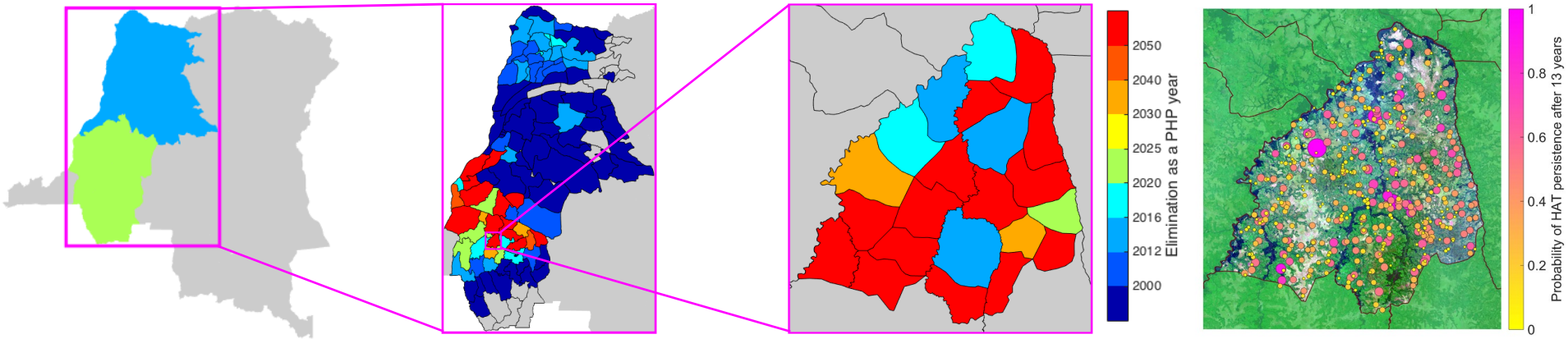
Quantifying transmission dynamics of HAT in a peri-elimination era through mathematical modelling

Kat Rock, Ching-I Huang and Marina Antillon
University of Warwick and Swiss TPH
On behalf of HAT modelling/economics groups in NTD Modelling Consortium and HAT MEPP

Predictive modelling

- **Prediction across scales**: Province, health-zone, health-area, village



- **Fully integrated approach**:

Epidemiology & ecology

Diagnostics & treatment

Inference & prediction

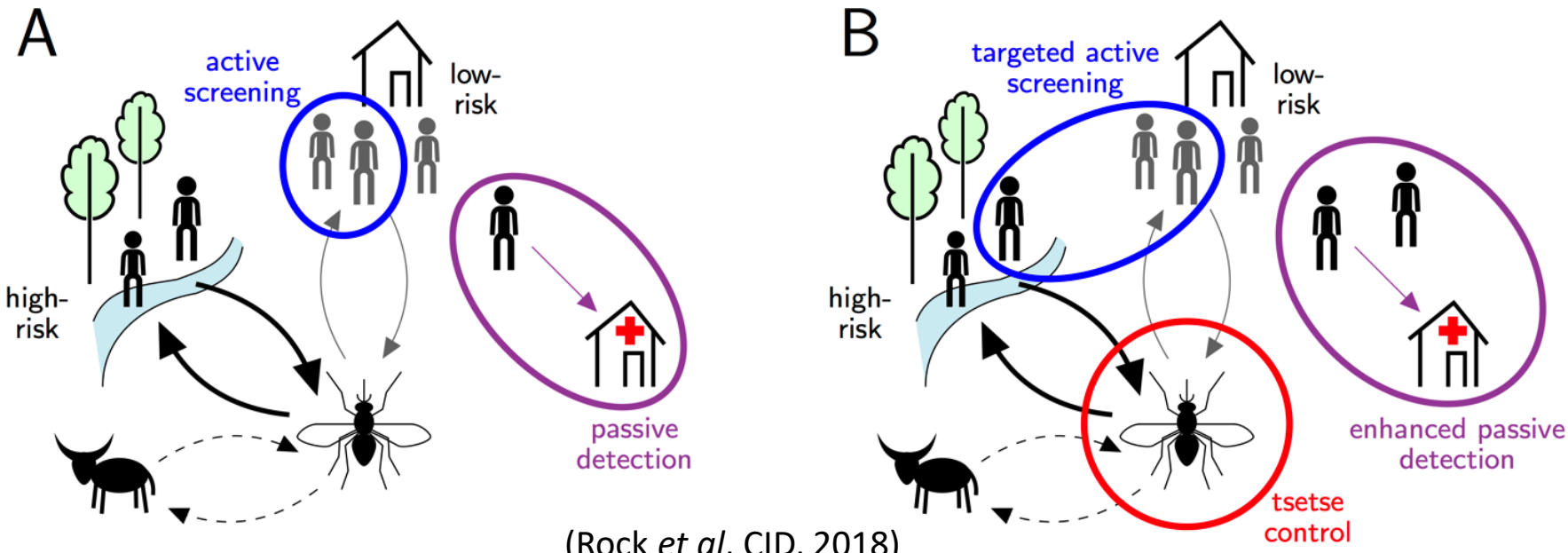
Economics & policy advice

Modelling strategy impact

What impact do the following strategies have on transmission of infection?

