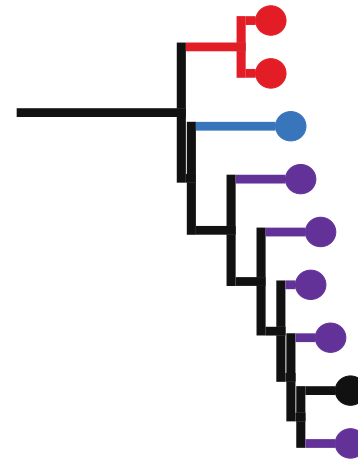
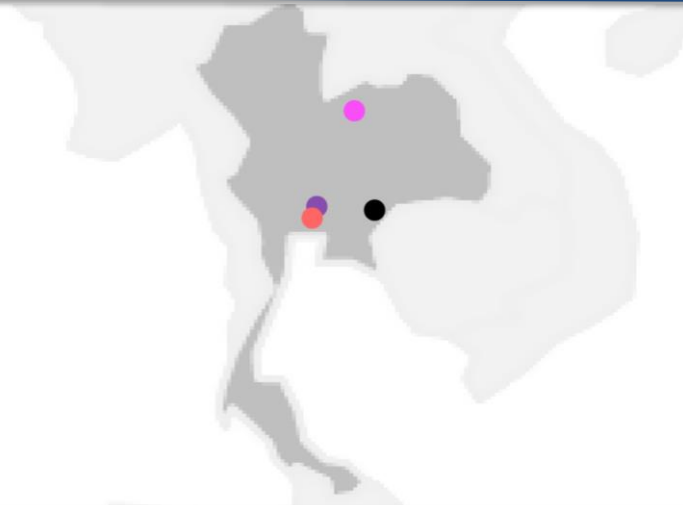
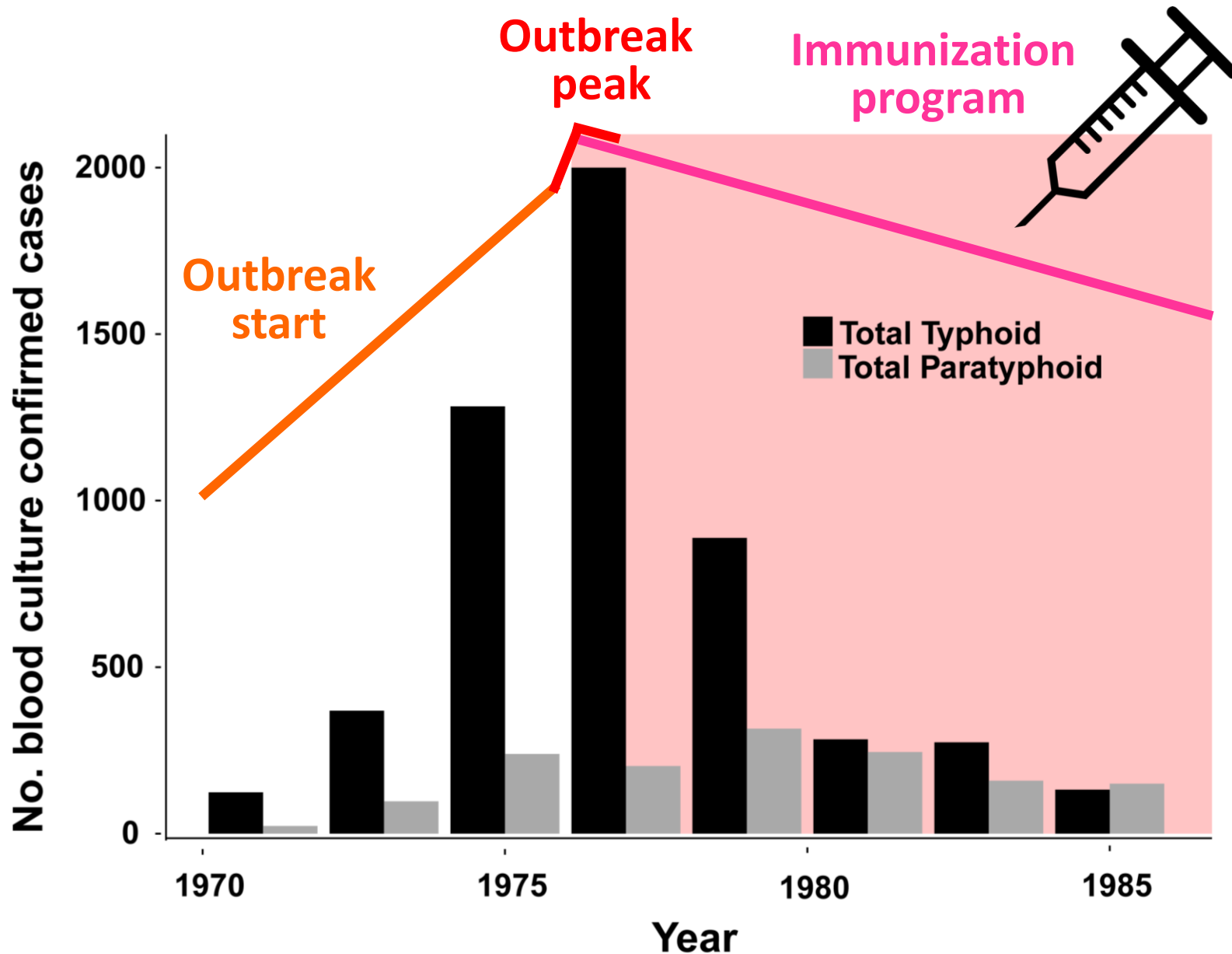


Salmonella Typhi in Thailand before and after a national immunization program



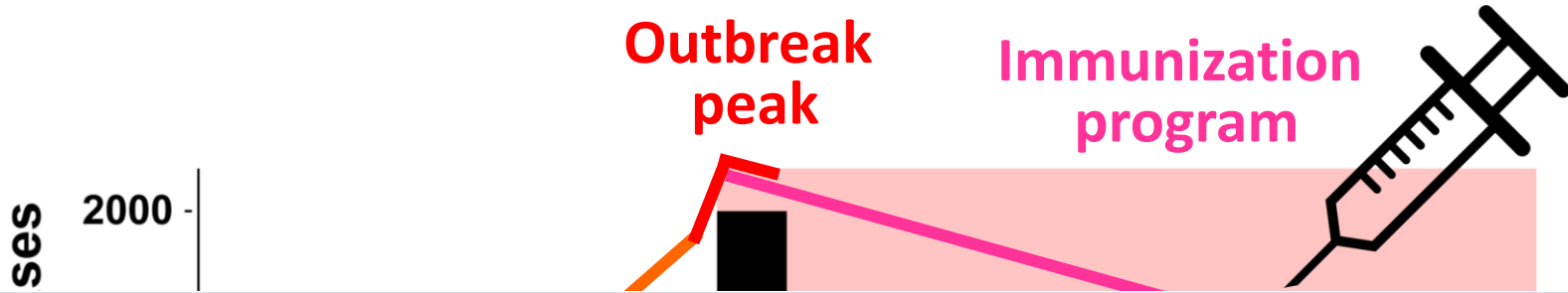
Zoe Anne Dyson, Duy Pham Thanh, Ladaporn Bodhidatta, Carl Mason, Apichai Srijan, Maia Rabaa, Phat Voong Vinh, Tuyen Ha Thanh, Guy Thwaites, Stephen Baker, and Kathryn Holt

Thai national immunization program



Reproduced from Bodhidatta et al 1987

Thai national immunization program

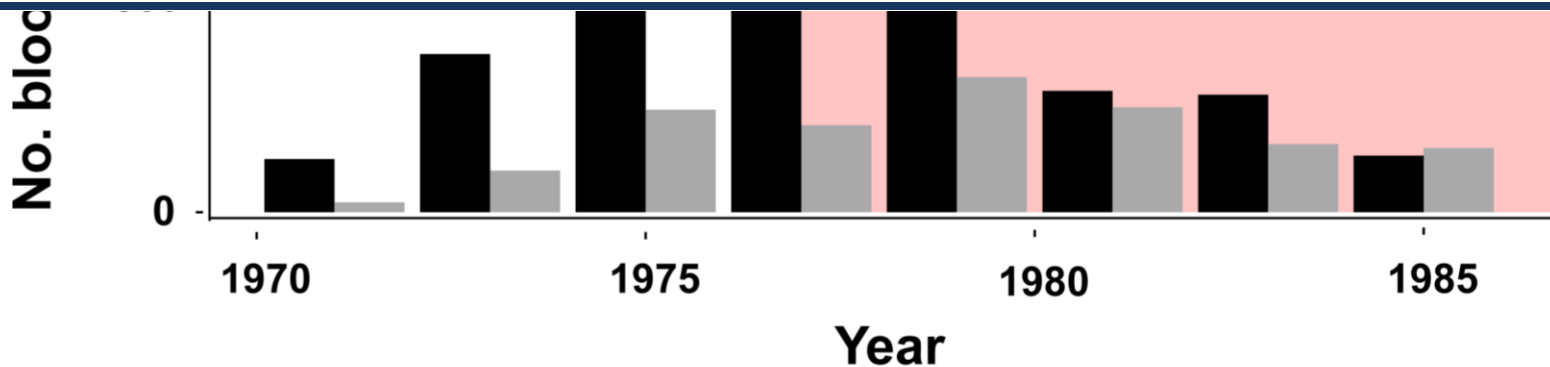


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Control of Typhoid Fever in Bangkok, Thailand, by Annual Immunization of Schoolchildren with Parenteral Typhoid Vaccine

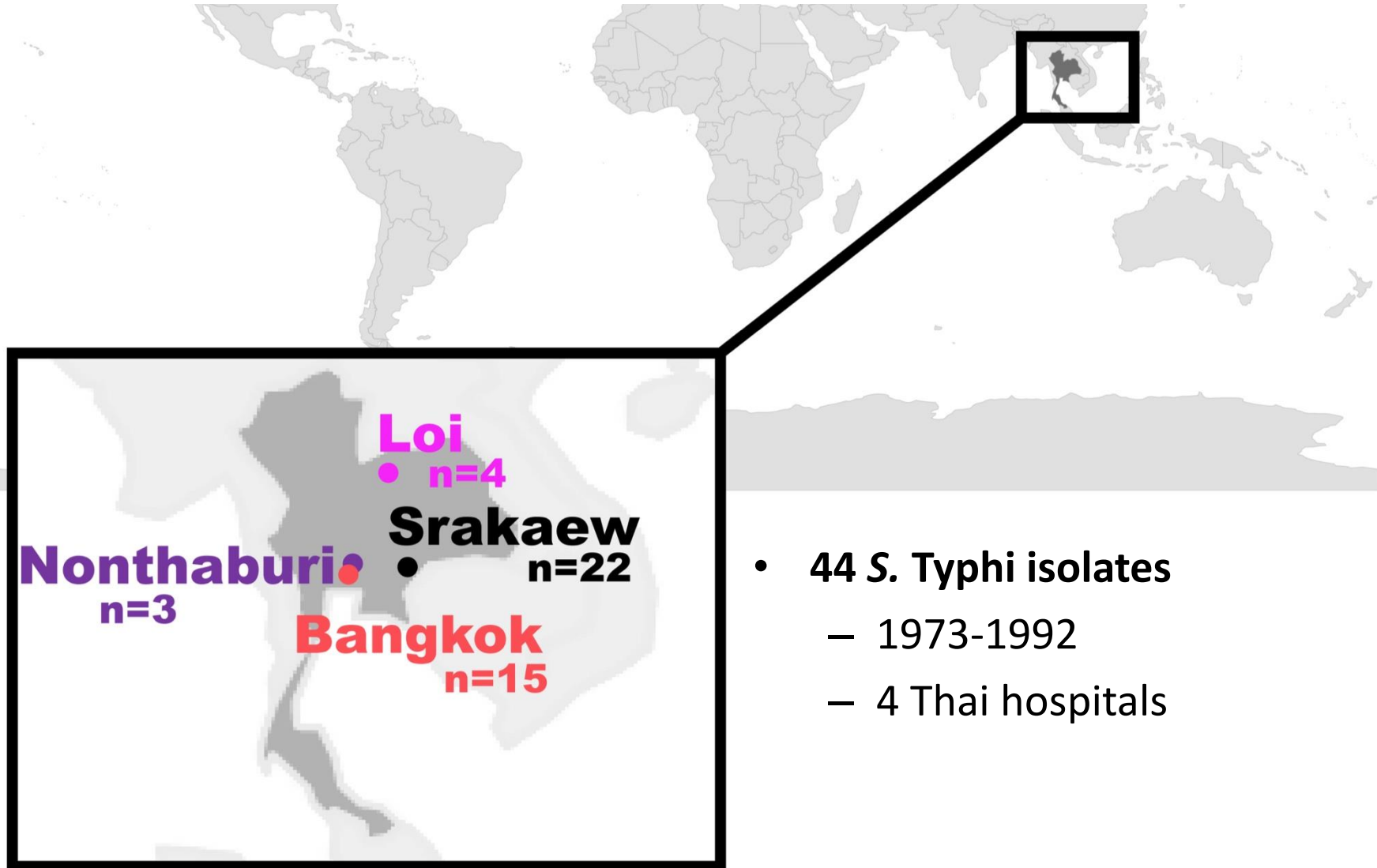
Ladaporn Bodhidatta, David N. Taylor,
Usa Thisyakorn, and Peter Echeverria

*From the Department of Bacteriology, Armed Forces
Research Institute of Medical Sciences; and the Department
of Pediatric Infectious Diseases, Chulalongkorn University,
Bangkok, Thailand*



