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TECHNICAL REPORT

Technologies, strategies and approaches for testing populations at risk of sexually transmitted infections in the EU/EEA

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Abbreviations

AMR	Antimicrobial resistance
EEA	European Economic Area
EMR	Electronic Medical Record
HIV	Human Immunodeficiency Virus
IUSTI	International Union against Sexually Transmitted Infections
IQR	Inter-quartile Range
LGBT	Lesbian, Gay, Bisexual and Transgender
LSHTM	London School of Hygiene and Tropical Medicine
MSM	Men who have Sex with Men
NAAT	Nucleic Acid Amplification Test
NCSP	National Chlamydia Screening Programme
OECD	Organisation for Economic Co-operation and Development
PATH	Program for Appropriate Technology in Health
PHE	Public Health England
PICO	Population, Intervention, Comparison and Outcome
PID	Pelvic Inflammatory Disease
POCT	Point-of-care test(ing)
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
PWID	People Who Inject Drugs
RCT	Randomised Controlled Trial
RDT	Rapid Diagnostic Test
RPR	Rapid Plasma Reagin
RST	Rapid Syphilis Test
STI(s)	Sexually Transmitted Infection(s)
SW	Sex Worker(s)
UK	United Kingdom
VDRL	Venereal Disease Research Laboratory
WHO	World Health Organization

Glossary

Quality improvement is a multidisciplinary, systems-focused, data-driven method of understanding and improving the efficiency, effectiveness and reliability of health processes and outcomes of care [1]. It may include clinical audit, patient education, provider education, organisational change, care manager, collaborative care model, technological innovations, performance benchmarking, etc [1,2].

Learning collaboratives are a quality improvement method centred on sharing of best practices between providers or healthcare facilities [2,3].

Express testing interventions refer to strategies based on testing without intimate examination; as opposed to traditional methods using healthcare provider examination as part of the testing cascade [4,5].

In-reach strategies focus on the use of methods to further engage existing participants of a health system, or engage participants in further activities conducted in the health system beyond those in which they have already participated [6].

Point-of-care tests (POC) are performed nearby the patient and on any part of the patient's body or its derivatives, during or very close to the time of consultation, allowing results at the time of the clinical decision-making, to support clinical decision-making.

Access to testing: 'Access is a broad term with varied dimensions: the comprehensive measurement of access requires a systematic assessment of the physical, economic, and socio-psychological aspects of people's ability to make use of health services' [7]. In publication selection for this review, it was defined as data presenting levels of barriers to testing in each of the following comparative groups, including data collected from healthcare workers (HCWs) and service users:

- physical (geographic/time e.g. waiting time in clinic, distance to testing location);
- economic (e.g. direct or indirect cost to consumer); and
- socio-psychological (e.g. acceptability/'comfort' of an intervention being used, stigma).

Testing coverage: 'Coverage of interventions is defined as the proportion of people who receive a specific intervention or service among those who need it' [7]. In publication selection for this review it was defined as proportion tested in each comparative group with a specified denominator for comparable population: e.g. denominator may be total population covered by service, clinic attendees, patients referred for testing.

Linkage-to-care: 'Proportion of infected people (people with positive test results) treated or referred for treatment, results reporting to patient, etc.' [8]. In publication selection for this review, this was defined as:

- the proportion in each comparative group diagnosed as positive (by test implemented in the intervention strategy or gold standard) referred for, asked to return for, returned for or undergoing, management (e.g. with antibiotic therapy or behavioural intervention); or
- the time in each comparative group from diagnosis or testing to referral for, request to return for, return for, or provision of management.

Executive summary

There is a substantial burden of sexually transmitted infections (STIs) in Europe, and surveillance data show that, despite significant variations between countries in the testing and notification of cases, chlamydia is the most frequently reported notifiable infection in this region. In addition, data show that young people and men who have sex with men (MSM) are disproportionally affected by bacterial STIs. Pregnant women from several vulnerable groups, such as migrants and women exercising high-risk behaviours (e.g. injecting drug use and sex work) have also been identified as being at risk of adverse pregnancy outcomes due to STIs and poor access to antenatal care. New testing technologies, strategies and approaches could lead to increased access and coverage of STI testing and linkage to care in populations most at risk.

We conducted a systematic literature review with the primary objectives of:

1. identifying and describing novel STI testing strategies and approaches that impact on access to testing, testing coverage, and linkage to care for curable STIs (chlamydia, gonorrhoea, syphilis, trichomoniasis and *Mycoplasma genitalium* infection); and
2. describing how these testing strategies and approaches impact on access to testing, testing coverage, and linkage to care, in both traditional and non-traditional healthcare settings (e.g. primary care, outreach, home, internet-based).

There were five secondary objectives:

1. to describe the testing technologies used in these strategies and approaches;
2. to highlight the impact on public health surveillance programmes;
3. to highlight quality assurance needs and risks;
4. to highlight feasibility and acceptability; and
5. to identify gaps in knowledge and data availability to clarify future research needs.

The database search strategy was based on the primary objectives. We included eight databases in the search, and publications reporting primary data. Titles, abstracts and full texts were reviewed for inclusion by two independent reviewers, with a third reviewer acting as an arbiter. Data were extracted using a pre-specified and a previously piloted data extraction form. We used an adapted Cochrane risk of bias tool to assess randomised controlled trials, and an adapted ROBINS-I tool to assess the risk of bias in non-randomised studies of interventions. A narrative synthesis of the findings was conducted of publications addressing the impact of interventions on access to testing, testing coverage and linkage to care. Experts in the field were contacted for further information about ongoing or unpublished studies.

The search identified 13 703 non-duplicate records, resulting in 117 selected full texts. A wide variety of interventions were identified and categorised into 10 strategies or approaches (decreasing order of frequency):

1. interventions that employed **testing technologies** (n=28);
2. interventions based on **provider education or quality improvement** (n=26);
3. interventions based on **self-sampling** in a patient selection location (e.g. home sampling) (n=19);
4. interventions that used innovative **patient recruitment strategies** (n=18);
5. interventions that used **electronic medical records or data systems** (n=16);
6. interventions based on **triage** strategies (n=12);
7. interventions that employed innovative methods of **patient results reporting** (n=6);
8. interventions based on **outreach** strategies (n=5);
9. interventions based on **express testing** (n=4); and
10. interventions that assessed patient **self-sampling in clinic** (n=3).

Several publications reported on studies that employed two or more of these interventions.

Regarding outcomes, 11 publications reported on access to STI testing, 87 on testing coverage, 33 on linkage to care, and 10 addressed more than one outcome.

Interventions were implemented in five types of settings: primary care; sexual health clinics; antenatal care; emergency department and other hospital settings; and outreach, community and home settings.

Results are presented by implementation setting. We assessed the strength of evidence for each intervention according to the risk of bias assessment and statistical significance results.

In **primary care settings**, most publications reported on the impact of increasing testing coverage for chlamydia among young people and MSM. Interventions included quality improvement, e.g. training for healthcare workers and clinicians, implementation of services of sexual health nurses, changes in testing algorithms, changing to dual chlamydia and gonorrhoea tests; and the use of electronic medical records to prompt reminders and targeted interventions.

The strongest evidence available was for quality improvement interventions, with all 16 papers reporting increased testing coverage, of which four papers were at low risk of bias. We identified very little evidence for increasing access to testing or linkage to care in primary care settings.

In **sexual health clinics**, most publications reported on interventions that increased testing coverage and linkage to care for chlamydia, gonorrhoea and syphilis. Interventions included patient recruitment strategies involving outreach and health campaigns; healthcare worker reminders; provider education about testing policies; express testing; and the use of point-of-care tests (or near-point-of-care tests). Interventions that increased linkage to care included express testing and point-of-care tests.

The strongest evidence supported the use of patient recruitment interventions, with both papers at low risk of bias demonstrating a positive impact on testing coverage. There was little evidence identified for increasing access to testing in sexual health clinics.

In **antenatal clinics**, most publications reported on interventions that increased access to testing, testing coverage and linkage to care for syphilis testing. In contrast to other settings, almost all publications from antenatal clinics were conducted in low and middle-income countries (LMICs).

The majority reported on interventions using rapid and affordable point-of-care tests for syphilis. Provider training combined with point-of-care syphilis testing also improved testing coverage and linkage to care. Testing coverage was improved by undertaking community outreach using posters and flyers about testing for syphilis.

Evidence was strongest for the use of rapid point-of-care syphilis tests to increase testing coverage and linkage to care with two of three publications at low risk of bias. These findings may have limited applicability in EU/EEA settings (due to wide access to antenatal care) but may inform testing approaches of women from sub-population groups still vulnerable to vertical transmission of infections (e.g. migrants, asylum seekers, displaced populations, socially disadvantaged).

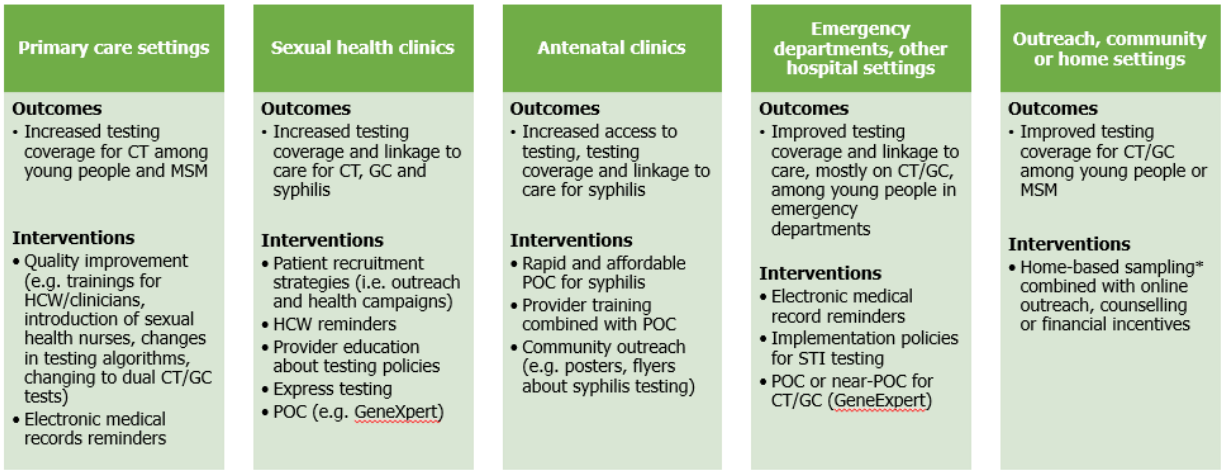
In **emergency departments and other hospital settings**, an equal number of publications reported impact on testing coverage and linkage to care, and most focused on chlamydia and gonorrhoea testing among young people in emergency departments. Interventions that increased testing coverage included the use of electronic medical record reminders and implementation policies for STI testing. Linkage to care was increased by the implementation of point-of-care tests (or near-point-of-care tests) for chlamydia, gonorrhoea and trichomoniasis.

In emergency settings, the strongest evidence was for the use of electronic medical records and electronic tool-based interventions, with both publications at low risk of bias demonstrating increased testing coverage. In addition, one paper at low risk of bias for linkage to care supported use of a near-point-of-care test for chlamydia and gonorrhoea rather than laboratory-based nucleic acid amplification tests (NAATs).

In **outreach, community or home settings**, most publications assessed testing coverage, with the majority focused on testing chlamydia and gonorrhoea among young people or MSM. Successful interventions included home-based sampling combined with online outreach (e-STI testing); and counselling or financial incentives.

Only one paper reported on impact on testing coverage (online outreach) with low risk of bias. Several studies indicated that home-based sampling or testing, when compared to clinic-based sampling or testing, reduced linkage to care.

Figure 1. Testing of populations at risk of sexually transmitted infections: outcome and interventions with proven impact, by settings: a summary of literature review findings



** Home-based sampling or testing compared to clinic-based sampling or testing reduced linkage to care*

Note: CT: chlamydia, GC: gonorrhoea, HCW: healthcare worker, POC: point of care, MSM: men who have sex with men

There are, however, gaps in the evidence. There were few, and in some cases no, publications related to populations at risk, such as sex workers, prisoners, migrants, refugees, people who inject drugs and pre-exposure prophylaxis users. Furthermore, we identified very few publications that investigated the impact of interventions on testing for trichomoniasis, and no publications that investigated the impact on interventions for testing for *M. genitalium.* The scarcity of data on the EU/EEA burden on trichomoniasis and the inconclusive evidence on the benefits of large-scale testing for *M. genitalium* may explain these.

While the search was based on the primary objectives, we also extracted data for the secondary objectives. Innovative testing technologies (e.g. point-of-care tests) were represented with some data on quality assurance in the antenatal care settings, and self-sampling and testing publications reported on acceptability and feasibility. However, little data were available regarding the impact of these strategies and approaches on surveillance programmes. In addition, the search strategy did not include costs or cost-effectiveness, as this was beyond the scope of the review. As a result, reviewing the impact on surveillance programmes and cost-effectiveness of the strategies with the strongest evidence base would be a significant next step to provide further evidence.

The review provides a direction for researchers and programme managers seeking to improve STI testing services among key populations at risk of STIs. The outcomes of this systematic review can inform policy-makers, national and international programme coordinators, public health and clinical experts, and civil society organisations involved in STI prevention and control in EU/EEA countries and elsewhere.

Background

Current state of knowledge and understanding

In 2016, there were an estimated 376.4 million new cases of the four most common curable sexually transmitted infections (STIs) worldwide: chlamydia (127.2 million cases), gonorrhoea (86.9 million cases), syphilis (6.3 million cases), and trichomoniasis (156.0 million cases) [9]. These infections have a profound impact on the health and well-being of people, and may result in foetal and neonatal deaths, pelvic inflammatory disease, chronic pelvic pain, infertility, increased human immunodeficiency virus (HIV) risk, and have psychological and social consequences [10].

Compared to other regions, the prevalence and incidence of the four curable STIs in the World Health Organization (WHO) European Region were among the lowest; however, there was substantial burden of STIs in Europe, the highest being chlamydia [9,11]. The 2018 European Union/European Economic Area (EU/EEA) surveillance data reflect WHO estimates and show that, despite a significant variation in testing and notification of cases between countries, chlamydia is the most frequently reported STI in Europe (406,406 cases; a notification rate of 146 per 100 000 population) followed by gonorrhoea (100 673 cases; 26 per 100 000 population) and syphilis (33 927 cases; seven per 100 000 population) [12]. In addition, these data indicate that young people (15-24 years old) and men who have sex with men (MSM) are disproportionally affected by bacterial STIs. Pregnant women from several vulnerable groups, such as migrant women and women exercising high-risk behaviours (injection drug use, sex work, etc.) were also identified as at-risk of adverse pregnancy outcomes due to STIs and poor access to antenatal care [13]. In addition to chlamydia, gonorrhoea and syphilis, trichomoniasis and infection with *Mycoplasma genitalium* are important and under-recognised causes of poor health [14-16]. Poor outcomes related to curable STIs are preventable if timely and effective testing and treatment are implemented.

New testing technologies, strategies and approaches may lead to increased coverage and enhanced delivery of public health services to improve the prevention and control of disease in populations most at risk of STIs. For example, rapid point-of-care (POC) tests can pave the way for decentralised STI testing including self-sampling and self-testing outside of traditional healthcare settings, encompassing community-based organisations, pharmacies and the home [17]. While novel testing technologies, such as POC tests, can provide faster and more flexible STI testing, they must be paired with innovative strategies and approaches for reaching populations most at risk of STIs. Indeed, innovative strategies and approaches may even utilise older technologies to increase testing access and coverage in these populations, such as 'express testing' triage algorithms in sexual health clinics [18] , sending home-based samples by post (or sample drop-off locations) to an STI laboratory [19], online interventions designed to provide users with knowledge about STIs and providing information about where to test [20], and other digital innovations such as using mHealth (e.g. SMS) and social media [21].

In 2012, ECDC published the technical report 'Novel approaches to testing for STIs, including HIV and hepatitis B and C in Europe' [22]. This was a comprehensive review of testing technologies and strategies across Europe, the United States, Canada and Australia. In subsequent years, there have been several new developments in the field. The aim of this review is to add to the 2012 review, refocusing on curable STIs and strategies and approaches to testing that increase access, coverage and linkage to care among populations at risk of STIs in the EU/EEA and elsewhere.

Purpose, scope and relevance to public health

This report presents the results of a systematic literature review investigating the impact of novel strategies and approaches (using existing and/or novel testing technologies) on access to testing, testing coverage, and linkage to care of key populations at-risk for STIs. In addition, the report presents the following: the testing technologies used for the identified novel strategies and approaches; reported quality assurance needs and risks; and reported feasibility and acceptability. Lastly, the report identifies gaps in knowledge and research priorities. The target audience of this report is policy-makers, national programme coordinators, public health or clinical experts and civil society organisations involved in STI prevention and control in EU/EEA countries.

Methods

Research questions and objectives

The research questions of the systematic literature review were agreed between ECDC, the project team (PHE and LSHTM) and a group of experts who reflected expertise on different STIs and implementation of STI programmes in Europe. These experts constituted an Advisory Committee (Annex 1). Agreement was reached for the following primary and secondary research questions.

The primary research question was 'What is the impact of novel testing strategies and approaches that have been in use since 2012, on access to testing, testing coverage and linkage to care for curable STIs (chlamydia, gonorrhoea, syphilis, trichomoniasis and *M. genitalium* infection)?'

The research question was formulated using the Population, Intervention, Comparison and Outcome (PICO) model:

P	Populations reported in publication, not pre-defined
I	Novel (2012-2018) testing strategies and approaches used to increase testing access, coverage, or linkage to care for chlamydia, gonorrhoea, syphilis, trichomoniasis and *M. genitalium* infection
C	Comparator required, but not pre-defined (comparator reported in the publication)
O	Access to testing Testing coverage Linkage to care

The secondary research questions were 'What testing technologies are used in these novel strategies and approaches to impact on access to testing, testing coverage and linkage to care?' and 'What is the impact of novel testing technologies, strategies and approaches on STI public health surveillance programmes?'.

Definitions for the outcomes are given in Box 1.

Box 1. Definitions of outcomes in the primary research question (adapted from WHO definitions) [7]

Access: 'Access is a broad term with varied dimensions: the comprehensive measurement of access requires a systematic assessment of the physical, economic and socio-psychological aspects of people's ability to make use of health services.' In publication selection this was defined as data presenting levels of:

- Physical (geographic/time e.g., waiting time in clinic, distance to testing location)
- Economic (e.g., direct or indirect cost to consumer)
- Socio-psychological (e.g., acceptability/'comfort' of an intervention being used, stigma) barriers to testing in each comparative group, including data collected from healthcare workers (HCWs) and service users.