- Standard medical interventions: active and passive screening
- Vector control
- *Intensified/targeted active screening (such as a door-to-door strategy)
- *Enhanced passive surveillance (improving access to diagnostics)

*Current these interventions have been simulated but not matched to data



(Rock *et al*, CID, 2018)

Modelling strategy impact

Considered strategies

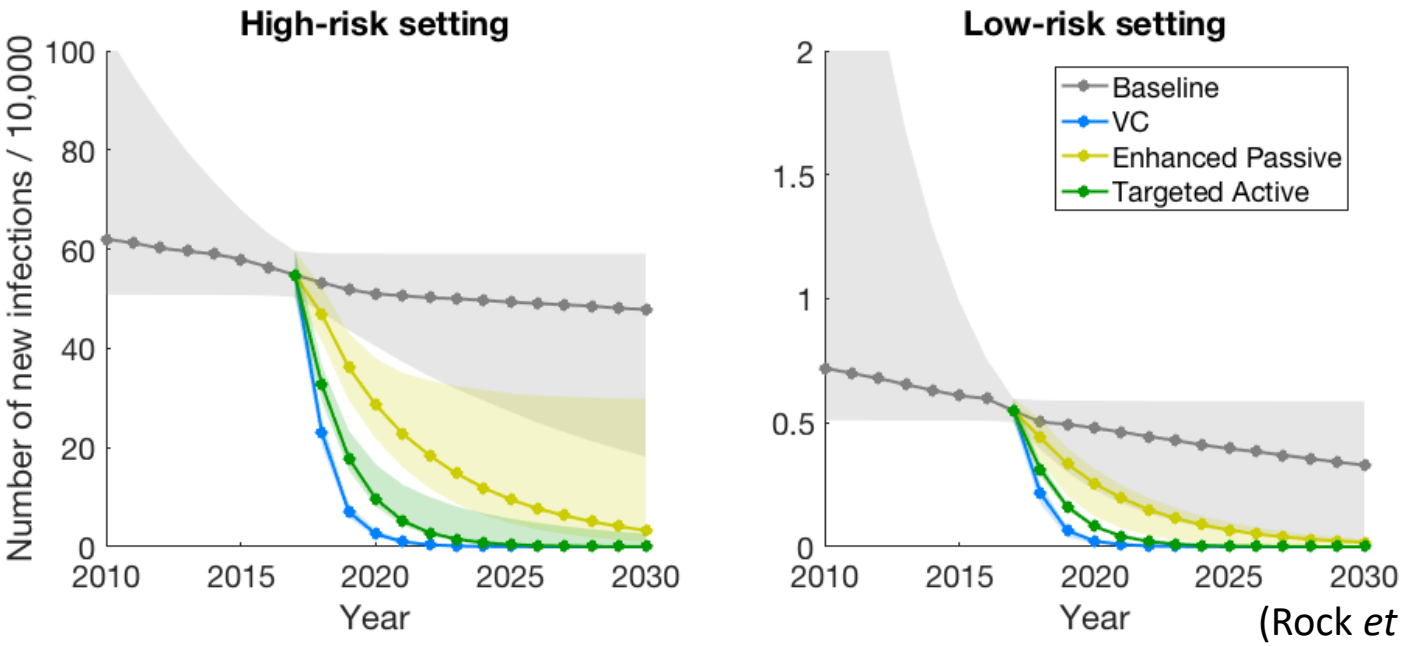
	Baseline	Vector control	Enhanced passive surveillance	Targeted active screening
Basic passive detection rate	Y	Y		Y
Passive detection rate doubled			Y	
30% active screening	Y	Y	Y	
60% active screening (with equal coverage of low- and high-risk people)				Y
Tiny targets with 60% tsetse reduction after one year		Y		

Incidence

(Rock *et al*, CID, 2018)

"High-risk" setting = 50-60 new infections per 10,000 (in 2017)
"Low-risk" setting = 0.5-0.6 new infection per 10,000 (in 2017)

