## Supplemental Material for

# Costs, health benefits, and cost-effectiveness of chlamydia screening and partner notification in the United States, 2000–2019: a mathematical modeling analysis

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The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention (CDC).

**Table S1.** Description of the calibration scenarios investigated as part of the sensitivity analysis in calibration of the transmission model (described in Rönn *et al*, 2019).1 We examined the impact of prior assumptions on changes in screening coverage and completeness of chlamydia case reporting, which were implemented as time-varying parameters.

|  |  |  |
| --- | --- | --- |
| Calibration Scenario Name  | Prior Assumptions on Reportinga of Cases | Prior Assumptions on Screeningb |
| Scenario 1: More Constrained Priors on Reporting and Screening | Percentage of infections reported assumed to be at least 50% in 2000, and it was constrained to increase over time from 2000 to 2015 | Screening coverage was allowed to remain stable or to increase from one year to the next from 2000 to 2015  |
| Scenario 2: Less Constrained Priors on Reporting, More Constrained Priors on Screening | Reporting was not constrained as in Scenario 1, but it was only allowed to increase over time from 2000 to 2015 | Same as Scenario 1 |
| Scenario 3: More Constrained Priors on Reporting, Less Constrained Priors on Screening | Same as Scenario 1 | Screening was allowed to decrease, remain stable or increase from 2000 to 2015 |
| Scenario 4: Less Constrained Priors on Reporting and Screening | Same as Scenario 2 | Same as Scenario 3 |

a) Reporting completeness (i.e., the percentage of diagnosed infections reported as cases to the national surveillance) is modeled as a logistic function. Prior parameter for reporting in 2000 was estimated as (Beta(7,3)/2+0.5) with a median reporting 86% (IQR 80-90%) in Scenarios 1 and 3, and estimated as Beta(7,3) with a median of 71% (IQR 61-80%) in Scenarios 2 and 4. The beta distribution is defined by shape parameters (α,β), IQR: interquartile range.

b) Screening is modeled as a Bezier function with 4 control points to allow for more flexible time trends (in Web Appendix 1.8 in Rönn *et al.* 2019 1). Changes implemented in the screening priors in the calibration scenarios apply to ages 15–18 years and 19–24 years.

**Figure S1.** Proportion of chlamydial tests which were NAATs among women ages 15-54 years. Data from the Infertility Prevention Project



## Utility values

Estimation of overall disutility using age-specific background utilities incorporated multiplicatively: disutility (d) was calculated as $d=a-au$, where a is the age specific background utility and u the sequelae specific utility. We adopted age-specific background utility using the EQ-5D index scores to account for age-related co-morbidity.2

**Table S2.** Utilities fromthe Global Burden of Disease (GBD) study3 used in the sensitivity analyses

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Outcome** | Mean | 95% uncertainty Interval | Distribution and parameters | Reference |
| **Symptomatic infection (women)** | 0.994 | 0.988-0.998 | Beta (886.74, 5.35) | 3 |
| **Symptomatic urethral infection (men)** | 0.961 | 0.946-0.974 | Beta (740.36, 30.15) | 3 |
| **PID utility** | 0.864 | 0.816-0.905 | See below | 3,4 |
| PID severity (proportion) |  |  |  |  |
| Moderate PID | 0.895 | 0.888-0.902 | 1-severe PID | 4 |
| Severe PID | 0.105 | 0.098-0.112 | Beta (696.96, 5962.39) | 4 |
| PID severity (utility) |  |  |  |  |
| Moderate PID | 0.886 | 0.844-0.924 | Beta (205.24, 26.41) | 3 |
| Severe PID | 0.677 | 0.560-0.784 | Beta (44.97, 21.55) | 3 |
| **CPP** | 0.923 | 0.897-0.945 | See below | 3,4 |
| CPP severity (proportion) |  |  |  |  |
| Mild CPP | 0.472 | 0.470-0.474 | 0.5\*(1-severe CPP) | 4 |
| Moderate CPP | 0.472 | 0.470-0.474 | 0.5\*(1-severe CPP) | 4 |
| Severe CPP | 0.056 | 0.053-0.060 | Beta (924.87, 15534.36) | 4 |
| CPP severity (utility) |  |  |  |  |
| Mild CPP | 0.989 | 0.979-0.996 | Beta (600.65, 6.68) | 3 |
| Moderate CPP | 0.886 | 0.844-0.924 | Beta (205.24, 26.41) | 3 |
| Severe CPP | 0.677 | 0.560-0.784 | Beta (44.97, 21.55) | 3 |
| **TFI** | 0.993 | 0.988-0.997 | See below | 3,5 |
| Sequelae severity (proportion) |  |  |  |  |
| Primary infertility | 0.659 | 0.464-0.850 | 1-secondary infertility | 5 |
| Secondary infertility | 0.341 | 0.150-0.536 | Uniform(0.140, 0.546) | 5 |
| Sequelae severity (utility) |  |  |  |  |
| Primary infertility  | 0.992 | 0.985-0.997 | Beta (828.67, 6.68) | 3 |
| Secondary infertility | 0.995 | 0.989-0.999 | Beta (829.49, 4.17) | 3 |
| **EP**  | 0.886 | 0.843-0.924 | Beta (205.24, 26.41) | 3 |
| **EDS** | 0.872 | 0.822-0.916 | Beta (165.78, 24.33) | 3 |
| **Duration estimates used in the sensitivity analysisa**  |  |  |  |  |
| TFI | NA | NA | Uniform(5,10) | Assumption |
| CPP | NA | NA | Uniform(5,10) | Assumption |

