PREVENTION

One to one interventions to reduce sexually transmitted infections and under the age of 18 conceptions: a systematic review of the economic evaluations

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Objective: To systematically review and critically appraise the economic evaluations of one to one interventions to reduce sexually transmitted infections (STIs) and teenage conceptions.
Design: Systematic review.
Data sources: Search of four electronic bibliographic databases from 1990 to January 2006. Search keywords included teenage, pregnancy, adolescent, unplanned, unwanted, cost benefit, cost utility, economic evaluation, cost effectiveness and all terms for STIs, including specific diseases.
Review methods: We included studies that evaluated a broad range of one to one interventions to reduce STIs. Outcomes included major outcomes averted, life years and quality adjusted life years (QALY). All studies were assessed against quality criteria.
Results: Of 3190 identified papers, 55 were included. The majority of studies found one to one interventions to be either cost saving or cost effective, although one highlighted the need to target the population to receive post-exposure prophylaxis to reduce transmission of HIV. Most studies used a static approach that ignores the potential re-infection of treated patients.
Conclusion: One to one interventions have been shown to be cost saving or cost effective but there are some limitations in applying this evidence to the UK policy context. More UK research using dynamic modelling approaches and QALYs would provide improved evidence, enabling more robust policy recommendations to be made about which one to one interventions are cost effective in reducing STIs in the UK setting. The results of this review can be used by policy makers, health economists and researchers considering further research in this area.

The number of sexually transmitted infection (STI) diagnoses in the UK has risen steadily since the mid-1990s, and the latest figures show that diagnoses rose by 8% (from 95 879 to 104 155) between 2003 and 2004.[1] The rise in incidence in STIs is also likely to lead to increased numbers of complications. Complications include pelvic inflammatory disease (PID), ectopic pregnancy and infertility. There are also government targets to reduce the level of teenage conceptions. There is a need, therefore, to identify and focus on those interventions which offer the best outcomes at an acceptable cost in reducing both STIs and teenage conceptions.

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METHODS

Four electronic databases were searched (Econlit, NHS HEED, NEED, and DARE) limited to 1990 to studies included in the databases up to January 2006. These databases focus on economic evaluations. We note that separate effectiveness reviews commissioned by NICE reviewed a wider set of databases (such as PubMed) and provided references to us. Key words included teenage, pregnancy, adolescent, unplanned, unwanted, cost benefit, cost utility, economic evaluation, cost effective, cost effectiveness, and all terms for STIs, including specific diseases. Articles that included both search terms for interventions and for types of economic evaluation (such as chlamydia and economic evaluation) were selected. Full details of the search strategy and results, including a listing of the potentially relevant papers identified by the search strategy but not included in this review, are reported by Lewis *et al*.[2]

Inclusion criteria

Participants from countries in Europe, USA, Canada and Australia. Any one to one intervention to reduce STIs and teenage conceptions, excluding interventions to reduce transmission through injecting behaviour, occupational exposure, blood-based transmission and vertical transmission from mother to child, vaccination and pre-vaccination screening, mandatory pre-material testing for HIV and frozen semen donation. No definitions of one to one interventions were provided by the literature and so reviewers had to use judgement in determining which interventions were one to one interventions. Reviewers took the view that one to one interventions were interventions that for the majority of the intervention was delivered to one individual at a time. This definition allows for multiple staff to deliver an intervention and for interventions that consist of a variety of elements (including, for example, one to one counselling and information delivered to a group of participants) to be included. Studies focusing on the relative effectiveness of different types of screening test were excluded, as were studies on the relative effectiveness of different treatments for STIs.

Abbreviations: MOA, major outcomes averted; NICE, National Institute for Health and Clinical Excellence; PID, pelvic inflammatory disease; QALY, quality adjusted life years STI, sexually transmitted infection

