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CPO

Modelling screening of HPV vaccinated birth cohorts

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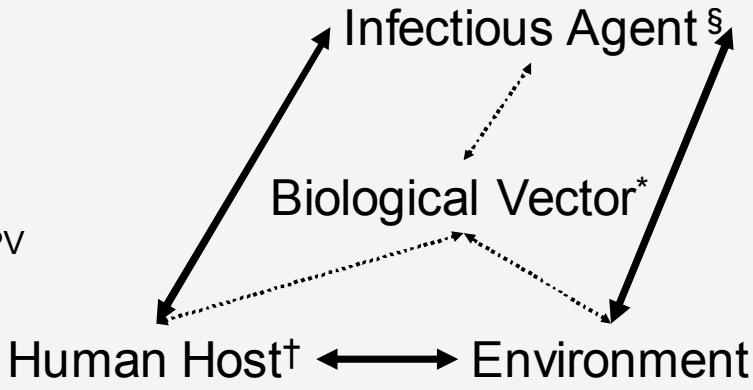
The infection transmission system

*in case of CC: men

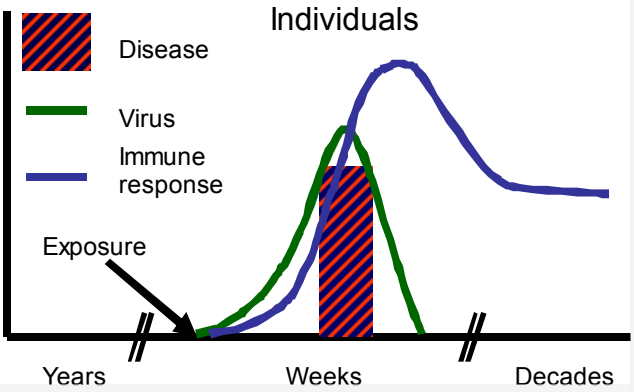
†in case of CC: women

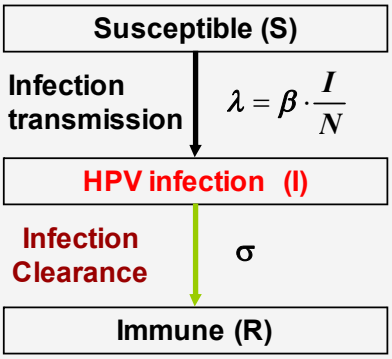
§ in case of CC: carcinogenic HPV



Dynamic transmission systems: mechanistic models based on the assumption that infectious agent transmission results from the dynamic interaction between populations (IA, HH, BV) within a specific and changing environment.

