



HPVsim

A new tool for rapid assessments of the impact of interventions on the pathway towards global cervical cancer elimination

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Disclosures

Authors are employees of / contracted to the Bill & Melinda Gates Foundation

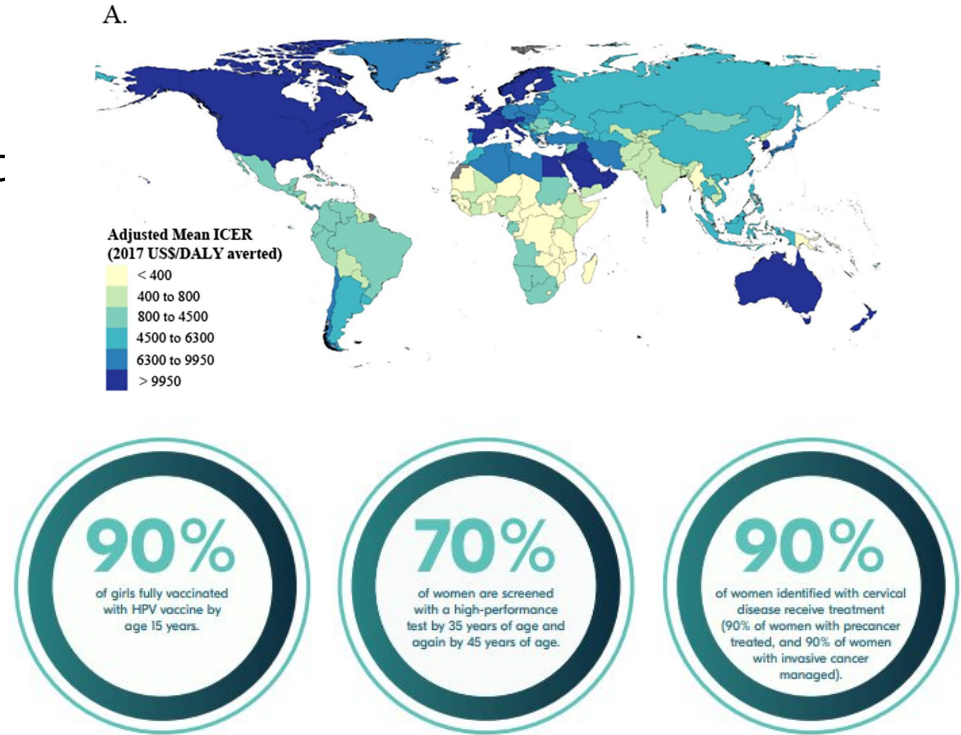
Outline

- Motivation and background
- Model framework overview
- Example use case
- Access and info

Motivation & background

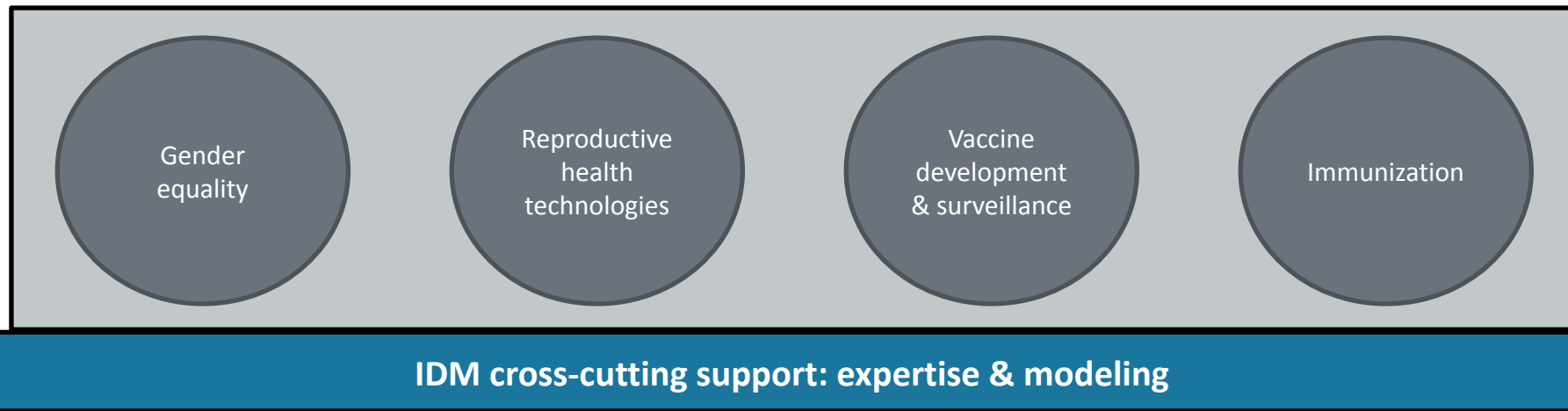
Mathematical models have well-established roles in HPV / cervical cancer

- Cost-effectiveness: HPV vaccination is among the most studied interventions in public health economics
- Elimination modeling: including target-setting
- Evaluating and incorporating new technologies into guidelines and health policies



IDM: an embedded research group in BMGF

- Provides internal support
- Conducts independent scientific research
- Develops open-source modeling tools



Vision for HPVsim

HPVsim belongs to Starsim: IDM's next-generation agent-based **model framework**

Starsim includes: Covasim, FPsim, HPVsim,...

