

Introduction to Field Epidemiology and Outbreak Response

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Table of contents

Preface	4
Disclaimer	4
Notice	4
1 Introduction	5
2 Before you go	6
2.1 Travel medicine clinic	6
2.2 Packing for your travel	9
2.2.1 Prescription Medications	9
2.2.2 Medical supplies	9
2.2.3 Prevention	9
2.2.4 First Aid	9
2.2.5 Documentation	9
2.3 Travel insurance	10
2.4 Joining the Smart Traveler Enrollment Program	10
2.5 Fitness preparation	10
I Organization	11
3 Incident Command	12
4 Logistics	13
II Human epidemiology	14
5 Ten Steps of a Field Investigation	16
6 Defining a case	17
7 Bioethics during an outbreak	18

III Vector capture	19
8 Mosquitos	21
9 Ticks and mites	23
10 Rodents and small mammals	25
11 Bats	26
IV After action	27
12 Reporting	28
12.1 Situation Reports	28
12.2 After Action Reports	28
V Conclusion	29
13 Conclusion	30
References	31
Appendices	32
A PPE	32
B Learning R	33
B.1 Learning the basics	33
B.2 Epidemiology focused	33
B.3 Geospatial focused	33
C Diagnostics	34
C.1 Lateral Flow Assays	34
C.2 PCR	34
C.3 Immunochemistry	34
C.3.1 LAMP	34
C.3.2 ELISA	34
C.3.3 Western Blots	34
Glossary	35

Preface

The handbook evolved after my experience during the International Field Epidemiology program conducted during June 2024 in Lima and Tumbes, Peru.

Disclaimer

The conclusions, findings, and opinions expressed by authors contributing to this journal do not necessarily reflect the official position of the authors' affiliated institutions.

Notice

This material is not intended to be and should not be considered a substitute for medical or other professional advice. Treatment for the conditions described in this material is highly dependent on the individual circumstances. While this material is designed to offer accurate information with respect to the subject matter covered and to be current as of the time it was written, research and knowledge about medical and health issues are constantly evolving, and dose schedules for medications and vaccines are being revised continually, with new side effects recognized and accounted for regularly. Readers must, therefore, always check the product information and data sheets provided by the manufacturers and the most recent codes of conduct and safety regulations. The publisher and the authors make no representations or warranties to readers, express or implied, as to the accuracy or completeness of this material, including without limitations that they make no representations or warranties as to the accuracy of the drug dosages mentioned in this material. The authors and the publishers do not accept, and expressly disclaim, any responsibility for any liability, loss, or risk that may be claimed or incurred as a consequence of the use and/or application of any of the contents of this material.

1 Introduction

During an outbreak, the key mission is two-fold– save as many lives as possible and learn enough to stop the outbreak. Zoonoses are growing (Woolhouse and Gowtage-Sequeria 2005).

2 Before you go

One of the worst things to happen to a team investigating an outbreak is for a teammate to come down with an illness during the investigation. In the best case, everyone on the team has been vaccinated against the likely infections known for the region in which the outbreak occurs. Similarly, you may need to take prophylaxis for different pathogens before, during, and after your visit. It may also be good to have some common drugs in case a member of the team comes down with an illness. The best way to prepare for this is to visit a travel medicine clinic.

2.1 Travel medicine clinic

[Travel medicine clinics](#) are typically staffed by infectious disease physicians who can recommend different vaccines, prophylaxis, and counseling on what to do in case of emergencies. Visits to a travel medicine provider are typically covered by your insurance.

These providers will examine things like the Centers for Disease Control and Prevention (CDC)'s [yellow book](#) or other resources like [Shoreland Travax](#). Based on the ongoing disease dynamics within the country, you will see three different categories for vaccination:

- **Recommended**
- **Generally not recommended**
- **Not recommended**

We can look at the [CDC recommendations for Peru](#).

Table 2.1: Recommended vaccines for travelers to Peru retrieved from <https://wwwnc.cdc.gov/travel/destinations/traveler/none/peru> on 2024-07-13

