

The cost-benefit and cost-effectiveness of providing menstrual cups and sanitary pads to schoolgirls in rural Kenya

Masih A Babagoli*, Anja Benshaul-Tolonen*[†], Garazi Zulaika, Elizabeth Nyothach, Clifford Oduor, David Obor, Linda Mason, Emily Kerubo, Isaac Ngere, Kayla F. Laserson, Rhiannon Tudor Edwards, Penelope A Phillips-Howard

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I. Chlamydia (*C. trachomatis*) health impact calculation

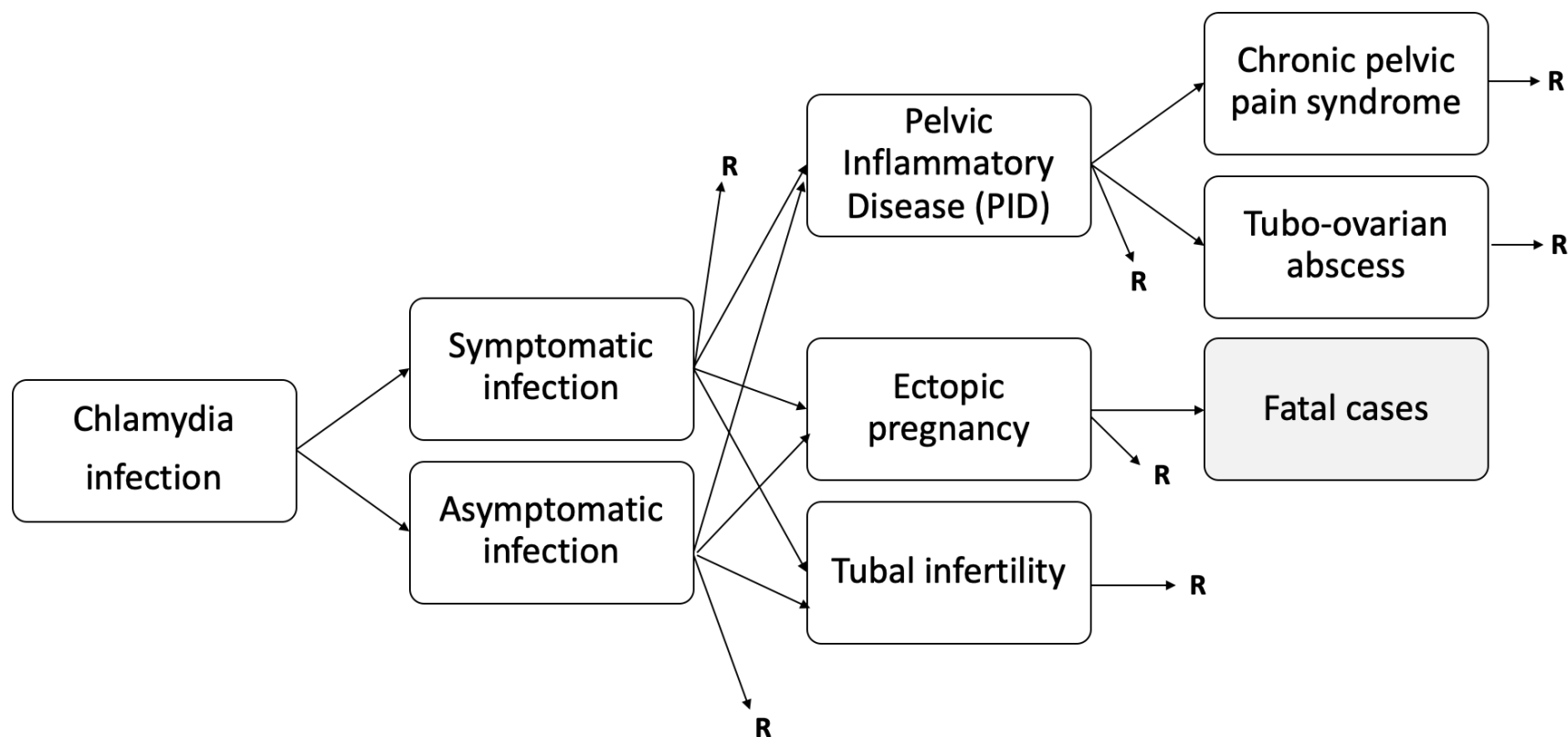


Figure S1: Pathogen-based disease model for chlamydia. Adopted from Burden of Communicable Diseases in Europe, BCoDE v2.0.0 (European Centre for Disease Prevention and Control 2020).