1. Same as in the main analyses

PID: pelvic inflammatory disease; TFI: tubal factor infertility; CPP: chronic pelvic pain; EP: ectopic pregnancy; EDS: epididymitis.

**Table S3.** Utilities fromthe Institute of Medicine (IOM) study6 used in the sensitivity analyses

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Outcome** | Mean | 95% uncertainty Interval | Distribution and parameters | Reference |
| **Utility estimates** |  |  |  |  |
| Symptomatic chlamydia (women) | 0.751 | 0.621- 0.864 | Beta (34.32, 11.44) | 6 |
| Symptomatic urethral infection (men) | 0.839 | 0.754-0.911 | Beta (68.85, 13.11) | 6 |
| Asymptomatic infection | 1 | Fixed | NA |  |
| PID | 0.651 | 0.472-0.811 | Beta (18.93, 10.19) | 6 |
| CPP | 0.602 | 0.405-0.785 | Beta (14.53, 9.68) | 6 |
| TFI | 0.820 | 0.726-0.900 | Beta (58.04, 12.74) | 6 |
| EP  | 0.580 | 0.375-0.777 | Beta (12.86, 9.32) | 6 |
| EDS | 0.460 | 0.206-0.729 | Beta (5.80, 6.80) | 6 |
| **Duration estimates used in the sensitivity analysisa** |  |  |  |  |
| TFI | NA | NA | Uniform(5,lifetime) | 6 |
| CPP | NA | NA | Uniform(5,lifetime) | 6 |

1. Longer than in the main analyses

PID: pelvic inflammatory disease; TFI: tubal factor infertility; CPP: chronic pelvic pain; EP: ectopic pregnancy; EDS: epididymitis.

**Supplemental results**

1. **Results using GBD utilities**

**Table S4**. Incremental costs and benefits and cost-effectiveness ratio for the current policy compared to no screening and no partner notification (PN). Costs are in 2020 US dollars. All results are shown to 5 significant digits.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Scenario** | **Cumulative costs in ‘000s****(discounted)($)** | **Cumulative QALYs lost in ‘000s****(discounted)** | **Incremental Costs, in ‘000s ($)** | **Incremental QALYs gained, in ‘000s** | **ICER ($/ QALY gained)** |
| **1. 2000-2015** |  |  |  |  |  |
| **No screening and no PN** | 15,969,000 | 1,528.00 | NA | NA | NA |
| **Current Policy** | 21,157,000 | 1,098.90 | 5,188,000 | 429.10 | 12,090 |
| 95% Uncertainty | NA | NA | -270,670; 11,369,000 | 113.28; 1,002.6 | Cost-saving; 67,630 |
| **2.1 2016-2019** |  |  |  |  |  |
| **Current Policy** | 6,919,100 | 279.74 | NA | NA | NA |
| **Guidelines** | 8,042,900 | 249.26 | 1,123,800 | 30.480 | 36,870 |
| 95% Uncertainty | NA | NA | 416,440; 1,938,200 | 8.1948; 69.736 | 9,420.9; 161,320 |
| **2.2 2016-2019 + 5 years** |  |  |  |  |  |
| **Current Policy** | 14,541,000 | 590.21 | NA | NA | NA |
| **Guidelines** | 15,494,000 | 544.53 | 953,000 | 45.680 | 20,863 |
| 95% Uncertainty | NA | NA | 202,170; 1,785,400 | 12.112; 106.35 | 3,102.2; 101,790 |

