VMMC Prioritization and Strategies Informed by Mathematical Models

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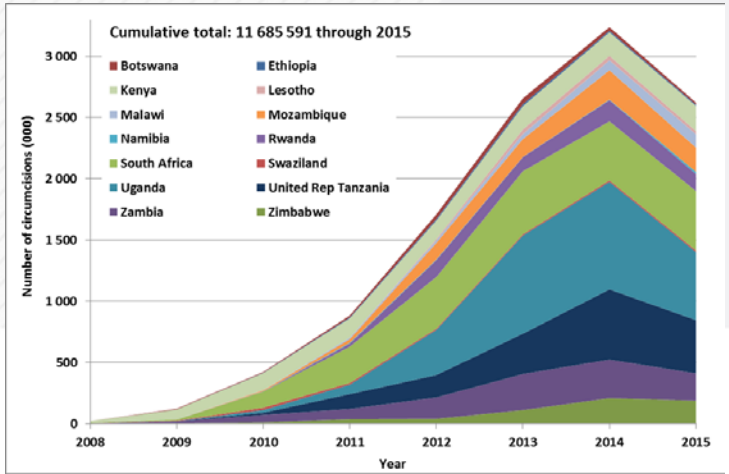
First VMMC Cost and Impact Models

- First models of VMMC impact published 2006 – 2009
- Njeuhmeli *et al*. (2011) estimated from DMPPT model
  - 20.3 million circumcisions required to achieve 80% coverage in 15-49 yr age group by 2015 and maintain 80% coverage through 2025
  - Would cost US$ 2bn, avert 3.36 m HIV infections, and avert US$ 16.5 bn treatment costs
- Rapid expansion of VMMC programmes 2011 – 2016 with estimated total ~14 m MCs