Table 1 Studies focused on chlamydia ordered alphabetically by author's name

Author	Intervention	Setting	Country	Quality	Static/ dynamic model	Main CE findings
Adams *et al* (2004)[4]	Opportunistic screening and partner notification	GUM clinics, family planning clinics, antenatal clinics, termination of pregnancy clinics, GP clinics	UK	+	Static	£38.38 cost per positive episode (2001 value)
Blake *et al* (2004)[5]	Universal screening of males with NAAT including partner follow up	Detention facilities	US	+	Static	$172k for 62 PID cases avoided; $148k for 99 PID cases avoided (year unclear)
Buhaug *et al* (1990)[6]	Screening for chlamydia	Women undergoing gynaecological examinations in primary care	Norway	+	Static	Age 16 net saving NKr 42 PID cases avoided, age 34 net cost NKr1,536
Cohen *et al* (1998)[7]	Screening for chlamydia	School	USA	−	Static	$272 cost per infected student (year unclear)
Dryden *et al* (1994)[8]	Screening for chlamydia	Primary care	UK	−	Static	£245.78 cost per cure (year unclear)
Genc (1996)[9]	Screening (DNA amplification assays or ligase chain reaction) with standard practice	Primary care	Sweden	−	Static	Not explicitly stated but concludes 'cost effective'
Gift (2002)[10]	Test for both chlamydia and gonorrhoea. Treat gonorrhoea positive for both diseases, and treat positive for just chlamydia	Primary care	USA	+	Static	−$130 to $557 cost per PID case avoided (2000 value)
Gift *et al* (2005)[11]	Range of interventions to increase repeat screening in patients treated for gonorrhoea or chlamydia (verbal recommendation, monetary incentive, reminder card, counselling, phone call, letter)	Sexually transmitted disease clinics	USA	+	Static	$224–$1620 cost per infection treated (2001 value)
Ginnochio (2003)[12]	LCR assay testing all young men	Primary care	USA	++	Static	$6 to $1738 cost per case prevented (2000 value)
Howell *et al* (1997)[13]	Partner notification of index male/female of pelvic inflammatory disease	Primary care	USA	+	Static	−$3900 to −$1700 (cost saving) per PID case avoided (1994 value)
Howell *et al* (1998)[14]	Screening of asymptomatic women based on CDC criteria	Family planning clinics	USA	+	Static	64 PID cases prevented saving $213k; 26 prevented saving $74k; 6 prevented cost $19k (1995 values)
Howell *et al* (1999)[15]	Screening for chlamydia in female army recruits	Army	USA	+	Static	−$800 to $166 cost per PID case avoided (1995 value)
Hu (2004)[16]	No screening versus screening for all women	Primary care	USA	++	Static and dynamic	$2350 to $7490 cost per QALY (2000 value)
Humphreys (1992)[17]	Universal screening of women	Primary care	USA	−	Static	Not explicitly stated but concludes 'cost effective'
Kraut-Becher *et al* (2004)[18]	Screening for chlamydia and gonorrhoea	Jail	USA	+	Static	−$172 to 3690 per case of PID avoided (2002 value)
Marrazzo *et al* (1997)[19]	Universal screening	Family planning and STD clinics	USA	+	Static	−$1044 (cost saving) to $43 per case avoided (1993 value)
Mehta *et al* (2002)[20]	Screening for chlamydia and gonorrhoea	Emergency departments	USA	−	Static	−$437 (cost saving) to $1694 per case treated (1999 value)
Mrus *et al* (2003)[21]	Screening	Juvenile detention centres	USA	−	Static	$80 to $505 cost per infection treated (1998 value)
Norman *et al* (2004)[22]	Screening for chlamydia	Women attending antenatal, abortion, colposcopy and family planning clinics	Scotland	+	Static	£258 to £1196 cost per sequelae averted (2001 value)
Paavonen *et al* (1998)[23]	Screening of women	Unclear what group of women	Finland	−	Static	$50 cost per case without screen; $44 if 100% screened $47 if 50% (year unclear)
Peeling *et al* (1998)[24]	Screening of men	STI clinic	Canada	+	Static	CAN$453 cost per infected case (1990 value)
Postma (2000)[25]	Screening of sexually active women	General practice	the Netherlands	+	Static	−$35 (cost saving) to $2582 cost per major outcome averted (1996 value)
Postma (2001)[26]	Treatment of partners to females identified with chlamydia through opportunistic screening	Primary care	the Netherlands	+	Static	€132 to €781 cost per major outcome averted (1996 value)
Sellors *et al* (1992)[27]	Screening for chlamydia selectively versus universally	Family planning clinics	Canada	+	Static	CAN$28 to Can$9,864 cost per case detected (1989 value)

