

# RECON | vimes

An evidence-synthesis approach for detecting outbreak clusters

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Thibaut Jombart

4-6th September 2018

**London School of Hygiene and Tropical Medicine**

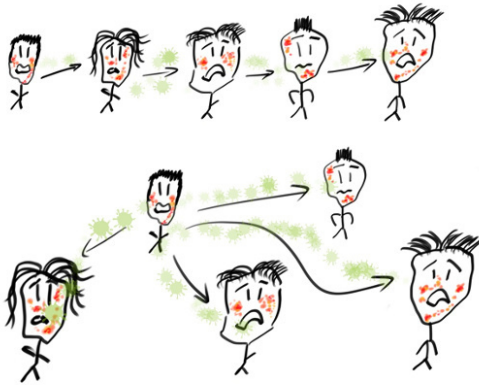
Imperial College London

Context...

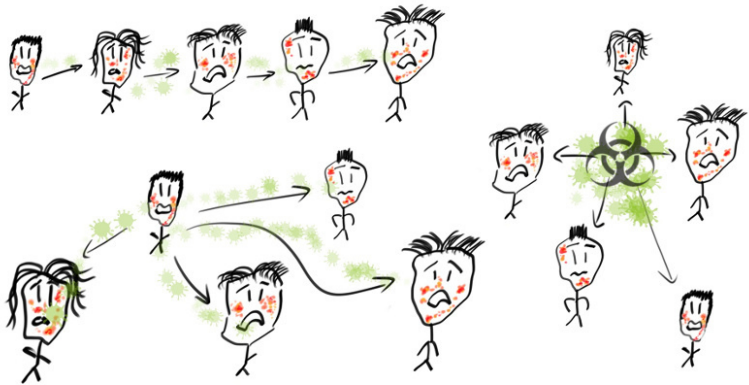
# Sustained transmission vs repeated introductions



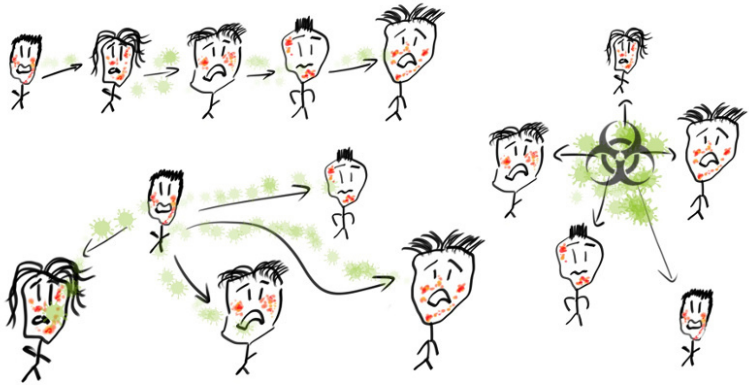
# Sustained transmission vs repeated introductions



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Different **transmission patterns** call for **different interventions**

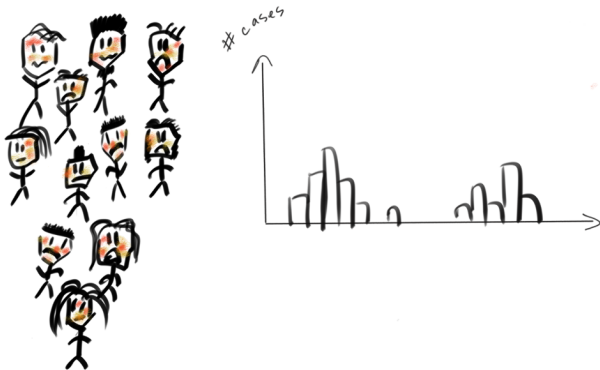
Can we use data to identify these patterns?