Reproduced from Bodhidatta et al 1987

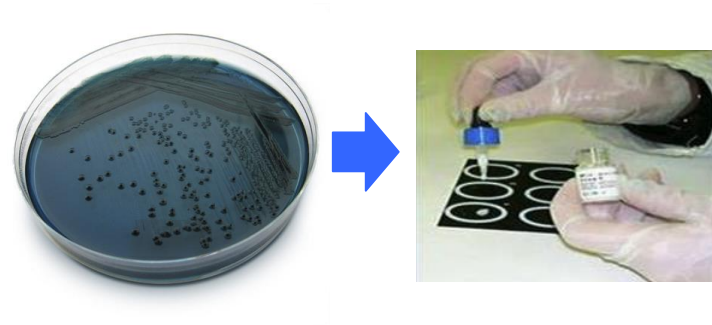
S. Typhi isolates from 4 Thai hospitals



Analysis workflow



Analysis workflow



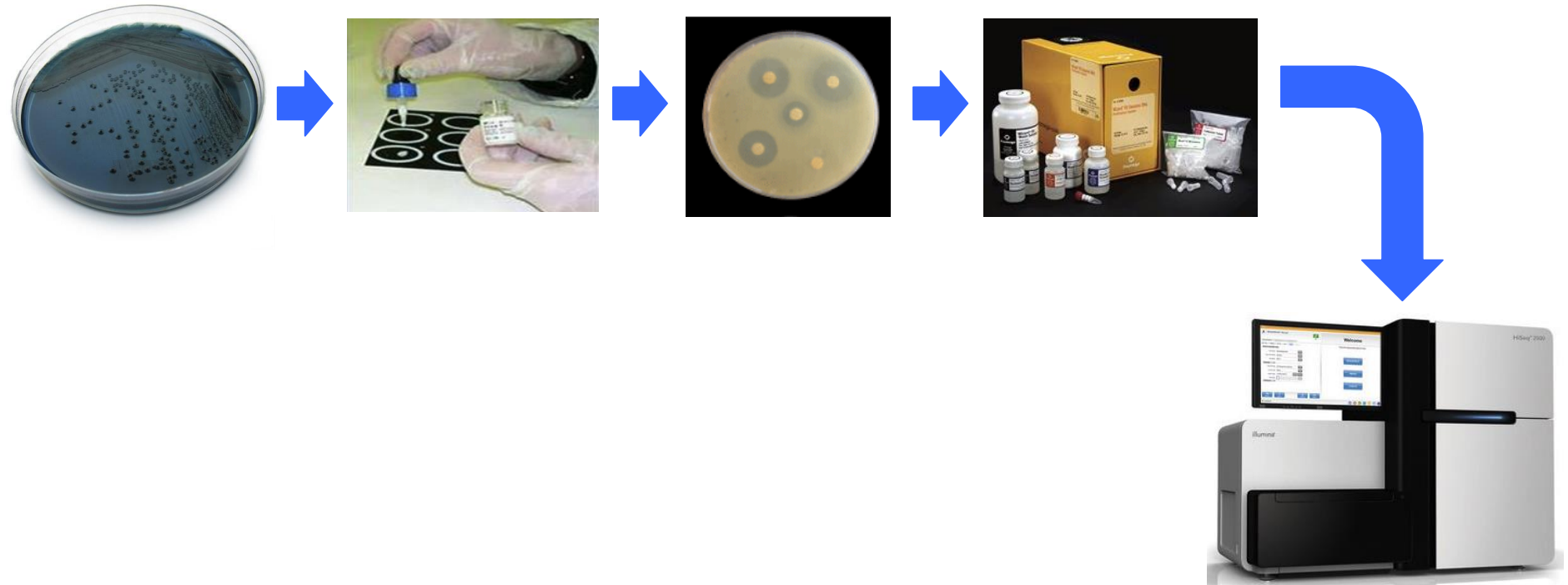
Analysis workflow



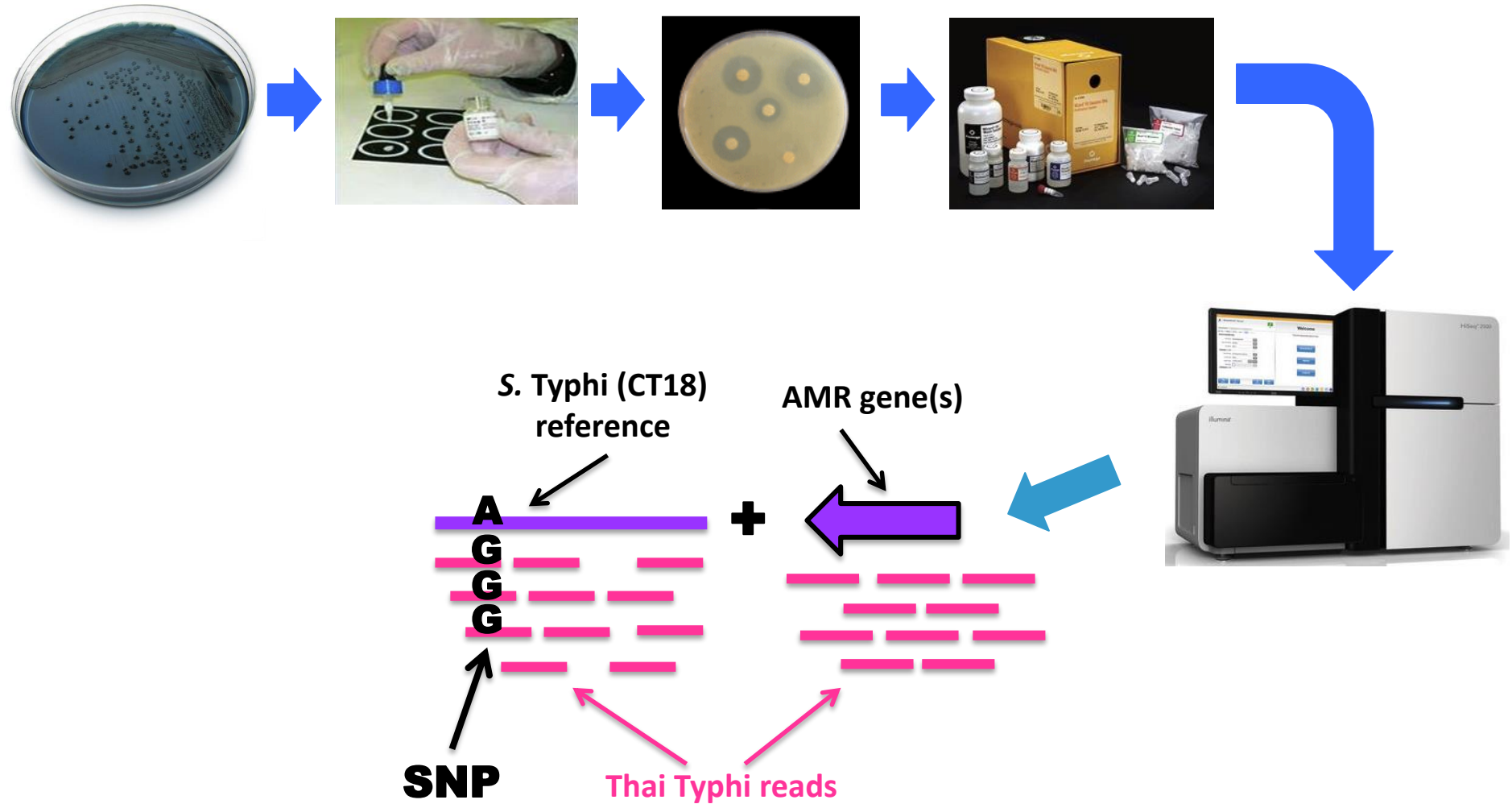
Analysis workflow



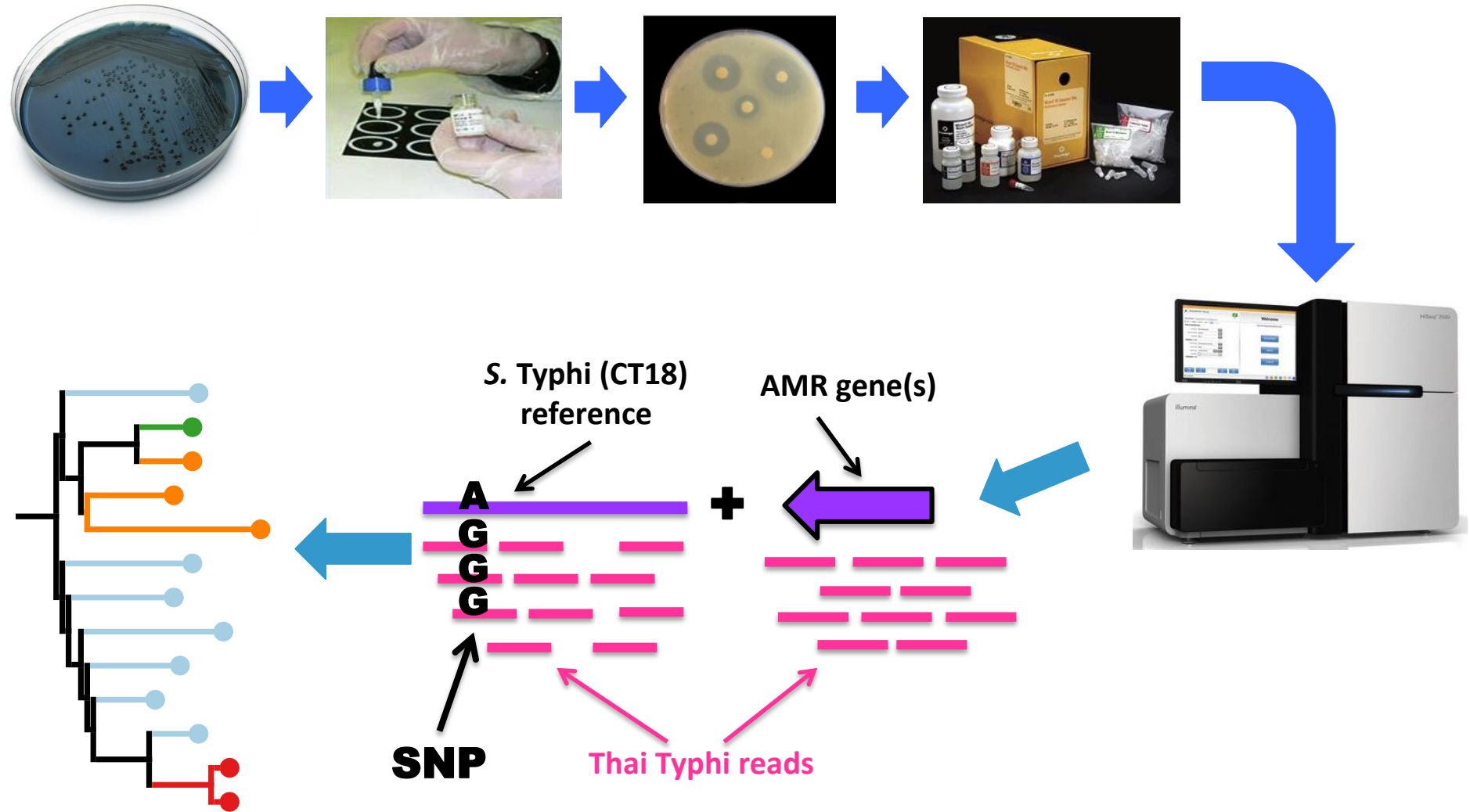