1. **Results using IOM utilities**

**Table S5**. Incremental costs and benefits and cost-effectiveness ratio for the current policy compared to no screening and no partner notification (PN). Costs are in 2020 US dollars. All results are shown to 5 significant digits.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Scenario** | **Cumulative costs in ‘000s****(discounted)($)** | **Cumulative QALYs lost in ‘000s****(discounted)** | **Incremental Costs, in ‘000s ($)** | **Incremental QALYs gained, in ‘000s** | **ICER ($/ QALY gained)** |
| **1. 2000-2015** |  |  |  |  |  |
| **No screening and no PN** | 15,969,000 | 6,828.00 | NA | NA | NA |
| **Current Policy** | 21,157,000 | 4,909.20 | 5,188,000 | 1,918.8 | 2,703.8 |
| 95% Uncertainty | NA | NA | -270,670; 11,369,000 | 541.56; 4,162.7 | Cost-saving; 14,318 |
| **2.1 2016-2019** |  |  |  |  |  |
| **Current Policy** | 6,919,100 | 1,251.40 | NA | NA | NA |
| **Guidelines** | 8,042,900 | 1,112.70 | 1,123,800 | 138.70 | 8,102.4 |
| 95% Uncertainty | NA | NA | 416,440; 1,938,200 | 39.412; 294.20 | 2,166.8; 33,932 |
| **2.2 2016-2019 + 5 years**  |  |  |  |  |  |
| **Current Policy** | 14,541,000 | 2,640.20 | NA | NA | NA |
| **Guidelines** | 15,494,000 | 2,433.90 | 953,000 | 206.30 | 4,619.5 |
| 95% Uncertainty | NA | NA | 202,170; 1,785,400 | 57.967; 446.97 | 695.70; 21,426 |

1. **Results discounting to the year of infection**

**Table S6**. Incremental costs and benefits and cost-effectiveness ratio for the current policy compared to no screening and no partner notification (PN). Costs are in 2020 US dollars. All results are shown to 5 significant digits.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Scenario** | **Cumulative costs in ‘000s****(discounted)($)** | **Cumulative QALYs lost in ‘000s****(discounted)** | **Incremental Costs, in ‘000s ($)** | **Incremental QALYs gained, in ‘000s** | **ICER ($/ QALY gained)** |
| **1. 2000-2015** |  |  |  |  |  |
| **No screening and no PN** | 19,818,000 | 2,367.10 | NA | NA | NA |
| **Current Policy** | 26,580,000 | 1,671.60 | 6,762,000 | 695.50 | 9,722.5 |
| 95% Uncertainty | NA | NA | -351,390; 14,658,000 | 205.12; 1,524.8 | Cost-saving; 49,511 |
| **2.1. 2016-2019** |  |  |  |  |  |
| **Current Policy** | 7,229,700 | 365.73 | NA | NA | NA |
| **Guidelines** | 8,399,300 | 325.58 | 1,169,600 | 40.150 | 29,131 |
| 95% Uncertainty | NA | NA | 430,360; 2,021,200 | 12.013; 86.736 | 7,669.6; 115,790 |
| **2.2. 2016-2019 + 5 years**  |  |  |  |  |  |
| **Current Policy** | 16,323,000 | 829.09 | NA | NA | NA |
| **Guidelines** | 17,294,000 | 766.94 | 971,000 | 62.150 | 15,623 |
| 95% Uncertainty | NA | NA | 180,490; 1,845,800 | 18.357; 135.92 | 2,047.6; 70,317 |

**Figure S2.** Cost-effectiveness acceptability curves for the three scenarios performed. Results using the **GBD utilities.**



**Figure S3.** Cost-effectiveness acceptability curves for the three scenarios performed. Results using the **IOM utilities**.

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**Figure S4.** Cost-effectiveness acceptability curves for the three scenarios performed. Results **discounted to the year of incident infection**.

