Cost-effectiveness of screening programs for Chlamydia trachomatis: a population-based dynamic approach

Record Status
This is a critical abstract of an economic evaluation that meets the criteria for inclusion on NHS EED. Each abstract contains a brief summary of the methods, the results and conclusions followed by a detailed critical assessment on the reliability of the study and the conclusions drawn.

Health technology
The use of a screening programme for Chlamydia trachomatis (CT) compared with a 'no programme' strategy. The screening programme involved the ligase chain reaction test, and was offered once per year to patients visiting their general practitioner (GP).

Type of intervention
Screening.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised men and women, aged 15 to 64 years, with a baseline prevalence of CT of 4.1%.

Setting
The setting was primary care. The study was conducted in The Netherlands.

Dates to which data relate
The effectiveness data for the ligase chain reaction test and antibiotic treatment were taken from studies published in 1995 and 1997. The probabilities for the events and complications were taken from studies published between 1979 and 2000. The resource use data were taken from sources published between 1986 and 1998. The unit cost data were taken from sources published in 1993 and 1997. The currency conversion data were published in 1998.

Source of effectiveness data
The effectiveness data were derived from a synthesis of completed studies.

Modelling
A model was used to estimate both the outcomes and costs. This was adapted from a published epidemiological model (see Other Publications of Related Interest), in order to capture the relevant outcomes of the complications averted and the costs. The model was a stochastic simulation model that was able to aggregate a number of different subgroups, for example, age, gender, sexual activity and CT prevalence.

Outcomes assessed in the review
The outcomes assessed were the events and complications. The estimates taken from the literature were:
the probability of being a sexually active person (age-specific);
the probability of visiting a GP (age- and gender-specific);
the sensitivity and specificity of the ligase chain reaction test;
the effectiveness of the antibiotic treatment;
the probability of a current partner being referred (gender-specific) or being infected with CT;
the probability of CT transmission per sexual contact;
the probability of CT infection being symptomatic (gender-specific);
the probability of asymptomatic infections leading to pelvic inflammatory disease (PID) requiring in- or outpatient treatment;
the probability of chronic pelvic pain;
the probability of women considering future pregnancy (age-specific);
the risk of ectopic pregnancy, infertility, giving birth whilst CT infected (age-specific), neonatal conjunctivitis and neonatal pneumonia;
the probability of requiring an infertility investigation (in- or outpatient);
the probability of requiring in-vitro fertilisation;
the probability of epididymitis (treated as in- or outpatient).

The probabilities of accepting the CT test (gender-specific) and antibiotic treatment were quoted as having been extracted from a pilot study, although no further details were given.

**Study designs and other criteria for inclusion in the review**
The authors included published statistics and prospective cohort studies in their analysis of effectiveness. No inclusion or exclusion criteria were stated.

**Sources searched to identify primary studies**
Not stated.

**Criteria used to ensure the validity of primary studies**
Not stated.

**Methods used to judge relevance and validity, and for extracting data**
Not stated.

**Number of primary studies included**
Twenty-six published studies were included in the review.

**Methods of combining primary studies**
Investigation of differences between primary studies
Not stated.

Results of the review
The point estimates were listed for all the probabilities. The ranges were provided for those probabilities that were age-specific.

The probability of being sexually active ranged from 0.49 to 0.94, depending on age.

The probability of visiting a GP ranged from 0.55 to 0.87, depending on age and gender.

The probability of a patient accepting the CT test was 0.91 for men and 0.96 for women.

The sensitivity of the ligase chain reaction test was 0.80 and the specificity was 0.995.

The effectiveness of the antibiotic treatment was 0.95.

The probability of a person with a positive test result receiving treatment was 0.90.

The probability of a partner acquiring CT was 0.1 per sexual contact.

The probability of a CT infection being asymptomatic was 0.50 in men and 0.70 in women.

The probability of PID in an asymptotically-infected woman was 0.25, with a 40% chance of the PID being symptomatic.

The probability of chronic pelvic pain was 0.18 in women with PID.

The probability of a woman considering future pregnancy ranged from 0.00 to 0.88, depending on age. The risk of associated complications ranged from 0.08 for ectopic pregnancy, to 0.11 for infertility and to 0.30 for neonatal conjunctivitis (if the woman was infected at the time of the birth).

The probability of epididymitis in an asymptomatic CT-infected man was 0.02.

Measure of benefits used in the economic analysis
The measure of benefit was the major outcome averted (MOA). A major outcome was defined as symptomatic PID, chronic pelvic pain, ectopic pregnancy, infertility or neonatal pneumonia.

Direct costs
The direct costs were presented for a given complication or event. The individual components of the cost of complications were also listed. The direct costs included were relevant a health service or a third party payer.