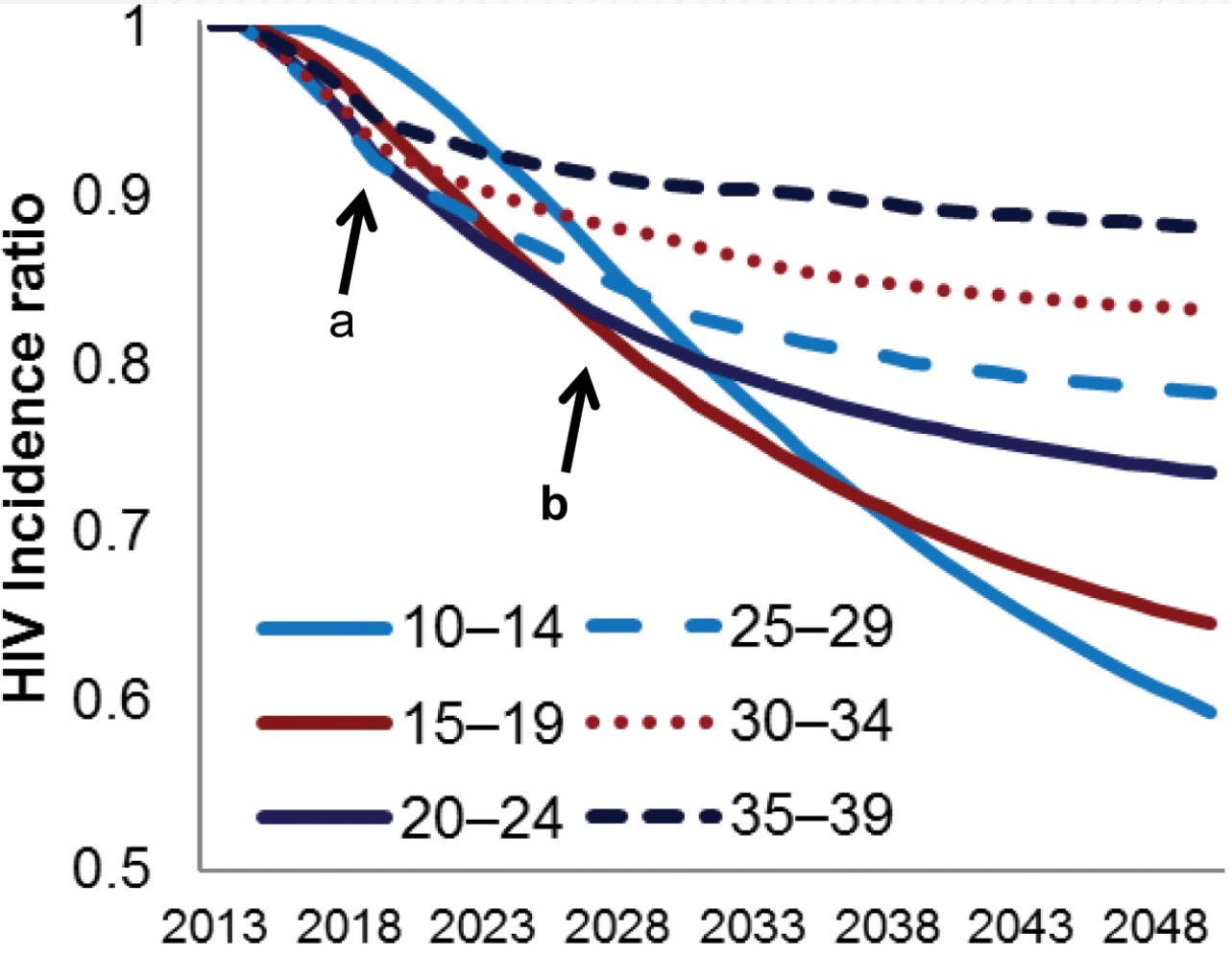
Updated VMMC Models 2015-17

- Updated models
  - Revised (DMPPT) and new (World Bank, Weill-Cornell, CDC) models
  - Key differences from earlier models
    - Non-uniform circumcision coverage by age group
    - Updated HIV incidence estimates
    - Lower annual ARV treatment costs
    - Slower and non-uniform circumcision scale-up
- WHO-UNAIDS consolidated review of all models
  - Implications for optimal use of resources 2016-21 and sustainability of VMMC programmes into future

Age Targeting

- Updated models can assess relative impact of targeting different 5-year age bands
- Results very consistent across models and priority countries

Relative Impact of Scaling up in Specific 5-year Age Strata



Reduction in HIV incidence by age group, 2014–2050. Each line represents HIV incidence ratio under scenario in which only indicated 5-year age group circumcised.

Marker ***a*** represents 5-yr period from 2014. Marker ***b*** represents a 15-yr period from 2014.

(doi:10.1371/journal.pone.0157071.g001)

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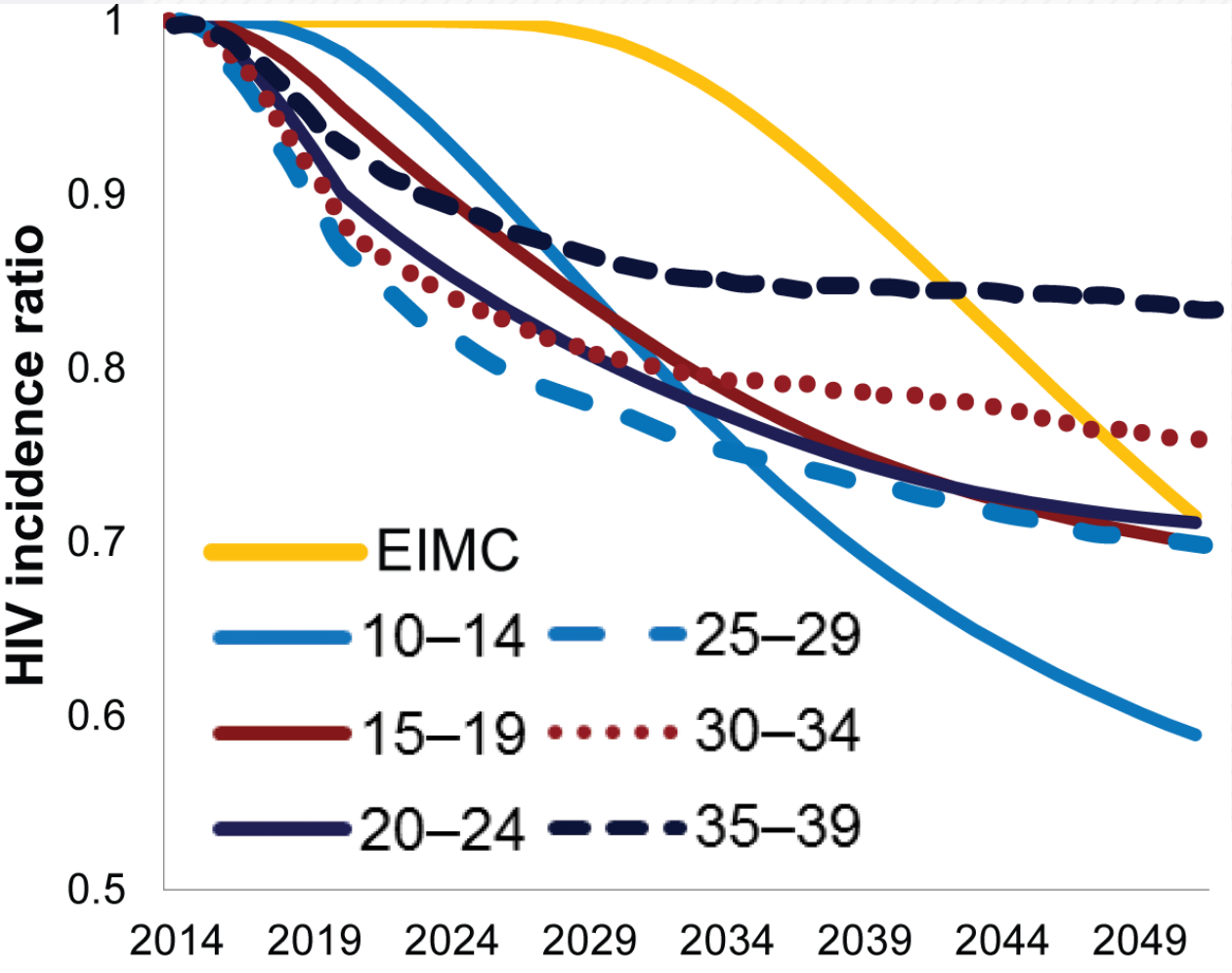
Relative Impact of Scaling up in Specific 5-year Age Strata