Table S1: Inputs used in calculating DALYs per chlamydia infection and associated long-term sequelae.

Health state	Transition probability [†]	Transition input	Source/assumption	Disability weight [‡]	DW input	Health state name	Duration (years) [^]	Duration input	Source/assumption
Symptomatic infection	10–30%	0.2	Stamm, 1999; Stamm, 2005; Gaydos & Quinn, 2012; Gaydos, 1998; Kalwij, 2010	0.006 (0.002–0.012)	0.006	Infectious disease, acute episode, mild	0.03	0.03	Murray, 1996
Pelvic inflammatory disease (PID)	9% (4–19%)	0.09	ECDC, 2014	0.011–0.324	0.1675	Abdominopelvic problem, mild to severe	0.04	0.04	Westrom, 1980
Tubo-ovarian abscess	0.80%	0.008	Ness, 2002	0.324 (0.220–0.442)	0.324	Abdominopelvic problem, severe	0.01	0.01	Goharkhay, 2007; Teisala, 1990
Chronic pelvic pain syndrome	18–75%	0.465	ECDC, 2014; Soper 2010	0.011–0.114	0.0625	Abdominopelvic problem, mild to moderate	2.8	2.8	Sharma, 2011
Ectopic pregnancy	0.07%	0.0007	van Valkengoed, 2004	0.324 (0.220–0.442)	0.324	Abdominopelvic problem, severe	0.08	0.08	Murray, 1996
Tubal Infertility	0.02%	0.0002	Land, 2010; ECDC, 2014	0.008 (0.003–0.015)	0.008	Infertility, primary	34	34	Average study age 15; female reproductive age 15–49
Fatal cases following ectopic pregnancy	0.038%	0.00038	Goldner, 1993		1		71	71	Average study age 15; life expectancy 86

Gray columns indicate point estimates used as inputs in DALY calculation.

[†]Estimate reflects transition probability to health system from previous health state, not from initial infection. Compiled by BCoDE v2.0.0 (European Centre for Disease Prevention and Control 2020).

[‡]From Global Burden of Disease 2017 (James et al. 2018)

[^]Compiled by BCoDE v2.0.0 (European Centre for Disease Prevention and Control 2020).

Table S2: DALY calculation per chlamydia infection and associated long-term sequelae.

Health state	DALYs per infection [†]
Symptomatic infection	0.000036
Pelvic inflammatory disease (PID)	0.00060
Tubo-ovarian abscess	2.3E-06
Chronic pelvic pain syndrome	0.0073
Ectopic pregnancy	0.000018
Tubal Infertility	0.000054
YLD per infection	0.0080
Fatal cases following ectopic pregnancy	0.000019
YLL per infection	0.000019
Total DALYs per chlamydia infection*	0.0081

[†]Calculated using disability weight, duration, and probability of respective health state.

*Infection is either symptomatic or asymptomatic case.

Based on information in Table S1.