# One outbreak.. how many introductions?

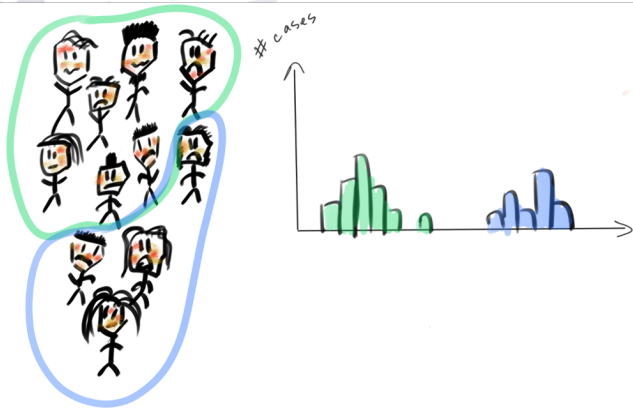




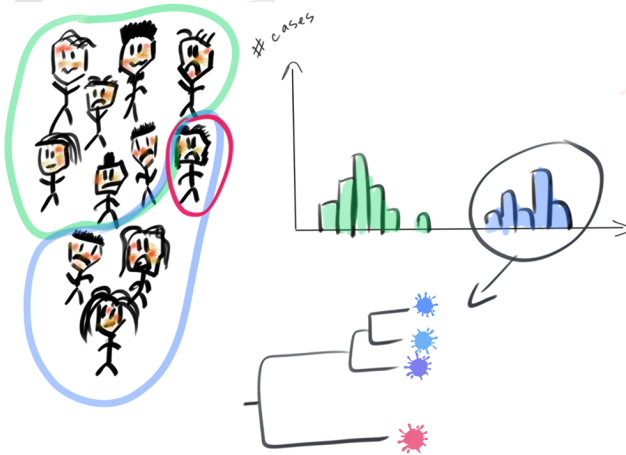
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Combined data sources can detect outbreak clusters

# VIMES: Visualisation and Monitoring of EpidemicS<sup>1</sup>



Aims: develop a new method which..



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<sup>1</sup> well, really, I made that up because I was reading 'Snuff' by Terry Pratchett at the time; incidentally, Pratchett was a huge fan of using long footnotes in his novels, which are often quite entertaining to read; well, this does not apply here: if you are still reading this, you probably missed what I just said

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Aims: develop a new method which..

- **detects outbreak clusters**: cases stemming from same introduction (same transmission tree)
- **integrates different data**: temporal, spatial, genetic, etc.
- **works fast, scales well**: so that it can be used for real-time outbreak detection

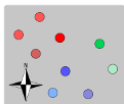


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# A graph-based evidence synthesis approach