Coverage: 'Coverage of interventions is defined as the proportion of people who receive a specific intervention or service among those who need it.' In publication selection this was defined as proportion tested in each comparative group with a specified denominator for comparable population: e.g. denominator may be total population covered by service, clinic attendees, patients referred for testing.

Linkage to care: e.g. proportion of infected people (people with positive test results) treated or referred for treatment, results reporting to patient, etc. In publication selection this was defined as:

- the proportion in each comparative group diagnosed as positive [by test implemented in the intervention strategy or gold standard] referred for, asked to return for, returned for, or undergoing, management [e.g. with antibiotic therapy or behavioural intervention]; or
- time in each comparative group from diagnosis or testing to referral for, request to return for, return for, or provision of, management [e.g. with antibiotic therapy or behavioural intervention].

The primary objectives were:

1. To identify and describe novel STI testing strategies and approaches that impact on access to testing, testing coverage, and linkage to care for curable STIs (chlamydia, gonorrhoea, syphilis, trichomoniasis and *M. genitalium* infection);
2. To describe how these novel testing strategies and approaches impact on access to testing, testing coverage, and linkage to care, in both traditional healthcare settings and non-traditional healthcare settings (e.g. primary care, outreach, home, internet-based, and resource-poor).

The secondary objectives were:

1. To describe what testing technologies are used in these novel strategies and approaches;
2. To highlight the impact on public health surveillance programmes;
3. To highlight quality assurance needs and risks;
4. To highlight feasibility and acceptability; and
5. To identify gaps in knowledge and data availability to highlight future research needs.

Information/data collection

The search was designed based on the primary research question and the primary objectives. This formed the database from which data were extracted for the secondary objectives.

Eligibility criteria

Inclusion criteria:

1. Publications from January 2012 to November 2018 (included in search terms);
2. Publications investigating testing strategies or approaches of one or more of the infections of interest: chlamydia, gonorrhoea, syphilis, trichomoniasis and *M. genitalium* infection (included in search terms)
3. Publications reported in English from any country;
4. Publications reported in any European language from an EU/EEA country and Switzerland;
5. Publications reporting primary data;
6. Publications reporting on a testing approach or strategy for initial diagnosis of the index case, with the purpose of improving access to testing, testing coverage, or linkage to care (e.g. service evaluations);
7. Publications reporting on genital and extra-genital (rectal and pharyngeal) infections resulting from sexual transmission in patients; and
8. Publications presenting evidence of impact of novel testing strategies and approaches on access to testing, testing coverage, or linkage to care, through use of one or more comparative or baseline groups [e.g., multiple arms in traditional randomised controlled trials (RCT), clusters in step wedged trials, cohort data before and after intervention implementation].

Exclusion criteria:

1. Publications reported in a non-English language outside of the EU/EEA and Switzerland (e.g. Chinese, Japanese, Korean, or, for example, a paper reported in French from Senegal);
2. Publications not reporting primary data, e.g. systematic reviews, guidelines, organisational reports, abstract booklets, mathematical modelling studies only;
3. Publications evaluating a testing approach or strategy not for the purpose of improving access to testing, testing coverage, or linkage to care (e.g. prevalence study only, diagnostic accuracy study, risk factor/association study) only;
4. Publications evaluating a testing approach or strategy not for the purpose of initial diagnosis of the index case (e.g. studies on test of cure, partner notification, or retesting) only;
5. Publications concerned with testing for complications of infection (e.g. pelvic inflammatory disease, tubal infertility, neurosyphilis) only;
6. Publications reporting on ocular, pulmonary or other (not pharyngeal or rectal) extra-genital infection only;
7. Publications reporting on animal or *in vitro* infections (e.g. diagnostics used in the laboratory only);
8. Publications reporting on antimicrobial resistance testing only;
9. Publications reporting surveillance data for access to testing, testing coverage, and linkage to care only, i.e. without identifying a service utilising a specified strategy or approach; and
10. Publications without a comparator.

For the purposes of providing a comprehensive systematic review of the topic, the review was not restricted by study design, but incorporated all literature reporting original research. Eligible publications had to be reported in English from any country or in any official European language from an EU/EEA country or Switzerland. A list of EU/EEA countries (2018) is provided in Annex 2. The study population comprised all groups at-risk for STI. The interventions included were testing strategies or approaches of one or more of the five infections: chlamydia, gonorrhoea, syphilis, trichomoniasis and *M. genitalium* infection. The outcomes of interest were improved access to testing, testing coverage, or linkage to care, defined adapting WHO definitions [7]. Due to the broad nature of the review, specific comparators were not specified; however, in order to report on impact, a comparator was required.

Search strategy

The period of time covered by the review was literature published from 1 January 2012 to November 2018. This start date was selected to minimise overlap of target material with a previous ECDC report 'Novel approaches to testing for sexually transmitted infections, including HIV and hepatitis B and C in Europe', which included references until 1 January 2012.

The search strategy was defined in consultation with the ECDC, the Advisory Committee, and London School of Hygiene & Tropical Medicine (LSHTM) librarians. The terms for chlamydia, gonorrhoea and syphilis were taken from the Cochrane STI group systematic review (2012) of topical microbicides for prevention of sexually transmitted infections [23]. Terms for *M. genitalium* and trichomoniasis were developed by adapting the Cochrane STI group strategy for these two infections. Two librarians were consulted to provide guidance for searching terms for 'testing technologies', 'approaches' and 'strategies'.

The final Medline search was peer-reviewed by an ECDC librarian, not associated with the project, following application of the PRESS (Peer Review of Electronic Search Strategies) guidelines [24]. The search was then adapted to meet the thesaurus terms and syntax of the other databases (Annex 3) and published in an open access data repository (https://doi.org/10.17037/DATA.00001047).

Sources

Peer-reviewed literature was searched using the following online information sources:

- MEDLINE (Ovid platform: https://ovidsp.tx.ovid.com). Including epub ahead of print, in-process and other non-indexed citations, daily, and versions. Time span: 1946 to present. Topic coverage: biomedicine, medicine and healthcare.
- Embase: Elsevier produce the data. Ovid provides the interface (Ovid platform: https://ovidsp.tx.ovid.com). Time span: 1947 to present. Requires subscription.
- PsycINFO: database encompassing psychiatry, psychology, behaviour and mental health. Time span: 1806 to date. Updated monthly.
- Global Health: The Global Health database deals with international Public Health publications. CABI compiles the data and Ovid provides the interface (Ovid platform: https://ovidsp.tx.ovid.com). Time span: 1910 to present.
- Cochrane Database: Provides high quality evidence of clinical trials worldwide. The Cochrane Collaboration collects the information (https://www.cochranelibrary.com) and Wiley-Blackwell publishes it. Time span: 1995 to present.
- Epistemonikos: multilingual database of health evidence. Freely available at: https://www.epistemonikos.org/en. Time span: 2002 to present.
- CINAHL Plus: Nursing and health database. EBSCO information services (https://www.ebsco.com) collects and publishes the information. Time span: 1937 to present.
- Web of Science Core Collection: owned by Clarivate Analytics (https://apps.webofknowledge.com) and includes, among others, the Science Citation Index (time span: 1970 to present), the Social Science Citation Index (time span: 1970 to present) and the Conference Proceedings Citation Index- Science (time span: 1990 to present).

Screening and data extraction

References were managed using EndNote bibliographic software (Clarivate Analytics, Philadelphia, US). References were exported into EndNote, where de-duplication was conducted. Titles, abstracts and full-text screening was carried out independently by two reviewers with the support of an eligibility criteria screening tool (Annex 4). Titles and abstracts were scanned to select full-text publications for in-depth analysis. Publications were selected for full-text review if both reviewers agreed on eligibility criteria or if the abstract did not provide sufficient information to make a decision. A third reviewer provided a tie breaker for any discrepancies between reviewers. In addition, the Advisory Committee members reviewed the final report in order to provide further information about ongoing or unpublished publications.

Data were extracted from included publications using a pre-specified extraction form developed using a password secured online questionnaire (Online Surveys: https://www.onlinesurveys.ac.uk). Variables extracted included the following: pathogen, study design, population, setting, testing methodology, testing intervention strategy or approach, impact on testing access, coverage, or linkage to care, quality assurance data, reporting for surveillance, feasibility and acceptability, and gaps identified for future research. Additional data were extracted to assess the risk of bias at the study level according to Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [25]. Validated tools were adapted to assess the risk of bias. An adapted Cochrane risk of bias tool was used to assess RCTs [26], and an adapted ROBINS-I tool was used to assess risk of bias in non-randomised studies of interventions [27]. Both tools were applied to the selected publications and

used to produce ratings of 'low risk of bias', 'unclear risk of bias' or 'high risk of bias'. Methodology for rating risk of bias is outlined in Annexes 5 and 6.

The extraction form was piloted with five publications to ensure ease of use and that all pertinent data items were included. Extractors were trained in extraction through the use of at least one trial publication each, with extracted material examined for potential issues and iterative feedback given throughout the extraction process.

The protocol was registered with the International Prospective Register of Systematic Reviews (PROSPERO) on 30 January 2019: CRD42019118261 and published [28].

Expert opinion

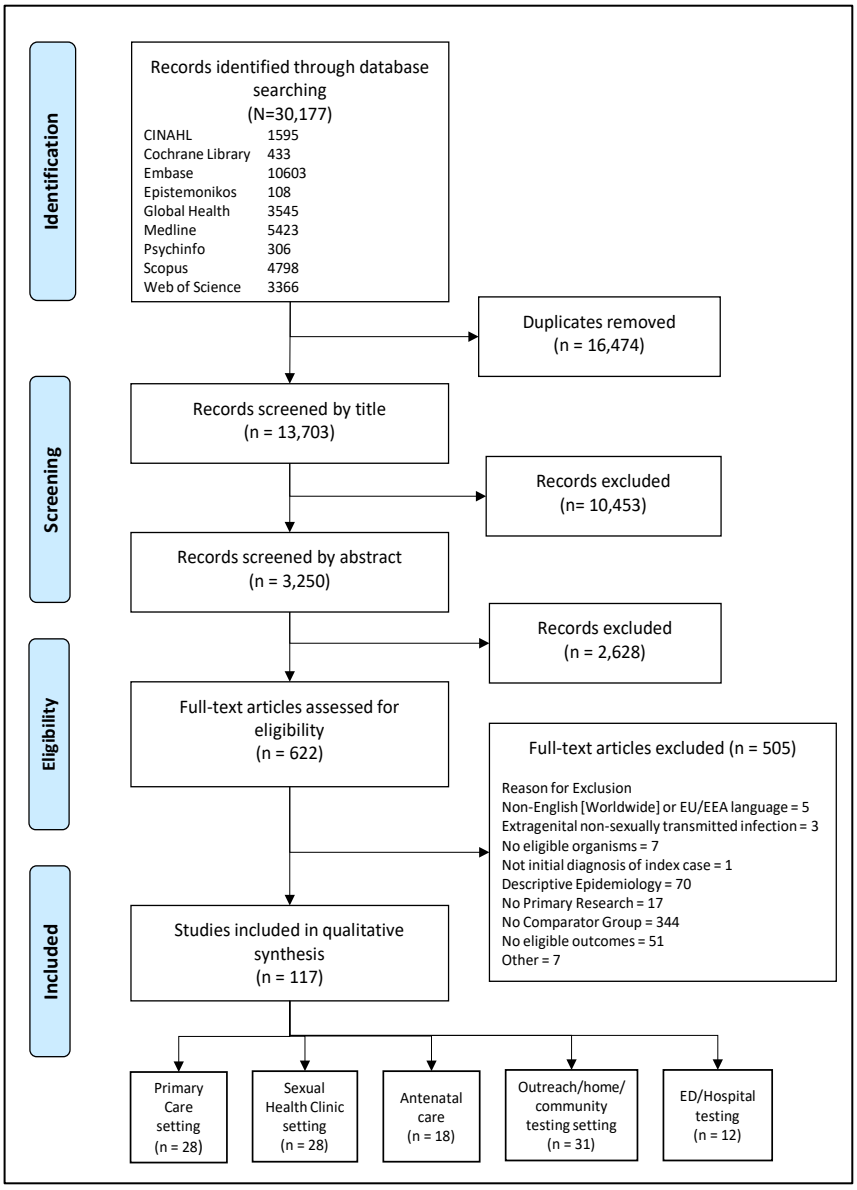
The Advisory Committee was constituted by leading experts in sexually transmitted infections, namely Dr Tania Crucitti (Institute of Tropical Medicine, Antwerp, Belgium), Dr Colin Brown (PHE, London, UK), Dr Silvia de Sanjose (PATH, Seattle, US), Dr Kevin Dunbar (PHE, London, UK), Jane Falconer (LSHTM, London, UK), Dr Steen Hoffmann (SSI, Copenhagen, Denmark), Dr Jørgen Skov Jensen (SSI, Copenhagen, Denmark), Prof David Mabey (LSHTM, London, UK), Dr Anthony Nardone (Epiconcept, Paris, France), Prof Rosanna Peeling (LSHTM, London, UK) and Dr Magnus Unemo (WHO Collaborating Centre for Gonorrhoea and other STIs, Örebro, Sweden). These experts examined the evidence gathered during this review and identified gaps that were then addressed through in-depth structured interviews with four leading researchers, experts in the areas identified as gaps: Prof. Rosanna Peeling (LSHTM), Prof. Charlotte Gaydos (Johns Hopkins University School of Medicine), Prof. Chris Bonell (LSHTM) and Dr. Tania Crucitti (Institute for Tropical Medicine, Antwerp).

The four expert interviews were carried out by Skype, in a 30-60-minute-long semi-structured format, with all interviews recorded using MP3 Skype Recorder [29]. Prior to the call, experts were consented (Annex 9), sent a topic guide (Annex 10) outlining the format of interview and presenting findings in the area in which the interviewee was identified as an expert. In addition, experts had received an information sheet introducing the project (Annex 11).

Results

The literature search on strategies and approaches to increase access to testing, testing coverage, and linkage to care resulted in 13 703 unique publications screened, of which 622 were selected based on title and abstract, and 117 selected for extraction (85 research articles, 30 conference abstracts and two letters) following full-text eligibility assessment (Figure 1).

Figure 2. PRISMA Flow diagram of the search conducted for the primary research question

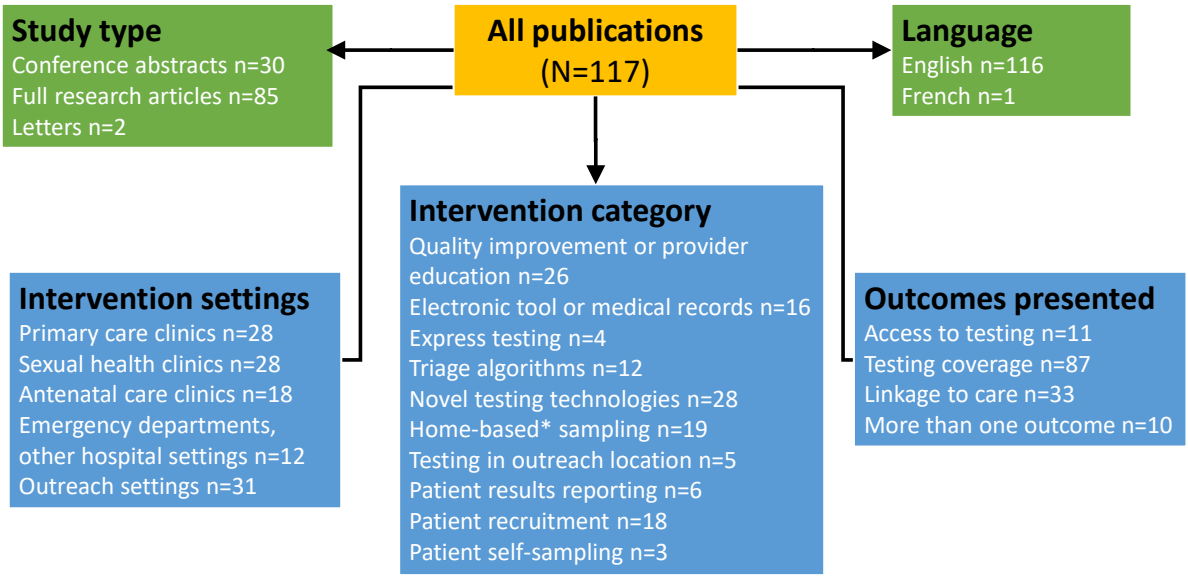


Studies were categorised by setting, intervention type and outcome. Figure 2 presents the number of selected publications on the strategies implemented in primary care clinics, sexual health clinics, antenatal care clinics, the community or home-based settings, and in hospital emergency departments or other hospital settings.

The different types of strategies and approaches implemented included 26 interventions based on provider education or quality improvement (see Table 1a, Table 1b, Table 1c in Annex 7), 16 interventions based on electronic medical records or data systems use, four interventions based on express testing, 12 interventions based on other forms of triage, 28 interventions making use of novel testing technologies, 19 interventions based on 'home-based' (self-sampled patient selected location) sampling, five interventions using testing based in an outreach location, seven interventions testing innovative ways of reporting patient results, 17 interventions using novel methods of patient recruitment, and three interventions assessing patient self-sampling in clinic. Some publications reported on more than one strategy and approach (Figure 3).

With regards to outcomes, 11 publications reported on access to STI testing, 87 reported on testing coverage, 33 reported on linkage to care, and 10 addressed more than one outcome.

Figure 3. Overview of included publications



Note: Geographical representation by WHO regions: 60 publications were from the Region of the Americas (53 from North America), 29 from the European Region, 15 from the Western Pacific Region, 11 from the African Region, and two from the South-East Asia Region.

Of the 117 publications included, 30 were judged to be of low risk of bias, 28 were judged to be of high risk of bias, and 59 were judged to be of indeterminate (unclear) risk of bias, due to insufficient information given on methodology, including the 30 conference abstracts selected. In 91 non-randomised papers, the modified ROBINS-I domain with the highest number of papers at low risk of bias was classification of interventions (57/91), and the domain with the highest number of papers at high risk of bias was measurement of outcomes (31/91) (Table 2a, Annex 8). In 26 randomised papers, the modified Cochrane domain with the highest number of papers at low risk of bias was selective reporting (15/26), and the domain with the highest number of papers at high risk of bias was blinding (12/26) (Table 2b, Annex 8).

The narrative synthesis of the findings below is structured, first by setting (primary care; sexual health; antenatal care; emergency department and other hospital settings; and outreach, community, or home-based testing), followed by the strategy or approach implemented, and outcome. Within this, results are reported by STI and study population.