II. Gonorrhea (*N. gonorrhea*) health impact calculation

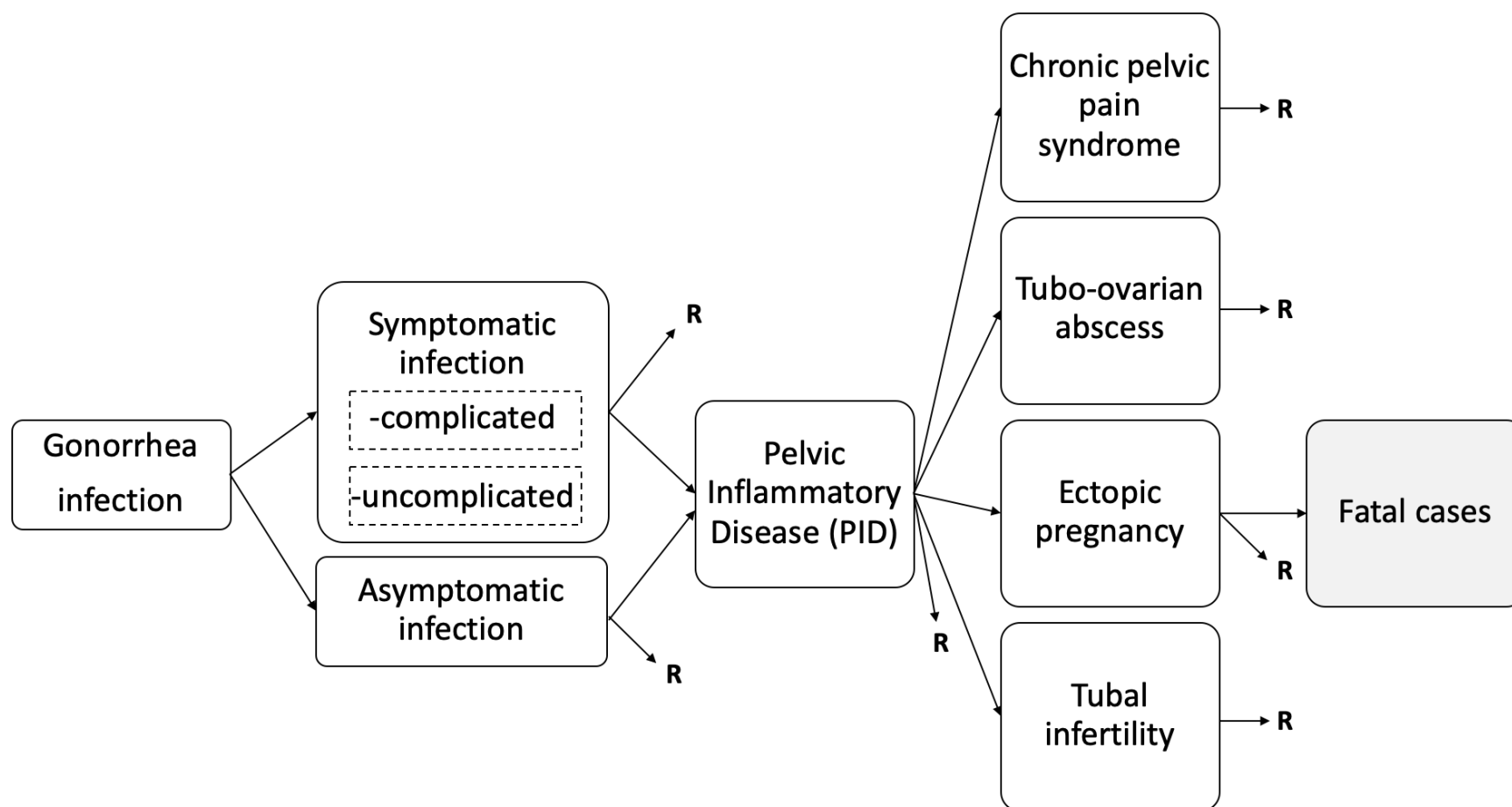


Figure S2: Pathogen-based disease model for gonorrhea. Adopted from Burden of Communicable Diseases in Europe, BCoDE v2.0.0 (European Centre for Disease Prevention and Control 2020).

Table S3: Inputs used in calculating DALYs per gonorrhea infection and associated long-term sequelae.