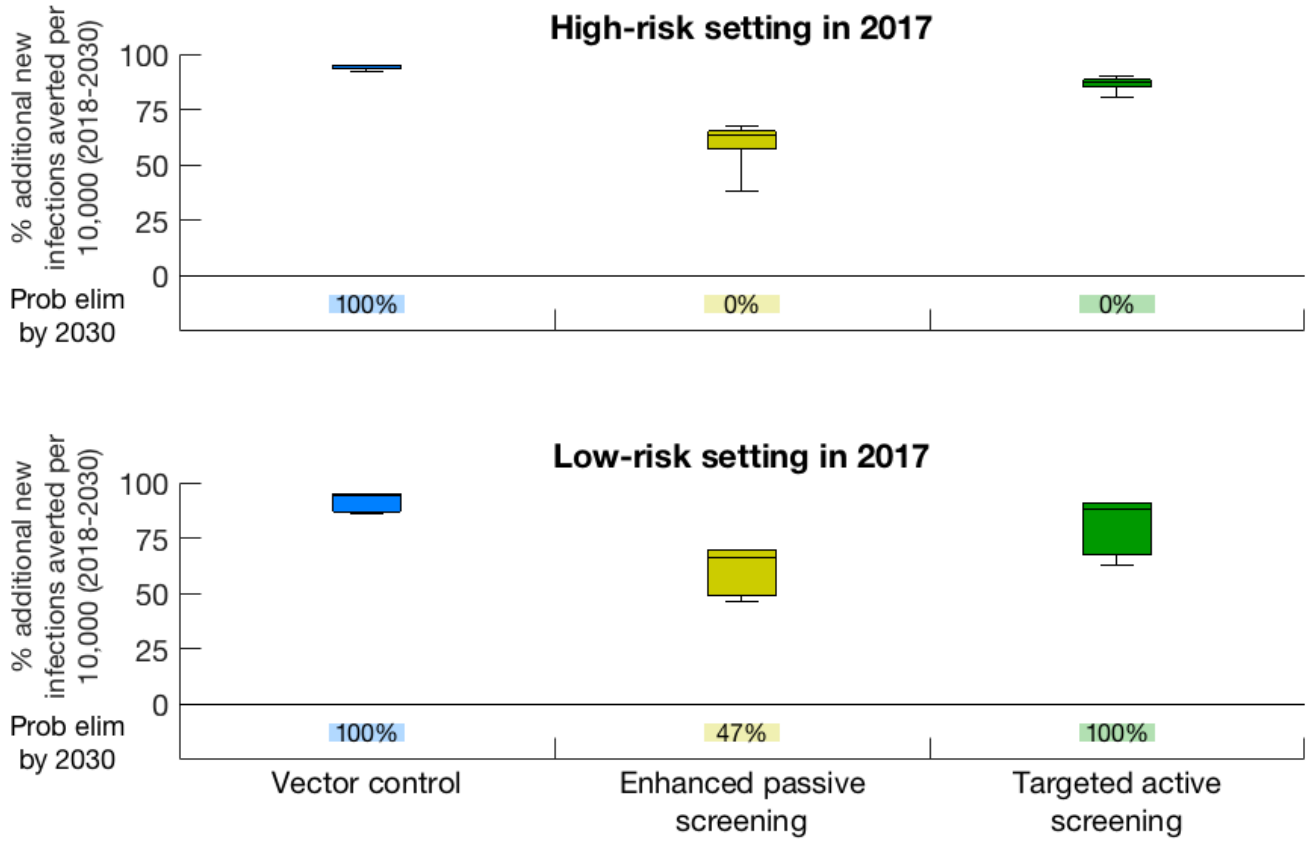
Results: New infections



(Rock *et al*, CID, 2018)

- All complimentary strategies are an improvement
- Vector control is quick to impact new infection

Results: New infections averted



- Vector control averts most new infections
- Medical strategies reduce human infection pool, but take longer to impact transmission
- Elimination by 2030 seems very likely with VC, or in low-risk settings

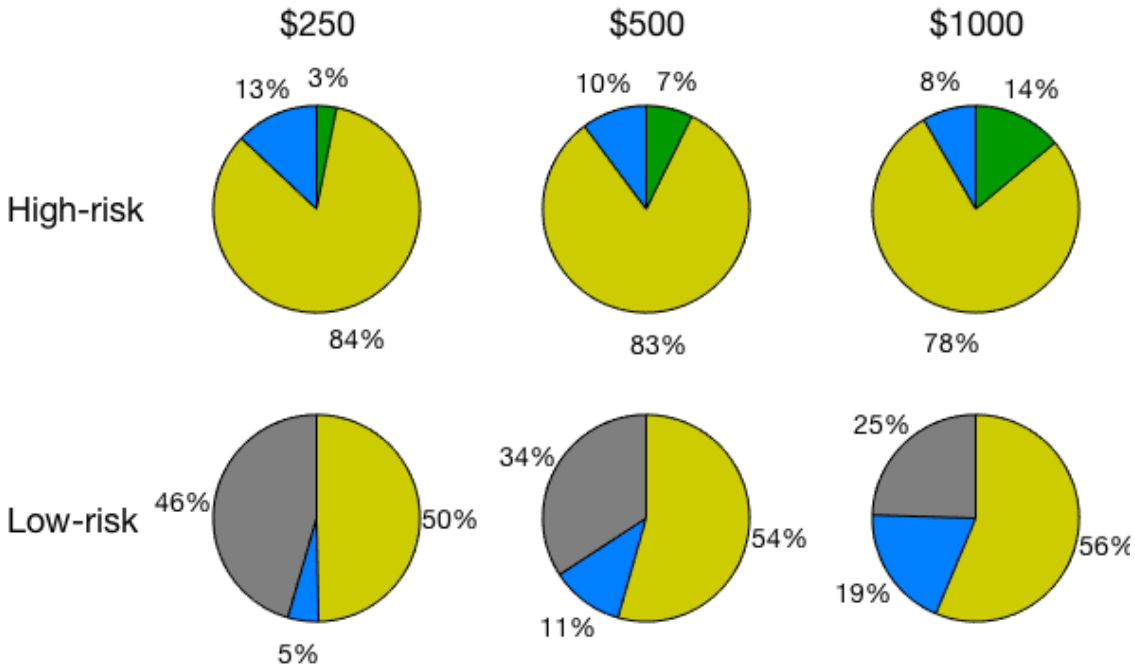
(Rock *et al*, CID, 2018)

