks of the year, followed by ILI counts that remain either at, or slightly above or below the calculated threshold for the year-to-date - similar to the national-level graph.
- However, the recent data for the last two smaller islands looks different, compared to the rest - there is a clear sudden increase in weekly ILI notifications for Echo and Foxtrot islands over the past few weeks.

You wonder, what makes the ILI data from Echo and Foxtrot islands different from the rest?

You'll need to have a closer look at what's happening on Echo and Foxtrot islands. To find answers, you'll need to examine these data in further detail, and decide to also speak with the surveillance focal points for these two islands.

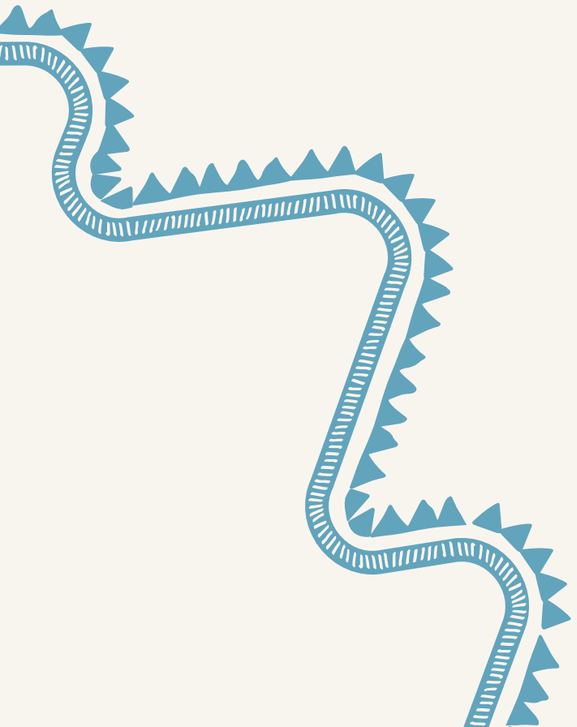


Figure 12: Provincial ILI notifications in 2022 YTD, compared to pre-pandemic 5-year average (2015–2019) and pandemic average (2020–2021).

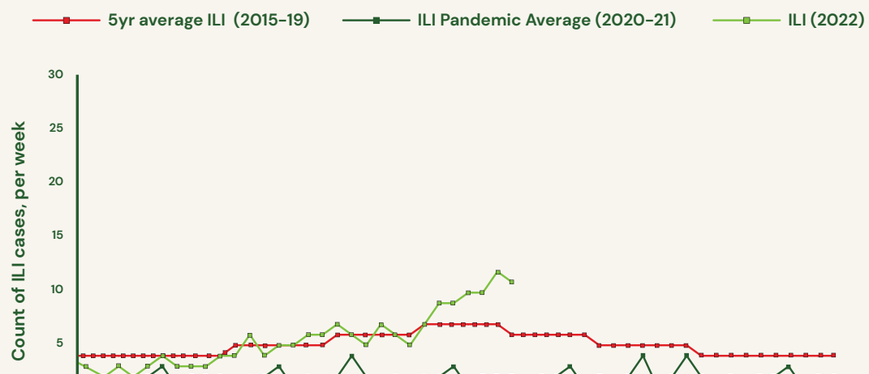
6.1.3 Foxtrot Island

You decide to first investigate the data for Foxtrot, the smallest of the provincial islands.

You make a call to Nurse John, the surveillance focal point on Foxtrot Island. You mention that you noticed the ILI threshold has been exceeded for the past six weeks, and ask if he has investigated these ILI signals data any further.

Nurse John sounds a bit surprised, and mentions that he's just returned to Foxtrot Island after four weeks of annual leave, during which time he visited family members living on neighbouring Bravo Island. He promises to examine the data more closely, and report back as soon as possible.

Figure 13: Influenza-like illness notifications in 2022 compared with pre-pandemic 5-year average and pandemic average, by epidemiological week, Foxtrot Island, 2015-2022



The next day, you receive a call back from Nurse John. Nurse John says:

Thank you for bringing these data to my attention!

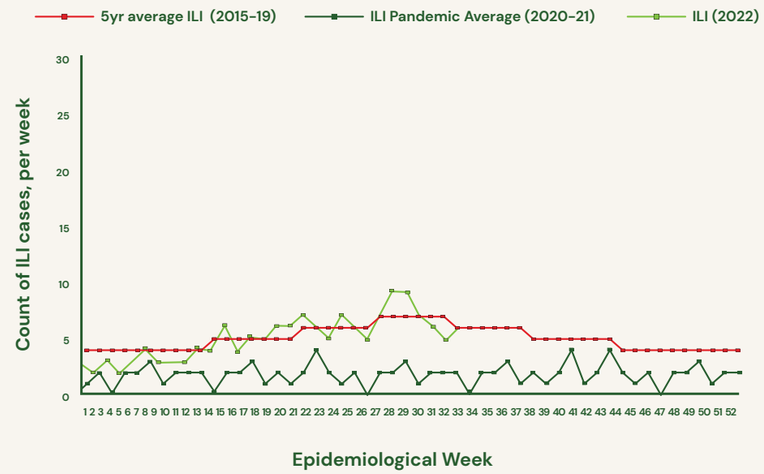
I returned to Foxtrot Island by ferry last night after a month-long holiday. During this time, the responsibility of collating and analysing the weekly syndromic surveillance data was assigned to our trainee public health officer here at the health centre. I've examined the weekly notification forms, spoke to my trainee and found the cause for the apparent increase. During the past four weeks, it seems our trainee accidentally miscounted the ILI cases from one of our health clinics. That means the data reported for the past four weeks are incorrect. The counts for Epi weeks 27 to 30 are actually 7, 6, 5 and 6. Not 10, 10, 12 and 11 as previously reported. Sorry about that, I'll review our weekly ILI case counting and reporting processes with my trainee.

