UK Health Security Agency

The effectiveness of interventions to reduce gonorrhoea in heterosexual adolescents and young adults (aged 15 to 25 years)

A rapid evidence summary

April 2026

Contents

Main messages

1. The purpose of this rapid evidence summary was to summarise evidence in the peer-reviewed literature on the effectiveness of interventions to reduce the public health burden of gonorrhoea in heterosexual adolescents and young adults, aged 15 to 25 years. Studies were included with outcomes concentrated on the reduced incidence of gonorrhoea (and/or chlamydia with transferable findings) and or intermediary outcomes, including increased awareness and or knowledge of sexually transmitted infections (STIs), condom use and testing.
2. Records published between 1 January 2013 and 18 October 2023 were included in this rapid evidence summary.
3. After deduplication, 197 records were identified and screened on title and abstract. A total of 66 records were screened on full text to confirm eligibility. Of these, 28 studies[1] met the criteria and were included in the review.
4. Of the 28 studies included, the majority were based in the United States of America (USA) (17 studies), followed by European countries (10 studies), of which 2 studies were based in the United Kingdom (UK). One study was included from China.
5. The most common study designs included were Randomised Control Trials (RCTs) (8 studies) and quasi-experimental (6 studies), followed by true experimental designs (3 studies), systematic reviews/meta-analysis (3 studies) and feasibility studies (3 studies). Observational studies (2 studies), other literature reviews (integrative and evidence review for guidelines) (2 studies) and a model-based cost-effectiveness study (one study) were also included.
6. Sex education interventions in school and university settings were the most frequent intervention reported (8 studies), as may be anticipated due to the target age range. A range of other interventions were also identified, including mobile phone apps and SMS messaging interventions (4 studies), online interventions (3 studies), expedited partner therapy (2 studies), awareness campaigns and messaging (2 studies), behavioural risk reduction programmes (2 studies), testing and screening interventions (2 studies), cash transfer (one study) and more holistic, family-based programmes (4 studies).
7. Just over half the studies (15 studies) reported multiple outcomes (knowledge, behavioural and or biological). Behavioural outcomes were the most common outcome type reported (20 studies).
8. Of the 28 studies, 27 reported some evidence of effectiveness in reducing the incidence of gonorrhoea and/or improving an intermediary outcome (for example, knowledge and awareness, condom use and testing) for at least one outcome. Of these, 3 were feasibility studies and would not have been designed to evaluate effectiveness so the results need to

[1] Studies refers to the included manuscripts. For this rapid evidence summary, a systematic review was considered as one study.

be treated with caution. Only one study reported that an intervention was not effective for any outcome, which was for a smartphone intervention in Sweden.

9. Critical appraisal of the studies was not undertaken and so the review highlights relevant studies in the literature but cannot make any recommendations. Caution therefore needs to be taken in interpreting the claims of effectiveness reported in the studies, for example, in relation to whether potential confounding factors have been adequately addressed and the validity of the causality of claims made.

Background and aims

Gonorrhoea is a bacterial sexually transmitted infection (STI), that if untreated can lead to severe consequences such as ectopic pregnancy, infertility and pelvic inflammatory disease (1). It is the second most common bacterial STI in the UK (1) and in 2022 cases reached the highest level in England since records began in 1918 (2). This increase is not confined to the UK and an increase in gonorrhoea cases has also been reported by other countries in Western Europe in recent years (3). An incident management team (IMT) led by UKHSA was established in the South West of England in 2022 to investigate the increase in gonorrhoea and reduce transmission.

In England, while gonorrhoea cases increased among people of all ages, a steeper increase was observed among young adolescents and adults aged 15 to 24 years (2). The IMT therefore requested further evidence on interventions to reduce gonorrhoea among young heterosexuals in this age group to inform interventions in the region.

This review aimed to identify evidence in the peer-reviewed literature on the effectiveness of interventions to reduce the incidence of gonorrhoea among heterosexual adolescents and young adults, aged 15 to 25 years.

Methods

One review question was addressed:

1. What published evidence exists on the effectiveness of interventions to inform public health interventions aimed at reducing sexually transmitted infection incidence (gonorrhoea or chlamydia), increasing testing uptake or increasing awareness and reducing risk behaviours amongst the specific population groups affected (heterosexual, young people aged 15 to 25)?

A rapid evidence summary was undertaken to provide information for the IMT as quickly as possible. This summary considers gonorrhoea, but studies considering chlamydia or STIs as a broad term were included if they were relevant to reducing the incidence of gonorrhoea. This is in part because dual testing for chlamydia and gonorrhoea is often offered in England.

A search was conducted to identify primary studies and reviews published in the peer-review literature relevant to the research question. Records were identified in PubMed, from which search terms were designed to conduct database searches in OVID Embase and OVID Medline. The search was restricted to records published in English between 1 January 2013 and 18 October 2023.

Title and abstract screening and subsequent full text screening were undertaken by one reviewer. Second reviewers screened 10% of the title and abstracts and 10% of the full text records in duplicate.

The inclusion and exclusion criteria are provided in Appendix 1 and Table A.1.

Data extraction was conducted by one reviewer and 10% of studies checked by a second reviewer. Studies were defined as having ‘some effectiveness’ if the intervention was reported to be effective for one or more outcomes.

Critical appraisal and quality assessment of the included studies was not undertaken. Full details of the methodology are provided in Appendix 1 and the search strategies are provided in Appendix 2 and Appendix 3.

Evidence

Records identified

A total of 240 records were identified from the database searches. A total of 43 duplicates were removed and title and abstract screening was conducted for 197 records. Of these, 66 full text records were assessed for eligibility. A total of 28 studies met the eligibility criteria and are included in this evidence summary. A Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) diagram is provided in Appendix 1 (Figure A.1). The PRISMA diagram outlines reasons for exclusion during the full text review. The full data extraction table is provided in Appendix 4 and Table A.2.

Intervention types and outcomes

A range of interventions were identified (Table 1). The majority were sex education interventions, followed by mobile and holistic, family-based interventions. Interventions ranged from online interventions to opt-out testing. Just over half of the studies reported multiple types of outcomes (15 studies). In total, 13 studies reported knowledge and perception outcomes, 20 reported behavioural outcomes, 12 reported biological outcomes and 2 reported cost-effectiveness outcomes.

All the studies reporting knowledge and perception outcomes of interventions found some reported effectiveness. The interventions were reported to have some effectiveness for at least one behavioural outcome measured, with the exception of one mobile phone app intervention in Sweden. The reported outcomes were more mixed for biological outcomes. Of the interventions reported with biological outcomes, 9 were reported to have some effectiveness and 3 reported no effectiveness (expedited partner therapy (EPT), mobile and in-person counselling and a holistic intervention).

The following types of interventions reported some effectiveness for all outcomes measured:

- sex education (4 to 11)
- web-based (12 to 14)
- holistic education and family-based interventions (15 to 17)
- mobile phone apps and SMS messaging (18, 19)
- awareness campaigns and messaging (20, 21)
- behavioural sexual risk reduction programmes (22, 23)
- opt-out testing (24)
- intervention involving screening, interviews and same day treatment (25)
- expedited partner therapy (26)
- conditional cash transfer and life skills (27)

Table 1. Intervention type and outcomes reported by effectiveness of intervention reported [note 1]

In the following table, figures in columns 4, 6, 8 and 10 are positive, as indicated by +, figures in columns 5 and 9 are negative, as indicated by -.

Intervention type	Number of papers	Number of outcomes reported [note 2]	Behaviour: some effectiveness	Behaviour: not effective	Knowledge and perception: some effectiveness	Knowledge and perception: not effective	Biological: some effectiveness	Biological: not effective	Cost-effectiveness: some effectiveness	Cost-effectiveness: not effective
Sex education	8	13	+5	0	+7	0	0	0	+1	0
Mobile	4	7	+3	-1	+2	0	0	-1	0	0
Holistic and family-based interventions	4	8	+3	0	+1	0	+3	-1	0	0
Web based	3	6	+2	0	+2	0	+1	0	+1	0
Expedited partner therapy	2	4	+1	0	+1	0	+1	-1	0	0
Awareness campaign and messaging	2	3	+2	0	0	0	+1	0	0	0
Behavioural sexual risk reduction programmes	2	2	+1	0	0	0	+1	0	0	0
Opt-out testing	1	2	+1	0	0	0	+1	0	0	0
Screening, interviews, same day treatment	1	1	0	0	0	0	+1	0	0	0

Intervention type	Number of papers	Number of outcomes reported [note 2]	Behaviour: some effectiveness	Behaviour: not effective	Knowledge and perception: some effectiveness	Knowledge and perception: not effective	Biological: some effectiveness	Biological: not effective	Cost-effectiveness: some effectiveness	Cost-effectiveness: not effective
Conditional cash transfer and life skills	1	1	+1	0	0	0	0	0	0	0
Total	28	47	+19	-1	+13	0	+9	-3	+2	0

Notes

Note 1: this is a simplified representation to highlight important points. For example, the effectiveness of one mobile phone intervention and one expedited partner therapy intervention on behavioural outcomes was mixed and the interventions were mostly not effective for these outcomes but there was some evidence from the self-reported data on effectiveness.

Note 2: the total reflects 47 outcomes rather than 28 studies since 15 studies reported multiple types of outcomes.

The following interventions solely reported a ‘not effective’ outcome in one case for behavioural outcomes:

- mobile phone intervention (28)

The following interventions reported a ‘not effective’ outcome in 3 studies for biological outcomes:

- mobile phone intervention (29)
- expedited partner therapy (30)
- in person counselling and holistic intervention (31)

Study designs

Table 2 outlines the types of study included. The most common study designs were RCTs and quasi-experimental designs. A total of 3 true experimental designs, 3 feasibility studies and 3 systematic reviews and meta-analyses were included. Other literature reviews (integrative and evidence review for guidelines), observational studies and a model-based cost-effectiveness study were also included.

Table 2. Type of study included in the evidence summary for 28 studies

Type of study	Number of studies	%
Randomised control trial (RCT)	8	28.6
Quasi-experimental	6	21.4
True experimental	3	10.7
Feasibility	3	10.7
Systematic review and meta-analysis	3	10.7
Observational	2	7.1
Other lit review	2	7.1
Model-based cost-effectiveness	1	3.6
Total	28	100.0

Context

The majority of studies were based in the USA (17 studies, 60.7%), followed by countries in Europe (10 studies, 35.7%) of which 2 studies were based in the UK. One study was included from China.

The majority of studies were based in a school setting, followed by health centres and clinics, the community or a university (Table 3). Two of the studies were based in juvenile detention settings, 2 were based in multiple settings and one was a review with one study based in a clinic and the other in the community.

Table 3. Country and setting for the 28 studies included in the evidence summary

Setting	USA	UK	Italy	Spain	Sweden	China	Finland	NL	Total
School	6	0	1	2	1	0	1	0	11
Clinic only [note 1]	2	1	0	0	1	0	0	1	5
Community only	3	1	0	0	0	0	0	0	4
University	2	0	0	0	0	1	0	0	3

Setting	USA	UK	Italy	Spain	Sweden	China	Finland	NL	Total
Juvenile detention	2	0	0	0	0	0	0	0	2
Community and clinic	1	0	0	0	0	0	0	0	1
School and university	0	0	1	0	0	0	0	0	1
Multiple settings	1	0	0	0	0	0	0	0	1
Total	17	2	2	2	2	1	1	1	28

Abbreviation

NL: Netherlands

Note

Note 1: clinic also refers to a health centre.