The direct costs were the costs of:

visits to a GP,

hospital stay,

diagnostic tests (CT and gonorrhoea),

medication (antibiotics and analgesics),
diagnostic laparoscopy,
ultrasonography,
ambulatory control,
gynaecological and other specialist referrals,
ectopic surgery,
anatomical examination,
the determination of human chorionic gonadotropin,
the determination of prolactine and progesterone levels,
hysterosalpingography,
sperm analysis,
in-vitro fertilisation cycles,
neonatal intensive care, and
referrals to a paediatrician.

The resource use and unit cost data for the categories of analgesic drugs, gynaecological referrals, ambulatory control and infertility investigations, were obtained from published studies. The resource use and unit cost data for hospital stay and CT medication were obtained from published data references.

The costs were discounted since a 10-year screening period was chosen for the analysis. The annual discount rate was 3%. The authors reported the marginal cost of an extra complication or event. The resource use data were taken from sources published between 1986 and 1998. The unit cost data were taken from sources published in 1993 and 1997. All of the costs were adjusted to 1997 Dutch guilders, and were then converted to US dollars using the gross domestic product (GDP) purchasing-power parities.

Statistical analysis of costs
No statistical analysis was conducted.

Indirect Costs
The authors stated that they calculated costs from the societal perspective, thus they included an estimate of productivity loss in the model. They valued the loss of paid work but excluded unpaid work, such as housework and child care, in the base-case. This, however, was addressed in the sensitivity analysis. A human capital approach was used to value the loss of work, on the basis of average labour costs by age and gender. The data were taken from the Dutch national statistics for 1997 and 1998.

The estimated quantity of the patient’s time off work was reported individually for each complication or event. The quantities were taken from studies published between 1986 and 1994, and from the authors’ estimates. The future indirect costs were discounted at 3%.

Currency
US dollars ($) (1997). These were converted from Dutch guilders using the GDP purchasing-power parity derived from 1998 data.
Sensitivity analysis
A number of one-way sensitivity analyses were carried out to investigate the following:

- the use of a smaller proportion of the population in the sexually active "core" group;
- a lower CT prevalence;
- high, low and no partner referral rates;
- a low and high valuation of unpaid work;
- low screening costs;
- a high and low risk of PID due to CT; and
- a lower test acceptance rate.

In addition, scenario analyses were carried out to analyse the effects of different screening programmes, such as the inclusion of people aged up to 34 years and women- or men-only programmes.

Estimated benefits used in the economic analysis
The study population comprised 10,000 men and women with a uniform age distribution of 15 to 64 years, and a baseline prevalence of CT of 4.1%. Over a 10-year period, the number of major outcomes averted from screening this population, compared with no screening, was 127 when discounted at 3% (158 undiscounted and 112 discounted at 5%). The side-effects of the treatment were not considered in this analysis as they were not thought to be serious.

Cost results
All costs were discounted at 3%. The costs were derived from a population of 10,000 patients, over a 10-year period.

The direct cost of the screening strategy was $175,800. The direct cost of no screening was $238,400.

The total cost (including the indirect costs) of the screening strategy was $180,100. The total cost of no screening was $318,200.

In the base-case, the direct costs of the screening strategy were $62,600 less than the no-screening strategy. When the indirect costs were included, the screening strategy saved $138,100 compared with no screening.

The undiscounted cost-savings were $87,800 for the direct costs and $178,600 for the total costs. The discounted (5%) cost-savings were $49,800 (direct costs) and $117,200 (total costs).

Synthesis of costs and benefits
The costs and benefits were combined into an (incremental) cost per MOA. The incremental cost-effectiveness ratio was -$492 per MOA when using the direct costs only, and -$1,086 per MOA when including the indirect costs. The ratio was negative because the strategy was cost-saving. The costs and benefits were discounted at 3%. The currency year was 1997.

The screening strategy was cost-saving under most of the scenarios. One of the exceptions was when the CT prevalence was 56% lower than the baseline (approximately 2% of population). The incremental direct cost was then $407 per MOA; however, the strategy was cost-saving once the indirect costs were included. The other exceptions were when there was no partner referral, and in the male and female 15 to 34 age group. With no partner referral, the incremental cost per MOA was $993 (direct costs only) or $286 (total costs). For the male and female 15 to 34 age group, the incremental direct cost was $385 per MOA.
In the male 15 to 24 age group, both the net direct and indirect costs were greater for the screening strategy, even though the screening resulted in more major outcomes than the ‘no screening’ strategy.