Results: cost framework

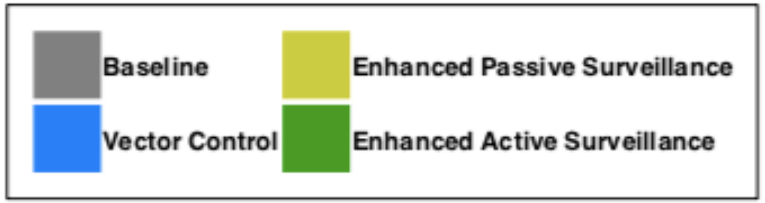
- We want to compare strategies in a fair way:
  - The vector control strategy costs more than the baseline strategy, but averts for new infections
  - The three complementary strategies cost different amounts
  - Other factors are important: preventing disease and death is our priority
- We use the mathematical modelling results in combination with intervention costs and disability adjusted life years (DALYs) to compare strategies

Results: probability cost effective

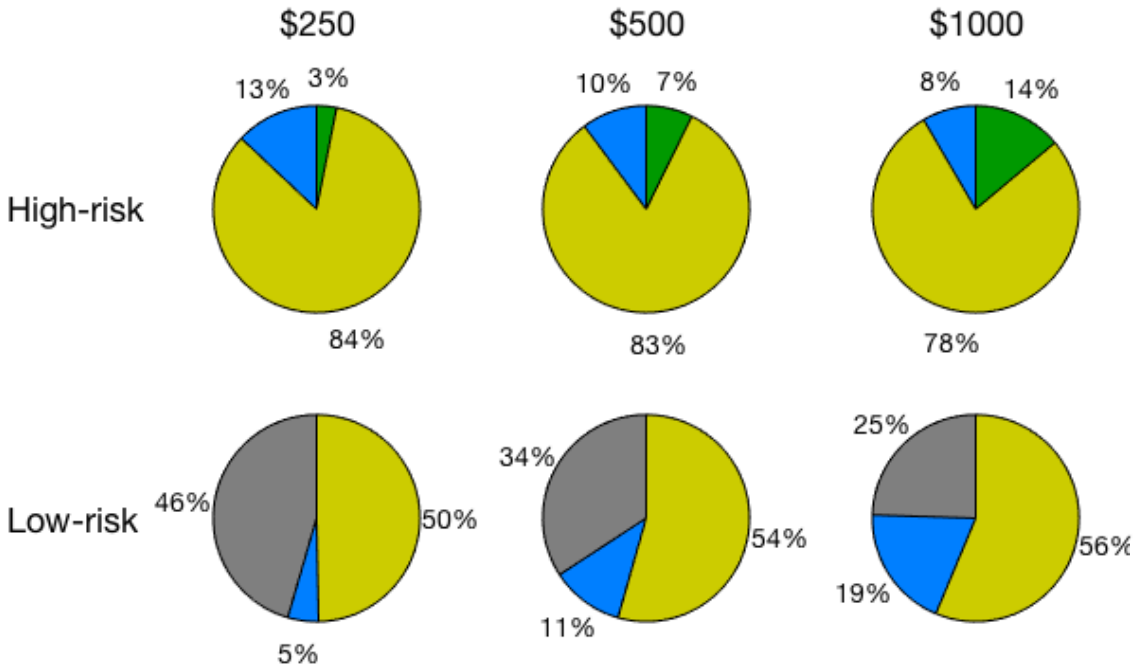
Willingness-to-pay per DALY averted

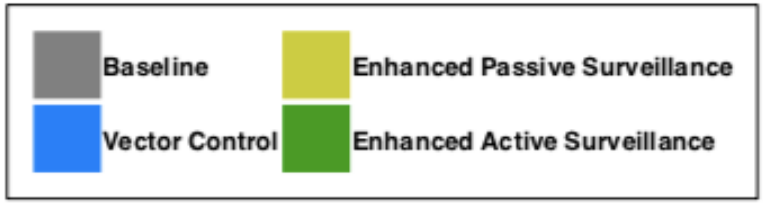


- Assumptions:
  - Time horizon: 2018-2030, discounting: 3%
  - Switch to fexinidozale
  - All interventions continue until 2030



