

One Health Outbreak Investigation Card Game



Rx One Health 2019 participants practice obtaining a milk sample for zoonotic disease surveillance in Iringa, Tanzania

Facilitator's Guide

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This document was prepared as part of the One Health Workforce – Next Generation Project to support activities conducted under One Health Workforce Academies and is intended for an audience of qualified professionals trained in standard best practices. This guide is not intended for use by untrained individuals.

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One Health Outbreak Investigation Card Game

Summary:

This activity uses a series of cards to walk small groups of participants through a fictitious One Health zoonotic disease outbreak scenario, following the 10 steps of an outbreak investigation.¹ This activity works best following a lecture (or series of lectures) on how to conduct a disease outbreak investigation and the corresponding knowledge to perform basic epidemiological calculations.

Complementary resources to this activity include the following:

1. [OHWA Outbreak Investigation & Response Online Training Modules](#)
2. [The CDC Field Epidemiology Manual](#)
3. [FOCUS on Field Epidemiology Series, University of North Carolina](#)
4. [Outbreak Investigations – a Perspective.](#) A. Reingold, Emerging Infectious Disease, 1998.
5. [The European Centre for Disease Prevention and Control online learning platform \(ECDC Introduction to Outbreak Investigation Video\)](#)
6. [Epidemiology: The Basic Science of Public Health](#) an online course by University of North Carolina at Chapel Hill offered on Coursera

Learning Objectives:

- 1) **Identify and practice** the steps required to investigate a disease outbreak
- 2) **Explain** what happens during each step of a disease outbreak investigation
- 3) **Identify** relevant stakeholders and organizations concerned with the management of a disease outbreak at a national level
- 4) **Discuss** the challenges encountered when investigating a disease outbreak

¹ Within the scientific literature and outbreak investigation community, there are various versions of steps that an outbreak investigation follows; all are similar, but sometimes the number, order, or exact wording of the steps differs. The steps this guide follows are detailed on pages 9-12 and are the steps taught by faculty at the School of Veterinary Medicine, University of California, Davis.

Time for Completion:

Around 2-3 hours. Can stretch longer depending on how long the “Report Results” portion of the activity lasts.

Audience:

This activity requires that participants have basic epidemiological knowledge and are familiar with the steps of an outbreak investigation.

Supplies Needed:

- 1) Enough sets of printed card prompts for as many small groups as you'll need (Found at the end of this document)
- 2) Scissors to cut the card prompts
- 3) Paper & pens/pencils
- 4) Enough facilitators so that the facilitator: small group ratio is about 1:3 or 1:4.

This guide is organized in the following way:

- 1) Instructional Sequence (Pages 5 – 8)
- 2) “Steps in a Disease Outbreak Investigation” - Supplemental Material (Pages 9 – 12)
- 3) Card Prompts (print enough copies for as many groups there will be, and then cut apart where indicated) (Pages 13 – 18; these pages are NOT numbered).

Facilitator Note: The information included in this facilitator's guide is not intended for distribution to participants. This is for your use in preparing and facilitating sessions only. Distributing or verbally disseminating this information directly will take away from the intended experience for the participants.

Instructional Sequence

1) **Divide participants into groups.** This activity works well with groups of 4-5 participants/group. If you have a mixed level of backgrounds and experience, it is helpful to purposely create groups to include a variety of different backgrounds and levels of expertise in each group (i.e., make “One Health” groups). There is no minimum or maximum number of groups recommended, however if you have a small number of groups, you may need to split groups up to conduct the Report Results portion of the activity, and if you have many groups, you will need a larger number of small group facilitators.

2) **Introduce the Activity.** Prepare participants for the activity they will be participating in, which will involve them moving through a fictitious outbreak scenario (caused by Marburg virus, but shhhh: don't tell them that). Ask participants to explain the steps of an outbreak investigation. Small groups will receive a series of cards from you in response to their asking appropriate questions, while practicing investigating an outbreak using the outbreak investigation 10 steps taught in the preceding lecture(s). Each card contains information necessary for them to move through the outbreak investigation scenario. For a group to receive a card, they'll need to ask the facilitator the right question(s) and/or illustrate adequate understanding of the details and findings presented on the cards they've already received.

