Swiss TPH
Swiss Tropical and Public Health Institute
Schweizerisches Tropen- und Public Health-Institut
Institut Tropical et de Santé Publique Suisse

Associated Institute of the University of Basel

Department of Epidemiology and Public Health
Infectious Disease Modelling Unit

Opisthorchis viverrini Transmission Models

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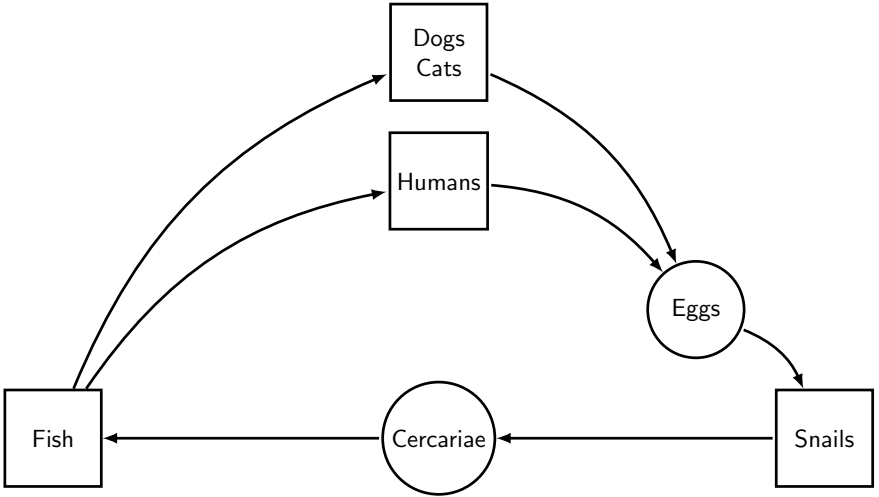
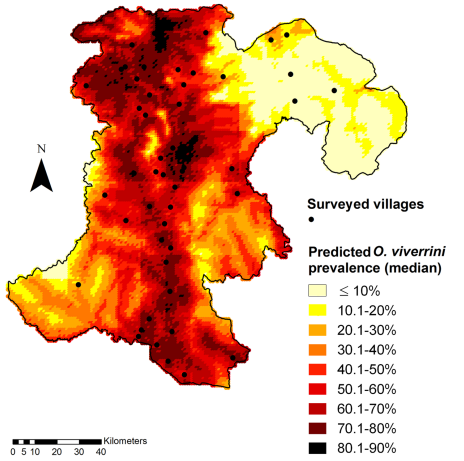
Swiss TPH Winter Symposium 2017
Helminth Infection – from Transmission to Control
Basel, Switzerland, 8 December 2017

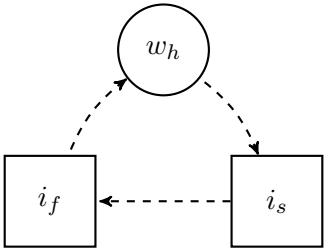

Dogs
Cats
Humans
Eggs
Fish
Cercariae
Snails

O. viverrini in South East Asia

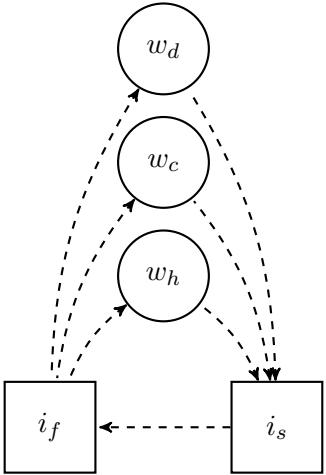


Forrer *et al.* (2012)

Basic Model



Reservoir Host Model



The basic reproduction number R_0 is the average number of new cases of an infection (or number of parasite offspring) caused by one typical infected individual (or one parasite), from one generation to the next, in a population with no pre-existing infections.

Type-reproduction numbers provide a threshold for whether certain host types can maintain transmission on their own.