Results: probability cost effective

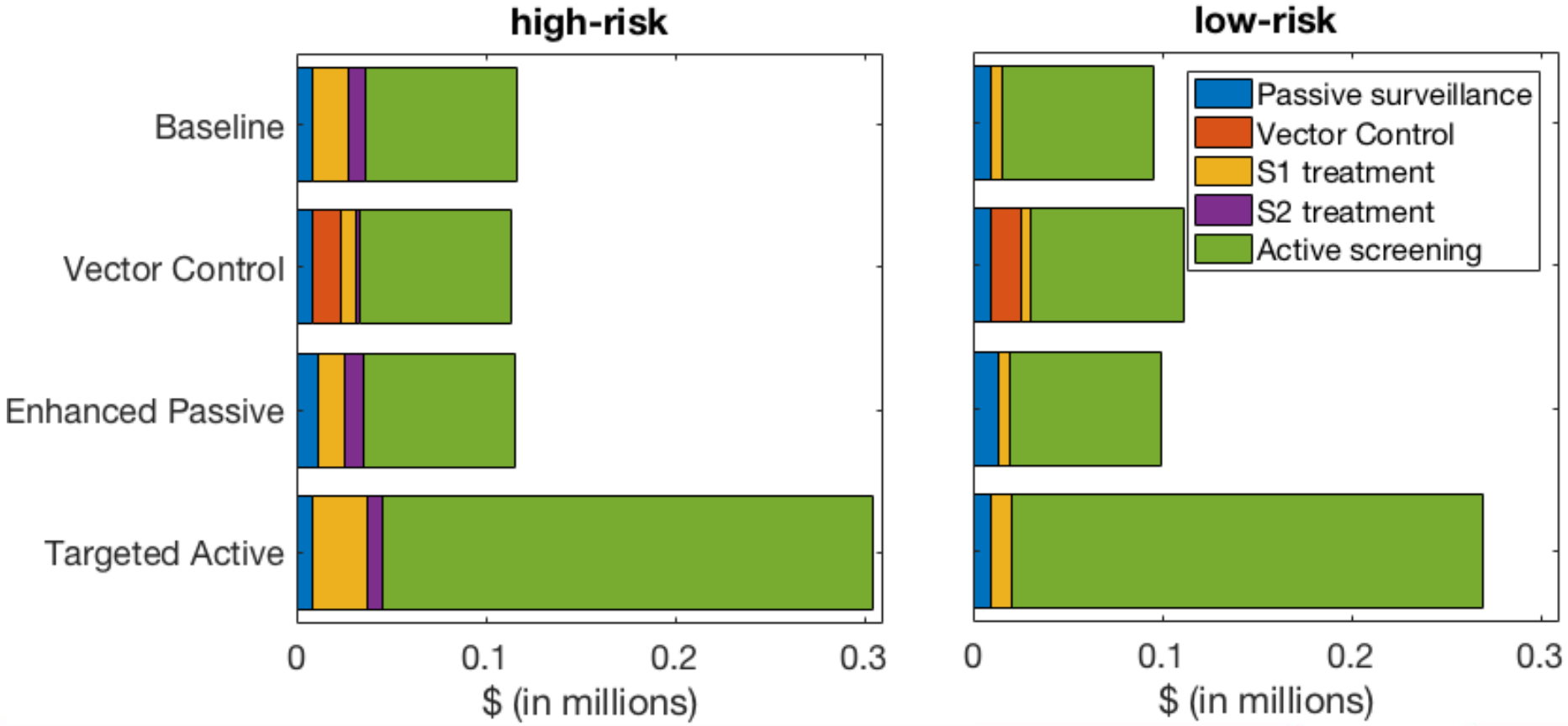




- High-risk
  - Enhanced passive appears more cost-effective
- Low-risk
  - The baseline strategy has similar probability of being cost-effective as enhanced passive for low WTP

Results: cost breakdown

- Total (undiscounted) costs from 2018-2030
- Population size: 10,000



Conclusions

- Passive surveillance is most cost-effective in some settings because it averts more DALYs
- But the enhanced passive surveillance strategy may not reach the 2030 elimination goal
- Vector control can help reduce transmission quickly

- **Combinations of strategies** could be more cost effective than individual complementary strategies