Analysis workflow



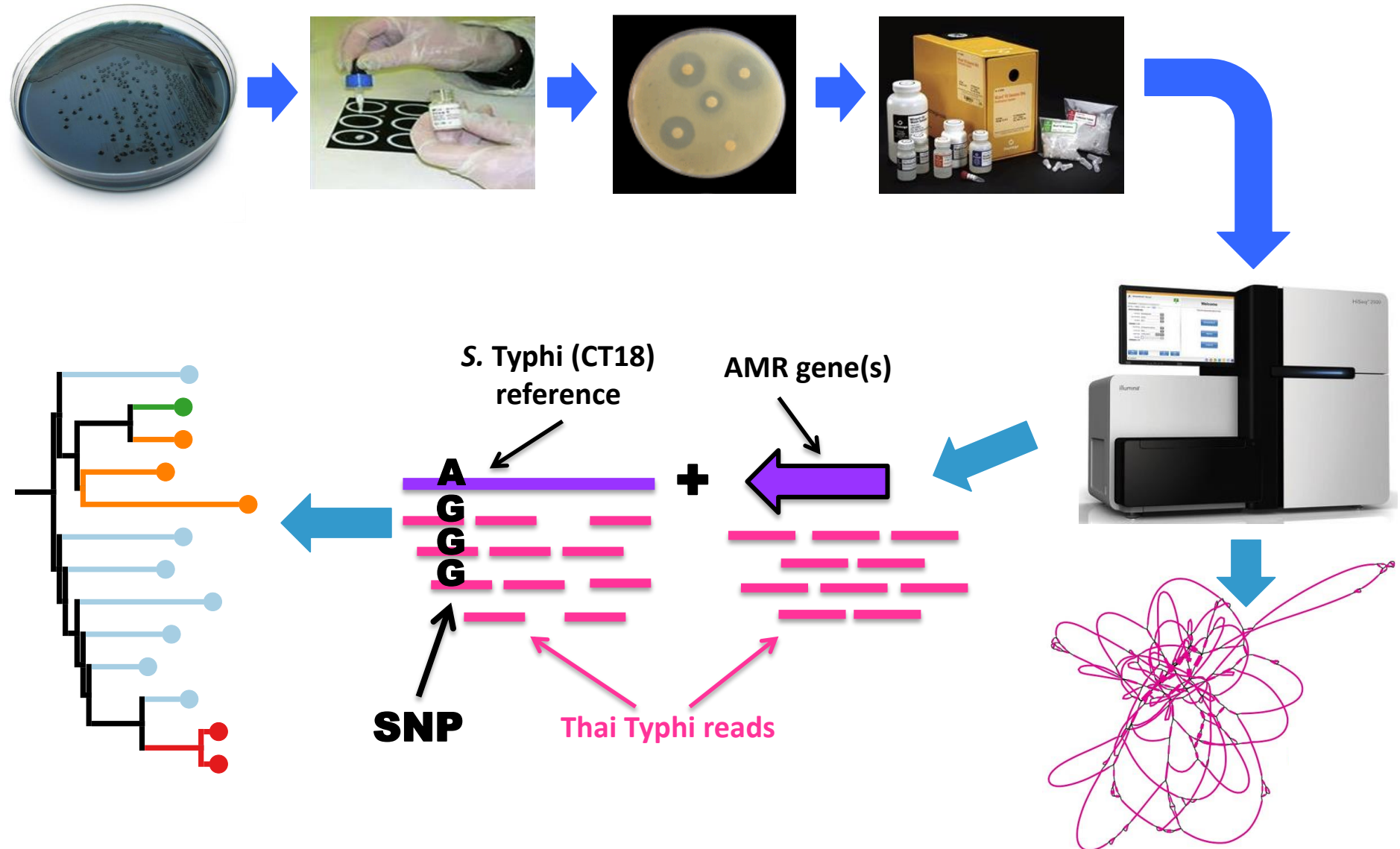
Analysis workflow



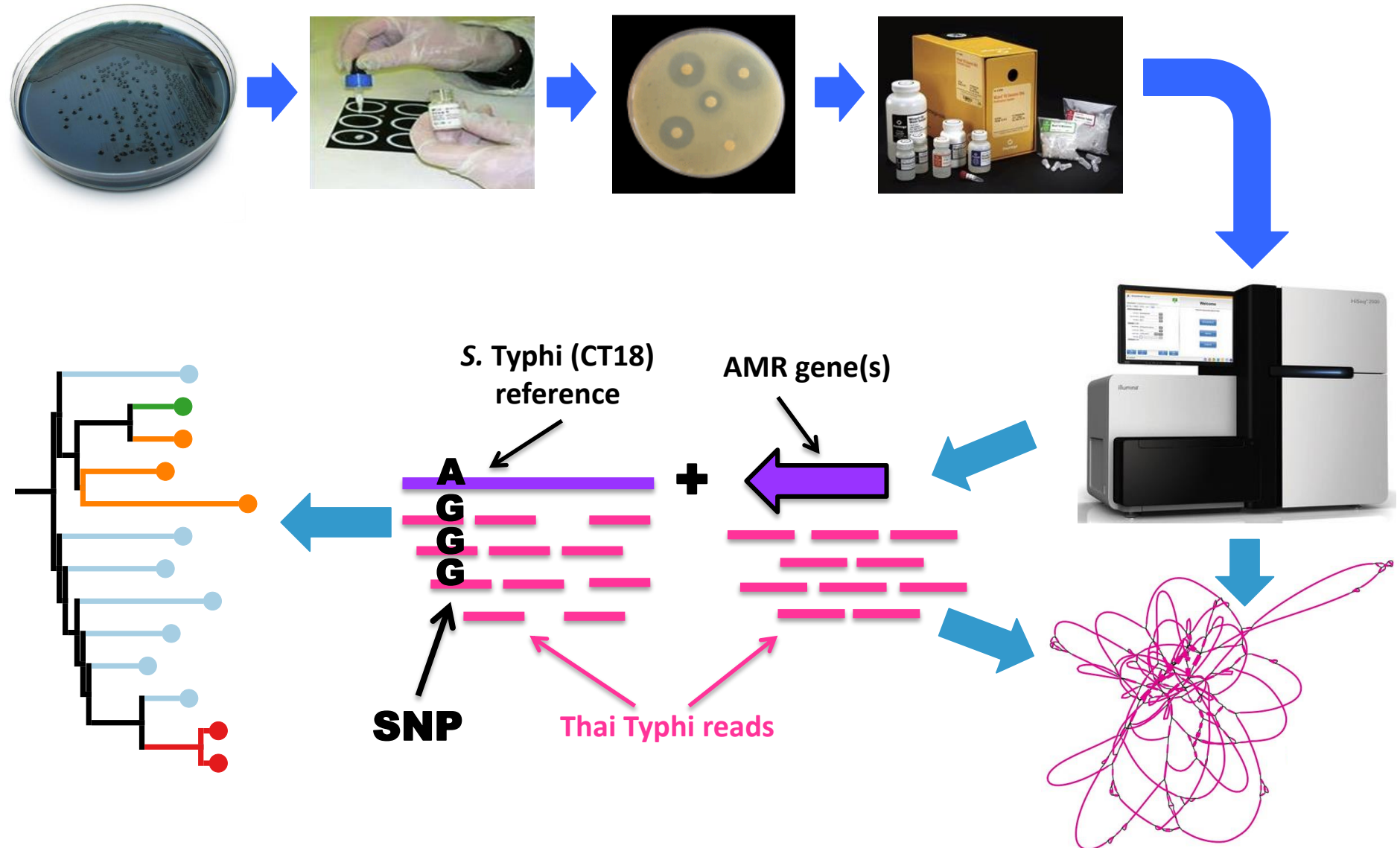
Analysis workflow



Analysis workflow



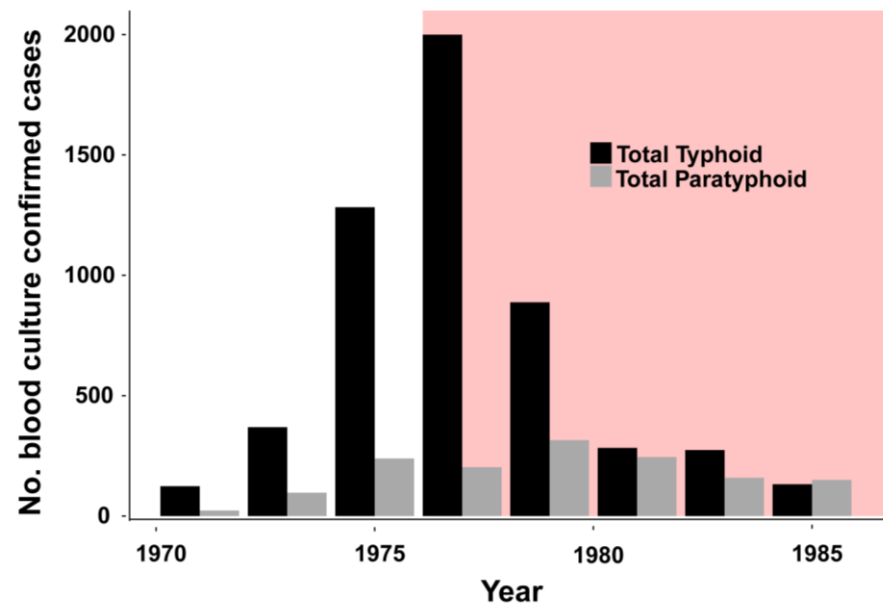
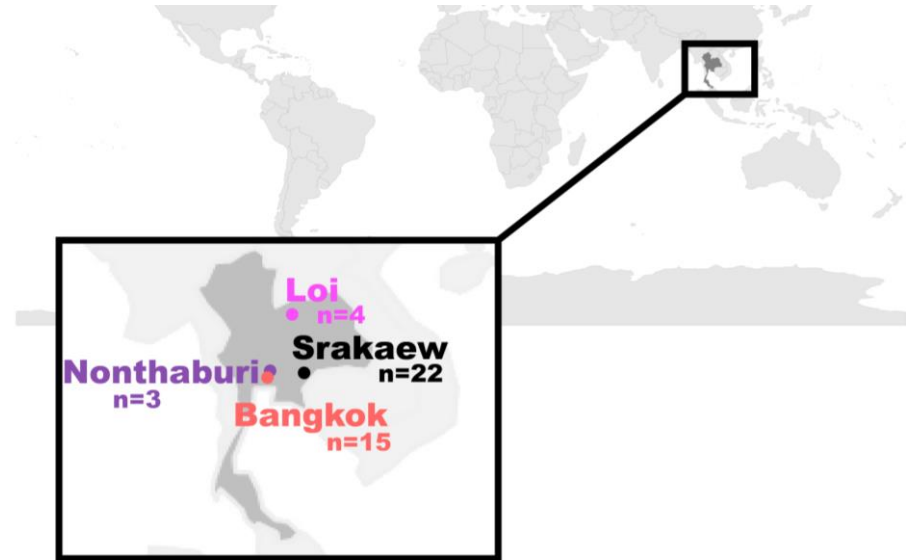
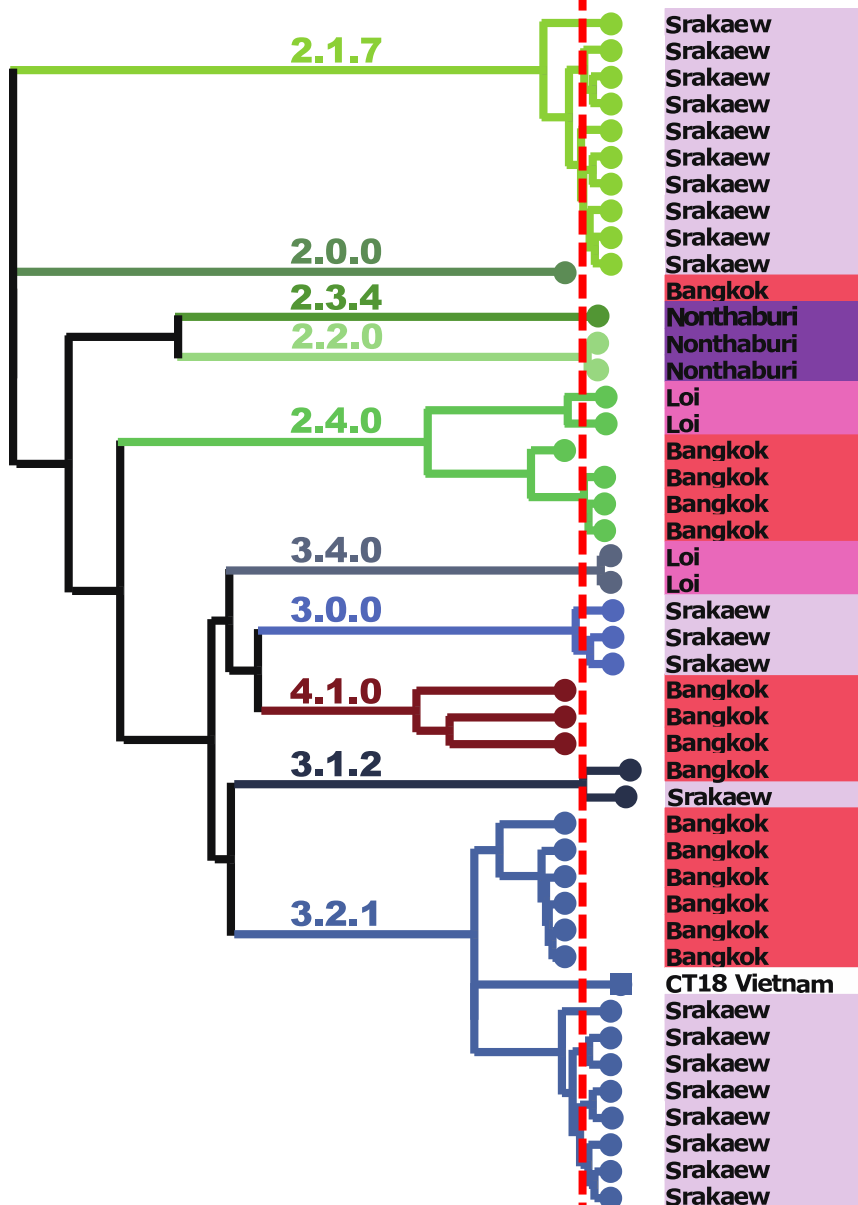
Analysis workflow