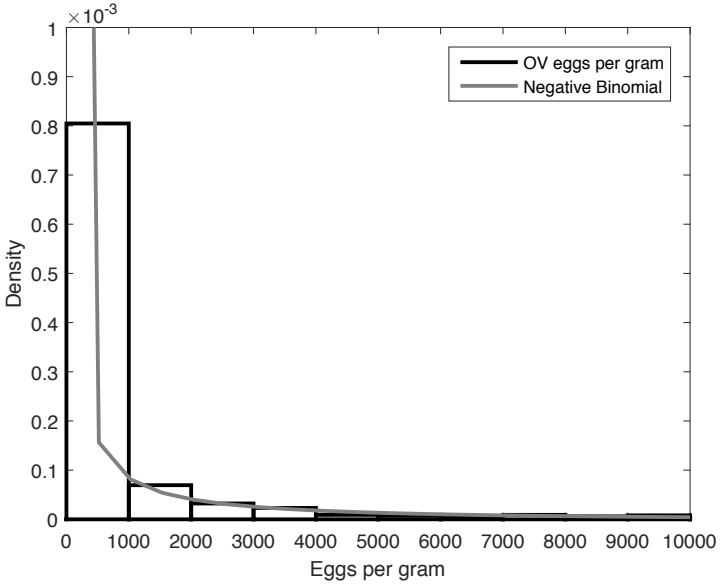
- U_i is the host-specific type reproduction number.
- Q_i is the host-excluded type reproduction number.

Data from Southern Champasack Province

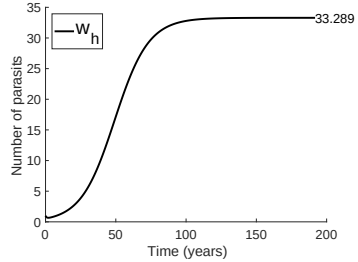
Species	Tested	Positive	Prevalence
Humans:	994	603	61%
Dogs:	68	17	25%
Cats:	64	34	53%
Fish:	628	129	21%
Snails:	3102	9	0.29%

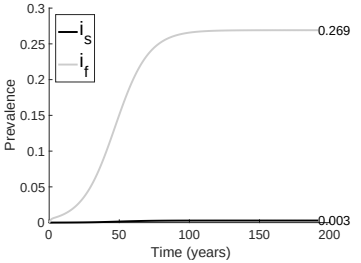
Vonghachack *et al.* (Submitted)

