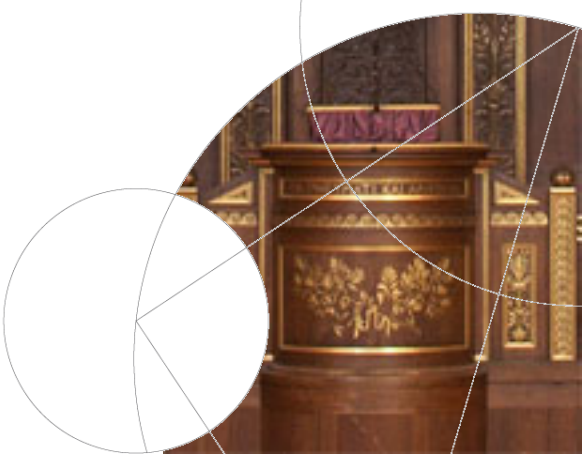
UNIVERSITY OF COPENHAGEN

Inferring Drivers of Cholera Transmission from Historical Data

Matthew Phelps



Rationale

- Uncertainty of cholera transmission pathways still exists and is difficult to infer
- High quality data from 1853 Copenhagen outbreak can potentially provide information on transmission pathways

Objectives

- Evaluate the degree to which water-borne transmission routes drove the Copenhagen cholera outbreak of 1853, relative to non-water-borne transmission routes

Methodology

- Construct spatially-explicit discrete-time models of Copenhagen outbreak
- Select most appropriate model using Deviance-Information Criteria