**Footnote:** Figures show the percentage of simulations in which the cost per QALY gained was less than the given threshold.Lines present the three main scenarios: CEAC for 2000-2015 current policy compared to no screening & no PN; CEAC for screening at guidelines level compared to current policy (2016-2019); CEAC for screening at guidelines level compared to current policy with additional 5 years of follow-up (2016-2019 + 5 years)

**Table S7A. Scenario: Current policy 2000-2015.** Yearly mean number of select outcomes. QALYs lost and costs discounted. All outputs in ‘000s. Testing and PN costs include both screening and testing of symptomatic infections (with a NAAT or non-NAAT), and costs associated with PN services.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year** | **Incident infection** | **PID** | **CPP** | **TFI** | **EP** | **EPID** | **QALYs lost** | **All costs ($)** | **Testing and PN costs ($)** |
| **2000** | 3,458 | 251 | 82 | 57 | 30 | 47 | 133 | 1,292,802 | 212,376 |
| **2001** | 3,412 | 241 | 79 | 55 | 29 | 45 | 124 | 1,320,345 | 305,429 |
| **2002** | 3,342 | 229 | 75 | 52 | 28 | 43 | 114 | 1,334,822 | 392,326 |
| **2003** | 3,271 | 219 | 71 | 50 | 27 | 42 | 106 | 1,349,120 | 473,000 |
| **2004** | 3,208 | 210 | 68 | 48 | 25 | 40 | 99 | 1,356,890 | 537,135 |
| **2005** | 3,157 | 203 | 66 | 46 | 25 | 39 | 93 | 1,346,943 | 573,920 |
| **2006** | 3,116 | 197 | 64 | 45 | 24 | 39 | 87 | 1,344,710 | 614,754 |
| **2007** | 3,082 | 191 | 62 | 43 | 23 | 38 | 82 | 1,367,443 | 677,269 |
| **2008** | 3,055 | 186 | 61 | 42 | 23 | 37 | 78 | 1,370,110 | 715,133 |
| **2009** | 3,035 | 182 | 59 | 41 | 22 | 37 | 74 | 1,370,988 | 746,535 |
| **2010** | 3,020 | 179 | 58 | 41 | 22 | 37 | 71 | 1,353,719 | 755,750 |
| **2011** | 3,008 | 177 | 58 | 40 | 21 | 36 | 68 | 1,325,912 | 751,348 |
| **2012** | 2,996 | 175 | 57 | 40 | 21 | 36 | 65 | 1,308,021 | 754,797 |
| **2013** | 2,982 | 174 | 57 | 39 | 21 | 36 | 63 | 1,275,846 | 742,837 |
| **2014** | 2,962 | 172 | 56 | 39 | 21 | 35 | 60 | 1,240,026 | 726,864 |
| **2015** | 2,935 | 171 | 56 | 39 | 21 | 36 | 58 | 1,198,872 | 706,475 |
| **Total** | **50,036** | **3,158** | **1,030** | **715** | **383** | **624** | **1,374** | **21,156,569** | **9,685,950** |

**Table S7B. Scenario: No screening and no PN 2000-2015.** Yearly mean number of select outcomes. QALYs lost and costs discounted. All outputs in ‘000s. Testing and PN costs include both screening and testing of symptomatic infections (with a NAAT or non-NAAT), and costs associated with PN services.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year** | **Incident infection** | **PID** | **CPP** | **TFI** | **EP** | **EPID** | **QALYs lost** | **All costs ($)** | **Testing and PN costs ($)** |
| **2000** | 3,523 | 260 | 85 | 59 | 31 | 51 | 137 | 1,135,811 | 33,790 |
| **2001** | 3,587 | 268 | 87 | 61 | 33 | 52 | 138 | 1,140,741 | 36,921 |
| **2002** | 3,624 | 274 | 89 | 62 | 33 | 53 | 137 | 1,133,000 | 40,319 |
| **2003** | 3,646 | 277 | 90 | 63 | 34 | 53 | 134 | 1,117,763 | 43,886 |
| **2004** | 3,659 | 279 | 91 | 63 | 34 | 53 | 131 | 1,097,172 | 46,560 |
| **2005** | 3,668 | 281 | 92 | 64 | 34 | 53 | 128 | 1,071,647 | 46,672 |
| **2006** | 3,673 | 282 | 92 | 64 | 34 | 53 | 125 | 1,044,659 | 46,415 |
| **2007** | 3,677 | 282 | 92 | 64 | 34 | 53 | 122 | 1,019,449 | 48,264 |
| **2008** | 3,679 | 283 | 92 | 64 | 34 | 53 | 118 | 992,747 | 48,501 |
| **2009** | 3,680 | 283 | 92 | 64 | 34 | 53 | 115 | 966,337 | 48,651 |
| **2010** | 3,681 | 283 | 92 | 64 | 34 | 53 | 112 | 939,295 | 47,642 |
| **2011** | 3,682 | 284 | 93 | 64 | 34 | 53 | 108 | 912,359 | 46,133 |
| **2012** | 3,683 | 284 | 93 | 64 | 34 | 53 | 105 | 886,924 | 45,479 |
| **2013** | 3,683 | 284 | 93 | 64 | 34 | 53 | 102 | 861,484 | 44,160 |
| **2014** | 3,683 | 284 | 93 | 64 | 34 | 53 | 99 | 836,744 | 42,878 |
| **2015** | 3,684 | 284 | 93 | 64 | 34 | 53 | 97 | 812,634 | 41,633 |
| **Total** | 58,512 | 4,472 | 1,459 | 1,013 | 542 | 850 | 1,909 | 15,968,762 | 707,903 |