Conclusions

A range of interventions were identified in 28 studies from the peer-reviewed literature that report some effectiveness in targeting knowledge, behaviours or biological outcomes relevant to reducing the incidence of gonorrhoea among young heterosexuals aged 15 to 25 years.

Sex education interventions in schools were the most frequent intervention reported, as may be anticipated due to the target age range. A range of other interventions were also identified, including mobile, online, expedited partner therapy, cash transfer and more holistic, family-based programmes.

Although the majority of studies reported some evidence of effectiveness, a critical review of the evidence was not undertaken and so caution needs to be undertaken in interpreting the findings and the strength of the evidence. For example, 3 studies examining the effectiveness of a mobile (18), online (12), and conditional cash transfer (27) interventions were feasibility studies and would not have been designed to report on the effect of interventions.

Further work could be conducted to critically appraise the evidence in the studies identified to assist in making recommendations for interventions that could be implemented in England.

Limitations

This rapid evidence summary was conducted at pace following simplified methodologies therefore only 10% of title and abstract and full text screening and data extraction were formally double reviewed. Critical appraisal and quality assessment of the studies was not undertaken. This review therefore highlights relevant studies in the literature, but these studies could contain inaccurate or outdated information and so cannot be used to make recommendations for an intervention. Caution therefore needs to be taken when interpreting the claims of effectiveness reported in the studies, for example, in relation to whether potential confounding factors have been adequately addressed and the validity of the causality of claims made.

A snapshot of the evidence between 2013 and 2023 is provided in this rapid evidence summary. Further records will be available outside this time period. A search was conducted using 2 databases and while it is likely the majority of relevant records would be reported in these databases, other records could be identified if searches of other databases are conducted. Citation searching was not undertaken during this review and further records could be identified through this process.

The search strategy restricted the context to high-income countries with a context relevant to the UK and records published in English. The majority of studies were reported from the USA and caution needs to be taken in assessing the applicability of the findings to the UK context. Two studies were based in juvenile detention centres and may not have wider applicability outside of these settings.

As with all reviews, the evidence identified may be subject to publication bias, where null or negative results are less likely to have been published by the authors. Only one study was identified that reported a completely negative result and so this needs to be considered as a source of bias in this review.

Due to the inclusion and exclusion criteria, the study types identified were predominantly RCTs and quasi-experimental studies. Other study types may provide further information on the effectiveness of interventions, for example, in relation to the implementation of interventions and could be identified in wider searches. A number of records were identified during the screening process that would be useful in informing the design of effective interventions but did not evaluate the effectiveness of interventions. An evidence review of these records would be a useful avenue for future work.

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Disclaimer

This rapid evidence summary aimed to provide the best available evidence to decision makers in a timely and accessible way, based on published peer-reviewed scientific papers. Please note that the reviews: i) use accelerated methods and may not be representative of the whole body of evidence publicly available, ii) have undergone an internal, but not independent, peer review, and iii) are only valid as of the date stated on the review.

In the event that this review is shared externally, please note additionally, to the greatest extent possible under any applicable law, that UKHSA accepts no liability for any claim, loss or damage arising out of, or connected with the use of, this review by the recipient and or any third party including that arising or resulting from any reliance placed on, or any conclusions drawn from, the review.

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Appendix 1. Methods

Research question

A rapid evidence summary was conducted, following simplified systematic methodologies, to address the review question: 'What published evidence exists to inform public health interventions aimed at reducing sexually transmitted infection incidence (gonorrhoea or chlamydia), increasing testing uptake or increasing awareness and reducing risk behaviours amongst the specific population groups affected (heterosexual, young people aged 15 to 25)?'

Search strategy

Records were identified in PubMed, from which search terms were designed to conduct database searches to identify relevant primary studies and reviews in OVID Embase and OVID Medline. The search strategy is provided in Appendix 2 and Appendix 3. Results were restricted to records published in English, between 1 January 2013 and 18 October 2023 and which were conducted in high-income countries with a context relevant to the UK. Citation analyses and reference searching were not conducted. Duplicate references were removed using Deduklick prior to screening.

Eligibility criteria

The eligibility criteria are summarised in Table A.1. To be considered for inclusion, studies should describe the effectiveness of an intervention among heterosexual adolescents and young adults in high-income countries, which are comparable to the UK. Studies reporting on a cross-sectional association between an outcome and an intervention, or factors which may improve the design of an intervention were therefore excluded from this review.
Due to the likelihood of transferable learning, and dual testing availability for gonorrhoea and chlamydia, studies which reported the effectiveness of interventions to reduce chlamydia or STIs in general were included if they met the other inclusion and exclusion criteria and did not consider population-wide screening or pregnancy screening.

Table A.1 Inclusion and exclusion criteria

Criteria	Inclusion	Exclusion
Population	Heterosexual adolescents and young adults (defined as 15 to 25 years). Studies with other sexual orientations and ages will be accepted if some of the population sample meets the	Adolescents aged under 15 years or adults aged under 25 years. Non-heterosexual populations, for example, but not limited to, men who have sex with men (MSM).

Criteria	Inclusion	Exclusion
	inclusion criteria (no threshold defined). Studies which do not specify sexual orientations will be accepted on the assumption that some of the population will be heterosexual.	
Intervention	Studies which measure the effect of an intervention on the incidence of gonorrhoea and chlamydia. Studies which measure the effect of an intervention on all STIs, for which there is transferable learning. These may include, but are not limited to, increased awareness or intention to test, increased condom use, reduced sexual risk behaviours and knowledge of STIs.	Studies which only measure the effect of an intervention on chlamydia, in the context of population-wide chlamydia screening or screening during pregnancy. Studies which measure the effect of an intervention on an STI other than gonorrhoea and chlamydia, and do not measure the effect on all STIs as a generalised outcome. For example, but not limited to, HIV.
Outcome	Studies which measure effectiveness of a relevant intervention. This requires a comparator for a measurement of change before and after implementation. These can include the following outcomes, but are not limited to: biological; behavioural; knowledge, perceptions and attitudes.	Studies which do not measure effectiveness before and after implementation but measure associations or factors which may improve the implementation of an intervention.
Study design	Peer-reviewed primary studies and literature reviews. Expert recommendations will only be included if evidence of effectiveness is described.	Grey literature or non-primary studies such as, but not limited to, opinion pieces, position statements and expert panel recommendations (if no evidence of effectiveness is described).
Time period	Studies published from 2013 to 2023.	Any studies published before 2013 or studies published before 2013 which are described in a systematic review of later publication.

Criteria	Inclusion	Exclusion
Geographical location	Studies conducted in high-income countries which are comparable to the UK.	Studies conducted in low- and middle-income countries. Studies conducted in high-income countries with remote or culturally unique settings which are not comparable to the UK. For example, but not limited to, indigenous communities in the Arctic or abstinence-based interventions in the USA where policy means abstinence education is the only option.
Language	Studies published in English.	Studies published in a language other than English.

Screening

Title and abstract screening and full text screening were conducted by one reviewer, using the inclusion and exclusion criteria outlined in Table A.1. A second reviewer screened at least 10% of the records in duplicate during the title and abstract and full text screening processes. Any disagreements were resolved by discussions between the 2 reviewers undertaking the duplicate screening.

A PRISMA diagram depicting the flow of the screening process is provided in Figure A.1. Endnote 20 and Microsoft Excel were used for screening and data extraction.

Data extraction

Data extraction was primarily undertaken by one reviewer and 10% were checked by a second reviewer.

For reviews, data was only extracted for individual studies which met the inclusion criteria. If a review did not report in sufficient detail to determine the eligibility of a study, the original study was referred to. For reviews with eligible studies, data was extracted from the review. If discrepancies were identified between the review and original study, these were noted in the extraction table. The data extraction table is provided in Appendix 4.

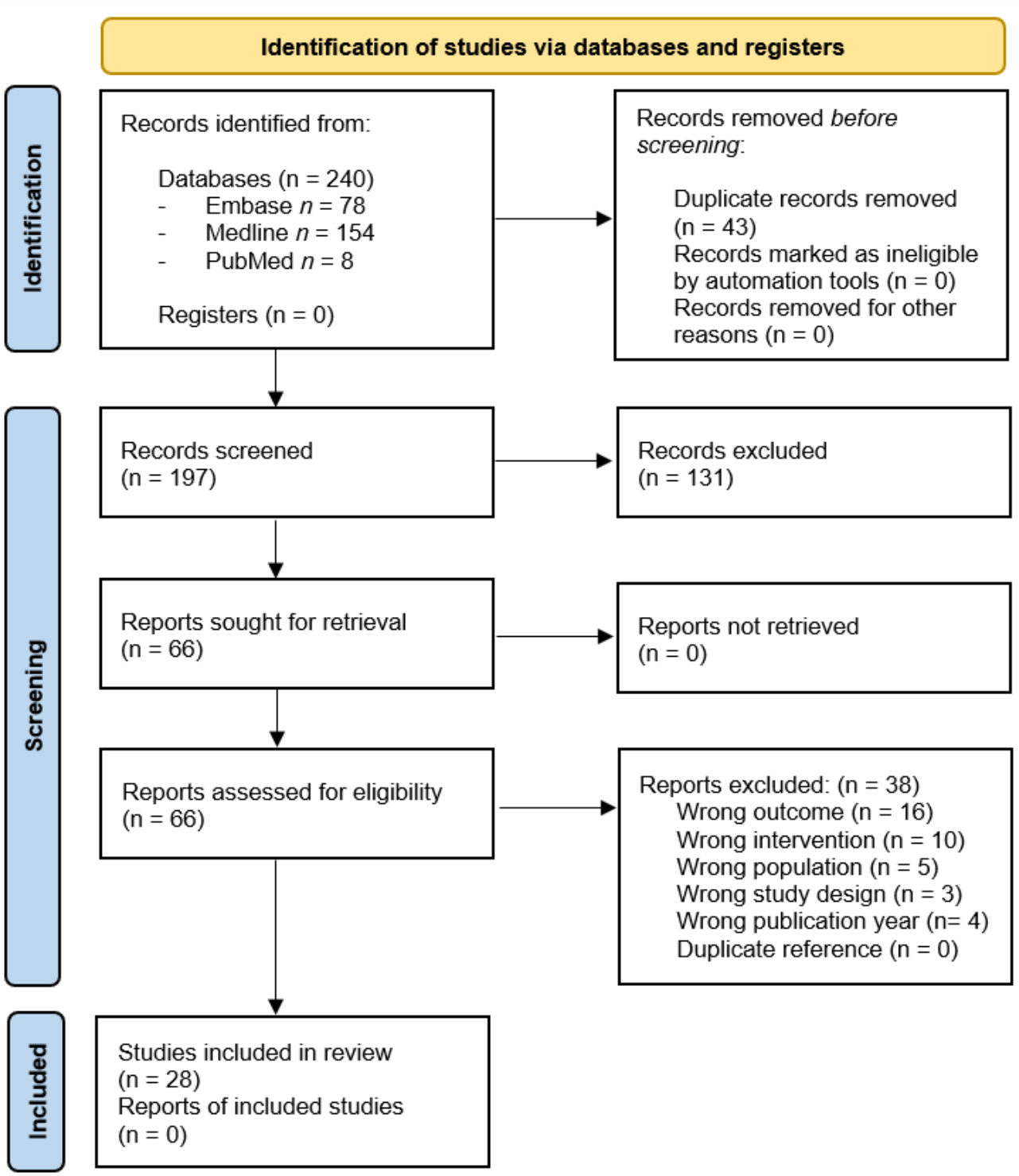
Critical appraisal

A critical appraisal and quality assessment of the studies identified was not undertaken and so the strength of evidence for the claims of effectiveness in the studies cannot be verified and should be interpreted with caution.