**Authors’ conclusions**
In the early stages of the programme, the cost of screening outweighed the savings. However, the programme will eventually become cost-saving to the society. Due to the risk of re-infection, a screening programme for Chlamydia trachomatis (CT) should run for a specific minimum period to significantly reduce the incidence of CT.

**CRD COMMENTARY - Selection of comparators**
The study examined the cost-effectiveness of a screening programme, therefore the only logical comparator was the absence of such a programme. This comparator represented current practice in many health care systems, including the National Health Service.

**Validity of estimate of measure of effectiveness**
The authors did not state that a systematic review of the literature had been undertaken. In addition, there was no information provided on how the studies were identified, or the criteria on which they were selected and assessed. The effectiveness estimates were taken from more than one source and were combined narratively, although the exact method used was not reported. The authors stated that their results were sensitive to the model parameters chosen, and that there was some uncertainty about certain parameters. Details of the epidemiological model were reported elsewhere (see Other Publications of Related Interest).

**Validity of estimate of measure of benefit**
The benefit was estimated from the model by summing the major outcomes for each strategy. The modelling approach used was appropriate.

**Validity of estimate of costs**
The authors stated that the costs were analysed from a societal perspective. However, whilst they included the costs of lost productivity for the employed, they excluded the out of pocket costs to the patients. The lost production attributable to non-waged workers, such as housekeepers and child carers, was included in a scenario analysis.

The quantities of cost items were reported separately for each complication or event. Some of the unit costs were not reported. The quantities were obtained from published statistical sources. A sensitivity analysis of the quantities was not conducted.

The prices were taken from national sources, hospital fees and charges, and market prices for standard prescriptions. A sensitivity analysis of prices was not performed. The authors converted all of the prices to 1997 Dutch guilders using the GDP price indices, then converted them to US dollars at purchasing-power parity. The costs were discounted at 3% in the base-case, and 0% and 5% in the sensitivity analysis. The use of hospital charges/fees rather than costs may have overestimated the opportunity cost for that resource. Ideally, costs should reflect the true resource consumption involved in production. The charges and fees may be above this level.

The authors included the cost of in-vitro fertilisation in this analysis. Access to in-vitro fertilisation varies between different (public) health care systems. Thus, if the perspective of the health care system perspective is adopted, it may not be appropriate to include this cost in all settings.

**Other issues**
This study took a dynamic approach to modelling the impact of screening, rather than a static decision model which, according to the authors, has been used in many cost-effectiveness studies. The dynamic approach enabled the transmission dynamics of CT to be modelled over a longer period of time. In particular, this was useful to model the
risk of re-infection by the same or a new partner. Both of these elements have important effects on the cost-
effectiveness of screening programmes.

The authors referred to the prevalence of CT found in other studies. However, they did not make any comparisons with
the cost-effectiveness ratios for screening reported elsewhere. It was not stated whether this was due to an absence of
other studies.

The authors recognised that there may be difficulties in transferring the incremental cost-effectiveness ratios found in
this study to other countries. These difficulties could arise on account of the differences in the underlying prevalence or
incidence of CT, sexual behaviour, resource use and cost. However, the underlying methodology was transferable.

The authors did not appear to have presented their results selectively. Their conclusions reflect the scope of the study,
i.e. a sexually active population aged from 16 to 64 years.

The authors reported a number of limitations to their study. These were mainly due to the uncertainty surrounding the
parameter estimates. In particular, these included a lack of knowledge on sexual behaviour, and the probability of CT
transmission per sexual contact. The model also excluded the possibility of other public health measures having an
impact on the prevalence of CT. The authors recognised that, over the 10-year time period, medical technology may
shift relative costs, and productivity per capita may increase. These effects were excluded from the analysis. The
authors also stated that they have not calculated the gains in quality of life due to screening. They justified this on the
grounds that the intervention was cost-saving anyway, with the implicit assumption that the screening procedure was not
detrimental to quality of life.

The authors did not comment on the results in the male 15 to 24 age group. The study showed that, uniquely for this
group, the screening procedure not only cost more, but also resulted in a fewer number of major outcomes avoided than
no screening. It was unclear why this should be, as the exact parameters inputted into the model for this group were not
reported. The implication was that screening this (presumably high-risk) group was the least cost-effective option.

Implications of the study
The screening programme was found to be costly over an initial period of one year, since the benefits were accrued
over the subsequent years. Therefore, a screening programme should run for a number of years in order for the full
prevalence-lowering and cost-saving potential to be realised. Further studies are needed to determine how the cost-
effectiveness of screening changes with the duration of the programme.

Source of funding
None given.

Bibliographic details

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Other publications of related interest
Kretzschmar M, van Duynhoven THP, Severijnen AJ. Modelling prevention strategies for gonorrhea and chlamydia

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