Intervention and Infectious Disease Modelling

An introduction to who we are and what we do

Chitra M Saraswati · 9 September 2024

The Kids Research Institute Australia acknowledges Aboriginal and Torres Strait Islander people as the Traditional Custodians of the land and waters of Australia. We also acknowledge the Nyoongar Wadjuk, Yawuru, Kariyarra and Kaurna Elders, their people and their land upon which the Institute is located and seek their wisdom in our work to improve the health and development of all children.

Our work

- Develop and apply models of disease epidemiology
- Estimate intervention impact; economic and cost-effectiveness analyses
- Support global research and development (R&D) funding decisions
- Support strategies with global partners

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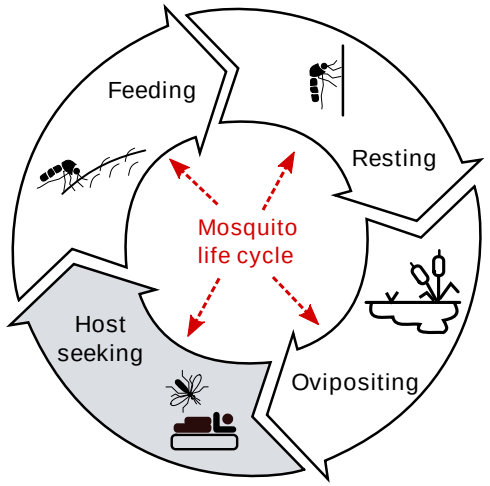
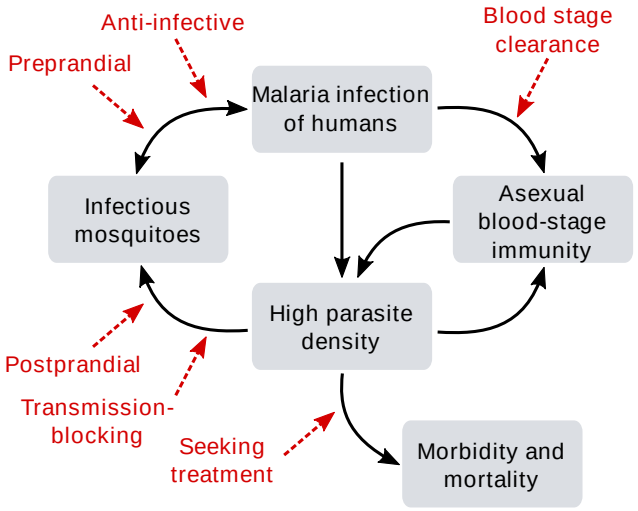
- Understanding of disease dynamics
- Which interventions are most effective?
- Which novel interventions should we develop?
- How should we implement interventions for the greatest impact?

OpenMalaria

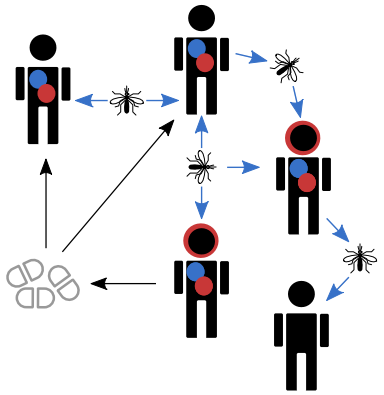
An individual-based stochastic simulator of malaria epidemiology and control
(Plasmodium falciparum)



Mosquito life-cycle and the process of transmission



Dynamics of parasitemia over the course of an infection



Dynamics within populations

- Parasite densities
  Infectiousness
  Number of infections
  Immunity
  Drug level
- Infectiousness
  Mosquito density
  Feeding cycle
  Parasite development
  seasonality
- Health System
  Drugs & quality
  Adherence
  Compliance
- Drugs
  Vector Control (IRS, ITNs)
  Vaccines
  Mass treatment
  Reactive strategies