Synthesis

A brief narrative summary was provided, with the main findings presented in a data table.

Figure A.1 PRISMA diagram



The same intervention was described in 2 papers (4, 7) but both were included as Morales and others (7) was a follow up on the same intervention and they examined different outcomes. The intervention is also evaluated by Serowoky, George and Yarandi (10).

Appendix 2. Search strategy for Embase

Ovid database login

1. *adolescent/
2. exp adolescent sexual behavior/
3. adolescen*.ti,kw,kf.
4. *young adult/
5. (young adj (person* or people or adult*)).ti,kw,kf.
6. student/
7. school child/
8. ((university or college or school) adj1 (student* or pupil* or child*)).ti,kw,kf.
9. “emerging adult*”.tw,kw,kf.
10. (teen or teens or teenager*).tw,kw,kf.
11. (youth or juvenile*).ti,kw,kf.
12. (millennial* or “gen Z” or “generation Z”).tw,kw,kf.
13. (“under 25” or “15-25”).tw,kw,kf.
14. or/1-13
15. *gonorrhea/
16. exp Neisseria gonorrhoeae/
17. gonorrh?ea.tw,kw,kf.
18. (gonococcal adj (infection or urethritis)).tw,kw,kf.
19. *Chlamydia/
20. *Chlamydia infection/
21. chlamydia.tw,kw,kf.
22. *sexually transmitted disease/
23. (“sexual* transmitted” adj (disease* or infection*)).tw,kw,kf.
24. or/15-23
25. infection prevention/
26. sexually transmitted disease/pc [Prevention]
27. exp gonorrhea/pc [Prevention]
28. exp Chlamydia infection/pc [Prevention]
29. or/25-28
30. early intervention/
31. web-based intervention/
32. ((Internet or web) adj (based or intervention or delivered)).ti,kw,kf.
33. psychosocial intervention/
34. intervention study/
35. intervention*.ti,kw,kf.
36. school health service/
37. school health nursing/
38. (school*?based adj (intervention* or program*)).tw,kw,kf.

39. education program/
40. health program/
41. voucher program/
42. program evaluation/
43. sexual education/
44. sex* education.tw,kw,kf.
45. contact examination/
46. ((contact or partner) adj (notification or tracing or identification)).tw,kw,kf.
47. testing.ti,kw,kf.
48. screening/
49. mass screening/
50. rescreening/
51. expedited partner therapy/
52. partner therapy.tw,kw,kf.
53. exp condom/
54. (condom adj (provision* or suppl* or “use”)).tw,kw,kf.
55. sexual* transmitted infection clinic*.tw,kw,kf.
56. STI clinic*.tw,kw,kf.
57. sexual health clinic*.tw,kw,kf.
58. GUM clinic*.tw,kw,kf.
59. genitourinary medicine clinic*.tw,kw,kf.
60. health promotion/
61. text messaging/
62. messaging.ti,kw,kf.
63. Pay-it-forward.tw,kw,kf.
64. reward/
65. opt-out.tw,kw,kf.
66. or/30-65
67. exp highest income group/
68. exp developed country/
69. ((high-income or developed) adj countr*).tw,kw,kf.
70. exp United Kingdom/
71. United Kingdom.ti,kw,kf.
72. Great Britain.ti,kw,kf.
73. England.ti,kw,kf.
74. Wales.ti,kw,kf.
75. Scotland.ti,kw,kf.
76. Ireland.ti,kw,kf.
77. exp Europe/
78. Europe.ti,kw,kf.
79. United States/
80. North America/
81. Canada/

82. (United States or America or USA or Canada).ti,kw,kf.
83. exp China/
84. China.ti,kw,kf.
85. exp Australia/
86. Australia.ti,kw,kf.
87. exp New Zealand/
88. New Zealand.ti,kw,kf.
89. or/67-88
90. 14 and 24 and 29 and 66 and 89
91. limit 90 to (english language and yr="2013 -Current")
92. limit 91 to (article or article in press or "preprint (unpublished, non-peer reviewed)" or "review")

Appendix 3. Search strategy for Medline

https://ovidsp.ovid.com/ovidweb.cgi?T=JS&NEWS=N&PAGE=main&SHAREDSEARCHID=3EmbExjmWtS8QGyMF2JNo4jATVe1vVeXi8OdSFYgrh1xsNesZAMLESsjMsu4fnADN

1. *Adolescent/
2. adolescen*.ti,kw,kf.
3. *Young Adult/
4. (young adj (person* or people or adult*)).ti,kw,kf.
5. Students/
6. ((university or college or school) adj1 (student* or pupil* or child*)).ti,kw,kf.
7. “emerging adult*”.tw,kw,kf.
8. (teen or teens or teenager*).tw,kw,kf.
9. (youth or juvenile*).ti,kw,kf.
10. (millennial* or “gen Z” or “generation Z”).tw,kw,kf.
11. (“under 25” or “15-25”).tw,kw,kf.
12. or/1-11
13. *Gonorrhea/
14. exp Neisseria gonorrhoeae/ or Neisseria/
15. gonorrh?ea.tw,kw,kf.
16. (gonococcal adj (infection or urethritis)).tw,kw,kf.
17. *Chlamydia/
18. *Chlamydia Infections/
19. *Chlamydia trachomatis/
20. chlamydia.tw,kw,kf.
21. *Sexually Transmitted Diseases/
22. (“sexual* transmitted” adj (disease* or infection*)).tw,kw,kf.
23. or/13-22
24. Infection Control/
25. (infection adj2 prevention).tw,kw,kf.
26. Sexually Transmitted Diseases/pc [Prevention & Control]
27. exp Gonorrhea/pc [Prevention & Control]
28. exp Chlamydia Infections/pc [Prevention & Control]
29. or/24-28
30. exp Early Intervention, Educational/
31. ((Internet or web) adj (based or intervention or delivered)).ti,kw,kf.
32. intervention*.ti,kw,kf.
33. School Health Services/
34. School Nursing/
35. (school*?based adj (intervention* or program*)).tw,kw,kf.
36. Health Education/
37. Patient Education as Topic/

38. Program Evaluation/
39. exp Sex Education/
40. sex* education.tw,kw,kf.
41. exp Contact Tracing/
42. ((contact or partner) adj (notification or tracing or identification)).tw,kw,kf.
43. testing.ti,kw,kf.
44. Mass Screening/
45. screening.ti,kw,kf.
46. partner therapy.tw,kw,kf.
47. exp Condoms/
48. (condom adj (provision* or suppl* or “use”)).tw,kw,kf.
49. sexual* transmitted infection clinic*.tw,kw,kf.
50. STI clinic*.tw,kw,kf.
51. sexual health clinic*.tw,kw,kf.
52. GUM clinic*.tw,kw,kf.
53. genitourinary medicine clinic*.tw,kw,kf.
54. Health Promotion/
55. Text Messaging/
56. messaging.ti,kw,kf.
57. Pay-it-forward.tw,kw,kf.
58. Reward/
59. opt-out.tw,kw,kf.
60. or/30-59
61. exp Developed Countries/
62. ((high-income or developed) adj countr*).tw,kw,kf.
63. exp United Kingdom/
64. United Kingdom.ti,kw,kf.
65. Great Britain.ti,kw,kf.
66. England.ti,kw,kf.
67. Wales.ti,kw,kf.
68. Scotland.ti,kw,kf.
69. Ireland.ti,kw,kf.
70. exp Europe/
71. Europe.ti,kw,kf.
72. United States/
73. North America/
74. Canada/
75. (United States or America or USA or Canada).ti,kw,kf.
76. exp China/
77. China.ti,kw,kf.
78. exp Australia/
79. Australia.ti,kw,kf.
80. exp New Zealand/

81. New Zealand.ti,kw,kf.
82. or/61-82
83. 12 and 23 and 29 and 60 and 82
84. limit 83 to (english language and yr=”2013 -Current”)

Appendix 4. Data extraction table for included studies

All studies which met the inclusion criteria on full text are listed below in alphabetical order.

Table A.2 Data extraction table

Abbreviations

NG = *Neisseria gonorrhoeae*; CT = *Chlamydia trachomatis*

Reference	Study design	Intervention	Main outcome
Bryan and others (22) Effect of Including Alcohol and Cannabis Content in a Sexual Risk-Reduction Intervention on the Incidence of Sexually Transmitted Infections in Adolescents: A Cluster Randomized Clinical Trial	**Study aim:** Cluster RCT analysing 3 intervention conditions: theory-based intervention combined with cannabis and alcohol, intervention combined with alcohol only and an intervention without substance use content in south-western USA **Study design:** • Type: RCT • Time period: 2010 to 2014 • Follow-up duration: pre-randomisation and 12 months post-intervention **Population:** • Age: 14 to 18 years • Sex: mixed	**Intervention:** Two years of exposure to a theory-based behavioural sexual risk reduction programme, Good Behaviour Game **Category of intervention:** Behavioural risk reduction **Disease remit:** Specific to NG and CT	**Outcome category:** Biological **Main results:** Biological: Measured effect on STI incidence. The sexual risk reduction intervention with alcohol and cannabis content was more effective in reducing the rate of CT and NG at 12 months than the interventions without the cannabis reduction element. However, the study was not originally powered for this outcome

Reference	Study design	Intervention	Main outcome
	• Ethnicity: Mixed ethnic backgrounds (57% Hispanic ethnic group) • Sexual orientation: not reported • Sample size: 460 at baseline **Specific context:** • Country: USA • Setting: juvenile detention. Adolescents who spoke English, had a remaining detention term less than one month and signed a release granting access to STI results if tested at intake		
Cordova and others (18) Pilot Study of a Multilevel Mobile Health App for Substance Use, Sexual Risk Behaviors, and Testing for Sexually Transmitted Infections and HIV Among Youth: Randomized Controlled Trial	**Study aim:** Examined the feasibility of a pilot RCT study, which evaluates the efficacy of mobile health apps against substance use, sexual risk behaviours and STI testing. Compared Storytelling 4 Empowerment (S4E) against enhanced usual practice **Study design:** • Type: feasibility study • Time period: 2016 to 2017	**Intervention:** Mobile health app followed by a clinician session on prevention and risk reduction. Contained 3 modules: alcohol and drug use, tobacco, and STI and HIV **Category of intervention:** Mobile phone apps and SMS messaging **Disease remit:** General to all STIs	**Outcome category:** Multiple **Main results:** Intervention was feasible. While outcome measures were reported, as a feasibility study, this was not designed to measure outcomes. Authors caution the statistical significance of outcomes due to the small-scale pilot. Behaviour: There was an increased proportion of youths reporting

Reference	Study design	Intervention	Main outcome
	• Follow-up duration: assessed at baseline, immediate post-intervention and 30-days post baseline **Population:** • Age: 13 to 21 years • Sex: mixed (82% women, 8% men, 8% trans men, remaining not disclosed) • Ethnicity: mixed ethnic backgrounds (46% non-Hispanic White ethnic group, 42% Black ethnic group, 2% Native American ethnic group, 8% ascribing to more than one ethnicity, 2% 'Other') • Sexual orientation: not reported • Sample size: 50 at baseline **Specific context:** • Country: USA • Setting: youth-centred community health clinic in South East Michigan		higher sexual risk refusal self-efficacy (small difference in self-efficacy for sexual risk between control group, which also experienced an increase). Sexually active S4E participants demonstrated a reduction in the proportion of youths reporting condomless sex (10% reduction from baseline to 30-day follow up) and alcohol before sex at 30-day follow up (5% reduction from baseline). Both control and S4E group experienced reductions in reported drug use before sex at 30-day follow up (10% for S4E). Relative to the control group, S4E participants reported a higher uptake of STI and HIV testing over time, but this was not statistically significant (although there were small sample sizes). Knowledge: Immediately post-intervention, S4E participants demonstrated higher clinical-youth risk communication and increases