Data on Intensity of Infection in Humans

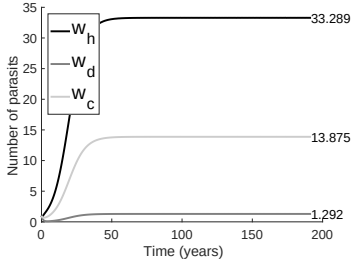


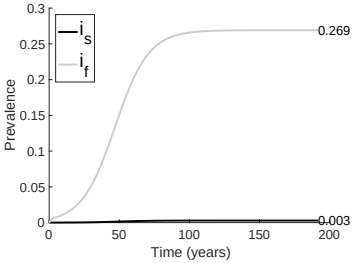
Basic Model



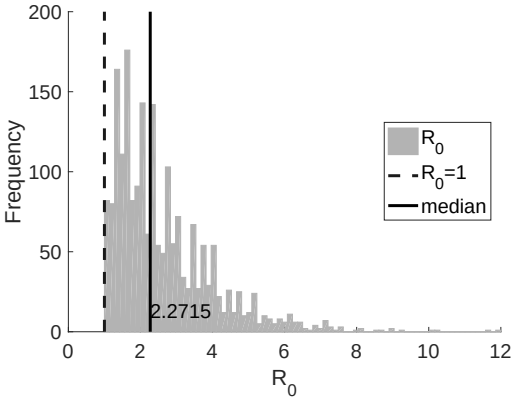


Reservoir Host Model

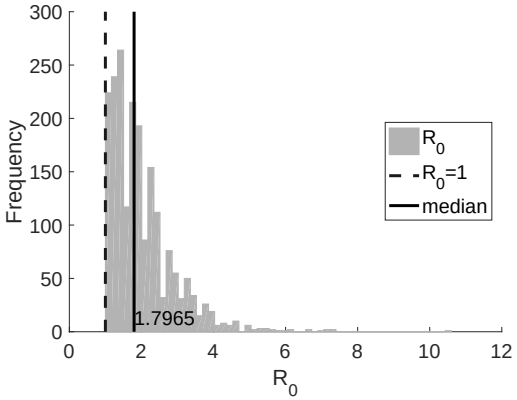




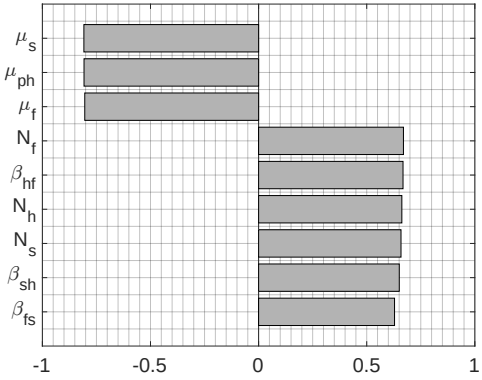
Basic Model



Reservoir Host Model

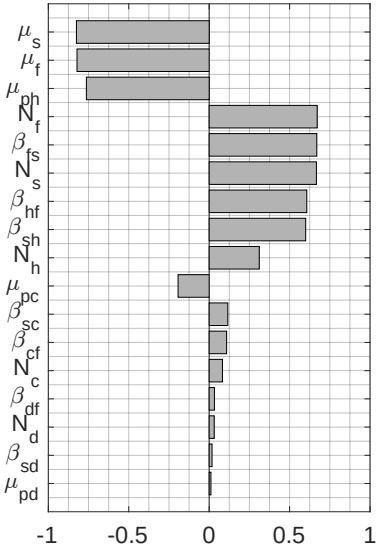


Basic Model



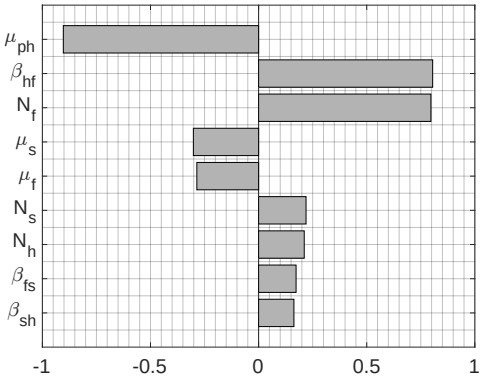
Parameter Descriptions

Reservoir Host Model

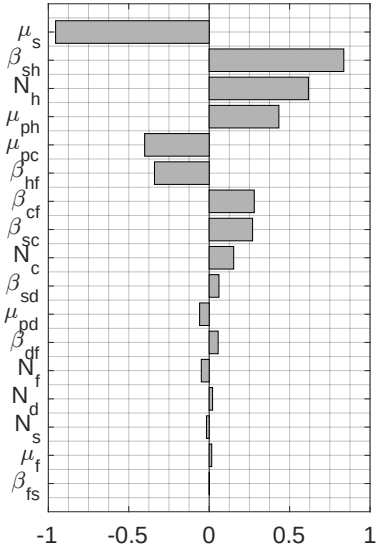


Swiss TPH

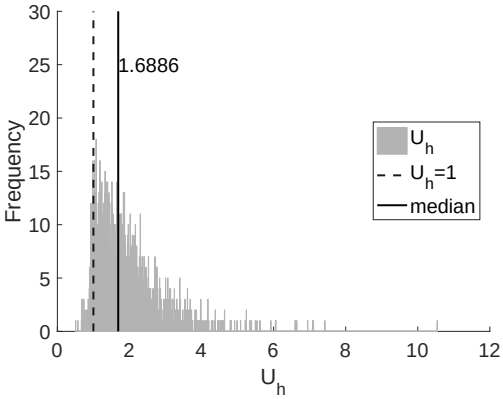
Basic Model



Reservoir Host Model

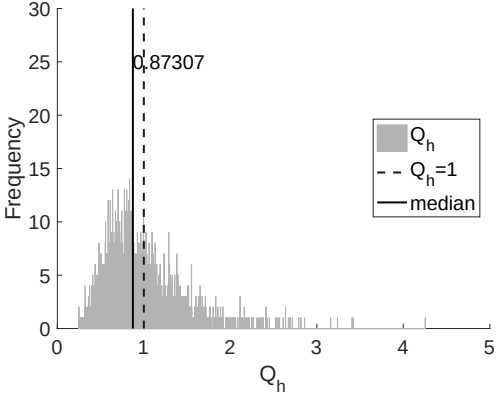


Only Human Transmission



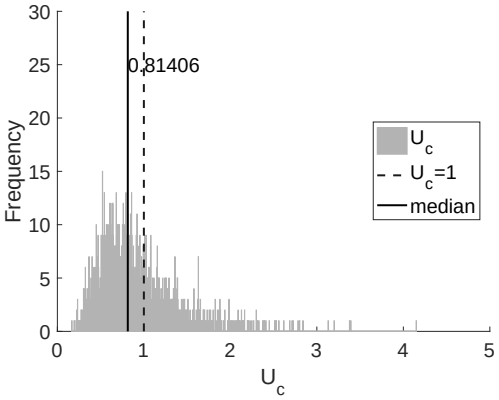
