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Regional AMR surveillance as a basis of co-reactive prevention and control

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No COI to declare

What I will not talk about

- Population-based surveillance, potential for determining risk or burden of disease
- Patient-based surveillance, determining appropriate antibiotic therapy (ABS – effectiveness)

What I will talk about

- Pathogen-based surveillance

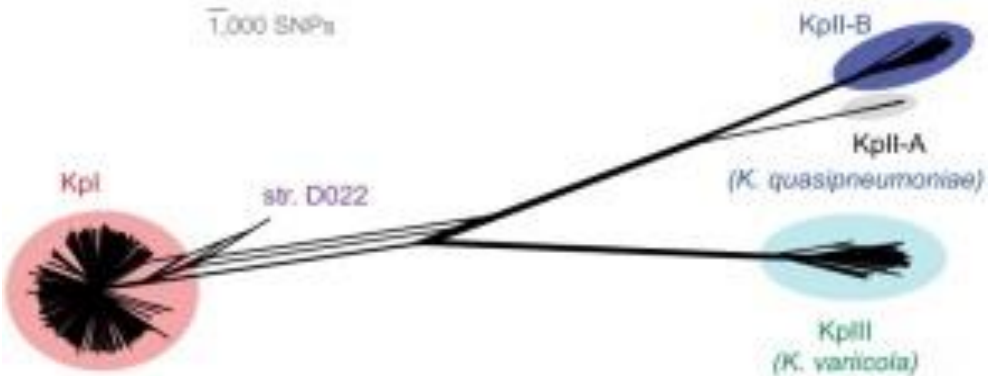
And that can be translated into regional AMR surveillance as a basis of co-reactive prevention and control

(Which is a challenge but can be achieved)

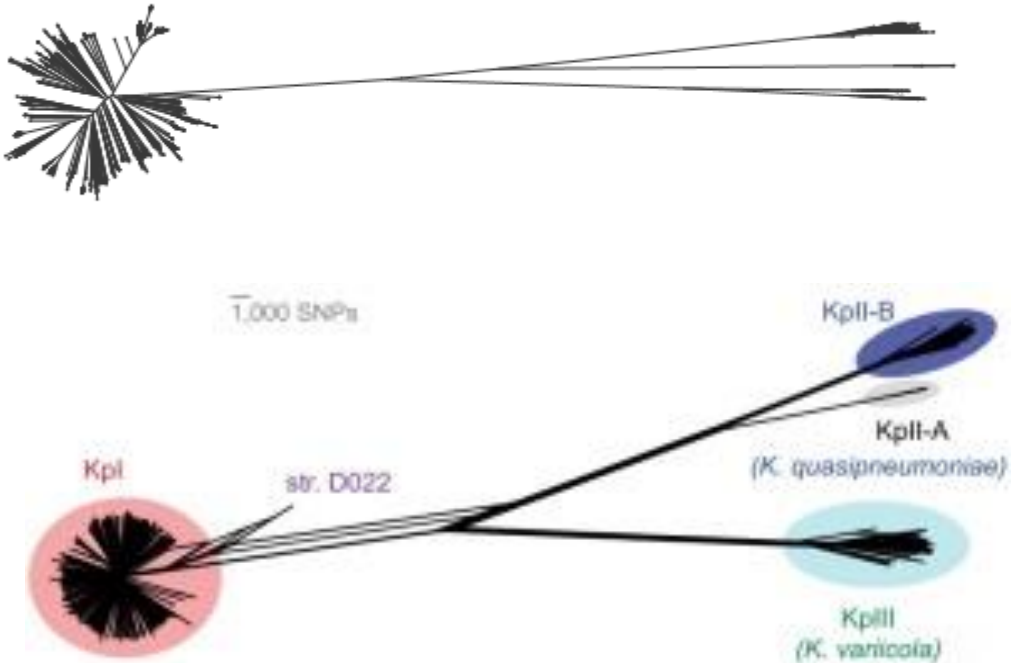
Overview

- Phylogeography of High Risk Clones
- Transmission
- Network properties

Population structure of *K. pneumoniae* from a global collection (n=328)



Population structure of *K. pneumoniae* in Europe: Clinical isolates from the EuSCAPE collection (n=1717)



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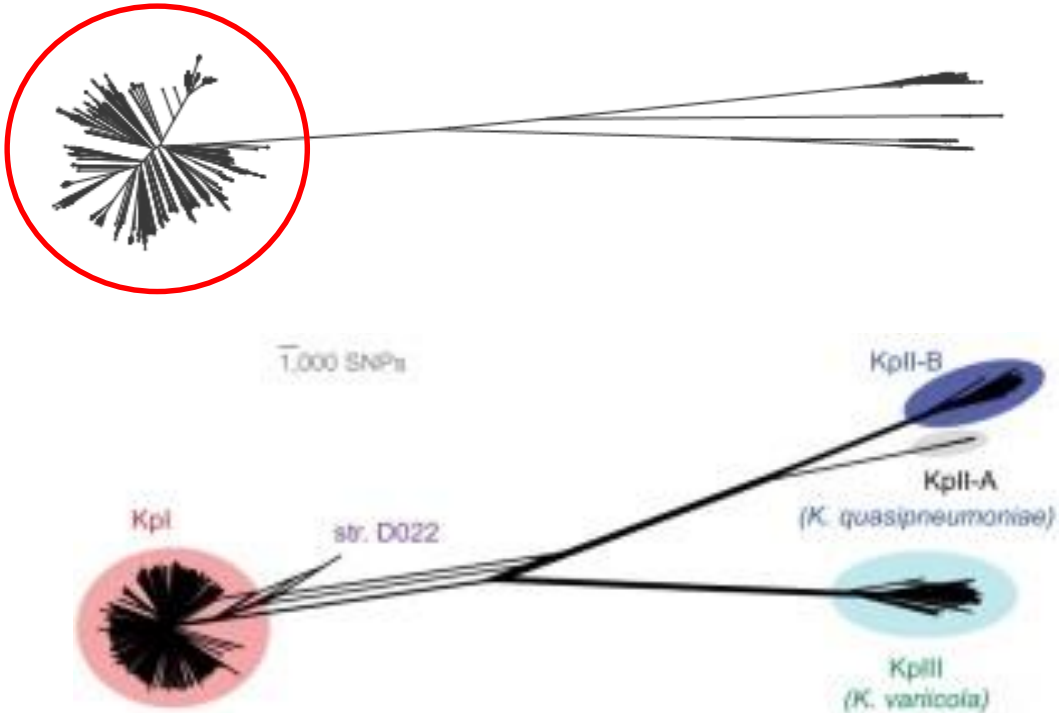
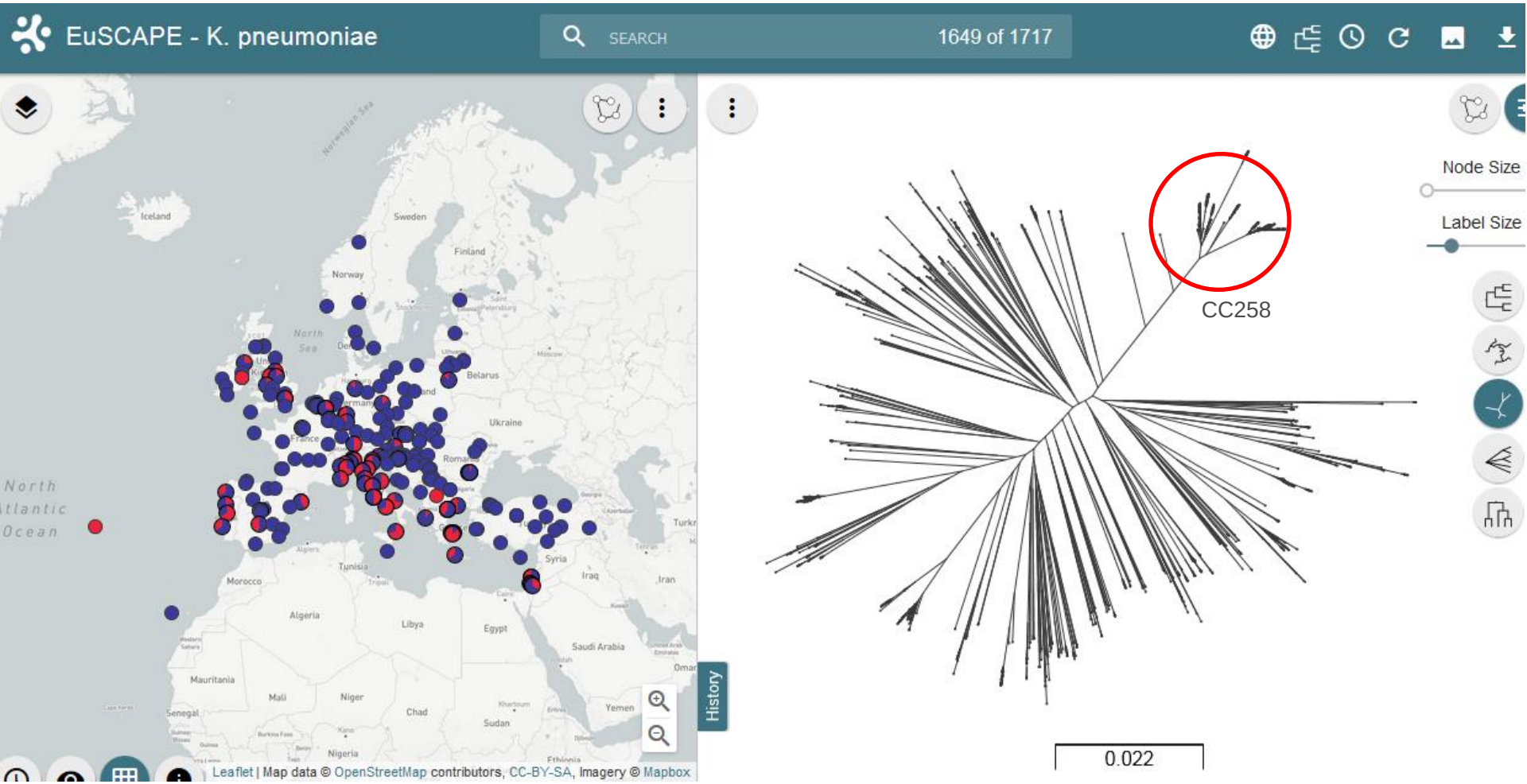
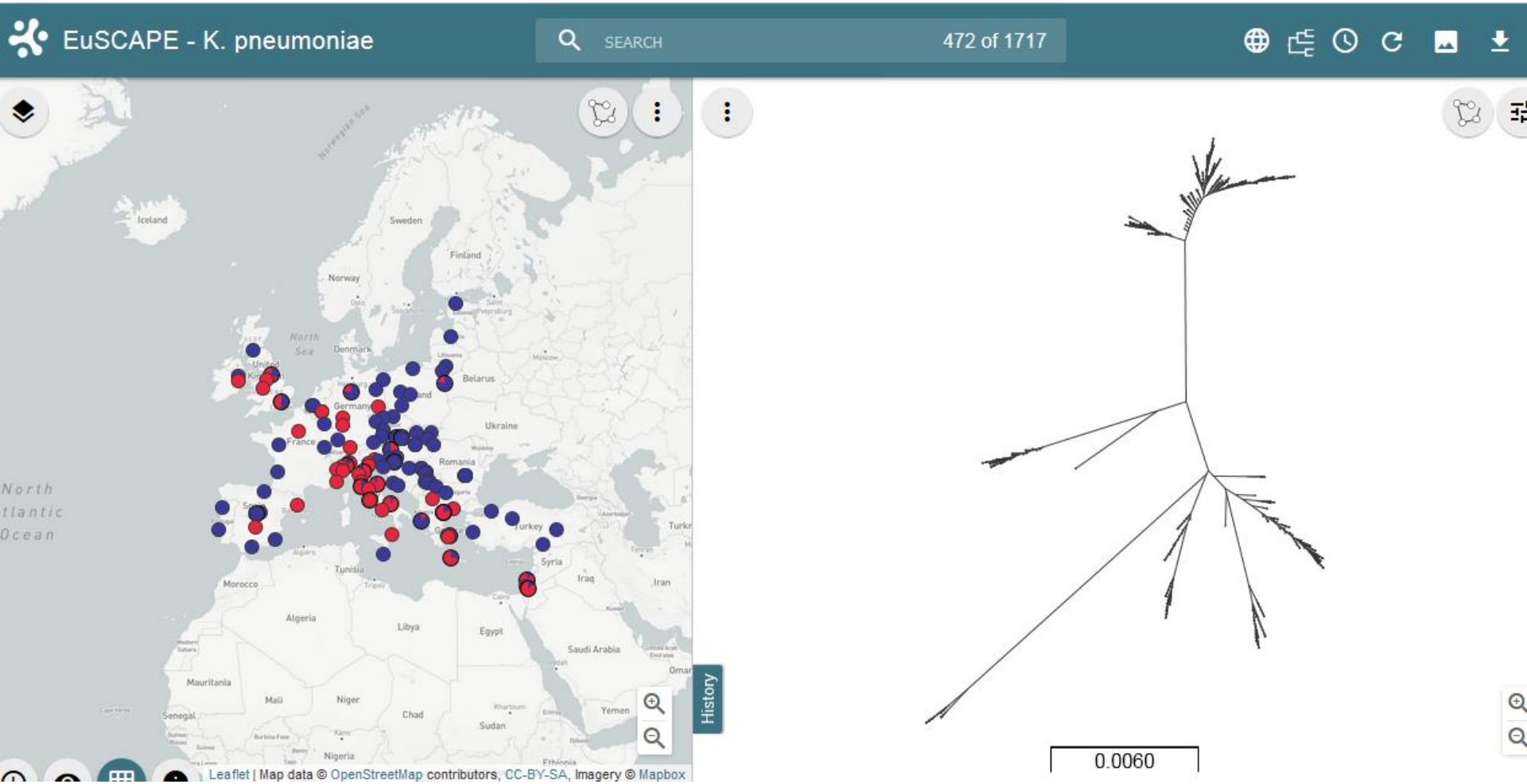