To durably promote quantitative decision making...

We seek to build inclusive, collaborative, and open modeling communities...

Via tools that encourage innovation, scientific curiosity, and rapid exploration.

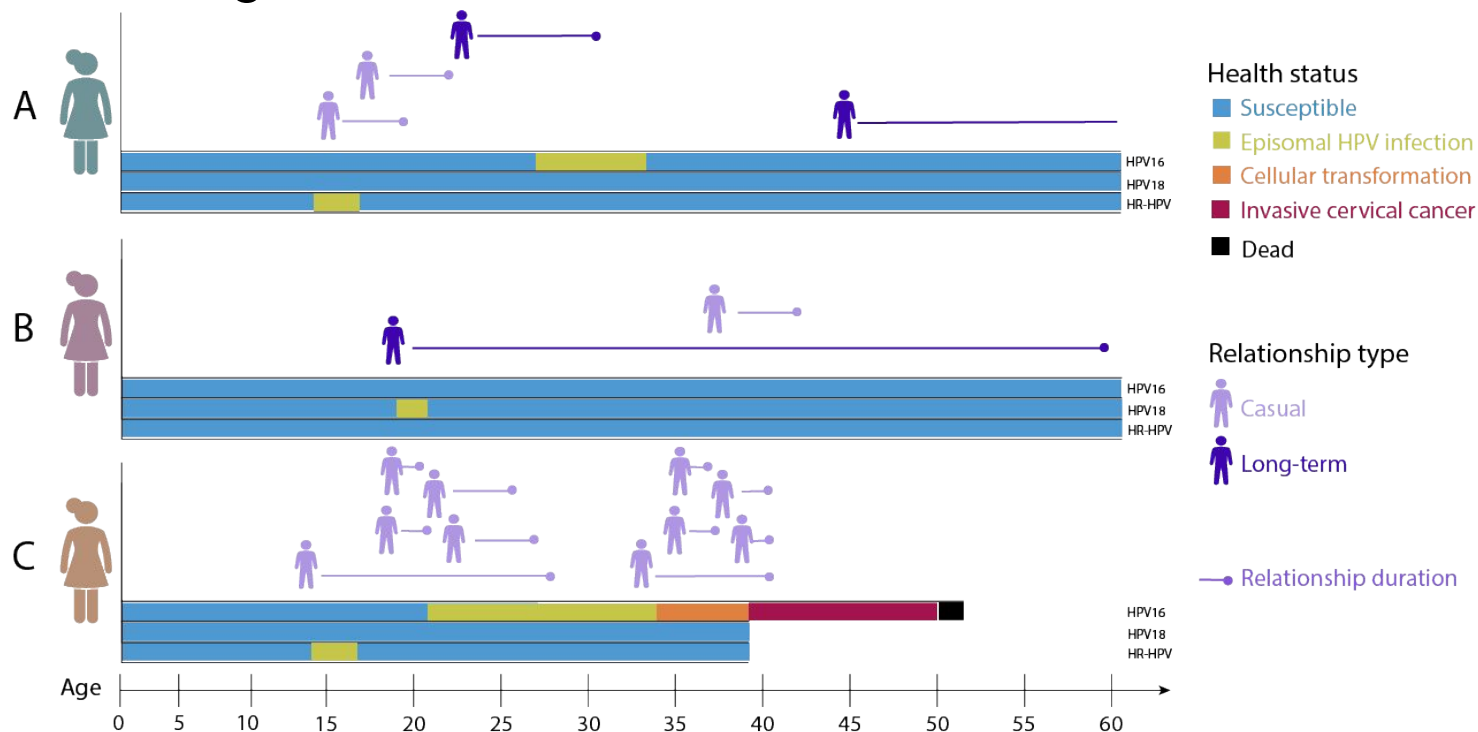
We therefore take a user-centric approach to software design:

- All aspects should be simple, intuitive, and accessible → easier for ourselves and others
- Software should get out of the way of science, with simple solutions preferred → facilitates creativity and boldness in which scientific/policy questions to tackle
- Embrace a diversity of users, from novice to elite → all levels of technical expertise