Facilitator Note: **Except for the cards titled “Introduction” and “Laboratory Results” cards will not necessarily be delivered in sequential order.** Each group should receive the card sharing information and details appropriate to the question(s) they are asking. For this reason, cards are titled, but not numbered, so that groups aren't inadvertently prompted to realize they are “missing” cards. This concept also helps reinforce the fact that the steps in an outbreak investigation can be iterative and aren't always sequential.

Facilitator Note: This activity follows the steps of an outbreak investigation outlined on the One Health Workforce Academy Outbreak Investigation and Response module. Within the scientific literature and outbreak investigation community, there are various versions of steps that an outbreak investigation follows; all are similar, but sometimes the number, order, or exact wording of the steps differs. The steps this activity follows are summarized below (and a supplemental resource is included on pages 9-12). Instructors are encouraged to refer to and use resources within [OHWA Outbreak Investigation & Response Online Training Modules](#) to refresh their own knowledge and can also point participants to the module as a resource. To be successful, the participants should already be familiar with and know the steps of an Outbreak Investigation. It is up to the instructor or facilitator if they'd like to share these steps with the participants during the activity as a reminder.

The 10 Steps in an Outbreak Investigation Followed by this Activity

- 1) Define a case
- 2) Determine the magnitude of the problem
- 3) Verify the diagnosis
- 4) Describe the temporal pattern
- 5) Describe the spatial pattern
- 6) Describe the subject pattern (species, age, sex, etc.)
- 7) Analysis of Data – Epidemiologic Measures
- 8) Form a Working Hypothesis
- 9) Intensive Follow-up
- 10) Report Results

2) **Begin the Activity.** To begin, the lead facilitator reads the “Introduction” card out loud to the entire group, asks for any questions, and passes a copy of the “Introduction” card to each group. Then each group moves through the activity at their own pace, asking questions that should prompt the receipt of one card or another.

Facilitator Note: Each facilitator holds the cards for 3 -4 groups, and hands them out as they move through the scenario. Facilitators should make sure to keep each group's cards separated to help smooth the process of knowing which cards a particular group has not received yet.

3) Card Titles & Specific Instructions for each card

Card Title	Card Specific Instructions
Introduction	Everyone receives this card as the FIRST card.
Local Developments	Only share this card if a group asks questions related to the anything changing or activities in the region (I.e. – tourism, ecosystem protection, etc.)
Suspected Cause and Preliminary Diagnostic Testing	This card relates to Steps 1 and 3 in an outbreak investigation and helps reinforce both the challenge and importance of establishing a diagnosis. Often clinicians and managers may already think they have a “known” disease and might jump to conclusions. When working through an outbreak, one needs to investigate all possible options, including the possibility of a novel or uncommon pathogen, and not just pursue the most common or likely diagnosis.
Individuals Affected and Clinical Signs	To receive this card, participants need to ask something like “Who is affected? How many? What are their clinical signs?” This card is necessary to help build a case definition
Hematology/Clinical Chemistry of Patients	This card is handed out if participants ask about any lab work findings, or if they request information about laboratory tests. If they ask for clinical tests or results from tests not reported on this card, indicate that they can submit those tests, but that results will not be available for some time because the samples have to be sent out to a lab. (Image shows <i>P. falciparum</i> [malaria parasite] in red blood cells).
Gross Pathology Findings	This card is handed out if participants ask for any necropsy or veterinary clinical diagnostic findings.
Magnitude of the Problem	Ideally, participants will ask questions that relate to this card very early on, if they are correctly following the steps. This card relates to Step 2.
Appearances of Cases in Time	This card relates to Step 4 and includes information participants need to make an epidemic curve. To receive this card participants should ask about how cases were spread over time. This card should not be distributed to groups until they have developed a case definition.
Epidemic Curve	This card can be shared after participants begin to make their epidemic curve and ideally after they ask if there were any more cases.
Spatial pattern	This card can be shared if participants ask how cases are distributed spatially.
Risk of Disease by Factor	Instructors are encouraged to make sure groups have really thought about and considered all the steps thus far, before sharing this card. Prompt groups with questions about their understanding of data and

	information received to ensure they are ready for this card. This card is related to Step 7, Analysis of the Data. A group should NOT receive this card until they have determined the Magnitude of the problem and received that card.
Developments	This card is a delaying tactic card. If some groups are moving through the exercise more quickly than others, this card can be shared. You can also use this card to help convey concepts around time required to gather permissions, pack, and ship samples, laboratory limitations, safe transportation requirements, etc.
Laboratory Results	This is the LAST card. Groups should have their hypothesis, Step 8 and have worked through all the other possible steps, before receiving this card.