Reference	Study design	Intervention	Main outcome
			in prevention knowledge to those in the enhanced usual practice group
Danielson and others (12) Feasibility of delivering evidence-based HIV and STI prevention programming to a community sample of African American teen girls via the internet	**Study aim:** Open pilot trial to determine the feasibility of HIV and STI prevention via the internet to African American teen girls **Study design:** • Type: feasibility study • Time period: not reported • Follow-up duration: analysed at baseline and 3-months post intervention **Population:** • Age:13 to 18 years • Sex: women • Ethnicity: African American ethnic group • Sexual orientation: not specified • Sample size: 41 at baseline **Specific context:** • Country: USA • Setting: traditionally underserved community and participants recruited from local community partners (local	**Intervention:** Evidence-based online and interactive intervention, Sistas Informing, Healing, Living and Empowering (SiHLEWeb). Involves 4, one-hour modules online **Category of intervention:** Online intervention **Disease remit:** General to all STIs	**Outcome category:** Multiple **Main results:** Intervention was feasible. While outcome measures were reported, as a feasibility study, this was not designed to measure outcomes. Behaviour: Participants who completed the intervention demonstrated significant increases in condom use self-efficacy. Knowledge: Participants who completed the intervention demonstrated significant increases in knowledge about HIV and STI risks and risk reduction behaviour, particularly for STI education and condom demonstration

Reference	Study design	Intervention	Main outcome
	high schools, Department of Juvenile Justice, child advocacy centre, medical university)		
DiClemente and others (30) Efficacy of an HIV and STI sexual risk-reduction intervention for African American adolescent girls in juvenile detention centres: a randomized controlled trial	**Study aim:** Two-arm RCT in juvenile detention centre analysing the efficacy of a risk reduction intervention in reducing STIs, improving HIV-preventative behaviours and psychosocial outcomes **Study design:** • Type: RCT • Time period: 2011 to 2012 • Follow-up duration: assessments occurred at baseline, 3- and 6-month post randomisation **Population:** • Age: 13 to 17 years • Sex: women • Ethnicity: African American ethnic group • Sexual orientation: participants needed to have willingly had vaginal intercourse with a man (restricted to a heterosexual history)	**Intervention:** Peer sessions with expedited partner therapy for STI-positive adolescents. Involved 3 individual-level and 4 phone sessions **Category of intervention:** Expedited partner therapy **Disease remit:** Specific to NG and CT	**Outcome category:** Multiple **Main results:** Overall: Improved condom use skills and psychosocial outcomes but there is still a need to reduce sexual risk. Biological: Analysed the effect on STI incidence. There were no significant differences compared to the control group for the incidence of CT and NG infections at 3- or 6-month assessments. Behaviour: At 6-month assessment (which was 3-months post intervention), participants reported significantly higher condom use skills compared to controls. Between trial conditions, no significant differences were

Reference	Study design	Intervention	Main outcome
	• Sample size: 188 at baseline **Specific context:** • Country: USA • Setting: juvenile detention centres in Atlanta, Georgia		observed for consistent condom use, unprotected vaginal sex, proportion of condom-protected sex acts and number of vaginal sex partners at 3- or 6-month assessments. Knowledge: At 6-month assessment (which was 3-months post intervention), participants reported higher HIV and STI knowledge and greater condom use self-efficacy than controls at 3- or 6-month assessments.
Espada and others (4) Short-term evaluation of a skill-development sexual education program for Spanish adolescents compared with a well-established program	**Study aim:** Cluster RCT evaluating 2 sex education programs: a Spanish school-based education programme (COMPAS), and an adapted version of a USA, CDC approved programme (¡Cuídate!) for Latino teens against a control group (no intervention) **Study design:** • Type: RCT • Time period: 2012	**Intervention:** School sex education (implemented during school hours, one session per week by facilitators who were psychologists. Two intervention groups (COMPAS and ¡Cuídate!) and one control group **Category of intervention:** Sex education **Disease remit:** General to all STIs	**Outcome category:** Knowledge **Main results:** Overall: COMPAS found to be at least as effective at increasing the intention to engage in safer sex behaviours as the ¡Cuídate! programme. Authors note that by adapting ¡Cuídate! programme for Spanish culture, not all material

Reference	Study design	Intervention	Main outcome
	• Follow-up duration: assessed one week pre- and post-intervention **Population:** • Age: 14 to 16 years • Sex: mixed (51.1% men) • Ethnicity: not addressed • Sexual orientation: mixed but majority heterosexual (similar baseline characteristics between 2 interventions and control group) • Sample size: 1,563 at baseline **Specific context:** • Country: Spain • Setting: high school students (from 18 different public high schools in 5 provinces in the north, south, east and south-east of Spain)		was used therefore this could have limited effectiveness. Knowledge: Measured mean scores for STI and HIV Knowledge, HIV-related attitudes, behavioural intention, sexual risk perception, self-efficacy and perceived norms. For STI and HIV Knowledge: Increased knowledge among both intervention groups compared to the control group. No significant change in the control group or between intervention groups. For HIV-related attitudes: Improved attitudes in COMPAS group (total and on subscales) compared to the control. Improved attitudes in ¡Cuídate! group on 2 subscales compared to the control. No significant difference between intervention groups. For behavioural intentions: Compared to the control, both intervention groups increased their behavioural intention scores

Reference	Study design	Intervention	Main outcome
			surrounding condom use. The 2 interventions did not differ from each other. For perceptions of sexual risk: Increased in COMPAS group compared to the control (small effect size). No significant difference between ¡Cuídate! group compared to the control and COMPAS groups For self-efficacy: Increased in COMPAS group (small effect size). No differences were found between the ¡Cuídate! and control groups. For perceived norms: Compared with the control group, neither intervention had a significant effect nor differed from each other
Evans and others (31) Association of Sexual Health Interventions With Sexual Health Outcomes in Black Adolescents: A	**Study aim:** Systematic review and meta-analyses analysed the association between interventions and behavioural, biological and psychological outcomes of black adolescents	**Intervention:** For 2 relevant studies: 1. DiClemente and others (30): 3 in-person 1.5 hour counselling sessions [note 1] 2. Wechsburg and others (32): 3 in-person individual sessions, one	**Outcome category:** Multiple **Main results:** Overall findings for systematic review: Generated 22 independent effect sizes for abstinence, 26 for condom use, 10 for number of sex

Reference	Study design	Intervention	Main outcome
Systematic Review and Meta-analysis	**Study design:** • Type: systematic review and meta-analysis • Time period: studies published until 2019 (lower range not reported) • Follow-up duration: not applicable **Overall population for 29 studies:** • Age: mean age 12.43 years • Sex: mixed • Ethnicity: Black ethnic group • Sexual orientation: not reported • Sample size:11,918 across 29 studies **Overall context:** • Country: USA • Setting: studies were included if: participants were USA-based, Black adolescents (at least 95% were Black and mean sample age less than or equal to18 years and no participant was above 24 years); evaluated a primary prevention sexual health intervention (excluded secondary prevention so those pregnant or STI-positive youths); used	group session, and 1-on-1 time with interventionist post sessions **Category of intervention:** Holistic and family-based programmes **Disease remit:** General to all STIs	partners, 4 for pregnancy, 4 for STI contraction, 14 for sexual health intentions, 11 for sexual health knowledge and 15 for sexual health self-efficacy. Intervention effect sizes consistent across factors like participant sex, age and intervention dose. Authors report that most studies assessed behaviour change after only 12-months, at which point many adolescents may not have become sexually active so there may be limitations measuring the effect. However, the authors theorise that based on psychological outcomes, this will lead to healthier sexual decision-making. Behavioural outcomes: Measured effect on abstinence, condom use, number of sex partners. There was a significant weighted mean association of interventions with improvements in abstinence and

Reference	Study design	Intervention	Main outcome
	experimental or quasi-experimental designs; included at least one behavioural or biological outcome; provided sufficient statistics to calculate effect sizes; and were published in English until 31 January 2019 **For the 2 relevant studies:** **1. DiClemente and others (30):** **Population:** • Age: 13 to 17 years • Sex: women • Ethnicity: African American ethnic group • Sexual orientation: participants needed to have willingly had vaginal intercourse with a men (restricted to a heterosexual history) • Sample size: 188 at baseline **Specific context:** • Country: USA • Setting: juvenile detention in Georgia		condom use. No significant association with the number of sex partners. However, there was significant heterogeneity among studies on abstinence and condom use outcome. For abstinence, the intervention setting and study publication year moderated the association: school-based interventions had stronger association with improvements than community centres, as did older studies, compared to more recent studies. For condom use, the publication year moderated the association with older studies reporting stronger associations with improvements. Biological outcomes: Measured the effect on pregnancy and STI contraction. There was no significant association of interventions with pregnancy or STI contraction but authors state caution is warranted during interpretation since only 4 out of 29

Reference	Study design	Intervention	Main outcome
	2. Wechsburg and others (32): **Population:** • Age: 16 to 19 years • Sex: women • Ethnicity: African American ethnic group • Sexual orientation: participants who have reported having vaginal intercourse in the last 3 months with a man (restricted to a heterosexual history) • Sample size: 237 at baseline **Specific context:** • Country: USA • Setting: adolescent women who use substances and have dropped out, or considered dropping out, of school		studies reported either pregnancy or STI contraction as an outcome. The authors propose another meta-analysis is warranted to evaluate the long-term success of primary prevention sexual health programmes once more studies evaluate the effect on biological outcomes. Knowledge outcomes: Measured the effect on sexual health intentions, knowledge and self-efficacy. There was a significant association with improvement but the effect sizes ranged from small to moderate. Outcomes were measured for 2 relevant studies but separate outcomes were not reported by review authors: 1. DiClemente and others (30): Measured outcomes for condoms, sex partners, STIs, knowledge and self-efficacy

Reference	Study design	Intervention	Main outcome
			2. Wechsburg and others (32): Measured outcomes for condoms, sex partners
Free and others (29) Behavioural intervention to reduce sexually transmitted infections in people aged 16 to 24 years in the UK: the safetxt RCT	**Study aim:** Randomised superiority trial analysed the effect of theory-based safetxt mobile messaging intervention to reduce chlamydia and gonorrhoea incidence. Based on capability, opportunity and motivation model of behaviour (COM-B). **Study design:** • Type: RCT • Time period: 2016 to 2018 • Follow-up duration: primary outcome measured at one year post-intervention and secondary outcomes at one and 12 months post-intervention **Population:** • Age: 16 to 24 years • Sex: mixed (65.5% women, 34.1% men and 0.4% non-binary) • Ethnicity: mixed ethnic backgrounds	**Intervention:** Mobile messaging: 42 to 79 text messages with educational and motivational content to follow STI treatment instructions, inform partners about infection, recommend condom use with new or casual partners, and encourage testing before unprotected sex. Tailored to infection, gender and sexuality **Category of intervention:** Mobile phone apps and SMS messaging **Disease remit:** Specific to NG and CT	**Outcome category:** Multiple **Main results:** Overall: No difference in safety outcomes at the end of the trial between intervention and control group, but there was a positive effect on broader definitions of positive sexual health. Authors made recommendations against using safetxt messages for partner notifications in the NHS since they may cause more infections. Authors caution that further trial data is required to explain trends. Intervention partly beneficial since it was shown to improve condom use. However, condom promotion content costed £1.80 per person based on 5p text message.