Next steps: graphical user interface

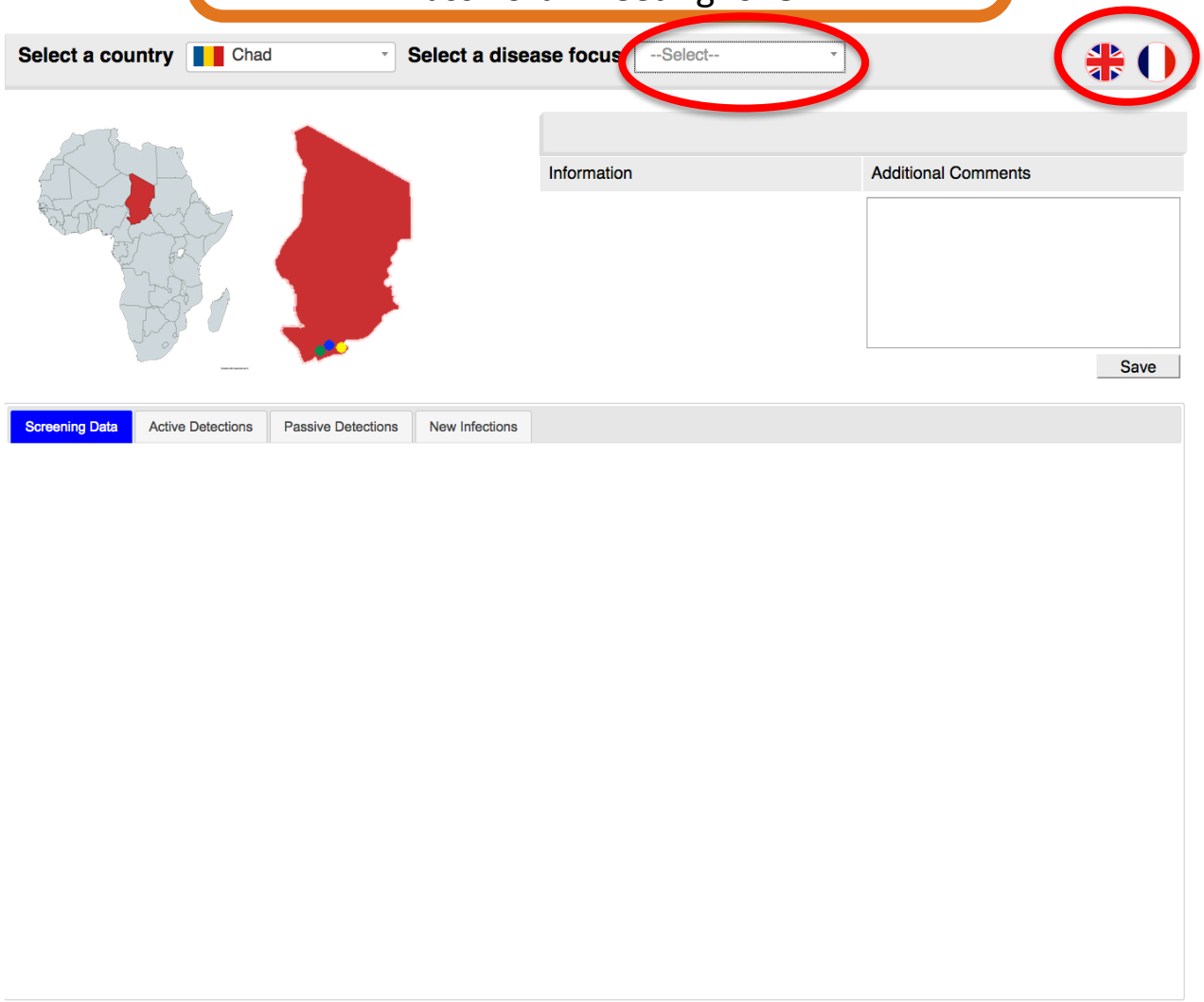
- This study demonstrates the type of infection dynamics in a generic high- or low-risk setting
- Future work is needed to fit to regional data, and to include local costs and strategies
- HAT MEPP will work with national programmes and other researchers to provide these outputs

