Examining Treatment Strategies for Cholera Incorporating Spatial Dynamics

Group: Plague Doctors
Jessa Mallare, Sid Reed, Daniel Segura, Aref Jadda

McMaster University

Instructor: Dr. David Earn

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Introduction

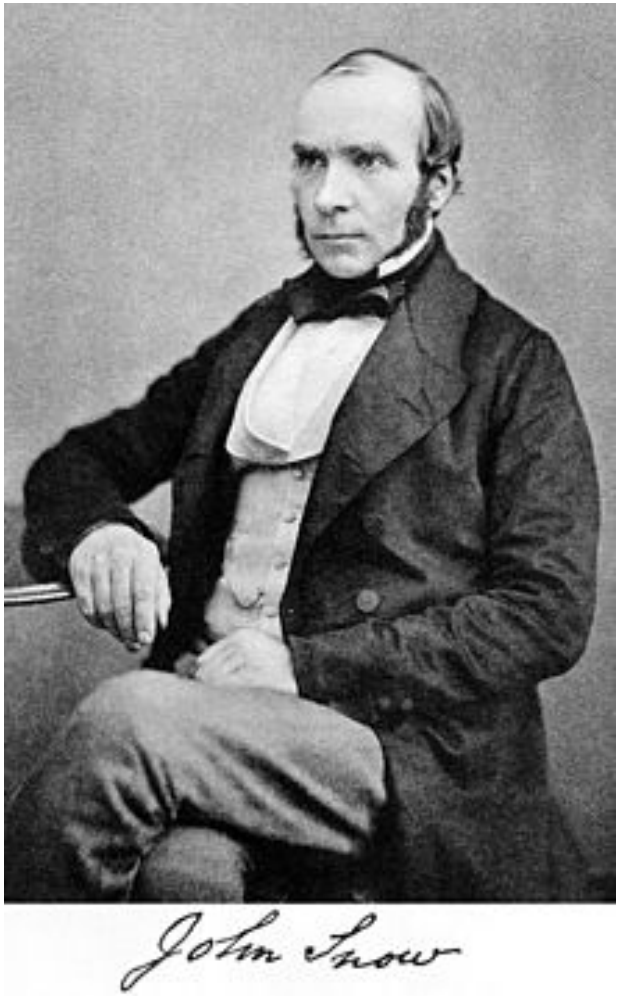
- Treatments have not always gone as planned in history
- Cholera

Some Biology on Cholera

- Vibrio cholerae
- Colonize small intestines
- 10
- Causes dehydration

Outbreaks in London (19^{th} Century)