The good news is, there's no reason for alarm! Our staff in some of the other health clinics on the island confirmed to me by text message that they have not seen an unusual increase in respiratory illness in the past few weeks while I was away on leave.

That's good news indeed!

So, a data reporting error explains your findings, and nothing is happening on Foxtrot Island that requires further investigation or action. Next, you'll need to contact the surveillance focal point on **Echo Island** to obtain further information about their data. You update the ILI line graph for Foxtrot Island to reflect the correctly reported data.

Figure 14: Influenza-like illness notifications in 2022 compared with pre-pandemic 5-year average and pandemic average, by epidemiological week, Foxtrot Island, 2015-2022



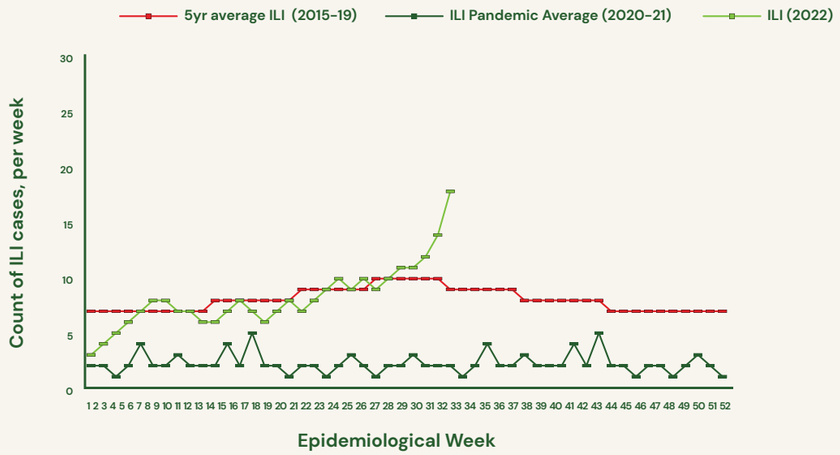
6.1.4 Echo Island

Next, you decide to investigate the high ILI signals on Echo Island.

Although it has a comparatively smaller population, Echo Island is known as the country's "bread-basket island" due to a few large commercial livestock farming operations that are owned by prominent businesspeople. The island produces lots of pigs, and chickens are intensively farmed for meat and eggs. There are also a few crocodile farms which produce leather for the export fashion industry.

You call Nurse Lorraine, the syndromic surveillance focal point on Echo Island. You mention that you noticed the ILI threshold has been exceeded in the past five weeks, and ask if she has investigated these rapidly increasing ILI signals data for the past three weeks any further?

Figure 15: Influenza-like illness notifications in 2022 compared with pre-pandemic 5-year average and pandemic average, by epidemiological week, Echo Island, 2015-2022



The news you receive from Nurse Lorraine is indeed alarming!

Nurse Lorraine says:

I'm so glad to hear from you, I was about to give you an urgent call!

I'm feeling very worried about some of the ILI cases we've seen here on Echo Island in the past few weeks. I think we're seeing a cluster of severe ILI that I've never experienced before. I'm worried this could be an outbreak.

In the past three weeks, we've had 44 cases of ILI notified, which is about 1.5 times more than we'd expect to normally see during the same period. It's true that we've seen some cases of COVID-19 this year, but this event seems more serious than normal. A lot of these cases have been very unwell, and several of the earlier cases have died. What's even more unusual, unlike COVID-19 cases, most of these cases are younger, healthy adult men working on livestock farms, or their immediate household family members.

When I looked at the detailed patient records, I was surprised to find that the earliest cases were all animal farm workers. Most of them were younger men working on a crocodile farm, or on nearby chicken farms. We've heard some rumours of lots of chickens suddenly dying on a large chicken farm in recent weeks.

You thank Nurse Lorraine for this information, and ask her to please send through the patient records data as a matter of urgency. You agree this sounds like an unusual and concerning event! This information will need to be urgently shared with your supervisor, and the Ministry's senior managers. A decision must be made about what public health action to take, including if an outbreak investigation needs to be initiated. As a FETP fellow, you recall from your training it's possible that this case cluster could be a **zoonotic disease** outbreak - meaning a disease that can spread between animals and humans. It may therefore be very important to collaborate with the animal health authorities to conduct a **One Health investigation**, to find out what's been happening with the livestock and farmers working in this area. In the meantime, you ask Nurse Lorraine to contact the local animal health officials on Echo Island to verify if the rumours about chicken deaths are indeed true, and to help determine if there may be any epidemiological links with the human ILI cases.Your supervisor, Officer Simone sounds equally concerned upon hearing the news you've received from Echo Island.