Testing initiatives in primary care settings

Overview

Testing initiatives in primary care settings (n=28)				
Objective	Access to testing	Testing coverage	Linkage to care	
	1	26	2	
Strategies				
Quality improvement interventions (n=16)	1	16		
Electronic medical records (E-health) interventions (n=10)		10		
Patient recruitment interventions (n=4)		4		
Screening and triage interventions (n=5)		5	1	
Other interventions (n=2)		1	1	
Infection	Chlamydia	Gonorrhoea	Syphilis	Trichomoniasis

	26	11	6	0

Of the 28 publications evaluating testing strategies and approaches in primary care (Table 1a, Annex 7), 25 publications assessed the impact of testing coverage [3,6,30-52]; one assessed both the impact of testing coverage and of access to testing [53], and two assessed the impact on linkage to care [54,55].

The majority of publications (26/28) reported on chlamydia [3,6,30-35,37-42,44-55], of which 10 also reported on gonorrhoea [3,33,37,40,41,46,50,52,54,55] and five also reported on syphilis [33,37,41,52,55]. Overall, 11 publications focused on gonorrhoea [3,33,36,37,40,41,46,50,52,54,55], six on syphilis [33,37,41,43,52,55], and no publications focused on infection with trichomoniasis or infection with *M. genitalium*.

Five publications reported on interventions targeting MSM [37,40,43,50,52] and 13 publications reported on interventions targeting adolescents and young people [3,30,32,34,35,41,42,44,45,48,49,51,53]. No publications reported interventions targeting migrants, people who inject drugs (PWID), incarcerated or homeless people, transgender people, or other vulnerable populations. Three publications reported on interventions targeting aboriginal or first nations people or health services primarily serving these populations [36,38,54].

Strategies and approaches implemented

Quality improvement interventions

Sixteen publications reporting strategies and approaches implemented in primary care settings assessed quality improvement, learning collaboratives, or provider education [3,6,30-36,46-51,53].

Access to testing: One study at low risk of bias (RoB) in 15-19-year-old females attending primary care assessed impact on access to testing to chlamydia by investigating time barriers [53]. This study investigated time spent in consultation before and after a quality improvement intervention among female adolescents attending primary care clinics in the United States. The intervention included streamlined test ordering, labelled specimen cups before history and examination, signs communicating universal adolescent testing policy, electronic medical record prompts based on symptom history. The intervention showed little difference in median time spent in consultation, from 79.2 minutes (inter-quartile range [IQR] 59.5-103.3) to 80.4 minutes (IQR 61.6-102.8) but a 21% increase in annual chlamydia screening rates among female adolescents.

Testing Coverage: All 16 quality improvement (QI) publications (see Table 1a, Annex 7) showed increased testing coverage, ranging from a 2.6% increase in chlamydia testing coverage in asymptomatic 13-21 years female primary care attendees in the United States after the implementation of a combined intervention using physician education, a novel triage algorithm, and a tablet alert to recommend testing (low RoB) [35], to a 33% increase in chlamydia annual screening rate among asymptomatic 12-19 years primary care attendees in the United States using a one-week rapid quality improvement intervention based on increasing use of a psychosocial interview to identify sexually active adolescents and offer chlamydia screening (indeterminate RoB)[49]. Other successful quality improvement interventions included an intervention in 13-24-year-olds attending paediatric primary care in the United States including electronic medical record improvements, universal urine collection or confidentiality and alone-time with teens (indeterminate RoB) [47]; an intervention among primary care clinic attendees aged 15-29 years in Australia using a five-part methodology (high RoB) [46]; and an intervention among MSM living with HIV attending a primary care clinic in the United States using a multi-component intervention that included self-collection of multi-infection site swabs for *Chlamydia trachomatis* (CT)/*Neisseria gonorrhoeae* (NG) (indeterminate RoB)[50].

None of the studies investigating quality improvement/educational interventions reported on impact on linkage to care.

Electronic medical record (E-Health) interventions

Testing coverage: Ten publications (four at low RoB) reporting on impact of electronic medical record interventions evidenced increased testing coverage ranging from a 2.6% increase in chlamydia testing in an intervention in asymptomatic female primary care attendees in the United States [35], to a 36.9% increase in chlamydia testing coverage among people attending a health service clinic serving American Indian and Alaskan natives that introduced an electronic medical records testing reminder system, with an increase in coverage from 14.0% pre-intervention to 48.9% post-intervention [38]. The most successful interventions included implementation of electronic medical record systems, the use of provider reminders (where providers are given electronic alerts guiding the use of testing) and bundled sample orders (where order sets for multiple organisms are bundled electronically in order to encourage simultaneous testing of multiple pathogens) [30-38,53].

None of the studies investigating electronic medical record interventions reported on impact on linkage to care.

Patient recruitment interventions

Testing coverage: Four publications assessed patient recruitment interventions, including recruitment through patient financial incentives and poster, television and email, and community outreach [3,6,44,45]. All four

publications reporting the impact on testing coverage of patient recruitment interventions showed varying levels of impact although none had a low RoB. The local government authority use of patient financial incentives to encourage chlamydia testing among primary care attendees aged 15-24 years in the United Kingdom (UK) was associated with a small yet statistically significant greater proportion of young people tested in those authorities compared to local authorities without incentives (2.5% vs 3.4%; p=0.03, high RoB) [44]. A quality improvement intervention that included in-reach (providers trained to encourage women to reach male partners, friends, family community members about reproductive health services, and to train community members to promote male reproductive services among men in waiting rooms), community outreach, clinic flow analyses (to help program managers), provider training and 'male appropriate' brochures and materials, was implemented in a primary care clinic in the United States to increase chlamydia and gonorrhoea testing in men. This intervention achieved an increase in testing coverage from 34.8% before implementation to 41.8% after implementation (p<0.001, indeterminate RoB) [6].

None of the publications investigating patient recruitment interventions reported on impact on access to testing or linkage to care.

Screening and triage interventions

Five publications assessed screening and triage algorithms [30,31,41-43].

Testing coverage: Three publications (one at low RoB) showed an increase of chlamydia testing coverage with the introduction of universal screening (testing of all individuals coming into contact with the service). The largest increase was seen after introduction of universal screening among asymptomatic women aged 16-25 years; screening coverage was 8.5% before implementation of universal screening and 28.8% after implementation (p<0.001) [42]. In a randomised cluster trial at low RoB, universal screening plus quality improvement (including education, auto reminder system, computer alerts reminding providers to order testing, reminder to recall, and partner notification) was compared to the standard of care for chlamydia testing coverage in sexually active young people aged 16-29 years attending rural primary care clinics in Australia, and found that the intervention had better coverage (20.1% [95%CI 18.4%-21.8%] vs 1.9% [95%CI 11.2%-14.5%], respectively) [31]. In the third study, at indeterminate RoB, universal screening and provider education was implemented among young women aged 15-19 years attending an urban primary care clinic in the United States for chlamydia testing, and showed an increase from 52.0% before implementation to 59.3% after implementation [30].

Two publications evaluated the impact on testing coverage of changes in frequency of STI testing when 1) chlamydia and gonorrhoea testing was offered in association with cervical cancer screening test (Papanicolaou test) in young women [41] or 2) testing for syphilis was connected with HIV viral load testing in MSM [43]. Decreased frequency of Pap-smear testing (after a change of cervical cancer screening guidelines) determined a decrease in STI screening (odds ratio of undergoing STI testing of 0.38 (95% CI 0.19-0.74), p =0.003, indeterminate RoB) because STI screening was commonly performed along with Pap-smear testing [41]. In the second study, 68.3% of men having 3 or more HIV viral load tests also had 3 or more syphilis tests per year (p=0.001, low RoB), while of those having 1 viral load test in the year, only 6.4% also had 3 or more syphilis tests per year [43]. Changes in testing policies for service delivery need to include a review of the impact of these changes to associated testing algorithms, including testing frequency and data collection strategies.

None of the studies investigating screening and triage interventions reported on impact on access to testing or linkage to care.

Novel testing technologies

Three publications assessed the role of strategies and approaches based on use of novel testing technologies [39,40,54].

Testing Coverage: Two publications assessed the impact of strategies and approaches based on use of novel testing technologies on testing coverage. The first publication assessed the impact of dual chlamydia and gonorrhoea NAAT testing among sexually active young people aged 15-24 years attending primary care in the UK and found that settings using dual CT/GC tests had similar chlamydia testing coverage than settings not using dual testing (29% vs 26%, p=0.24, indeterminate RoB) [39]. The study found a higher gonorrhoea diagnosis rate in settings using dual testing (53/100,000 vs 32/100,000, p=0.03) but with a low positive predictive value (PPV) of 17%. The second study assessed the impact of dual chlamydia and gonorrhoea testing among MSM attending HIV services and found an increase of testing coverage after introduction of the dual-probe nucleic acid techniques; from 26% before implementation to 40% after implementation (P<0.001, low RoB) [40]. The introduction of multiplex NAAT testing strategies for STIs have improved testing coverage, although in areas of low prevalence, confirmation testing might be indicated to compensate for test low positive predictive value.

Linkage to care: A cluster randomised trial (at low RoB) among young people aged 16-19 years using health services serving predominantly indigenous regional, remote, or very remote communities in Australia, investigated linkage to care after testing positive for chlamydia and gonorrhoea using a near POC test

(GeneXpert, Cepheid, US). 76% of cases received treatment within seven days after being tested with GeneXpert compared to 47% of cases in the control arm (RR 1.66, 95% CI 1.41–1.93; p<0.001) [54].

None of the studies investigating novel testing technologies reported on impact on access to testing.

Other interventions

Testing Coverage: One publication at indeterminate RoB was identified reporting on introduction of a sexual health nurse in primary care clinics in Australia to increase the coverage of chlamydia, gonorrhea, syphilis and HIV testing among MSM. In the first clinic, introduction increased testing from 38.3% to 46% (p<0.001), while in a control clinic, there was no strong evidence against the null hypothesis for change in testing coverage (pre-intervention: 20.6%, post-intervention: 22.8%, p>0.01) [52].

Linkage to Care: One publication at low RoB reported on the comparison of a text (e.g. SMS)-based STI test results reporting among symptomatic primary care attendees aged 12-84 years in county health department clinics in the United States compared to traditional appointment-based patient results reporting. There was a reduction in time to treatment following texting-based reporting (5.1 days in texters vs 6.7 days in nontexters, p=0.036) [55].

Summary and quality of the studies

The publications reviewed above indicate that the following interventions will likely increase testing coverage in primary care settings. It should be noted that some of these interventions were evaluated in combination and therefore independent impact could not be assessed.

- Combined clinic approaches such as education, novel triage algorithms, and electronic alerts
- Overall improvements in electronic medical record systems e.g. to remind and alert providers to recall patients, to order testing, and to notify partners
- Sample order bundling to encourage simultaneous testing of multiple pathogens using NAATs
- Introduction of universal screening (testing of all individuals encountering the service)
- Introduction of a sexual health nurse in primary care clinics
- Encouraging women to reach male partners, friends, family, and community members about reproductive health services, and to train community members to promote male reproductive services among men in waiting rooms. Use of male-directed brochures and materials.
- Confidential psychosocial interview and planning with adolescents
- Recruitment through patient financial incentives, poster, television and email, and community outreach
- Self-collection of site swabs
- Faster access to treatment when applying point-of-care molecular diagnostic systems
- SMS based result reporting

The quality of evidence was however not optimal as the majority of interventions in primary care assessed outputs on *testing coverage*, and less evidence is available on interventions that assess impact on access to testing or linkage to care. Most studies were based on before and after designs and the highest number of publications with low risk of bias was found among quality improvement and electronic medical record interventions (Table 2a and Table 3, Annex 8) while only three publications reported on studies with randomised components (Table 2b, Annex 8) [31,45,54]. In future, it is necessary to improve study design for intervention evaluation in primary care settings as opportunistic sampling seriously affects the quality of evidence gathered. And although the evidence indicates that combined interventions can improve access to testing, testing coverage and linkage to care in primary healthcare settings, effectiveness and cost-effectivity studies are needed in the near future in order to assess feasibility and sustainability in European states.

Testing initiatives in sexual health clinic settings

Overview

Testing initiatives in sexual health clinic settings (n=28)				
Objective	Access to testing	Testing coverage	Linkage to care	
	3	17	9	
Strategies				
Patient recruitment interventions (n=5)		5		
Quality improvement interventions (n=5)		5		
Express testing (n=4)	2	1	2	
Screening and triage interventions (n=5)		4	1	
Novel testing technologies (n=4)		2	2	
Test results reporting interventions (n=4)			4	
Self-sampling in the clinic (n=2)	1	1		
Funding and care delivery structures (n=2)		2		
Infection	Chlamydia	Gonorrhoea	Syphilis	Trichomoniasis
	23	19	12	0

There were 28 publications that reported strategies and approaches in sexual health clinics (Table 1b, Annex 7). Of these, three targeted access to testing [4,56,57], 17 testing coverage [4,58-73], and 9 linkage to care [5,74-81]. Of the 28 publications, 23 focused on chlamydia testing; 17 publications focused on both chlamydia and gonorrhoea, and nine focus on chlamydia, gonorrhoea, and syphilis testing. Overall, 19 publications assessed interventions for gonorrhoea testing and 12 publications interventions for syphilis.

Three publications reported on interventions targeting young people and adolescents [62,63,73], eight publications reported on interventions targeting MSM [58-60,64,67-70] including three in people living with HIV [PLWH] [59,64,69], one reported on interventions targeting sex workers [60], four reported on interventions for PLWH [59,64,69,71], and one on interventions in 'high-risk' patients which included MSM, symptomatic cases, notified partners, people involved in commercial sex work, or uninsured people living in sub-Saharan Africa [77]. No publications reported interventions targeting migrants, PWID, incarcerated or homeless people, ethnic minorities, or transgender people.

Strategies and approaches implemented

Patient recruitment interventions

Five publications (two at low RoB) assessed patient recruitment-based interventions in sexual health clinics [58,59,63,64,70].

Testing Coverage: One study with high RoB showed that the proportion of attendees getting a complete set of tests (including CT, NG, *Treponema pallidum* (TP), and HIV) increased with the introduction of the option to get automated email and SMS reminders to undergo testing (39.0%) compared to concurrent (25.5%) and historical control (21.5%) groups ($p<0.001$ for intervention group compared to historical control) [58]. Also, a study at low RoB used enhanced syphilis screening through physician or nurse reminders to perform *T. pallidum* testing in MSM undergoing HIV viral load testing in a hospital clinic. This strategy increased syphilis testing from 23% to 55%; $p<0.0001$, which was linked to a significant increase in new syphilis diagnoses (4 out of 574 pre-intervention vs 18 out of 574 post-intervention, $p=0.004$) [59]. Another study, also in the United States, saw an increase of 89.4% in the proportion of visits by 13-17-year-olds to family planning clinics involving STI testing after implementing a social media campaign driven by peers that was supplemented with community events (proportion of visits with testing pre-campaign: 5.4%; post-campaign: 94.8%; $p<0.001$, with indeterminate RoB) [63].

A study at low RoB, in the US, found that the proportion of asymptomatic MSM tested for CT/NG increased (from 44.1% to 51.0%, $p<0.001$ for testing at any anatomic site; 16.0% to 30.9%, $p<0.001$ for testing at three sites), at an HIV care clinic after introduction of an intervention aimed at overcoming barriers to STI testing. The intervention involved clinician education and clinician- or patient-initiated recruitment to a newly designed self-testing programme. Waiting room advertisements (poster and leaflets) and provision of wall posters in a self-testing restroom assured adequate instruction for specimen collection. Syphilis specimens were not part of the self-collection programme and it was observed that the proportion of patients tested for TP remained the same

(63.3% to 64.6%, p=0.44) as at pre-intervention phase [64]. One publication also at indeterminate RoB, in patients attending sexual health clinics in the United States found increased testing coverage (increase in STI screening and gonorrhoea diagnoses) following provision of quadrivalent HPV vaccination along with CT/NG testing (pre-vaccination: 1.47 CT/NG tests per person/year, post introduction of vaccination: 1.88 CT/NG tests per person/year, p<0.05) [70].

Quality improvement interventions

Five publications (two at low RoB) evaluated quality improvement interventions in sexual health clinics [59,62,66,71,73].

Testing Coverage: A publication at high RoB on an educational intervention in conjunction with a universal flag and screen policy on chlamydia testing among sexually active women less than 26 years seeking annual preventive and routine reproductive healthcare at a university health centre in the United States, showed an increase in screening from 53.4% to 76.1 % (p=0.021) corresponding to an increase in chlamydia testing from 44.4% to 64.6%. The authors highlight multifaceted interventions as feasible for behaviour modification for prevention service providers and recommend the designation of a facilitator for monitoring among the team [73]. A similar strategy was evaluated in a study at indeterminate RoB by means of a brief provider training for use of a risk assessment tool with identification of motivated workers to guide best practice (risk behaviour assessment and counselling) aimed at increasing STI testing coverage among PLWH attending HIV/AIDs primary care clinics. Minor difference in chlamydia/gonorrhoea testing coverage before or after implementation (9.3% vs 9.5% in males and 8.9% vs 12.1% in females, p-value unreported) was observed, but authors report that 100% of patients were assessed for STI risk post-intervention [71].

A publication at low RoB investigated a quality improvement intervention that included face-to-face educational sessions to increase chlamydia testing among individuals from a range of clinical settings in New Zealand, and found no significant difference in chlamydia testing volumes between six month assessment periods before, during and after the intervention; however it is noticeable that pre-intervention testing coverage in young women was among the highest reported internationally (p-value unreported). Using the data as an audit of the service, gaps in partner management and in testing of males between 15 to 24 years of age were revealed [66].

No studies investigating quality improvement interventions reported on impact on access to testing or linkage to care.

Express testing interventions

Four publications (one at low RoB) assessed express testing, in which testing was performed without intimate examination [4,5,57,74]. All publications compared express testing to standard testing with healthcare worker (including clinician and nurse) examination.

Access to testing: One publication at high RoB reported on access to testing and showed that where express testing was applied to 'low risk' patients in Canada, median time with a registered nurse in females decreased from 38 minutes (IQR 30-50) for standard testing to 25 minutes (IQR 20-32) in express testing (p<0.001), and in males from 30 minutes (IQR 24-40) for standard testing to 21 minutes (IQR 16-27) in express testing (p<0.001) [57].