Reference	Study design	Intervention	Main outcome
	• Sexual orientation: mixed sexuality at baseline (WSM, MSW, WSW, MSM, WSMW) • Sample size: 6,248 randomised at baseline but primary outcome data only available for 4,675 participants **Specific context:** • Country: UK • Setting: patients at 92 sexual health clinics. Participants needed a positive chlamydia and or gonorrhoea test result, diagnosis of non-specific urethritis or treatment for chlamydia and or gonorrhoea or non-specific urethritis in last 2 weeks and needed to own a mobile phone		Biological: Primary outcomes were measured as the incidence of CT and NG infection at 12 months. No reductions in infection with slightly more infections in the intervention group. The post hoc per-protocol analysis showed slightly higher odds of CT and NG in the intervention group (not thought to be due to bias). Behavioural: Secondary outcomes measured at 1- and 12-months for self-reported partner notification, condom use and STI testing before sex with new partners. Intervention increased condom use and slightly increased the number of people telling their partner about an infection but also increased the number of partners and new partners. There was no difference in the number of people testing for STIs before sex with a new partner or the number of partners attending clinic for treatment based on clinic records and self-report. However,

Reference	Study design	Intervention	Main outcome
			there was increased participant report of partners testing for STI prior to sex with the participant. Knowledge: Increase in knowledge and self-efficacy on how to use condoms
Geisler and others (26) Diagnosis and Management of Uncomplicated Chlamydia trachomatis Infections in Adolescents and Adults: Summary of Evidence Reviewed for the 2021 Centers for Disease Control and Prevention Sexually Transmitted Infections Treatment Guidelines	**Study aim:** Summary of evidence for epidemiology, diagnosis and management of uncomplicated chlamydia for 2021 CDC STD Treatment Guidelines **Study design:** • Type: other lit review • Time period: 2013 to 2019 • Follow-up duration: not applicable **Overall population:** • Age: adolescents and adults but age range not reported • Sex: mixed • Ethnicity: not reported • Sexual orientation: not reported • Sample size: not reported	**Intervention:** Expedited partner therapy (EPT) on CT infection with 3 relevant studies. **Category of intervention:** Expedited partner therapy **Disease remit:** Specific to CT, except for Golden and others (35) which was specific to NG and CT	**Outcome category:** Biological **Main results:** Overall: Majority of outcomes excluded from this study. For the 3 relevant studies: Biological: Effect of expedited partner therapy on CT infections measured. 2 studies show expedited partner therapy can lower rates of repeat CT detection in women after treatment and the other study reported lower rates of CT positivity in women at the population level. The review author note that reinfection rates were still

Reference	Study design	Intervention	Main outcome
	Overall context: • Country: USA **For 3 relevant studies:** **1. Taylor and others (33):** **Population:** • Age: median age 22 years for women and 23 years for men • Sex: mixed but majority women • Ethnicity: not reported by review authors • Sample size: 492 at baseline **Specific context:** • Country: USA • Setting: CT cases diagnosed at urban Indian health centre, Arizona **2. Vacca and others (34):** **Population:** • Age: 13 to 19 years • Sex: women • Ethnicity: not reported by review authors • Sample size: 46 at baseline		high with expedited partner therapy so other measures should be implemented at the same time. 1. Taylor and others (33): 52% of cases received expedited partner therapy (with azithromycin). Of the 324 patients retesting after treatment, repeat CT detection was less common among those receiving EPT (13% compared to 27% with an odds ratio of 0.5) 2. Vacca and others (34): CT-infected adolescent women in health centres at 2 public high schools in New York presented for treatment and were offered patient-delivered expedited partner therapy for their sexual partners. Received urine CT NAAT at 3- and 6-month follow up visits. 17 out of 37 subjects had expedited partner therapy provided to their partner. Reinfection rate was lower in subjects who provided expedited partner therapy (3 compared to 8, p

Reference	Study design	Intervention	Main outcome
	Specific context: • Country: USA • Setting: adolescents using school-based health centres **3. Golden and others (35):** **Population:** • Age: 14 to 25 years • Sex: women • Ethnicity: not reported by review authors • Sexual orientation: heterosexual individuals • Sample size: 23 local health jurisdictions (participants not reported by review author) **Specific context:** • Country: USA • Setting: population-level effect on heterosexual individuals with NG or CT infection in Washington state		= 0.08) however the reinfection rate did not differ between the 2 groups at the 6-month visit. 3. Golden and others (35): Stepped-wedge, community-level randomised trial of expedited partner therapy intervention (included patient-delivered partner therapy and partner services) compared to the control group (ongoing partner services without expedited partner therapy). Chlamydia test positivity and gonorrhoea incidence in women decreased over the study period, from 8.2% to 6.5% and from 59.6 to 26.4 per 100,000, respectively. After adjusting for temporal trends, the intervention was associated with an approximate 10% reduction in both chlamydia positivity and gonorrhoea incidence. However, the confidence bounds on these outcomes both crossed one (chlamydia positivity prevalence ratio = 0.89, 95% CI = 0.77 to 1.04,

Reference	Study design	Intervention	Main outcome
			p = 0.15; gonorrhoea incidence rate ratio = 0.91, 95% CI = 0.71 to 1.16, p = 0.45). Review authors caution study findings are potentially limited by inadequate statistical power, with some aspects of the study intervention outside the research randomisation sequence since local health jurisdictions do not constitute truly isolated sexual networks
Gobin and others (20) Do sexual health campaigns work? An outcome evaluation of a media campaign to increase chlamydia testing among young people aged 15 to 24 in England	**Study aim:** Retrospective analysis via interrupted time series and negative binomial and logistic regression modelling to evaluate the effect of a multimedia health campaign on coverage and chlamydia positivity in the National Chlamydia Screening Programme in England. **Study design:** • Type: quasi-experimental with interrupted time series analysis • Time period: 2008 to 2010 • Follow-up duration: reports assigned to pre-campaign, during campaign and	**Intervention:** Awareness campaign to increase CT testing **Category of intervention:** Awareness campaigns and messaging **Disease remit:** Specific to CT	**Outcome category:** Multiple **Main results:** Biological: Once cyclical and secular trends were accounted for, the positivity rate increased during the campaign and further increased in the post-campaign phase (associated with increased testing of high-risk groups in target population who were less likely to come forward for testing). Proportion of CT infections increased for all socio-demographic

Reference	Study design	Intervention	Main outcome
	post-campaign phase according to test date **Population:** • Age: 15 to 24 years • Sex: mixed (majority women) • Ethnicity: mixed ethnic backgrounds • Sexual orientation: not addressed • Sample size: 1,555,139 test records **Specific context:** • Country: England • Setting: National Chlamydia Screening Programme data		and self-reported sexual behaviour groups both during and after the campaign. Behavioural: After adjusting for cyclical and secular trends, there was no change in the overall testing coverage during or after the campaign compared to pre-campaign (crude changes showed increase during and decrease post-campaign, but still higher than pre-campaign). Coverage varied in different socio-demographic groups: testing of men increased during the campaign while testing of people of black and other ethnic groups decreased. Coverage did not vary by age group or socio-economic status across the 3 stages. Authors recommend tailoring information campaigns to ensure relevance to all target populations
Jerlstrom and Adolfsson (5)	**Study aim:** Cluster RCT with web surveys to determine if theatre in school sex education affects	**Intervention:** School sex education with supplementation of theatre	**Outcome category:** Multiple

Reference	Study design	Intervention	Main outcome
Prevention of Chlamydia Infections With Theater in School Sex Education	knowledge, attitudes and behaviour. Intervention, called SAFETY, included a play, value exercises, chlamydia games, condom school and interactive replay with professional actors and staff. Control had standard sex education from school staff **Study design:** • Type: RCT • Time period: 2016 to 2017 • Follow-up duration: 1-month pre-intervention and post-intervention **Population:** • Age: 15 years • Sex: mixed • Ethnicity: not addressed • Sexual orientation: not addressed • Sample size: 963 students at baseline **Specific context:** • Country: Sweden • Setting: high school students	**Category of intervention:** Sex education **Disease remit:** Specific to CT	**Main results:** Knowledge: Knowledge about condom use, chlamydia and protection had increased significantly in both groups but intervention participants reported significantly higher levels of knowledge in comparison to the controls. Behaviour: Attitudes about condom use improved and less risky behaviour reported by intervention participants to a greater extent afterwards. For example, more students reported intention to use condoms. However, exception to improvements in risky behaviour of intervention group found in regards as to whether they would still risk having sex without a condom (25% in both groups stated they would still risk it)
Kampman and others (19)	**Study aim:** Assessed the effectiveness of reminder text	**Intervention:** Text reminders for re-testing, 5 and	**Outcome category:** Behaviour

Reference	Study design	Intervention	Main outcome
Retesting young STI clinic visitors with urogenital Chlamydia trachomatis infection in the Netherlands; response to a text message reminder and reinfection rates: a prospective study with historical controls	messages on retesting and chlamydia reinfection rates **Study design:** • Type: observational study with prospective follow up and historical control • Time period: 2012 to 2013 for prospective follow-up cohort and 2011 to 2012 for historical control group • Follow-up duration: 6-months after initial treatment **Population:** • Age: 16 to 23 years • Sex: mixed • Ethnicity: mixed ethnic backgrounds • Sexual orientation: heterosexuals (MSM were excluded) • Sample size: 828 at baseline **Specific context:** • Country: The Netherlands • Setting: Individuals with a positive CT test at 10 STI clinics, mostly in rural areas	a half months after CT treatment with a later 2-week reminder **Category of intervention:** Mobile phone apps and SMS messaging **Disease remit:** Specific to CT	**Main results:** Behaviour outcomes: Intervention was found to be effective on test uptake for re-testing and infection rates. 30.6% returned for re-test compared to 9.2% in the historical control. Of those re-tested, 20.4% had chlamydia infection

Reference	Study design	Intervention	Main outcome
Kellam and others (6) The Impact of the Good Behavior Game, a Universal Classroom-Based Preventive Intervention in First and Second Grades, on High-Risk Sexual Behaviors and Drug Abuse and Dependence Disorders into Young Adulthood	**Study aim:** Measured the effect of Good Behaviour Game, a behaviour management strategy in schools, on high-risk sexual behaviours, drug abuse and dependence disorders **Study design:** • Type: true experimental study with a randomised field trial design and matching • Time period: first cohort recruited in 1985 to 1986 and second cohort from 1986 to 1987. Time period of young adult follow-up was not reported by authors • Follow-up duration: measured at 9 time points until the students were aged 19 to 21 years **Population:** • Age: from first graders (not reported but approximately 6 to 7 years) to 19 to 21 years • Sex: mixed • Ethnicity: mixed ethnic backgrounds	**Intervention:** School sex education **Category of intervention:** Sex education **Disease remit:** General to all STIs	**Outcome category:** Behaviour **Main results:** Behaviour outcomes: Intervention was found to be effective when measuring the effect on high-risk sexual behaviours. However, only observed for men within the highest group for aggressive and disruptive behaviours. Intervention found to be effective at increasing reported condom use, later age for first sex and composite measure of lifetime high-risk sexual behaviour