Model framework overview

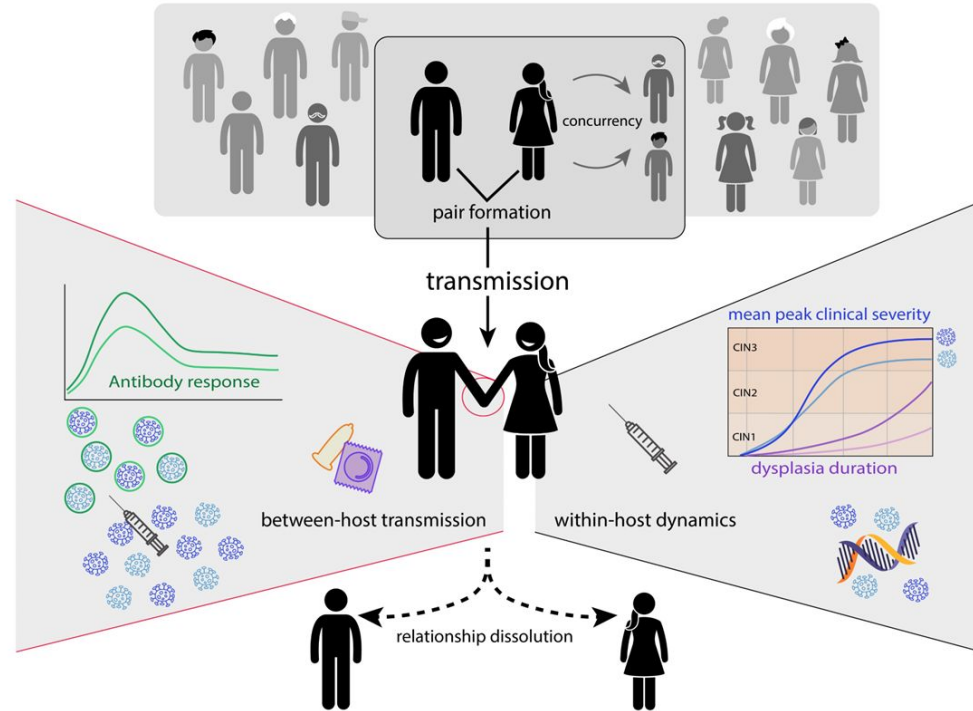
HPVsim overview

- Agent-based modeling framework



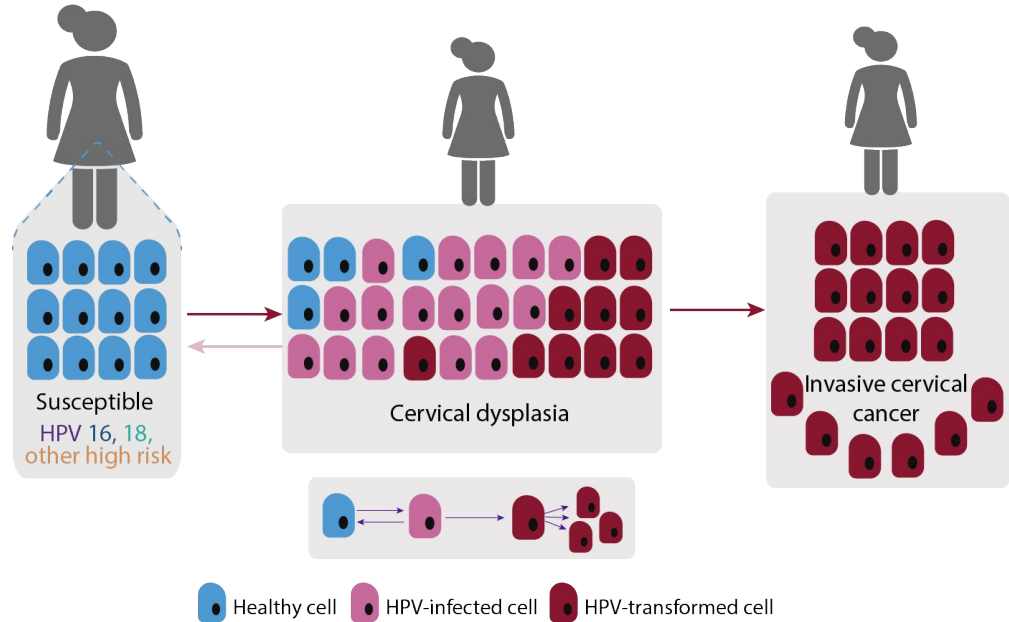
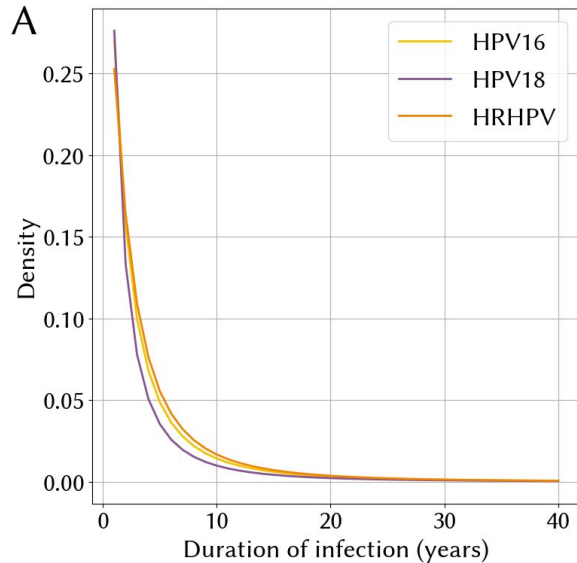
HPVsim overview