Modelling ID natural history

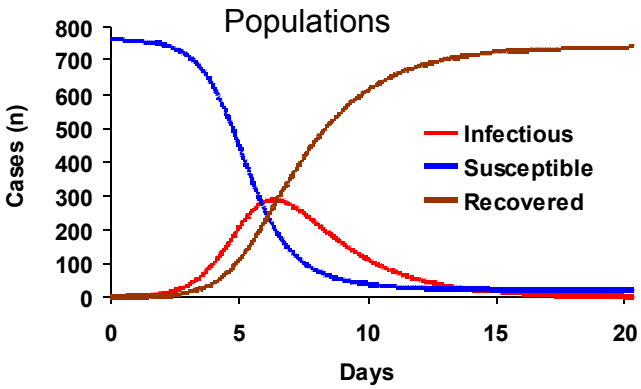




Susceptibles: $\frac{dS}{dt} = -\lambda S,$

Infected: $\frac{dI}{dt} = \lambda S - \sigma I,$

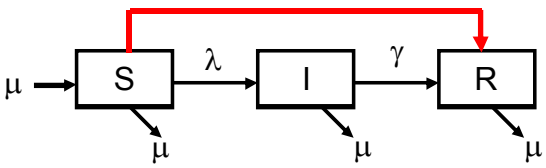
Recovered: $\frac{dR}{dt} = \sigma I$

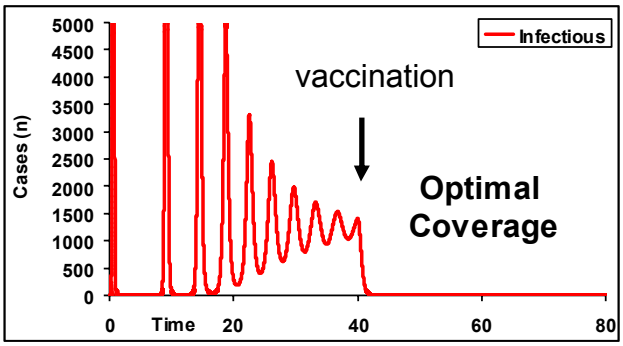


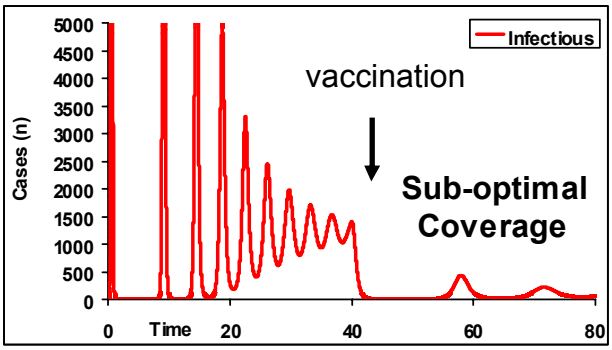
Modelling ID control - Vaccination

Incidence of infection is <u>directly proportional</u> to ***exposure*** (characterized by *contact rate, probability of transmission, duration of infectiousness)* and ***fraction of susceptible*** *individuals*

Vaccination acts on *Incidence of infection* by decreasing the ***fraction of susceptible***

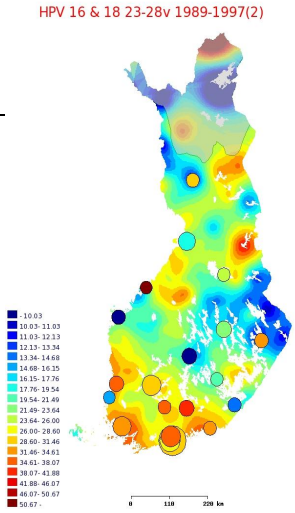


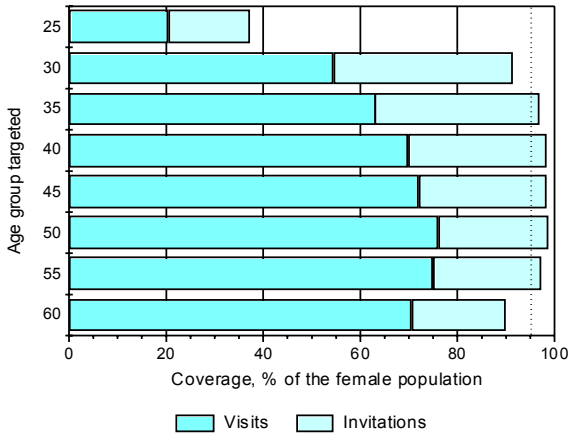


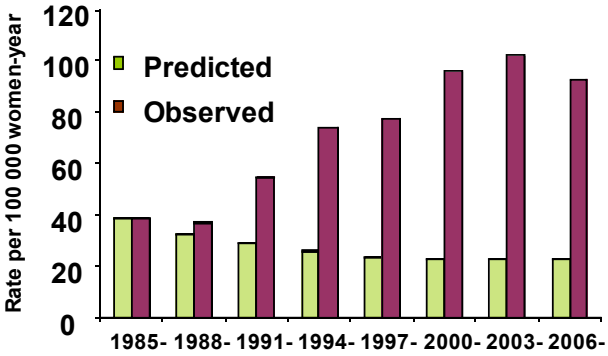


Behaviour Changes

- Impact on cervical cancer incidence
  - Changes in sexual behavior
    - Changes in HPV16 incidence
      - Changes in attitude towards screening