Thai S. Typhi population structure

1977

Pre-vaccine | Post-vaccine



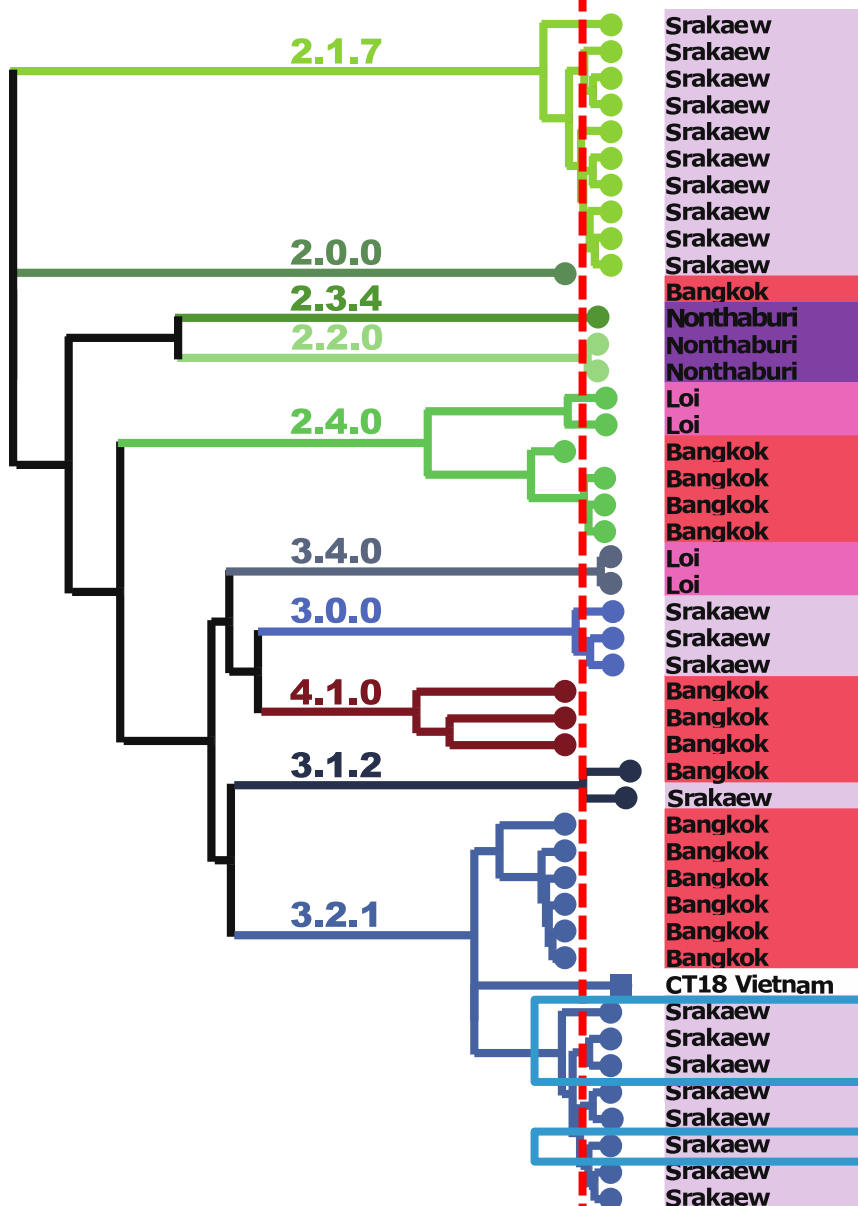
Genotyping framework: Wong et al 2016, Nat Comms 7
 Genotyphi script: <http://github.com/katholt/genotyphi/>



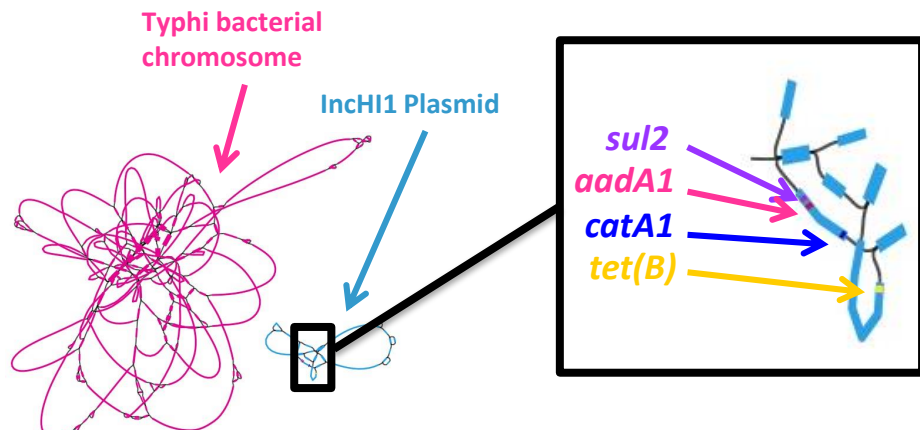
Post-vaccine MDR isolates

1977

Pre-vaccine | Post-vaccine



- Resistance only observed in 4 post-vaccine 3.2.1
- Confirmed resistance genes for
 - Aminoglycosides (*aadA1*)
 - Chloramphenicol (*catA1*)
 - Tetracyclines (*tet(B)*)
 - Sulphonamides (*sul1*)
- IncHI1 plasmid *rep* gene
 - Identical sequences
 - Inherited by common ancestor

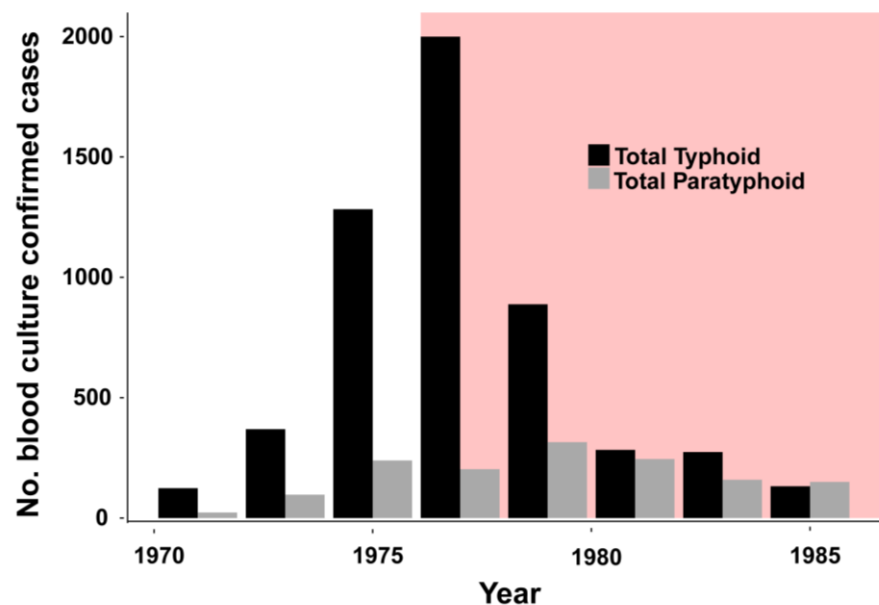
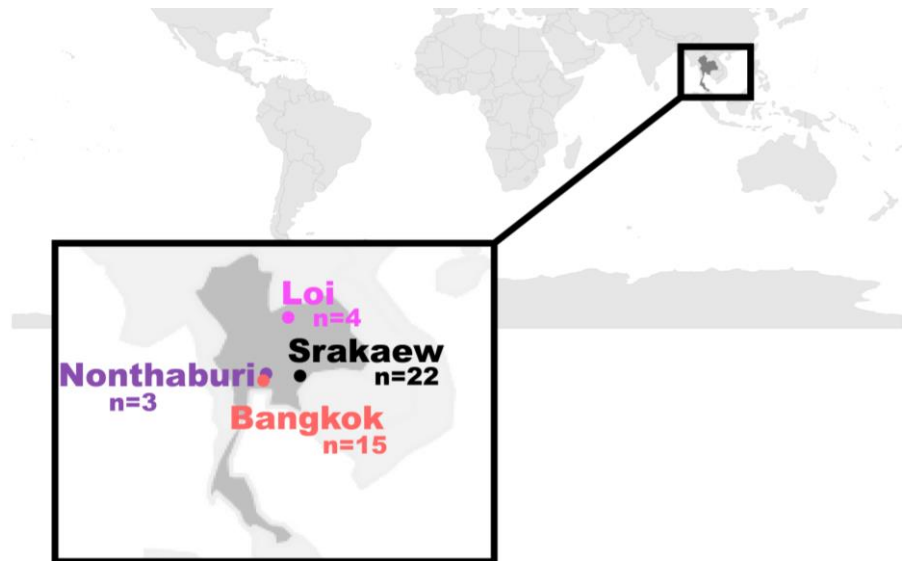
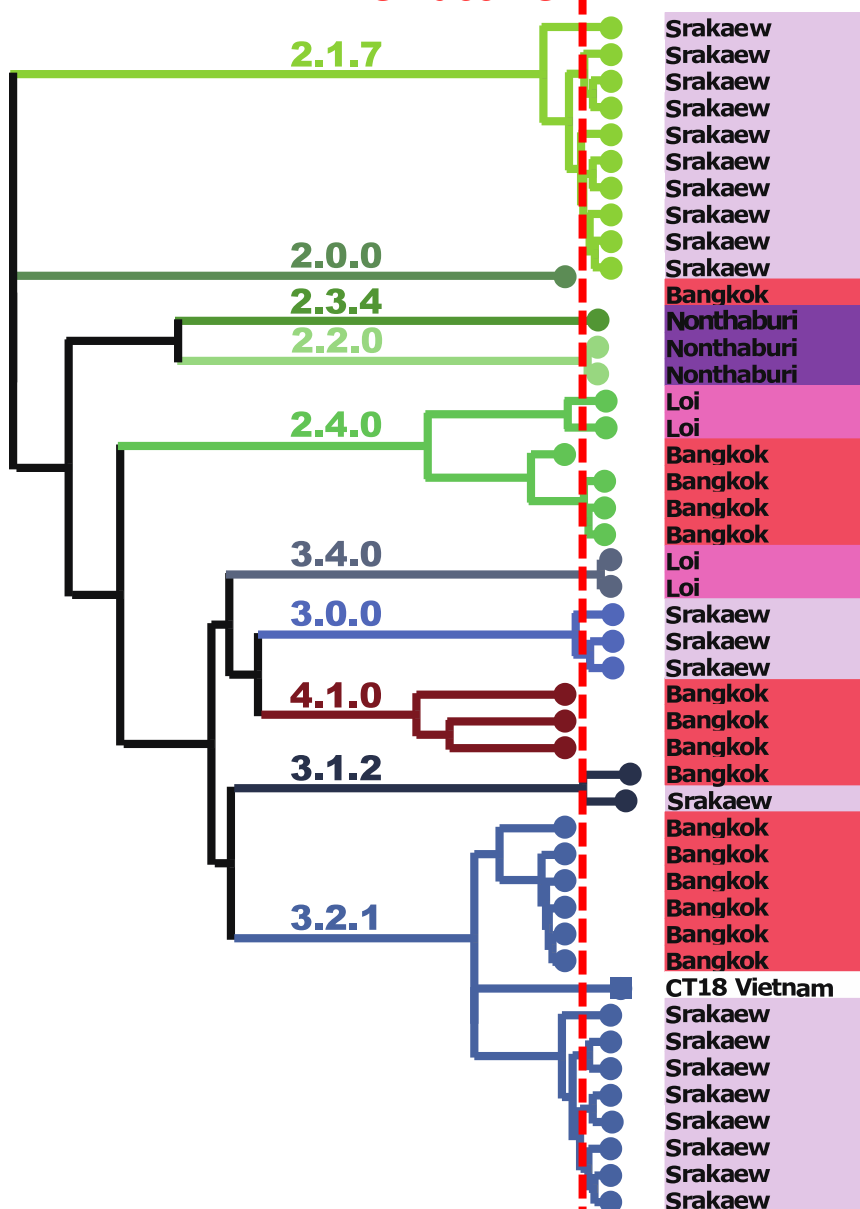


Bandage: <https://github.com/rrwick/Bandage>
 SRST2: <http://github.com/katholt/SRST2/>

Little persistence following vaccine

1977

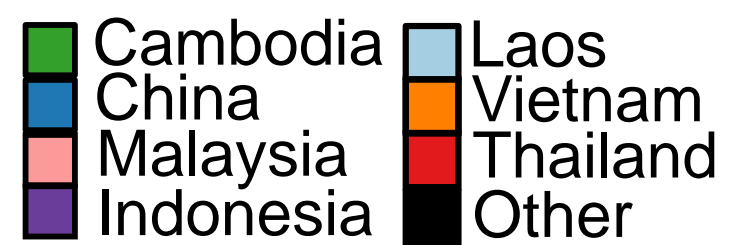
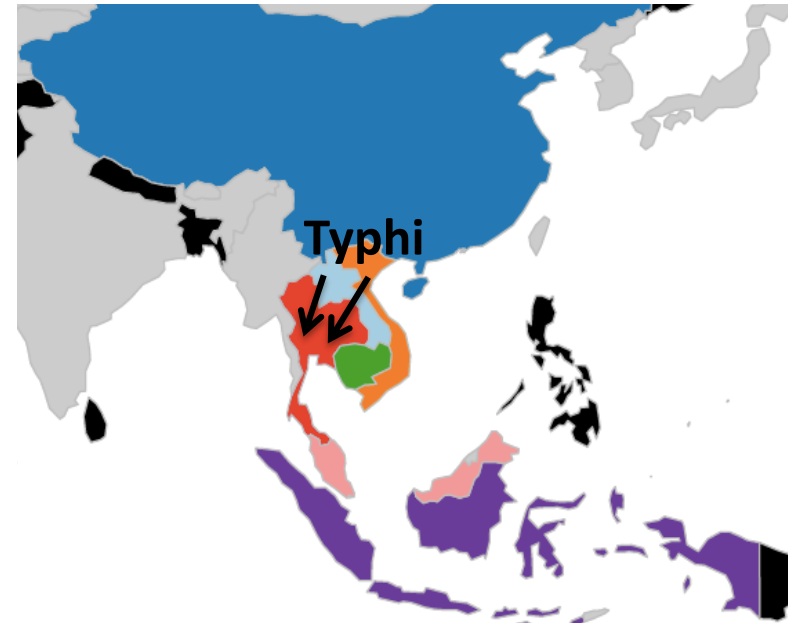
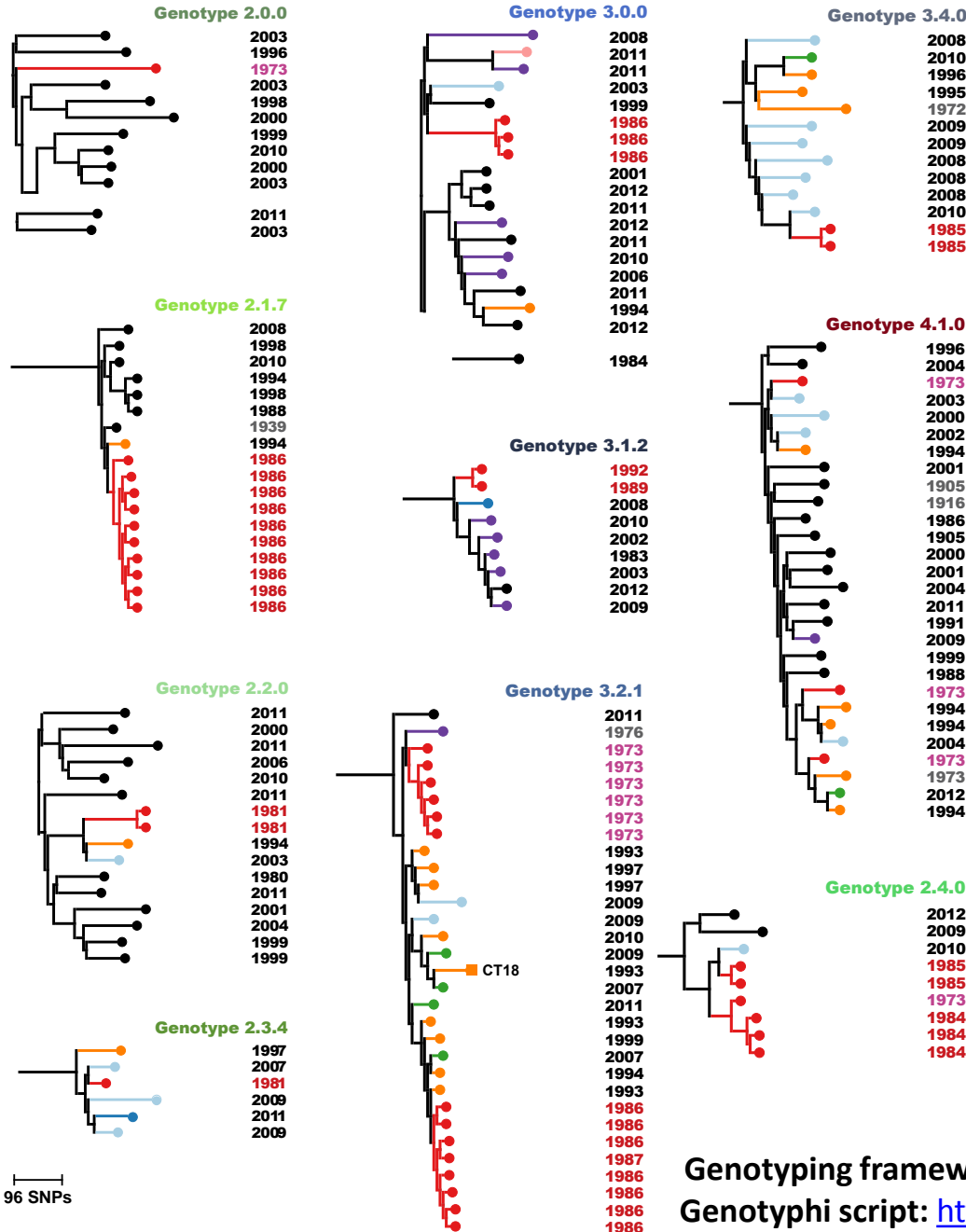
Pre-vaccine | Post-vaccine