Health state	Transition probability [†]	Transition input	Source/assumption	Disability weight [‡]	DW input	Health state name	Duration (years) [^]	Duration input	Source/assumption
Symptomatic infection (uncomplicated)	19-60%*	0.395	Handsfield & Sparling, 2005; De Maio & Zenilman, 1998; Nelson, 2007; Westrom, 1992; Holmes, 2007	0.051 (0.032-0.074)	0.051	Infectious disease, acute episode, moderate	0.03	0.03	Murray, 1996
Symptomatic infection (complicated)	0-1.8%**	0.009	Handsfield & Sparling, 2005; De Maio & Zenilman, 1998; Nelson, 2007; Westrom, 1992; Holmes, 2007	0.133 (0.088-0.190)	0.133	Infectious disease, acute episode, severe	0.03	0.03	Murray, 1996
Pelvic inflammatory disease (PID)	30% (10-40%)	0.3	Bernstein, 2006	0.114 (0.078-0.159)	0.114	Abdominopelvic problem, moderate	0.07	0.07	Westrom, 1980
Tubo-ovarian abscess	0.80%	0.008	Ness, 2002	0.324 (0.220-0.442)	0.324	Abdominopelvic problem, severe	0.01	0.01	Goharkhay, 2007; Teisala, 1990
Chronic pelvic pain syndrome	18% (15-30%)	0.18	Bernstein, 2006	0.114 (0.078-0.159)	0.114	Abdominopelvic problem, moderate	2.8	2.8	Sharma, 2011
Ectopic pregnancy	7.8-9.1%	0.0845	Bernstein, 2006	0.324 (0.220-0.442)	0.324	Abdominopelvic problem, severe	0.08	0.08	Murray, 1996
Tubal Infertility	15% (9-18%)	0.15	Bernstein, 2006	0.008 (0.003-0.015)	0.008	Infertility, primary	34	34	Average study age 15; female reproductive age 15-49
Fatal cases following ectopic pregnancy	0.038%	0.00038	Goldner, 1993		1		71	71	Average study age 15; life expectancy 86

Gray columns indicate point estimates used as inputs in DALY calculation.

[†]Estimate reflects transition probability to health system from previous health state, not from initial infection. Compiled by BCoDE v2.0.0 (European Centre for Disease Prevention and Control 2020).

[‡]From Global Burden of Disease 2017 (James et al. 2018)

[^]Compiled by BCoDE v2.0.0 (European Centre for Disease Prevention and Control 2020).

*20-60% transition probability to overall symptomatic infection, and 97-99.5% of symptomatic infections are uncomplicated, resulting in specific transition probability of 19-60% to uncomplicated symptomatic infections.

**20-60% transition probability to overall symptomatic infection, and 0.5-3% of symptomatic infections are complicated, resulting in specific transition probability of 0-1.8% to complicated symptomatic infections.

Table S4: DALY calculation per gonorrhea infection and associated long-term sequelae.

Health state	DALYs per infection [†]
Symptomatic infection (uncomplicated)	0.00060
Symptomatic infection (complicated)	0.000036
Pelvic inflammatory disease (PID)	0.0024
Tubo-ovarian abscess	0.0000078
Chronic pelvic pain syndrome	0.017
Ectopic pregnancy	0.00066
Tubal Infertility	0.012
YLD per infection	0.033
Fatal cases following ectopic pregnancy	0.00068
YLL per infection	0.00068
Total DALYs per gonorrhea infection*	0.033

[†]Calculated using disability weight, duration, and probability of respective health state.

*Infection is either symptomatic or asymptomatic case.

Based on information in Table S3.