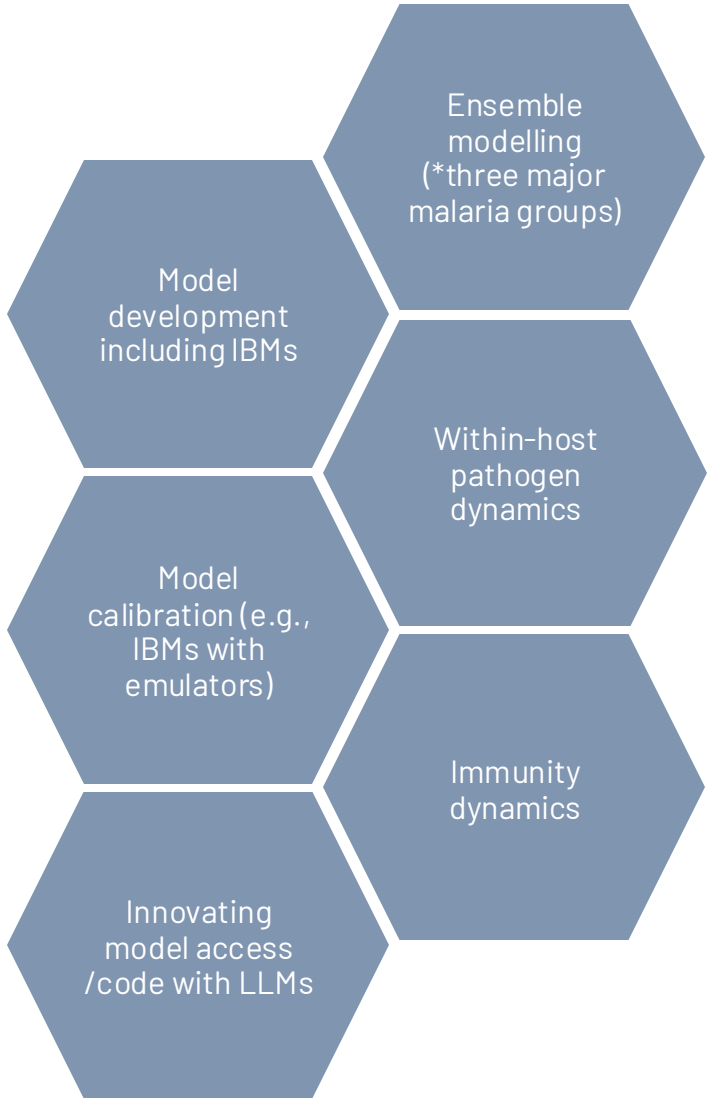
github.com/SwissTPH/openmalaria/wiki

Model and methods development

Models to understand disease/immune dynamics

Translational medicine: preclinical and clinical trial analysis and modelling

Modelling evidence for decision making



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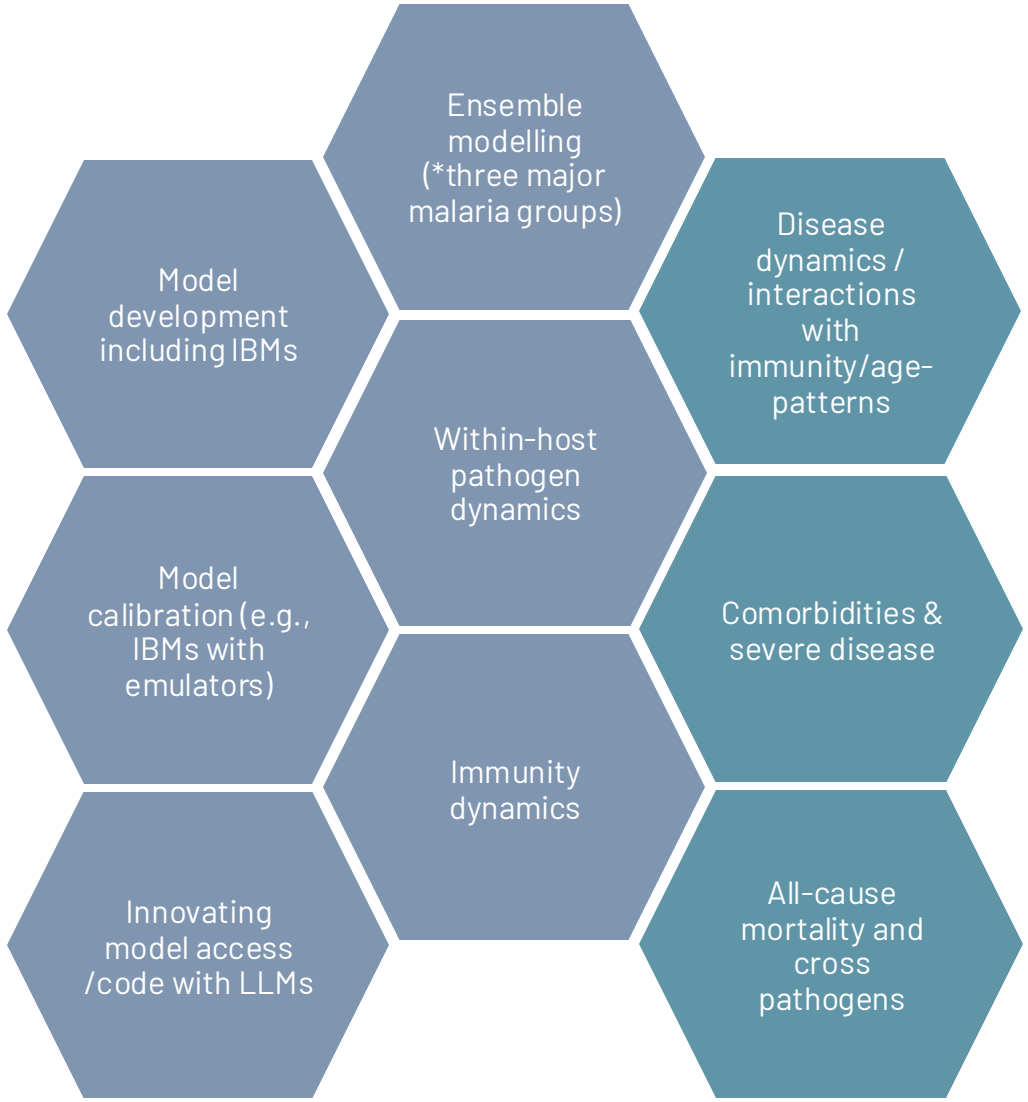