Table 1 *(Continued)*

Author	Intervention	Setting	Country	Quality	Static/ dynamic model	Main CE findings
Van Bergen (2004)[28]	Pharmacy provision of tests to a high risk population, which are returned by post	Pharmacy setting	the Netherlands	+	Static	Cost saving to €3740 cost per PID case avoided (2001 value)
Van V *et al* (2001)[29]	Systematic screening of women on home-based collection of urine	Primary care	the Netherlands	+	Static	$11 100 to $15 800 per major outcome averted (1996 value)
Ward (2006)[30]	Screening	Not explicit	Australia	+	Static	−AUS$56 (cost saving) to AUS$56 net benefit (2002 value)
Welte *et al* (2000)[31]	GP-based screening	Primary care	the Netherlands	++	Dynamic	$492 per major outcome averted (1997 value)
Welte *et al* (2005)[32]	GP-based screening	GP clinics	the Netherlands	++	Dynamic and static	Cost saving to $700 cost per major outcome averted (1997 value)

CE, clinical evidence; GP, general practitioner; GUM, genito-urinary medicine; NAAT, nucleic acid amplification test; Nkr, Norwegian Kronor; PID, pelvic inflammatory disease; STI, sexually transmitted infection.

Principle outcomes included major outcomes averted (MOA), life years, infections averted and quality adjusted life years (QALYs).

Formal economic evaluations, including cost effectiveness analysis, cost utility analysis, cost benefit analysis and cost minimisation analysis were studied.

Selection of papers for review

The review of papers was completed by two reviewers (LB, NL). Titles and abstracts (where abstracts were available) were screened against the inclusion criteria.

Studies were assessed for quality using the Drummond checklist (Appendix G in NICE Guideline Development Methods[3]) and graded as either ++ (higher quality), + or – (lower quality). In practice, judgement had to be applied and we note that some authors may have unique reasons to use a different approach than that advocated by the Drummond checklist. No papers were excluded on the basis of low quality.

RESULTS

Our search found 3190 potentially relevant studies. Altogether 235 were potentially relevant based on review of titles and abstracts. Upon inspection, some of these papers had to be excluded on the basis of being in a foreign language, an out of scope country or comparison of specific screening tests, and so forth. Full details are provided in Lewis *et al*.[2] A total of 202 papers were read in full; 55 papers met the full inclusion criteria and were fully assessed. We did not exclude any STIs but instead noted that there were no papers identified which focused on some STIs such as gonorrhoea.

Studies on reducing chlamydia

Twenty nine papers focused on reducing chlamydia (table 1).

All of the studies focusing on chlamydia examine the cost effectiveness of different forms of screening. Only three studies are undertaken in the UK with the majority from the USA. They differ in the settings for screening, including schools, pharmacies, family planning clinics, general practice, genito-urinary clinics and jails. The majority take a static modelling approach; only three use a dynamic approach. Dynamic models, unlike static models, can incorporate effects such as further onward transmission or re-infection. However, dynamic approaches are reliant on the available data, which may introduce further uncertainty. Primary outcomes are focused upon major outcomes averted or PID cases averted. All studies find that screening is beneficial and within what the authors perceive to be acceptable cost effectiveness thresholds. Sometimes the intervention was found to be cost saving.

Studies on reducing HIV

Nineteen studies looked at the cost effectiveness of one to one interventions to reduce HIV (table 2). Interventions varied from antenatal screening, through to provision of condoms, post-exposure prophylaxis, multiple interventions (counselling, testing, partner notification, referral) and screening. Again the studies are predominantly US based, with only two from the UK. All studies use a static modelling approach. Studies used a variety of outcomes, including cost per life year gained, cost per QALY and cost per case averted. The majority of studies concluded interventions were cost effective; however, Pinkerton *et al* demonstrated a significant range in cost effectiveness, with cost per QALY for post-exposure prophylaxis ranging from US$6354 (for those having receptive anal intercourse) to US$7million (for those having receptive vaginal intercourse) (1996 values). This emphasises the importance of targeting interventions to the appropriate population in order to deliver best value for money.[45]

Studies on reducing syphilis

Four studies were focused on reducing syphilis; all are US based (table 3). The interventions ranged from universal screening to selective screening and cluster investigation. They reflect diverse settings, including military, public health clinics, genito-urinary clinics, family planning clinics, drug treatment clinics and jails. Outcomes included cost per case detected and cost per year of military service. Again these studies all use static modelling approaches. All studies found cost effectiveness ratios perceived by the authors to be favourable.

Studies on reducing herpes

Only one study focused on herpes, based on screening in primary care in the USA (table 4). This study used a static modelling approach and suggested a relatively high cost for an infection avoided of US$8200 (1999 value).