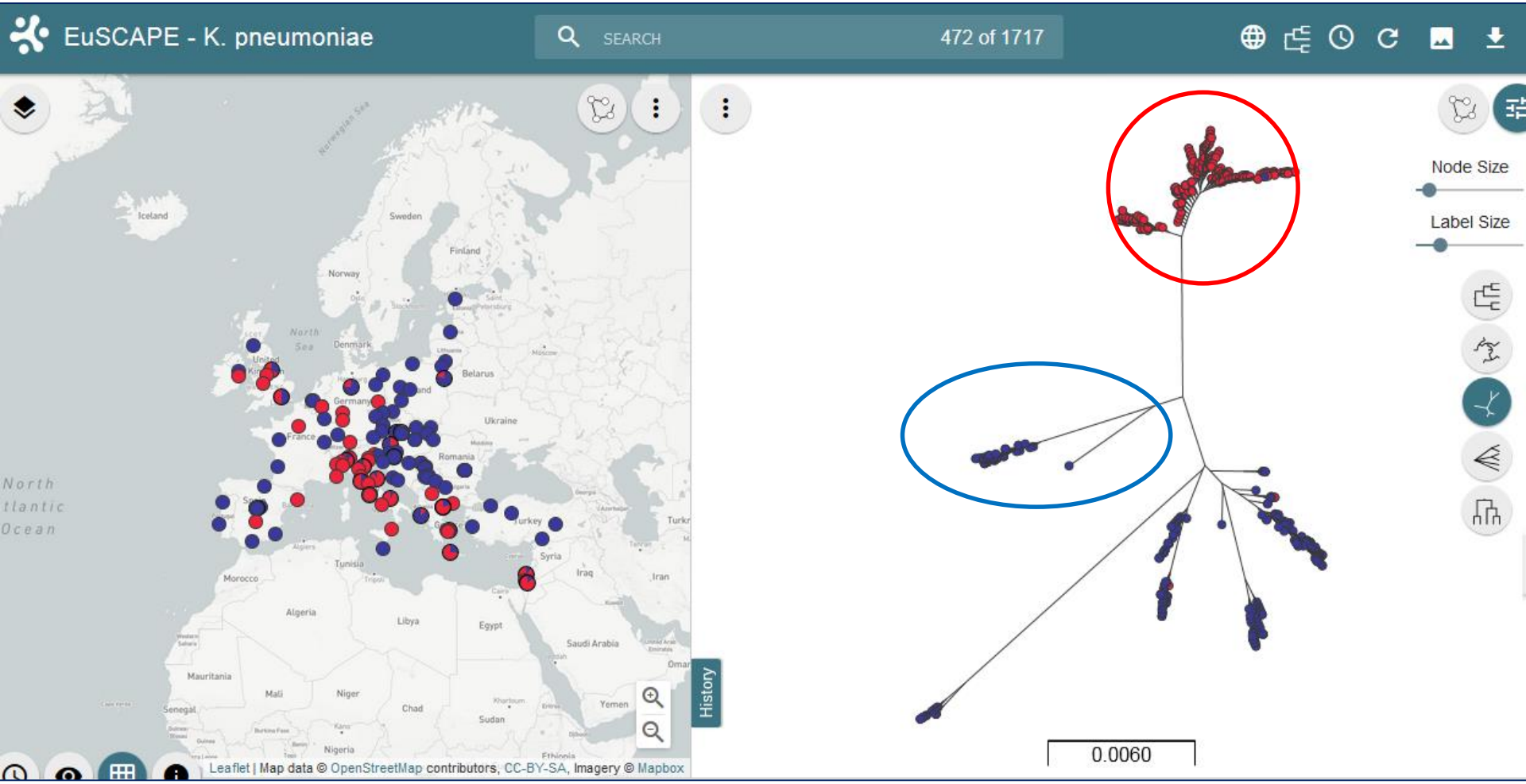
Population structure of *K. pneumoniae* in Europe: Phylogroup KpI (n=1649)



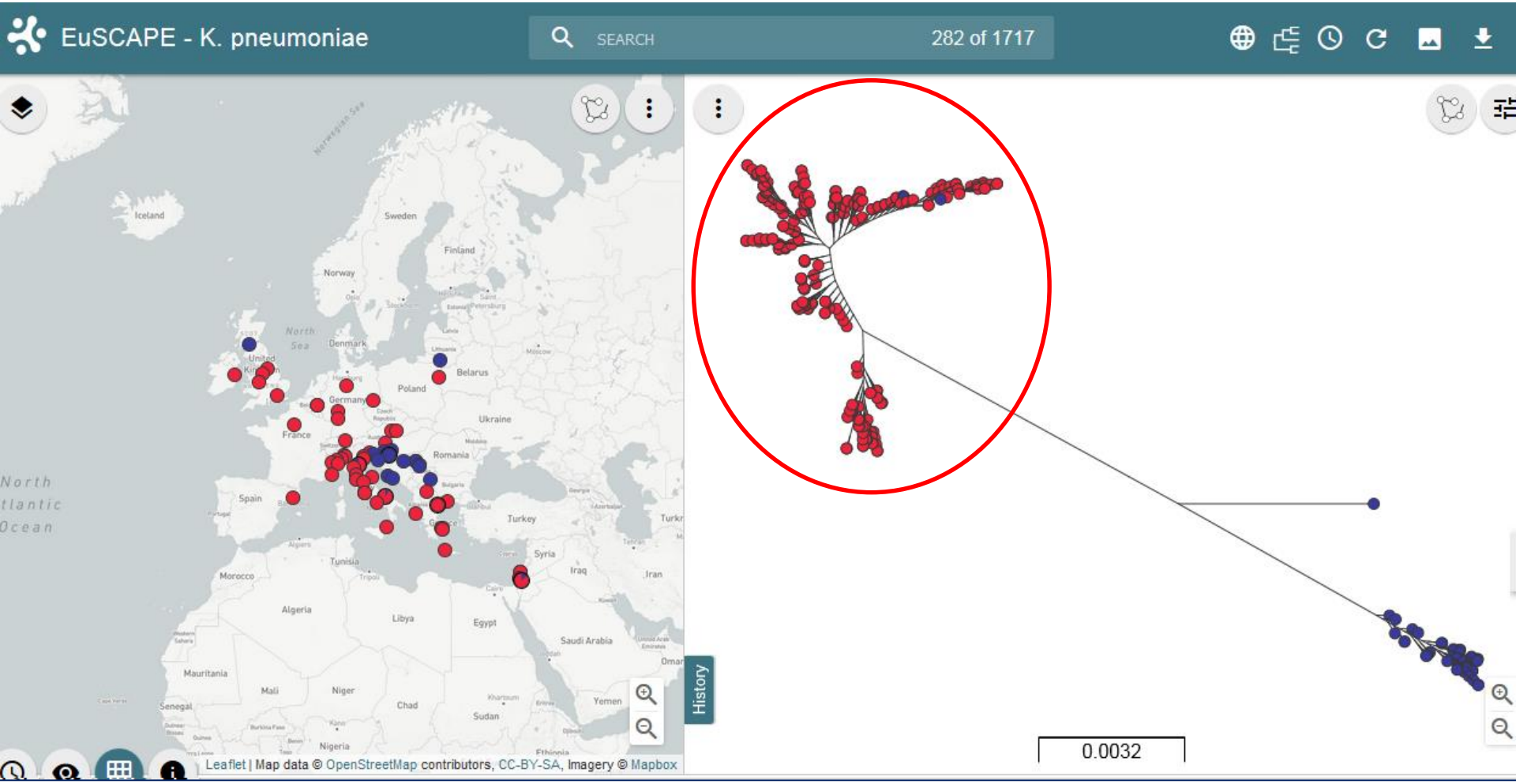
Population structure of *K. pneumoniae* in Europe: Clonal complex 258 (n=472)