$$\mathbb{P}(U_h > 1) = 0.92$$

No Human Transmission



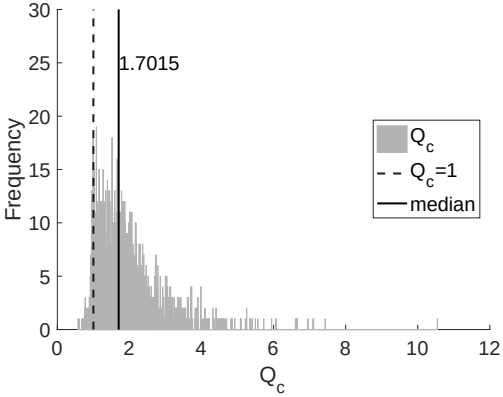
$$\mathbb{P}(Q_h > 1) = 0.38$$

Only Cat Transmission



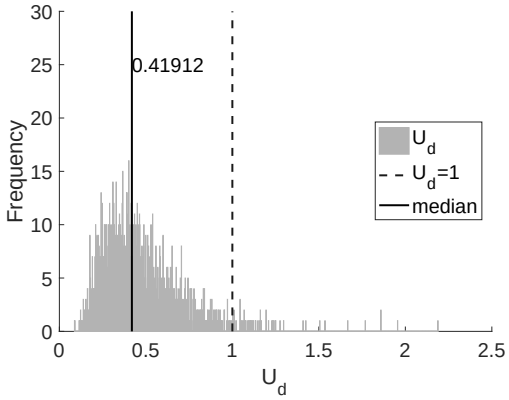
$$\mathbb{P}(U_c > 1) = 0.33$$

No Cat Transmission



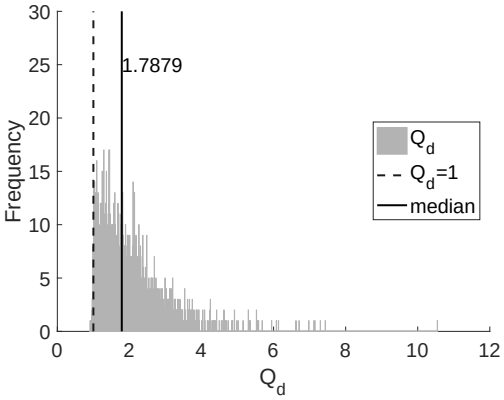
$$\mathbb{P}(Q_c > 1) = 0.94$$

Only Dog Transmission

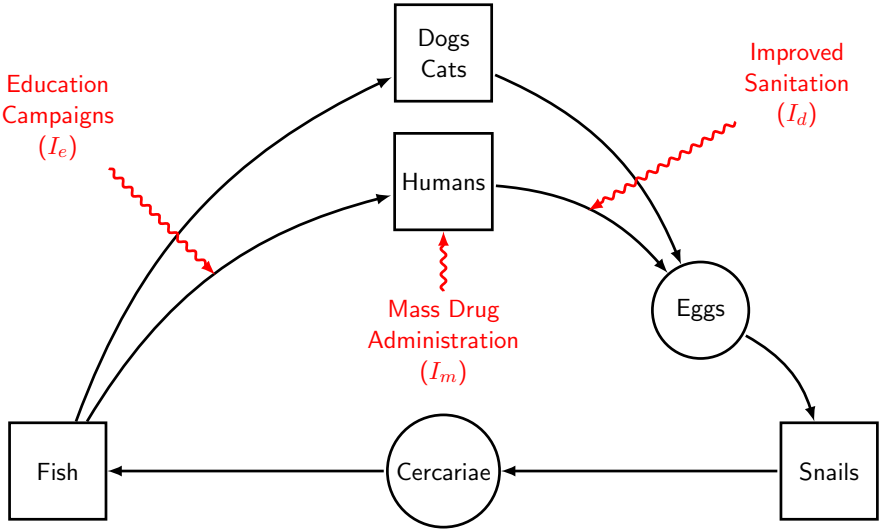


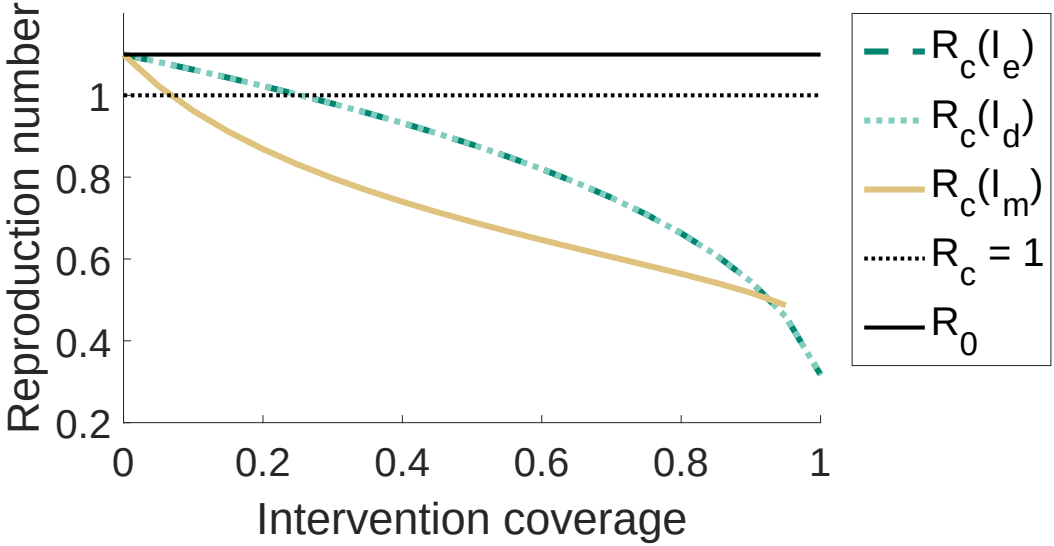
$$\mathbb{P}(U_d > 1) = 0.03$$

No Dog Transmission

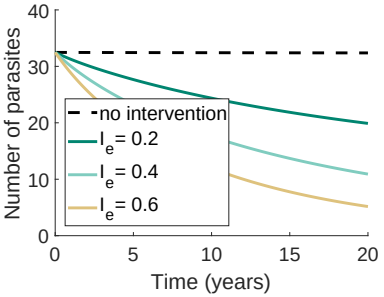


$$\mathbb{P}(Q_d > 1) = 0.99$$

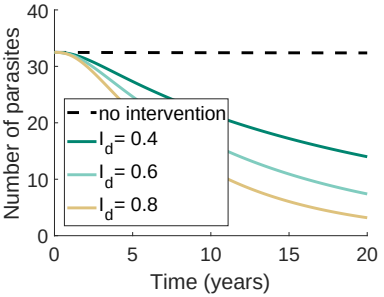

Dogs
Cats
Education
Campaigns
(I_e)
Improved
Sanitation
(I_d)
Humans
Mass Drug
Administration
(I_m)
Eggs
Fish
Cercariae