Testing Coverage: The function of express testing services (ETS) is to increase the throughput of symptomatic high-risk clients needing access to sexual health clinic service and by default improving testing coverage. A publication (at indeterminate RoB), assessing impact of the introduction of express service on STI testing coverage among low risk sexual health clinic attendees in Australia, demonstrated a reduction in consultation time and in time spent at clinic for low risk clients when using ETS as compared to standard service (6.1 minutes vs 24.7 minutes, p<0.001 and 29 minutes vs 59.4 minutes, p<0.001 respectively). After introduction of express testing in 2010, 9% of 55,648 clinic clients accessed the express service between 2011 and 2012, and fewer had full consultations compared to before the express service was available (53% to 50%, p<0.001), thus increasing access to full consultation services for high risk clients. Only a modest increase in chlamydia and HIV testing was observed (70% vs 68%, p=0.015 and 48% vs 47%, p=0.017 respectively). However the study authors argue that the clinician time savings and the increase in service capacity for high risk clients make the ETS a successful strategy [4]. In similar fashion, a study (at low RoB) in sexual health clinic attendees in the United States, routing low risk patients (20% of all clients) through express testing increased access to testing, improved treatment coverage and provided savings, which was the main objective of the introduction of the express service. Treatment completion rates were comparable but slightly higher in the traditional testing provider arm than in the express testing arm (98.8% vs 94.3%, p<0.001) as high risk patients (symptomatic, contact to an infected partner, or health department referral) were routed through the traditional provider service arm [74].

Linkage to care: One publication, at high RoB, investigated the impact of express testing on linkage to care among sexual health clinic attendees in Canada and found no difference in the proportion of cases being treated when comparing express testing and screening visits (p=0.86) after a positive chlamydia, gonorrhoea or syphilis result between express or conventional approaches [57]. In the UK, an investigation (at high RoB) reported on

the impact of express testing compared to standard testing on linkage to care among asymptomatic patients using self-collected samples. The mean time from appointment to test result notification was 8.68 days less in the express testing group (0.27; 95% CI 0.26–0.28 days vs 8.95 days; 95% CI 8.91–8.99 days, respectively, p value unreported), allowing for effective linkage to care. Through modelling, authors estimated a positive impact on reducing transmission opportunities, partner notifications and service delivery costs [5].

Screening and triage interventions

Five publications (one with low RoB) investigated interventions based on screening and triage [67,69,71,73,77].

Testing Coverage: Results ranged from a negligible 0.2% increase in testing coverage for chlamydia or gonorrhoea among PLWH attending a sexual health HIV/AIDS primary care clinic in the United States after the introduction of provider education and a risk assessment tool (indeterminate RoB) [71], to an 8.5% increase (p=0.001) in chlamydia and gonorrhoea screening among MSM living with HIV attending an HIV clinic utilising same interventions (low RoB) [69].

A pilot study (indeterminate RoB) offered universal extragenital screening (oropharyngeal and anorectal) in addition to urogenital testing to MSM at 12 municipal STD clinics in the United States in order to increase chlamydia and/or gonorrhoea diagnosis at any anatomical site. Results evidenced an overall increase (despite range variation of -3.1% to 30.7% between clinics) in the proportion of visits with universal screening from 60.6% (n=815) pre-introduction of intervention, to 67.1% (n=1099) post intervention, p<0.001. Clinics with more than 5% increase in clients offered multiple anatomical sites testing also reported an increase in chlamydia and/or gonorrhoea positivity at any anatomical site [67].

At high RoB, a study measuring the effect of a practice provider intervention on chlamydia screening among women younger than 26 demonstrated that clinician and nursing education, along with introduction of a site screening policy and a designated liaison champion (i.e., clinic's nurse manager), resulted in an increased proportion of eligible clinic attendees offered testing (pre-intervention 53.4% vs post intervention 76.1%, p=0.021). From those, the proportion undergoing CT screening also increased (44.4% pre-intervention vs 64.6% post-intervention, p=0.026), with positivity rates of 3.4% pre-intervention and 7.1% post-intervention, p=0.35 [73].

Linkage to care: One publication at high RoB investigated a new screening algorithm for urogenital chlamydia and its impact on linkage to care in the Netherlands. The switch from POC testing algorithm using Gram stain urethral smear for all male high risk patients between 2008 and 2009 to urethral smear for symptomatic only (between 2010 and 2011) found that the proportion with delayed treatment was significantly higher in the period 2010-2011 (symptomatic only Gram stain: 22.8%, universal Gram stain: 10.5%, p<0.001). There was no significant difference in the proportion lost to follow-up (universal Gram stain: 1.8% [95% CI 1.0% to 2.9%], symptomatic only Gram stain: 2.3% [95% CI 1.7% to 3.0%], p=0.36) but the impact was favourable, with a reduction of 14.3% in costs between 2010-2011 when infections were correctly managed [77].

No studies investigating screening and triage interventions reported on impact on access to testing.

Novel testing technologies

Testing technologies were assessed in four publications [60,61,75,76]. Two publications presented results related to rapid POC testing involving rapid treponemal testing for syphilis, and two involving nucleic acid amplification test (NAAT)-based assays for chlamydia or gonorrhoea.

Testing coverage: Two publications with indeterminate RoB compared rapid treponemal testing to standard of care and both found increased testing coverage. One, with indeterminate RoB, evaluated trends in coverage of twice yearly syphilis screening at clinics providing HIV prevention services to key populations at high risk of HIV in India [60]. When immunochromatographic syphilis tests were introduced, the proportion of people screened increased from 9.0% to 21.6% (p <0.001) as compared to previously using Rapid Plasma Reagin (RPR) test for screening. A reduction in RPR reactivity rate from 6.6% in 2007 to 4.4% (p value not provided) was observed by 2009. The authors report that despite the improvement in coverage, challenges around data collection and merging of databases generated under-reporting of testing data. The other publication evaluated the feasibility of diagnosing syphilis at point of care at a STI clinic in Mexico City by comparing two different testing algorithms: rapid treponemal test, results in 15 minutes and if positive, Venereal Disease Research Laboratory (VDRL) test results in 10 days or rapid treponemal test, and if positive VDRL results in one hour, to the standard testing protocol (treponemal test and if positive VDRL results in 10 days). All of those in the group with treponemal rapid test and VDRL within an hour received test results within 90 minutes. In the group of those diagnosed by the treponemal rapid test with VDRL results in 10 days, 64% received VDRL results. In the group on standard testing 62.8% of those diagnosed received VDRL results. All those with a confirmed result received treatment. Therefore the authors recommend rapid test with immediate confirmation by VDRL as the best standard of care available at their site [61].

Linkage to care: One publication (indeterminate RoB) investigated the impact of introduction of NAAT for gonorrhoea (introduction period April-June 2015) as compared with standard diagnosis using gonococcal culture (pre-introduction period April-June 2014) on linkage to care, measured as time (days) to treatment among

attendees of a large urban sexual health clinic in Australia. The analysis of results indicated that the time to laboratory result for gonorrhoea was significantly less in post-introduction (median=3, n=189) compared to pre-introduction period (median=5, n=50) (p= 0.000). It found however, no difference in median time (days) from results reporting to treatment (pre-introduction median=3, post-introduction median=4, p=0.4) despite the early availability of GC NAAT results [75]. Another publication (indeterminate RoB) investigated the impact of POC testing using GeneXpert for chlamydia and gonorrhoea compared to laboratory-based NAAT testing on linkage to care among sexual health clinic attendees in the UK, and found that median time from testing positive to management was 8 days less with GeneXpert: 2 days (IQR: 1-6 days) compared to 10 days (IQR: 7-11 days) with laboratory-based NAATs [76].

No studies investigating novel testing technologies reported on impact on access to testing.

Test results reporting interventions

Four publications presented the results from interventions of innovative methods for reporting patient results [78-81]. Methods included online platforms, smartphone applications, text, and phone; in all cases presenting data on *linkage to care*.

One publication at low RoB investigated an intervention call 'Healthvana' that included an online patient engagement platform and smartphone application among men attending AIDS Healthcare Foundation Wellness Centres in the United States, and found no significant difference in mean time (days) from test to treatment of chlamydia, gonorrhoea or syphilis before or after implementation of the interventions (11.67, 95%CI 10.63-12.70 before, and 10.15, 95%CI 9.39-10.91 after) [78]. Another publication (indeterminate RoB) compared result-reporting in sexual health clinic attendees in the United States by online portal, to phone reporting, and found an increased proportion of gonorrhoea cases treated within 7 days (16.3% increase in pharyngeal, 9.3% increase in rectal, and 8.5% increase in urethral gonorrhoea) [81]. A study (low RoB) in the United States comparing patient result reporting by text, to patient result reporting by appointment or phone found a 15.9% higher proportion testing positive treated within 1-4 days (text: 56.9%, appointment/phone: 40.8%, P<0.001) [80].

The fourth publication (indeterminate RoB) evaluated mean days from diagnosis to treatment in a sexual health clinic in the United States after implementation of a text and email-based results reporting strategy, compared to a pre-intervention strategy using direct referral to Disease Intervention Specialists (DIS). The results indicated that the new results reporting strategy increased time to treatment from 11.7 days (95% CI 10.5 -12.9 days) to 14.0 days (95% CI 12.2-15.9 days) in spite of reduced DIS workload, savings generated to the service, and increased efficiency. Time to treatment was optimal by direct referral to DIS [79].

Self-sampling in the clinic

A patient self-sampling intervention and impact on *access to testing* was assessed by comparing the self-collection of vaginal swabs to clinician collection for chlamydia and gonorrhoea among female sexual health clinic attendees aged 17-57 years in the UK. The authors reported (indeterminate RoB) a higher percentage of participants preferred self-swabbing to clinician swabbing (42% vs 34%) [56]. In the UK, a study (low RoB) on the suitability of self-taken swabs for detection of extragenital infections with chlamydia and gonorrhoea found an increased detection of extra-genital chlamydia and gonorrhoea (before: 4.4%, after: 19% (p< 0.0001). A rise in detection of rectal (4.4 to 9.9% p<0.001) and pharyngeal (2.45% to 11.8%, p<0.001) infections was observed, affecting MSM and women. Increasing acceptability in both groups, grew from 0% to 58.5% p<0.001 and from 0 to 89% in samples of 100 consecutive patients later on [72].

No studies investigating patient sampling interventions reported on impact on testing coverage or linkage to care.

Funding source and efficiency of care delivery structures

An audit performance measured adherence to national chlamydia screening guidelines of 833 family planning providers in the United States and examined clinic and client characteristics by financial provider type (Federal grant-funded public sector, non-Federal grant funded public sector and private sector providers). The study, at low risk of bias, found that Federal grant funded clinics followed guidelines more closely, providing higher levels of testing coverage to <25-year-old women (as per national guidelines) and among them, to African American women, than in non-Federal grant publicly funded clinics or privately funded clinics (Federal grant: 64.4%, non-Federal grant: 54.3%, private: 63.8% p<0.001 t test for trend) but private sector providers had higher screening rates than Federal grant providers. Non-Federal grant public clinics and private clinics on the other hand, screened more women >26 years of age, generating concerns regarding over-screening (a fee-for-service offered). A further analysis of results also indicated that that Federal grant providers and private providers were mainly located in urban areas (84% and 92%, p<0.0001) while 43% of Non-Federal grant public providers were present in rural areas. The audit demonstrated that best practice in screening varies according to client characteristics and location and that gathering information on the provider-associated characteristics that affect adherence to screening guidelines will have a positive impact in the design of quality improvement initiatives for service delivery of chlamydia control services. [65].

Also comparing care delivery models among MSM in UK, a publication (indeterminate RoB) dealing with testing and treatment at the community-based contraception and sexual health clinic (CASH) versus standard of service testing and treatment by referral to Genitourinary Medicine (GUM) clinics, found that of 716 men self-identifying as MSM or bisexual, 124 attended CASH and 592 attended GUM for care. When ethnicity records were analysed, 21% of men attending CASH were native from India, Pakistan, Bangladesh and 'other Asian' backgrounds compared to GUM (11.5%). The analysis also highlighted that in CASH a larger proportion of MSM were young (<35 years) (CASH 68.6% vs GUM 46.8%). Regarding multiple STI testing, more MSM accepted chlamydia, gonorrhoea, HIV and syphilis testing at GUM (75.5% tested) than in CASH 64.5% tested in CASH). Oppositely, MSM tested at CASH more likely to accept chlamydia and gonorrhoea testing only (11.4% CASH vs 7.8% GUM) or HIV only (10.5% at CASH vs 5.1% at GUM) during the same period. The proportions for HIV positivity were 0.8% and 2.0% for CASH and GUM respectively. This authors recommended CASH venues to be included as providers of care for populations at risk, especially young MSM by providing CASH staff training to ensure wider promotion and provision of testing to clinic clients that are non-GUM attendees [68].

Summary and quality of the studies

The majority of publications reported on testing coverage and linkage to care. While most publications focused on chlamydia, several publications also reported on gonorrhoea and syphilis. Only one publication [56] reported on an intervention with a randomised component and it had an unclear risk of bias (Table 2b, Annex 8). Most of the other publications were from before/after designs. Most publications with the lowest risk of bias were from interventions on patient recruitment, quality improvement, express testing and results reporting (Table 2a and Table 3, Annex 8).

The literature (from all areas above) indicates that the following interventions can be advantageous increasing access to testing, testing coverage and/or linkage to care in sexual health clinics:

- Implementation of electronic systems e.g. automated email and SMS reminders, result reporting by online portal;
- Physician or nurse reminders;
- Online recruitment campaigns and community events;
- Clinician and nursing education. Provider education and training in use of a risk assessment tool;
- Face-to-face educational sessions;
- Educational intervention in conjunction with a universal flag and screen policy;
- Identification of motivated workers to guide best practice;
- Designation of specific job and roles e.g. facilitator for monitoring, liaison champion;
- Self-collection of swabs;
- Express testing service to reduce consultation time for low risk clients and increase access to full consultation services for high-risk clients; and
- Rapid testing e.g. treponemal or NAAT testing for CT/GC (though there can be challenges around increased staff workload, data collection, merging of databases and under-reporting of testing data).

Testing initiatives in antenatal care settings

Overview

Testing initiatives in antenatal care settings (n=18)				
Objective	Access to testing	Testing coverage	Linkage to care	
	4	15	8	
Strategies				
Novel testing technologies (n=16)	4	14	7	
Quality improvement interventions (n=2)		2	1	
Patient recruitment interventions (n=1)		1		
Test results reporting interventions (n=1)			1	
Infection	Chlamydia	Gonorrhoea	Syphilis	Trichomoniasis
	1	1	17	1

There were 18 publications reporting strategies and approaches applied in antenatal care (Table 1c, Annex 7). Of these, four reported on access to testing [82-85], 15 reported on testing coverage [84-98], and eight reported

on linkage to care [84,85,94-99]. One publication targeted chlamydia and gonorrhoea testing [99], and 17 publications targeted syphilis testing [82-98], of which one also included data on testing for trichomoniasis [91].

No publications presented interventions specifically in high-risk populations, and all publications were conducted in low-and-middle-income country settings.

Strategies and approaches implemented

Novel testing technologies

There were 16 publications that assessed the use of novel testing technologies [82-92,94-98]. Of these, 13 publications compared rapid treponemal testing to rapid plasma reagin or to standard of care in the pre-implementation period. One publication compared a separate POC HIV and treponemal test for syphilis to a POC dual HIV and treponemal test ([85], and another publication assessed two different models of rapid treponemal tests for acceptability and feasibility among healthcare workers [83].

Access to testing: Four papers assessed impact of rapid treponemal tests on access to testing. One publication (at low RoB) reported results from a study investigating median time in clinic among first attendees of a second level hospital in a marginalised area in Peru. It found that mean time decreased from 111-140 minutes with standard laboratory testing algorithms to 45 minutes after implementation of rapid treponemal testing. Results of POC test were issued within the required 45 minutes to all (100%) patients at this site, as compared to 15 to 30 days on standard hospital service. Other benefits of the introduction of POC test at the hospital included reduced workload for hospital personnel, and for patients, reduction from two hospital visits for testing and management respectively during pre-POC test introduction to one visit after POC test introduction. [82].

Following the introduction of syphilis rapid testing in antenatal clinics (ANC) in Tanzania in 2009, an increase in the number of pregnant women tested (17.9% vs 100%, $p<0.01$), allowed healthcare workers to test and treat more clients during the same visit. The report (indeterminate RoB), presents qualitative outcomes, including lower socio-psychological barriers to testing due to less blood taken, less pain, and lower patient transport costs due to immediate results reporting, and more importantly, the proportion of pregnant women who tested positive for syphilis that received treatment increased from 46.3% to 94.8%, $p<0.01$. From the healthcare worker point of view, the procedure was simple, saved time and had great acceptability as it was familiar, due to its similarity with the HIV rapid testing methodology [84]. In a cluster randomised trial (high RoB) assessing rapid testing in pregnant women aged 14 years or more attending their first antenatal check in Colombia, there was no difference in acceptability between separate POC HIV and treponemal tests for syphilis when compared to a dual POC HIV and treponemal tests. Interestingly, despite the high patient and healthcare worker acceptability rates, 13 of 49 physicians (26.5%) were not confident that the positive test results by separate rapid syphilis test warranted treatment, therefore 24/29 (82.9%) pregnant women with positive rapid tests received treatment for syphilis in the individual rapid test group (Arm A) compared to 20/20 (100%) in the dual test group (Arm B) [85].

Dual rapid POC HIV and treponemal tests were also compared among ANC attendees in Zambia (low RoB). Two tests were evaluated for acceptability and feasibility in field settings, where POC tests are especially useful to diagnose co-infections with HIV and syphilis. Both rapid tests had high acceptability from participants (99.7%) with 99.9% of participants willing to wait up to one hour for results. ANC nurses considered both test highly feasible. Authors report both tests were equally acceptable and feasible in this field application where rapid diagnosis is pivotal to avoid mother to child transmission due to high prevalence of HIV and syphilis [83].

Testing coverage: Fourteen publications assessed the impact of novel testing technologies on testing coverage in antenatal care, the majority (10/14) of which reported a significant increase in testing coverage of syphilis (Table 1c, Annex 7).

Linkage to care: Seven publications assessed the impact of rapid testing for syphilis on linkage to care. A study in Zambia reported an increase of 44% in linkage to care for pregnant women when rapid syphilis treponemal (RST) tests were integrated to prevention of mother-to-child transmission (PMTCT) in HIV clinics (RPR: 51.1%, RST: 95.2% $p<0.001$) [95]. In contrast, a publication at low risk of bias identified the challenges to achieving sustainable use of rapid syphilis tests and linkage to care for pregnant women when rolling out syphilis rapid testing services in Zambia, during a period of a year in selected antenatal care facilities. The authors report that compared to baseline syphilis testing using RPR, RST use increased the proportion of pregnant women tested ($p<0.001$). Even with small numbers of syphilis positive women, results indicated that there was a decrease in antenatal care attendees being treated (RPR: 50%, RST: 13% at 6 months of introduction; $p=0.199$). Poor documentation of treatment administration as well as lack of supervision were identified as bottlenecks for effective impact evaluation of linkage to care in pregnant women with a positive syphilis test. Stock outs of tests and supplies were also identified as challenges to achieve testing sustainability, but these didn't explain the decline in linkage to care 7-12 months after RST introduction. There were no stockouts of penicillin during the study period [97].