III. HIV health impact calculation (for use in health impact calculation for other infections)

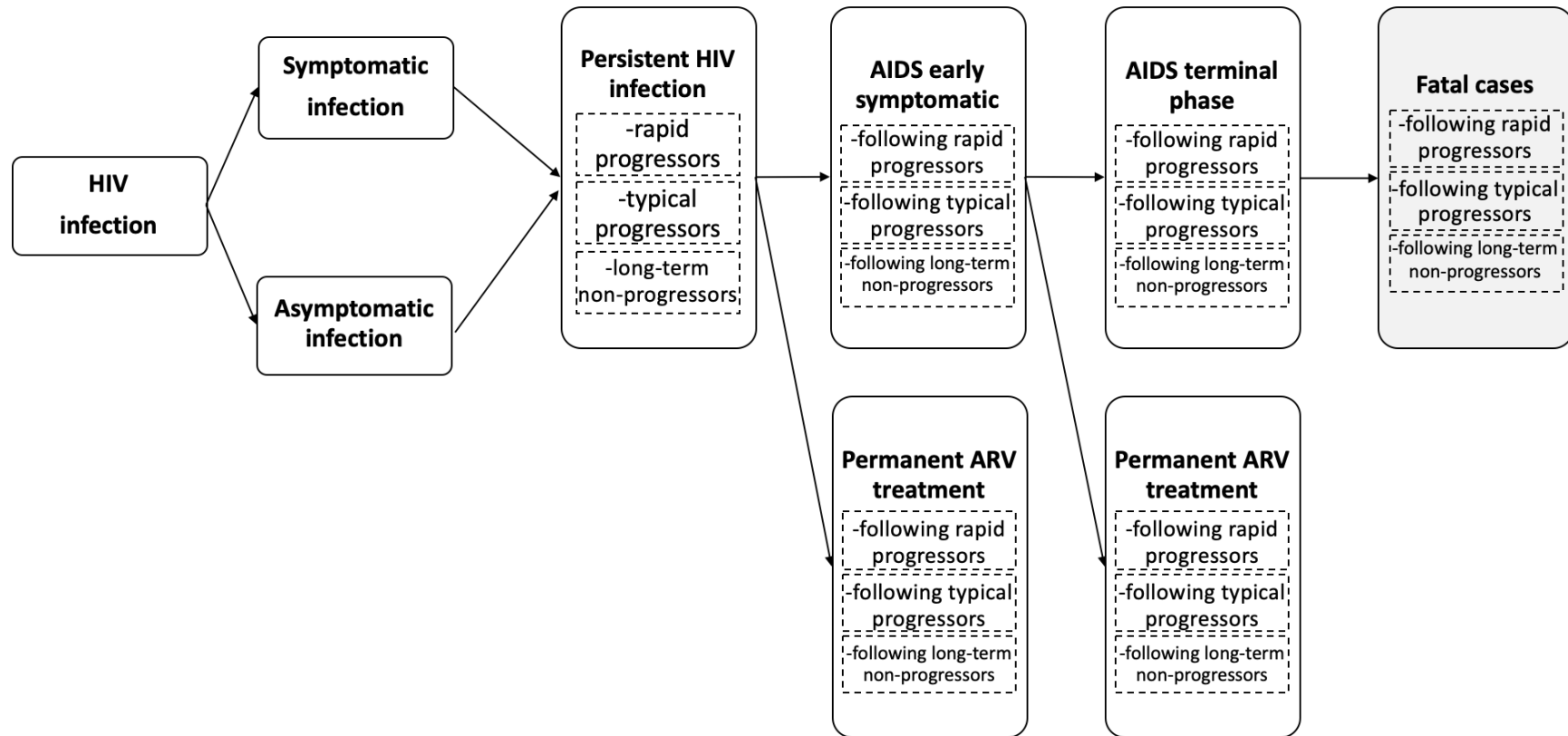


Figure S3: Pathogen-based disease model for HIV. Adopted from Burden of Communicable Diseases in Europe, BCoDE v2.0.0 (European Centre for Disease Prevention and Control 2020).

Table S5: Inputs used in calculating DALYs per HIV infection and associated long-term sequelae.