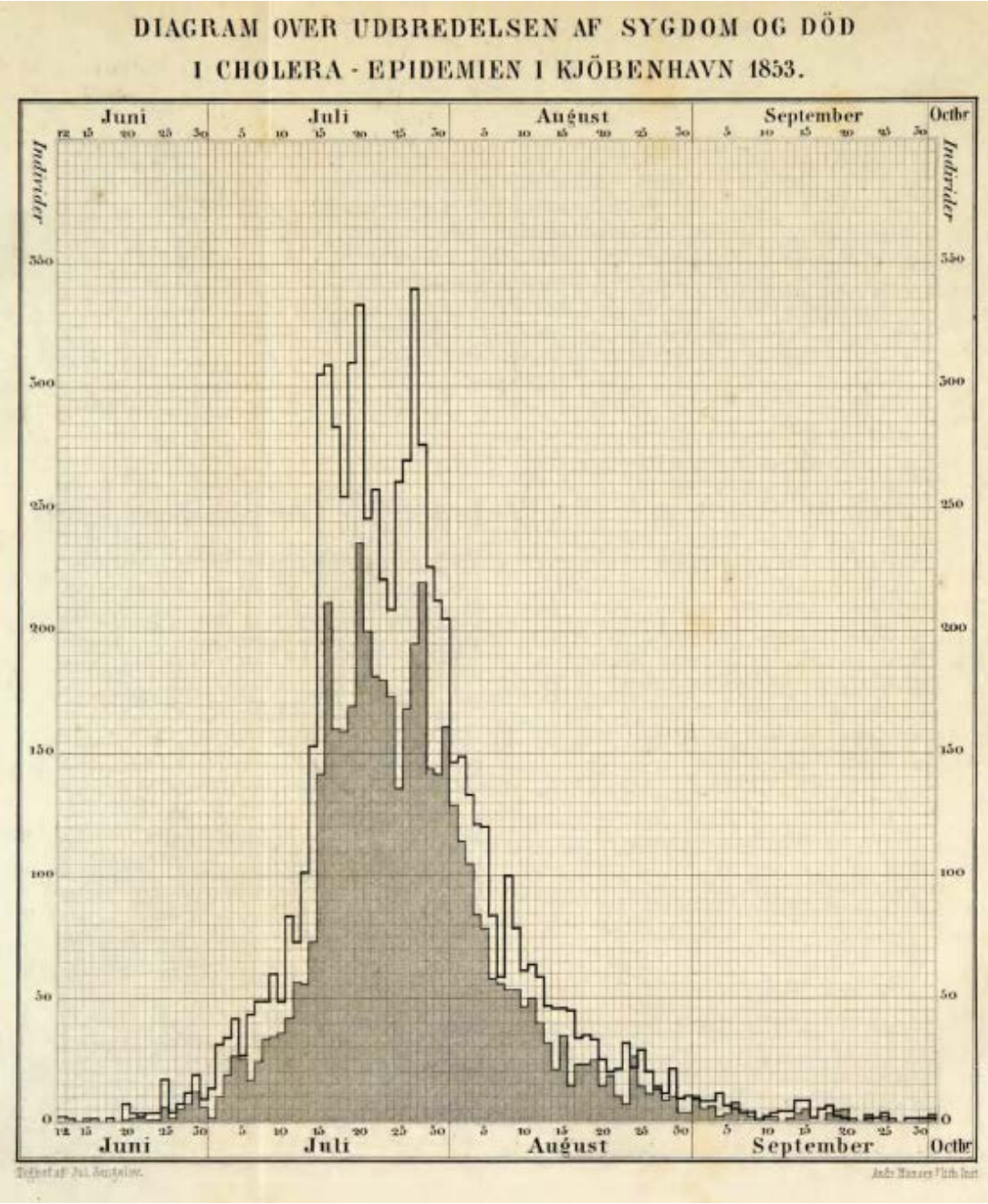
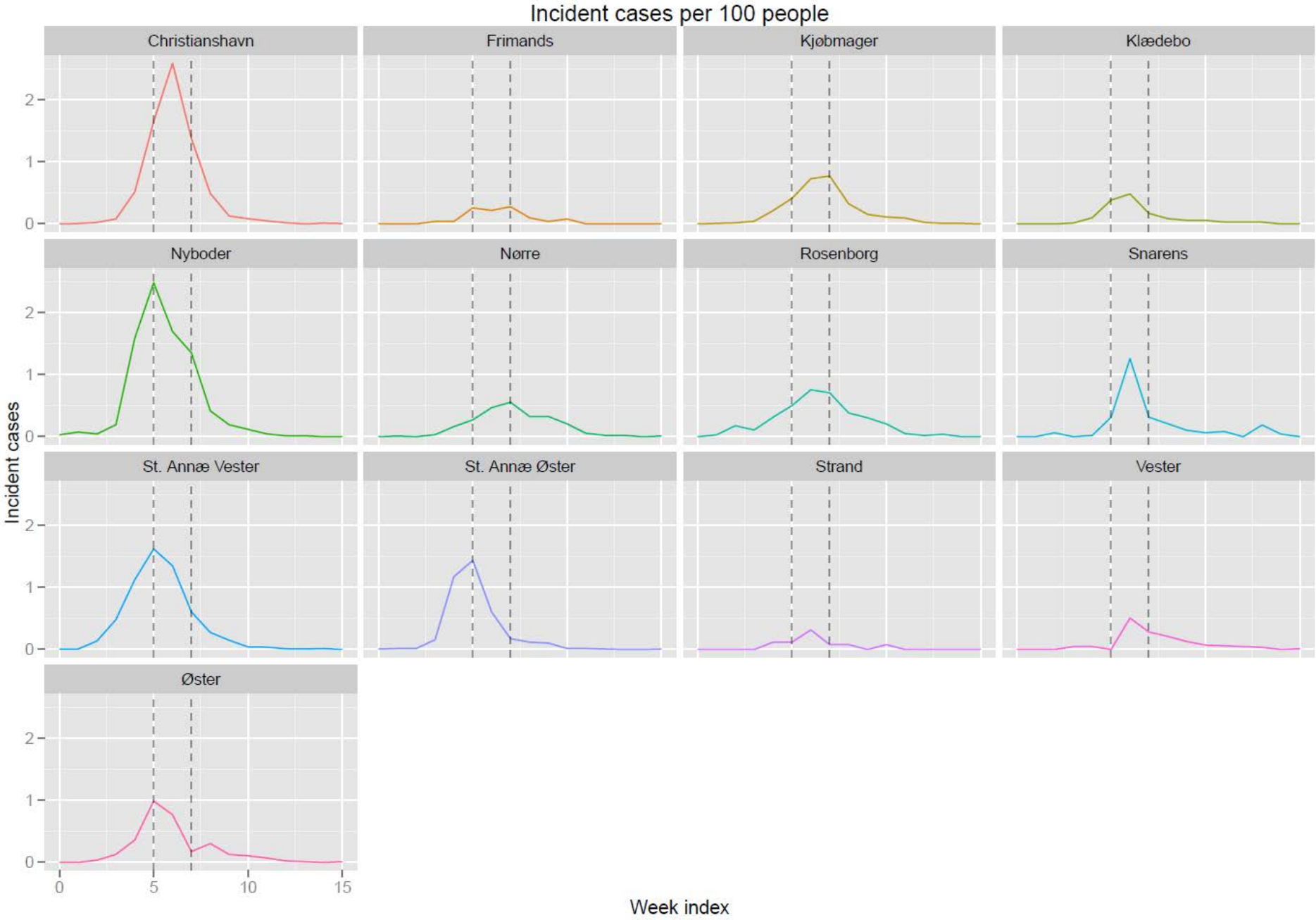