Studies not focused on a specific disease

Two studies were not focused on a specific disease: one analysed the cost effectiveness of a social marketing campaign, including free access to condoms, the other provided pharmacist prescribed emergency contraception (table 5). Both studies found these interventions to be cost saving using static modelling approaches.

DISCUSSION

This systematic review identified a substantial number of economic evaluations of one to one interventions to reduce STIs. Interventions were varied but screening was considered by the majority of studies (and in particular was most often considered for reducing chlamydia), although counselling was

Table 2 Studies focused on HIV ordered alphabetically by author's name

Author	Intervention	Setting	Country	Quality	Static/ dynamic model	Main CE findings
Bramley (2003)[33]	Antenatal screening	Secondary care	New Zealand	+	Static	NZ$17 241 per life year gained (year unclear)
Brandeau (1992)[34]	Screening women of childbearing age	Undefined	USA	+	Static	−$35 (cost saving) to −$12 132 per woman screened (1998 value)
Bos (2001)[35]	Screening of STD clinic attendees	Primary care	the Netherlands	+	Static	€1333 to €1638 per life year gained (2000 value)
Gibb (1999)[36]	Antenatal screening	Antenatal care	UK	+	Static	£51 258 cost per life year saved (1996/7 value)
Heumann (2001)[37]	Referral of high risk groups to prevention services	Primary care, San Francisco	USA	+	Static	$43 765 cost per infected averted (year unclear)
Holtgrave *et al* (1993)[38]	Multiple interventions delivered by entire programme (counselling, testing, referral, partner notification)	Public health centres	USA	+	Static	$ 80 per infection averted (1990 value)
Hughes (1996)[39]	GP prescribed condoms	Primary care	UK	+	Static	£180 to £1.3m per life year gained (1993/4 value)
La Croix (1996)[40]	Voluntary screening	Inpatients	USA	−	Static	$1391 to $47 722 net benefit (year unclear)
Lurie *et al* (1994)[41]	Voluntary counselling and screening for HIV	Acute care	USA	−	Static	$16 104 cost per patient infected, $753m per health care worker infection avoided (year unclear)
Owens *et al* (1996)[42]	Screening for HIV	Acute care	USA	+	Static	$44 200 to $70 000 cost per QALY (1993 value)
Paltiel (2005)[43]	Routine screening in outpatient settings in addition to current practice of background testing or testing those with opportunistic infections	Outpatient settings	US	+	Static	$36k to $100k cost per QALY (2001 value)
Phillips and Fernyak (2000)[44]	HIV counselling and testing	Primary care	USA	+	Static	$5300 to $23 300 cost per QALY (1999 value)
Pinkerton *et al* (1998)[45]	Post-exposure prophylaxis following sexual exposure to HIV	Setting not explicit	USA	+	Static	$6354 to $7m cost per QALY (1996 value)
Sanders (2005)[46]	Voluntary screening with highly active antiretroviral treatment	Primary care and outpatient settings	USA	+	Static	$15 078 to $57 138 cost per QALY (2004 value)
Tao (1998)[47]	Individual risk assessment, risk reduction counselling, referral to medical and psychosocial services, for gay and bisexual male adolescents	Community setting	USA	+	Static	$6180 cost per QALY (1994 value)
Toomey *et al* (1998)[48]	Partner notification	STD clinics	USA	−	Static	$251 per index patient identified, $2200 per partner newly identified (year unclear)
Varghese (1999)[49]	Counselling, testing, and partner notification	STD clinics	USA	+	Static	$28 025 to $31 943 per case averted (1997 value)
Varghese and Peterman (2001)[50]	HIV counselling and testing	Prison	USA	+	Static	$34 000 per case averted (1999 value)
Zowall *et al* (1990)[51]	Screening	Pre-immigration testing	Canada	−	Static	CAN1.7m to CAN $13.7m (1988 value)

CE, clinical evidence; GP, general practitioner; STD, sexually transmitted disease; QALY, quality adjusted life years.

also frequently assessed. Studies were primarily from the USA, with very few studies based in the UK. Settings varied but were dominated by primary care settings. Studies tended to use static approaches, which do not account for the potential for re-infection of treated individuals or reduced onward transmission. Most studies focused on major outcomes averted, although there were a number that looked at life years gained or QALYs. The vast majority of studies concluded that one to one interventions are cost effective and in some instances are cost saving. This applies even across the diverse interventions and settings considered. One notable difference is for post-exposure prophylaxis, which must be targeted to those having receptive anal intercourse in order to fall within acceptable cost effectiveness thresholds.