Officer Simone says:

Excellent work - I agree the Ministry will need to urgently follow up on these case reports of a severe ILI cluster. I hope this information shows that our indicator-based, syndromic surveillance system has provided early warning of a potential outbreak on Echo Island. We now need to increase our efforts and conduct additional enhanced surveillance.

I'm particularly worried about the reports of large numbers of chickens dying, especially if the human ILI cases are somehow linked to the chicken deaths. I will arrange a briefing for the Ministry's Senior Management, and will contact our colleagues in the Ministry of Agriculture to request further information and their involvement in an inter-Ministry One Health risk assessment and outbreak investigation, if needed.

When you receive the patient records from Nurse Lorraine, can you conduct an initial **descriptive analysis of the cluste**r? We need to find out as much information about how, when and where these sick farm workers contracted their illness, and if there's any obvious links between them or their animal exposures. I will need this information before I brief the Ministry's Senior Management.

6.2 Echo Island: Descriptive analysis

It's now Monday, 8 August 2022.

At the request of Officer Simone, you've spent the past week on Echo Island, working hard to assist Nurse Lorraine and other provincial health staff to investigate the cluster of severe ILI cases occurring in farm workers and their household family members.

One of your first tasks upon arrival on Echo Island was to assist Nurse Lorraine and her colleagues to:

1. Collect blood and nasopharyngeal swabs from recent cases, then send the specimens for urgent bacteriological and virological testing at the national public health laboratory on Alpha Island; and
2. Conduct an initial descriptive analysis, meaning summarise the data to describe the case cluster by person, time and place.
3. After describing the data, you need to interpret it to help generate ideas about what has happened (hypothesis generation).

Figure 16: Free-range livestock in a village on Echo Island, part of the Alphabet Islands.

Figure 17: Depiction of diagnostic testing of specimens at the National Public Health Laboratory, Alphabet Islands.

6.2.1 Person

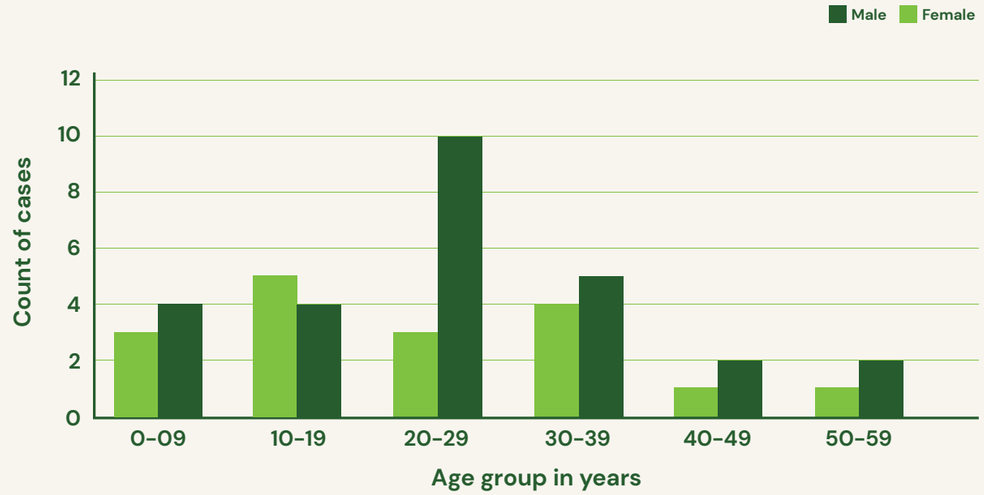
Using Nurse Lorraine's Excel linelist, you create some pivot tables to examine the distribution of the 44 cases by age group and sex, so you can begin to understand the characteristics of the people who got sick.

You notice that most of these ILI cases were male (27/44, 61%). You also notice that the majority of cases occurred in younger age groups, with a significant majority (38/44, 86%) being younger than 40 years of age. This suggests the illness predominantly occurred in adults of working age, and children. This is a different epidemiological pattern compared to the recent wave of COVID-19 infections in the Alphabet Islands which was distributed across all age groups, and with the most severe illness and death occurring in older or immunocompromised persons.

You realise that the age distribution of cases may be an important clue - perhaps this is really not COVID-19 after all!

You wonder if the reported link to animal farming and dead chickens may have anything to do with the age distribution of this ILI cluster. You decide to examine the data by occupation, and find that 19/44 (43%) of the cases were chicken farm workers.

Figure 18: Distribution of influenza-like illness cases by age group and sex, Echo Islands, July 2022



Next, you decide to look at the **timeline** of illness occurrence, and to investigate any **epidemiological links** between the cases.

6.2.2 Time

An **epidemiological curve (epicurve)** displays the count and distribution of cases over time, by reported symptom onset date.