Snails


Reproduction number
1
0.8
0.6
0.4
0.2
0
0.2
0.4
0.6
0.8
1
Intervention coverage
$R_c(I_e)$
$R_c(I_d)$
$R_c(I_m)$
$R_c = 1$
R_0

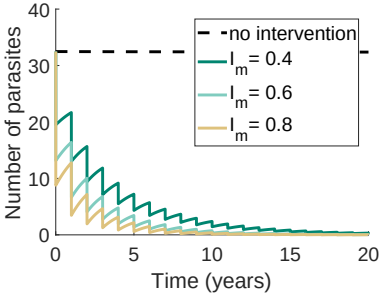
Education Campaigns

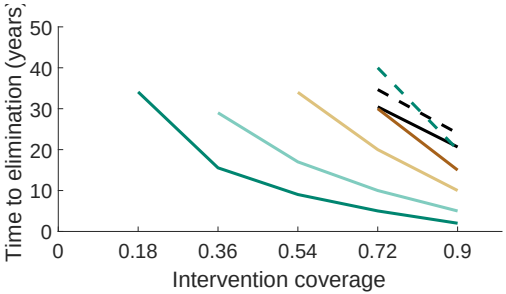


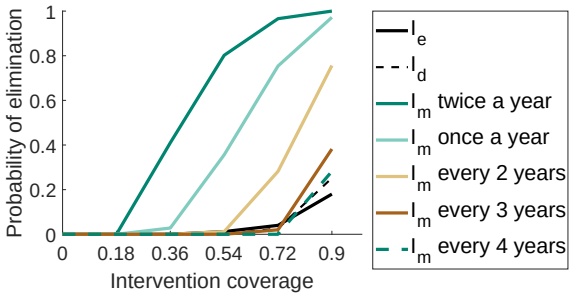
Improved Sanitation



Annual Treatment




Time to elimination (years)
50
40
30
20
10
0
0
0.18
0.36
0.54
0.72
0.9
Intervention coverage


Probability of elimination
1
0.8
0.6
0.4
0.2
0
0
0.18
0.36
0.54
0.72
0.9
Intervention coverage
I_e
I_d
I_m twice a year
I_m once a year
I_m every 2 years
I_m every 3 years
I_m every 4 years

Conclusions

- Transmission is unlikely to persist without humans.
- Humans can maintain transmission on their own.
- Education and improved sanitation require a very high coverage to eliminate.
- Best strategy is a medium coverage of humans with treatment and as high as possible with education campaigns and improved sanitation.

Outlook

- Calibrate model with age-dependence in humans.
- Model seasonality in fish and snail population dynamics.
- Model heterogeneity and morbidity in humans.
- Model intensity of infection in fish.

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Acknowledgements

NIOPH

- Somphou Sayasone
- Youth Vonghachack

Swiss TPH

- Christine Bürli
- Nakul Chitnis
- Peter Odermatt
- Thomas Smith

University of Basel

- Helmut Harbrecht

Funding

- Swiss National Science Foundation