A

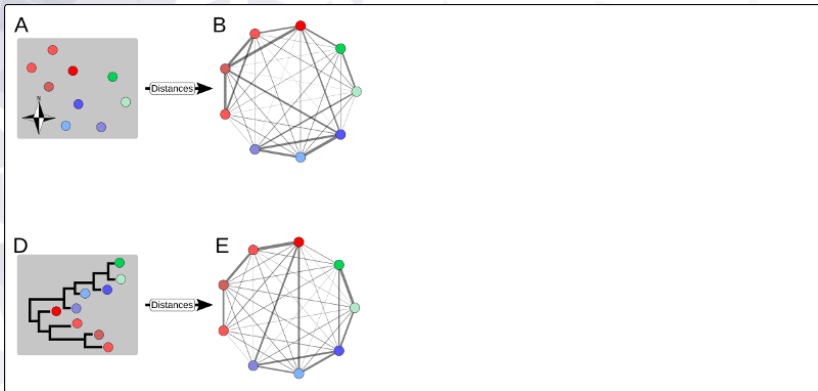


D

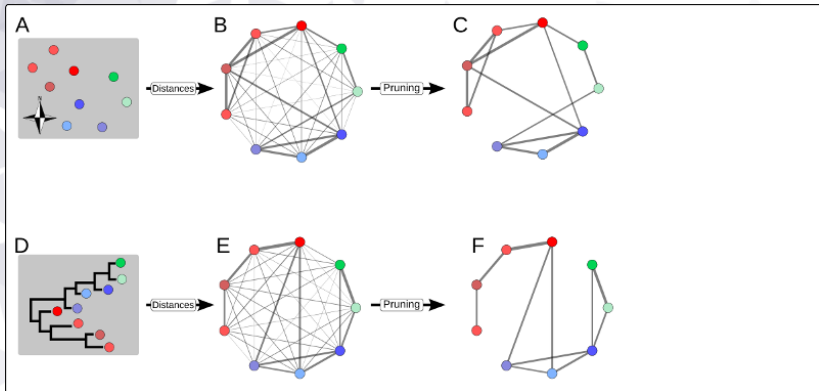




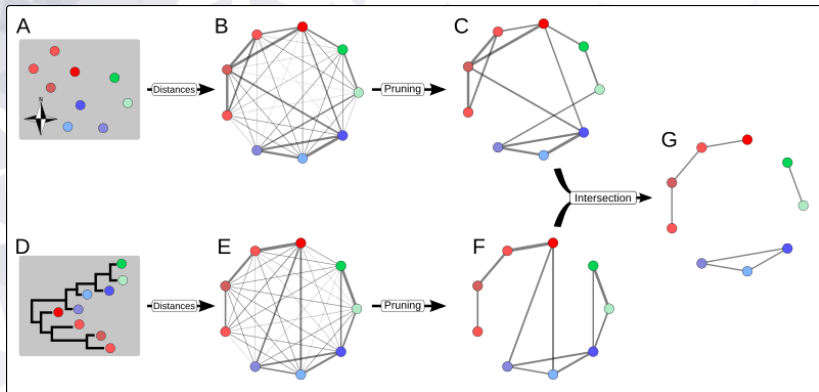
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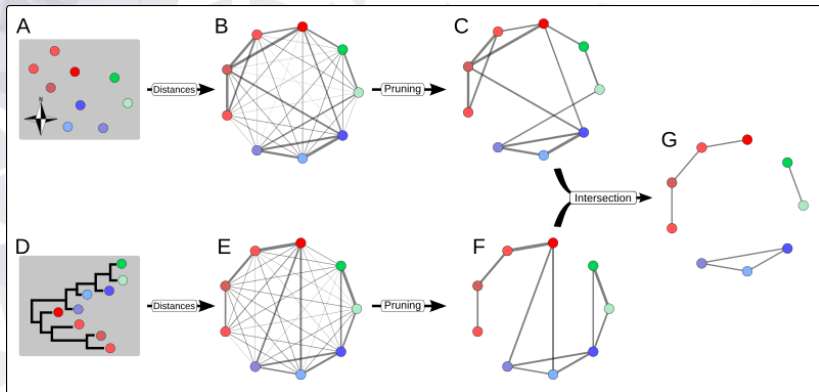
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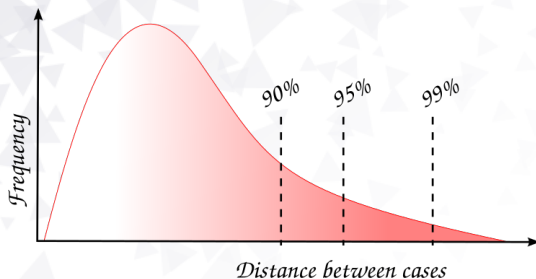


Can be extended to **any number of data sources**.

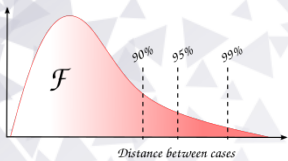
But it seems too simple...