Using data available in the initial case reports, you use Excel to construct an epicurve to show the distribution of cases' illness onset over the 3-week period, by their occupation and/or epidemiological link to another case.

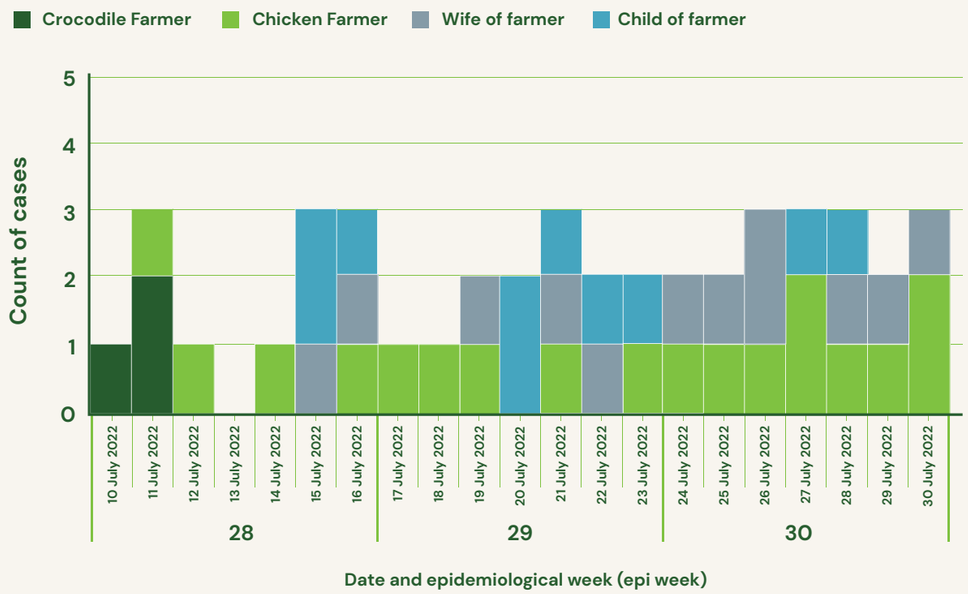
Turns out, Nurse Lorraine was correct!

It's a very interesting finding that three crocodile farm workers, and two chicken farm workers were the first cases to fall ill. This occurred in a very short space of time – only three days. Three of these animal farm workers (two crocodile farm workers, and one chicken farm worker) died. You start to wonder if these cases maybe infected each other, or had some other common exposure?

What's more, the next 41 cases were all either chicken farmer workers, or the wives or children of chicken farm workers! All the workers were employed by the same farm, and residing in staff compounds on or near the property.

This presents a very unusual epidemiological picture, and is something which has not been seen in the Alphabet Islands before. What is it about these animal farm workers and their household family members that put them at risk of this illness?

Figure 19: Epidemiological curve of influenza-like illness cases by occupation and close contact status, Echo Island, July 2022



While examining this epicurve, you receive a call from Officer Simone. You report the findings of your initial analysis.

Officer Simone says:

Thanks for your analysis on this ILI cluster in the animal farm workers and their families.

I received a call back from our colleagues at the Ministry of Agriculture. They told me their local Ministry office on Echo Island received a call from a prominent local businessman and politician. He was very upset about a sudden, large-scale die-off of chickens on one of his properties, and demanded an investigation from the authorities. On this farm, a large number of chickens are kept in constructed chicken houses and intensively farmed for meat and egg production.

However, they've received no news about anything unusual happening on a nearby crocodile farm, which is also owned by the same businessman. So that part of the story doesn't make any sense to me yet.

Either way, based on this information the Ministries of Health and Agriculture have decided to conduct a joint **One Health outbreak investigation**. Congratulations, you've been assigned to lead the health sector part of the investigation on the ground!

Our agriculture colleagues will join you and Nurse Lorraine to visit the chicken farm to conduct an initial field site visit. The animal health officer will work with the farm management to investigate the chicken deaths.

From a public health perspective, it's important for your team to understand the layout of the property, and start to systematically interview all the cases, or close contacts, namely family members and colleagues of cases, about their activities and possible exposures.

Good luck, everyone is counting on you!

Wow, that's a lot of additional responsibility!

Along with Nurse Lorraine and the local team, you immediately start planning for a field site visit and case interviews.

6.2.3 Place

A few days later, your team travels to the area to conduct detailed interviews of cases, and the close contacts of cases (including the household family members and work colleagues of persons that have died). You complete detailed outbreak case investigation forms.

You also use Google Maps (7) to examine the layout of the properties where the animal farm workers and their families live and work. Based on the map and information the surveillance team collected during case and next-of-kin interviews, you start to develop your outbreak hypothesis.

In consultation with the animal health workers, you identify the following as key epidemiological links and events in the outbreak timeline:

The chicken and crocodile farm workers are all employed by the same businessman, who owns both farms.

The farm workers and their families live in three staff compounds located near the public road which passes both properties.

Both the chicken and crocodile farms source their water supply from the nearby river, which flows down from the highlands on Echo Island.