Genotyping framework: Wong et al 2016, Nat Comms 7
 Genotypi script: <http://github.com/katholt/genotypi/>



Post-vaccine Typhi from neighboring countries

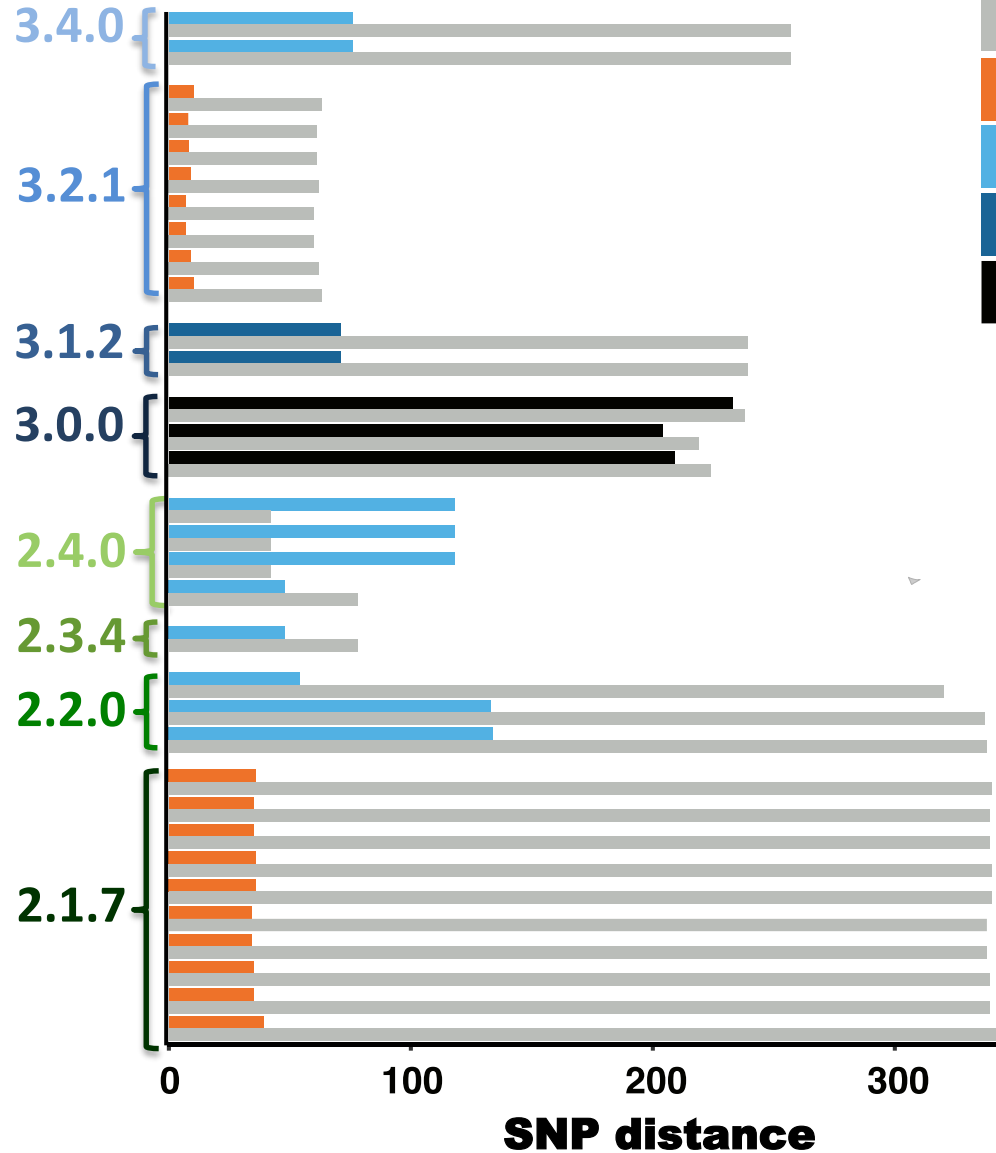


Genotyping framework: Wong et al 2016, Nat Comms 7
 Genotyphi script: <http://github.com/katholt/genotyphi/>

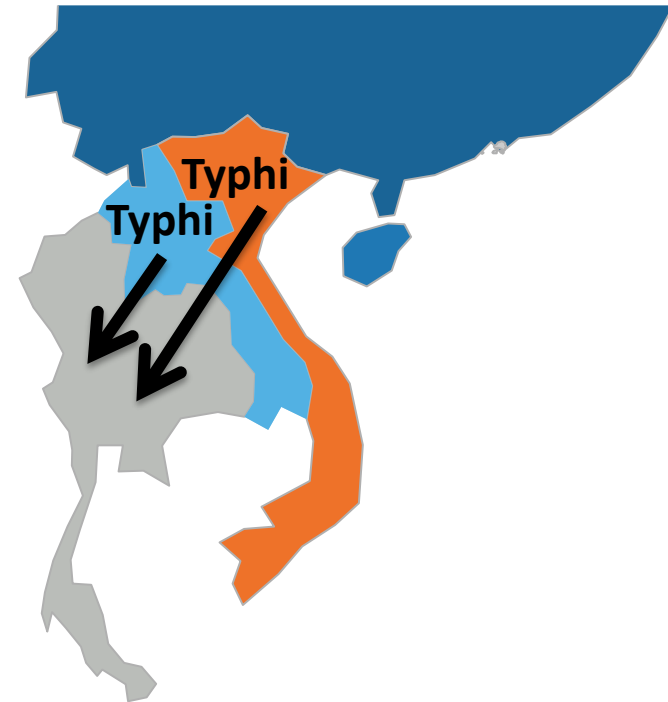
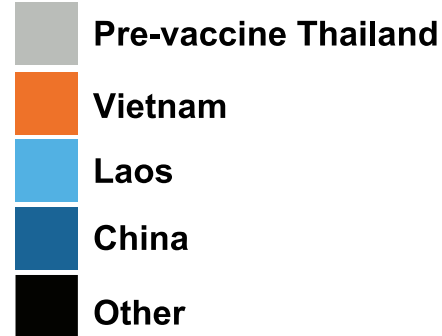


Post-vaccine Typhi from neighboring countries

Post-vaccine isolate

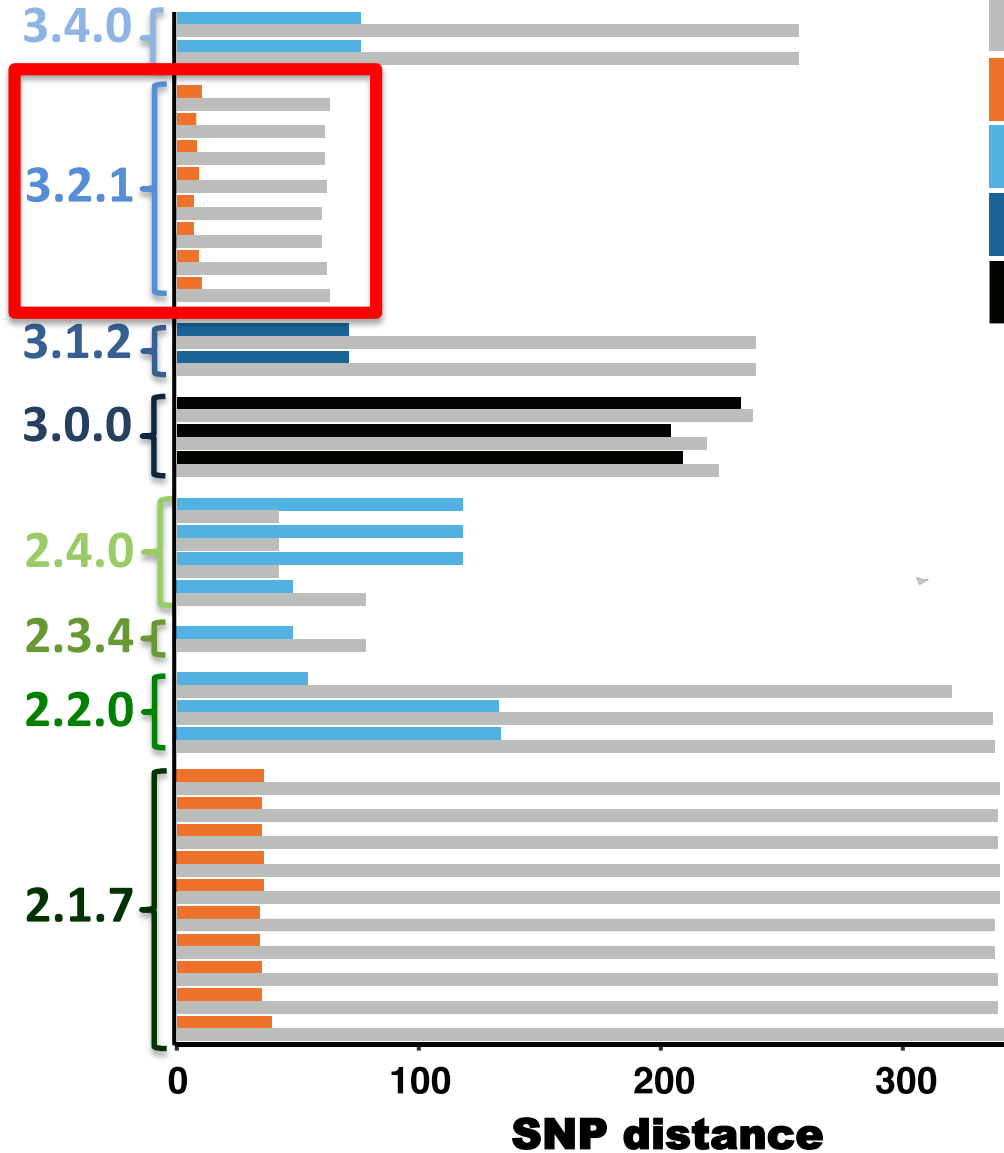


Source Country

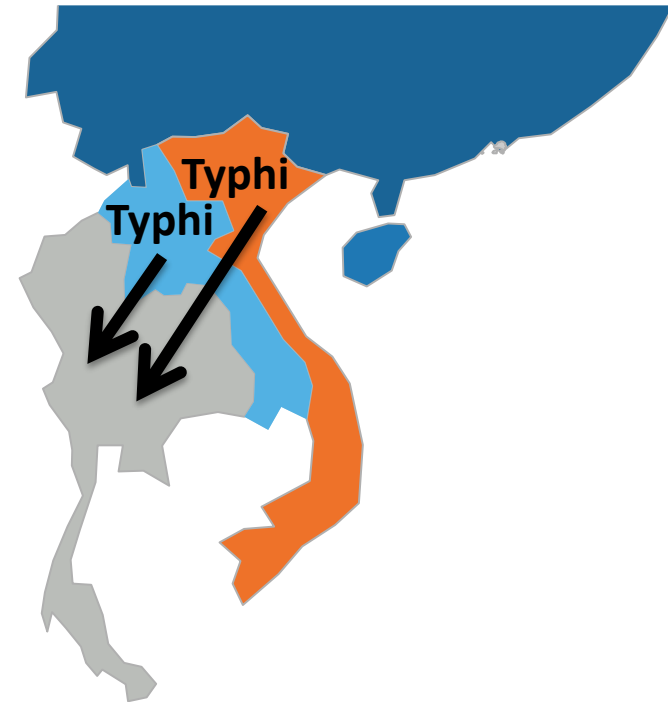
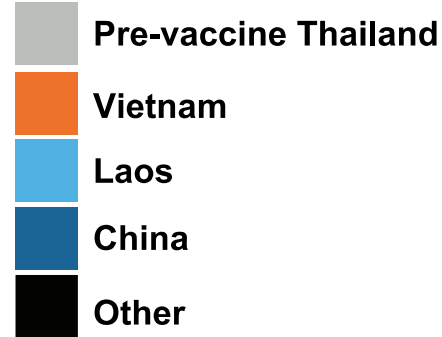