- Short-term impact
  - Greatest if circumcise age groups at highest current HIV risk
- Medium-term impact
  - Greatest if circumcise age groups soon to enter highest HIV risk
  - Least if circumcise men 30 years or older
- Example from South Africa, but similar results obtained in other priority countries

Early Infant Male Circumcision (EIMC)



Early infant circumcision has similar relative impact as circumcising 10-14 year age stratum, but delayed by about 20 years.

(doi:10.1371/journal.pone.0159167.g001)

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Early Infant Male Circumcision (EIMC)

- With no EIMC programme, maintaining circumcision coverage requires fewer total annual circumcisions but concentrated in a single age stratum (e.g. 10-14 years, 'adolescent programme')
- Once EIMC coverage is 80%, adolescent programme phases out approx. 15 years later
- With partial EIMC programme, smaller adolescent programme, but is required indefinitely

Prioritizing Region and/or Risk Group

- Region
  - In most countries data not sufficiently detailed to explore prioritization by age and region
  - Clear regional differences in HIV incidence in Kenya and Malawi which lead to obvious prioritization
  - Urban areas in general have higher HIV incidence than rural areas
- Risk group
  - Models show substantial impact of prioritizing men at higher sexual risk (e.g. multiple partners). Implies should focus on e.g. STI clinic patients, (some) occupational groups, …

UNAIDS Fast Track Target Circumcision Numbers

Estimated number of circumcisions required by country to achieve 80% or 90% coverage in 10-29 yr age group by 2020

Source: UNAIDS

Country	% in 2015	Target 80%	Target 90%
Botswana	31%	240,000	280,000
Ethiopia (Gambela)	75%	10,000	19,000
Kenya (Nyanza)	72%	290,000	505,000
Lesotho	69%	55,000	100,000
Malawi	26%	2.5 million	3.0 million
Mozambique	57%	2.2 million	2.9 million
Namibia	27%	310,000	370,000
Rwanda	35%	1.3 million	1.6 million
South Africa	56%	2.7 million	3.9 million
South Sudan	26%	1.8 million	2.1 million
Swaziland	32%	150,000	180,000
Uganda	53%	3.6 million	4.6 million
Tanzania	84%	1.1 million	2.4 million
Zambia	37%	2.0 million	2.4 million
Zimbabwe	22%	2.2 million	2.6 million
Total		20.4 million	26.8 million