In early July, the week before the first farm workers became ill, all of the chickens in one of the chicken houses suddenly started dying.

When the farm manager called the owner to report this sudden chicken die-off, he instructed the manager to tell some workers to collect all the dead chickens and store them in a freezer on the crocodile farm, for later use as crocodile food.

The first five cases (three crocodile farm workers, and two chicken farm workers) were the ones who collected the dead chickens in the first chicken house, and then transported the few thousand chicken carcasses to the crocodile farm, using a tractor and trailer.

Over the following three weeks, more chickens continued dying in the other chicken houses on the farm. Because there was no space left in the freezer, the workers were told to feed as many as possible to the crocodiles, and then to bury the rest of the carcasses in a pit.

The workers were also told to clean and disinfect the empty chicken houses However, during the case interviews many farm workers also reported taking some dead chickens home to the staff compound, where they were butchered and cooked for food.

None of the workers used any personal protective equipment (PPE) during their on-farm work activities.

By the end of July, a lot of chicken farmers and some of their household close contacts had started to become unwell. Most cases experienced ILI symptoms including fever, coughing, runny nose, sore throat, headache and body aches. The more severe cases experienced signs of pneumonia, and difficulty breathing.

The three early cases who died did not seek health care; and died at home. Their exact cause of death remains unknown, but their family members reported they experienced severe fever, respiratory illness and difficulty breathing, before losing consciousness and dying.

Because of all the work required on the farms, most of the sick farm workers did not seek health care. Most cases have since recovered, and were nursed by their wives and children at home.

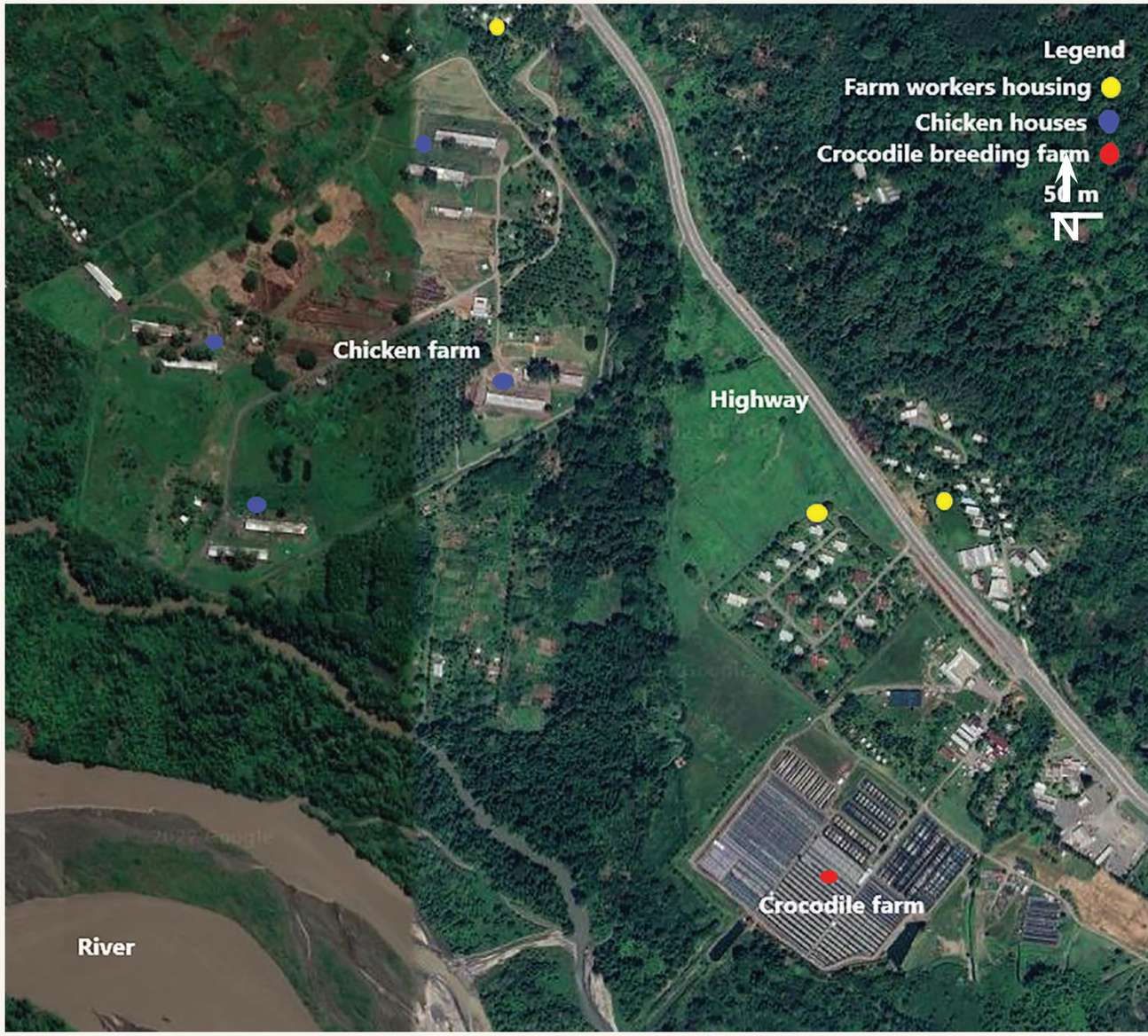
Of those farmer's wives and children who became ill, 18/22 (82%) reported butchering and cooking the carcasses of chickens that had died.