Vaccines for disease	Recommendations	Clinical Guidance for Healthcare providers
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Routine vaccines	Make sure you are up-to-date on all routine vaccines before every trip. Some of these vaccines include Chickenpox (Varicella) Diphtheria-Tetanus-Pertussis Flu (influenza) Measles-Mumps-Rubella (MMR) Polio Shingles	Immunization schedules
COVID-19	All eligible travelers should be up to date with their COVID-19 vaccines. Please see Your COVID-19 Vaccination for more information.	COVID-19 vaccine
Chikungunya	There has been evidence of chikungunya virus transmission in Peru within the last 5 years. Chikungunya vaccination may be considered for the following travelers: People aged 65 years or older, especially those with underlying medical conditions, who may spend at least 2 weeks (cumulative time) in indoor or outdoor areas where mosquitoes are present in Peru, OR People planning to stay in Peru for a cumulative period of 6 months or more	Chikungunya - CDC Yellow Book
Hepatitis A	Recommended for unvaccinated travelers one year old or older going to Peru. Infants 6 to 11 months old should also be vaccinated against Hepatitis A. The dose does not count toward the routine 2-dose series. Travelers allergic to a vaccine component or who are younger than 6 months should receive a single dose of immune globulin, which provides effective protection for up to 2 months depending on dosage given. Unvaccinated travelers who are over 40 years old, immunocompromised, or have chronic medical conditions planning to depart to a risk area in less than 2 weeks should get the initial dose of vaccine and at the same appointment receive immune globulin.	Hepatitis A - CDC Yellow Book Dosing info - Hep A
Hepatitis B	Recommended for unvaccinated travelers younger than 60 years old traveling to Peru. Unvaccinated travelers 60 years and older may get vaccinated before traveling to Peru.	Hepatitis B - CDC Yellow Book Dosing info - Hep B

Malaria	CDC recommends that travelers going to certain areas of Peru take prescription medicine to prevent malaria. Depending on the medicine you take, you will need to start taking this medicine multiple days before your trip, as well as during and after your trip. Talk to your doctor about which malaria medication you should take. Find country-specific information about malaria.	Malaria - CDC Yellow Book Considerations when choosing a drug for malaria prophylaxis (CDC Yellow Book) Malaria information for Peru.
Measles	Cases of measles are on the rise worldwide. Travelers are at risk of measles if they have not been fully vaccinated at least two weeks prior to departure, or have not had measles in the past, and travel internationally to areas where measles is spreading. All international travelers should be fully vaccinated against measles with the measles-mumps-rubella (MMR) vaccine, including an early dose for infants 6–11 months, according to CDC's measles vaccination recommendations for international travel.	Measles (Rubeola) - CDC Yellow Book
Rabies	Dogs infected with rabies are sometimes found in Peru. Rabies is also commonly found in some terrestrial wildlife species and bats. If rabies exposures occur while in Peru, rabies vaccines may only be available in larger suburban/urban medical facilities. Rabies pre-exposure vaccination considerations include whether travelers 1) will be performing occupational or recreational activities that increase risk for exposure to potentially rabid animals and 2) might have difficulty getting prompt access to safe post-exposure prophylaxis. Please consult with a healthcare provider to determine whether you should receive pre-exposure vaccination before travel. For more information, see country rabies status assessments.	Rabies - CDC Yellow Book
Typhoid	Recommended for most travelers, especially those staying with friends or relatives or visiting smaller cities or rural areas.	Typhoid - CDC Yellow Book Dosing info - Typhoid

Yellow Fever	Recommended for travelers 9 months old going to areas <2,300 m (7,550 ft) elevation in the regions of Amazonas, Cusco, Huánuco, Junín, Loreto, Madre de Dios, Pasco, Puno, San Martín, and Ucayali, and designated areas of Ancash (far northeast), Apurímac (far north), Ayacucho (north and northeast), Cajamarca (north and east), Huancavelica (far north), La Libertad (east), and Piura (east). Generally not recommended for travel limited to the following areas west of the Andes: the regions of Lambayeque and Tumbes, and designated areas of Cajamarca (west-central), and Piura (west). Not recommended for travel limited to areas >2,300 m (7,550 ft) elevation, areas west of the Andes not listed above, the city of Lima (the capital), and the highland tourist areas (the city of Cusco, the Inca Trail, and Machu Picchu).	Yellow Fever - CDC Yellow Book
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2.2 Packing for your travel

2.2.1 Prescription Medications

2.2.2 Medical supplies

2.2.3 Prevention

2.2.4 First Aid

2.2.5 Documentation

It is important that you have all of your documentation along with additional copies of your documentation.

Passport you should make sure that you have a valid passport with at least 6 months of time before it expires (at the time of your visit). Additionally, you should make several copies of the identification page of your passport. It is important that you do not have both the copies and your physical passport on you at the same time when traveling. Having paper copies of your passport on you while in the field can prevent your actual passport from being stolen.

Visas check with your embassy and relationship of your home country with the country you are visiting. For example, U.S. citizens visiting Peru can check the [U.S. State Departments webpage](#). At the time of writing, you can stay without a visa for between 30 and 183 days. If you are not a U.S. citizen, it is essential that you contact your embassy and discuss what is required in order to enter the country (e.g., for Peru [you can see some of those nationals that might require an additional visa application](#)).

Copies of prescriptions for the medications that you are taking abroad. Some medicines might be illegal in the country you are visiting and therefore it is important that you have proper documentation for them prior to going. Additionally, if you are a physician bringing medications it is important that you claim these on entry if asked.

2.3 Travel insurance

It is important that you verify that you have international health insurance before you go. The United States government **does not provide insurance** and your domestic policy will likely not cover you when you are abroad. If you are attending the course, the university should help to arrange for international traveler's insurance (e.g., companies like [GeoBlue](#) among others). The [CDC](#) has more [comprehensive guides](#) on their travel webpage.