- 1832, 1849, 1854, 1866
- Miasma Theory
- John Snow



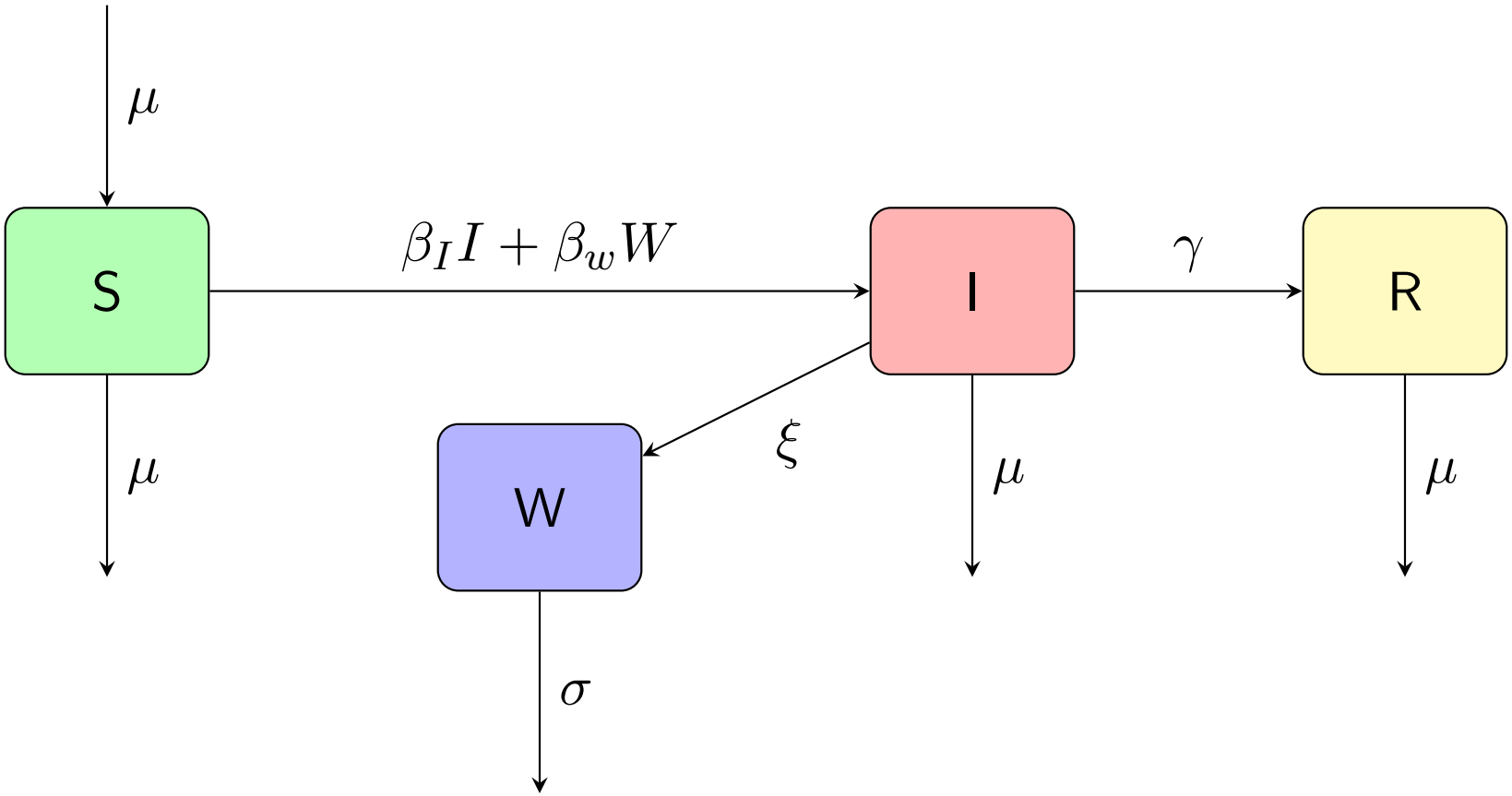
Single-Patch Model

- Entire population (N) included
- 3 Compartments : S, I, R
- Compartment values are proportional
- Environment (Water)

SIRW Model Assumptions

- Birth Rate = Natural Death Rate and is constant
- Homogenous susceptibility to cholera across population
- No waning immunity
- No latency period
- Only infected individuals can infect the water sources
- Water source is still