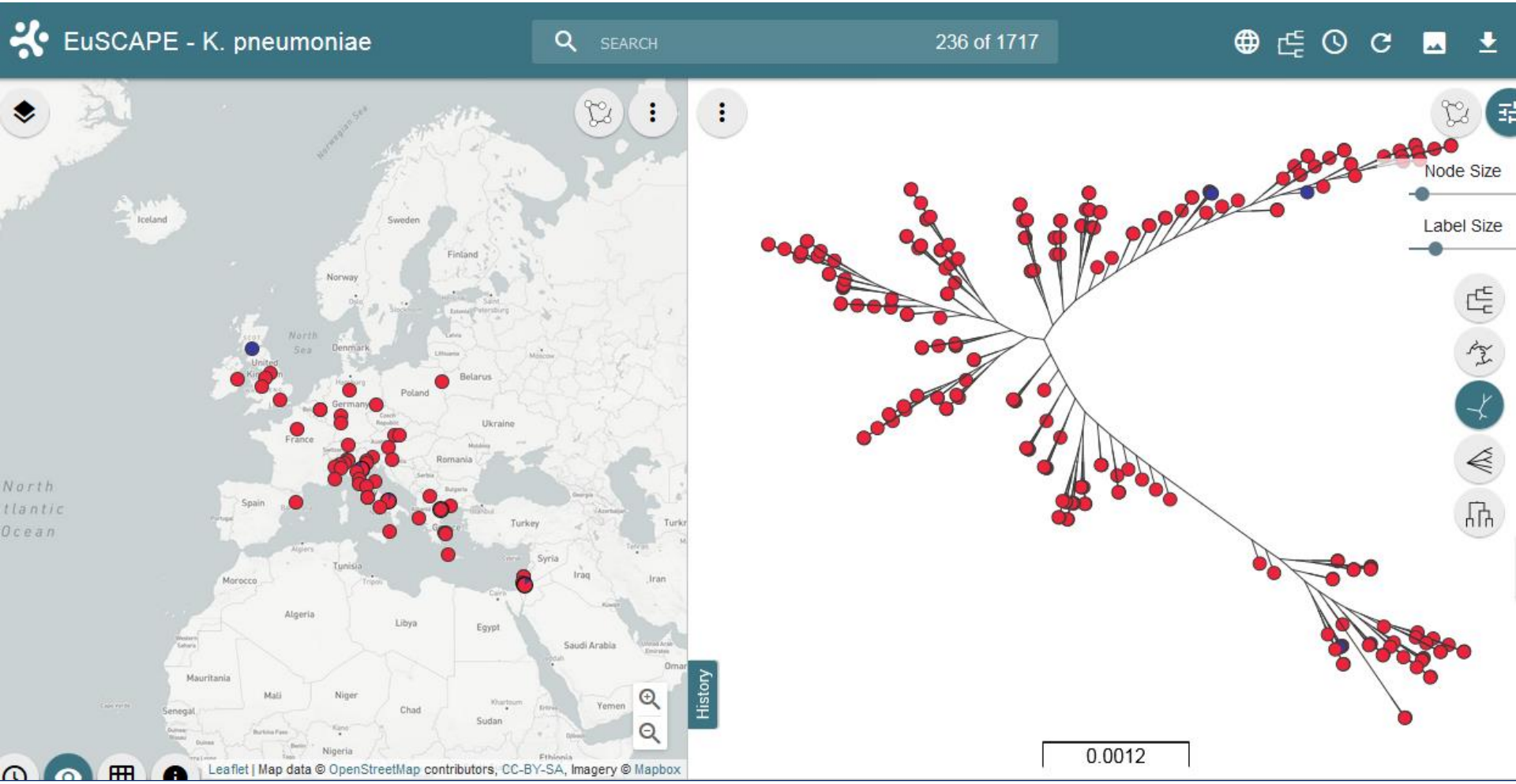
Population structure of *K. pneumoniae* in Europe: Sequence type 258 & 512 (n=236)



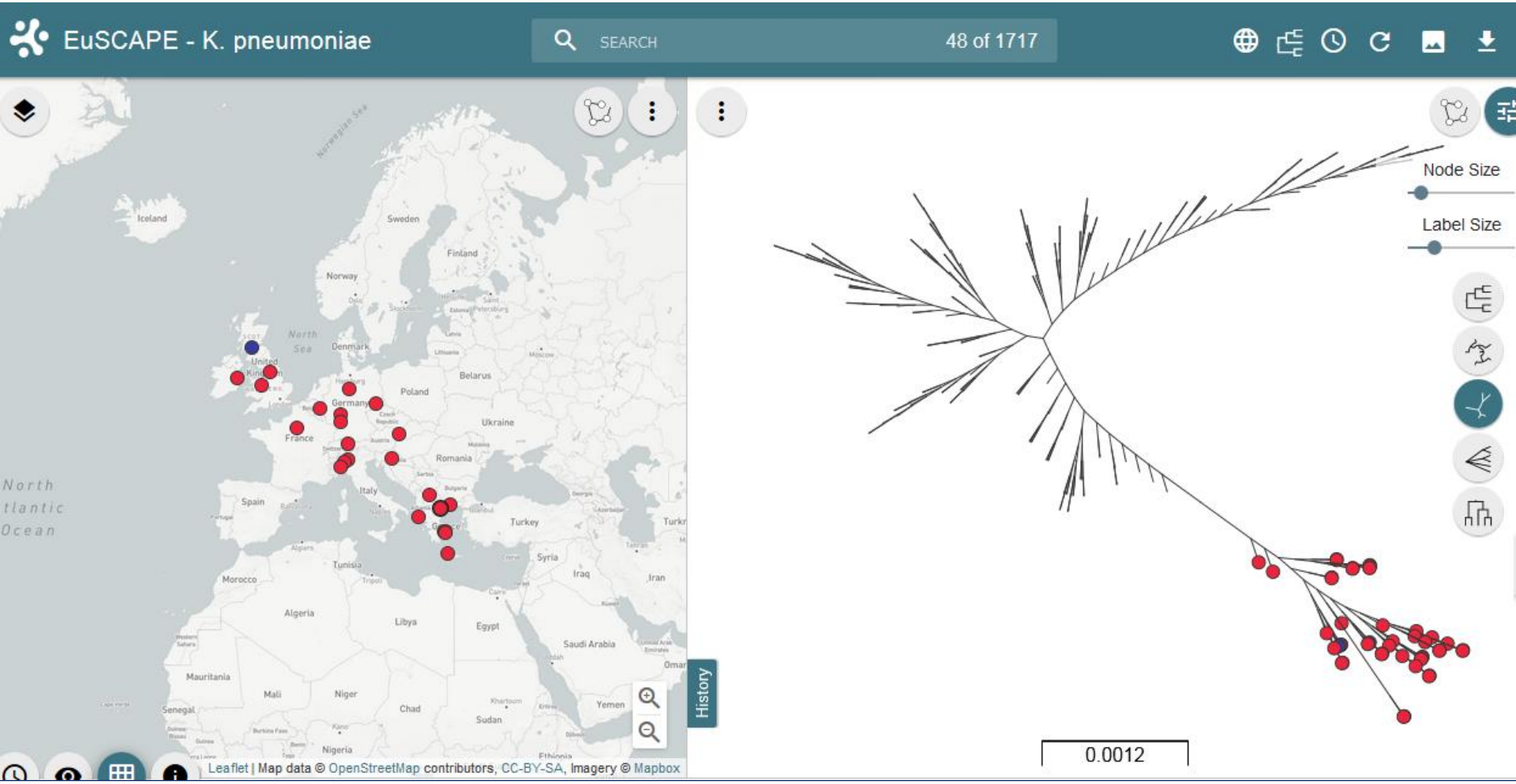
Population structure of *K. pneumoniae* in Europe: Sequence type 258 & 512 (n=236)



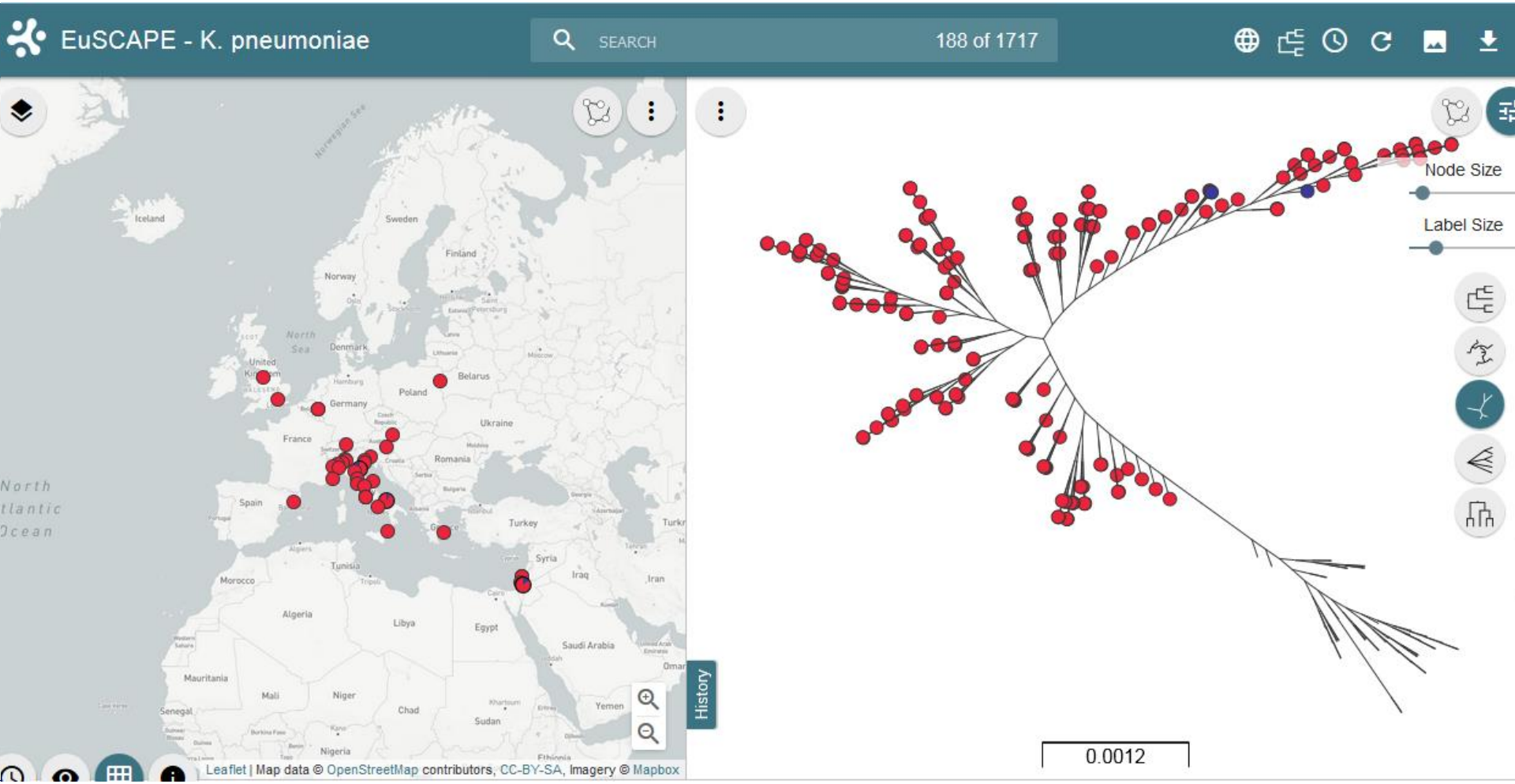
Population structure of *K. pneumoniae* in Europe: Sequence type 258 & 512 (n=236)



