

Basics of outbreak Investigation

Njoki Miriam Karinja

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Outline of the session

- After this session you should be able to:
 - Define an outbreak
 - Describe the principles of outbreak investigations
 - List and explain the steps of an outbreak investigation

What is an outbreak?

- Occurrence of more cases of disease than expected
 - Over a particular period of time
 - In a given geographical area
 - Amongst a specific group of people

Why investigate an outbreak?

- To characterise the problem
- To stop/control the outbreak
- Prevent future outbreaks
- Improve surveillance and outbreak detection
- Opportunity to train epidemiologist
- Research - answer certain questions

Steps in Outbreak Investigation

1. Establish the existence of a real outbreak
2. Confirm the diagnosis
3. Define a case
4. Search for cases
5. Generate hypotheses using descriptive findings
6. Test hypotheses using analytical epidemiology
7. Draw conclusions
8. Conduct additional investigations
9. Communicate findings
10. Execute control and prevention measures

Step 1: Detect Outbreak

- Indicator-based surveillance system (IBS) - Routine surveillance data from IPD/OPD
- Event-based surveillance (EBS) - Trustworthy network that can notify you
 - Media, hotline, others
- Laboratories
- Reported by clinicians/clinics
- Reported by schools (school health services)

What if its not an outbreak?

- Artifact
 - Increased awareness- active case finding, media coverage
 - Change in surveillance practices - new case definition or new laboratory tests available
 - Laboratory error
- Variation of the denominator:
 - Rapidly changing population denominators
 - Hospital patients, migrants, refugees, mass gathering

Step 2: Confirm the diagnosis

A two-stage process

1. Clarify the syndrome and identify diagnoses
 - Communicate with clinicians, specialists
 - Examine the frequency of symptoms among cases
 - Which age groups affected?
2. Confirm diagnosis with laboratory tests
 - Discuss best tests to use with laboratory and clinicians

Confirm the outbreak

- **Establish the baseline**
 - Surveillance data where available
 - Ask around: Hospital/ laboratories/physicians
- **Compare the magnitude of current problem with the historical data**
- **Caution**
 - Seasonal variation
 - Notification artefacts - weekends, new staff
 - Diagnostic bias, new lab techniques, more labs

Population Denominators

- **Important at this point to:**
 - Determine possibly affected population;
 - Calculate attack rates by geographic area;
 - Used in estimating of supplies for control measures: latrines, water, vaccination, community health workers etc.
- **Where to find population denominators?**
 - Last census of the area?
 - Local authorities: municipality or village leaders
 - Other stakeholders: UN agencies? NGOs

If no population denominators available?

- Count shelters/tents - estimate average tent size and extrapolate;
- Comprehensive population count - house to house if possible;
- Satellite imagery and automatic shelter counting:
 - Possible in urban areas and displaced persons settlements;
 - Requires recent satellite image;
 - Fly a drone

Outbreak confirmed

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graph TD; A[Outbreak confirmed] --> B[Immediate control measures]; A --> C[Further investigation];
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Immediate control measures

- Prophylaxis
- Exclusion/isolation
- Public Warning
- Hygienic measures
- others

Further investigation

- Aetiological agent
- Mode of transmission
- Vehicle of transmission
- Source of contamination
- Population at risk
- Exposure to causing illness

Step 3: Define a case

- Standard set of criteria for deciding if a person should be classified as having the disease under investigation
- Clear, simple, and practical
- Critical components:
 - Time (when?)
 - Place (where?)
 - Person (who?)
 - Clinical/biological criteria (what?)

Consideration for case definition

- **Case definition tiers**
 - Suspected cases
 - Probable cases: i.e. with epidemiological link to a confirmed case
 - Confirmed cases: through laboratory diagnostics
- **Case definitions can evolve over an outbreak**
 - As lab methods become available
 - As new geographic areas are identified
 - Ensure that case definitions are compatible or acceptable by local and national health authorities