SIRW Model



SIWR Model Phase Portrait

R_0 Calculation

Equilibria and Stability

Final Size

Effect of the 19th Century Treatments

Multi-Patch Model

Multi-Patch Model Assumptions

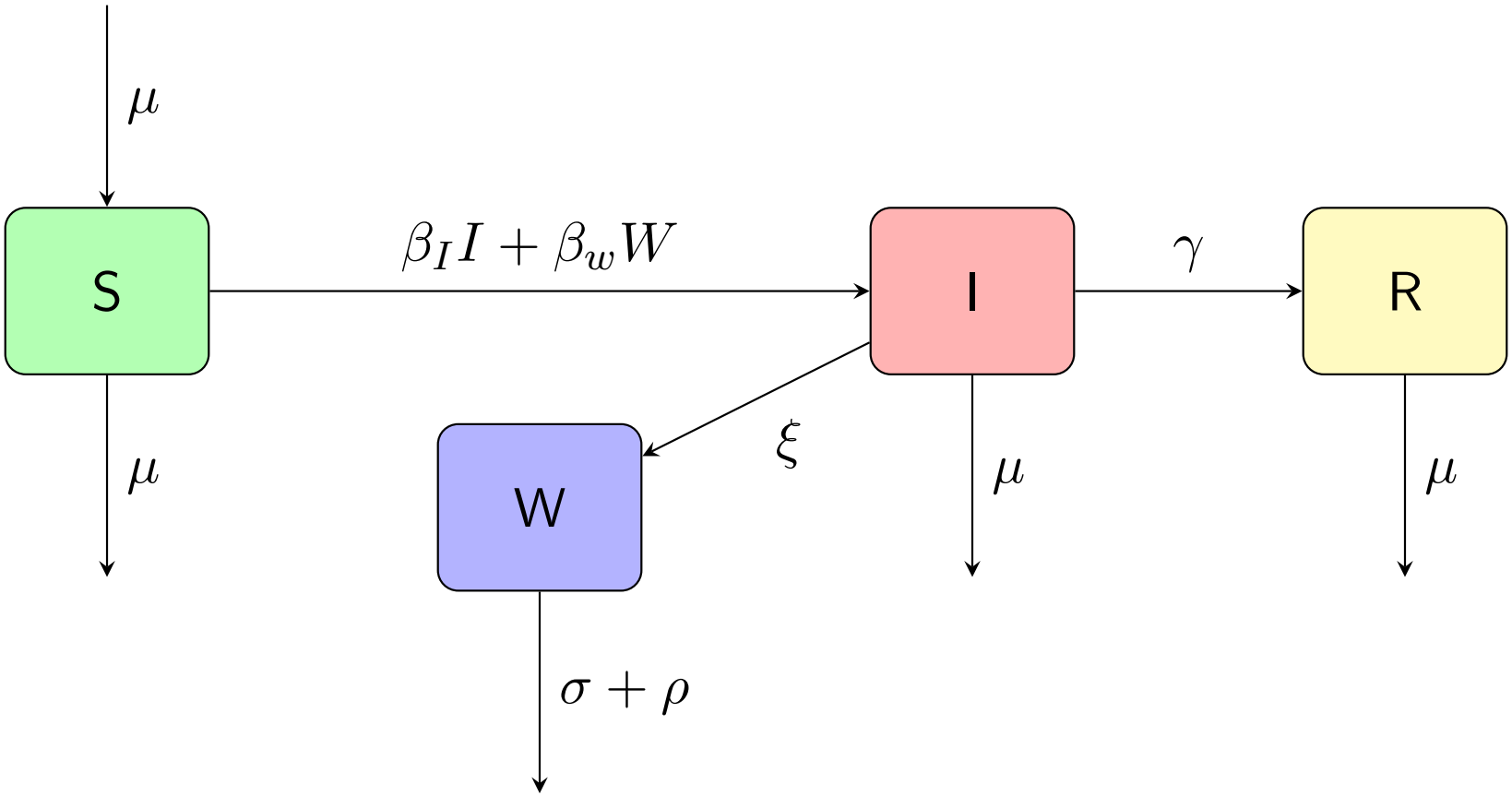
- No dispersal of individuals
- Infected individuals can infect the susceptible in neighboring patches
- All patches neighbouring i have the same transmission rate to patch i