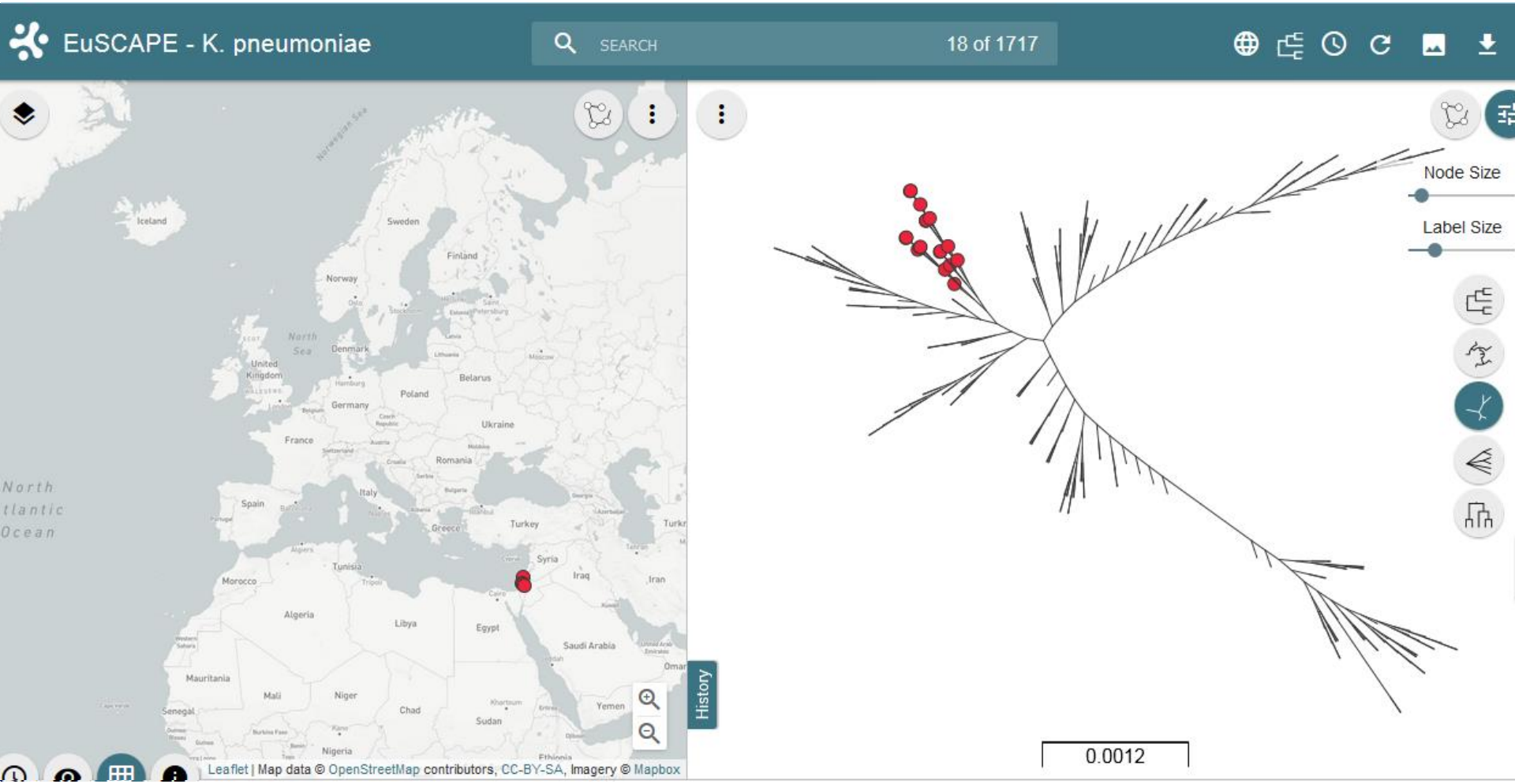
Population structure of *K. pneumoniae* in Europe: Sequence type 258 (n=48) 27 are from Greece



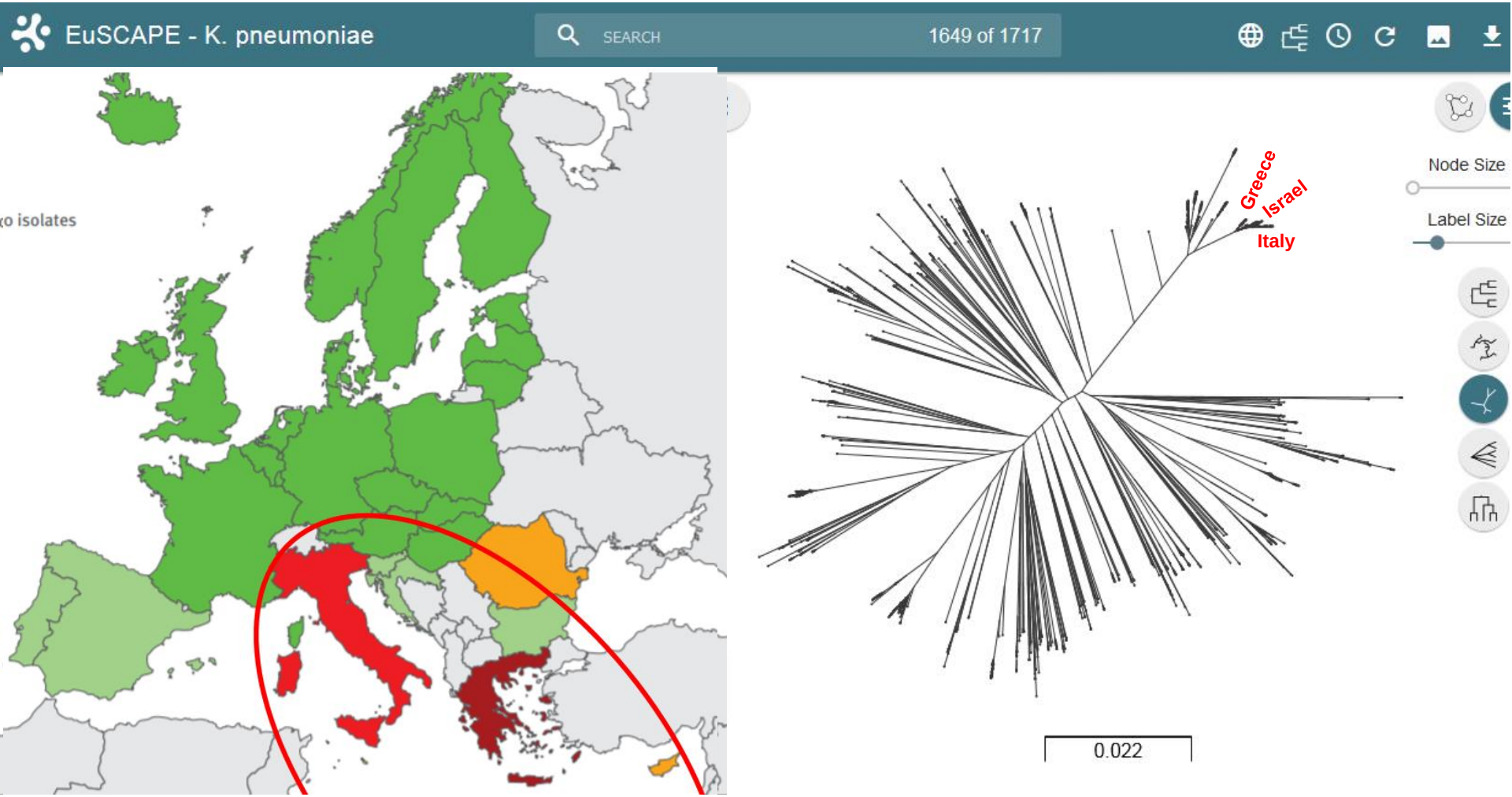
Population structure of *K. pneumoniae* in Europe: Sequence type 512 (n=188) 113 are from Italy



Population structure of *K. pneumoniae* in Europe: Sequence type 512 (n=188) 18 are from Isreal



Population structure of *K. pneumoniae* in Europe: Clonal expansion of KPC2-producing *K. pneumoniae* 2013