Quality improvement interventions

Two publications assessed quality improvement. No studies investigating quality improvement interventions reported on impact on access to testing. One publication at low RoB reported on testing coverage by introducing both rapid testing for syphilis and quality improvement in pregnant Haitian women attending primary care clinics. This publication found an increase in syphilis testing from 91.5% to 96.8% after implementation of the

intervention, with an accompanying increase in proportion of syphilis positive pregnant women treated from 70.2% before to 84.3% after implementation of the intervention (p<0.001) [94].

Another publication, at high RoB reported on a cluster randomised trial that evaluated a multi-component intervention providing antenatal care kits, a supply cupboard, tracking sheet, and provider training (site nurses, laboratory and pharmacy technicians) to curve stock out issues in antenatal care clinics in Mozambique. The study found an increase in proportion of clinics attendees undergoing testing for syphilis from 65.7% before to 95.5% after implementation of the intervention (p<0.001) and an increase in proportion of syphilis positive cases treated from 60.8% before to 86.2% after implementation of the intervention (p< 0.001). The authors discuss how implementation of chain supply strategies work effectively when careful planning takes into account the baseline needs at the point-of-care provider setting, allowing for these strategies to be adopted under routine conditions of service not only in low-resource settings [98].

Patient recruitment interventions

One publication (low RoB) reported on the 'PRENACEL' study, a health promotion and health education initiative which targeted patient recruitment of Brazilian pregnant women aged 18 or over attending ANC. Recruitment was achieved through posters and flyers distributed by PRENACEL trained staff at primary healthcare units and hospitals. Once recruited, women received four weekly texts with information related to pregnancy and childbirth up to delivery. The premise of the study was to empower users of the ANC services to learn to evaluate the quality of service received through these health promotion and education initiatives, that lead to improved coverage of ANC practices. The authors compared women who received routine ANC services to women who received routine ANC plus PRENACEL interventions and they report not only an increase in the proportion of women undergoing three syphilis tests (identified in the study as a strategy for detection and prevention of transmission) from 24.8% before to 40.5% after implementation of the intervention (p<0.0001), but also increased HIV testing (46.6% vs 25.7%, p<0.001) and recorded ≥6 antenatal visits (96.6% compared to 84.4%, p=0.001), with better compliance with ANC protocols, although coverage remained low for several of the ANC recommended tests. The study team faced data documentation challenges when accessing patient records to obtain baseline or follow up data [93]. No publications investigating recruitment interventions reported on impact on access to testing or linkage to care.

Test results reporting interventions

One publication at low RoB compared same day appointment-based results reporting and treatment to same day phone-based and delayed reporting and treatment in pregnant women aged 18 years or more attending antenatal care in Botswana. The study introduced GeneXpert (Cepheid, US) testing technology that provided test results for CT/GC in 90 minutes and for TV in 45 minutes. 400 pregnant women were tested and 54 had positive results for CT, NG and/or TV. Treatment was received immediately after the results were issued by all women (40 of 40) that received results same day in person and all women (8 of 8) that received results on the phone on the same day. Of the six women with delayed results, four were eventually treated. The authors highlight that integrating sensitive and specific point-of-care tests for curable STIs to antenatal services will likely increase testing coverage, which in turn will improve pregnancy and birth outcomes in Botswana. However, studies considering the short and long term cost-effectiveness of using point-of-care tests for STI screening in ANC settings are needed [99].

Summary

Most publications in this section reported on testing coverage, with a few publications reporting on access to testing and linkage to care. Almost all publications focused on syphilis testing with POC testing in low and middle-income countries. There were only two studies with randomised components [85,93], one with high risk of bias and one with low risk of bias (Table 2b, Annex 8). Most of the other studies were quasi experimental or before/after designs. A high number of low risk of bias publications were from the sub-section POC tests (Table 2a and Table 3, Annex 8).

The literature (from all areas above) indicates that the following interventions can be advantageous in antenatal care:

- Rapid and novel testing (led to several benefits including increased testing coverage in most studies, reduced attendee time in clinic, faster issuing of results, reduced workload for staff, reduction in number of hospital visits for patients, lower transport costs, higher number of clients treated during the same visit);
- Dual rapid testing (HIV and Treponema) was accepted by participants and feasible for staff;
- Multi-component interventions such as provision of kits, organised stock, tracking systems, and provider training;
- Health promotion and educations initiatives such as posters, flyers, weekly texts; and
- Same-day appointment-based results are generally well accepted. However, depending on the population, the length of time from specimen to result varies.

While rapid testing appears to improve linkage to care, there were some examples in the literature where managerial and operational issues can challenge sustainable use e.g. poor documentation of treatment, appropriate training records, supervision and stock control.

Testing initiatives in emergency departments or other hospital settings

Overview

Testing initiatives in emergency departments or other hospital settings (n=12)				
Objective	Access to testing	Testing coverage	Linkage to care	
	1	6	6	
Strategies				
Novel testing technologies (n=6) Near-POCT (GenXpert)	1		5	
Electronic medical records and computerised screening tools (n=4)		4		
Screening and triage interventions (n=1)		1	1	
Patient recruitment and education interventions (n=2)		2		
Infection	Chlamydia	Gonorrhoea	Syphilis	Trichomoniasis
	9	8	2	3

There were 11 publications that reported strategies and approaches for testing STIs in emergency departments and one publication that reported a strategy or approach in other hospital settings. One publication assessed access to testing [100], six assessed testing coverage [101-106], and six assessed linkage to care [106-111]. Nine publications reported on testing for chlamydia [102-105,107-111], of which eight also presented data on testing for gonorrhoea [103-105,107-111], with two of these publications also presenting data on testing for syphilis [109,110]. In total, eight publications presented data on testing for gonorrhoea [103-105,107-111], two presented data on testing for syphilis [109,110], and three publications presented data on testing for trichomoniasis [100,101,106].

Four publications reported on interventions targeting young people and adolescents [101,107,108,112], and one reported an intervention in PLWH [110]. No publications reported on interventions targeting migrants, PWID, incarcerated or homeless people, ethnic minorities, transgender people, MSM, or other vulnerable populations.

Strategies and approaches implemented

Novel testing technologies

Six publications presented assessments of novel testing technologies, including four publications comparing laboratory-based NAATs to a near-POCT (GeneXpert, Cepheid, US) [102-105], and two publications assessing a POC test for trichomoniasis compared to pre-intervention standard of care [100,101].

Access to testing: One publication (indeterminate RoB) assessed the impact on access to testing by introducing self-testing for trichomonas using a POC test in female emergency room attendees aged 14 to 20 years in the United States, and found an increase in the proportion of women thinking self-testing was 'not at all hard' from 66% to 83% after implementation of the POC test ($p<0.001$), highlighting that this intervention significantly decreased barriers to access to testing [101].

Linkage to care: The four publications on chlamydia and gonorrhoea demonstrate the evolution of the assessment of the benefit of near patient testing with GeneXpert (Cepheid, CA, US) on linkage to care in the United States. One publication (low RoB) found that a reduced number of empiric treatments were issued to CT/GC negative patients tested with GeneXpert (Cepheid, CA, US) than to those tested with the usual laboratory-based NAATs (28.6% vs 60.7%) among symptomatic patients aged over 18 years attending an urban emergency department [102]. Another paper (low RoB) reported not only on an increase in patients testing positive for CT/GC that received appropriate treatment (60% vs 72.5%, $p=0.008$), but also on a reduction in the median time to result (2.4 h vs 31.7 h, $p=<0.001$). A reduction in the time to positive result notification to patients was also observed (17.4h vs 53.7h, $p=0.010$) [103].

These observations are also supported by a recent publication that highlights that near patient testing for CT/GC using GeneXpert (result turn around 90-100 minutes) facilitates accurate patient management in the ED as opposed to standard of care NAAT (2-3 day turnaround time), thus benefiting antibiotic stewardship policies by avoiding overtreatment while also averting undertreatment, curtailing transmission events [104]. This study followed on the finding of increased access to treatment on female emergency department attendees who tested positive for chlamydia by GeneXpert compared to those tested with NAAT at the central laboratory (100% vs

41.7%, respectively; p<0.017). Similar results were reported for those testing positive for gonorrhoea by GeneXpert compared to the laboratory-based NAAT (100% vs 33.3%, respectively; p<0.061) [105].

The successful replacement of culture by a POC test for trichomoniasis (OSOM Trichomonas Rapid Test; Sekisui Diagnostics, LLC, Lexington, MA) among female urban paediatric academic centre emergency department attendees aged 14-20 years in the United States favoured access to treatment of positive patients during the same visit: 69.8% before and 96.8% after implementation of the POC test (p<0.005) [101].

No studies investigating novel testing technologies interventions reported on *testing coverage.*

Electronic medical records and computerised screening tools

Four studies evaluated electronic medical records or computerised screening tools including two publications investigating screening tools [107,108] and two assessing electronic reminders [109,110].

Testing coverage: One publication (low RoB) assessed the use of an audio computer assisted self-interview (ACASI) among young people aged 15-21 years attending emergency departments in the Netherlands, and found an increase in testing coverage from 9.7% before to 17.8% after the implementation of ACASI (p<0.001) [107]. Another publication (low RoB) investigated the impact of computerised sexual health survey based 'decision support' tools on physician decisions on screening, compared to physician decision-making without decision support, in the United States, and found that those with decision support had twice the odds of screening for chlamydia and gonorrhoea than those without decision support (aOR, 95% CI 1.1-3.8). Using a computerised sexual health survey encourages adolescents to be open regarding their risk behaviours, facilitating decision-making on STI testing by the ED physicians, without impact on length of stay. [108].

Electronic medical record reminders also increased testing coverage. One publication (indeterminate RoB) among patients attending an urban emergency department in the UK showed that the proportion of chlamydia and gonorrhoea-tested patients undergoing syphilis testing increased from 41% before to 72%, along with an increase from 41% to 78% for HIV testing after implementation of a standard STI laboratory order set. This resulted in the detection of 6 syphilis infections in the control group vs 13 in the intervention group, evidencing that introduction of these reminders and linking STIs testing sets have a beneficial impact in testing coverage [109]. Subsequently these strategies have proven to increase testing coverage among PLWH attending a district general hospital where the proportion of those with at least one STI screen per year increased from 90% to 97%, enhancing STI detection from 15.6 to 31.8/100 person years, p <0.001 for MSM and from 0.8 to 2.5/100 person years in heterosexual men, p<0.005 [110].

No studies investigating electronic medical record interventions reported on impact on access to testing or linkage to care.

Screening and triage interventions

One publication (at low RoB) investigated the impact of a screening and triage intervention on *testing coverage* among symptomatic females aged 13-20 years attending an emergency department in the United States, and found that integration of routine testing for trichomoniasis into STI testing protocols in the emergency department resulted in an increase in testing coverage for trichomoniasis among those eligible for testing, from 13% eligible tested before the intervention (1.3% found positive) to 99.5% eligible tested after the introduction of rapid antigen and NAAT TV testing (p<0.001, 18.4% found positive overall), of which 13.6% (p<0.001) were positive by rapid trichomonas antigen test vs 15.5% (p<0.001) by NAAT in the central laboratory. The same publication showed that screening of TV infections in the emergency department favoured *linkage to care*, with 95% of women treated after introduction of the intervention [106].

Patient recruitment and education interventions

Two publications, both from the United States, assessed patient recruitment or education interventions [107,111].

Testing coverage: The first paper (low RoB) set up a brief intervention on sexually active heterosexual women 18-35 years old attending the emergency department with non-STI complaints. Based on achieving potential behavioural change, the intervention was to offer education and counselling with the objective of increasing women's awareness of their CT/GC risk and to evaluate condom use attitudes and own risk perception using acceptance of free CT/GC testing as the measurable primary outcome. All eligible participants answered a survey using an audio computer-assisted self-interviewer on a tablet computer and were asked to provide a urine specimen for CT/GC NAAT testing. Results indicated that there was no difference in testing uptake between the intervention (48% uptake, 95% CI 32% to 64%) and the control (36% uptake, 95% CI 19% to 53%) groups, despite some women attending the ED exhibited risk behaviours (substance use, condomless sex with casual partners or previous STI diagnosis). The authors discuss that perhaps the lack of incentives, the need to report positive results to the Department of Health and the need to provide a urine specimen deterred testing uptake. An extended sample was deemed necessary to analyse impact in subgroups (ethnicity, substance use, condom

use, etc) for future studies aiming at behaviour change. The team concluded that different approaches may be needed to increase testing uptake in this group [111].

In contrast, the second publication (at low RoB) investigated the impact of education and counselling on CT/GC testing among emergency department attendees aged 15-21 years. The intervention included medical and staff education on the use of an audio-enhanced computer-assisted self-interview (ACASI), to collect data that feeds into a healthcare provider decision tree on patient risk supporting targeted screening. The results indicated that when using prompts by electronic medical records linked to ACASI, the proportion of patients that agreed to be tested increased from 9.3% to 17.8% during ACASI availability and reduced to 12.4% once the survey tool was no longer available (P<0.001). Contact information on ACASI aided follow up by nurses using phone and letters to patients with positive test results, therefore all positive individuals were notified and linked to care. The study team concluded that the use of ACASI had acceptability and had a beneficial impact on *testing coverage* and result notification in young people attending the ED, with the possibility of modification to include ordering of STI screen and collection of information relevant for partner notification [107].

Summary

All the publications with only one exception reported on studies in emergency departments. The majority identified an impact on testing coverage and linkage to care. Of the 12 studies in this section, five were RCTs [102,104,105,108,111], all of which were of low or unclear risk of bias (Table 2b, Annex 8). The rest of the studies were mostly before/after designs, the highest number of papers with low risk of bias (n=2) were on electronic medical record interventions (Table 2a and Table 3, Annex 8).

The literature (from all areas above) indicates that the following interventions can be advantageous in emergency departments or other hospital settings:

- Audio computer assisted self-interview (ACASI) among young people;
- Electronic medical record reminders;
- Use of computerised sexual health survey 'decision support' tools (impacting on physician decisions on screening);
- Self-testing using a POC test for Trichomonas to improve patient acceptability and increase access to testing and number of positive patients treated at the same visit;
- Integration of trichomoniasis testing into STI testing protocols (leading to an increase in testing coverage for trichomoniasis among those tested for other STIs);
- Patient education and counselling (leading to an increase in testing coverage).

Several studies presented advantages regarding linkage to care when applying the GeneXpert (Cepheid) compared to laboratory-based NAATs, especially in the emergency department. The use of computer tools in conjunction with electronic medical records opens the possibility for improved testing coverage and linkage to care when using targeted approaches, for example groups at high risk of STIs.

Testing initiatives in outreach, community or home settings

Overview

Testing initiatives in outreach (n=31)				
Objective	Access to testing	Testing coverage	Linkage to care	
	2	23	8	
Strategies				
Self-sampling in a patient selected location (n=19)		15	6	
Outreach recruitment to clinic-based testing (n=8)		8		
Testing in outreach (n=5)	2	3	2	
Infection	Chlamydia	Gonorrhoea	Syphilis	Trichomoniasis
	28	11	2	

A total of 31 publications reported strategies and approaches used in outreach, community or home settings. Of these, two targeted access to testing [112,113], 23 testing coverage [114-136], and eight linkage to care [135-142]. Two publications' interventions were set in further education settings, one in student halls, one in a school, one in sexual services-related settings (brothels, saunas, etc.), one used a mobile van and Lesbian, Gay, Bisexual, Transgender (LGBT) community centre, two in football clubs, one at a motorsports festival, one at a prison, nine recruited patients online, and 20 involved patients using self-sampling kits for location-/home-based testing.

Of the 31 publications, 28 focused on chlamydia testing [112,114-120,122-133,135-141] (11 with gonorrhoea [126-133,139-141], and two with syphilis [132,133]. A total of 11 publications assessed interventions for gonorrhoea testing [126-133,139-141] and two for syphilis testing [132,133].

Four publications assessed interventions in MSM [113,114,131,142], 12 in young people [112,115,118-120,122,124,126,129,135,136,139], and one publication each evaluated interventions in PLWH [132] and incarcerated women [127]. No publications reported interventions targeting migrants, PWID, homeless people, ethnic minorities, transgender people, or any other particularly vulnerable populations.

Strategies and approaches implemented

Self-sampling in a patient selected location

There were 19 publications that assessed interventions in outreach settings with use of self-sampling in a patient selected location (i.e. home-based sampling) [114-123,128,131,133,135-138,140,141]. Of these, five provided home-based sampling kits in a clinic setting [115,128,131,135,140], three assessed letter-based recruitment to home sampling [116,117,136], seven assessed online services for provision of home-based sampling kits [118-120,133,137,138,141]. Five of the 19 publications assessed provision of home sampling kits in outreach settings [114,121-123,131] such as a sauna based study, a further education dormitory setting, and a multi-arm study including a health club, football club, and 'other' settings. One publication compared home-based testing provided through primary care to that provided through an online service [118].

Testing coverage: There were 15 publications that assessed the impact of home-based sampling on testing coverage. Testing coverage was higher for home-based sampling compared with clinic-based sampling in all cases. In an RCT among 200 men aged 18-45 years in the United States men assigned to home-based CT/GC screening by self-collected urine samples at home were 60% more likely to complete screening compared with men invited to clinic-based screening (72% vs. 48%, adjusted relative risk (RRadj) =1.6, 95% CI=1.3, 2.0) [128]. A publication reporting on an intervention among asymptomatic sexual health clinic attendees aged 16 to 25 years in the Netherlands compared self-collected clinic sampling to home-based samples or self-collected clinic samples plus patient counselling; no difference was found in testing coverage (clinic-collected 86.1% vs home-collected 87.8%, p=0.45 and vs. clinic-collected plus counselling 95.5%, p=0.45) [135].

Two publications showed higher testing coverage in interventions using letters to offer home-based sampling compared to passive clinic recruitment. One, an RCT among symptomatic Norwegians aged 18-25 years assessed impact of a letter-based recruitment strategy that offered home-based testing, and found increased testing coverage among those who had the intervention (unadjusted risk ratio 4.9, 95% CI 4.5-5.2) [136]. Another publication reported on a register-based programme of annual personalised invitations for annual chlamydia screening sent to 16-29-year olds listed in municipal registers in the Netherlands, resulting in a higher testing coverage using the letter than passive recruitment (36.4% vs 13.0%, respectively) [116].

Another publication reported on an online self-collected home-based sampling service assessing chlamydia testing coverage with two different letter designs among young people aged 16 to 29 years in the Netherlands, and found no difference in testing coverage [117].

Three papers compared online recruitment services for home-based sampling to clinician collected sampling, and all showed higher testing coverage among those using home-based sampling. A French RCT among sexually active young people aged 18-24 years showed higher chlamydia testing coverage among those randomised to home-based collection compared to clinic-based collection (29.2% vs 8.7%; adjusted RR 4.55; 95% CI 3.77 to 5.49) [119]. A British RCT among sexually active young people aged 16 to 30 years showed higher testing coverage for chlamydia, gonorrhoea, or syphilis among those randomised to home-based collection compared to clinic-based collection (28.8% vs 26.6%, RR 1.87, 95% CI 1.63 to 2.15, p<0.001]) [133].