Only after three of the earlier cases had died, did some workers decide to seek care at the local health clinic. Several were admitted and treated in hospital. Their case reports of severe ILI were collected on the hospital's weekly syndromic surveillance form and the data sent by text message to Nurse Lorraine.

When Nurse Lorraine heard about these very sick farm workers, she asked the local health clinic to investigate these unusual cases of ILI further. This led to the identification and recording of all 44 of the sick workers and their family members as ILI cases.

This sequence of events is what triggered the ILI signal for Echo Island, which you noted before making a call to Nurse Lorraine.

Figure 20: Layout of animal farming operations, relative to staff housing compounds where all ILI cases were identified.



Based on all this information, you hypothesize that there is a likely epidemiological connection between the sick and dying chickens, and the severe ILI cluster in the animal farm workers and their family members.

You wonder if there's been any test result from the specimens collected earlier - it would be great to have a laboratory-confirmed diagnosis!

In the meantime, the Ministry is under pressure to share this information with other Government Ministries and the public, because there are already a lot of rumours and concerns in the local community about a dangerous new COVID-19 variant outbreak on these farms.

The next step is data dissemination - you need to urgently prepare an epidemiological report of the Echo Island ILI outbreak investigation findings so further preventive public health action can be taken by the Government and local communities.

You also need to prepare the routine monthly ILI syndromic surveillance report.

7

Data dissemination

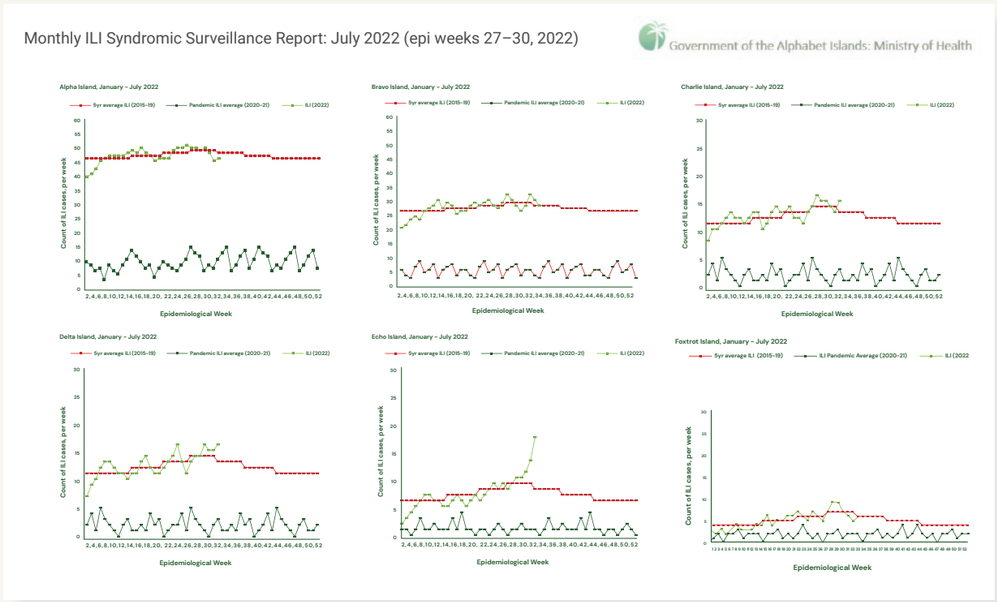
Data dissemination involves regularly reporting data analyses back to the data collectors and the community, and those responsible for policy or public health action. Your ILI syndromic data analysis needs to be summarised in a written report and shared with key stakeholders every month.

You recall the instructions provided by Officer Simone during your introductory job briefing.

> Officer Simone says:
>
> Part of your job includes analysing the data and preparing a monthly syndromic surveillance report.
>
> This report goes to the Ministry's senior management, and importantly, is also shared with the surveillance sentinel sites on each island. The reports are also put on the Ministry's public webpage. This helps everyone understand what is going on with the disease syndromes under surveillance - not only in their local health clinic area or island, but also on the other islands across the country.

Using the provincial islands data you previously analysed, you prepare a brief ILI syndromic surveillance summary report for July 2022, to be shared with all the key stakeholders (2).

Figure 21: Example of Alphabet Islands Monthly ILI Syndromic Surveillance Report.



Next, you need to develop an **epidemiological report** for the ILI outbreak investigation on Echo Island. This should provide an accurate, concise scientific overview of the key findings, and document all steps undertaken during the course of the outbreak investigation and the response.

However, one key piece of information is still missing - what has caused this illness outbreak? You're still awaiting laboratory testing results of the specimens collected from the Echo Island ILI cases and their close household contacts by Nurse Lorraine's team.