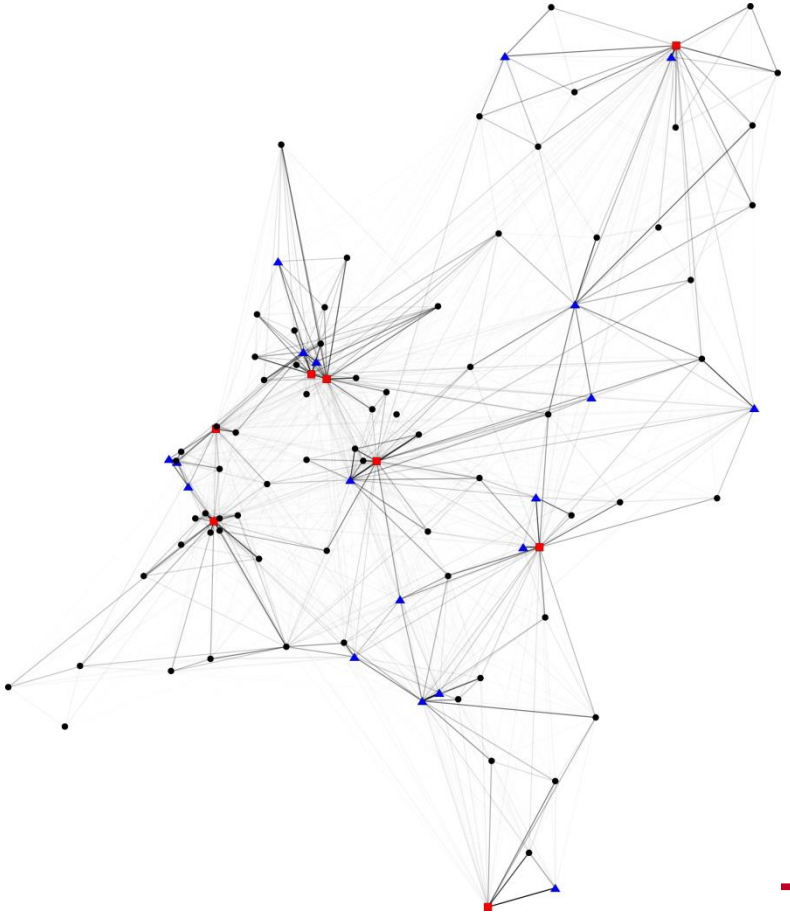
Transmission

A property of all but a privilege of a few

Not only a property of infectious agents but also a property of the host

National patient referral networks

National patient referral networks



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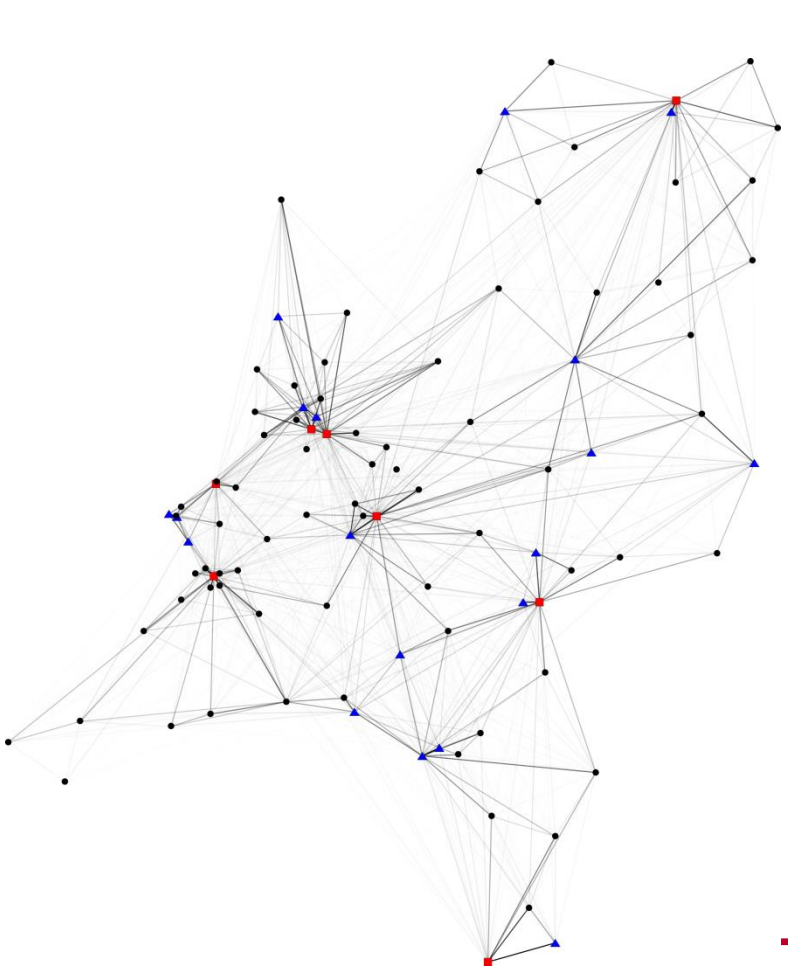
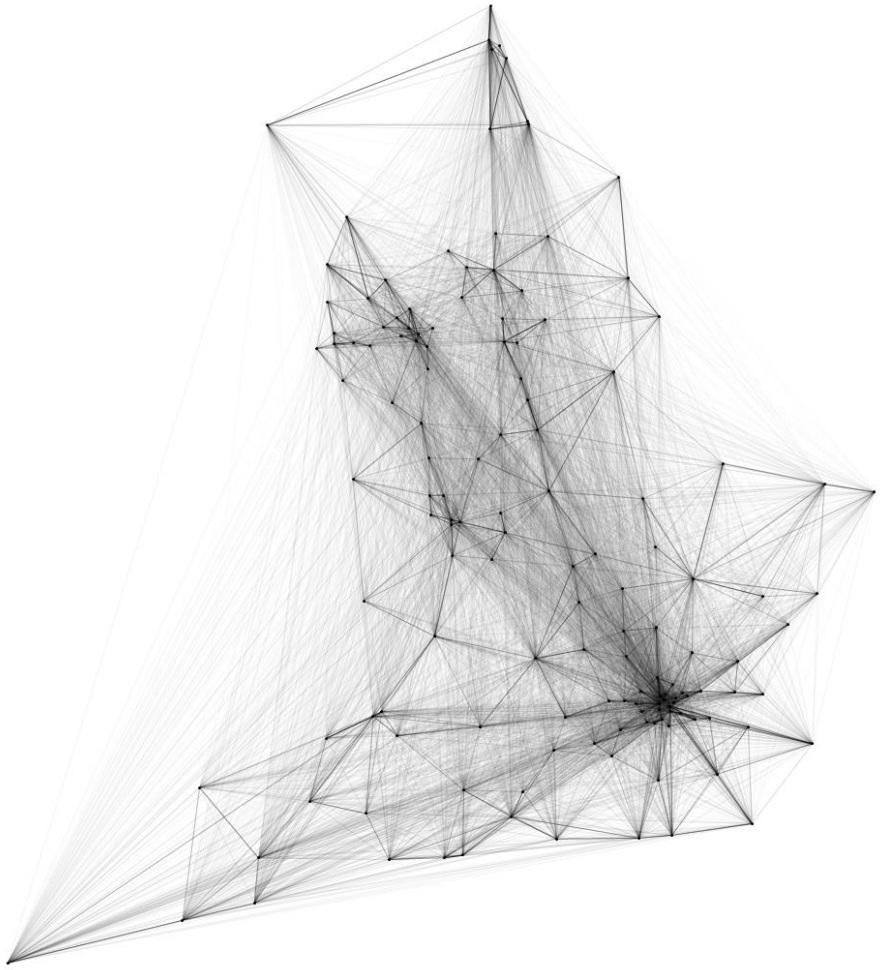
National patient referral networks





The English health care network

51.1 million inhabitants in England in 2007

From the NHS Hospital Episode Statistics (HES)

- Financial Year 2007

146 acute care hospital trusts

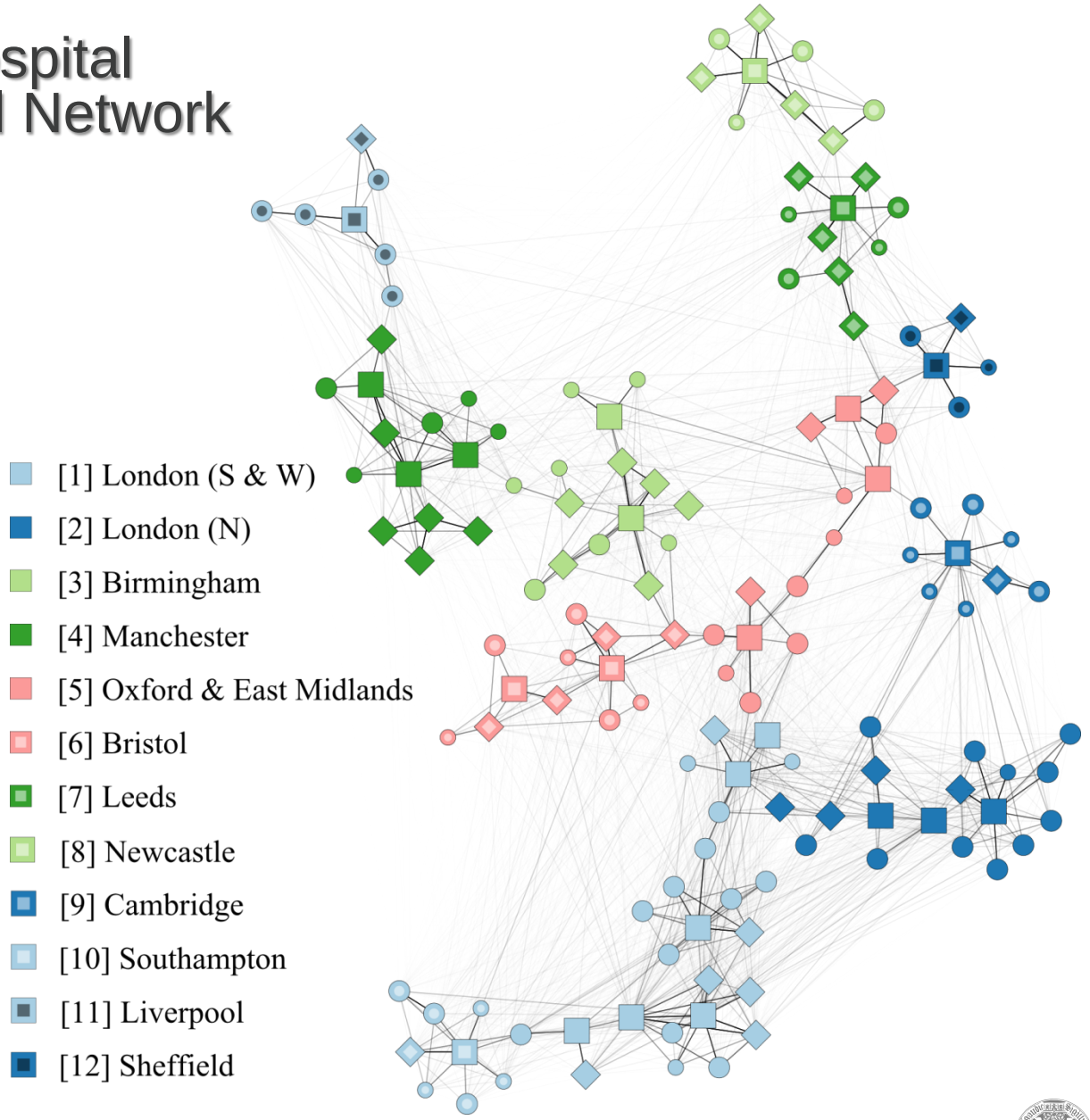
- 25 University hospitals
- 42 Large acute care
- 50 Medium acute care
- 29 Small acute care

7.4 million patients

12.9 million admissions

Network properties

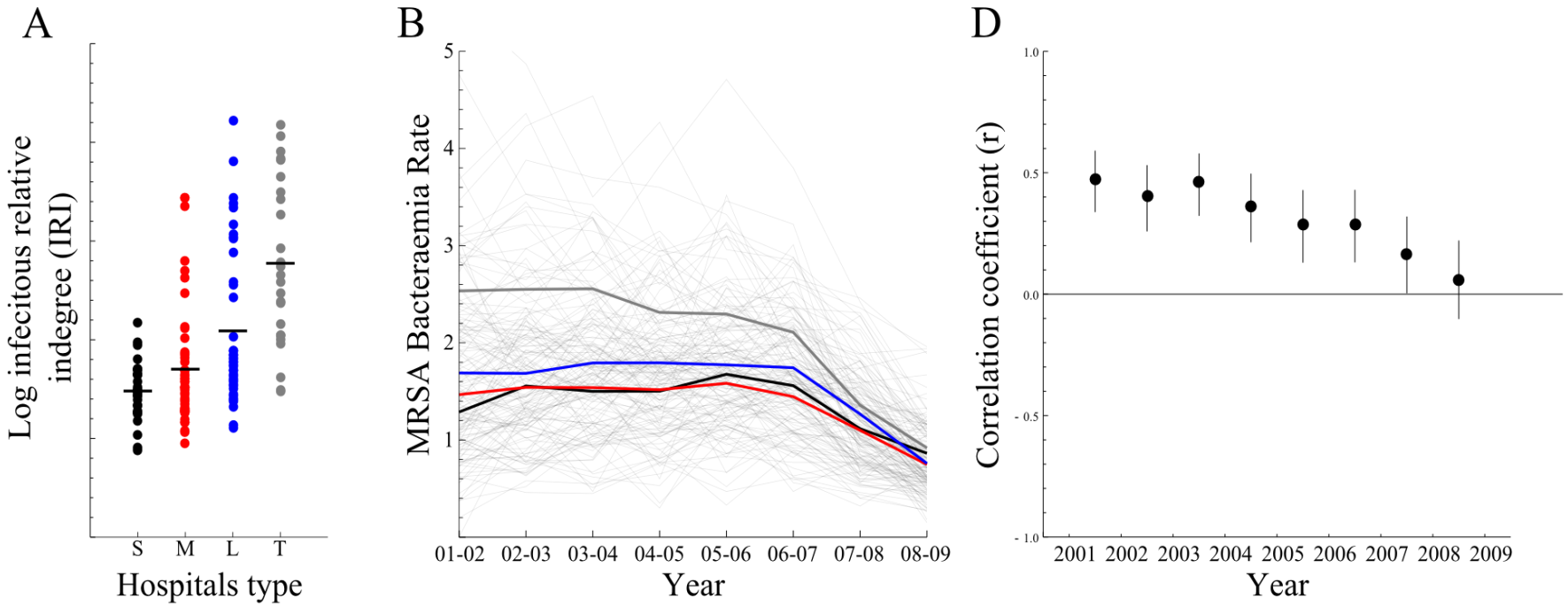
The English Hospital Patient Referral Network