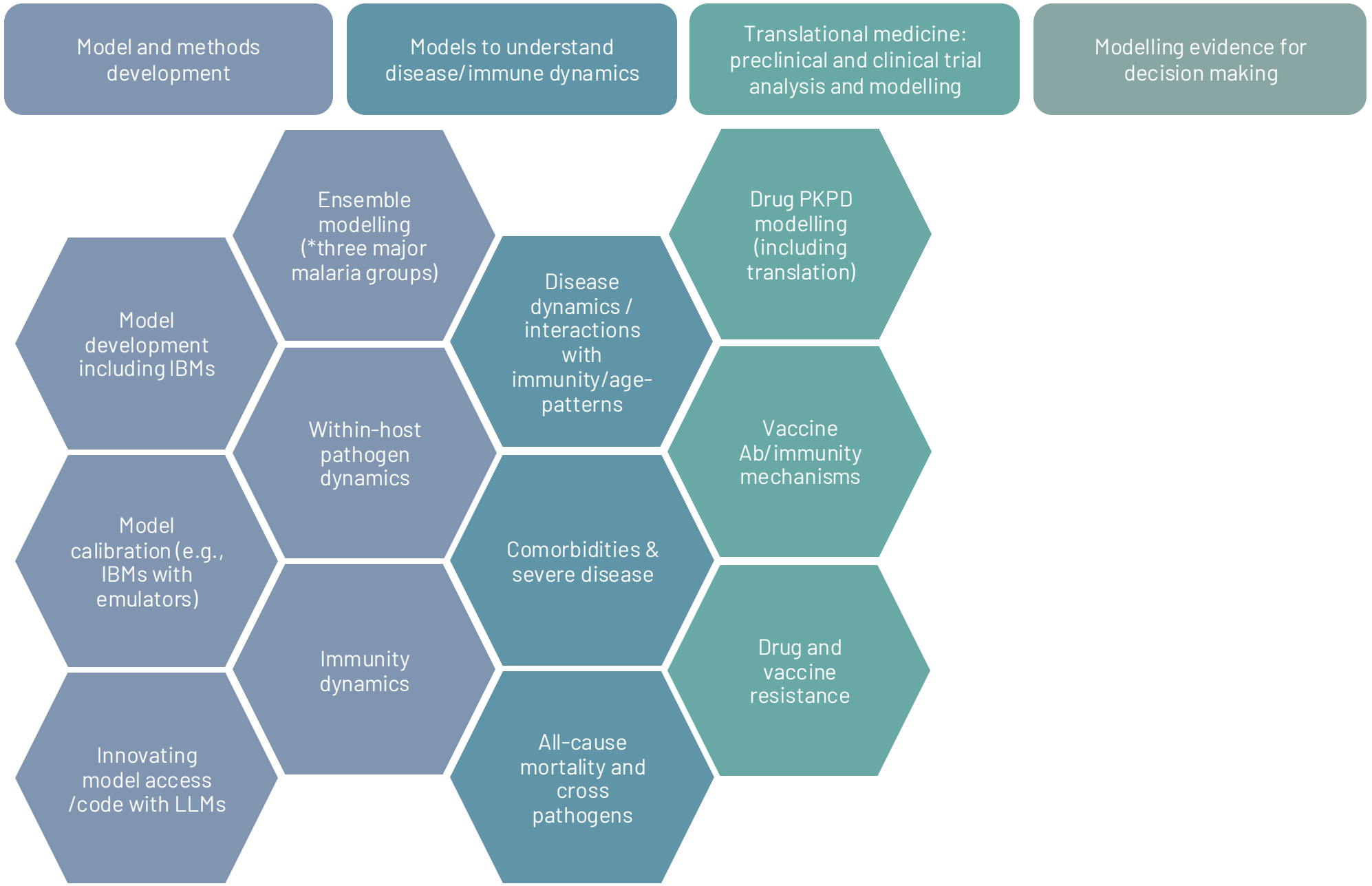
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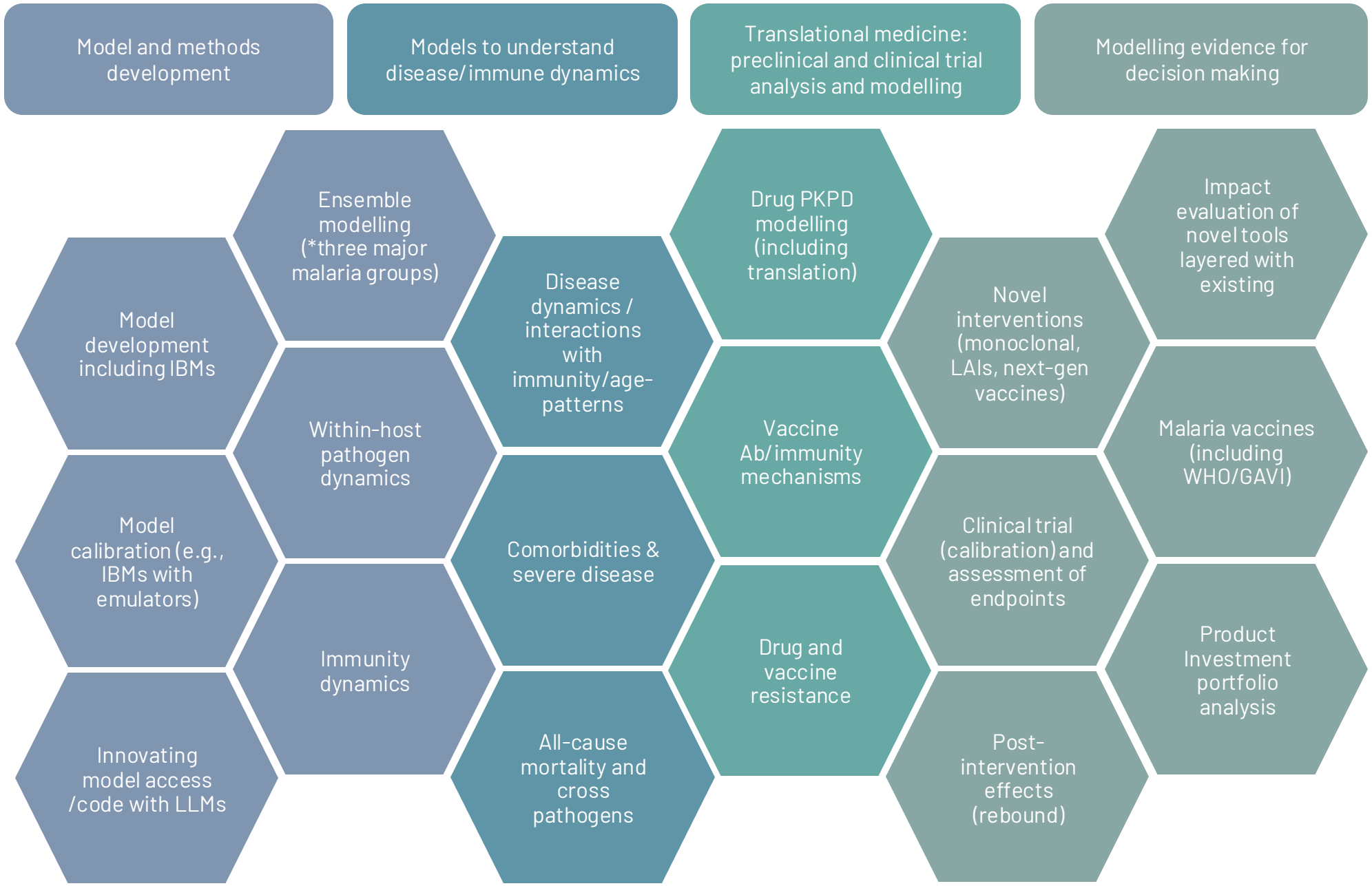
Models to understand disease/immune dynamics
Translational medicine: preclinical and clinical trial analysis and modelling
Modelling evidence for decision making
Ensemble modelling (*three major malaria groups)
Drug PKPD modelling (including translation)
Model development including IBMs
Disease dynamics / interactions with immunity/age-patterns
Within-host pathogen dynamics
Vaccine Ab/immunity mechanisms
Model calibration (e.g., IBMs with emulators)
Comorbidities & severe disease
Immunity dynamics
Drug and vaccine resistance
Innovating model access /code with LLMs
All-cause mortality and cross pathogens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Drug PKPD modelling (including translation)
Vaccine Ab/immunity mechanisms
Drug and vaccine resistance
Novel interventions (monoclonal, LAIs, next-gen vaccines)
Clinical trial (calibration) and assessment of endpoints
Post-intervention effects (rebound)
Impact evaluation of novel tools layered with existing
Malaria vaccines (including WHO/GAVI)
Product Investment portfolio analysis