4) **Report Results.** As a component of the final step in an outbreak investigation, “report results”, have each group discuss the process of their investigation, what was challenging, where they wished they’d had more information, etc. Then have each group nominate one representative to report to the entire class on their group’s experience and discuss results. This could also take the form of a press conference, where each group nominates a group member to play a role in a press conference, discussing the outbreak, what they should know about it, what is being done to address it, etc.

Roles could include:

- 1) Epidemiologist
- 2) Ministry level government official
- 3) Town mayor and/or Village headman
- 4) WHO CDC representative
- 5) Wildlife Park Warden
- 6) Chief Medical Officer or local Hospital doctor
- 7) Chief Veterinary Medical Officer or local Animal Health Officer
- 8) Environmental Health Officer
- 9) Local Farmers Union/Organization representative
- 10) Tourism representative/minister
- 11) Local Citizen (i.e. could be a non-affected guano harvester, park worker, tourism guide, etc.)

5) **Discuss next steps.** As a way of wrapping up the session, the instructor could do a review of the outbreak scenario, addressing issues that came up while facilitating the groups and providing perspective on different ways of working through an outbreak situation. If the instructor has participated in a real outbreak response, they could share that experience and reflect on how it was similar or varied from the scenario.

Reflection

Toward the end of the class, provide participants with time for reflection. The reflection period will provide an opportunity for them to discuss the challenges and successes that they experienced both individually and as a member of the group. During the reflection period, the facilitator should move between groups observing for indicators that groups are functioning well and asking open-ended questions to help assess participants’ understanding of current topics and processes. It is also important to identify and address any misunderstandings participants might have.

Go Further:

Stakeholder Communication Activity. As a stand-alone, follow-up activity, participants could create and share various strategies to communicate with various types of stakeholders about the outbreak. This could include an activity, such as creating radio jingles and/or other types of public service type announcements to warn tourists and local residents about the outbreak and what steps are necessary to protect themselves and others from disease.

Explore Additional Outbreak Investigation Resources. Another separate activity participants could pursue, either as a group or on an individual basis, is to explore the World Health Organization (WHO) GoData resources, including an [open access course](#) on the OpenWHO platform. Developed by the WHO in partnership with the Global Outbreak Alert and Response Network (GOARN), GoData is an outbreak investigation software for field data collection during public health emergencies. Designed for use by outbreak responders, the tool can help facilitate case and contact investigation, incorporation of laboratory information and data visualization.

Steps in a Disease Outbreak Investigation - SUPPLEMENTAL MATERIAL

(Adapted from University of California, Davis, School of Veterinary Medicine Population Health Teaching Materials)

Definitions and terminology

The term outbreak is often used synonymously with epidemic. It is defined as the occurrence in a community, or region, of cases of an illness, specific health-related behavior, or other health related events clearly in excess of normal expectancy (relative to the usual frequency of the disease in the same area, among the specified population, at the same season of the year). More simply, it is an increase in the number of cases over past experience for a given population, time, and place.

Approach to an outbreak investigation

Each disease outbreak investigation presents differently and has its own set of challenges; however, there are a set of steps outlined below that can be used for a systematic approach. The steps are presented in conceptual order. In practice, however, several of the steps may be initiated simultaneously rather than sequentially or may be done in a slightly different order. Control measures should be implemented as soon as the source and mode of transmission are known, which may be early or late in the outbreak investigation.

10 Steps in an Outbreak Investigation

1) Define a case

The presenting problems should be carefully evaluated, and a case definition developed to accurately identify cases and obtain accurate measures of disease frequency (prevalence, incidence, etc.). The case definition should be broad enough to include most, if not all, of the actual cases. However, it should also be specific enough not to include “false-positive” cases or endemic disease in the population. If endemic disease is included in the case definition, the magnitude of the disease may be misclassified. In practice, a loose case definition that includes categories such as confirmed (i.e., has laboratory confirmation), probable (i.e., has the typical clinical features of the disease but does not have laboratory confirmation), and possible (i.e., fewer of the typical clinical features than a probable case) is commonly used in the field to capture as many cases as possible. As the investigation progresses and more information is obtained, this definition may be tightened to include only confirmed or confirmed and probable.