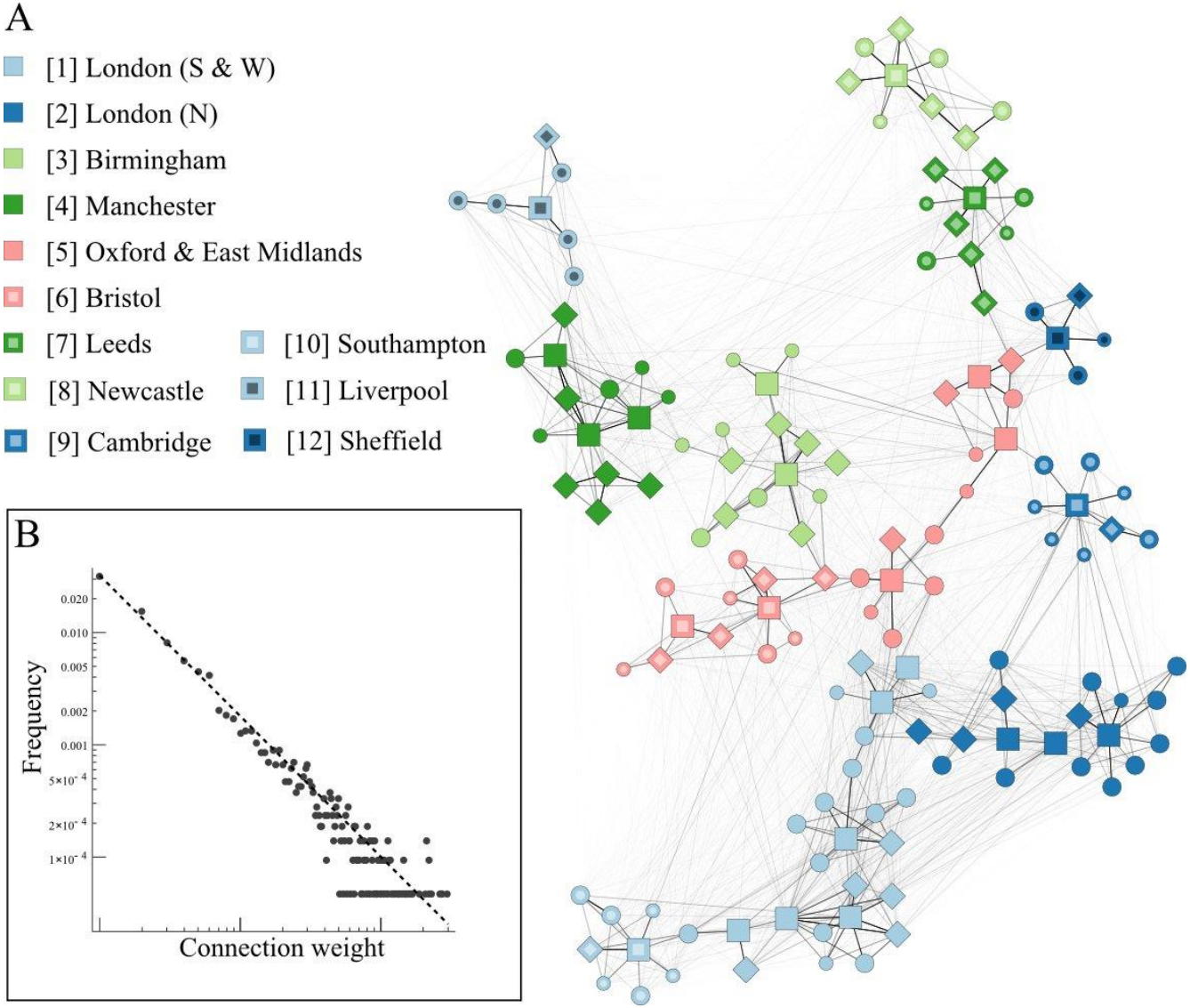


Properties of Health care Networks

- Regionality
- Centrality

MRSA rates correlate with patient movements



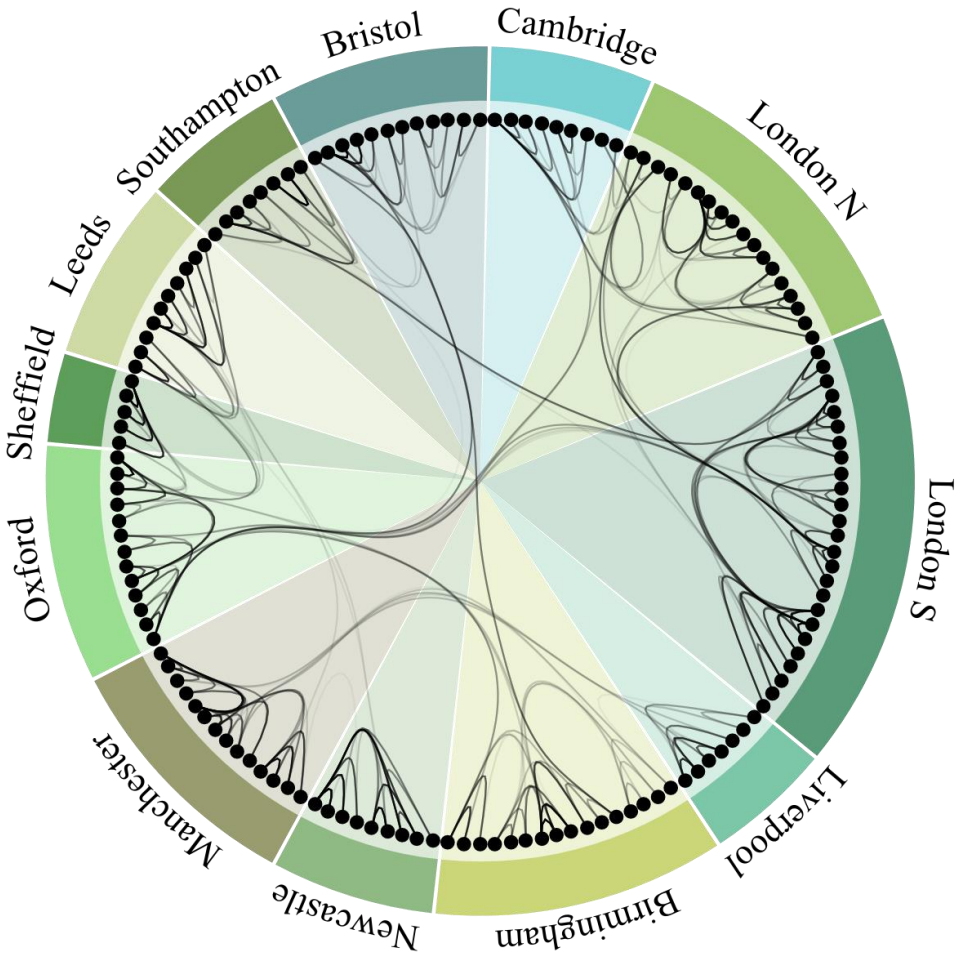

A
[1] London (S & W)
[2] London (N)
[3] Birmingham
[4] Manchester
[5] Oxford & East Midlands
[6] Bristol
[7] Leeds
[8] Newcastle
[9] Cambridge
[10] Southampton
[11] Liverpool
[12] Sheffield
B
Frequency
0.020
0.010
0.005
0.002
0.001
5×10⁻⁴
2×10⁻⁴
1×10⁻⁴
Connection weight

Properties of Health care Networks

- Regionality
- Centrality
- Scale-freeness

Introduction of Health Care-associated Pathogens

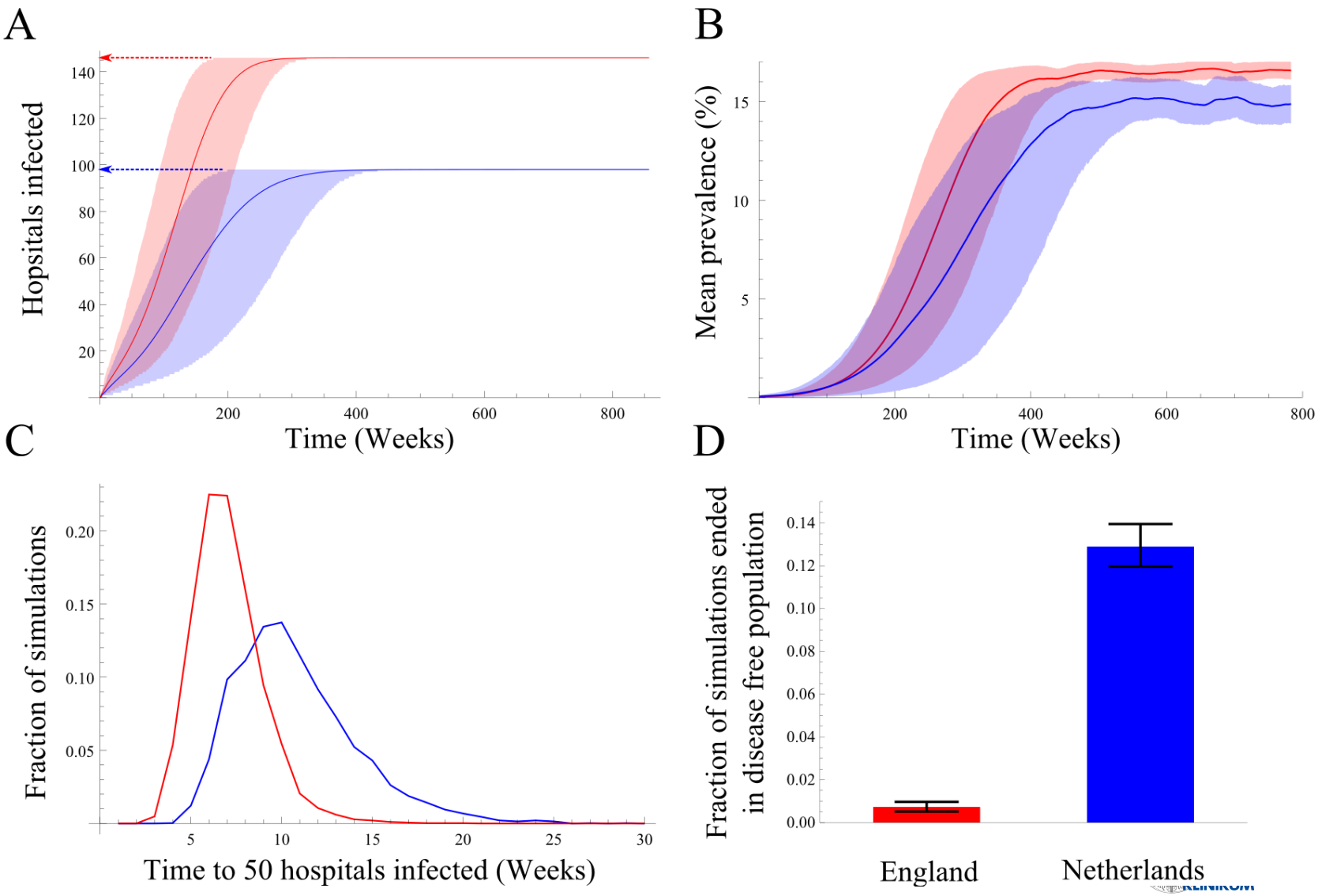
- Patients do not move randomly
- Health care utilisation creates structured networks
  - **Centrality**
    - High indegree
    - Strong connectedness
  - **Health care collectives**
    - Geographical cooperativeness



