Strategies to accelerate cervical cancer elimination

A modeling study for Rwanda

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Background & motivation

- Human papillomavirus (**HPV**) is a very common sexually transmitted infection, implicated as the causative agent in >90% of cervical cancers
- **Vaccination** against HPV for girls 9-14 is a safe & effective way to prevent cervical cancers, but the benefits will take decades to materialize
- **Rwanda** has exemplary HPV vaccination rates (90% coverage), but even so ~72k Rwandan women will acquire cervical cancer over 2025–2100 (**Fig 1**)

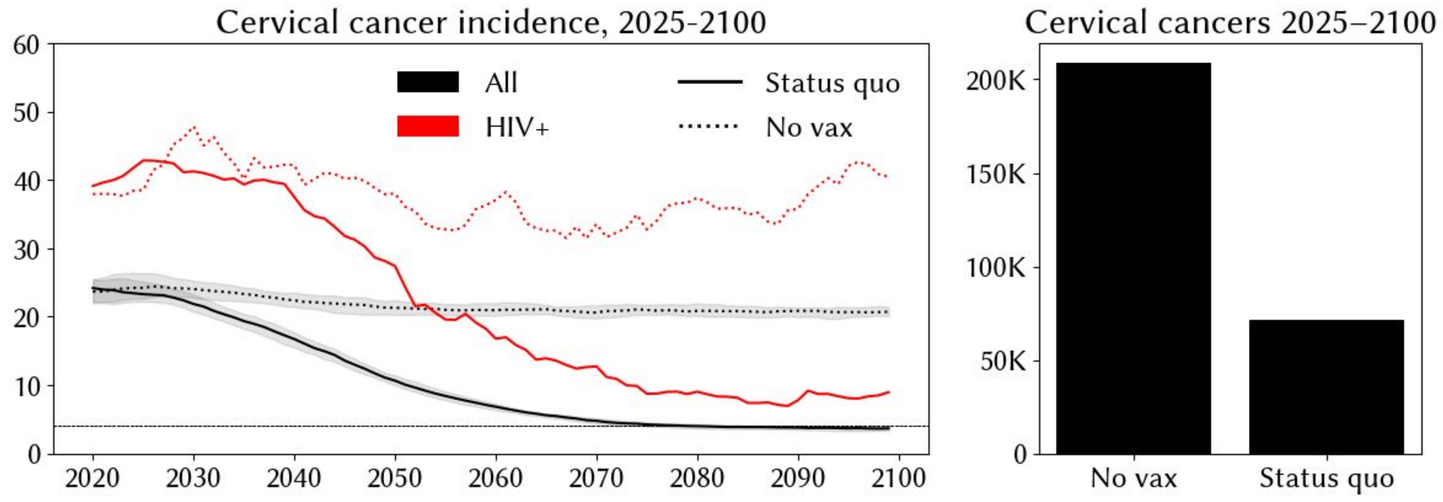

Fig 1: Impact of ongoing interventions and the residual burden of cervical cancer over 2025-2100

Study aims & design

- **Objective**: assess seven strategies for reducing Rwanda's cervical cancer burden, focusing on the value of novel therapeutic vaccines (**Table 1**)
- **Design**: simulation study using **HPVsim**, open source software for creating agent-based models of HPV built on the Starsim platform

Attribute	Screen-triage-treat	Screen-treat	Screen-TxV-triage-treat	Screen-TxV	HPV-Faster	Mass TxV (virus-clearing)	Mass TxV (lesion-regressing)
Target age	30-50	30-50	30-50	30-50	20-50	20-50	20-50
Strategy	Screen → Triage → Treat	Screen → Treat	Screen → TxV → Triage → Treat	Screen → TxV	Screen + Treat + Vaccinate	Therapeutic vaccine only	Therapeutic vaccine only
Description	VIA screening with triage before ablation (status quo)	VIA screening with immediate ablation, no triage	Add virus-clearing therapeutic vaccine before triage	Add lesion-regressing therapeutic vaccine instead of ablation	Mass campaign: screen, treat, and vaccinate eligible women	Mass campaign: deliver therapeutic vaccine (90% efficacy vs. infection)	Mass campaign: deliver therapeutic vaccine (50% infection, 90% lesions)

Table 1: Overview of cervical cancer elimination strategies. TxV=therapeutic vaccine; VIA=visual inspection with acetic acid