Examples of case definitions

- **Hepatitis E outbreak Chad:**
- **Suspected case:** Any case of Acute Jaundice Syndrome (yellow eyes) identified at hospital or community level from 3 September 2016
- **Confirmed case:** any suspected case that tests positive for anti-HEV IgM with the RDT or positive for viral RNA at the reference laboratory
- **Measles outbreak Moba, Katanga 2013**
- Suspected case: any child that presents for care with:
- Rash
- and cough
- and coryza (i.e. runny nose) or conjunctivitis (i.e. red eyes)

Step 4: Search for cases

- Start with the case definition and population at risk
- Aim for *uniform* strategy to search for cases
- Use multiple sources:
 - Laboratories
 - Mandatory notification systems
 - Health facilities
 - Community level active case finding

Collect information

- **Type of information:**
 - Identifying information: date of birth, sex, age etc.
 - Demographic information: occupation, village of residence etc.
 - Clinical details
 - Known exposures and risk factors
- **Where to collect information:**
 - ‘mild’ disease: outpatient clinics
 - ‘severe’ disease: hospital admissions, cholera treatment centres;
 - Community surveillance (through CHWs)

Step 5: Generate hypotheses using descriptive findings

Line listing of cases

Unique identifier



Time



Place



Person



Outcome



Lab



Uni. ID	OnsetDate	Street	Area	City	AgeYears	Sex	Hospital	Death	HEVIgM	HAVIgM
1	1-Mar-05	18	2	HYD	12	1	1	2	1	9
2	3-Mar-05	22	1	HYD	25	2	1	2	2	1
3	5-Mar-05	23	3	HYD	36	1	2	9	9	9
4	6-Mar-05	-	-	SEC	23	2	1	1	1	2

Line list

- **Ensure information on:**

- Demographics: Age, sex, residence
- Health history: vaccination or previous disease
- Known symptoms
- Contacts if relevant
- Laboratory data

- **Only include:**

- What is feasible (consider resources and trained staff) to collect;
- What is necessary to collect in that moment to answer specific questions (quality of care, spread?);
- What data can contribute to improved response?

Data description

- **TIME:** when did the outbreak take place
 - Epidemic curve
- **PLACE:** where did the cases occur?
 - Maps
- **PERSON:** Who was affected
 - Distribution by age, sex, occupation

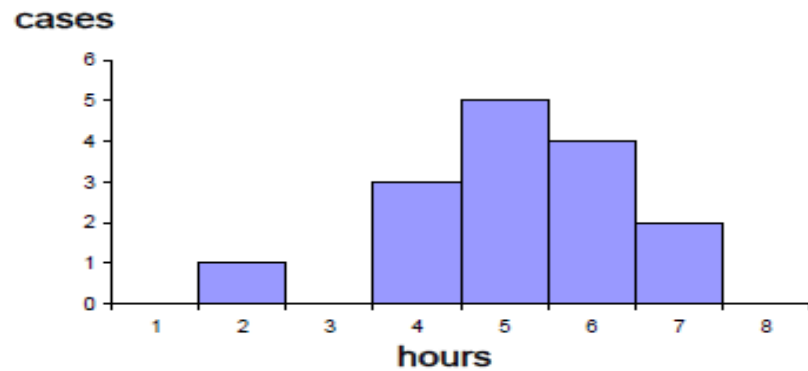
The epidemic curve

- **Drawing the histogram**
 - Time in X axis
 - Plot cases on Y-axis
- **Description**
 - Beginning, peak(s) (Number, Duration) and end
- **Helps to develop hypotheses**
 - Incubation period
 - Aetiological agent
 - Type of source
 - Type of transmission
 - Time of exposure