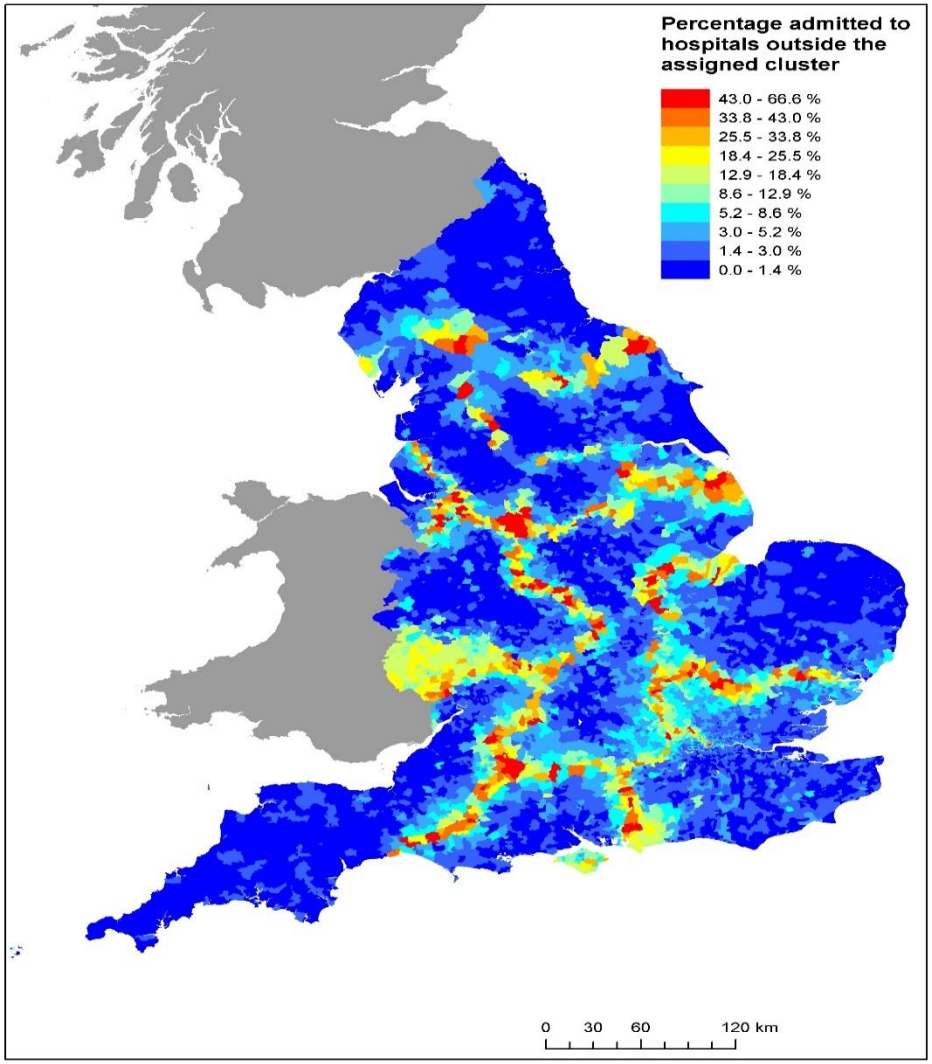
Properties of Health care Networks

- Regionality
- Centrality
- Scale-freeness
- Small World
- Tipping point dynamics

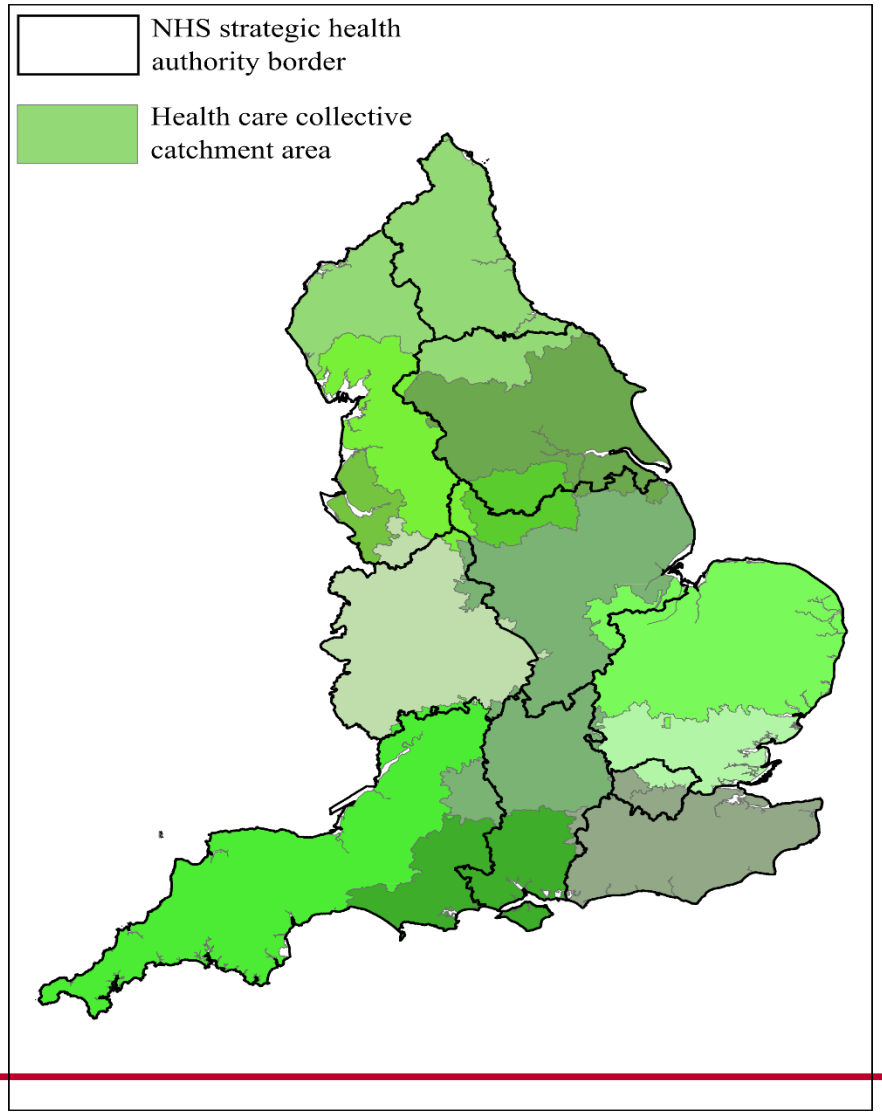
The fate of national epidemics



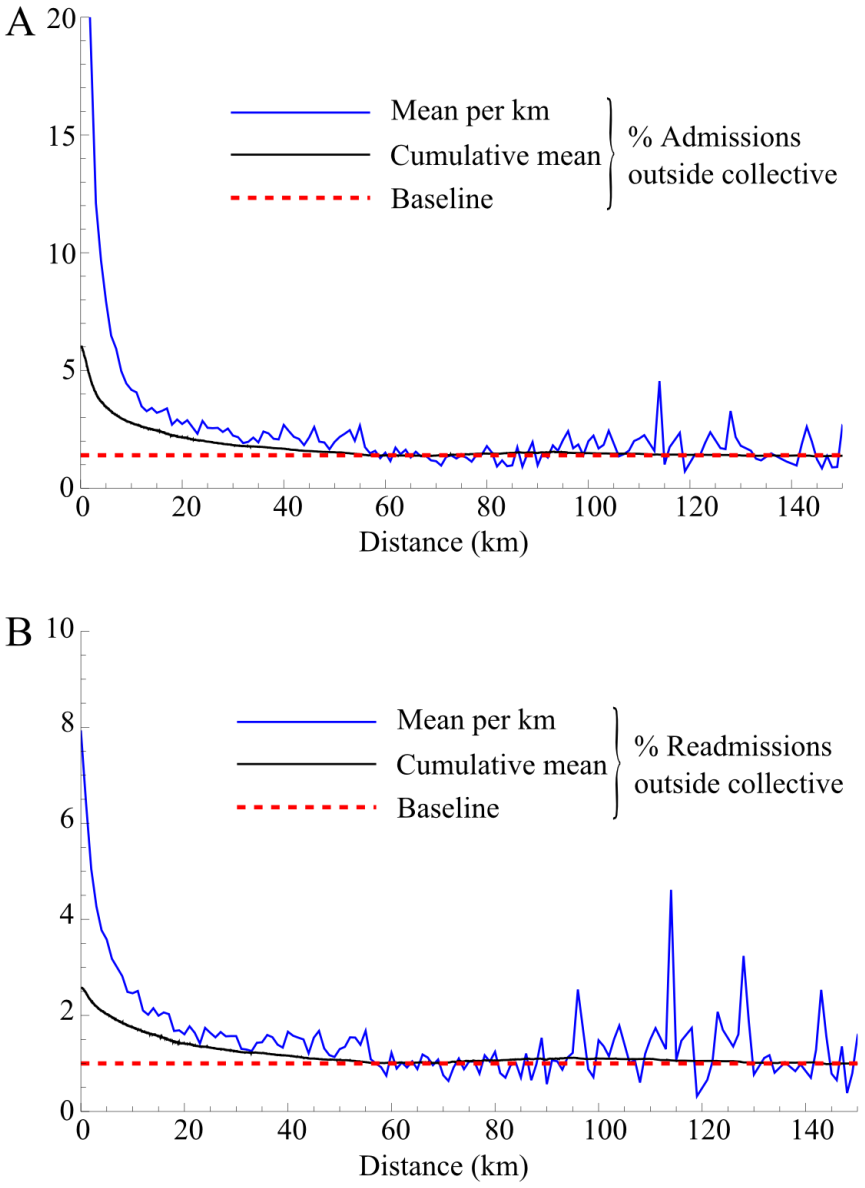
Regional referral networks are non-hermetic



Regional referral networks vs. Strategic Health Authorities



Hospital choices



From watersheds to germsheds

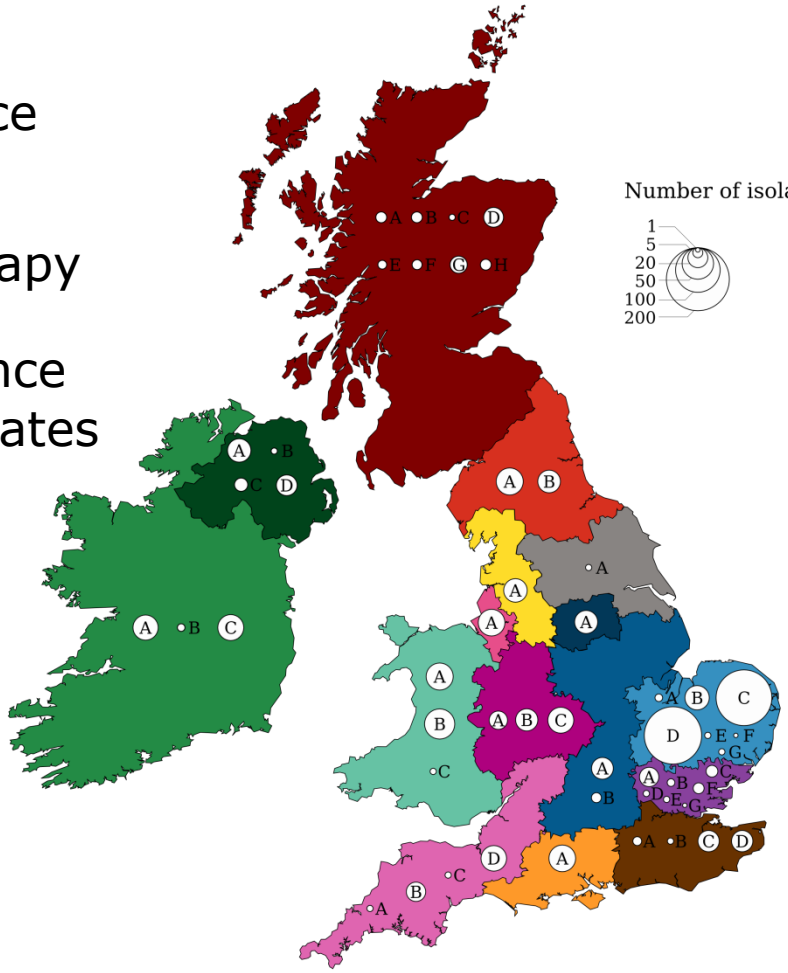
Phylogeography of MRSA in England

Opportunistic sample

- Retrospective convenience sample
- British Society for Antimicrobial Chemotherapy (BSAC)
  - Bacteraemia surveillance
  - First 7 MRSA Bac. Isolates