Recent papers

1. Masserey T., Lee T., Kelly S., Hasting I. M., & **Penny M. A.** (2024). Seasonal malaria chemoprevention and the spread of Plasmodium falciparum parasites resistant to sulfadoxine-pyrimethamine: a mathematical modelling study. *Lancet Microbe*. https://doi.org/10.1016/S2666-5247(24)00115-0

2. **Le Rutte, E. A., Shattock, A. J.**, Marcelino, I., Goldenberg, S. G., & Penny, M. A. (2023). Efficacy Thresholds for Cost-Saving Antiviral SARS-CoV-2 Treatment Strategies: A Modelling Study. eClinicalMedicine, 73.

3. De Salazar P. M., Kamau A., **Cavelan A.**, Akech S., Mpimbaza A., Snow R. W. & **Penny M. A.** (2024). Severe outcomes of malaria in children under time-varying exposure. *Nature Communications*, 15, 4069. https://doi.org/10.1038/s41467-024-48191-7

4. **Shattock, A. J.**, et al. (2024). Contribution of vaccination to improved survival and health: modelling 50 years of the Expanded Programme on Immunization. *The Lancet*, 403.10441 (2024): 2307-2316.

5. **Braunack-Mayer L.**, **Malinga J.**, **Masserey T.**, **Nekkab N.**, **Sen S.**, Schellenberg D., Tchouatieu A., Kelly S. L., **Penny M. A.** (2024). Designing and selecting drug properties to increase the public health impact of next-generation malaria chemoprevention. *The Lancet Global Health*, 12.3 (2024): e478-e490.