# Pruning graphs: where to cut?

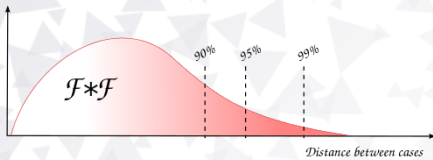
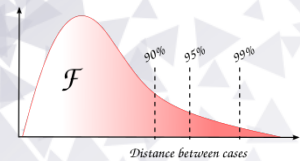
Assuming a known expected distribution between pairs of cases (e.g. serial interval, spatial kernel, molecular clock), different quantiles can be used:



# Pruning graphs: where to cut?

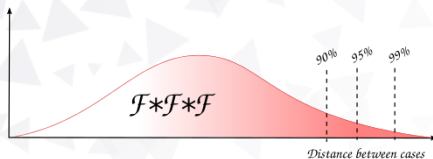
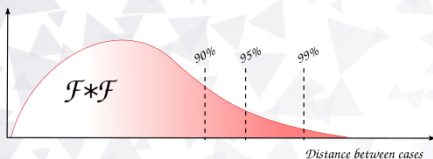
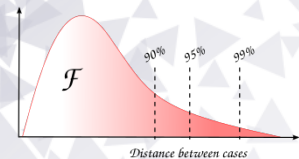


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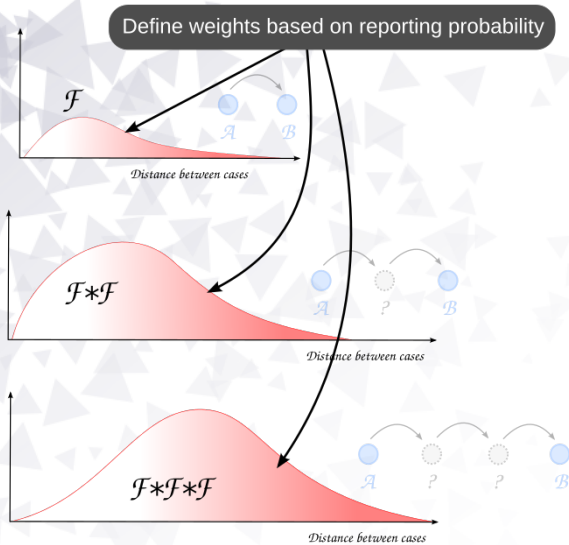




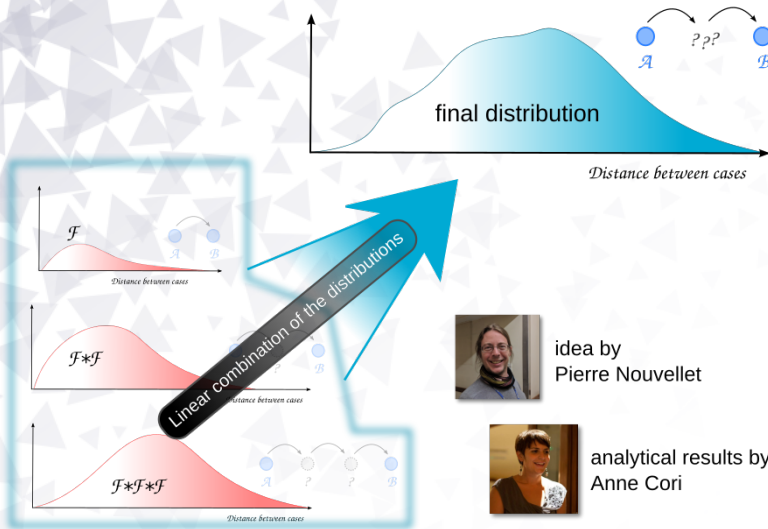
# Pruning graphs: where to cut?



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idea by  
Pierre Nouvellet



analytical results by  
Anne Cori

**What does it look like in practice?**

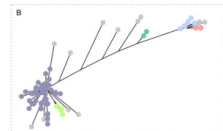
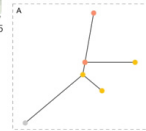
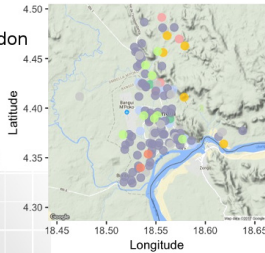
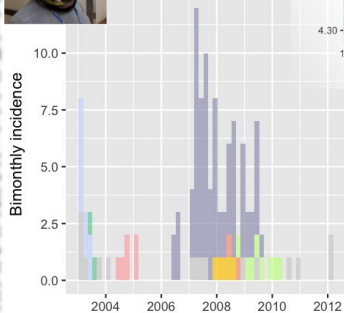
# Application: dog rabies epidemics, Central African Republic