Post-vaccine Typhi from neighboring countries

Post-vaccine isolate

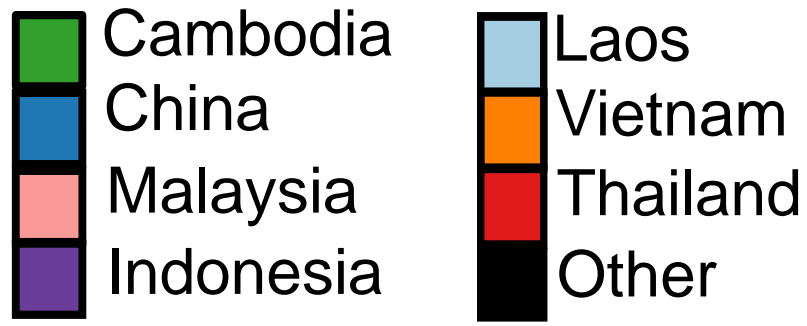
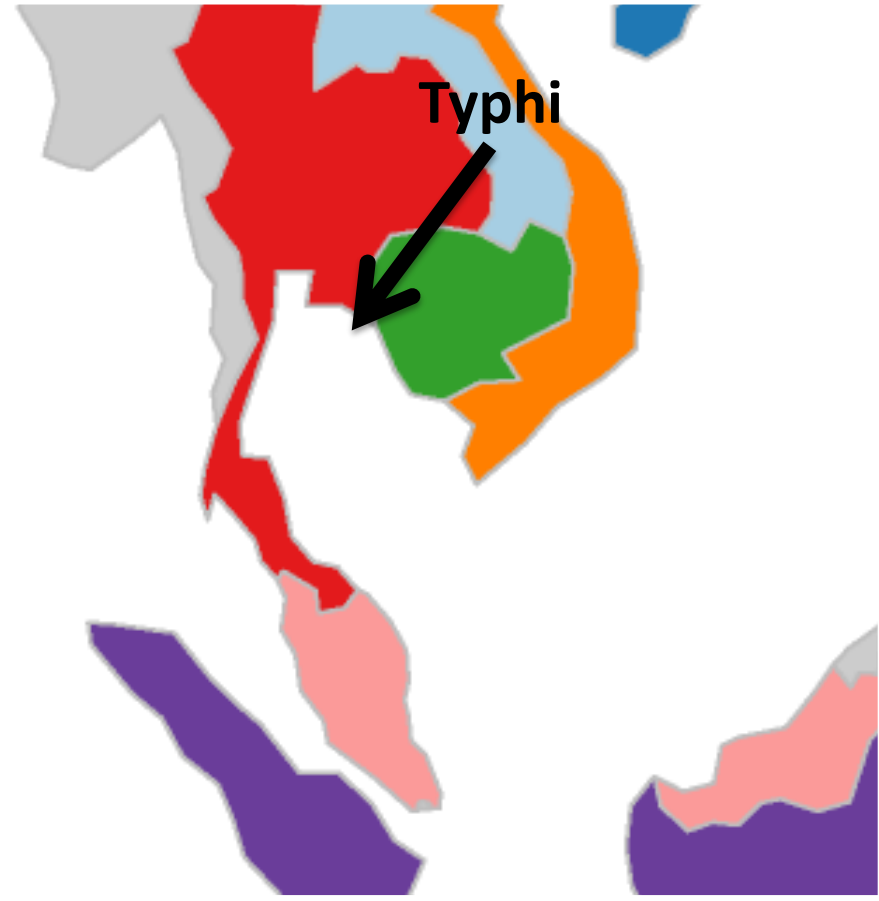
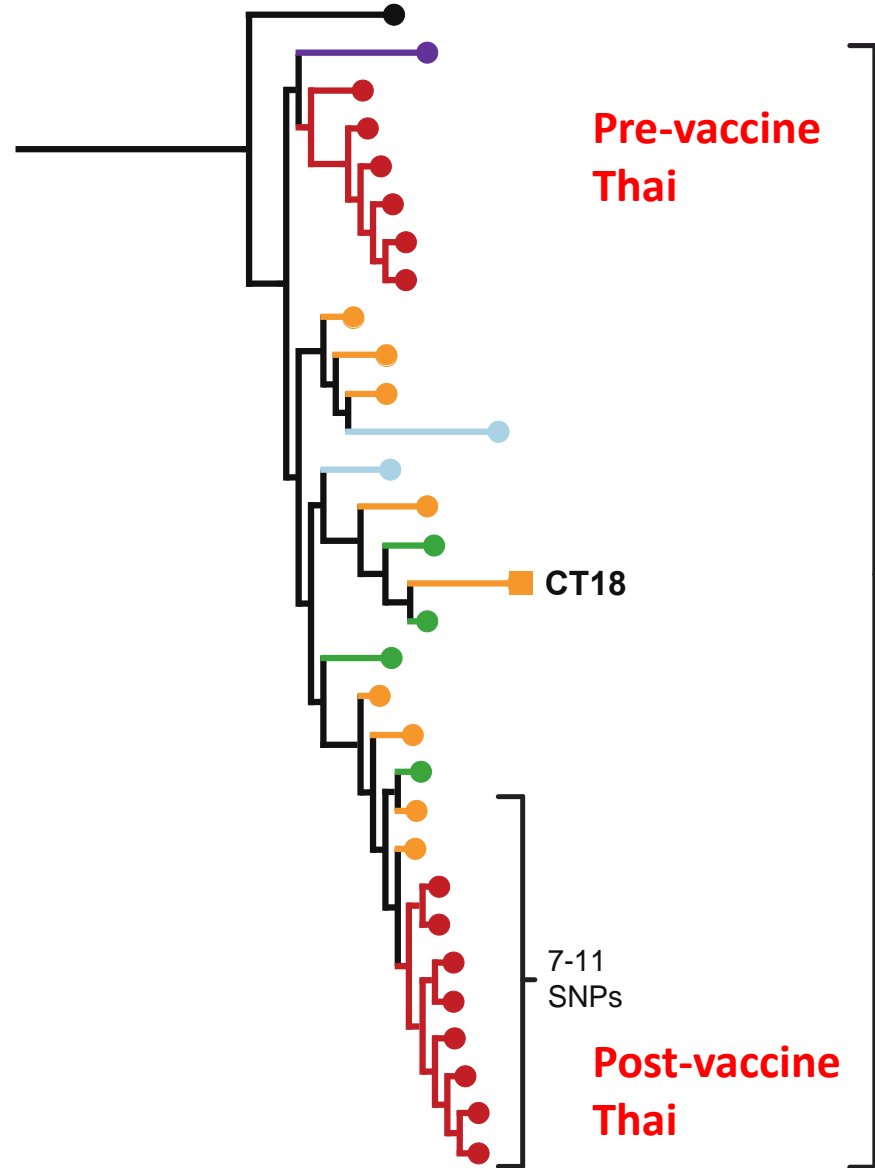


Source Country



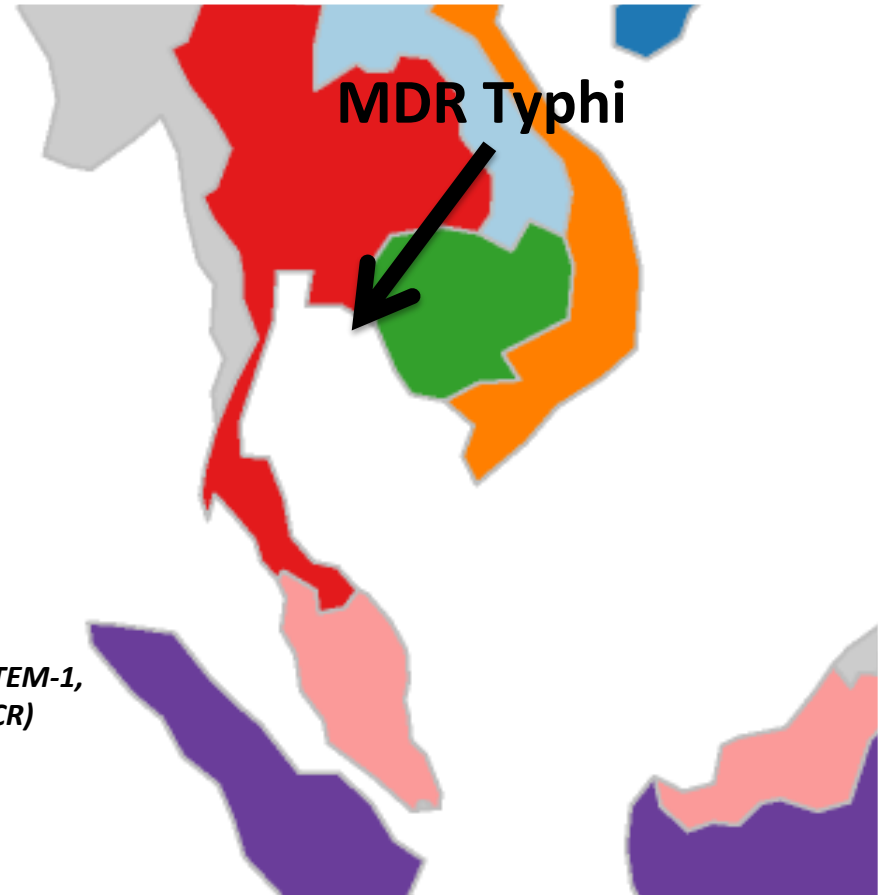
Post-vaccine 3.2.1 from Vietnam

Genotype 3.2.1



MDR Typhi in Thailand from Vietnam

Genotype 3.2.1

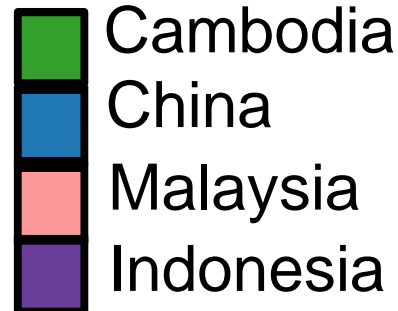


MDR Typhi

CT18 IncHI1: *dhfr1b*, *cat1*, *blaTEM-1*,
sul2, *strAB*, *tet(ACR)*

IncHI1: *aadA1*, *catA1*, *sul2*, *tet(B)*
IncHI1: *aadA1*, *catA1*, *sul2*, *tet(B)*

IncHI1: *aadA1*, *catA1*, *sul2*, *tet(B)*
IncHI1: *aadA1*, *catA1*, *sul2*, *tet(B)*



Conclusions and future work

- **Vaccination program was highly effective**
 - Elimination of endemic Typhi in Thailand
 - Later cases (post-vaccine) and resistance plasmid from sporadic introduction of common Typhi genotypes circulating in South East Asia
- **Large-scale typhoid immunization programs in endemic areas could result in lasting local disease elimination**
- **Useful framework for using genetic epidemiology to monitor the impact of Typhoid fever control measures**

Acknowledgements

Holt Research Group

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Publication:

Dyson et al 2017, PLoS NTDs, 11(1): e0005274

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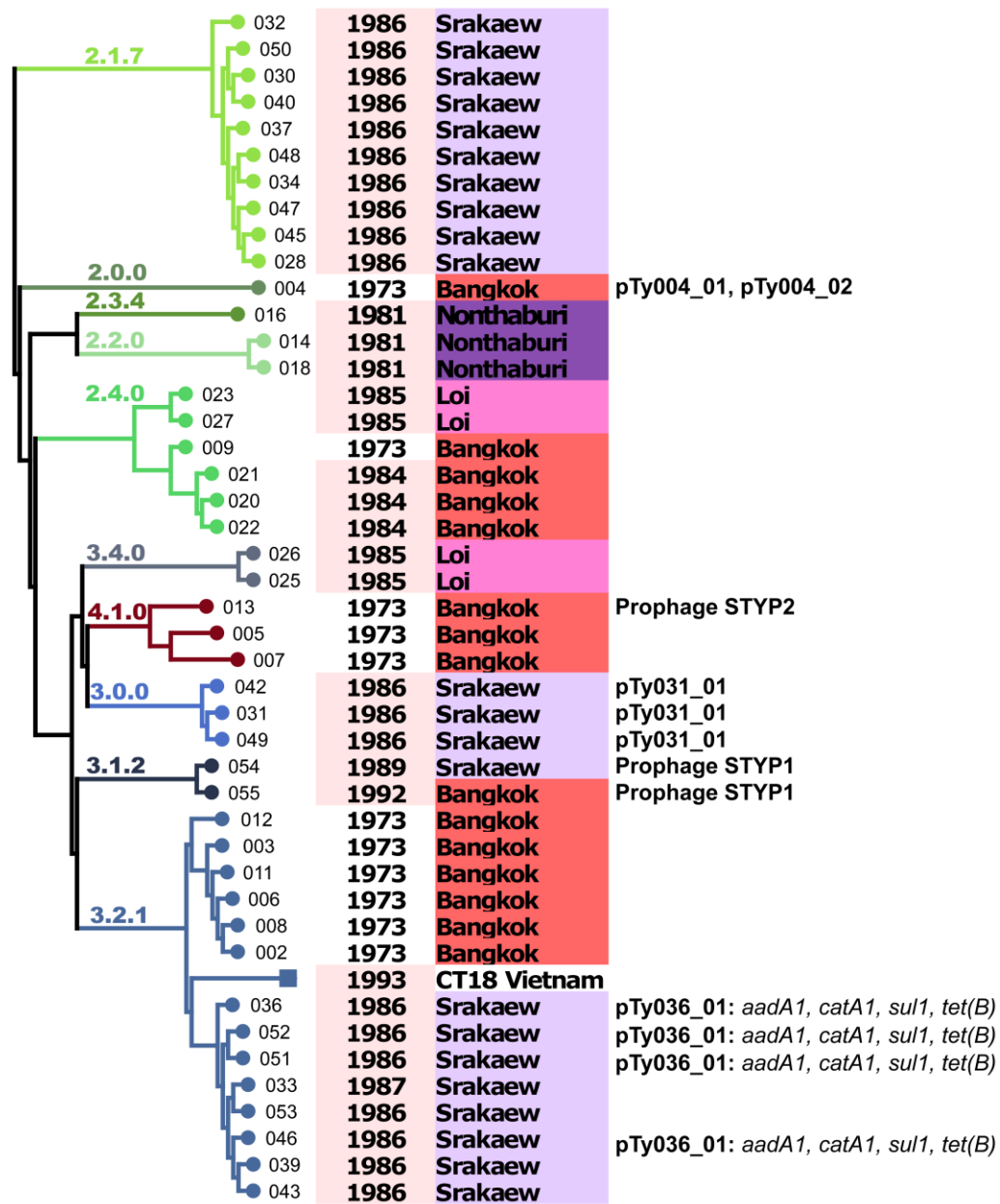
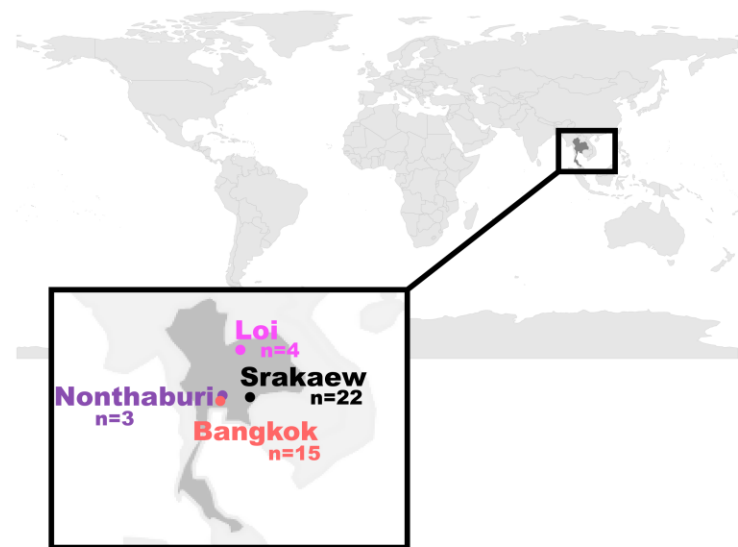
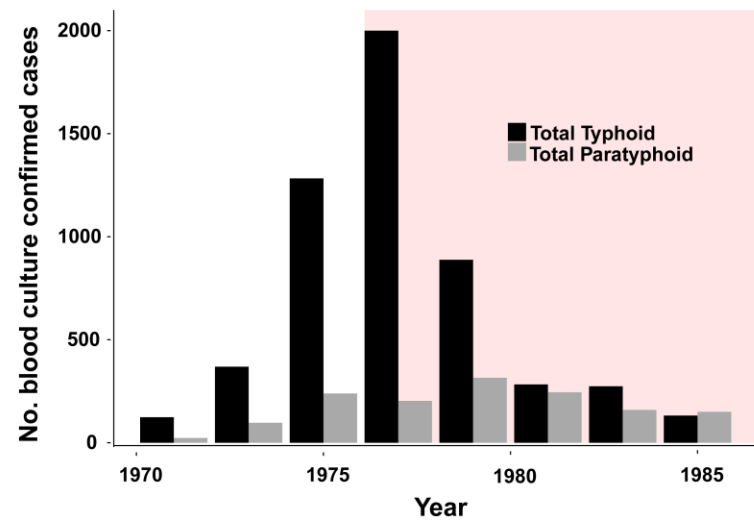
Research Fellow