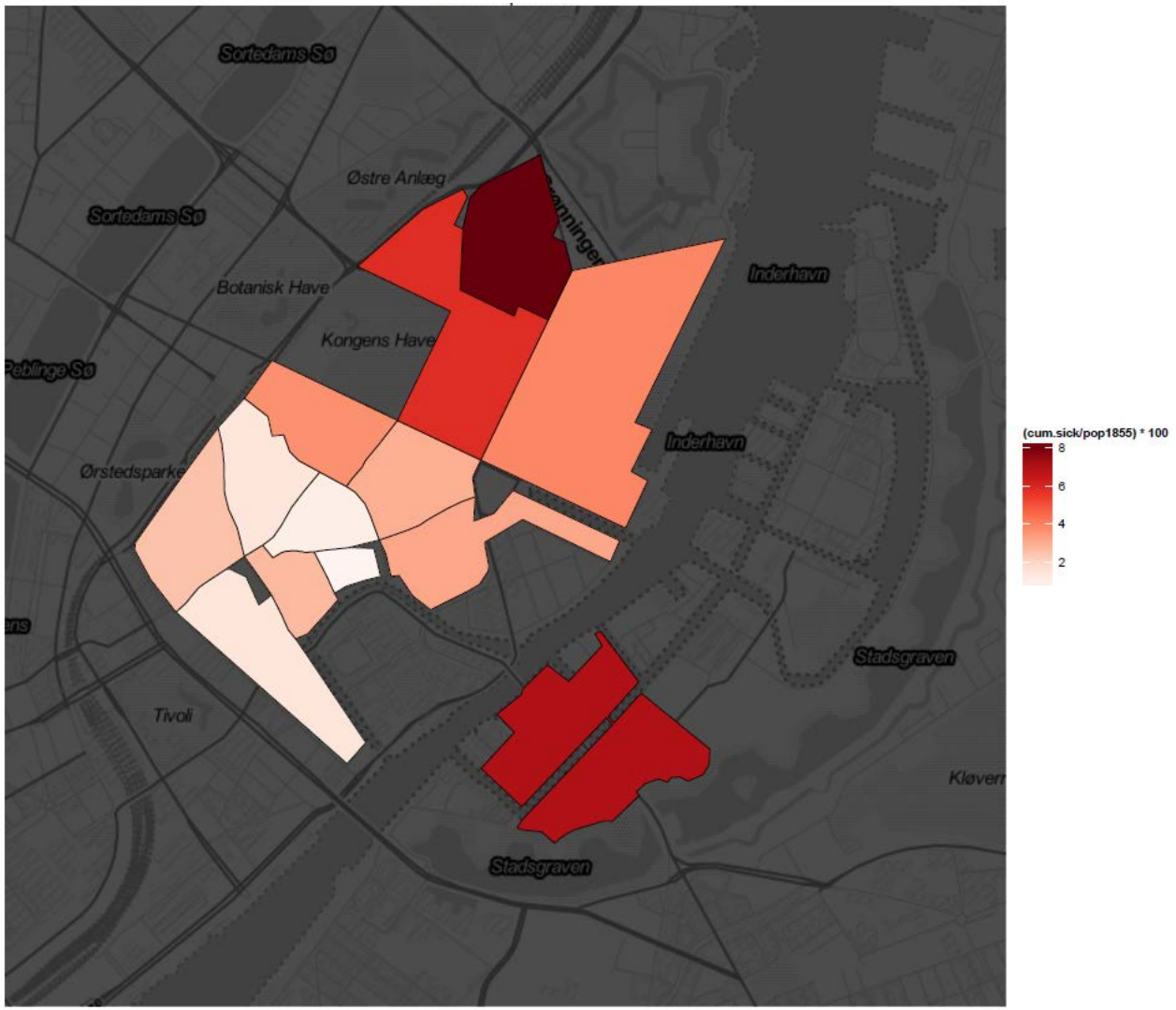