Multi-Patch Model Simulation

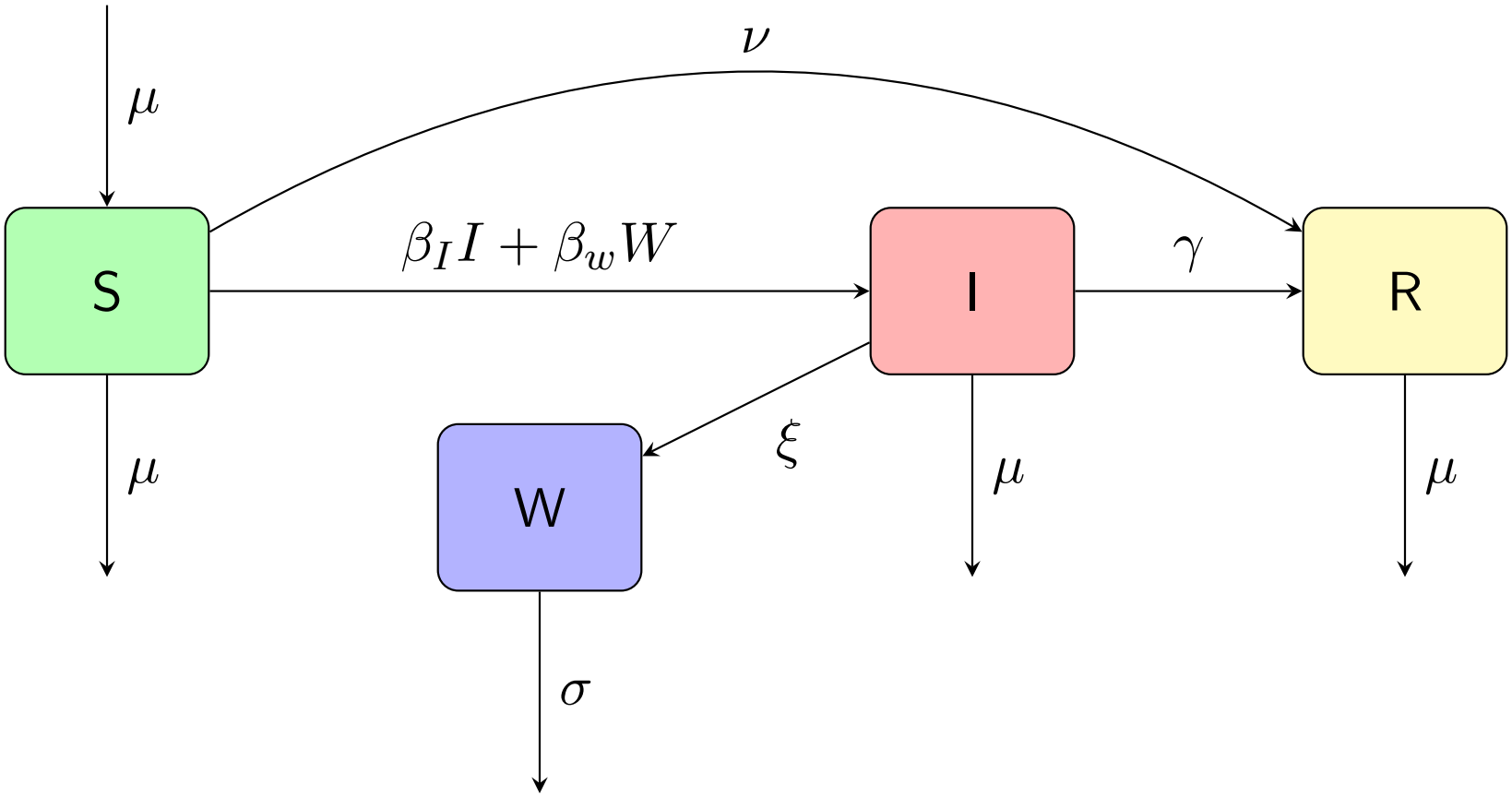
Treatment Strategies For Cholera

1. Sanitation of Water
2. Vaccinations
3. Antibiotics

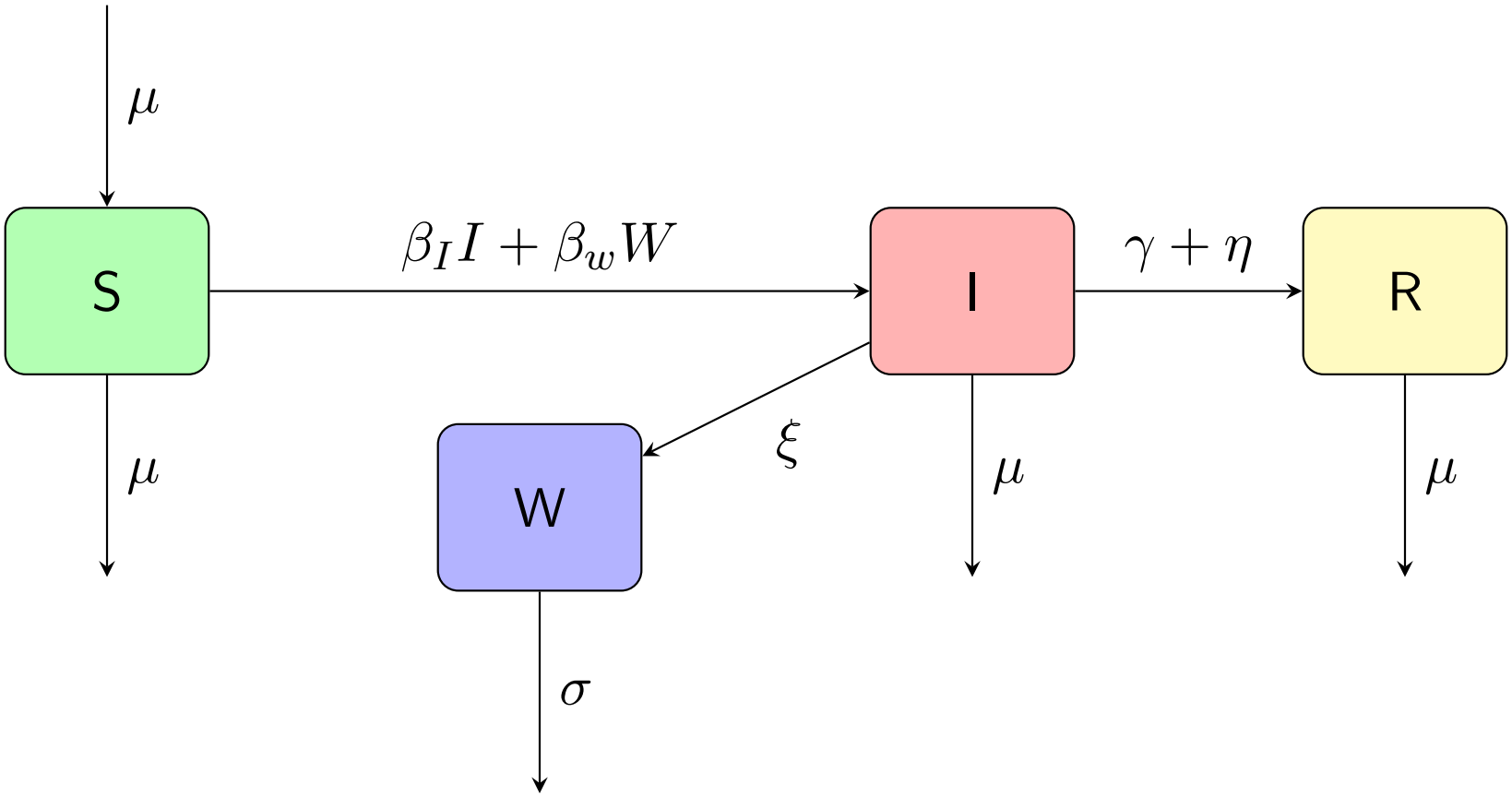
Sanitation of Water



Vaccinations



Antibiotics



Comparing the Treatment Strategies

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Conclusions and Further Research

- 19th century outbreaks
- Significance of the using multi-patch model
- Our treatment simulations suggest...
- Further research on the spread of water borne diseases like cholera can be done in areas like...

Thank you!