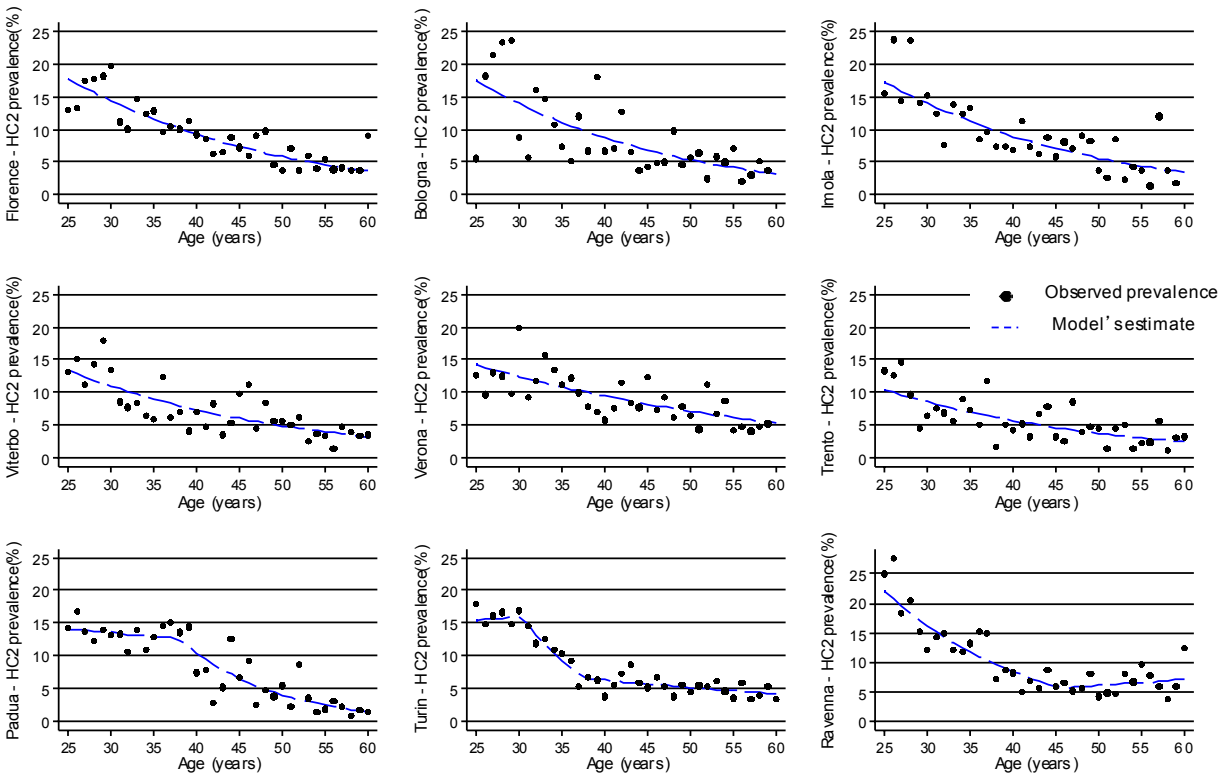






(www.cancer.fi)