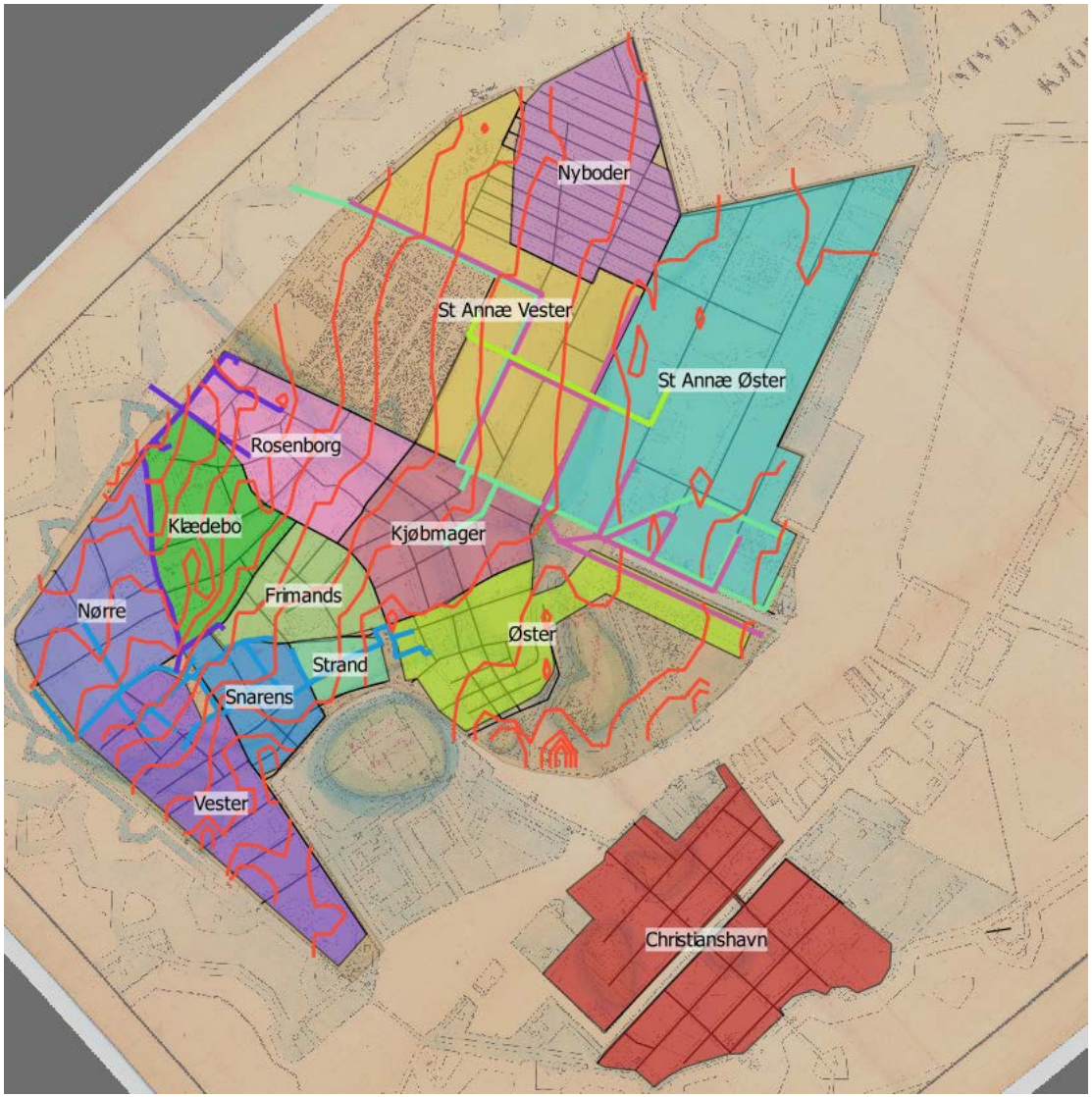
DIAGRAM OVER UDBREDELSEN AF SYGDOM OG DÖD
I CHOLERA - EPIDEMIEN I KJÖBENHAVN 1853.
Juni
Juli
August
September
Octbr
Individer
350
300
250
200
150
100
50
0