You receive another call from Officer Simone, and this time she provides an update with some very alarming news!

> Officer Simone says:
>
> The specimens your team collected during the Echo Island investigation were tested at the national public health laboratory here on Alpha Island. The results were negative for bacterial diseases, and also negative for the COVID-19 virus and other common respiratory viruses.
>
> However, some specimens tested positive for influenza A virus. These human case specimens, along with a few environmental specimens collected from the chicken houses were sent overseas to a World Health Organization (WHO) reference laboratory for additional testing (8).
>
> "We received information that several specimens tested positive for avian (bird) influenza. That means some of the chicken farm workers and their household contacts tested positive for bird flu – **highly pathogenic avian influenza (HPAI),** of the sub-type **A(H5N6)** (9-11). This virus showed a very unusual genetic pattern, quite different from normal seasonal influenza virus.
>
> This illness has never been reported from the Alphabet Islands before.
>
> Remember, the third objective of our national syndromic surveillance system is to comply with international reporting obligations, under the International Health Regulations (IHR 2005) (5). I first reported this unusual ILI outbreak event in animal farm workers last week, but we now need to update WHO about the avian flu diagnosis, because this zoonotic illness may have the potential to become another pandemic, and is therefore of major international public health importance.
>
> We can also use this notification process to raise international awareness and request additional logistical, diagnostic and operational support for the public and animal health authorities to further investigate and respond to this HPAI outbreak in birds and humans.

Officer Simone explains this diagnosis confirms the epidemiological link between the dead chickens, the sick farm workers and their families. Thankfully, it seems that while this particular HPAI virus may result in a severe illness if humans become infected, it is not very good at transmitting (spreading) between people. It's likely that most of these human HPAI cases got sick because they handled or butchered sick or dead chickens, or cleaned the poultry houses which were contaminated with very high viral loads, without using personal protective equipment.

Because your Surveillance Branch is the National IHR Focal Point (12) for the Alphabet Islands, you assist Officer Simone to update WHO on the laboratory diagnosis of this zoonotic HPAI outbreak event in humans by using the online WHO Event Information Site (13).

Furthermore, because HPAI is also an internationally notifiable animal disease, the animal health authorities in the Ministry of Agriculture reports the outbreak in chickens to the World Organisation for Animal Health (WOAH) (14) using the World Animal Health Information System (WAHIS) (15).

Next, the Ministries of Health and Agriculture review the progress of the **One Health Investigation**, and consider the public and animal **health action** that needs to occur in response to this serious ILI outbreak event.

8

Public health action

Based on the written reports that you developed, decisions are made to help control and prevent further spread of the HPAI bird flu outbreak in humans and farmed chickens on Echo Island.

The epidemiological and laboratory information collected, analysed and reported on during the routine, weekly ILI syndromic surveillance and the inter-Ministry One Health Investigation, allowed the public and animal health authorities to identify the following additional actions required to prevent and control HPAI on Echo Island:

Public Health Authorities

- Continue active surveillance to identify any possible additional human cases who may have been exposed to sick or dead chickens, wild birds or other animals, or contaminated environments and equipment on the affected farm or other locations.
- Training of farm workers and farm management to strengthen on-farm biosecurity and the use of personal protective equipment (PPE).
- Implement a risk communication strategy to raise community awareness of the risk of HPAI and sensible prevention strategies like avoiding close contact with sick birds or potentially contaminated environments, and not butchering sick or dead chickens as a food source.
- Raise community awareness of the need to report unusual health events, including sudden die-offs of wild or farmed animals.
- Continue monthly ILI syndromic surveillance, and carefully monitor ILI trends in the Alphabet Islands for any unusual trends.
- Work with international partners to improve national capacity for laboratory-based surveillance, including diagnosis of influenza virus strains.
- Continue collaboration and information-sharing with the animal health authorities about current syndromic surveillance trends including ILI, zoonotic illness clusters or outbreaks in humans, or other unusual public health events.

Animal Health Authorities

- Ensure that any remaining chickens on the affected farm are destroyed and safely disposed of by burial or burning by staff wearing appropriate personal protective equipment.
- Ensure thorough decontamination (cleaning and disinfection) of all chicken houses, surfaces, farm equipment, tools and clothing that were in contact with sick or dead chickens.
- Conducting enhanced surveillance for avian influenza in domestic poultry and wild birds looking for the influenza viruses in circulation.
- Conduct tracing investigations to try and determine the source of the avian influenza virus outbreak on this farm.

  - For example, the virus may have been introduced by wild migratory water birds active on or near the chicken farm, like at the river which also serves as the source of the farm's water.

  - The virus may also have been introduced to the farm due to human activities, e.g. by contaminated feed imported from overseas, or contaminated vehicles, equipment, clothing or other sick chickens bought elsewhere and brought to the farm.
- Continue collaboration and information-sharing with the public health authorities about current influenza viruses circulating in birds in the Alphabet Islands, as well as zoonotic illness clusters or outbreaks in animals, or other unusual public health events.