Results: strengthening screening

- **Removing the VIA triage** step from the screening algorithm could:
  - reduce cumulative cancers by 10%
  - accelerate cervical elimination by ~6 years
  - necessitate ~2x as many thermal ablations
  - may not increase ablations/cancer averted
- **Achieving higher screening coverage** could:
  - avert 10-14k cervical cancer cases
- **Adding novel therapeutic vaccine to screening algorithms** could avert an additional 12k cases

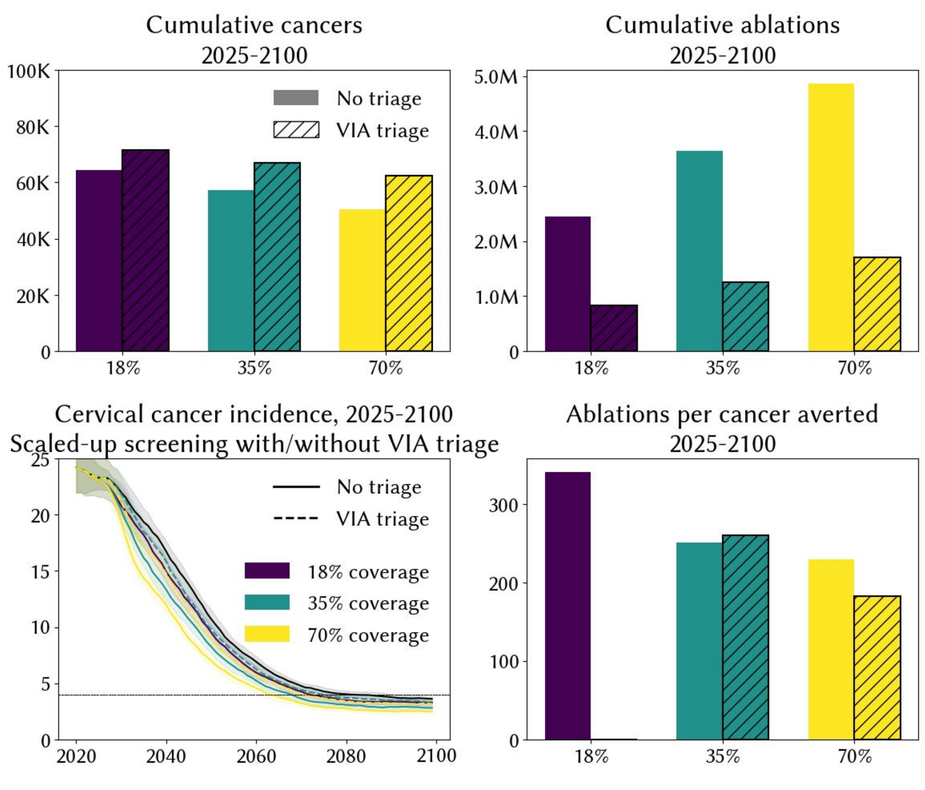

Fig. 2: Cervical cancer burden in Rwanda over 2025-2100, by screening coverage level (18%, 35%, 70%) with/ without VIA triage

Results: campaigns

- **A one-time campaign to capture women missed by vaccination** could:
  - avert >10k cases if using existing tools
  - avert 25k cases if novel therapeutic vaccines were available
  - accelerate elimination by 3 decades