Examples of case definitions:

Probable: Puppy at shelter X with acute onset of lethargy, fever, and cough between January 4 and 10, 2017.

Confirmed: Puppy at shelter X with acute onset of lethargy, fever, and cough between January 4 and 10, 2017 that was laboratory confirmed by detection of *Bordetella bronchiseptica* DNA by polymerase chain reaction (PCR) testing.

2) Determine the magnitude of the problem

$$\text{Affected Proportion (AP)} = \frac{\text{\# of affected individuals}}{\text{population at risk at start of epidemic}}$$

Also, keep in mind that there may be a background level of disease.

3) Verify the diagnosis

Verifying the diagnosis requires that you review the clinical findings and laboratory results for affected individuals. If no diagnosis is hypothesized, you may be able to propose one; however, laboratory diagnostics are almost always required to verify the diagnosis.

4) Describe the temporal pattern

Epidemic curves (number of affected individuals on the y-axis and time on the x-axis) should be produced using various time intervals (i.e. date of onset). These curves may allow you to draw inferences about the epidemic pattern – whether the outbreak is of the point source or propagated type (i.e. whether it is an outbreak resulting from a point or common source exposure, from person-to-person spread, or both) (Fig. 1).

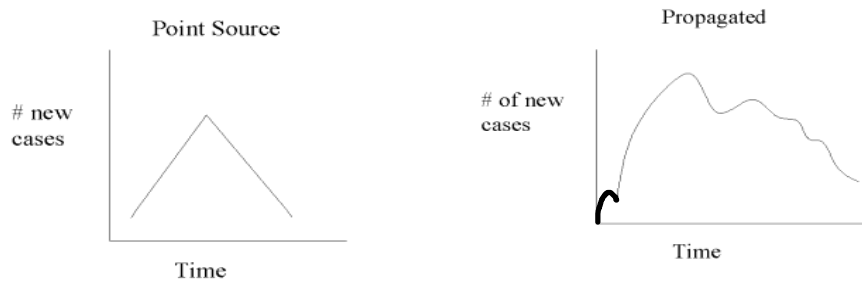


Figure 1. Two plots showing point source and propagated epidemic curves.

5) Describe the spatial pattern

A topographic map of the area illustrating the distribution of the cases will help identify the interrelationships among cases and their juxtaposition with geographic elements.

6) Describe the subject pattern (species, age, sex, etc.)

Data on species, age, sex, and other outbreak-specific factors should be collected for analysis. These factors may be closely associated with temporal and spatial patterns of the outbreak.

7) Analysis of data

Factor-specific affected proportions for species, age, sex, and other exposure factors should now be calculated in an affected proportion (AP) table. A table with the following headings can be used during an outbreak to organize and analyze the data collected (Table 1). See examples in Table 2.

Table 1. Example table with headings for outbreak investigation calculations.

Factor	Number exposed	Number not exposed
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	total	ill/dead	well	AP	total	ill/dead	well	AP
				AP ₁				AP ₂

Table 2. Data collected from a food-borne outbreak that caused diarrhea in farmed mink are presented below.

Affected Proportion or Attack Proportion for Feed Items in Outbreak of Disease in Mink

Feed Item	Mink eating feed					Mink not eating Feed				
	Total	Sick & Dead	Well	AP ₁ %	Rel. ^a Risk	Total	Sick & Dead	Well	AP ₂ %	Attrib. ^b Risk
Fish	3445	1214	2231	35.2	0.7	1462	744	718	50.9	-15.7
Protein Supp.	1476	387	1089	26.2	0.57	3431	1571	1860	45.8	-19.4
Red Meat	2911	1543	1368	53.0	2.5	1996	415	1581	20.8	21.2
Liver	4687	1956	2731	41.7	45	220	2	218	0.9	40.8
Cereals	4907	1958	2949	39.9		0				
Blood/Bone Meal	4387	1930	2457	44.0	8	520	28	492	5.4	38.6
Horse Fat	1557	949	608	61.0	2	3350	1009	2341	30.1	30.9
Fish Fat	3350	1009	2341	30.1	0.5	1557	949	608	60.9	-30.8
Vegetable Fat	2804	1917	887	68.4	35	2103	41	2062	1.9	66.5
Vitamins & Minerals	4907	1958	2949	39.9		0				

from Schwabe, Reimann, & Franti; ^aRel. = relative; ^bAttrib. = Attributable

Interpretation of the AP table should include the following values and calculations:

- Highest affected proportion
- Lowest affected proportion
- Greatest difference: Attributable Risk = AR = AP₁ - AP₂
- Relative Risk: RR = AP₁/AP₂
- Fit of disease pattern and distribution factors
- Etiologic Fraction:

$$EF = \frac{AP_1 - AP_2}{AP_1}$$

8) Working hypothesis

At this point, a working hypothesis should be in place, or an existing hypothesis can be fine-tuned, based on additional or more reliable data. Specifically, you should determine:

- The kind of epidemic: point source vs. propagated
- The source of the epidemic: common source, multiple exposure, toxins, other
- The possible mode of spread: contact, fomite, vector, other

Your hypothesis should be compatible with all of the observations collected in the investigation, and if it is not, the hypothesis must be revised. Now, you should be able to make recommendations for corrective action and prevention.

9) Intensive follow-up

Clinical, pathological, microbiological, and toxicological data can now be evaluated in greater detail. Previously collected data on distribution of subjects and background level of disease should also be examined and researched in more detail at this point. Further epidemiologic investigations must continue.

10) Report results

The distribution of accurate information is often a difficult task, especially when you consider the diversity of the audience that may need to access the information in the future. It is your obligation to ensure that information regarding the outbreak is distributed to the appropriate organizations, agencies, and other entities that may have an interest in the outcome. However, there may be potential restrictions on the dissemination of information due to legal concerns, security, or other reasons.

Introduction

Early morning on a day in May, you receive a call from the Ministry of Health of New Taifa informing you that 23 people (5 New Taifa citizens and 18 international tourists) have presented in the last week to the Kantarange District Hospital with an unusual set of severe symptoms. All of the tourists visited the La Grotte caves, as well as the Miriti National Park for ecotourism activities. Of these 23 patients, 11 have died (10 tourists and 1 New Taifan), and 9 are in critical condition (5 tourists and 4 New Taifans).

Because you are a world-renowned epidemiologist specializing in outbreak investigations, the health officer asks you to go to Kantarange District to support the investigation of what appears to be a severe outbreak. While you are considering the request to travel to New Taifa, you receive an email from your friend, a ranger at Miriti National Park located in Kantarange District, informing you that 2 vervet monkeys (*Chlorocebus pygerythrus*) were recently found dead within the park on the same day – very unusual according to your friend. You are intrigued and want to help, so you arrange for a flight to New Taifa as soon as possible.



Local Developments

Tourists that visit Miriti National Park often hire guides to go trekking into the forest where several species of endangered primates live and to visit local villages to learn about daily life in Kantarange and to purchase homemade crafts; the area is well known for its wood carvings, textiles, and basket making.

In addition to primate and cultural tourism, New Taifa has started to promote caving for recreation and bat ecotourism activities in Kantarange District. Other related activities include harvesting of bat guano by locals periodically for agricultural purposes.

The government of New Taifa is very interested in protecting bat populations and the cave ecosystems, while also promoting economic endeavors that positively affect the country's economic development.



Suspected Cause and Preliminary Diagnostic Testing

No pathogen-specific molecular tests have been run, as authorities did not want to move samples out of Kantarange District, including to the reference laboratory in Grandeville (the only laboratory in New Taifa capable of conducting PCR tests) because of biosecurity concerns. Malaria is present in the region but not as prevalent as it is in lower altitudes.

People Affected and Clinical Signs

New Taifans: All are from villages located in Kantarange District. Two of them have been working as guano harvesters, while the other 3 worked at Miriti National Park as guides. All of them are between 20 and 42 years old; 3 are women, and 2 are men. These patients presented with sudden onset of high fever, severe headache, and myalgia, with some also complaining of abdominal pain with vomiting and diarrhea. The dead New Taifan patient also presented with a rash on the chest and back and massive hemorrhaging.

The autopsy of the New Taifan guano harvester revealed focal areas of necrosis in the liver and spleen, along with signs of disseminated intravascular coagulation.