Nyboder
St Annæ Vester
St Annæ Øster
Rosenborg
Klædebo
Kjøbmager
Frimands
Nørre
Øster
Strand
Snarens
Vester
Christianshavn


Incident cases per 100 people
Christianshavn
Frimands
Kjøbmager
Klædebo
Nyboder
Nørre
Rosenborg
Snarens
St. Annæ Vester
St. Annæ Øster
Strand
Vester
Øster
Incident cases
Week index
0
1
2
0
5
10
15

Cumulative infections





$$I_{i,t+1} \sim Poisson\left(\frac{S_{i,t}}{N_i}\left(\beta_i I_{i,t} + \sum I_{j,t}\alpha_{j,i}\right) + \Omega_{water}\right)$$

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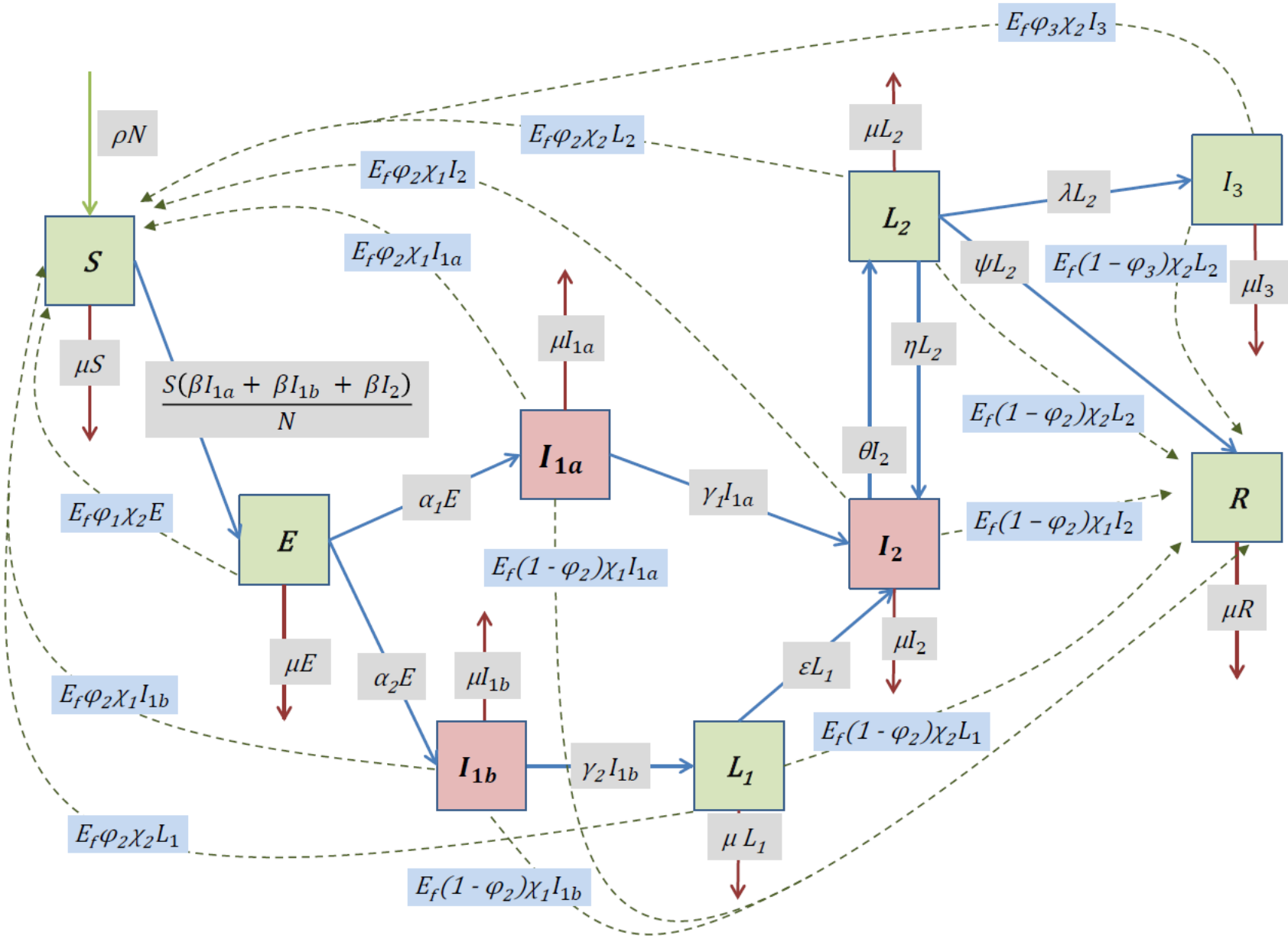
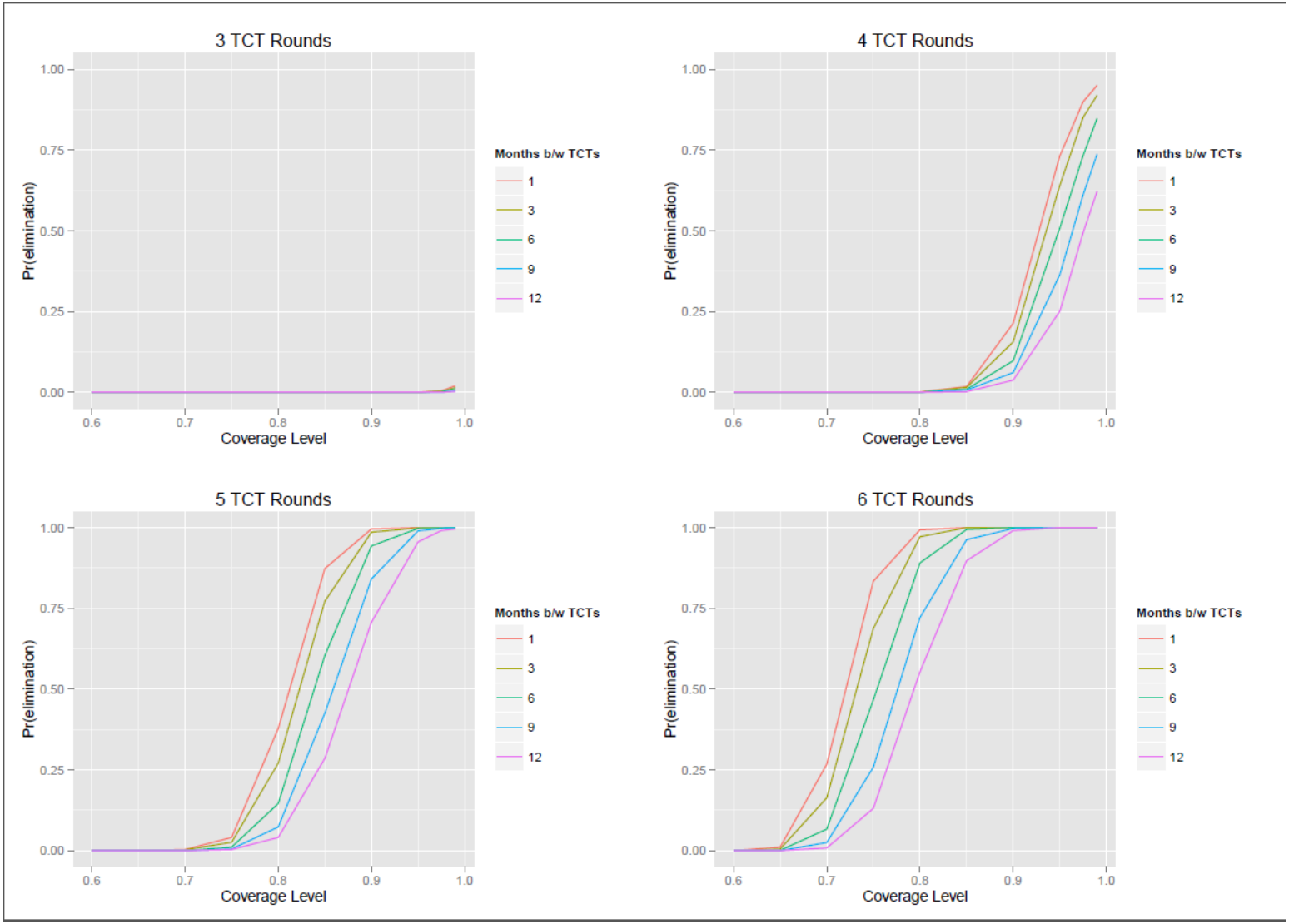
Collaborators