Geographical Heterogeneity

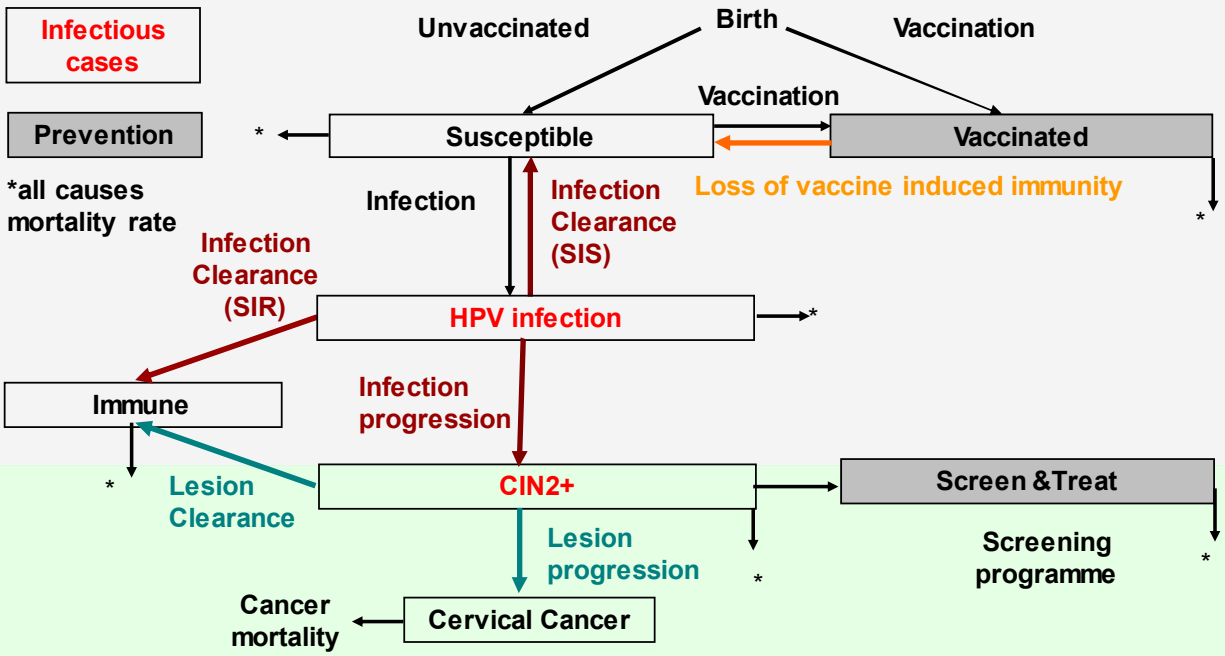


Baussano et al., 2011.In progress

Modelling Cervical Cancer Control

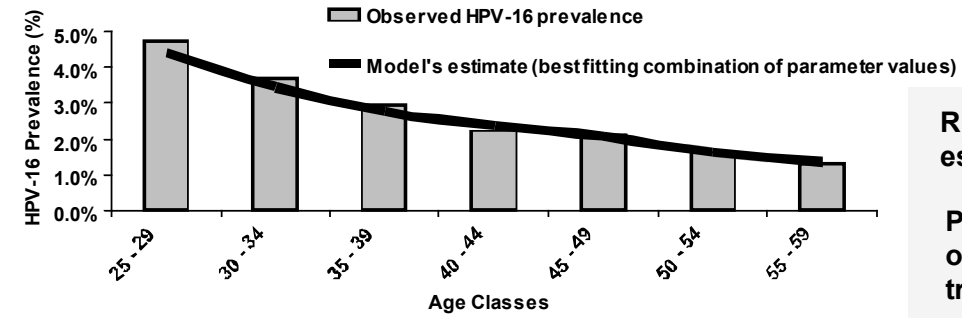
- HPV infection and Cervical Cancer Natural History
  - Estimation of the probability of transmission of HPV-16 infection.
- Impact of vaccination or screening (separately)
  - Impact of vaccination as a function of patterns of clearance of HPV-16 infection.
  - Impact of screening as a function of changes in sexual behaviors over time.
- Investigation of integration of vaccination and screening
  - Identification of optimal screening round intervals as a function of vaccination coverage.
  - Sample size definition for a RCT combining HPV vaccination & screening strategies.

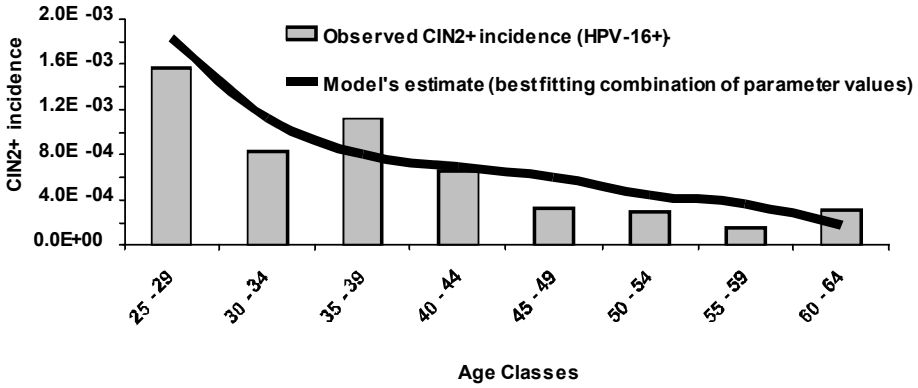
HPV and Cervical Cancer Model



Baussano et al., Epidemics 2010; 2: 21–28.

Transmission probability & assortativeness





Baussano et al., Epidemics 2010; 2: 21–28.