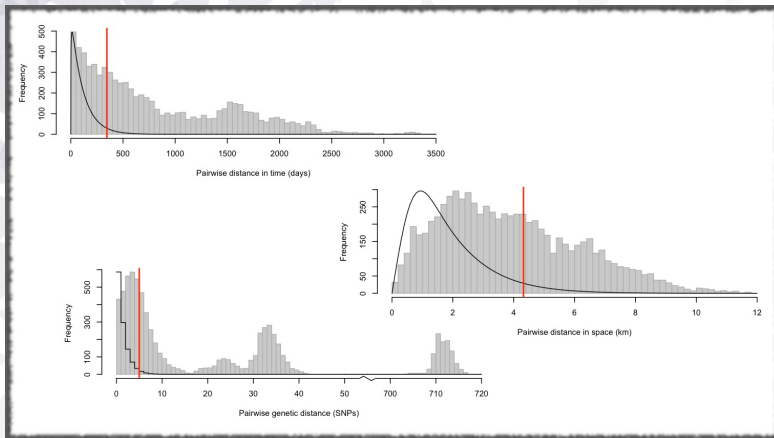
Anne Cori  
Imperial College London



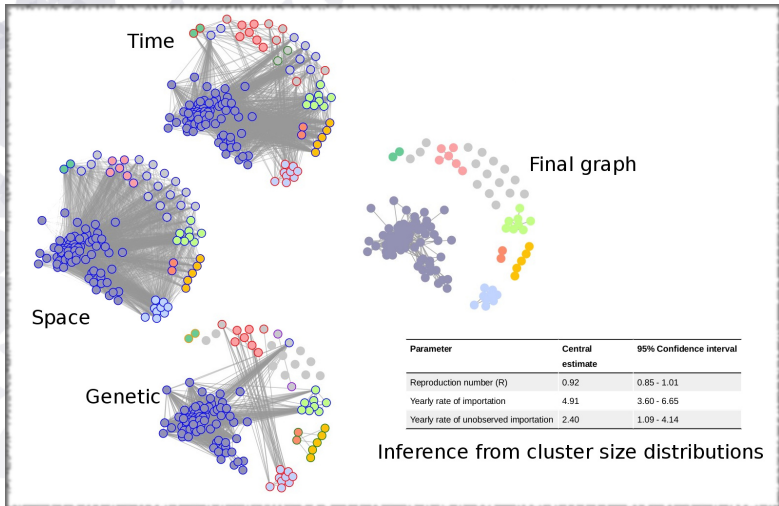
Pierre Nouvellet  
University of Sussex



# Distributions of distances between cases



# Results



What's the take home message?



# Summary

## vimes..

- .. can **integrate** different data sources to detect outbreak clusters
- .. need arbitrary **threshold**: unsatisfying, but sensitivity study easy
- .. is **fast**, and can integrate data pipelines easily

# Summary

## vimes..

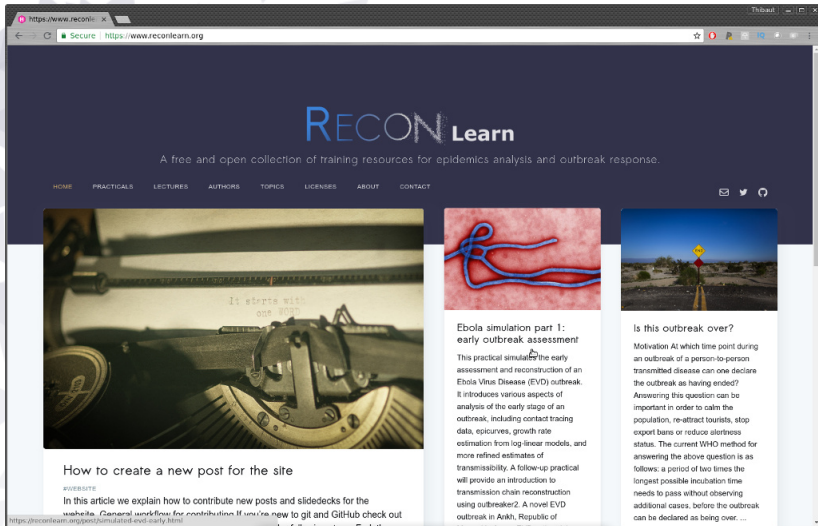
- .. can **integrate** different data sources to detect outbreak clusters
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## On our TODO list