In contrast, one three-armed RCT among young people attending primary care aged 17-18 years in the UK compared clinic-based chlamydia sampling with or without a completion incentive, with access to an online service allowing kit ordering, and found much lower testing coverage among those randomised to the online service than the clinic-based services, with or without an incentive (clinic: 7.8%, clinic plus incentive: 14% [p<0.001 vs. arm 1], online: 1.0%) [118].

The final publication reported on a case-control study investigating the association between non-cash incentive and testing coverage among young people aged 16-24 years using an online and text chlamydia screening service in the UK. There was a 3.8% higher proportion of service users returning samples within 30 days of request if given either a £5 unconditional or conditional (on return) voucher, but no difference if given a £10 conditional voucher, compared with no incentive [120]. Irrespective of the financial incentive the more socially deprived participants were less likely to return the sample.

Linkage to care: Six publications assessed impact of home-based sampling on linkage to care. Five of the six publications that compared clinic-based sampling to home-based sampling also provided online information for management of cases, and found a lower proportion of chlamydia cases adequately treated who had home-

based sampling compared to clinic-based sampling, and a longer median time to treatment. One publication reported an intervention in the UK showing a higher proportion of treated cases among clinic-collected compared to home-collected samples (90% vs 60%, respectively) [140]. Another publication from the Netherlands reported marginally fewer chlamydia cases treated among those who had used a self-collected home-based sampling kit with the return by mail compared to clinic-based sampling (92% vs 100%, respectively) [135]. Furthermore, another publication reported an intervention among sexual health clinics attendees aged 16 years or more in the UK, and found a higher proportion of chlamydia or gonorrhoea cases treated among those who had home-collected samples compared to clinic-collected (88% vs 46%, p<0.007) [141].

Another publication reported an intervention among asymptomatic young people aged 18-25 years in Norway recruited to home-based sampling through letters, and found no difference in the proportion of syphilis cases treated between clinic-collected and home-collected samples (89% vs 85%, p>0.05) [136].

No publications reported on the impact of home-based sampling on *access to testing*.

Outreach recruitment to clinic-based testing

Eight publications assessed outreach recruitment to clinic-based testing [112,113,124-126,130,132,134]. Four publications assessed website or email-based patient recruitment interventions. Four publications assessed physical outreach activities. For example, one publication reported on a pamphlet or website based educational intervention among young people aged 15-24 years recruited from a youth centre and university in the United States, and found no difference in readiness for CT screening between website and pamphlet (67% vs 56%, respectively; p=0.46) [112]. Another publication reported on the 'Syphilis is Up' outreach intervention among MSM in the United States, and found an increase in proportion of users aware of outreach testing after versus before implementation (42% vs 28%) [113].

Another publication reported the results of an intervention comparing a static website to a dynamic website portal to access online services in Australia, including appointment booking, medication details, reminders, health record, and educational information, and found a higher proportion of patients testing for chlamydia in those randomised to the dynamic vs the static website (15.3% vs 7.7%, respectively; p=0.017) [125].

Three publications assessed physical outreach. One intervention in the US documented an increase of 83% in STI testing after a three-month 'Get Yourself Tested' campaign among sexually active young people aged 15-25 years, when testing was offered in mobile units versus 10% in LGBT community health centres [126]. A male-targeted intervention in the UK among football club attendees (18 years and older) identified a high uptake of urine-based STI screening (59%, 95%CI 35-79%) with small differences between the intervention arms: advocacy by the football team captain (50%), by health professional (67%) and control group, by STI screening promotion poster (61%) [130]. When syphilis testing was offered at home to male partners of pregnant women in the 'HOPE trial' in Western Kenya, 93% of men agreed to test during pregnancy and 98% agreed postpartum [134].

No studies investigating outreach recruitment reported on impact on linkage to care.

Community-based testing

Five publications assessed testing in outreach settings [114,126,127,139,142].

No publications investigating testing in outreach settings reported on impact on access to testing.

Testing coverage: One publication adapted an ongoing 'Get yourself tested' intervention among sexually active LGBT youth aged 15-25-years to be culturally relevant for black and Latino LGBT youth, and found a higher proportion of black and Latino LGBT youth testing for STIs (chlamydia, gonorrhoea, syphilis and HIV) after adaptation [126]. Furthermore, a publication from the UK compared nurse-delivered screening and self-sampled postal testing among MSM clients of a sex on premises venue to clinic-based testing in MSM, and found the outreach group less likely to have been previously tested (53.3% and 60% vs 93.3%, p ≤ 0.001). Uptake for chlamydia and gonorrhoea testing was similar across groups (86.6% nurse outreach, 10% postal kit vs 100% clinic) but uptake for blood testing was lower in the postal kit (nurse outreach 83.3%, postal kit 53.3% vs. clinic 100%, $p \leq 0.001$) [114].

In a third publication, an intervention implementing opt-out testing vs opt-in in a cohort of 18-35-year-old incarcerated females in the United States was associated with a 78% higher proportion of eligible patients tested for chlamydia and/or gonorrhoea (opt-out: 86%; opt-in: 8%) [127].

Linkage to care: Universal rapid syphilis testing of MSM attending non-clinical outreach settings (community-based organisations, bathhouses, mobile van, and pharmacy) in the United States, compared to a historical control group with RPR testing based on physician clinical judgement, found a substantial reduction in median time from testing to treatment, from 9 days to 1 day [142]. A study implementing universal chlamydia and gonorrhoea testing in 6th-12th grade students found no change in proportion of 'those requiring care' receiving appropriate antibiotic management (pre-intervention: 100%, post-intervention: 100%) [139].

Summary

Most of the publications in this section reported on testing coverage, some reported on linkage to care. The majority focused on testing for chlamydia and gonorrhoea, and most focused on young people or MSM. Of the 31 publications, 12 were RCTs [112,115,117-119,122,124,125,128,130,136]; however, only one of these RCTs was at low risk of bias (Table 2b, Annex 8). The rest of the studies were either observational epidemiological studies (e.g. cross-sectional or cohorts) or before/after designs. Publications from this section had a high number of studies that were high risk of bias. In addition, some studies showed divergent or inconclusive results.

The following interventions can be advantageous for STI testing in the community:

- Home-based sampling, leading to higher testing coverage;
- Personalised letter-based recruitment strategies;
- Online recruitment services (e-STI testing);
- Voucher reward systems;
- Outreach interventions focussing on specific issues (e.g, syphilis increase), or specific groups (e.g., males, LGBT youth, cultural groups); and
- Universal rapid testing in non-clinical outreach settings (community-based organisations, bathhouses, mobile van, and pharmacy) leading to reduction in time from testing to treatment.

The advantages of these interventions were not always confirmed in the literature e.g. there were examples in which home testing and online services led to no difference or lower testing coverage, or lower treatment rates; and where use of conditional vouchers at higher value led to no difference in the proportion returning samples.

Expert opinion

The Advisory Committee of experts in STIs gave their views regarding gaps in testing strategies, approaches or technologies not covered by the literature consulted for this review. Gaps were identified in relation to home based sampling (i.e., regulatory test kit legislation), novel testing technology studies with a comparator group and school based interventions. Insufficient published literature available in *M. genitalium* testing strategies and interventions was also identified as a gap. Subsequently, experts on intervention evaluations were interviewed in order to cover these gaps. Prof. Rosanna Peeling (LSHTM), Prof. Charlotte Gaydos (Johns Hopkins University School of Medicine), Prof. Chris Bonell (LSHTM) and Dr. Tania Crucitti (Institute for Tropical Medicine, Antwerp) kindly agreed to structured in-depth interviews on the key areas identified above.

School-based interventions

Expert interviews confirmed the limited evidence found meeting inclusion criteria in the area of school-based interventions for testing-coverage, which likely reflects a gap in the literature and not a failure of the literature review to identify eligible studies [143]. The interviewee identified a recently published protocol for a pilot cluster RCT, though based on the protocol, this study would not meet inclusion criteria, as outcomes do not meet our definitions for access-to-testing, testing-coverage, or linkage-to-care [144]. A key area for future research was identified in the role of school nurses in school-based sexual health interventions.

Home-based sampling

Expert interviews supported the systematic review findings that use of home-based sampling increased testing-coverage compared to clinic-based sampling interventions for chlamydia and gonorrhoea, particularly where home-based sampling was provided through direct provision of kits at clinics or by provision of access to an online service [145]. The interviewee supported the findings of the systematic review of a current gap in providing adequate linkage to care with home-based sampling, identifying evidence that e-services (including electronic prescription), may increase linkage to care compared to conventional home-based sampling [146]. The interviewee highlighted another key gap: the absence of quality assurance and regulatory approval for home-sampling kits, identifying a publication that confirms this lack of regulatory approval [147].

Novel testing technologies

Two of interviewed experts confirmed gaps in the literature retrieved reporting assessment of impact of technical advances on other outcomes of interest, including cost of testing to consumer and quality markers such as sensitivity and specificity of assays [148]. Experts interviewed contextualised mixed findings in impact on linkage to care with introduction of POC RST vs. RPR algorithms for syphilis diagnostics [81], identifying ongoing issues in many settings of using RST as a triage test, which requires confirmatory testing with RPR and limiting effective referral to case management in some settings [149]. Interviewees identified several ongoing gaps in testing

technologies for curable STIs, including the need for REASSURED criteria[1] [150], CT/NG POCT to overcome technical limitations, research around and implementation of regulation for marketing testing technologies, particularly in the context of home-based sampling, and clear assessment of the need for rapid testing platforms for *M. genitalium*.

[1] REASSURED: **R**eal-time connectivity, **E**ase of specimen collection, **A**ffordable, **S**ensitive, **S**pecific, **U**ser-friendly, **R**apid, **E**quipment-free, **D**elivered

Secondary objectives

Testing technologies used in these novel strategies and approaches

The testing technologies used in the publications were extracted. For the publications reporting from primary care settings, testing technologies to diagnose chlamydia and gonorrhoea included the GeneXpert (Cepheid, US), Cobas 4800 CT/NG (Roche Diagnostics), Abbott Multicollection Specimen Kits, GenProbe Aptima Combo 2 (Hologic, US), and Becton Dickinson ProbeTex Qx Amplified DNA [36,53,54,115]. In sexual health clinic settings, tests for chlamydia and gonorrhoea included Gen-Probe APTIMA Combo 2 and GeneXpert (Cepheid, US), and tests for syphilis included the Architect Syphilis TP Microparticle test (Abbott Laboratories, US) [5,57,64,135,141]. In antenatal care, POC tests for syphilis included Bioline Syphilis 3.0 (Standard Diagnostics Inc., Korea), Chembio Dual Path Platform (Chembio Diagnostics Systems, US), and Multiplo TP/HIV Antibody test (Medmira Inc., Canada) [82,83,85,87,90-92,96]. For trichomoniasis, the OSOM rapid POC test (Sekisui Diagnostics, US) was used [91], and for chlamydia and gonorrhoea, GeneXpert was used [99]. In emergency departments, tests for chlamydia or gonorrhoea included GeneXpert and APTIMA Combo 2 [102,103,105,108,111], and tests for trichomoniasis included wet mount, culture and OSOM rapid POC [101,106]. In community settings, Bioline Syphilis 3.0 was used, and RPR and TPPA were compared to an unspecified rapid POC test [134,142].

Impact on public health surveillance programmes

Very few papers address public health surveillance. Three papers reported STI cases through the Second Generation Surveillance System (SGSS) in the UK [54,55,137]. Three other publications stated that they would report cases to the government agencies [111,136,142]. No other surveillance considerations were addressed.

Quality assurance needs and risks

While there were many publications reporting on quality improvement as an intervention, few publications addressed quality assurance. Two studies stated that they used external proficiency tests [83,92], and one other publication mentioned quality control and assurance of POCTs, but did not provide more details [91].

Feasibility and acceptability

Of the 117 publications, 40 reported some measure of acceptability and feasibility. Categorised by setting, the following publications reported acceptability or feasibility: primary care settings 6/28 (21%) publications [43,45,53-55,115]; sexual health clinics 10/28 (36%) publications [5,56,60,63,64,69,74,79,80,135]; antenatal care 11/18 (61%) publications [82-85,88-91,96-98]; emergency departments and other hospital setting 2/11(18%) [100,111]; and community settings 11/31 (35%) publications [114,119,123,124,126,128,131,133,134,137,139]. Acceptability and feasibility were measured with a variety of methods including qualitative (focus group discussions and interviews), quantitative surveys and questionnaires, and uptake of services. The majority of studies reported good acceptability and feasibility of the strategies and approaches investigated.

Discussion

Primary objectives

This systematic review provides an evidence base for implementing testing strategies and approaches to increase testing access, testing coverage and linkage to care in populations at risk of STIs in the EU/EEA and elsewhere. This report goes beyond reporting on novel testing technologies to embrace a broader public health perspective that includes testing technologies, strategies and approaches to increasing testing and linkage to care. Importantly, publications included in this review must have been implemented in a population and had a comparison group. The resulting 117 papers meeting eligibility criteria represent a diverse group of interventions spanning different settings and focusing on different STIs and populations. However, within each setting, patterns do emerge: e.g. publications from primary care focus almost exclusively on chlamydia and testing coverage, while those in ANC focus on syphilis and linkage to care. Since infrastructures and policies differ between European countries, the results are presented according to the setting in which the strategy or approach was implemented to maximise the interpretability of the relevance of the results to the national or local situation.

Publications from primary care settings reported on interventions increasing testing coverage for chlamydia among young people and MSM. Interventions included quality improvement, such as trainings for healthcare workers and clinicians, implementation of sexual health nurses, changes in testing algorithms, changing to dual tests (e.g. chlamydia and gonorrhoea dual tests), and using electronic medical records for prompting reminders and for targeted interventions. The strongest evidence available was for the use of quality improvement interventions. There was very little evidence identified for increasing access to testing or linkage to care in primary care settings.

Publications from sexual health clinics reported on interventions that increased testing coverage and linkage to care for chlamydia, gonorrhoea and syphilis. Interventions included patient recruitment strategies involving outreach and media campaigns, healthcare worker reminders, provider education about testing policies, express testing, and use of point-of-care tests. Interventions that increased linkage to care included express testing and point-of-care tests. The strongest evidence supported the use of patient recruitment interventions, with both papers at low risk of bias supporting a positive impact on testing coverage. We found little evidence for increasing access to testing in sexual health clinics.

Publications from antenatal clinics reported on interventions that increased access to testing, testing coverage and linkage to care for syphilis testing. Use of rapid point-of-care syphilis testing was reported to increase testing coverage and linkage to care in two of three publications at low risk of bias. Provider training combined with point-of-care syphilis testing improved testing coverage and linkage to care. In contrast to other settings, almost all publications from antenatal clinics were conducted in low and middle-income countries. These findings may be of limited applicability in the EU/EEA due to successful antenatal screening policies that allowed the Member States to reach the WHO elimination targets for vertical transmission of HIV and syphilis [13]. Additional prevention efforts are needed for the remaining pockets of pregnant women not reached by the universal offer of antenatal testing and care and for whom vertical transmission is still documented [151,152].

In emergency departments and other hospital settings, an equal number of publications reported impact on testing coverage and linkage to care, and most focused on chlamydia and gonorrhoea testing among young people in emergency departments. Interventions that increased testing coverage included the use of electronic medical record reminders, and implementation policies for STI testing. Linkage to care was increased by the implementation of point-of-care tests (or near-point-of-care tests) for chlamydia, gonorrhoea and trichomoniasis. In an emergency department setting, the strongest evidence was for the use of electronic medical record and electronic tool-based interventions, with both publications at low risk of bias demonstrating increased testing coverage. In addition, the only paper at low risk of bias for linkage to care supported use of GeneXpert for chlamydia and gonorrhoea rather than laboratory-based NAAT testing.

Publications from community settings assessed testing coverage, and the majority focused on testing of chlamydia and gonorrhoea among young people or MSM. Successful interventions included home-based sampling combined with online outreach, counselling or financial incentives. However, there was very limited low risk of bias evidence available. There was only one paper at low risk of bias, which found an increase in testing coverage of home-based sampling. Several studies indicated that home-based sampling or testing compared to clinic-based sampling or testing reduced linkage to care.

Secondary objectives

The search was based on the primary objectives, but data were also extracted to address the secondary objectives. As a result, secondary data analyses were not comprehensive, and data quality is not assured.

Acceptability and feasibility of interventions were reported in one third of publications. The highest proportion was among interventions in antenatal care settings, followed by sexual health clinics and community settings.

Only one fifth of interventions in primary care and hospital settings reported these measures. Acceptability and feasibility are important indicators of effectiveness and sustainability, but there is a wide variety of measures for acceptability, with few studies using theoretical frameworks [153]. Notably, implementation studies should be considered when adapting interventions to new populations and settings. It is increasingly acknowledged that acceptability should be considered when designing, evaluating and implementing healthcare interventions. Using a theoretical framework may be useful for providing robust measures of acceptability.

Since the publication eligibility criteria required the strategy or approach to be implemented in a population, it is not surprising that where the diagnostic test was specified, all were existing commercially available assays and none were technologies in the pipeline. The future STI diagnostics landscape is exciting. Home-sampling and home-testing (with the distinction in terminology important to note) [154] for HIV is starting to be introduced in several European countries [155], and technological advances may mean home-testing for other STIs may be possible, such as for syphilis [156]. For chlamydia and gonorrhoea, NAAT-based rapid and POC tests have received European regulatory approval [157,158], overcoming the diagnostic accuracy concerns associated with lateral flow assays [159-161]. Novel approaches, such as the eSexual Health Clinic [137,162,163], have indicated how a POC test could be incorporated as part of a complex online clinical and public health intervention for the control of STIs. Further advances in POCT development enabling the detection of antibiotic susceptibility could revolutionise patient management by enabling appropriate treatment (including previously abandoned regimens) to be selected, and in turn reduce antimicrobial resistance (AMR) selection pressure. Laboratory-based assays that are able to detect gonorrhoea and *M. genitalium* infection as well as antibiotic susceptibility or resistance are now available [164,165], and AMR-POCTs are in development [166]. Other technologies, such as handheld whole genome sequencing [167], could also facilitate appropriate patient management based on antibiotic susceptibility, and potentially play a role in AMR surveillance.