Reference	Study design	Intervention	Main outcome
	• Sexual orientation: individuals who have engaged in vaginal sex (definition restricted to heterosexual activity) • Sample size: 407 at baseline **Specific context:** • Country: USA • Setting: middle-school students		
Lee and others (25) Community-based Implementation of Centers for Disease Control and Prevention's Recommended Screening for Sexually Transmitted Infections Among Youth at High Risk for HIV Infection in Los Angeles and New Orleans	**Study aim:** Examined whether CDC's recommended screening for NG and CT and the re-testing follow-up programme resulted in the decline of future diagnoses in youth at high risk of HIV in LA and New Orleans **Study design:** • Type: observational • Time period: 2017 to 2018 • Follow-up duration: screening and follow-up interviews conducted at 4-, 8-, and 12-months post-intervention **Population:** • Age: 12 to 24 years • Sex: mixed	**Intervention:** Repeated screening, interviews and same-day treatment in targeted community settings **Category of intervention:** Testing interventions **Disease remit:** Specific to NG and CT	**Outcome category:** Biological **Main results:** Overall: Binary gender identity and sexual behaviour covariates were considered so participants were categorised into 2 groups: MSM, transgender and GNC or cis-gender heterosexual and lesbian (CHL). Biological: Effect on STI incidence measured. When comparing the frequency of diagnoses between CHL and MSM, TG, and GNC youth there was a significant decline in diagnoses among MSM,

Reference	Study design	Intervention	Main outcome
	• Ethnicity: mixed ethnic backgrounds (for the cis-gender heterosexual and lesbian (CHL) group, majority are people from an African American background and for the men who have sex with men (MSM), transgender (TG) and gender non-conforming (GNC) group, majority are from a Black ethnic group) • Sexual orientation: mixed • Sample size: 437 at baseline **Specific context:** • Country: USA • Setting: community settings (including homeless shelters, social networking apps, and organisations serving LGBTQ youth) and clinic settings. Restricted to individuals with at least 7 risk factors of HIV in last year: gay or bisexual identity, MSM, transgender, gender nonconforming, jailed and incarcerated homeless, hospitalised for mental health disorders, condomless sex with HIV person, rape or traumatic assault, positive for alcohol or drugs on rapid		TG, and GNC from baseline (18.9%) to 4 months (4.1%), which is 80% lower adjusted odds and from baseline (18.9%) to 12 months (7.8%), which is 60% lower odds. This was also measured by positivity rates, defined as the percentage of positive STI tests by the number of follow-up assessments. For all youth, which received assessments every 4 months over a year, this resulted in a 41% decline in STIs over one year and youth with 3 tests in one year resulted in a 10% decline. A small proportion of youth which only had 2 assessments (baseline and 12 months) had a doubling of STI frequency

Reference	Study design	Intervention	Main outcome
	tests, suicide attempt, transactional sex, African American, or Latinx and Hispanic		
Lee and others (15) Factors related to sexual behaviors and sexual education programs for Asian American adolescents	**Study aim:** Integrative literature review which aimed to identify the influential factors related to sexual behaviours and evaluated common factors across 2 successful sex education programmes for Asian American adolescents **Study design:** • Type: other lit review • Time period: 2004 to 2015 • Follow-up duration: not applicable **Population:** • Age: adolescents (age range not reported by authors) • Sex: not reported by review authors • Ethnicity: Asian American ethnic group • Sexual orientation: not reported • Sample size: not reported **Specific context:** • Country: USA	**Intervention** For one relevant study: Holistic life skills school-based programme, SSDP. This intervention was not specific to STIs: it was aimed at a range of life skills, for example reducing non-violent crime, substance use, sexual activity, and expulsions with the ethos that each teacher can make a difference and every child can succeed. Trained parents in behaviour, academic support and skills to reduce high-risk behaviour. There were 6x teacher-based educations who had received 5 days of in-service training. Parents received 5 sessions of curriculum training **Category of intervention:** Holistic and family-based	**Outcome category:** Multiple **Main results:** For one relevant study, Hill and others (36): Behaviour outcomes: Experimental group demonstrated less early-onset problem behaviour, better school bonding and higher academic achievement. There was a significant increase in condom use. Biological outcomes: Decreased incidence of lifetime STI diagnosis in the intervention group, particularly African Americans and Asian Americans. Reviewers stated family bonding between parents and adolescents played a central role to this success and findings were supported by other studies

Reference	Study design	Intervention	Main outcome
	• Setting: successful sex education programmes (both experimental and non-experimental) reported by Advocates for Youth in 2012 and USDHHS in 2014. A successful programme needed to have greater than 10% Asian American study participants, more than 200 participants, effective outcomes for Asian American adolescents, at least one influential factor addressed in the study, and interventions concentrated on reducing STIs and pregnancy **For one relevant study:** First research question irrelevant but second relevant **Hill and others (36) [note 2 and 3]:** **Population:** • Age: elementary grades one to 6 at baseline (not reported but approximately 6 to 10 years) and at age 18 and 21 years at follow-up • Sex: mixed • Ethnicity: mixed ethnic backgrounds • Sexual orientation: not reported	programmes **Disease remit:** General to all STIs	which did not meet the eligibility criteria The intervention was developed for elementary students, not adolescents, but the authors report that earlier interventions can deter future risky sexual behaviours

Reference	Study design	Intervention	Main outcome
	• Sample size: 608 at baseline reported in original study **Specific context:** • Country: USA • Setting: Seattle Social Development Project for Asian American adolescents in the USA. Multi-year school-based quasi-experimental design with long-term measurements in 18 public schools. Outcomes measured in grades one to 6, at age 18 and age 21		
McCullock and Perrault (21) Exploring the Effects of Source Credibility and Message Framing on STI Screening Intentions: An Application of Prospect and Protection Motivation Theory	**Study aim:** 2 x 2 experiment which applied Prospect and Protection Motivation Theory to analyse whether the source credibility (high versus low) and message framing (positive versus negative) affected behavioural intentions for STI screening **Study design:** • Type: true experimental study with a randomised 2 x 2 experiment, repeated measures and between subjects design • Time period: not reported	**Intervention:** Public health education and awareness messaging (effect of source credibility and message framing) **Category of intervention:** Awareness campaigns and messaging **Disease remit:** General to all STIs	**Outcome category:** Behaviour **Main results:** Behaviour: Measured the intention to test. However, further testing required for STI screening behaviours in real-world scenarios. Both highly credible sources and negatively framed messages independently increased the intention to get screened for STIs. However, the interaction between source credibility and message

Reference	Study design	Intervention	Main outcome
	• Follow-up duration: pre- and post-messaging but duration not reported **Population:** • Age: mean age 20.11 years • Sex: mixed (53.6% women) • Ethnicity: mixed ethnic backgrounds (69.1% White ethnic group) • Sexual orientation: mixed (89.8% heterosexual) • Sample size: 207 at baseline **Specific context:** • Country: USA • Setting: sexually active university students in the Midwest		framing (for example, high-credibility source and loss-frame messaging) was not significant. Loss-frame messages were more effective than gain-frame messages and high credible sources directly and indirectly influence intentions by increasing self- and response-efficacy. Preliminary support for a directional relationship between self- and response-efficacy: self-efficacy influences perceived response-efficacy which then influences intentions. Mediation models suggest perceptions of efficacy partially explain the effect of source credibility on intentions to test, but not for messaging framing. Perceptions of severity and susceptibility did not mediate the effect of either

Minnis and others (27) Yo Puedo--a conditional cash transfer and life skills intervention to promote adolescent sexual health: results of a randomized feasibility study in San Francisco	**Study aim:** Randomised feasibility study to evaluate a conditional cash transfer and life skills intervention on adolescent sexual health in an area with gang exposure and early childbearing **Study design:** • Type: feasibility study • Time period: 2011 to 2012 • Follow-up duration: assessed at baseline and 6-months post-baseline (coincides with conclusion of intervention) **Population:** • Age: 16 to 21 years • Sex: mixed • Ethnicity: Latino and Latina ethnic groups • Sexual orientation: not addressed • Sample size: 162 at baseline **Specific context:** • Country: USA • Setting: participants in an area with gang exposure and early childbearing in San Francisco and frequented the Mission District at least 4 days per week, spoke	**Intervention:** 6-month exposure to life skills intervention with 8 group sessions offered weekly during the first 2 months of the interventions **Category of intervention:** Cash transfer **Disease remit:** General to all STIs	**Outcome category:** Behaviour **Main results:** Intervention was feasible. While outcome measures reported, as a feasibility study, this was not designed to measure outcomes. Behaviour outcomes: Holistic life skills intervention resulted in lower odds of having sex in the past 6-months but there was no effect on contraceptive self-efficacy and motivation (feasibility)

Reference	Study design	Intervention	Main outcome
	English or Spanish, and were not pregnant or parenting. Index participants recruited up to 2 friends who met this criteria		
Mirzazadeh and others (16) Do School-Based Programs Prevent HIV and Other Sexually Transmitted Infections in Adolescents? A Systematic Review and Meta-analysis	**Study aim:** Reviewed the effectiveness of school-based programmes to prevent HIV and other STIs among adolescents (only included those with reported changes in HIV and STI incidence or testing) **Study design:** • Type: systematic review • Time period: studies published up until 2017 (date range not reported by authors) • Follow-up duration: not applicable **Overall population:** • Age: 10 to 19 years • Sex: not reported • Ethnicity: not reported • Sexual orientation: not reported	**Intervention:** School-based programmes For 2 relevant studies: 1. Hill and others (36): Seattle Social Development Project - Not a sexual education programme: it aimed to engage students by providing opportunities to become actively involved with their community and form bonds with parents and teachers. There were 3 components: classroom instruction and management; child skills development, and parent intervention. This involved: 5 days of annual in-service training for teachers, with those in the intervention arm receiving additional training on	**Outcome category:** Biological **Main results:** Overall: Primary outcome of the review was biological: changes in HIV and STI incidence and testing rates. Secondary outcomes included self-reported sexual risk behaviour and STI knowledge and skills. All 9 studies for the 7 school-based programmes were at high-risk of bias and the effect of school-based interventions was heterogeneous (I^2 for STI incidence and prevalence ranged from 63.6 to 91.7%). For the 2 relevant studies: 1. Hill and others (36): Biological: Assessed STI onset

Reference	Study design	Intervention	Main outcome
	• Sample size: 19,000 baseline participants in 9 studies describing 7 interventions **Overall context:** • Country: USA • Setting: sexual risk reduction or avoidance intervention programmes in school settings **For 2 relevant studies:** **1. Hill and others (36) [note 3]:** **Population:** • Age: mean age 10.8 years • Sex: mixed • Ethnicity: mixed ethnic backgrounds • Sexual orientation: not reported by review authors • Sample size: 608 at baseline **Specific context:** • Country: USA • Setting: non-randomised controlled study in 15 public elementary schools in Seattle, USA with diverse populations in	interpersonal cognitive problem solving; students in the 5th to 6th grade in the intervention group received 4 hrs of training from project staff to develop skills to resist peer pressure and stay out of trouble; and 16 voluntary parent training classes were offered from grades one to 6. In the full intervention arm, students participated in grades one to 6, and in the late arm, those from 5 to 6 grade participated. This was compared to no intervention. 2. Spoth and others (37): PROSPER intervention - teams of community stakeholders chose 2 interventions which address multiple risk and protective factors aimed at reducing substance misuse: one family-based and one school-based programme. The family-based intervention, Strengthening Families Program, for parents and youth 10 to 14, was provided from the first year to the	among all youth regardless of baseline sexual activity after an 18 year follow up (at age 30). The non-RCT with 18 years of follow up found that the pooled effect of the intervention on STI incidence was 0.60 (95% CI 0.12, 1.08) and not statistically significant. The group that received the full intervention showed a significant reduction in STI incidence when compared with the control group. However, the effect was not statistically significant for the late intervention group. This was the only intervention provided to pre-teens in the systematic review that found a school-based program might reduce STI incidence in adulthood but this was unique because it was not a sex education programme: it aimed to engage students in community service and bond with parents and teachers. This effect was not observed in the other studies.