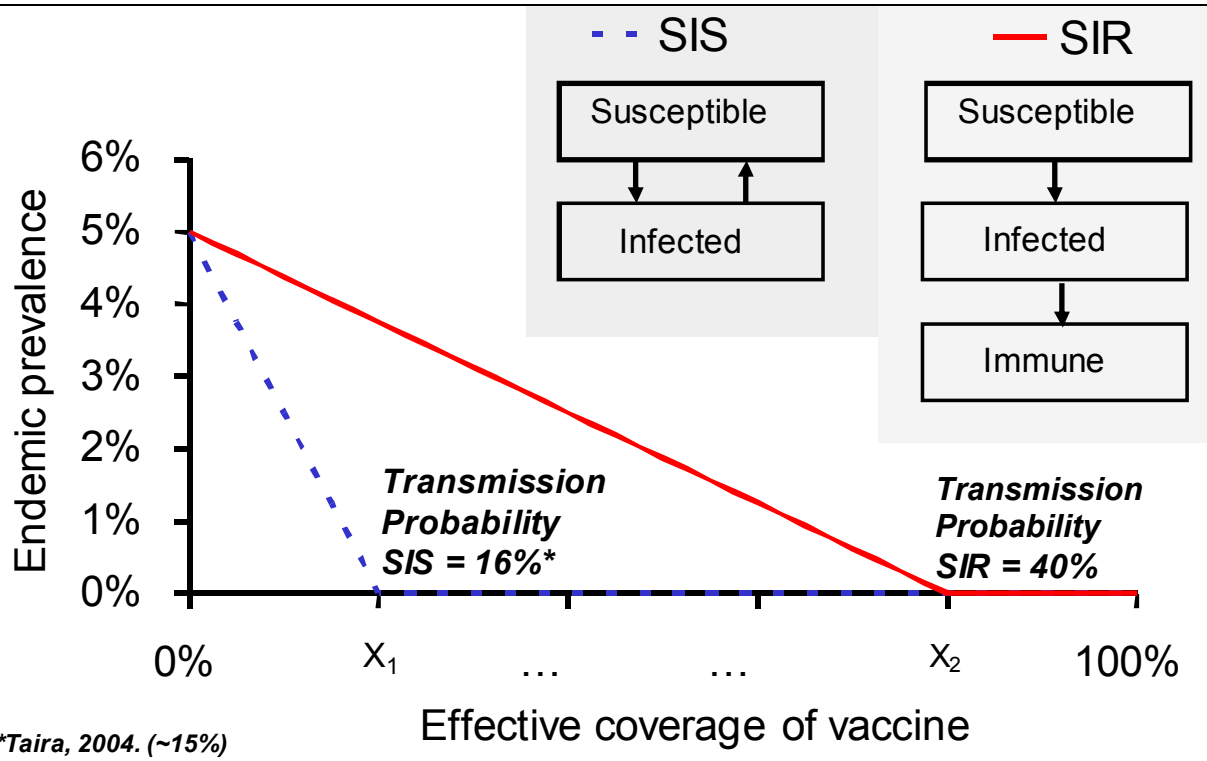
Range explored (best estimate)

Probability of HPV-16 transm.	**0 – 1 (0.4) §**
Assort. Age	**0* – 1† (0.4)**
Assort. CSA	**0* – 1† (0.4)**