6. Marsh K., Akl E., Achan J., Alzahrani M., Baird J. K., Bousema T., Gamboa D., Lacerda M., Mendis K., **Penny M. A.**, Schapira A. (2024). Development of WHO recommendations for the final phase of elimination and prevention of re-establishment of malaria. *The American Journal of Tropical Medicine and Hygiene*. 2024 Apr;110(4 Suppl):3.

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Pablo de Salazar
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Ottavia Prunas
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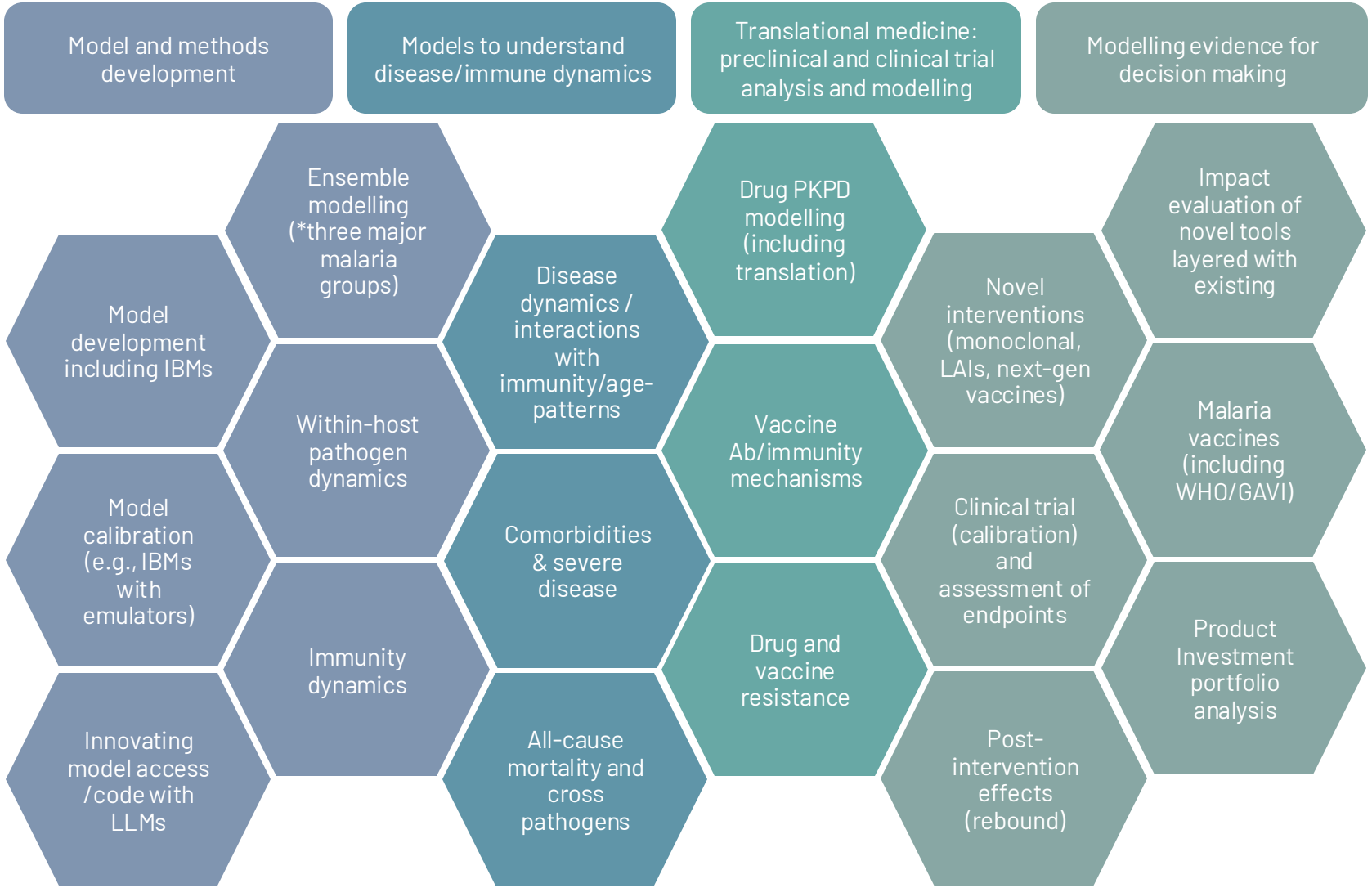

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