Reference	Study design	Intervention	Main outcome
	high-crime neighbourhoods from 1985 to 2003. 12 assessments when aged 10, 11, 12, 13, 14, 15, 16, 18, 21, 24, 27, and 30 years **2. Spoth and others (37):** **Population:** • Age: mean age 11.8 years at baseline and 19.5 years at follow-up • Sex: mixed • Ethnicity: mixed ethnic backgrounds • Sexual orientation: not reported by review authors • Sample size: 10,849 at baseline and 1,985 at follow-up **Specific context:** • Country: USA • Setting: randomised controlled study in 14 rural public school districts in each state: Iowa and Pennsylvania. Only a subsample of population was followed up into adulthood, defined as age 19	6th grade. The school-based intervention was provided from the 2nd year to the 7th grade. The family-based intervention concentrated on enhancing parenting skills to improve youth substance refusal skills and prosocial skills. For the school-based intervention, 3 different programmes were chosen across the districts but each was provided by a trained classroom teacher in a 7th grade class. Both interventions were compared to standard sex education and care **Category of intervention:** Holistic and family-based programmes **Disease remit:** General to all STIs	2. Spoth and others (37): Biological: Assessed lifetime STIs after 8 years (at age 19). The effect of the intervention after 8 years on lifetime STI prevalence had an RR of 0.70 (95% CI 0.42 to 1.16). May be susceptible to selection bias since they did not report sequence generation methods and loss to follow up was not reported in this RCT

Morales, Espada and Orgiles (7) A 1-year follow-up evaluation of a sexual-health education program for Spanish adolescents compared with a well-established program	**Study aim:** Evaluation of school-based intervention, COMPAS, compared to evidence-based intervention, ¡Cuídate!. Linked to earlier study, Espada and others (4) **Study design:** • Type: RCT • Time period: 2012 to 2013 • Follow-up duration: One week pre-intervention and one year post-intervention **Population:** • Age: 15 to 17 years • Sex: mixed • Ethnicity: not reported • Sexual orientation: mixed (majority heterosexual at baseline) • Sample size: 1,563 at baseline and 1,030 at follow-up **Specific context:** • Country: Spain • Setting: high school students	**Intervention:** School sex education **Category of intervention:** Sex education **Disease remit:** General to all STIs	**Outcome category:** Multiple **Main results:** Overall: COMPAS is the only school-based sexual health promotion program in Spain found to be as effective as the evidence-based intervention ¡Cuídate! at one year. Knowledge: COMPAS was as successful as ¡Cuídate! at increasing knowledge about STIs (HIV, gonorrhoea, syphilis, vaginal herpes, condom use and routes of transmission) at the 12-month follow up. COMPAS was as effective at increasing favourable attitudes about condom use and individuals with HIV and AIDS (no statistically significant difference). It was more effective at increasing perceptions of peer's consistent condom use and delay of first vaginal intercourse.

Reference	Study design	Intervention	Main outcome
			Behaviour: COMPAS resulted in a greater delay in first vaginal sex experience than ¡Cuídate!. However, it was less effective at delaying age of first oral sex experience. Neither program had a significant effect on the consistency of condom use or the number of sexual partners reported by participants compared to controls
Nielsen and others (28) The MOSEXY trial: mobile phone intervention for sexual health in youth-a pragmatic randomised controlled trial to evaluate the effect of a smartphone application on sexual health in youth in Stockholm, Sweden	**Study aim:** Evaluate the effectiveness of the smartphone application, MOSEXY, on sexual health in Swedish youth **Study design:** • Type: two-arm individually randomised RCT • Time period: 2017 to 2018 • Follow-up duration: remote follow-up with data collected at baseline, 3-months and 6-months post-intervention. Primary outcomes measured at 6-months and secondary outcomes measured during the study period	**Type of intervention:** 6-month mobile phone intervention. Tailored app with safe sex and STI messages, personal stories and games. Intervention arm had 2 to5 new pieces of information a day **Category of intervention:** Mobile phone apps and SMS messaging **Disease remit:** Specific to CT	**Outcome category:** Behaviour **Main results:** Behaviour: There was no effect of the intervention on the primary outcome, which was defined as self-reported condom use, and no effect on the secondary outcomes, which were defined as the number of sexual partners, STIs and STI tests

Reference	Study design	Intervention	Main outcome
	Population: • Age: 18 to 23 years • Sex: mixed • Ethnicity: not reported • Sexual orientation: mixed (majority heterosexual at baseline) • Sample size: 433 at baseline **Specific context:** • Country: Sweden • Setting: participants who owned smartphones and 2+ sexual partners in last 6 months at 8 youth health clinics		
Orlando and others (8) Impact of training conferences on high-school students' knowledge of sexually transmitted infections (STIs)	**Study aim:** Survey of training conferences, as part of a school health promotion programme, on the awareness of STIs among adolescents. Questionnaire covered a broad range of topics: prevalence of STIs, self-evaluated knowledge of STIs, knowledge of STIs, knowledge of prevention methods, risky behaviours, HPV vaccination, HIV and AIDS, preferred sources to seek sexual health help. Questionnaire conducted post-intervention included additional questions to evaluate	**Intervention:** School health education which incorporates 2-hour interactive conferences taught by an infectious disease specialist and a psychologist. **Category of intervention:** Sex education **Disease remit:** General to all STIs	**Outcome category:** Knowledge **Main results:** Knowledge: Mixed effects. There was no significant increase in perceived STI knowledge. However, a higher percentage were able to name at least 3 STIs post intervention (88% versus 48.2%) with greater knowledge of the range of STIs listed (shift

Reference	Study design	Intervention	Main outcome
	changes in attitudes, preferential information sources and the psychological and behavioural effect of the conference **Study design:** • Type: quasi-experimental before and after design • Time period: 2017 • Follow-up duration: immediate pre- and post-intervention (2 hour intervention) **Population:** • Age: 16 to 17 years • Sex: mixed • Ethnicity: not reported • Sexual orientation: unclear reporting but assumed to be mixed since a small percentage of homosexual intercourse reported in pre- and post-test questionnaire • Sample size: unclear. 178 students were reported but only 139 completed the pre-test survey and 100 completed the post-test. It was not specified if the 100 students who completed the post-test		towards non-HIV STIs). The effect on knowledge about preventative methods which decreased the risk of STIs was mixed: there was a significant increase in awareness that some vaccines prevent STIs, but misconceptions that contraceptive pills reduce the risk of STIs remained. Post-intervention, there was an increased awareness of risk factors for transmission such as the number of partners and contagiousness of disease. There was no significant differences in attitudes considering risky sexual behaviours, awareness of HIV and AIDS and the HPV vaccine. Despite improved knowledge of STIs, some misconceptions persisted post intervention. Caution by authors: Small cohort completed post intervention questionnaire (in one high school). Due to the anonymous nature of the survey, it is unclear if the same

Reference	Study design	Intervention	Main outcome
	also completed the pre-test since the anonymous survey prevented matching **Specific context:** • Country: Italy • Setting: school students		people participated in pre- and post- intervention surveys
Pakarinen and others (9) Attitudes, knowledge and sexual behavior among Finnish adolescents before and after an intervention	**Study aim:** Pre- and post- intervention questionnaire analysing the effectiveness of an intervention (classroom session, information materials and free condoms) on Finnish adolescents **Study design:** • Type: quasi-experimental before and after design • Time period: not reported • Follow-up duration: assessed pre-intervention, immediately post-intervention and at 3-months post-intervention **Population:** • Age: 15 to 19 years • Sex: mixed (majority men) • Ethnicity: not reported	**Intervention:** 11-week school sex education intervention including classroom session, information materials and free condom distribution **Category of intervention:** Sex education **Disease remit:** General to all STIs	**Outcome category:** Multiple **Main results:** Knowledge: Improvements in knowledge and attitudes post-intervention. Behaviour: Statistically significant increase in STI testing among participants post-intervention (20% before and 34% by the second follow-up). No statistically significant change in the control group. Caution by authors: Strong conclusions cannot be drawn since the study was conducted at the group level, not the individual level.

Reference	Study design	Intervention	Main outcome
	• Sexual orientation: not reported • Sample size: 683 at baseline **Specific context:** • Country: Finland • Setting: vocational school students in 8 schools		Changes in attitudes, knowledge and behaviours were relatively small and there was a limited number of controls in follow-ups
Serowoky, George and Yarandi (10) Using the Program Logic Model to Evaluate Cuidate!: A Sexual Health Program for Latino Adolescents in a School-Based Health Center	**Study aim:** Used a program logic model to evaluate long-term outcomes of ¡Cuídate!, a sexual health programme endorsed by CDC for Latino adolescents in school-based health centre **Study design:** • Type: quasi-experimental, repeated measures design • Time period: 2012 • Follow-up duration: assessed immediately post-intervention and at 8 to 12 weeks post-intervention **Population:** • Age: unclear reporting but possibly 13 to 18 years • Sex: women	**Intervention:** ¡Cuídate!, a school sex education programme endorsed by CDC. 5 to 8 week exposure to intervention with 6 modules provided over 8 sessions [note 4] **Category of intervention:** Sex education **Disease remit:** General to all STIs	**Outcome category:** Multiple **Main results:** Overall: Measured long-term outcomes compared to RCTs. Knowledge: Described as immediate outcomes and there were significant increases in STI or HIV knowledge and self-efficacy, particularly intention to use condoms in future sexual activity. All participants were satisfied with the ¡Cuídate! programme. Behaviour: Described as intermediate outcomes. Condom and contraceptive use increased

Reference	Study design	Intervention	Main outcome
	• Ethnicity: mixed ethnic backgrounds (majority Latina ethnic group) • Sexual orientation: unclear reporting • Sample size: 24 at baseline **Specific context:** • Country: USA • Setting: high school students		from 56% to 67%. No participants experienced an STI, pregnancy or sexual debut. Cost-effectiveness: Program costs less than budgeted at $1,974
Spoth, Clair and Trudeau (17) Universal Family-Focused Intervention with Young Adolescents: Effects on Health-Risking Sexual Behaviors and STDs Among Young Adults	**Study aim:** Questionnaires assessed the effect of family-based interventions (Iowa Strengthening Families Program or Preparing for the Drug Free Years) on health-risking sexual behaviours and STIs among young adults **Study design:** • Type: true experimental design with randomised block design • Time period: not reported • Follow-up duration: assessed pre-intervention and at 6, 18, 30, 48, and 72 months post-intervention with an additional follow-up once children reached 21 years of age (total of 7 data collections)	**Intervention:** Universal family-based intervention **Category of intervention:** Holistic and family-based programmes **Disease remit:** General to all STIs	**Outcome category:** Multiple **Main results:** Overall: Both universal family-based interventions showed indirect long-term effect on health-risking sexual behaviours and STI outcomes: number of partners, lifetime sexually transmitted diseases (ever been diagnosed) and substance use and sex. Behaviours: Neither intervention had a significant effect on condom use. There was an effect on the number of partners, substance use and sex (how often alcohol and or drugs were used when having sex).