***Fully assortative – †Random choice.**

§ Burchell et al., 2010. 0.42 (0.36–0.47) per partnership

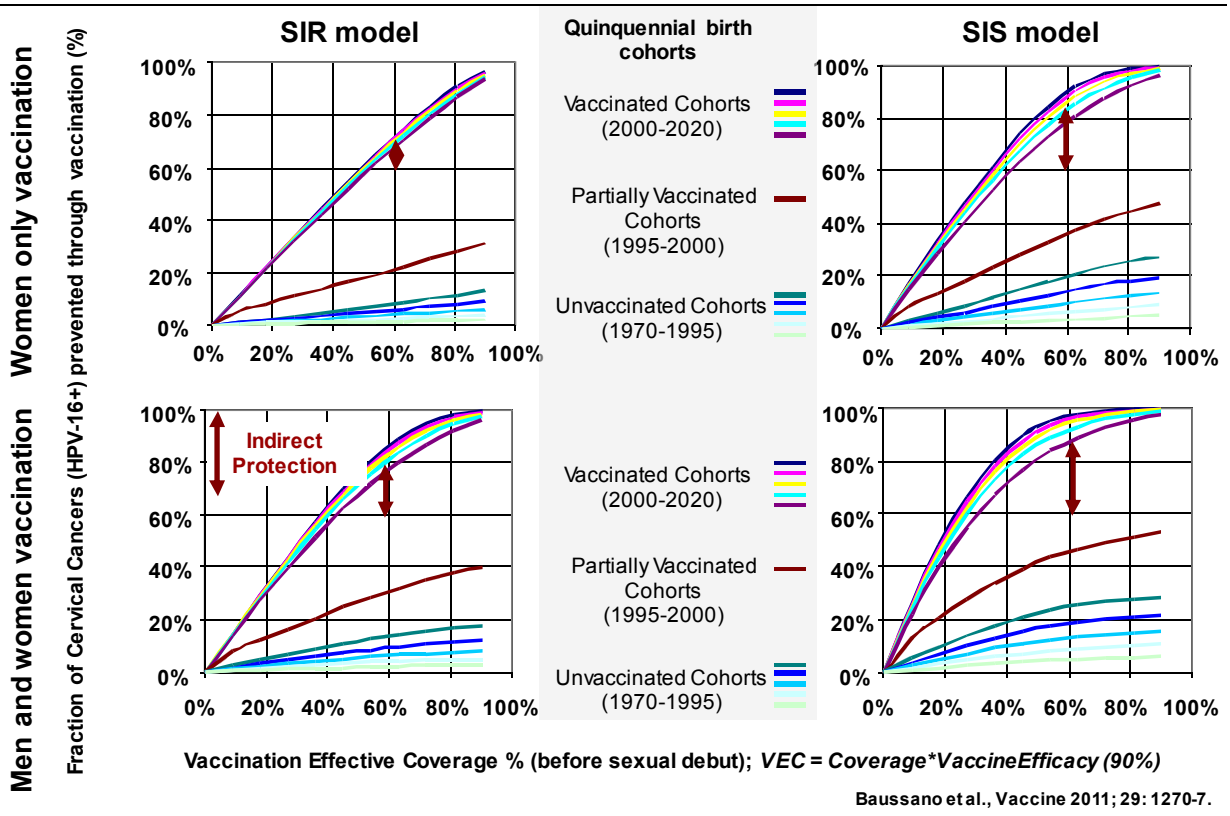
Patterns of clearance and vaccination



*Taira, 2004. (~15%)

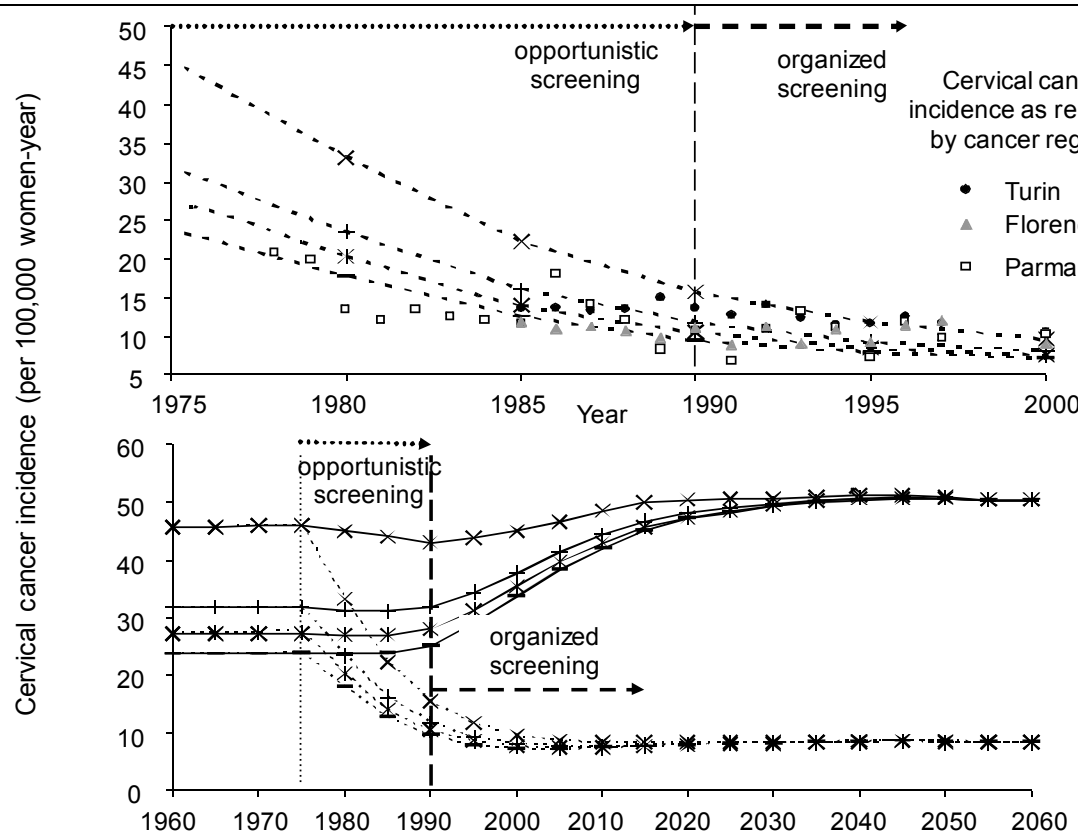
Baussano et al., Vaccine 2011; 29: 1270-7.