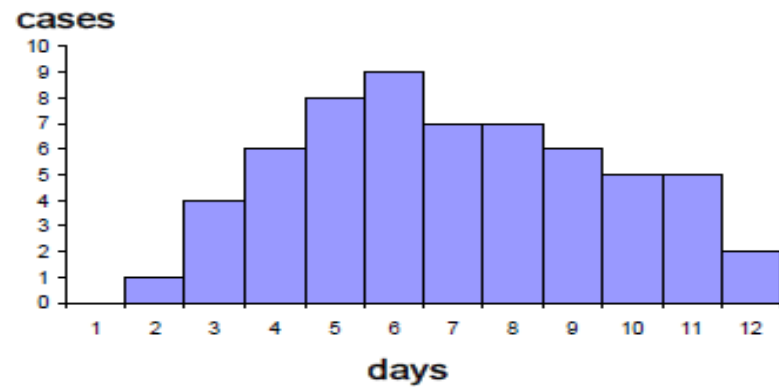
Epidemic curve

Outbreak dynamics in time

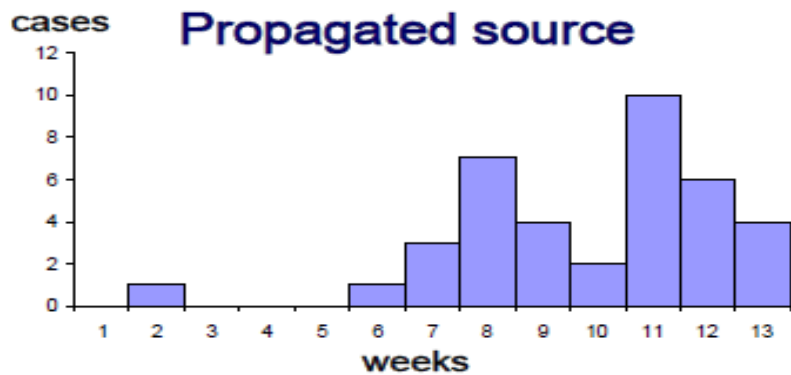
Common point source



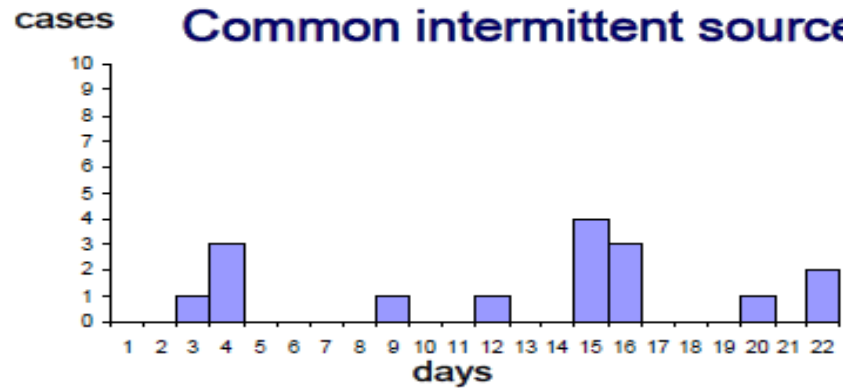
Common persistent source



Propagated source

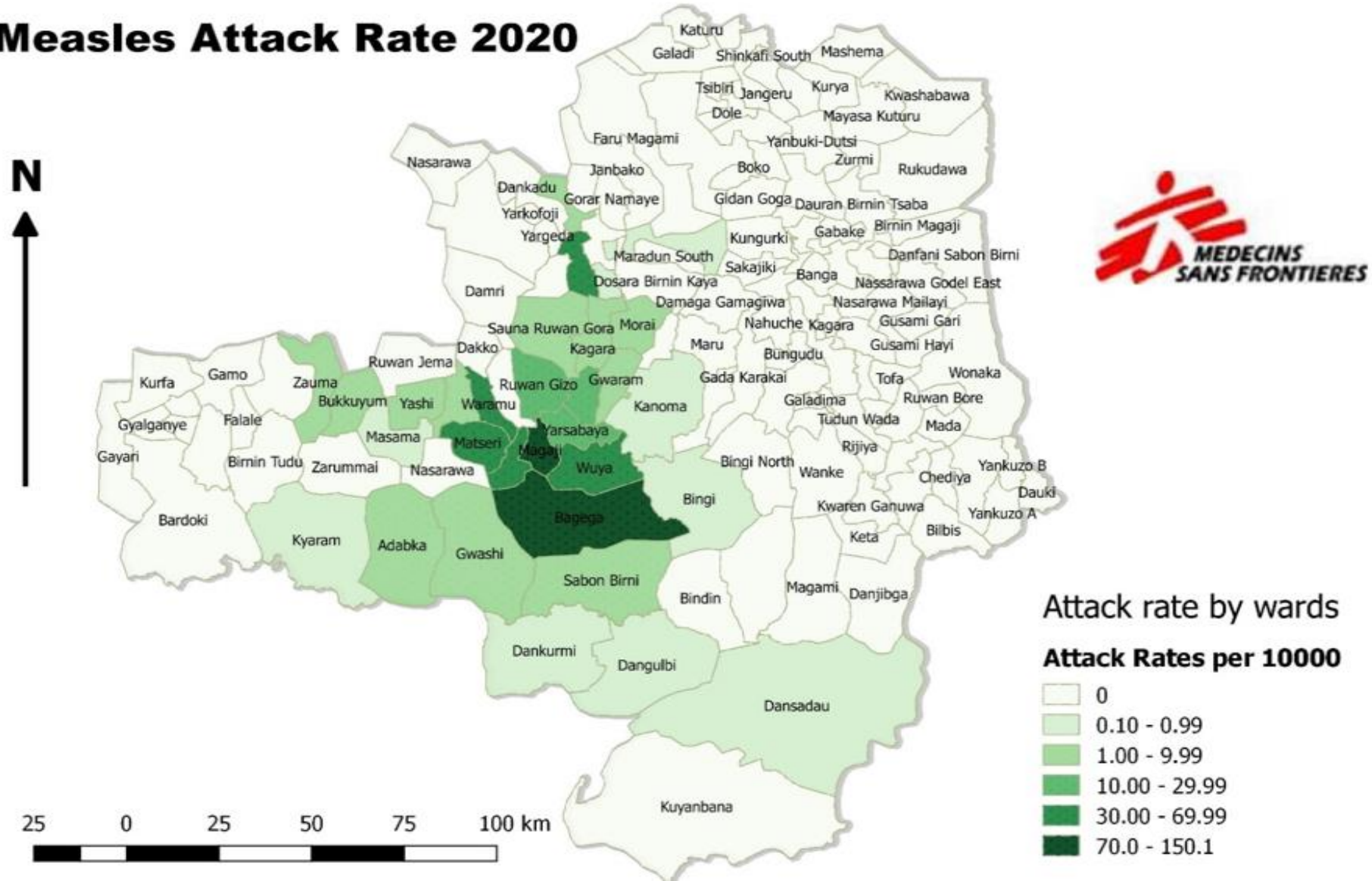


Common intermittent source

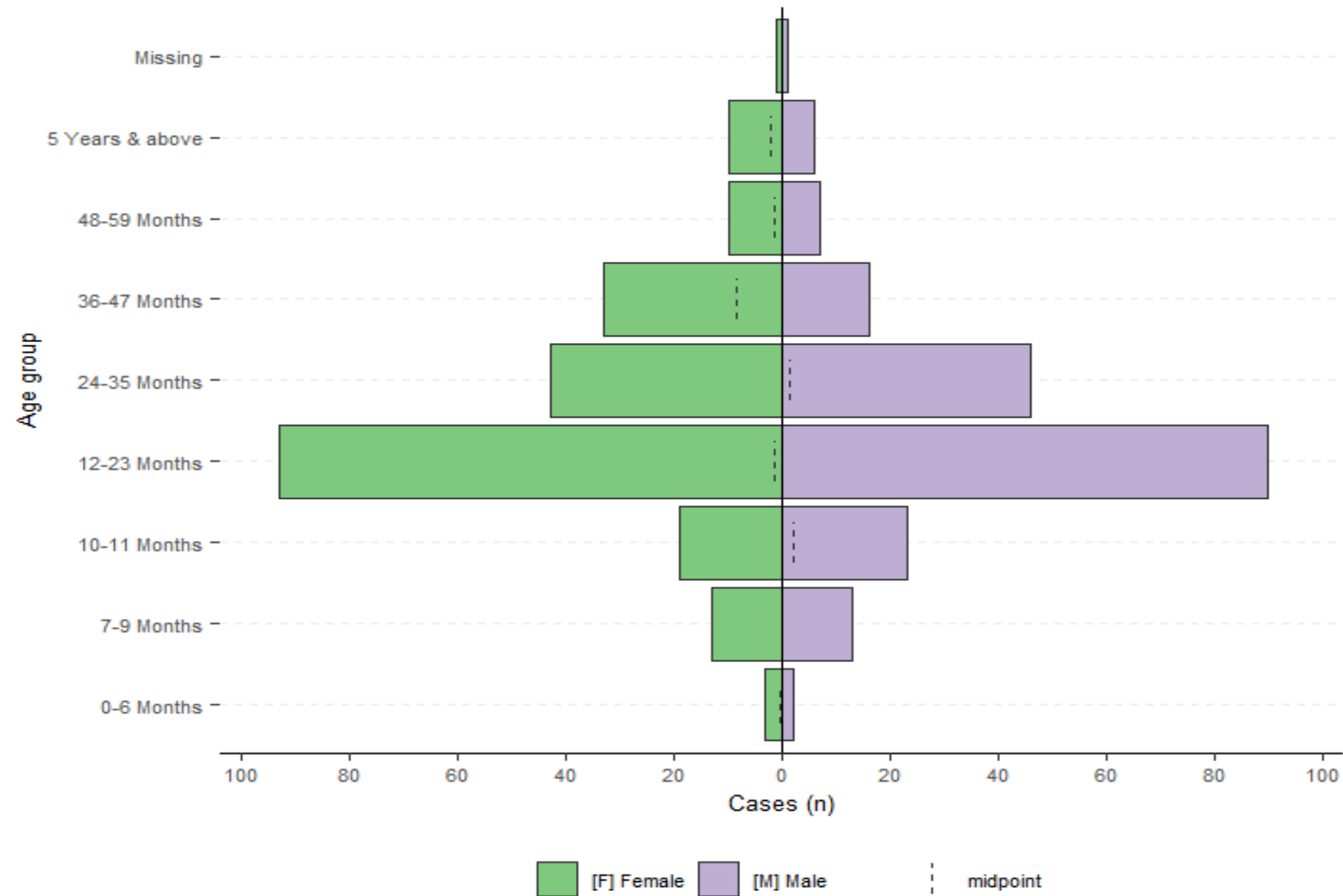


Mapping of cases

Measles Attack Rate 2020



Age pyramid



Step 6: Test hypotheses using analytical epidemiology

- Characteristics common to cases
 - Hypotheses generation
- More than one hypotheses may be generated
 - There may be more than one source
 - Maybe following a false lead?
 - Throw your nets wide
- Analytical study test hypotheses to sort out:
 - Characteristics common to all individuals
 - Characteristics specific to cases

Analytical epidemiology

- Which study designs are used most often in outbreak investigations?
- (Retrospective) cohort study
- Case control study
- Other designs:
- Case study
- cohort study

Step 7: Draw conclusion

- Interpretation of all the collected outbreak information incl. descriptive and analytical epidemiology
- Is the suspected exposure associated with illness?
 - What is the strength of association?
 - Is there a statistical significance?
 - Causality?
- Is there a dose response relationship?
 - Higher exposure, stronger association
- Does the source/vehicle identified explain most cases?
 - Are most of the cases exposed?

Step 8: Conduct additional investigations

- Laboratory studies
 - Microbiological typing
 - Identical isolates among cases
 - Identical isolates in source and cases
- Other investigations
 - Environmental
 - (e.g., test water, vector studies, visit the kitchen)
 - Anthropological
 - (e.g., understand a practice at risk)
 - Veterinarian
 - (e.g., test animals in zoonotic disease outbreaks)

Step 9: Communicate findings

- Epidemiological report to conclude an outbreak investigation
- Communicate findings timely with the different stakeholders
- Stakeholders include (context-specific):
 - Community / population at large
 - Health care staff
 - Laboratory staff
 - Epidemiologists
 - Ministry of Health (and other ministries depending on the outbreak)
 - Public health agencies
 - Health cluster (incl NGOs)
 - Scientific community

Step 10: Implement control and prevention measures

- Measures to stop the spread of disease
- Should be implemented at any time during the outbreak investigation
- Formulate clear, specific and feasible recommendations on the basis of your findings
- Ensure implementation of the recommendations
- Examples of control and prevention measures
 - Contact tracing
 - Vaccinations
 - Prophylaxis
 - Quarantine of contacts/ suspected cases
 - Isolation of cases
 - Risk communication
 - Hygienic measures

Acknowledgement

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