Methodological issues

This is the only study to our knowledge that provides a systematic review of one to one interventions to reduce STIs. It highlights the gaps in the literature in the UK. The main weakness of this study is the lack of detail in reporting of methodology used by studies, which makes interpreting the methodology used in these studies difficult. Another weakness is that, in practice, the reviewers had to use judgement in determining which interventions were one to one interventions. We also note that searches using different criteria and databases could potentially yield additional results. This is also a growing area of research and studies included in the databases that we searched which were added since January 2006 will have been omitted from this research.

Comparison with other studies

We did not locate reviews that were focused on one to one interventions other than those focused on economic evaluations of chlamydia screening.[59–66] These reviews generally suggest that chlamydia screening is cost saving or cost effective. However, the most recent review by Roberts suggests that

Table 3 Studies focused on syphilis ordered alphabetically by author's name

Author	Intervention	Setting	Country	Quality	Static/dynamic model	Main clinical evidence findings
Clark (1999)[52]	Universal screening of all army recruits	Military recruits at basic training	USA	+	Static	$8.21 to $9.52 cost per year of military service (1996 value)
Engelgau *et al* (1995)[53]	Rapid partner notification and cluster investigation	Public health clinics	USA	+	Static	$4171 cost per case (1991 value)
Reynolds *et al* (2001)[54]	Selective screening and partner notification	STD clinics, jail, drug treatment centres, prenatal and family planning clinics	USA	–	Static	$395 to $405 cost per case detected (1996 value)
Silberstein (2000)[55]	Rapid test and treatment protocol to speed up provision of treatment to inmates	Jail	US	–	Static	$1 473 084 net benefit (1994 value)

Table 4 Study focused on herpes ordered alphabetically by author's name

Author	Intervention	Setting	Country	Quality	Static/dynamic model	Main clinical evidence findings
Fisman *et al* (2003)[56]	Screening for herpes simplex virus type 2 and advice on condom use	Primary care	USA	++	Static	$8200 per infection avoided (1999 value)

Table 5 Studies not focused on a specific disease alphabetically ordered by author's name

Author	Intervention	Setting	Country	Quality	Static/dynamic model	Main clinical evidence findings
Bedimo *et al* (2002)[57]	Social marketing campaign providing free access to condoms	Community setting	USA	+	Static	−$15 809 cost per quality adjusted life years (cost saving) (1996 value)
Marciante *et al* (2001)[58]	Pharmacist prescribed emergency contraception	Community pharmacy	USA	+	Static	−$158 to −$48 cost avoided (cost saving) (1998 value)

although most studies found chlamydia screening to be cost effective and partner notification an effective adjunct, methodological problems limit the validity of these findings.[65] In particular, Roberts questions the data on complication rates, the reliance on static models and the applicability to the UK.

Further research

We recommend further research is needed in order to inform UK policy making on one to one interventions that reduce STIs and teenage conceptions. Research needs to fill the substantial gaps in the literature, which makes it extremely difficult to translate the findings of this review into policy recommendations. Further research required includes:

- Cost effectiveness analysis of one to one interventions in the UK. Few studies were focused on the UK and differences in costs, settings and populations make it difficult to translate findings from international studies to the UK. More research needs to be conducted in the UK to inform the future development of policies to reduce STIs in the UK. This research is also likely to need to consider differences across populations and regions within the UK.
- The overlap in benefits of one to one interventions recognising that some one to one interventions (such as counselling) can lead to reductions in more than one STI. This will make these interventions more cost effective and enable policy makers to choose more appropriately between interventions where some offer greater benefits than reducing a single STI.
- Development of QALY estimates. Relatively few studies used QALYs and this limits the comparability of findings and the ability to select those interventions that offer the best value for money, which should be adopted ahead of others

Key messages

No work has been completed to date to review the cost effectiveness of one to one interventions to reduce the incidence of STIs in the UK

This work is a first start at looking at this issue. It finds that the majority of interventions considered in the literature are considered by authors to be cost effective, with the exception of post-exposure prophylaxis, which must be targeted to those having receptive anal intercourse in order to fall within acceptable cost effectiveness thresholds.

This work highlights the need for further research to look at:

- Cost effectiveness of one to one interventions in the UK as few studies focused on the UK setting.
- The need to acknowledge the overlap in benefits from interventions (so that a single intervention can reduce the incidence of more than one sexually transmitted infection).
- Development of QALY estimates. Relatively few studies used QALYs, which limits comparability across interventions.

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