Patterns of clearance and Herd Effect

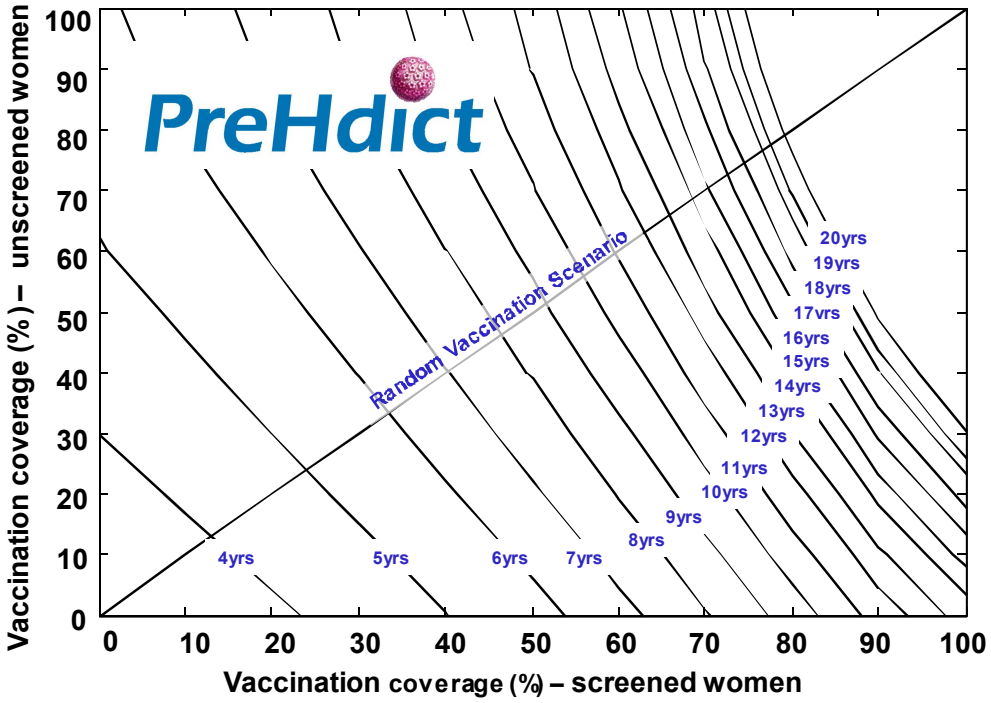


Baussano et al., Vaccine 2011; 29: 1270-7.

Sexual Behaviour & Impact of Screening



Integrated cancer control programmes



Baussano et al., 2011. in progress

Phase IV HPV16/18 vaccination trial

- **33 communities** (11 communities/arm):
  A-arm: HPV16/18 boys&girls
  B-arm: HPV16/18 girls, boys HBV
  C-arm: HBV boys&girls
- **Birth-cohorts enrolled:**
  1992/93 in 2007/08
  1994/95 in 2008/09/10
- **Total eligible: 80 000 early adolescents**
- **Enrolled:** **vaccin./ volunteers**
  1992/93 born 16 000 / 17 000
  1994/95 born 16 200 / 18 000
- **Total:** **32 200 / 35 000**
- **Follow-up:** 60% ♀ HPV-tested at 18 years of age
- **End-points:** Significant reduction of hrHPV prevalence by birth-cohort in 18-year old ♀ overall and in unvaccinated by 2010-14 (**A** vs. **C, B** vs. **C, A** vs. **B**)

Discussion: dynamic perspective

- Opportunities
  - Explicit theoretical framework
    - Support study design e.g. to estimate sample size for community RCT.
    - Cost-effectiveness analyses
    .
  - Unifying approach to investigate the epidemiology of cancers caused by infections
    - Combining dynamic and carcinogenic models
- Limitations
  - Overwhelming complexity and outputs are sensitive to assumptions and initial conditions
    - Limit the interpretation of the results (uncertainty and sensitivity analyses)
  - New skills and tools needed
    - Computing methods and high-performance clusters

Acknowledgments

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Thank you for your attention