**Table S7C. Scenario: Current policy 2016-2024.** Yearly mean number of select outcomes. QALYs lost and costs discounted. All outputs in ‘000s. Testing and PN costs include both screening and testing of symptomatic infections (with a NAAT or non-NAAT), and costs associated with PN services. Years 2020-2024 included only in the analysis where 5 additional years of follow-up were included.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year** | **Incident infection** | **PID** | **CPP** | **TFI** | **EP** | **EPID** | **QALYs lost** | **All costs ($)** | **Testing and PN costs ($)** |
| **2016** | 2,939 | 170 | 56 | 39 | 21 | 36 | 90 | 1,797,823 | 1,030,864 |
| **2017** | 2,961 | 172 | 56 | 39 | 21 | 36 | 89 | 1,753,223 | 1,001,658 |
| **2018** | 2,973 | 173 | 57 | 39 | 21 | 36 | 87 | 1,706,654 | 972,276 |
| **2019** | 2,979 | 174 | 57 | 39 | 21 | 36 | 84 | 1,661,374 | 945,652 |
| **2020** | 2,983 | 175 | 57 | 40 | 21 | 36 | 82 | 1,614,302 | 917,856 |
| **2021** | 2,985 | 175 | 57 | 40 | 21 | 36 | 80 | 1,568,125 | 891,060 |
| **2022** | 2,986 | 175 | 57 | 40 | 21 | 36 | 78 | 1,522,746 | 864,878 |
| **2023** | 2,987 | 175 | 57 | 40 | 21 | 36 | 75 | 1,480,230 | 841,219 |
| **2024** | 2,987 | 175 | 57 | 40 | 21 | 36 | 73 | 1,436,374 | 815,792 |
| **Total** | **26,779** | **1,565** | **510** | **354** | **190** | **323** | **738** | **14,540,851** | **8,281,256** |

**Table S7D. Scenario: Guidelines 2016-2024.** Yearly mean number of select outcomes. QALYs lost and costs discounted. All outputs in ‘000s. Testing and PN costs include both screening and testing of symptomatic infections (with a NAAT or non-NAAT), and costs associated with PN services. Years 2020-2024 included only in the analysis where 5 additional years of follow-up were included.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year** | **Incident infection** | **PID** | **CPP** | **TFI** | **EP** | **EPID** | **QALYs lost** | **All costs ($)** | **Testing and PN costs ($)** |
| **2016** | 2,879 | 161 | 53 | 36 | 20 | 33 | 85 | 2,139,736 | 1,404,718 |
| **2017** | 2,816 | 154 | 50 | 35 | 19 | 32 | 79 | 2,044,489 | 1,359,480 |
| **2018** | 2,781 | 151 | 49 | 34 | 18 | 32 | 75 | 1,968,748 | 1,316,568 |
| **2019** | 2,760 | 149 | 49 | 34 | 18 | 32 | 72 | 1,889,880 | 1,272,269 |
| **2020** | 2,807 | 156 | 51 | 35 | 19 | 33 | 73 | 1,536,345 | 908,412 |
| **2021** | 2,885 | 164 | 54 | 37 | 20 | 35 | 75 | 1,524,224 | 885,398 |
| **2022** | 2,929 | 169 | 55 | 38 | 20 | 35 | 75 | 1,497,312 | 861,542 |
| **2023** | 2,954 | 171 | 56 | 39 | 21 | 36 | 74 | 1,465,475 | 839,263 |
| **2024** | 2,968 | 173 | 56 | 39 | 21 | 36 | 72 | 1,427,808 | 814,649 |
| **Total** | **25,778** | **1,448** | **472** | **328** | **176** | **304** | **681** | **15,494,017** | **9,662,299** |

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