The Ministries involved in the One Health investigation also agree to conduct a collaborative **after-action review** (AAR) of the outbreak investigation and response - this provides health officers with a valuable opportunity to reflect on their experiences, and to share lessons learnt. As a key learning from the AAR, the Ministries agree to develop a memorandum of understanding to ensure regular information sharing and coordinated responses to future serious zoonotic illness outbreaks.

9

Conclusion

It's been a very eventful first month in the job of assistant national syndromic surveillance focal point in the Alphabet Islands!

Thankfully, with the help of your FETP training and supportive public and animal health colleagues, you were able to gain a lot of hands-on experience in the field. You now have a good understanding of how the national syndromic sentinel surveillance system operates, and feel confident about how best to ensure the ongoing, systematic collection, analysis, interpretation and dissemination of health-related data for public health action.

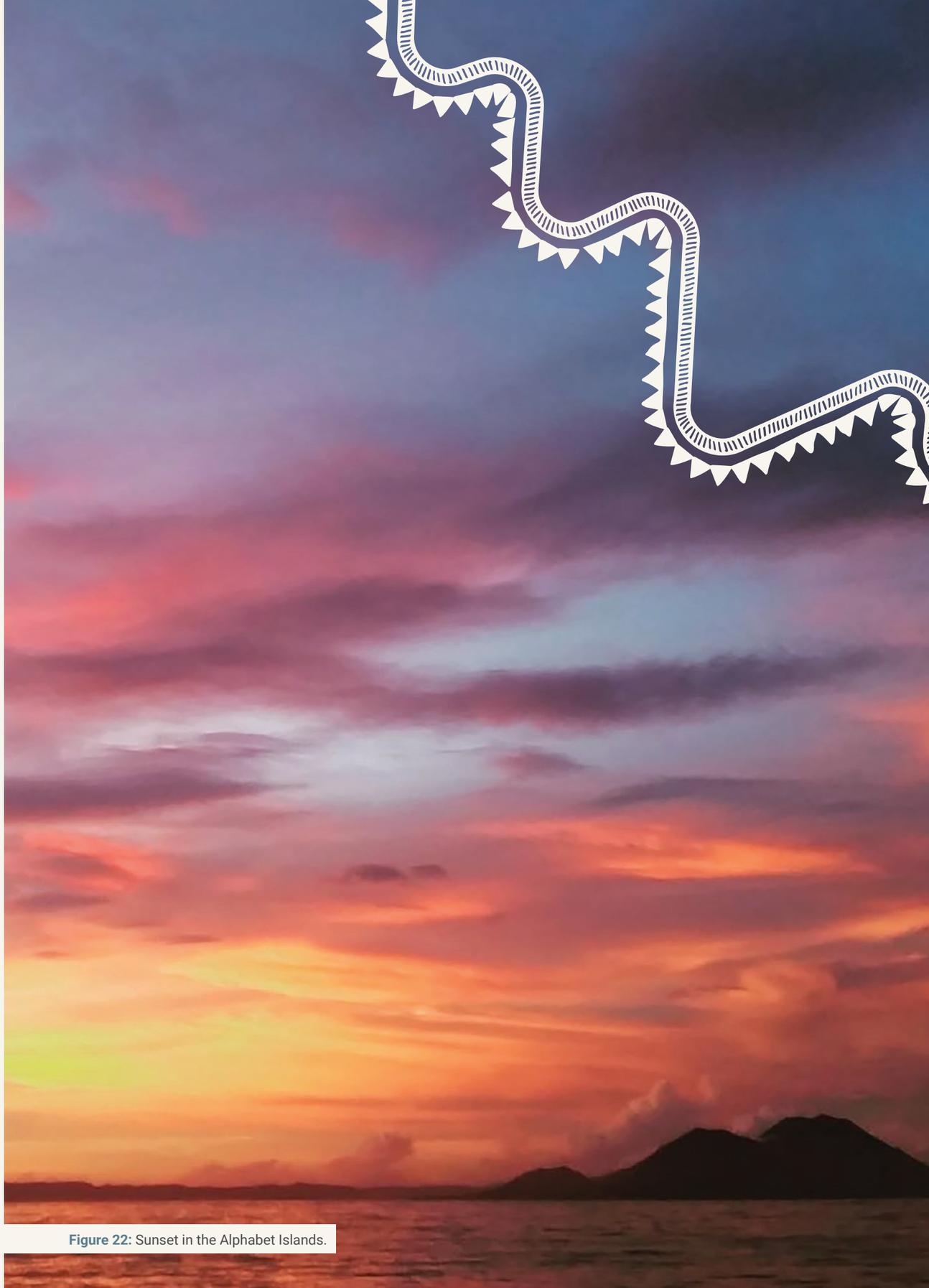


Figure 22: Sunset in the Alphabet Islands.

10 References and additional resources

This evidence-based case study was developed through a review of the scientific literature and publications produced by global public health agencies including the World Health Organization (WHO) and the Pacific Public Health Surveillance Network (PPHSN).

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CASE STUDY

PUBLIC HEALTH SURVEILLANCE

Field Epidemiology

IN ACTION