- Agent-based modeling framework
 - captures HPV transmission



HPVsim overview

- Agent-based modeling framework
 - captures HPV transmission
 - simulates progression



HPVsim overview

- Agent-based modeling framework
 - captures HPV transmission
 - simulates progression
- Software details:
 - Implemented in pure Python
 - Open source (MIT license)
 - Easy to use
 - Online tutorials
 - Documentation
 - Fast (aim: <1 min/simulation)

Example use case

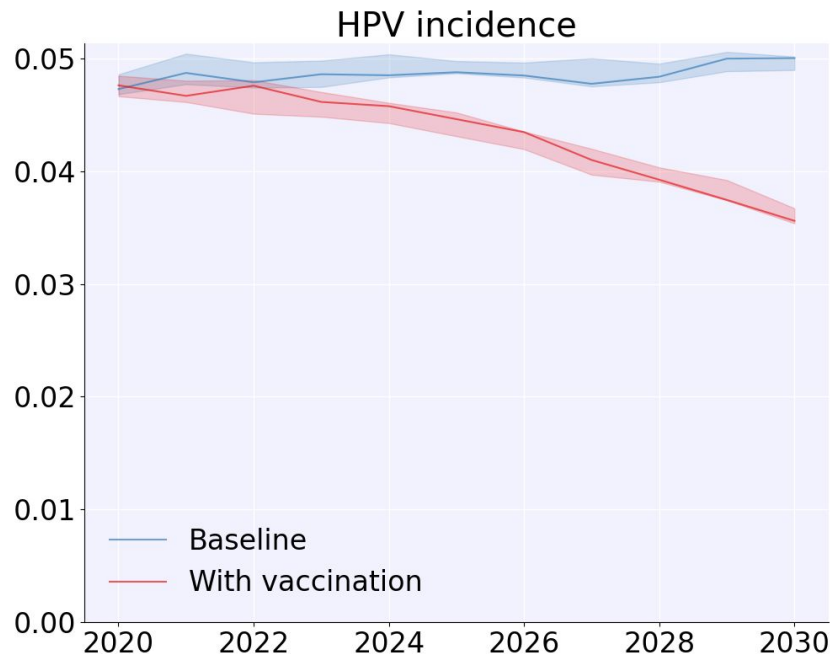
Vaccination effect

```
# Define a baseline simulation
sim = hpv.Sim()

# Define the vaccine intervention
vx = hpv.routine_vx(prob=0.6, start_year=2015,
age_range=[9, 10], product='bivalent')

# Create scenarios with and without vaccination
scenarios = {
'baseline': {'name': 'Baseline',
            'pars': {}},
'vax'      : {'name': 'With vaccination',
            'pars': {'interventions': vx}},
}
scens = hpv.Scenarios(sim=sim, scenarios=scenarios)

# Run and plot
scens.run()
scens.plot()
```



https://docs.idmod.org/projects/hpvsim/en/latest/tutorials/tut_interventions.html
[#Prophylactic-vaccination](#)

Access and info

Access and info

- Code is open source: hpvsim.org
- Manuscript under review, also on medrxiv:
 - Stuart RM, Cohen JA, et al. *HPVsim: An agent-based model of HPV transmission and cervical disease*
- Interested in HPVsim?
 - Low barrier to entry: easy installation with documentation & tutorials
 - High levels of support available
 - Especially interested in research studies & collaborations with policy implications

Limitations and discussion

- Have not spoken about calibration or validation, critical components of turning a modeling framework into a model
 - HPVsim has built-in calibration methods, but the proof is in the pudding
- HPVsim is still very much in development, please give us feedback and we welcome any and all collaboration!
- Underlying philosophy drove practical user-centric design decisions
- Next phases: applications, ongoing refinement

Thank you

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