- Lone Simonsen – University of Copenhagen Global Health Section
- Ginny Pitzer – Yale University
- Viggo Andreasen – Roskilde University
- Thomas Alexander Gerds – University of Copenhagen Biostatistics Section

Dynamic Compartmental Model of Yaws Elimination among Baka Communities in DRC

- Currently >65,000 incident cases worldwide
- One-time dose of oral antibiotic sufficient treatment (2012)
- WHO Targeted yaws for eradication by 2020 via MDA programs
- MDA programs for eradication never been modeled
- Our model tests 510 treatment scenarios
- Results indicate WHO guidelines too optimistic


$E_f\varphi_3\chi_2 I_3$
ρN
$E_f\varphi_2\chi_2 L_2$
μL_2
I_3
$E_f\varphi_2\chi_1 I_2$
λL_2
S
L_2
$E_f\varphi_2\chi_1 I_{1a}$
ψL_2
$E_f(1-\varphi_3)\chi_2 L_2$
μI_3
μI_{1a}
ηL_2
μS
$\frac{S(\beta I_{1a} + \beta I_{1b} + \beta I_2)}{N}$
$E_f(1-\varphi_2)\chi_2 L_2$
θI_2
I_{1a}
R
$\alpha_1 E$
$\gamma_1 I_{1a}$
$E_f\varphi_1\chi_2 E$
E
I_2
$E_f(1-\varphi_2)\chi_1 I_2$
$E_f(1-\varphi_2)\chi_1 I_{1a}$
μR
μI_2
μE
εL_1
$\alpha_2 E$
μI_{1b}
$E_f\varphi_2\chi_1 I_{1b}$
$E_f(1-\varphi_2)\chi_2 L_1$
I_{1b}
$\gamma_2 I_{1b}$
L_1
$E_f\varphi_2\chi_2 L_1$
μL_1
$E_f(1-\varphi_2)\chi_1 I_{1b}$


3 TCT Rounds
4 TCT Rounds
5 TCT Rounds
6 TCT Rounds
Pr(elimination)
Coverage Level
1.00
0.75
0.50
0.25
0.00
0.6
0.7
0.8
0.9
1.0
Months b/w TCTs
1
3
6
9
12