Tourists: as the law requires, all tourists were vaccinated against yellow fever before coming to New Taifa. Among the sick and dead tourists are 2 French, 1 American, 3 Germans, 4 Australians, 4 Italians, 1 Japanese, and 3 Spanish. From these tourists 10 are men, while 8 are women, all between 22 and 37 years old. All visited Miriti National Park and the La Grotte Caves within the week before hospitalization. These patients presented with similar symptoms to those of the New Taifans mentioned above. The 5 critical tourist patients are presenting with symptoms consistent with liver failure and multi-organ dysfunction.



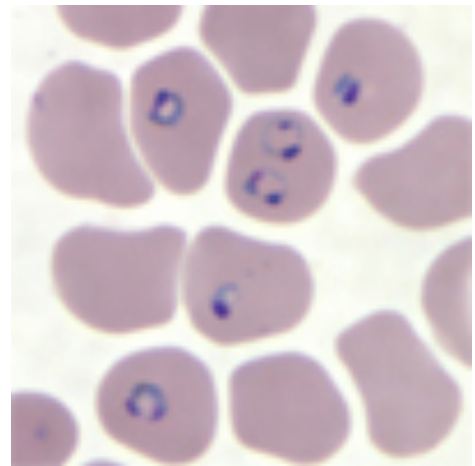
Hematology/Clinical Chemistry of Patients

Marked leucopenia (low white blood cells) and thrombocytopenia (low platelets).

Transaminases (ALT and AST) elevated (markers of liver and/or muscle damage).

Dead patients demonstrated decreased levels of total plasma protein and increased coagulation times just prior to death.

Moreover, what is shown in this image was found in 2 New Taifan patients:



Findings of Vervet Monkey Necropsy

Only one vervet monkey was maintained properly to conduct a valid necropsy. Necropsy findings included a macular rash covering on the face; lymphadenopathy (enlarged lymph nodes) with hemorrhage; a congested, enlarged liver; and urinary bladder petechiae (small hemorrhages). Microscopic examination of tissues was not possible to carry out given the lack of local equipment and supplies necessary, but the tissues have been saved in formalin for later analyses.

Magnitude of the Problem

During the following week, while you are awaiting permission and assistance to move samples to Grandeville for further testing, 4 of your critical patients die (all tourists) bringing the total to 15 deaths, while 21 more patients arrive at the hospital matching your case definition: 19 tourists and 2 New Taifans, 12 men and 9 women, all between 21 and 41 years old. One New Taifan was guano harvester while the other one worked in the Miriti National Park as a guide.

From this group, 11 die, and 6 are in critical condition. The tourists were all international and had visited the Miriti National Park and the La Grotte Caves within the week before hospitalization, just like the others. All contacts of these patients have been kept in quarantine while the Park and the Caves have been closed to the public.

You have started gathering information about these new patients and also gathered the information from guano harvesters, tourists, and Park workers that have not been hospitalized during these 2 weeks. The preliminary non-case population is considered to be 298.

No other vervet monkeys or primates of other species have been found sick or dead in this period.



Appearances of Cases in Time

These are the data for new cases, total cases alive (assumes no recovery) and dead by day. The case definition used for this data is: sudden onset of a fever of 40°C or higher, accompanied by severe headache and myalgia and not responsive to malaria treatment.

	Week 1 by Day							Total
New Cases Daily	1	3	4	2	5	1	7	23
Total Cases Alive	1	4	7	5	10	8	13	