Health state	Transition probability [†]	Transition input	Source/assumption	Disability weight [‡]	DW input	Health state name	Duration (years) [^]	Duration input	Source/assumption
Persistent HIV infection									
Rapid	5-15%	0.1	Qu, 2008; Herida, 2006	0.078 (0.052-0.111)	0.078	HIV/AIDS cases, receiving ARV treatment	2-5	3.5	Qu, 2008; Herida, 2006
Typical	70-90%	0.8		0.078 (0.052-0.111)	0.078		8-10	9	
Long-term	5-15%	0.1		0.078 (0.052-0.111)	0.078		17.2	17.2	
AIDS early symptomatic									
Following rapid	4.5-7%	0.0575	Grinsztejn, 2014	0.274 (0.184-0.377)	0.274	HIV cases, symptomatic, pre-AIDS	5.36	5.36	Herida, 2006
Following typical	4.5-7%	0.0575		0.274 (0.184-0.377)	0.274		5.36	5.36	
Following long-term	4.5-7%	0.0575		0.274 (0.184-0.377)	0.274		5.36	5.36	
Permanent ARV treatment									
Following rapid	93-95.5%	0.9425	1-probability of transitioning to AIDS early symptomatic	0.078 (0.052-0.111)	0.078	HIV/AIDS cases, receiving ARV treatment	66-69	67.5	Assuming average study age 15; life expectancy 86
Following typical	93-95.5%	0.9425		0.078 (0.052-0.111)	0.078		61-63	62	
Following long-term	93-95.5%	0.9425		0.078 (0.052-0.111)	0.078		53.8	53.8	
AIDS terminal phase									
Following rapid	32.09%	0.3209	Serraino, 2010	0.582 (0.406-0.743)	0.582	AIDS cases, not receiving ARV treatment	0.08	0.08	Kwong, 2010
Following typical	32.09%	0.3209		0.582 (0.406-0.743)	0.582		0.08	0.08	
Following long-term	32.09%	0.3209		0.582 (0.406-0.743)	0.582		0.08	0.08	
Permanent ARV treatment (following AIDS early symp.)									
Following rapid	67.91%	0.6791	1-probability of transitioning to AIDS terminal phase	0.078 (0.052-0.111)	0.078	HIV/AIDS cases, receiving ARV treatment	60.64-63.64	62.14	Assuming average study age 15; life expectancy 86
Following typical	67.91%	0.6791		0.078 (0.052-0.111)	0.078		55.64-57.64	56.64	
Following long-term	67.91%	0.6791		0.078 (0.052-0.111)	0.078		48.44	48.44	
Fatal cases									
Following rapid	100%	1			1		60.56-63.56	62.06	Assuming average study age 15; life expectancy 86
Following typical	100%	1			1		55.56-57.56	56.56	
Following long-term	100%	1			1		48.36	48.36	

Gray columns indicate point estimates used as inputs in DALY calculation.

[†]Estimate reflects transition probability to health system from previous health state, not from initial infection. Compiled by BCoDE v2.0.0 (European Centre for Disease Prevention and Control 2020).

[‡]From Global Burden of Disease 2017 (James et al. 2018)

[^]Compiled by BCoDE v2.0.0 (European Centre for Disease Prevention and Control 2020).

Table S6: DALY calculation per HIV infection and associated long-term sequelae.

Health state	DALYs per infection [†]
Persistent HIV infection	
Rapid	0.027
Typical	0.56
Long-term	0.13
AIDS early symptomatic	
Following rapid	0.0084
Following typical	0.068
Following long-term	0.0084
Permanent ARV treatment	
Following rapid	0.50
Following typical	3.6
Following long-term	0.40
AIDS terminal phase	
Following rapid	0.000086
Following typical	0.00069
Following long-term	0.000086
Permanent ARV treatment (following AIDS early symptomatic)	
Following rapid	0.019
Following typical	0.14
Following long-term	0.015
YLD per infection	5.5
Fatal cases	
Following rapid	0.11
Following typical	0.83
Following long-term	0.089
YLL per infection	1.0
Total DALYs per HIV infection*	6.6

[†]Calculated using disability weight, duration, and probability of respective health state.

*Infection is either symptomatic or asymptomatic case.

Based on information in Table S5.

IV. Bacterial vaginosis (BV) health impact calculation

Table S7: DALY calculation per bacterial vaginosis infection as a result of increased risk for other health states.