With regards to these technologies and their implementation, it is important to consider the nuanced differences between a rapid test and a POC test. In this review, POC, or 'near-POC' tests were associated with increased linkage to care in sexual health clinics, antenatal clinics for syphilis, chlamydia, gonorrhoea and trichomoniasis. They were further associated with increased treatment coverage in sexual health clinics as well as in antenatal clinics for syphilis. POC tests can be defined as those where sample provision, testing, results and treatment are provided in one consultation [168]. In contrast, the WHO definition of a rapid test is one in which results are available within two hours of sample provision [169]. As a result, depending on the context in which the test is deployed, it may be rapid but not POC, or vice versa. This is important for policy-makers to bear in mind when considering which tests to implement, where, and how, as the impact may vary.

Impact is also dependent on test performance. Different assays have different performances, which further vary depending on the population tested [160,161,170,171]. We included publications regardless of reported test performance; it is important to fully review the diagnostic accuracy of any test before it is implemented into routine practice so that appropriate decisions are made based on the results, for example whether a confirmatory test is required following a positive test result. Other considerations that will be context-specific when implementing new technologies, strategies or approaches include quality assurance systems, and the acceptability and feasibility of the intervention.

The ability of individuals to purchase tests online raises an additional concern regarding diagnostic accuracy. There is currently little, if any, regulation of POC tests available for purchase on the internet, with the result that poorly performing tests continue to be freely marketed [147,172]. However, new EU IVD Regulations published in 2017 [173] with implementation required by 26 May 2022, include new risk classifications and requirements for significantly more performance and clinical evidence. This should help address some of the concerns regarding diagnostic test performance and their quality assurance, but not the availability of diagnostics that have not received regulatory approval available on the internet.

Very few publications addressed the impact on testing strategies and approaches on quality assurance and surveillance. The European Network for STI Surveillance provides annual reports on prevalence of chlamydia, gonorrhoea and syphilis, which are used by policy-makers and programmers to plan and implement targeted interventions. While strategies and approaches which include decentralised services in the community using POC tests will create opportunities for increased testing access and coverage, it will also create challenges for quality assurance and surveillance. Differing levels of training, subjectivity of reading lateral flow tests, and the potential for transcription error is a concern for results quality for POC tests. Quality assurance of POC testing and case management can help ensure test quality in decentralised settings and identify where remedial training is required [174]. Devices that interpret POC test results can remove the human subjectivity of reading results and reduce transcription error by automated transmission of testing results to a central database for disease surveillance [175].

Gaps in the evidence

Our search did not identify any publications investigating the impact of *M. genitalium* infection testing on testing coverage, and identified only four publications on trichomoniasis. This may be related to the European guidelines [176] not recommending laboratory testing of *M. genitalium* infection in the absence of symptoms or high-risk behaviour, i.e. screening of asymptomatic individuals is not recommended. Testing of trichomoniasis is recommended if it is prevalent in the local population (>2% in symptomatic women) [177]. Neither infection is under routine surveillance in the EU/EEA. Testing for *M. genitalium* is relatively recent relative to testing for the other STIs included in this report, with few assays available. It is likely that as *M. genitalium* testing becomes more commonplace, the body of evidence to increase access to testing, testing coverage and linkage to care for this infection will also increase. While there is high prevalence of trichomoniasis in particular population groups worldwide, and several papers report an association with HIV acquisition and poor reproductive outcomes, consistent data are still lacking regarding severity of infection, preventability of associated adverse events, and costs [178].

There were no publications on STI education interventions, especially of school-aged young people. The need for more health education in schools has been noted by others [179]. This is an important gap to address, because without adequate education regarding STIs, individuals are unaware of their risks and the options available for testing and management. Furthermore, the review found no evidence to support specific services for other populations we had initially considered would be at-risk, such as sex workers, prisoners, migrants, refugees, people who inject drugs, or pre-exposure prophylaxis users. It is also notable that there were few studies measuring impact on access to care, which would be crucial to evaluation in these at-risk populations. Further work enabling impact of interventions in these populations to be assessed is required to ensure that these populations are being adequately supported.

Interestingly, despite an increase in home-based sampling and testing for STIs, there was very little evidence to support this approach in our review. A limited number of systematic reviews exist that have addressed this question specifically, finding evidence to support testing uptake through home-based versus clinic-based sample collection [180,181], but with a lower proportion of positive tests [182]. As these approaches become more commonplace, additional impact studies and systematic reviews addressing their (cost)-effectiveness would be worthwhile.

Conversely, for syphilis, traditional centralised testing has given way to effective and highly accepted novel approaches for testing using POC tests in outreach antenatal services in low- and middle-income countries, especially when linked to routine HIV testing in pregnancy. Whether these strategies will be successful in Europe remain to be explored. It is notable, however, that there are no impact studies investigating this in a European setting. A recent increase in reported cases of congenital syphilis in the UK, where very high syphilis testing coverage in pregnancy has been consistently achieved, highlighted gaps in the timely detection of infections in vulnerable pregnant women and hard-to-reach populations [183]. Effective testing and linkage to care strategies to close these gaps likely require implementation of a comprehensive syphilis prevention programme in women of reproductive age [184]. While there is consensus that the introduction of testing algorithms using rapid POC tests is not cost-effective in Europe due to the very high testing coverage by ANC services [151] and the risk of using low accuracy tests in low prevalence populations, the studies in African settings indicate that it would be feasible to use syphilis POC tests for targeted screening by adapting these outreach methods in at-risk and mobile pregnant women populations in high- and middle-income European countries. Timely syphilis case management in these women and their partners, and the use of syphilis POC tests linked to effective sampling strategies, will offer a strategy for modifying transmission risks and likely averting incident cases of congenital syphilis, as shown in LMIC [185]. Devising and adapting the logistical aspects of training, quality assurance and data transfer are challenges that need to be addressed.

The search strategy did not include costs or cost-effectiveness, as this was beyond the scope of the review's remit. Thus, rather than being a gap, reviewing the cost-effectiveness of the strategies with the strongest evidence-base would be an important next-step following this review. A list of the cost price of commercially available assays, as has been done in England for carbapenemase-producing Gram-negative detection assays [186], would enable decision-makers to combine the impact evidence synthesis with test cost, to make an informed choice.

Strengths and limitations

The strengths of this review are that it is based on an in-depth and well-defined search strategy, which was applied to a comprehensive set of databases. Input from European experts in the field of STIs (i.e. the Advisory Committee) ensured that the appropriate research questions, objectives, search strategy and eligibility criteria were used. Primary peer-reviewed journal publications as well as conference abstracts from 2012 onward were included to provide data on the most recent strategies and approaches, and to avoid overlap with a previous ECDC report on novel testing technologies. Another strength of the review was that a comparison was required in order to measure impact, thus improving the quality of the evidence. Although the ultimate goal of the review

is to inform policy-makers in the EU/EEA countries, there was no limitation on populations so that the EU/EEA may benefit from interventions used in a wide variety of settings and populations.

However, there were limitations. The search was based on the primary research question, thus data on testing technologies, quality assurance, surveillance and acceptability and feasibility are incomplete and of uncertain quality. We mitigated this limitation by inclusion of the Advisory Committee and identifying relevant published systematic reviews. In addition, due to the review's wide remit, there was a large amount of heterogeneity in the papers included, not only in terms of organisms, approaches, and outcomes, but also in the presentation of the data. For example, for access to testing, multiple different barriers were presented, ranging from factors such as median time in clinic to psycho-sociological barriers such as perceived difficulty of self-sampling. For testing coverage, a wide range of denominators were presented, such as total number of individuals attending a clinic, and the total population in a local authority. For linkage to care, different time intervals were presented, including time from positive test result or testing date, to treatment or referral for treatment. Due to the heterogeneity of data extracted, it was not possible to conduct a meta-analysis. Instead, we performed a narrative synthesis from which a number of patterns emerged.

It is likely that the requirement for a comparator meant that many publications reporting on innovative interventions and programmes to increase STI testing and linkage to care were not included. For example, a recent scoping review of syphilis testing interventions [187] identified a number of strategies, particularly among MSM, which were not identified in this systematic literature review. The inclusion of conference abstracts, the purpose of which was to capture strategies and approaches not published as full articles, presented an additional limitation: the quality of the studies and their methodologies were hard to assess, potentially affecting the quality of evidence included. We attempted to mitigate this through use of risk of bias assessment tools adapted from existing validated tools: the Cochrane risk of bias tool for RCTs [26], and the ROBINS-I tool for non-randomised studies of interventions [27]. Nevertheless, a high number of publications, 56, were judged to be of indeterminate bias, and all 30 included conference abstracts had insufficient detail to allow assessment of risk of bias. It is also worth noting that 40 of the included publications (23 full articles, 15 conference abstracts and two letters) did not report p-values to enable the strength of the evidence for a statistical difference between arms to be determined. Reporting of p-values was not a criterion in the risk of bias tool, and as such was not considered in the strength of evidence statements.

Conclusions and potential implications

This systematic literature review provides evidence for interventions that can increase access to testing, testing coverage and linkage to care among those most at-risk for STIs in five settings. In each setting, the evidence for innovative strategies and approaches is reviewed. There is evidence for increasing testing coverage for young people and MSM, especially for chlamydia, but also for gonorrhoea and syphilis among MSM. More studies are needed to evaluate the potential impact of POC testing in antenatal care in the EU/EEA countries among remaining cases of congenital syphilis. Nevertheless, all strategies and approaches must be piloted in new populations and settings to assess acceptability, feasibility and (cost-)effectiveness. More research is needed to define strategies and approaches for testing trichomoniasis and *M. genitalium* infection, as well for hard-to-reach populations most at-risk for STIs, such as sex workers, prisoners, migrants, refugees, people who inject drugs, and pre-exposure prophylaxis users. Furthermore, the implications on reporting for surveillance purposes, and quality assurance considerations, must be addressed for all interventions. A critical next step is to assess cost-effectiveness of the most effective interventions. The overall poor level of evidence indicates that more robust evaluations are needed to better assess the impact of different STI testing strategies on access to testing, testing coverage and linkage to care. The review provides a direction for researchers and programmers seeking to improve STI testing services among key populations at high risk for STIs. Outcomes of this systematic review can inform policy-makers, national and international programme coordinators, public health and clinical experts, and civil society organisations involved in STI prevention and control in EU/EEA countries, and elsewhere.

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Annex 1. Advisory Committee

Dr Tania Crucitti (Institute of Tropical Medicine, Antwerp, Belgium): Part of the ECDC STI Expert Committee, her areas of expertise are in *T. vaginalis*, bacterial vaginosis (disbiosis), HPV, HIV and STI diagnostics. She has also worked extensively in the area of HIV and STI co-infections, and has a special interest in the diagnostics and characterisation of syphilis infections. She brings the global and public health perspective to the team.

Dr Colin Brown (PHE, London, UK): Consultant in Infectious Diseases & Medical Microbiology at PHE, London, UK, and Honorary Consultant in Infectious Diseases & Medical Microbiology at the Royal Free London NHS Foundation Trust. He provides clinical infectious disease and microbiological input into different infectious diseases, and helps develop global health capacity in PHE's National Infection Service.

Dr Silvia de Sanjosé (Program for Appropriate Technology in Health (PATH), Seattle, US): An expert in HPV, and has participated in numerous studies involving evaluation of interventions for control of HPV, including diagnostics and cancer-associated infectious diseases.

Dr Kevin Dunbar (PHE, London, UK): Consultant in Public Health and the Director of England's National Chlamydia Screening Programme (NCSP), based at PHE, London, UK. His expertise lies in the delivery and evaluation of public health programmes.

Jane Falconer (LSHTM, London, UK): Leads LSHTM's Library User Support & Information Services Team. She has expertise in providing literature searching support for systematic reviews and has contributed to a number of projects.

Dr Steen Hoffmann (SSI, Copenhagen, Denmark): Section Manager and specialist in the Neisseria and Streptococcus Reference Laboratory, Department of Microbiology and Infection Control, Statens Serum Institut, Copenhagen, Denmark. He conducts laboratory monitoring of STIs (gonorrhoea, syphilis, chlamydia) as well as phenotypic and genotypic characterisation and resistance determination.

Dr Jørgen Skov Jensen (SSI, Copenhagen, Denmark): Chief Consultant Physician at the Department of Bacteriology, Mycology and Parasitology, Statens Serum Institut, Copenhagen, Denmark. He has achieved global recognition for his work on characterisation, diagnostics and research on *Mycoplasma genitalium* AMR and has contributed to treatment guidelines in Europe. Dr Jensen also has expertise in the epidemiology of syphilis and his work in clinical microbiology extends to the study of the vaginal microbiome and susceptibility to other STIs.

Prof David Mabey (LSHTM, London, UK): Professor of Communicable Diseases at LSHTM, London, UK. His particular research areas are infections of *C. trachomatis* (ocular and genital) and syphilis, and the development and evaluation of new point-of-care diagnostics for infectious diseases. He helped establish the International Diagnostics Centre (IDC) along with Professor Rosanna Peeling.

Dr Anthony Nardone (Epiconcept, Paris, France): Expertise primarily in HIV prevention, promotion of HIV testing, monitoring sexual behaviour and the evaluation of sexual health interventions and public health programmes. He brings significant experience and expertise on reaching at-risk, vulnerable and hard-to-reach populations.

Prof Rosanna Peeling (LSHTM, London, UK): Professor and the Chair of Diagnostics Research at LSHTM, London, UK, and Director of the International Diagnostics Centre (IDC), and previous Head of Diagnostics Research for the WHO/TDR Programme. Professor Peeling has extensive experience evaluating and implementing STI novel technologies to increase access to quality-assured diagnostics, especially in resource-poor settings. She has particular expertise in POCTs for syphilis, especially for preventing mother-to-child transmission, and for accelerating regulatory approval.

Dr Magnus Unemo (WHO Collaborating Centre for Gonorrhoea and other STIs, Orebro, Sweden): Director of the WHO Collaborating Centre for Gonorrhoea and other STIs and Swedish Reference Laboratory for Pathogenic Neisseria, Örebro University Hospital, Sweden. He is an expert in the characterisation of antimicrobial resistance in *Neisseria gonorrhoeae* and is involved with capacity development efforts to improve quality of diagnostics and AMR testing for STIs, especially in the development and application of POCTs for AMR testing.

Annex 2. List of EU/EEA countries (2018)

EU

Austria

Belgium

Bulgaria

Croatia

Republic of Cyprus

Czechia

Denmark

Estonia

Finland

France

Germany

Greece

Hungary

Ireland

Italy

Latvia

Lithuania

Luxembourg

Malta

The Netherlands

Poland

Portugal

Romania

Slovakia

Slovenia

Spain

Sweden

The United Kingdom (UK)

EEA

Iceland

Liechtenstein

Norway

Annex 3. Search strategy and results

Ovid MEDLINE(R) and Epub Ahead of Print, In-Process & Other Non-Indexed Citations, Daily and Versions(R) 1946 to November 28, 2018.

#	Searches	Results
1	chlamydia/	2 806
2	Chlamydia trachomatis/	11 475
3	exp Chlamydia infections/	20 129
4	Lymphogranuloma venereum.ti,ab.	1 062
5	Chlamydia trachomatis.ti,ab.	12 537
6	Chlamydia infect*.ti,ab.	1 816
7	Lgv.ti,ab.	543
8	or/1-7 [CHLAMYDIA]	26 858
9	Gonorrh*.ti,ab.	18 297
10	exp gonorrhea/	13 812
11	Neisseria gonorrhoeae.ti,ab.	9 116
12	Gonococc*.ti,ab.	7 563
13	or/9-12 [GONOCOCCI]	24 651
14	Syphilis.ti,ab.	23 524
15	exp syphilis/	26 723
16	treponema pallidum/	3 791
17	Treponema pallidum.ti,ab.	3 952
18	Chancre.ti,ab.	450
19	Condylomata lata.ti,ab.	46
20	or/14-18 [SYPHILLIS]	36 380
21	Trichomonas/	1 730
22	Trichomonas vaginalis/	3 422
23	exp Trichomonas Infections/	5 970
24	Trichomonas vaginalis.ti,ab.	4 431
25	Trichomonas Infections*.ti,ab.	100
26	Trichomoniasis*.ti,ab.	2 936
27	or/21-26 [TRICHOMONIASIS]	9 962
28	exp Mycoplasma genitalium/	597
29	Mycoplasma genitalium.ti,ab.	1 155
30	or/28-29 [M GENT]	1 225
31	8 or 13 or 20 or 27 or 30 [ALL STIs]	87 643
32	diagnos*.ti,ab.	2 215 209
33	diagnosis, computer-assisted/ or 'diagnostic techniques and procedures'/ or diagnostic self evaluation/ or diagnostic tests, routine/ or 'direct-to-consumer screening and testing'/ or mass screening/ or symptom assessment/	134 830
34	exp 'Clinical Decision-Making'/	4 494
35	((detect* or deliver* or screen*) adj5 (tests or test or testing or tested or tool* or technique* or method* or technolog* or advance* or assay* or device*)).ti,ab.	472 878
36	or/32-35 [DIAGNOSIS]	2 668 789
37	(sample adj1 collect*).ti,ab.	9 672

38	((Home* or self* or mail*) adj3 (collection* or sampl* or specimen* or test* or kit)).ti,ab.	16 860
39	or/37-38 [SAMPLING]	26 380
40	(near adj5 (patients or patient)).ti,ab.	6 866
41	point of care.ti,ab.	15 419
42	Point of Care Systems/	11 139
43	(rapid adj1 test*).ti,ab.	5 015
44	(real adj1 time).ti,ab.	219 574
45	or/40-44 [POCT or RDT]	250 299
46	exp telemedicine/	23 846
47	ccbt.ti,ab.	144
48	(ehealth or e-health or electronic health*).ti,ab.	15 408
49	(etherap* or e-therap* or electronic therap*).ti,ab.	429
50	(eportal or e-portal or electronic portal).ti,ab.	1 014
51	telehealth*.ti,ab.	3 160
52	telemed*.ti,ab.	9 117
53	telemonitor*.ti,ab.	1 250
54	telepsych*.ti,ab.	524
55	teletherap*.ti,ab.	1 312
56	icbt.ti,ab.	543
57	(mhealth or m-health).ti,ab.	2 170
58	or/46-57 [GENERAL E-HEALTH]	45 604
59	cell phone/	7 545
60	wireless technology/	2 911
61	exp microcomputers/	19 739
62	cellphone.ti,ab.	190
63	computer*.ti,ab.	278 352
64	(ipad or i-pad).ti,ab.	1 049
65	(iphone or i-phone).ti,ab.	646
66	(ipod or i-pod).ti,ab.	287
67	mobile*.ti,ab.	85 286
68	phone*.ti,ab.	31 264
69	smartphone.ti,ab.	5 617
70	technolog*.ti,ab.	398 219
71	telephon*.ti,ab.	54 735
72	wifi.ti,ab.	291
73	wireless.ti,ab.	11 307
74	or/59-73 [HARDWARE]	823 340
75	electronic mail/	2 469
76	text messaging/	2 066
77	exp videoconferencing/	1 583
78	exp internet/	70 976
79	mobile applications/	3 571
80	virtual reality/	567
81	android.ti,ab.	1 919
82	(app or apps).ti,ab.	22 368