http://nero.wsbc.warwick.ac.uk/hatmepp/

Username: hatplatform
Password: meeting2018

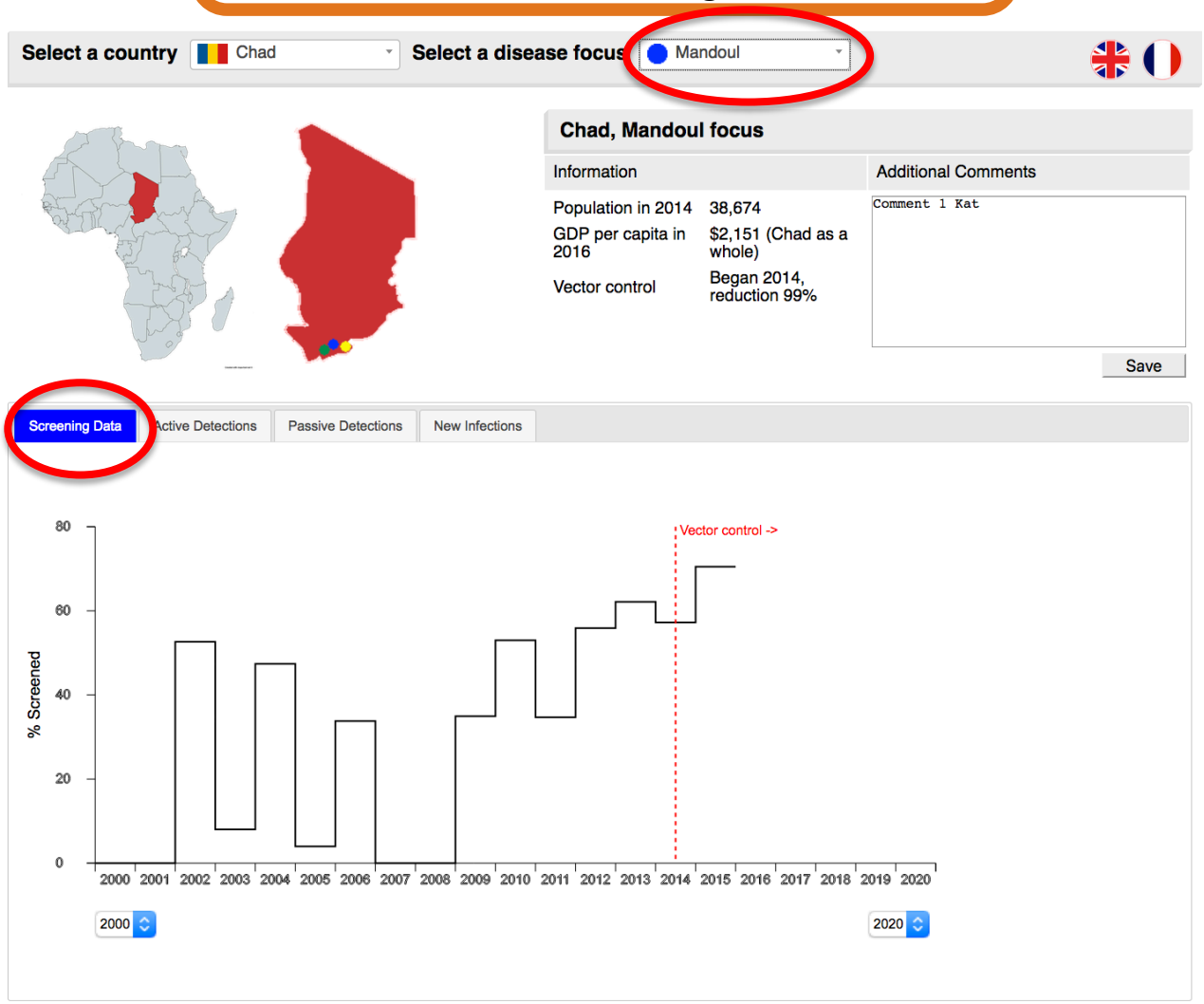
http://nero.wsbc.warwick.ac.uk/hatmepp/

Username: hatplatform
Password: meeting2018



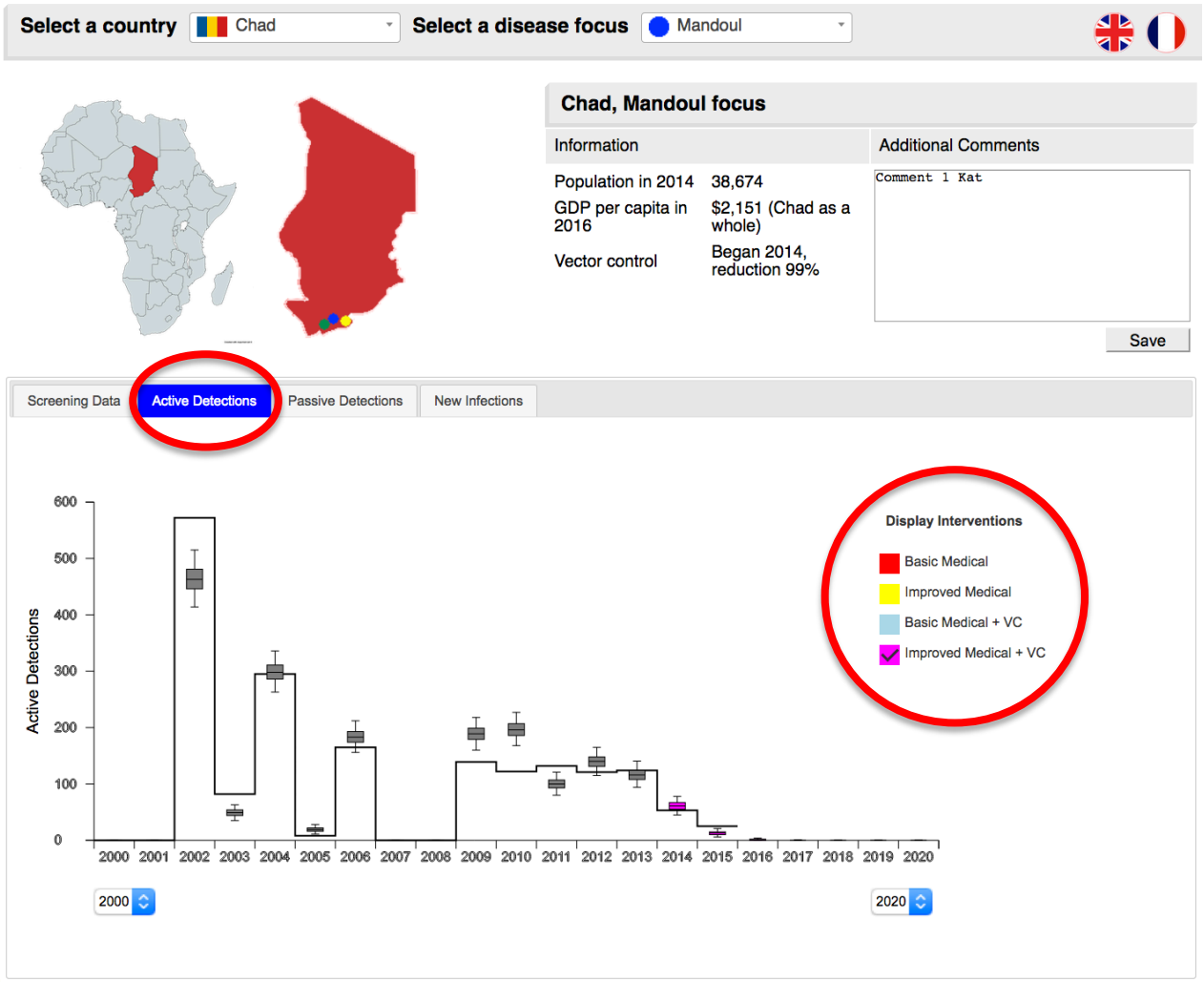
http://nero.wsbc.warwick.ac.uk/hatmepp/

Username: hatplatform
Password: meeting2018



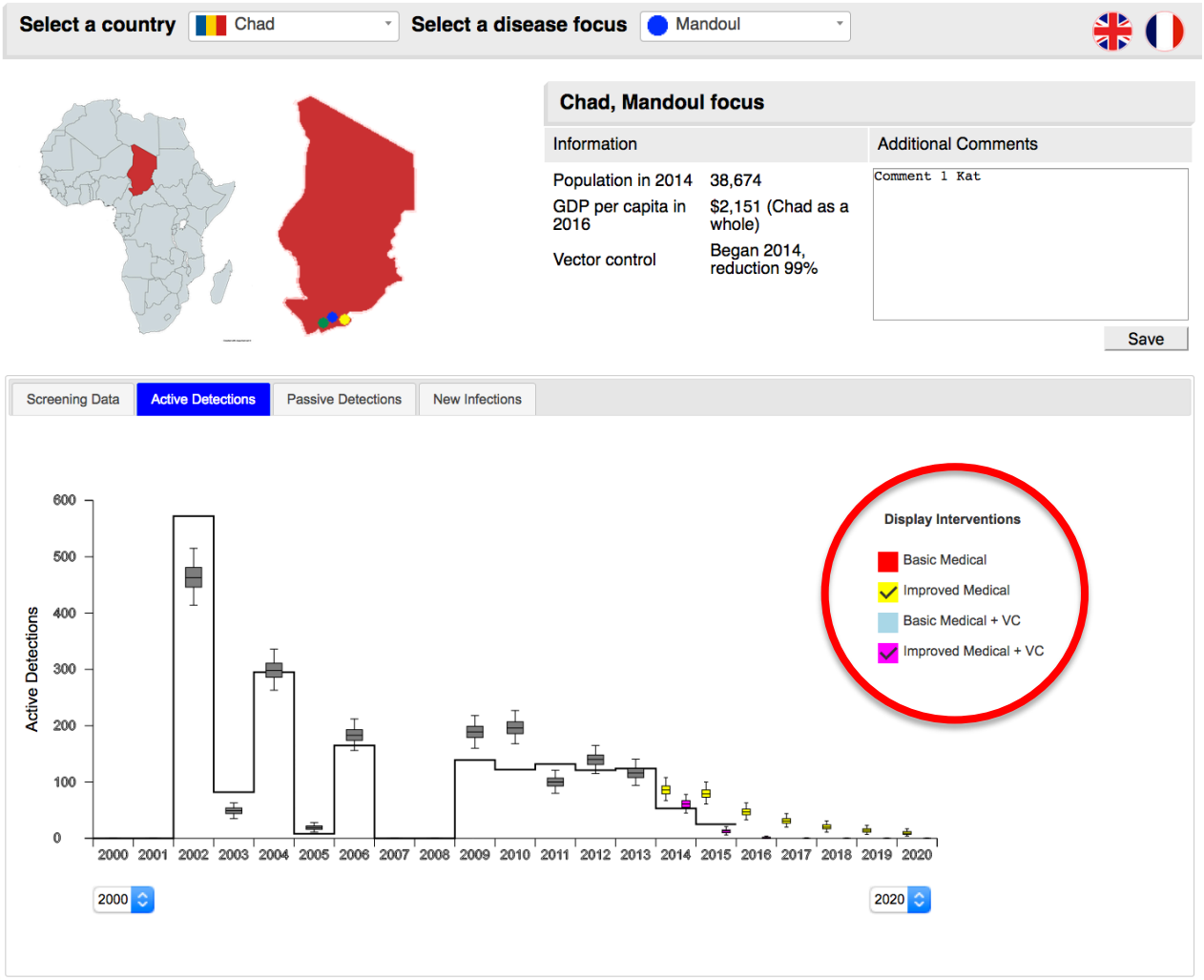
http://nero.wsbc.warwick.ac.uk/hatmepp/

Username: hatplatform
Password: meeting2018



http://nero.wsbc.warwick.ac.uk/hatmepp/

Username: hatplatform
Password: meeting2018



Acknowledgements

Collaborators and data:

PNLTHA of Chad

LSTM LIVERPOOL SCHOOL OF TROPICAL MEDICINE

CIRDES

INSTITUTE OF TROPICAL MEDICINE ANTWERP

World Health Organization

FIND Because diagnosis matters

IRD

Contact:

NTD MODELLING CONSORTIUM

Kat Rock
k.s.rock@warwick.ac.uk

HAT MEPP

www.go.warwick.ac.uk/hatmepp

Funding:
BMGF

www.warwick.ac.uk/HATMEPP

HAT MEPP

Warwick Team

Dr Kat Rock
Principal investigator

Prof Matt Keeling
Co-investigator

Dr Jason Madan
Health economist

Xia Wang – Steverding Researcher

Dr Paul Brown
Software developer

Ching-I Huang
Researcher

Swiss TPH Team

Dr Fabrizio Tediosi
Health economist

Dr Ron Crump
Researcher

IDM Team

Dr Caitlin Beaver
Lead Modeller

Dr Cody Palmer
Researcher

Dr Marina Antillon
Researcher

Chris Davis
PhD student

Oxford Team

Prof Déirdre Hollingsworth

Nakul Chitnis
Lead Modeller

Soledad Castaño
Researcher