- integration in **genomic surveillance** systems (PHE)
- improve scalability (sparse matrices)
- objective criteria for **automated threshold selection**

(place commercial here)

# RECON learn 2.0 online!



The screenshot shows the RECON Learn website in a web browser. The browser's address bar displays "https://www.reconlearn.org". The website has a dark blue header with the "RECON Learn" logo in white and blue. Below the logo, a tagline reads "A free and open collection of training resources for epidemics analysis and outbreak response." A navigation menu includes links for HOME, PRACTICALS, LECTURES, AUTHORS, TOPICS, LICENSES, ABOUT, and CONTACT. On the right side of the header are icons for email, Twitter, and GitHub. The main content area features three columns. The left column has a large image of a typewriter with the text "It starts with ONE WORD" on the paper. Below this image is the heading "How to create a new post for the site" and a subheading "#WEBSITE". The text explains how to contribute new posts and slide decks, mentioning a general workflow for contributors and a specific link for new users. The middle column has a red background with a blue line graph. The heading is "Ebola simulation part 1: early outbreak assessment". The text describes a practical simulation for early assessment and reconstruction of an Ebola Virus Disease (EVD) outbreak, covering aspects like contact tracing, data analysis, and model estimation. The right column has a background image of a road with a yellow diamond-shaped sign. The heading is "Is this outbreak over?". The text discusses the motivation for asking this question during an outbreak and lists criteria for declaring an outbreak as having ended, such as a period of two times the longest possible incubation time without additional cases.

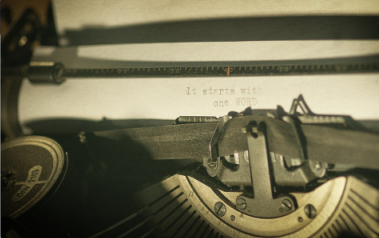
https://www.reconlearn.org

## RECON Learn

A free and open collection of training resources for epidemics analysis and outbreak response.

HOME PRACTICALS LECTURES AUTHORS TOPICS LICENSES ABOUT CONTACT

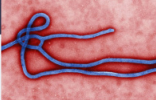
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### How to create a new post for the site


#WEBSITE

In this article we explain how to contribute new posts and slide decks for the website. General workflow for contributing. If you're new to git and GitHub check out <https://reconlearn.org/post/simulated-ebd-early.html>



### Ebola simulation part 1: early outbreak assessment

This practical simulates the early assessment and reconstruction of an Ebola Virus Disease (EVD) outbreak. It introduces various aspects of analysis of the early stage of an outbreak, including contact tracing data, epicurves, growth rate estimation from log-linear models, and more refined estimates of transmissibility. A follow-up practical will provide an introduction to transmission chain reconstruction using outbreaker2. A novel EVD outbreak in Ankh, Republic of



### Is this outbreak over?

Motivation At which time point during an outbreak of a person-to-person transmitted disease can one declare the outbreak as having ended? Answering this question can be important in order to calm the population, re-attract tourists, stop export bans or reduce alertness status. The current WHO method for answering the above question is as follows: a period of two times the longest possible incubation time needs to pass without observing additional cases, before the outbreak can be declared as being over. ...

*www.reconlearn.org*

# Thanks

- **Conference organisers**
- **Colleagues:** Anne Cori, Pierre Nouvellet, Tini Garske, Hervé Bourhy, Emmanuel Nakouné
- **funding:** HPRU-NIHR, MRC

*vimes*

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RECON

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