Selected:

- Clonal Complex 22
- 1058 samples
- Hospital >25 samples



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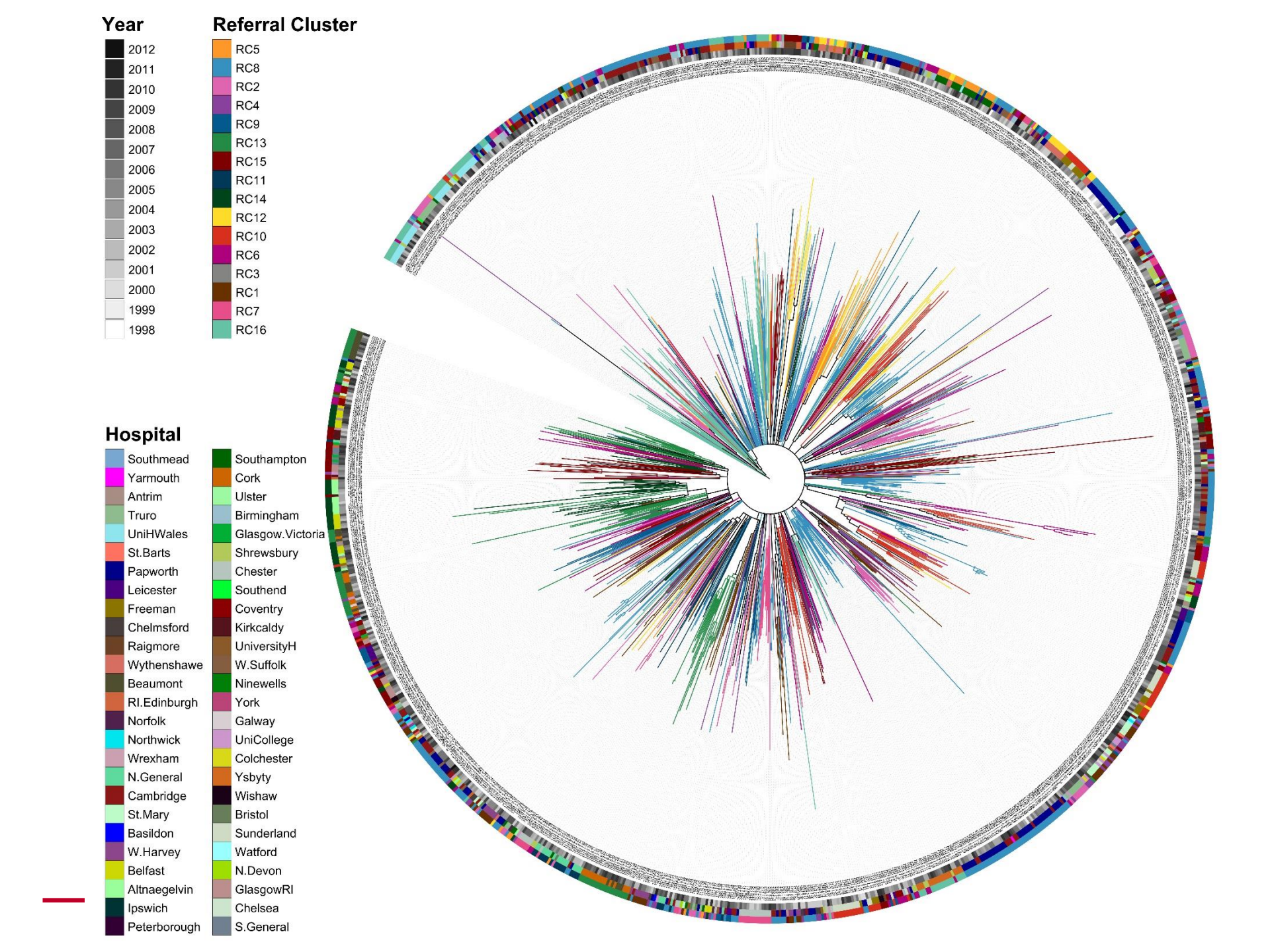
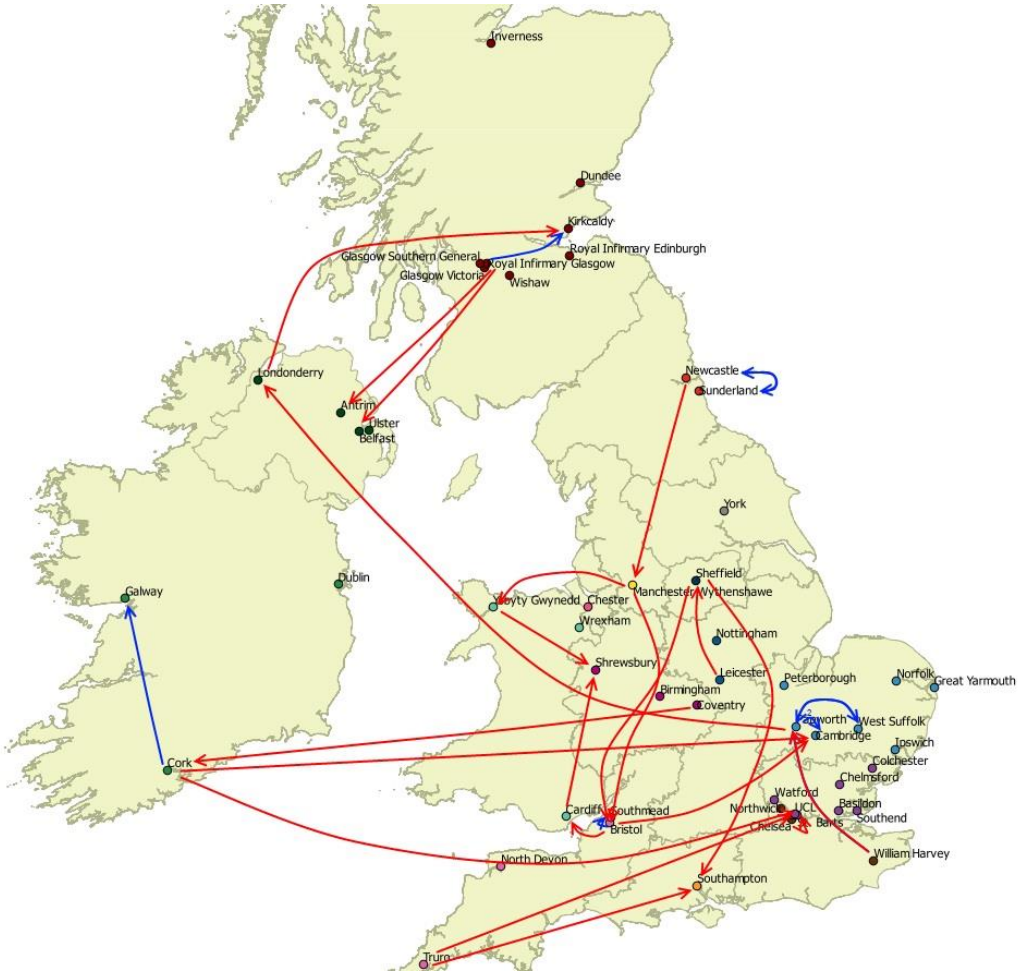

Year
2012
2011
2010
2009
2008
2007
2006
2005
2004
2003
2002
2001
2000
1999
1998
Referral Cluster
RC5
RC8
RC2
RC4
RC9
RC13
RC15
RC11
RC14
RC12
RC10
RC6
RC3
RC1
RC7
RC16
Hospital
Southmead
Yarmouth
Antrim
Truro
UniHWales
St.Barts
Papworth
Leicester
Freeman
Chelmsford
Raigmore
Wythenshawe
Beaumont
RI.Edinburgh
Norfolk
Northwick
Wrexham
N.General
Cambridge
St.Mary
Basildon
W.Harvey
Belfast
Altnaegelvin
Ipswich
Peterborough
Southampton
Cork
Ulster
Birmingham
Glasgow.Victoria
Shrewsbury
Chester
Southend
Coventry
Kirkcaldy
UniversityH
W.Suffolk
Ninewells
York
Galway
UniCollege
Colchester
Ysbyty
Wishaw
Bristol
Sunderland
Watford
N.Devon
GlasgowRI
Chelsea
S.General

Single events



Live-saving research investments in AMR (One-Health is it, or is it?)

How are we going to reconcile the epidemic spread of AMR associated high risk clones with a One Health approach?

Incidence of colonization and bloodstream infection with carbapenem-resistant Enterobacteriaceae in children receiving antineoplastic chemotherapy in Italy.

Caselli D, et al. Infect Dis (Lond). 2016.
Show full citation

Abstract

Few data are available on the incidence of carbapenemase-producing Enterobacteriaceae (CPE) infection or colonization in children receiving anticancer chemotherapy. We performed a nationwide survey among centers participating in the pediatric hematology-oncology cooperative study group (Associazione Italiana Ematologia Oncologia Pediatrica, AIEOP). During a 2-year observation period, we observed a threefold increase in the colonization rate, and a fourfold increase of bloodstream infection episodes, caused by CPE, with a 90-day mortality of 14%. This first nationwide Italian pediatric survey shows that the circulation of CPE strains in the pediatric hematology-oncology environment is increasing. Given the mortality rate, which is higher than for other bacterial strains, specific monitoring should be applied and the results should have implications for health-care practice in pediatric hematology-oncology.

PMID: 26393496 [PubMed - indexed for MEDLINE]

Are we well advised to spend scarce research resources on a One Health approach if we want to save patients' lives in European hospitals?

Given the limited supply of research funding, I regard it as irresponsible to portray a One Health approach as beneficial for patients that are at risk of infections with AMR pathogens in our hospitals !

Conclusions

- Transmission of health care-associated MDROs is characterized by highly non-normal dynamics, whereby few cause many and many cause few.
- Infection control measures should regard regional health care networks and not only individual hospitals as the target for interventions.
- Real-time patient tracking combined with rapid genomic analysis is essential for the early management of emergence and introduction of High Risk Clones into regional referral networks.

Thanks

University Medical Center Groningen
Tjibbe Donker
Mariano Ciccolini

Addenbrook's Hospital Cambridge
Sharon Peacock
Sandra Reuter

Sanger Centre
David Aanensen
Sophia David
Julian Parkhill

University of Bath
Ed Feil
Santiago Castillo-Ramirez

Imperial College London
David Aanensen

Central Bureau voor Statistic, The Hague, NL

Hospital Episode Statistics, NHS, Hemel-Hempstead, UK

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