Holt Research Group,

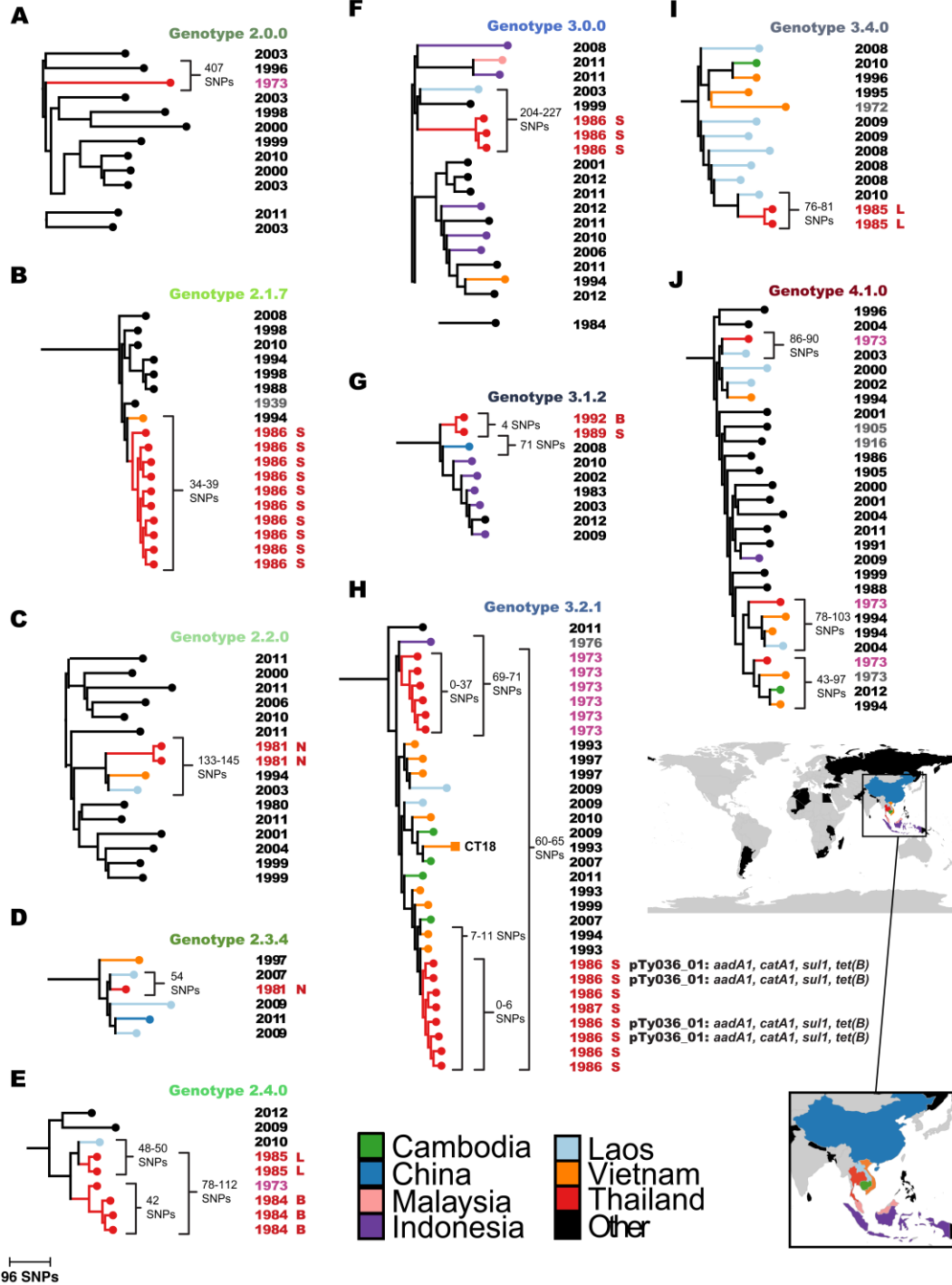
University of Melbourne

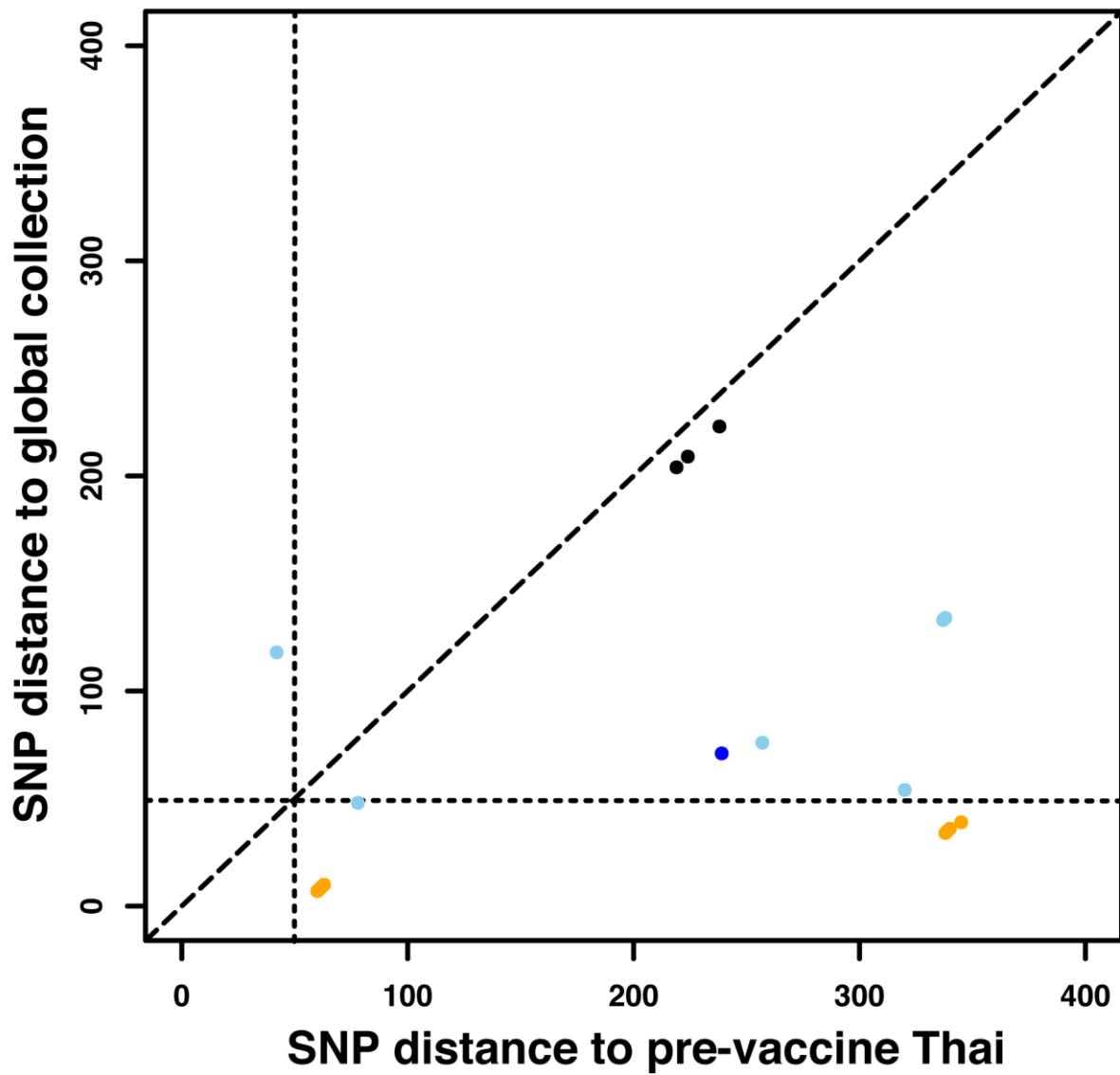
Australia



A**B****C**

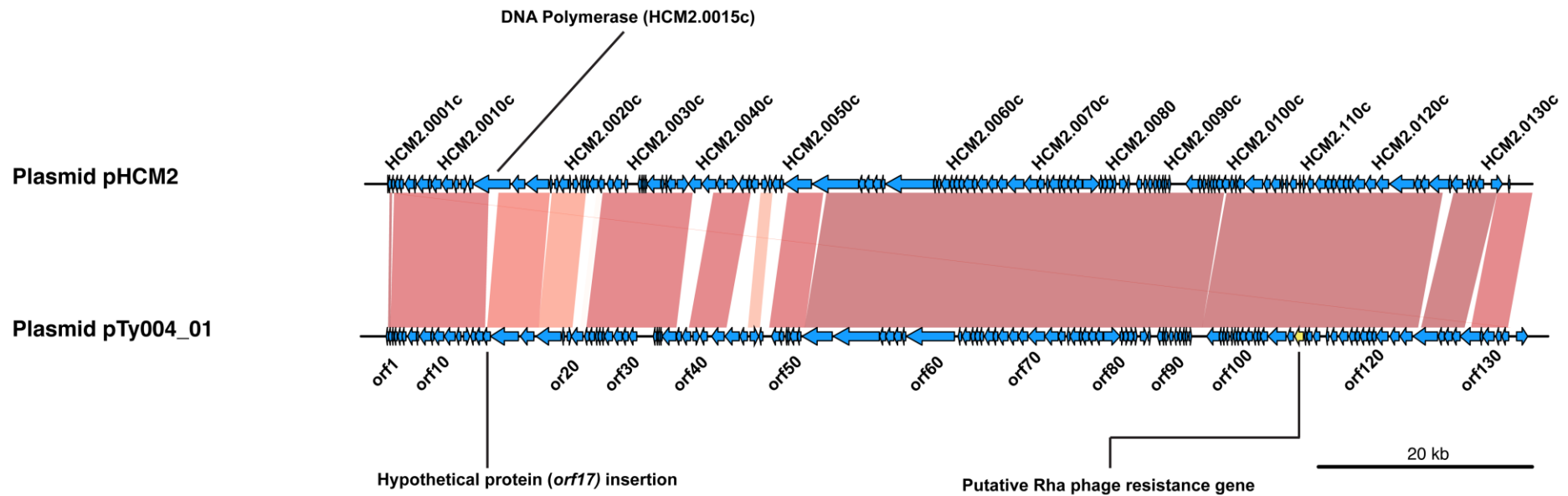
87 SNPs

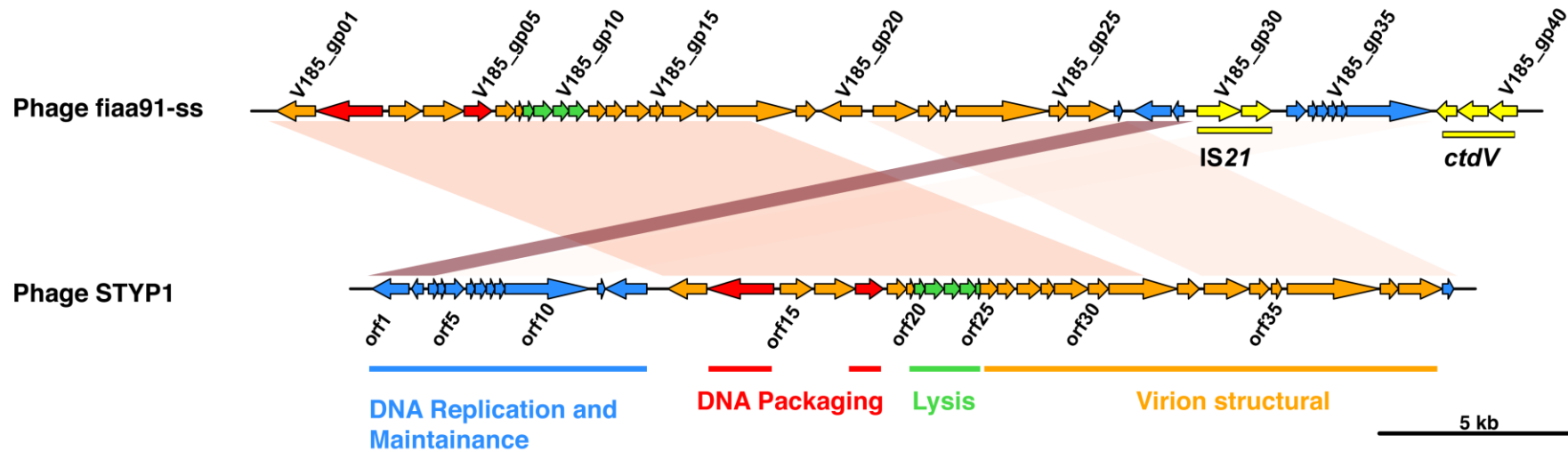
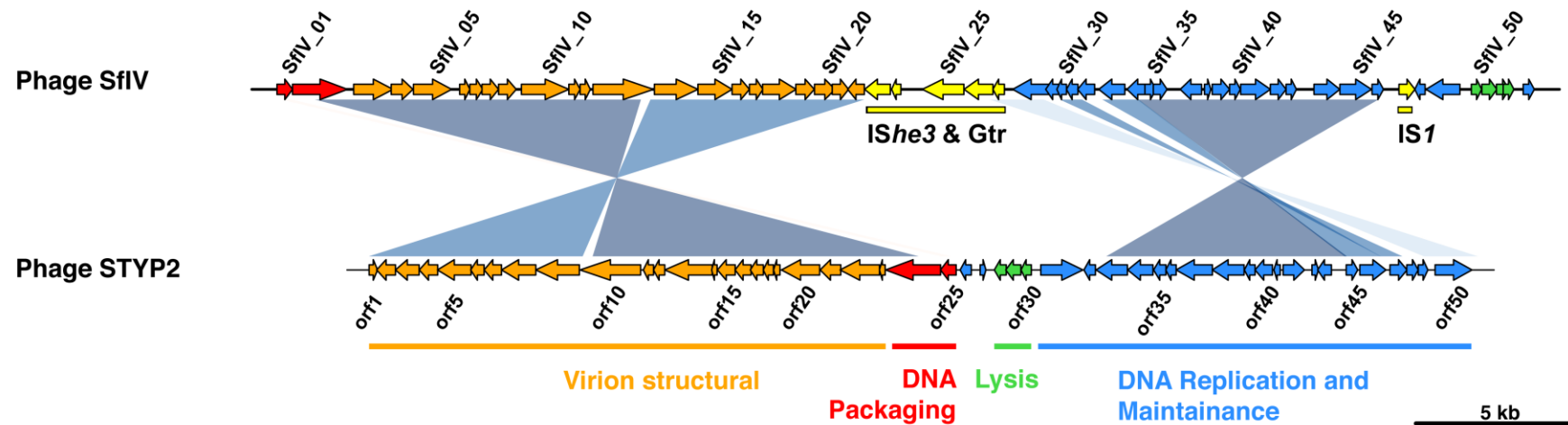




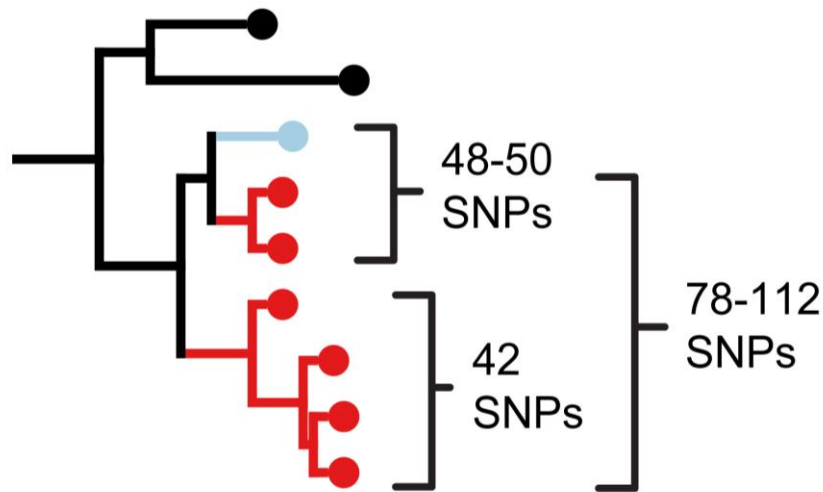
Global collection source country

- Vietnam
- Laos
- China
- Other



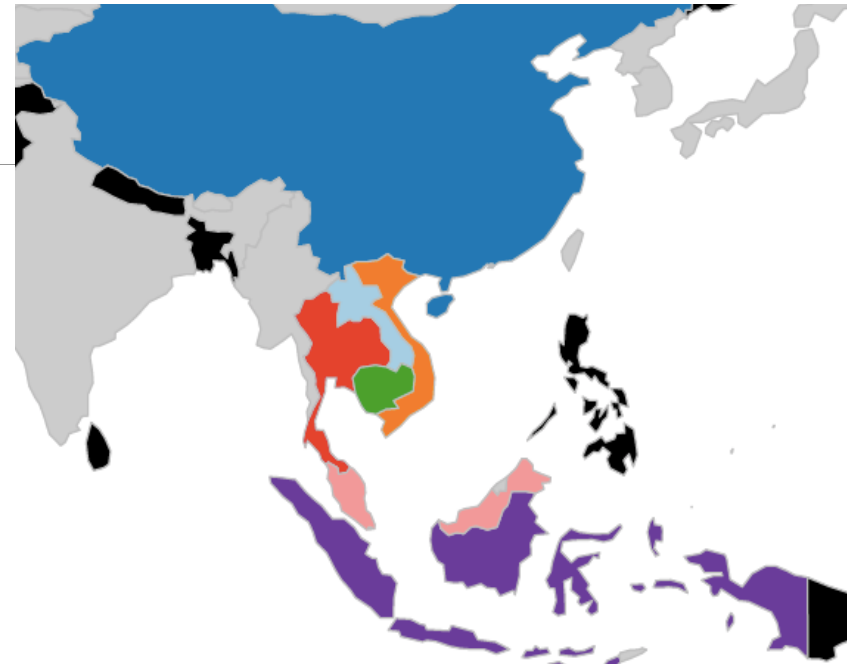
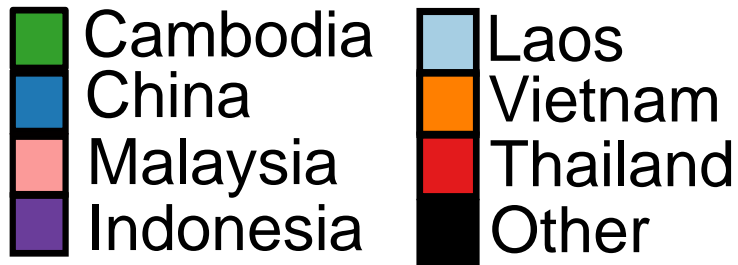
A**B**

Genotype 2.4.0

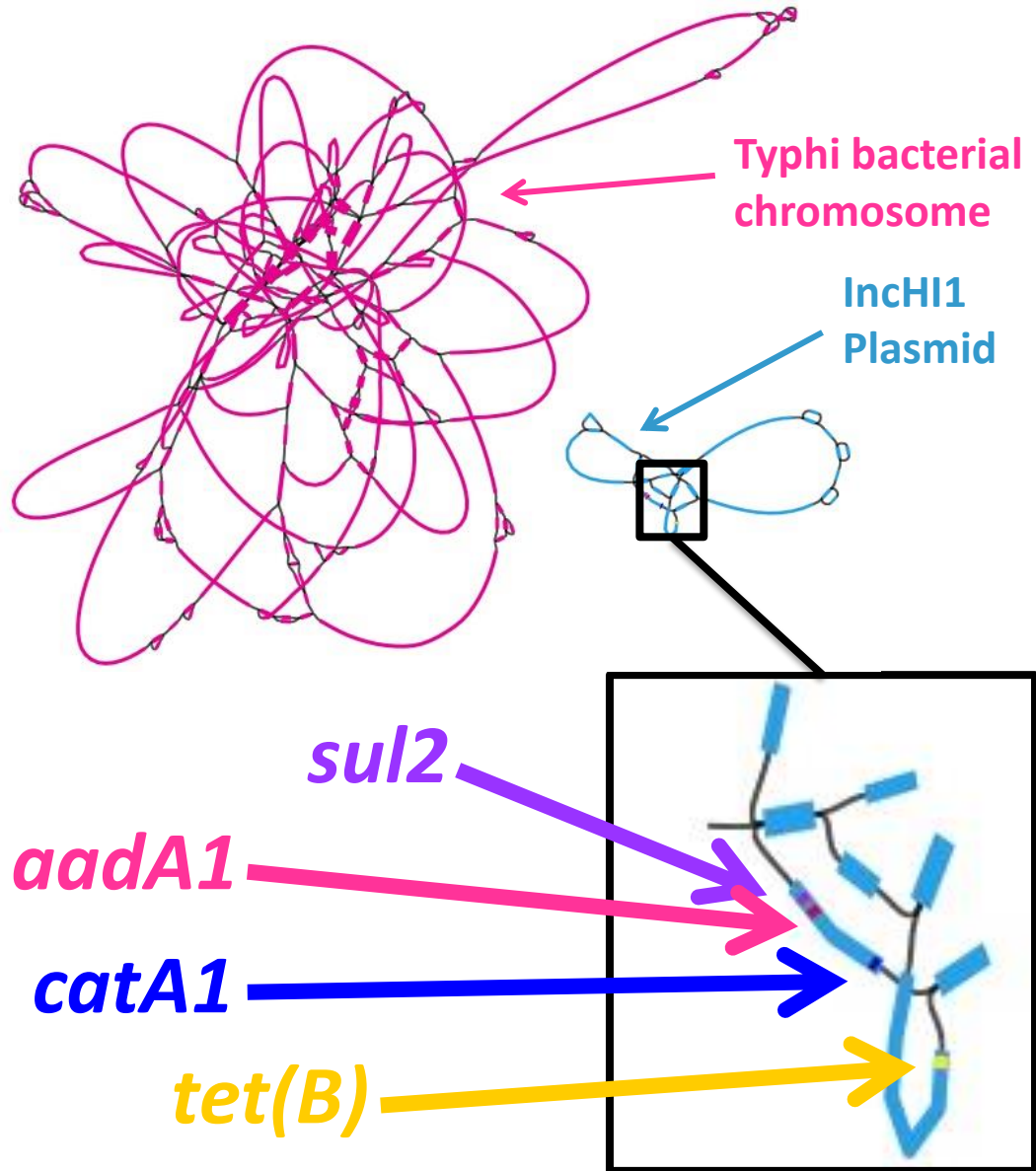


2012
2009
2010
1985 L
1985 L
1973
1984 B
1984 B
1984 B

96 SNPs



4 post-vaccine 3.2.1 have IncHI1 MDR Plasmid



- Resistance genes carried on plasmid – PST2
- Related to IncHI1 plasmid from Vietnam (1993)