Outcome	Risk without BV [†]	DALYs per infection*	Probability-weighted DALYs w/o BV	Hazard ratio for outcome w/ BV [‡]	Risk with BV	Probability-weighted DALYs w/ BV	Effect of BV on DALYs
Chlamydia	4.50%	0.0081	0.00036	1.75 ^a	7.88%	0.00064	0.00027
Gonorrhea	0.60%	0.033	0.00020	1.43 ^b	0.86%	0.00028	0.000085
HIV	0.18%	6.6	0.012	1.93 ^c	0.35%	0.023	0.011
SUM							0.011

[†] Baseline risk of chlamydia and gonorrhea in this population estimated by prevalence of each outcome in control group of RCT (Phillips-Howard et al. 2016). Baseline risk of HIV in this population estimated by incidence of HIV in Kenya in 2017 (National AIDS Control Council 2018).

* Calculated considering all long-term sequelae for each outcome based on BCoDE models.

[‡] Hazard ratio of impact of bacterial vaginosis on subsequent risk for each outcome.

^a Hazard ratio of incident chlamydia given bacterial vaginosis (7-10 Nugent Gram stain score) at visit 3 months prior. Adjusted for age, ethnicity, number of sex partners, condom use, other medications, vaginal douching, and other STI at prior visit (Brotman et al. 2010).

^b Hazard ratio of incident gonorrhea given bacterial vaginosis (7-10 Nugent Gram stain score) at visit 3 months prior. Adjusted for age, ethnicity, number of sex partners, condom use, other medications, vaginal douching, and other STI at prior visit (Brotman et al. 2010).

^c Hazard ratio of incident HIV given bacterial vaginosis (7-10 Nugent Gram stain score) at preceding visit within 6 months (van de Wijgert et al. 2008). Adjusted for country.

V. Trichomoniasis (*T. vaginalis*) health impact calculation

Table S8: DALY calculation per trichomoniasis infection as a result of increased risk for other health states.

Outcome	Risk without trich [†]	DALYs per infection*	Probability-weighted DALYs w/o trich	Hazard ratio for outcome w/ trich [‡]	Risk with trich	Probability-weighted DALYs w/ trich	Effect of trich on DALYs
HIV	0.18%	6.6	0.012	2.05 ^a	0.37%	0.024	0.012
SUM							0.012

[†] Baseline risk of HIV in this population estimated by incidence of HIV in Kenya in 2017 (National AIDS Control Council 2018).

* Calculated considering all long-term sequelae for each outcome based on BCoDE models.

[‡] Hazard ratio of impact of trichomoniasis on subsequent risk for each outcome.

^a Hazard ratio of incident HIV given trichomoniasis at preceding visit 3 months prior (Mavedzenge et al. 2010). Adjusted for age, education, living with partner, condom use at last sex, participant behavioral risk, primary partner behavioral risk, hormonal contraception, and other STIs.

VI. *C. albicans* infection health impact calculation

Table S9: DALY calculation per trichomoniasis infection as a result of increased risk for other health states.

Outcome	Risk without <i>C. albicans</i> [†]	DALYs per infection*	Probability-weighted DALYs w/o <i>C. albicans</i>	Hazard ratio for outcome w/ <i>C. albicans</i> [‡]	Risk with <i>C. albicans</i>	Probability-weighted DALYs w/ <i>C. albicans</i>	Effect of <i>C. albicans</i> on DALYs
HIV	0.18%	6.6	0.012	1.91 ^a	0.34%	0.023	0.011
SUM							0.011

[†] Baseline risk of HIV in this population estimated by incidence of HIV in Kenya in 2017 (National AIDS Control Council 2018).

* Calculated considering all long-term sequelae for each outcome based on BCoDE models.

[‡] Hazard ratio of impact of *C. albicans* infection on subsequent risk for each outcome.

^a Hazard ratio of incident HIV given candidiasis (including but not limited to *C. albicans*) at preceding visit within 6 months (van de Wijgert et al, 2008). Adjusted for country.

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