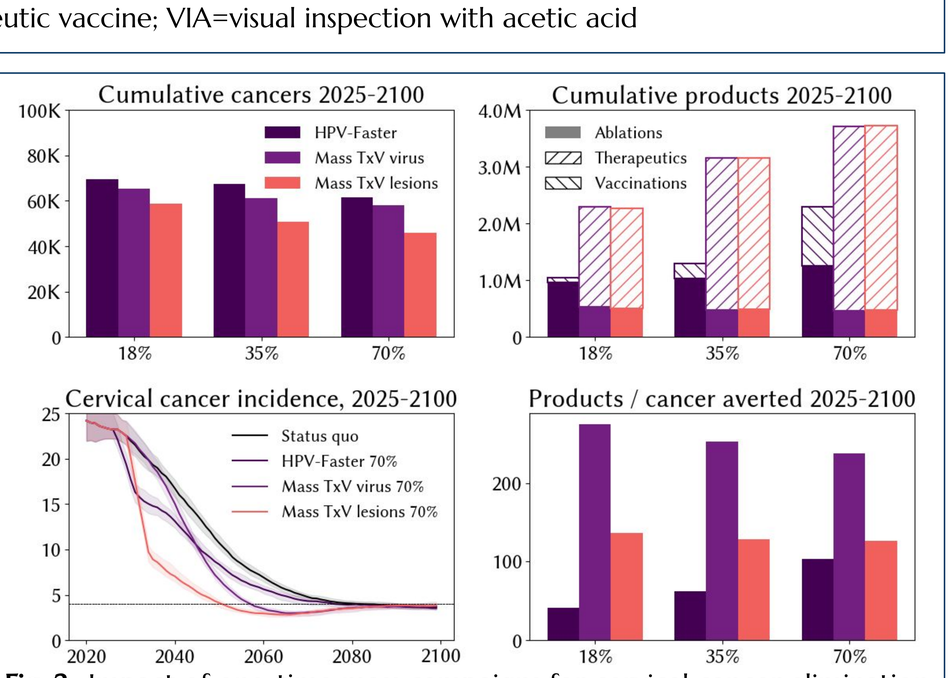

Fig. 3: Impact of one-time mass campaigns for cervical cancer elimination

Summary

- Rwanda is a global exemplar in HPV vaccination, but could further reduce the residual burden of cervical cancer with existing tools and techniques, optionally supplemented by novel therapeutic vaccines
- Contact: info@starsim.org

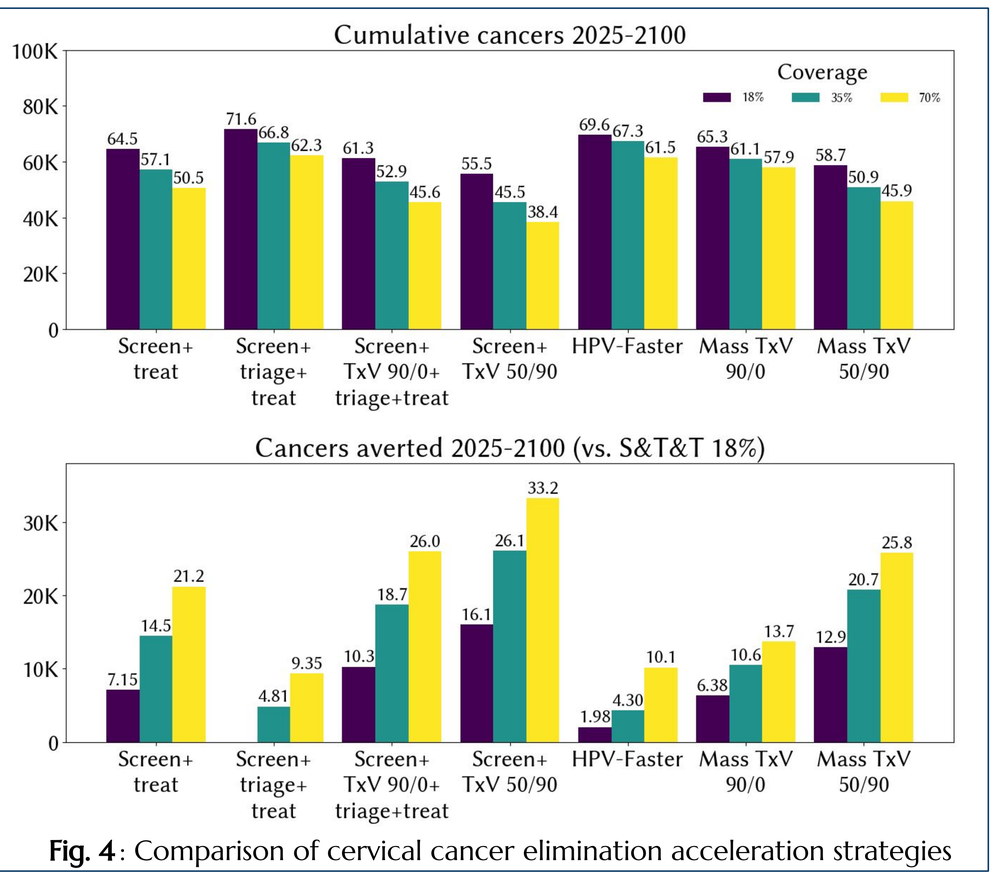

Fig. 4: Comparison of cervical cancer elimination acceleration strategies