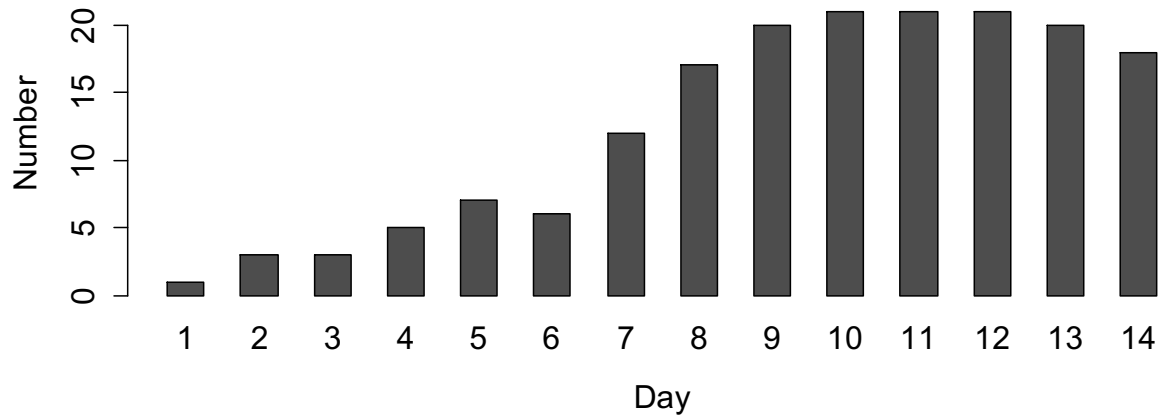
	Week 2 by Day							Total
New Cases Daily	9	5	4	1	0	2	0	21
Total Cases Alive	21	22	24	22	21	23	20	

Daily dead	0	1	4	0	3	2	1	11
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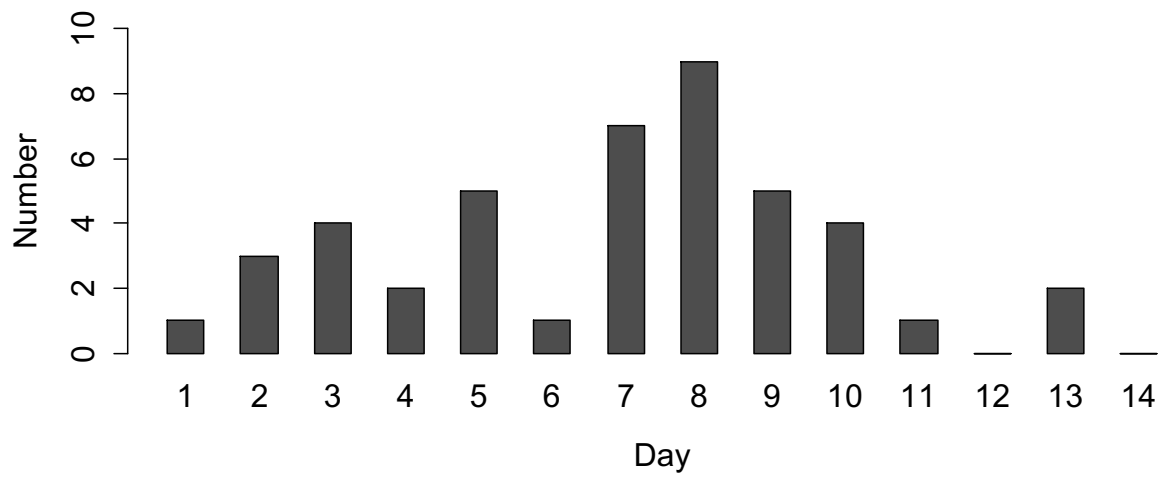
Daily dead	4	2	3	1	0	3	2	15
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Epidemic Curve

Daily total cases



Daily new cases



Spatial pattern



- Miriti National Park Boundary
- Estimated area used by tourists
- Estimated area used by park staff
- Estimated area used by guano harvesters

When interviewing relatives of guano harvesters, you find that some of them harvested guano illegally in a cave inside the park.



Developments

The authorities have given the permission to move samples to be tested to the National Reference Laboratory in Grandeville.

Risk of Disease by Factor

Risk Factor	Exposed			Not Exposed		
	Total	# Affected	AP ₁	Total	# Affected	AP ₂
Over 30	159	19	0.12	183	25	0.14
Female	170	21	0.12	172	23	0.13
Park Worker	38	4	0.11	304	40	0.13
Tourist	258	37	0.14	84	7	0.08
Guano Harvester	46	3	0.07	296	41	0.14
Illegal Guano Harvester (Compared to Legal Guano Harvester)	6	2	0.33	40	1	0.025
Park Workers (Compared to Guano Harvesters)	38	4	0.11	46	3	0.07
Tourists (Compared to Guano Harvesters)	258	37	0.14	46	3	0.07



Laboratory Results

Malaria – only the two New Taifans with positive blood smears were affected

Yellow fever virus – negative by PCR

Ebola virus (Zaire) – negative by PCR

Marburg virus – 28 positives by PCR