2.4 Joining the Smart Traveler Enrollment Program

The U.S. State Department also

2.5 Fitness preparation

During field responses you will spend a lot of time on your feet in relatively warm conditions (i.e., 8-12 hours a day in the field). This is compounded by the fact that you will likely be in long pants, long sleeves, and hiking shoes or boots to protect yourself from insects. As such a base level of physical fitness and acclimation is recommended before you go. This might take the form of walking or running a few miles a day outdoors in the months leading up to your departure. You know your body better than anyone and some level of preparation goes a long way before you are in the field.

Part I

Organization

3 Incident Command

One of the most critical tasks during an outbreak is organizing the activities. Public health practitioners and experts are typically very interested in responding to an outbreak. This energy needs to be appropriately directed in order to reduce the risk that these efforts detract from one another.

4 Logistics

Logistics

Part II

Human epidemiology

Human epidemiology.

5 Ten Steps of a Field Investigation

6 Defining a case

One of the key aspects of an outbreak investigation is establishing the case definition.

7 Bioethics during an outbreak

Ethical considerations are vital during an outbreak in order to preserve the trust of the community

Part III

Vector capture

Many infectious diseases may be transmitted through a *vector*.

8 Mosquitos

Infections

- Malaria (*Plasmodium spp.*)
- Dengue
- Zika
- Chikungunya
- Mayaro
- Rift Valley



Figure 8.1: Anopheles mosquito larva magnified under a microscope

9 Ticks and mites

i Infections

Tick-borne infections - Lyme disease (*Borrellia spp.*) - babesiosis - ehrlichiosis - Rocky Mountain Spotted Fever (*Rickettsia rickettsii*) - anaplasmosis - Southern Tick-Associated Rash Illness - Tick-Borne Relapsing Fever, and tularemia - Colorado tick fever - Powassan encephalitis - Q fever

Chiggers - Scrub typhus (*Orientia tsutsugamushi*)



Figure 9.1: Tick magnified under a microscope

10 Rodents and small mammals

i Infections

- Hanta
- Leptospirosis

11 Bats

Part IV

After action

12 Reporting

12.1 Situation Reports

12.2 After Action Reports

Part V

Conclusion

13 Conclusion

Importantly, field epidemiology requires a diverse team from a variety of skillsets in order to be successful.

References

Woolhouse, Mark E. J., and Sonya Gowtage-Sequeria. 2005. "Host Range and Emerging and Reemerging Pathogens." *Emerging Infectious Diseases* 11 (12). <https://doi.org/10.3201/eid1112.050997>.

A PPE

Personal protective equipment (PPE) is vital to protecting your staff and yourself during an outbreak investigation. Loss of personnel to sickness and quarantine can disrupt ongoing outbreak response actions. Importantly, while supplies allow and until testing indicates otherwise, you should operate at higher levels of PPE. This may include the use of N-95 respirators with facial shields and gloves (i.e., mask, gowns, and glasses/goggles). Depending on the pathogen suspected and the transmission modality, higher levels of PPE may be required. For instance during outbreaks of [Marburg and Ebola](#), higher levels of PPE are required including full protective suits, gloves, and PAPRs.

B Learning R

The basics of the R programming language

B.1 Learning the basics

- [R for Data Science](#)
- [Hands on programming with R](#)

B.2 Epidemiology focused

- [The Epidemiologist R Handbook](#)
- [R for Epidemiology](#)
- [Introduction to R for Epidemiologists](#)

B.3 Geospatial focused

- [Geocomputation with R](#)
- [Spatial Data Science](#)
- [Geospatial Health Data](#)
- [R for Geospatial](#)
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C Diagnostics

C.1 Lateral Flow Assays

C.2 PCR

C.3 Immunochemistry

C.3.1 LAMP

C.3.2 ELISA

C.3.3 Western Blots

Glossary

CDC The United States Centers for Disease Control and Prevention.

DOD The United States Department of Defense

ELISA Enzyme-linked Immunosorbent Assay

Epidemic More cases of a particular disease or infection spread across a large geographic area.

GEIS Global Emerging Infection Surveillance

LAMP Loop-mediated isothermal amplification

Outbreak The occurrence of more cases than expected in a particular geographic area, group of people or animals, over some period of time.

PCR Polymerization Chain Reaction. PCR approaches amplify DNA or cDNA (complement DNA from RNA sources).

Pseuoepidemic The phenomenon that describes when a series of cases have a pattern of reporting that mimics that of an epidemic or outbreak, but are the result of coincidence, changes in reporting practices, or some other artefact. This can result in the expense of resources (both people and materials) that this unnecessary highlighting the importance of conducting the diagnosis confirmation and verification of an outbreak.

PPE Personal Protective Equipment

WHO The World Health Organization