Reference	Study design	Intervention	Main outcome
	Population: • Age: at pre-test, 6th grade students (mean age 11.3 years) and their families. At post-test, 6th, 7th, 8th, 9th and 12th grade students (age range not stated) but additional follow up at 21 years • Sex: mixed • Ethnicity: mixed ethnic backgrounds (98% White ethnic group) • Sexual orientation: not reported • Sample size: 667 families (total sample size not reported) **Specific context:** • Country: USA • Setting: school students and their families attending 33 rural mid-western schools		Biological: Both interventions had significant indirect effect on lifetime STIs
Tomcho and others (24) Closing the Equity Gap: An Intervention to Improve Chlamydia and Gonorrhea Testing for	**Study aim:** Quasi-experimental design with interrupted time series analyses to evaluate testing and infection rates of an annual opt-out chlamydia and gonorrhoea testing programme for adolescents and young adults (to reduce inequity and improve testing)	**Intervention:** Annual opt-out testing programme in 28 federal health centres **Category of intervention:** Testing intervention	**Outcome category:** Multiple **Main results:** Overall: Authors state that an opt-out approach increased testing, reduced inequities between some groups and detected more

Reference	Study design	Intervention	Main outcome
Adolescents and Young Adults in Primary Care	**Study design:** • Type: quasi-experimental with interrupted time series analysis • Time period: baseline data collected from 2019 to 2020 and intervention data in 2020, and recovery data from 2020 to 2021 • Follow-up duration: multi-interrupted time series model assessed the effect in 3 time increments (baseline, intervention and recovery period) **Population:** • Age: 14 to 24 years • Sex: mixed • Ethnicity: mixed ethnic backgrounds (54% Hispanic ethnic group, 29% White ethnic group, 17% Black ethnic group) • Sexual orientation: not reported • Sample size: 57,452 encounters at baseline, 17,320 during the intervention, and 26,993 during pandemic-associated test supply shortage periods	**Disease remit:** Specific to NG and CT	infections than a risk-based approach. Behaviour: Measured the effect of testing uptake on NG and CT as the primary outcome. Unadjusted changes in testing increased from 66.8% to 81.0% between baseline and intervention periods (+14.2% increase), and a subsequent decrease between intervention and shortage (68.4%). Paediatric clinics had the largest increase at 30.9% compared to family medicine at 11.9%, internal medicine at 5.2% and women's care at 1.1%. Significant reductions in testing inequities by language preference and insurance status. Biological: Measured the effect on incidence. There was an increased number of CT cases (29.7 per 1000) and NG cases (7.4 per 1000) detected in intervention period than the baseline (20.7 and 4.4 per 1,000, respectively)

Reference	Study design	Intervention	Main outcome
	Specific context: • Country: USA • Setting: health centre patients attending Denver Health and Hospitality Authority centres for paediatrics, family medicine, school-based health centres, general internal medicine, and women's care (obstetrics and gynaecology)		
Whiting and others (23) Behavioral Interventions to Increase Condom Use Among College Students in the United States: A Systematic Review	**Study aim:** Systematic review of behavioural interventions which increase condom use behaviours or intentions. Followed PRISMA guideless and quality assessment tool for quantitative studies from Effective Public Health Practice Project (2010) **Study design:** • Type: systematic review • Time period: studies published between 2006 to 2016 • Follow-up duration: not applicable **Overall population:** • Age: Mean age ranged from 18.6 to 22.2 years	**Intervention:** Behavioural interventions to increase condom use in college students For 2 relevant studies: 1. Ellis and others (38): Experimental behavioural conditioning 2. Moore and Harris (39): IMB-based presentation workshops **Category of intervention:** Behavioural risk reduction	**Outcome category:** Behaviour **Main results:** Overall: All outcomes were associated with either intentions for or knowledge of condom use behaviours. Interventions developed with all 3 constructs of IMB model found significant increases in condom use or condom use intentions. Interventions that provided information about STI and pregnancy prevention, motivated participants by changing social norms and attitudes around condom use and provided

Reference	Study design	Intervention	Main outcome
	• Sex: mixed • Ethnicity: mixed ethnic backgrounds • Sexual orientation: not reported by review authors • Sample size: range of sample sizes from 95 to 198 in 7 studies **Overall context:** • Country: USA • Setting: undergraduate university students enrolled in 4-year college or university **For 2 relevant studies:** **1. Ellis and others (38):** **Population:** • Age: mean age 20.23 years • Sex: mixed • Ethnicity: mixed ethnic backgrounds • Sexual orientation: unclear reporting but participants were only included if they have had penetrative anal or vaginal sex • Sample size: 171 at baseline	**Disease remit:** General to all STIs	behavioural skills training such as how to use a condom or negotiate use with a partner, were effective. Authors noted that only providing information about the importance of condom use was not sufficient. For 2 relevant studies: 1. Ellis and others (38): Behaviour: Positive conditioning resulted in more positive affective associations and participants who regularly used condoms at baseline selected significantly more condoms after positive conditioning. 2. Moore and Harris (39): Behaviour: Motivation to use condoms during sex significantly increased and to get tested for STIs post workshop

Reference	Study design	Intervention	Main outcome
	Specific context: • Country: USA **2. Moore and Harris (39):** **Population:** • Age: mean age 19.2 years • Sex: mixed • Ethnicity: mixed ethnic backgrounds • Sexual orientation: mixed (majority heterosexual) • Sample size: 95 at baseline **Specific context:** • Country: USA		
Widman and others (13) Sexual Assertiveness Skills and Sexual Decision-Making in Adolescent Girls: Randomized Controlled Trial of an Online Program	**Study aim:** RCT of a web-based sexual health programme, HEART, on sexual assertiveness skills and enhanced sexual decision-making in adolescent girls. Program content grounded in Reasoned Action Model and Fuzzy Trace Theory **Study design:** • Type: RCT • Time period: 2015	**Intervention:** Web-based, interactive sex education programme, HEART, taught in one session lasting 45 minutes **Category of intervention:** Online intervention **Disease remit:** General to all STIs	**Outcome category:** Multiple **Main results:** Overall: Improved short-term outcomes among adolescent girls. No real differences by ethnicity, except for Hispanic youths who showed greater improvement in knowledge regarding HIV and STIs from pre-test to post-test than

Reference	Study design	Intervention	Main outcome
	• Follow-up duration: assessed at pre-test (computer survey), immediate post-test (computer survey and audio-recorded role play for behavioural skills) and 4-month follow-up (computer survey) **Population:** • Age: 10th grade students (unclear reporting but possibly 15 to 16 years) • Sex: women • Ethnicity: mixed ethnic backgrounds • Sexual orientation: mixed (majority heterosexual at pre-test) • Sample size: 222 at baseline **Specific context:** • Country: USA • Setting: high school students in rural, low-income schools in south-eastern USA		White or Black youths. Sexual activity status did not influence the intervention effectiveness. Knowledge and attitudes: Immediate post-test participants had greater knowledge about HIV, STIs, safer sex norms and attitudes. Effect size on sexual knowledge was particularly strong. At 4-months post-test, there was statistically greater knowledge regarding HIV and STIs, and more positive condom attitudes. Behaviours: Immediate post-test participants demonstrated better sexual assertiveness skills which was defined as higher self-reported assertiveness, intentions to communicate about sexual health and condom self-efficacy compared to controls. All effect sizes were small to moderate. At 4-months post-test, there was statistically greater condom self-efficacy compared to controls

Reference	Study design	Intervention	Main outcome
Zhang and others (14) A Web-Based Sexual Health Intervention to Prevent Sexually Transmitted Infections in Hong Kong: Model-Based Cost-Effectiveness Analysis	**Study aim:** Economic evaluation of web-based sexual health programme, Smart Girlfriend, in preventing STIs in the Chinese population and its long-term cost effectiveness. Used decision-analytic model with decision tree, followed by a Markov structure of chlamydia infections against a control, which was a single information sheet on condom use. A 3% annual discount rate was applied to cost-effective analysis **Study design:** • Type: model-based cost-effectiveness study • Time period: 2018 • Follow-up duration: behavioural data collected at 3-month and 6-month post-intervention **Population:** • Age: unclear • Sex: women • Ethnicity: unclear reporting • Sexual orientation: not reported but authors assumed all sexual relations were heterosexual for the model	**Intervention:** Web-based sex education programme, Smart Girlfriend **Category of intervention:** Online intervention **Disease remit:** Specific to CT	**Outcome category:** Multiple **Main results:** Biological: Modelled incidence of chlamydia. In the base-case analysis, the programme resulted in the prevention of 0.45% of CT infections. Cost-effectiveness: Incremental cost by quality-adjusted life year (QALY). In base-case analysis, the programme resulted in the prevention of 0.3% of PID and 0.04% of chronic pelvic pain, which when combined with the prevention of cases, resulted in a gain of 70 discounted QALYs and cost savings over 4-year time period. Programme is cost-effective at 4548 users and cost-saving with 8315 users

Reference	Study design	Intervention	Main outcome
	• Sample size: 781 recruited to develop model and 10,000 entered into model **Specific context:** • Country: China • Setting: sexually active, unmarried, non-pregnant, non-infectious women students from 5 Chinese universities who had intimate partners and not received sexual health information in past 12 months		
Zizza and others (11) Knowledge, Information Needs and Risk Perception about HIV and Sexually Transmitted Diseases after an Education Intervention on Italian High School and University Students	**Study aim:** Questionnaire pre- and post-intervention evaluated how targeted education interventions for students effects knowledge, information needs and risk perception of HIV and STIs. Students divided into 4 groups based on degree and field of study: Group 1: High-school students in biomedical fields Group 2: High-school students in non-biomedical fields, Group 3: University students in scientific degree courses, Group 4: University students in non-scientific degree courses **Study design:** • Type: quasi-experimental before and after design	**Intervention:** School sex education **Category of intervention:** Sex education **Disease remit:** General to all STIs	**Outcome category:** Knowledge **Main results:** Knowledge: Improvement in knowledge was measured in all groups with statistically significant differences between 4 groups in 60% of questions. Resulted in the perception of awareness and safety in more than 85% and 65% of high-school students and 91% and 60% of university students. These perceptions tended to increase after the intervention

Reference	Study design	Intervention	Main outcome
	• Time period: 2018 to 2019 • Follow-up duration: pre- and post-intervention questionnaires (time period of assessments not reported) **Population:** • Age: 15 to 24 years • Sex: mixed • Ethnicity: not reported • Sexual orientation: not reported • Sample size: 436 at baseline **Specific context:** • Country: Italy • Setting: high school and university students south-east Italy		

Notes

Note 1: DiClemente and others (30) was extracted under the review by Evans and others (31), but it was also included independently as its own study from the search strategy. This was counted as one study.

Note 2: The grades and follow up interventions reported in the review by Lee and others (15) differ from those reported in the original manuscript by Hill and others (36), where it is reported that interventions were assigned in grades one to 6 and interviews were conducted 12 times between the ages of 10 to 30 years.

Note 3: Hill and others (36) was extracted for 2 reviews: Lee and others (15) and Mirzazadeh and others (16). The 2 reviews were counted as 2 studies since Mirzazadeh and others (16) reported additional records.

Note 4: The intervention ¡Cuídate! was analysed in different contexts by 2 additional studies (4, 7).

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UK Health Security Agency (UKHSA) prevents, prepares for and responds to infectious diseases, and environmental hazards, to keep all our communities safe, save lives and protect livelihoods. We provide scientific and operational leadership, working with local, national and international partners to protect the public's health and build the nation's health security capability.

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