83	blog*.ti,ab.	1 555
84	cyber*.ti,ab.	5 657
85	(email* or e-mail*).ti,ab.	13 656
86	facebook.ti,ab.	2 555
87	instagram.ti,ab.	227
88	instant messag*.ti,ab.	252
89	internet*.ti,ab.	44 142
90	media-based.ti,ab.	798
91	media-deliver*.ti,ab.	51
92	messag* service?.ti,ab.	1 061
93	(multimedia or multi-media).ti,ab.	4 829
94	new-media.ti,ab.	625
95	(online* or on-line*).ti,ab.	116 235
96	podcast*.ti,ab.	627
97	reddit.ti,ab.	59
98	social network* site*.ti,ab.	957
99	sms.ti,ab.	4 962
100	snapchat.ti,ab.	32
101	social-medi*.ti,ab.	9 466
102	software.ti,ab.	140 358
103	telecomm*.ti,ab.	3 904
104	text messag*.ti,ab.	3 070
105	texting.ti,ab.	683
106	twitter.ti,ab.	2 138
107	video-based.ti,ab.	1 920
108	virtual*.ti,ab.	114 681
109	vlog*.ti,ab.	29
110	web*.ti,ab.	127 325
111	www.ti,ab.	1 453
112	youtube.ti,ab.	1 314
113	or/75-112 [SOFTWARE OR MEDIA]	571 356
114	58 or 74 or 113 [ALL E-HEALTH]	1 322 069
115	mass screening.ti,ab.	4 758
116	incentiv*.ti,ab.	27 242
117	Triage/	10 391
118	outreach.ti,ab.	11 768
119	crowdsourc*.ti,ab.	857
120	or/115-119 [OTHER STRATEGIES]	54 728
121	((strateg* or approach*) adj3 (collection* or sampl* or specimen* or test* or kit)).ti,ab.	35 711
122	36 or 39 or 45 or 114 or 120 or 121 [ALL STRATEGIES & APPROACHES]	4 030 221
123	31 and 122 [ALL STIs & STRATEGIES/APPROACHES]	20 485
124	limit 123 to yr='2012-Current'	5 373

Embase 1980 to 2018 Week 48		
#	**Searches**	**Results**
1	Chlamydia/	6 642
2	Chlamydia trachomatis/	17 461
3	exp chlamydiasis/	18 725
4	lymphogranuloma venereum.ti,ab.	902
5	chlamydia trachomatis.ti,ab.	14 925
6	Chlamydia infect*.ti,ab.	2 209
7	Lgv.ti,ab.	716
8	or/1-7 [CHLAMYDIA]	34 421
9	Gonorrhea.ti,ab.	5 476
10	exp gonorrhea/	13 967
11	Neisseria gonorrhoeae.ti,ab.	9 351
12	Gonococc*.ti,ab.	6 370
13	or/9-12 [GONORRHOEA]	22 688
14	Syphilis.ti,ab.	19 198
15	exp syphilis/	20 415
16	Treponema Pallidum/	5 003
17	Treponema pallidum.ti,ab.	3 775
18	Chancre.ti,ab.	337
19	Condylomata lata.ti,ab.	51
20	or/14-18 [SYPHILIS]	27 606
21	Trichomonas/	1 129
22	Trichomonas vaginalis/	5 138
23	exp trichomoniasis/	3 979
24	Trichomonas vaginalis.ti,ab.	4 345
25	Trichomoniasis*.ti,ab.	2 347
26	or/21-25 [TRICHOMONIASIS]	9 134
27	exp Mycoplasma genitalium/	1 723
28	Mycoplasma genitalium.ti,ab.	1 455
29	27 or 28 [MYCOPLASMA]	1 972
30	8 or 13 or 20 or 26 or 29 [ALL STIs]	76 959
31	Diagnos*.ti,ab.	2 989 383
32	computer assisted diagnosis/ or laboratory diagnosis/ or symptom assessment/	81 094
33	exp clinical decision-making/	37 565
34	((detect* or deliver* or screen*) adj5 (tests or test or testing or tested or tool* or technique* or method* or technolog* or advance* or assay* or device*)).ti,ab.	632 268
35	or/31-34 [DIAGNOSIS]	3 543 302
36	(sample adj1 collect*).ti,ab.	13 638
37	((Home* or self* or mail*) adj3 (collection* or sampl* or specimen* or test* or kit)).ti,ab.	22 095
38	36 or 37 [SAMPLING]	35 513
39	(near adj5 (patients or patient)).ti,ab.	10 246

40	point of care.ti,ab.	21 776
41	Point of care testing/	10 769
42	(rapid adj1 test*).ti,ab.	6 707
43	(real adj1 time).ti,ab.	300 175
44	or/39-43 [POCT or RDT]	340 230
45	exp telemedicine/	32 845
46	Ccbt.ti,ab.	191
47	ehealth*.ti,ab.	2 103
48	e-health*.ti,ab.	2 494
49	electronic health*.ti,ab.	16 761
50	etherap*.ti,ab.	9
51	e-therap*.ti,ab.	470
52	electronic therap*.ti,ab.	19
53	eportal.ti,ab.	4
54	e-portal.ti,ab.	15
55	electronic-portal*.ti,ab.	1 498
56	telehealth*.ti,ab.	3 884
57	telemed*.ti,ab.	12 192
58	telemonitor*.ti,ab.	1 868
59	telepsych*.ti,ab.	651
60	teletherap*.ti,ab.	880
61	icbt*.ti,ab.	766
62	mhealth*.ti,ab.	1 834
63	or/45-62 [GENERAL E-HEALTH]	61 325
64	Mobile phone/ or smartphone/	20 918
65	exp Wireless communication/	4 323
66	exp microcomputers/	14 504
67	cellphone*.ti,ab.	395
68	computer*.ti,ab.	322 017
69	(ipad or i-pad).ti,ab.	2 137
70	(iphone or i-phone).ti,ab.	1 281
71	(ipod or i-pod).ti,ab.	515
72	mobile*.ti,ab.	110 735
73	phone*.ti,ab.	45 893
74	smartphone*.ti,ab.	9 117
75	technolog*.ti,ab.	519 568
76	telephon*.ti,ab.	75 073
77	wifi*.ti,ab.	411
78	wireless*.ti,ab.	13 546
79	or/64-77 [HARDWARE]	1 031 129
80	e-mail/	17 688
81	text messaging/	3 705
82	exp videoconferencing/ or exp telecommunication/	60 553
83	exp internet/	100 103
84	mobile application/	7 031

85	virtual reality/	13 891
86	android*.ti,ab.	3 091
87	(app or apps).ti,ab.	29 949
88	blog*.ti,ab.	2 351
89	cyber*.ti,ab.	7 169
90	(email or e-mail).ti,ab.	22 158
91	facebook.ti,ab.	3 972
92	instagram.ti,ab.	305
93	instant messag*.ti,ab.	321
94	internet*.ti,ab.	59 282
95	media-based.ti,ab.	898
96	media-deliver*.ti,ab.	67
97	messag* service.ti,ab.	1 105
98	(multimedia or multi-media).ti,ab.	7 018
99	new-media.ti,ab.	765
100	(online* or on-line*).ti,ab.	159 868
101	podcast*.ti,ab.	1 032
102	reddit.ti,ab.	73
103	social network* site*.ti,ab.	1 192
104	sms.ti,ab.	6 585
105	snapchat.ti,ab.	57
106	social-medi*.ti,ab.	11 517
107	software.ti,ab.	234 185
108	telecomm*.ti,ab.	3 574
109	text messag*.ti,ab.	3 980
110	texting.ti,ab.	908
111	twitter.ti,ab.	2 952
112	video-based.ti,ab.	2 595
113	virtual*.ti,ab.	133 805
114	vlog*.ti,ab.	24
115	web*.ti,ab.	159 889
116	www.ti,ab.	2 618
117	youtube.ti,ab.	1 759
118	or/80-117 [SOFTWARE OR MEDIA]	834 013
119	63 or 79 or 118 [ALL E-HEALTH]	1 734 458
120	mass-screening*.ti,ab.	4 992
121	incentive*.ti,ab.	30 599
122	triage.ti,ab.	22 459
123	outreach.ti,ab.	16 088
124	crowdsourc*.ti,ab.	869
125	or/120-124 [OTHER STRATEGIES]	74 547
126	((strateg* or approach*) adj3 (collection* or sampl* or specimen* or test* or kit)).ti,ab.	44 209
127	35 or 38 or 44 or 119 or 125 or 126 [ALL STRATEGIES & APPROACHES]	5 280 546

128	30 and 127 [ALL STIs & STRATEGIES/APPROACHES]	25 374
129	limit 128 to yr='2012 -Current'	10 435

Global Health 1910 to 2018 Week 46		
#	**Searches**	**Results**
1	Chlamydia/	11 376
2	Chlamydia trachomatis/	8 778
3	lymphogranuloma venereum.ti,ab.	813
4	chlamydia trachomatis.ti,ab.	5 718
5	Chlamydia infection*.ti,ab.	744
6	Lgv.ti,ab.	280
7	or/1-6 [CHLAMYDIA]	12 233
8	Gonorrhea.ti,ab.	2 090
9	exp gonorrhoea/ or exp neisseria gonorrhoeae/	9 631
10	Neisseria gonorrhoeae.ti,ab.	4 306
11	Gonococc*.ti,ab.	4 457
12	or/8-11 [GONOCOCCI]	11 613
13	Syphilis.ti,ab.	16 178
14	exp syphilis/	16 132
15	Treponema Pallidum/	16 081
16	Treponema pallidum.ti,ab.	2 477
17	Chancre.ti,ab.	517
18	Condylomata lata.ti,ab.	14
19	or/13-17 [SYPHILIS]	18 735
20	Trichomonas/	6 537
21	exp Trichomonas vaginalis/	4 752
22	exp trichomoniasis/	3 600
23	Trichomonas vaginalis.ti,ab.	4 437
24	Trichomoniasis*.ti,ab.	2 168
25	or/20-24 [TRICHOMONIASIS]	6 851
26	exp Mycoplasma genitalium/	657
27	Mycoplasma genitalium.ti,ab.	621
28	26 or 27 [MYCOPLASMA]	680
29	7 or 12 or 19 or 25 or 28 [ALL STIs]	41 238
30	Diagnos*.ti,ab.	330 505
31	early diagnosis/ or laboratory diagnosis/	7 884
32	((detect* or deliver* or screen*) adj5 (tests or test or testing or tested or tool* or technique* or method* or technolog* or advance* or assay* or device*)).ti,ab.	119 447
33	or/30-32 [DIAGNOSIS]	423 136
34	(sample adj1 collect*).ti,ab.	2 769
35	((Home* or self* or mail*) adj3 (collection* or sampl* or specimen* or test* or kit)).ti,ab.	4 490
36	34 or 35 [SAMPLING]	7 179
37	(near adj5 (patients or patient)).ti,ab.	830

38	point of care.ti,ab.	2 567
39	(rapid adj1 test*).ti,ab.	3 016
40	(real adj1 time).ti,ab.	36 657
41	or/37-40 [POCT or RDT]	42 472
42	exp telemedicine/	994
43	ccbt.ti,ab.	3
44	(ehealth or e-health or electronic health*).ti,ab.	1 643
45	(etherap* or e-therap* or electronic therap*).ti,ab.	104
46	(eportal or e-portal or electronic portal).ti,ab.	5
47	telehealth*.ti,ab.	298
48	telemed*.ti,ab.	660
49	telemonitor*.ti,ab.	44
50	telepsych*.ti,ab.	36
51	teletherap*.ti,ab.	19
52	icbt.ti,ab.	5
53	(mhealth or m-health).ti,ab.	437
54	or/42-53 [GENERAL E-HEALTH]	3 358
55	mobile telephones/	1 938
56	exp microcomputers/	56
57	cellphone.ti,ab.	49
58	computer*.ti,ab.	19 703
59	(ipad or i-pad).ti,ab.	97
60	(iphone or i-phone).ti,ab.	35
61	(ipod or i-pod).ti,ab.	24
62	mobile*.ti,ab.	17 357
63	phone*.ti,ab.	4 463
64	smartphone.ti,ab.	573
65	technolog*.ti,ab.	64 888
66	telephon*.ti,ab.	11 001
67	wifi.ti,ab.	21
68	wireless.ti,ab.	516
69	or/55-68 [HARDWARE]	111 868
70	exp internet/	7 347
71	android.ti,ab.	429
72	(app or apps).ti,ab.	1 477
73	blog*.ti,ab.	196
74	cyber*.ti,ab.	381
75	(email* or e-mail*).ti,ab.	1 809
76	facebook.ti,ab.	435
77	instagram.ti,ab.	31
78	instant messag*.ti,ab.	29
79	internet*.ti,ab.	7 836
80	media-based.ti,ab.	186
81	media-deliver*.ti,ab.	7

82	messag* service.ti,ab.	263
83	(multimedia or multi-media).ti,ab.	689
84	new-media.ti,ab.	203
85	(online* or on-line*).ti,ab.	15 163
86	podcast*.ti,ab.	35
87	reddit.ti,ab.	6
88	social network* site*.ti,ab.	150
89	sms.ti,ab.	819
90	snapchat.ti,ab.	4
91	social-medi*.ti,ab.	1 722
92	software.ti,ab.	23 517
93	telecomm*.ti,ab.	310
94	text messag*.ti,ab.	848
95	texting.ti,ab.	133
96	twitter.ti,ab.	283
97	video-based.ti,ab.	117
98	virtual*.ti,ab.	11 408
99	vlog*.ti,ab.	2
100	web*.ti,ab.	19 233
101	www.ti,ab.	72
102	youtube.ti,ab.	120
103	or/70-102 [SOFTWARE OR MEDIA]	77 572
104	54 or 69 or 103 [ALL E-HEALTH]	181 250
105	mass screening.ti,ab.	898
106	incentiv*.ti,ab.	6 241
107	outreach.ti,ab.	3 547
108	crowdsourc*.ti,ab.	84
109	or/105-108 [OTHER STRATEGIES]	10 693
110	((strateg* or approach*) adj3 (collection* or sampl* or specimen* or test* or kit)).ti,ab.	6101
111	33 or 36 or 41 or 104 or 109 or 110 [ALL STRATEGIES & APPROACHES]	619 647
112	29 and 111 [ALL STIs & STRATEGIES/APPROACHES]	13 033
113	limit 112 to yr=‘2012-Current’	3 525

PsycINFO 1806 to November Week 4 2018		
#	**Searches**	**Results**
1	Lymphogranuloma venereum.ti,ab.	10
2	Chlamydia trachomatis.ti,ab.	255
3	Chlamydia infect*.ti,ab.	85
4	Lgv.ti,ab.	10
5	or/1-4 [CHLAMYDIA]	323
6	Gonorrhea.ti,ab.	479
7	exp gonorrhea/	159
8	Neisseria gonorrhoeae.ti,ab.	143
9	Gonococc*.ti,ab.	56
10	or/6-9 [GONORRHOEA]	645
11	Syphilis.ti,ab.	1 589
12	exp SYPHILIS/	574
13	Treponema pallidum.ti,ab.	74
14	Chancre.ti,ab.	7
15	Condylomata lata.ti,ab.	0
16	or/11-15 [SYPHILIS]	1 712
17	Trichomonas vaginalis.ti,ab.	72
18	Trichomonas Infections*.ti,ab.	1
19	Trichomoniasis*.ti,ab.	80
20	or/17-19 [TRICHOMONIASIS]	144
21	Mycoplasma genitalium.ti,ab.	18
22	21 [MYCOPLASMA]	18
23	5 or 10 or 12 or 16 or 20 or 22 [ALL STIs]	2 358
24	diagnos*.ti,ab.	290 574
25	computer assisted diagnosis/	1 541
26	((detect* or deliver* or screen*) adj5 (tests or test or testing or tested or tool* or technique* or method* or technolog* or advance* or assay* or device*)).ti,ab.	37 897
27	or/24-26 [DIAGNOSIS]	322 136
28	(sample adj1 collect*).ti,ab.	522
29	((Home* or self* or mail*) adj3 (collection* or sampl* or specimen* or test* or kit)).ti,ab.	11 369
30	or/28-29 [SAMPLING]	11 873
31	(near adj5 (patients or patient)).ti,ab.	562
32	point of care.ti,ab.	560
33	(rapid adj1 test*).ti,ab.	253
34	(real adj1 time).ti,ab.	12 395
35	or/31-34 [POCT or RDT]	13 733
36	exp TELEMEDICINE/	4 579
37	ccbt.ti,ab.	157
38	(ehealth or e-health or electronic health*).ti,ab.	2 499
39	(etherap* or e-therap* or electronic therap*).ti,ab.	171
40	(eportal or e-portal or electronic portal).ti,ab.	7

41	telehealth*.ti,ab.	1 102
42	telemed*.ti,ab.	1 382
43	telemonitor*.ti,ab.	148
44	telepsych*.ti,ab.	527
45	teletherap*.ti,ab.	56
46	icbt.ti,ab.	309
47	(mhealth or m-health).ti,ab.	473
48	or/37-47 [GENERAL E-HEALTH]	6 210
49	exp cellular phones/	4 145
50	exp MICROCOMPUTERS/	1 244
51	cellphone.ti,ab.	89
52	computer*.ti,ab.	84 881
53	(ipad or i-pad).ti,ab.	715
54	(iphone or i-phone).ti,ab.	248
55	(ipod or i-pod).ti,ab.	247
56	mobile*.ti,ab.	13 957
57	phone*.ti,ab.	24 464
58	smartphone.ti,ab.	1 785
59	technolog*.ti,ab.	98 764
60	telephon*.ti,ab.	23 065
61	wifi.ti,ab.	55
62	wireless.ti,ab.	1 454
63	or/51-62 [HARDWARE]	219 806
64	exp Computer Mediated Communication/	6 629
65	exp TEXT MESSAGING/	696
66	exp Teleconferencing/	858
67	exp INTERNET/	28 122
68	exp Virtual Reality/	7 330
69	android.ti,ab.	353
70	(app or apps).ti,ab.	5 561
71	blog*.ti,ab.	2 938
72	cyber*.ti,ab.	7 359
73	(email* or e-mail*).ti,ab.	8 454
74	facebook.ti,ab.	4 202
75	instagram.ti,ab.	236
76	instant messag*.ti,ab.	660
77	internet*.ti,ab.	34 548
78	media-based.ti,ab.	420
79	media-deliver*.ti,ab.	28
80	messag* service.ti,ab.	386
81	(multimedia or multi-media).ti,ab.	4 724
82	new-media.ti,ab.	1 942
83	(online* or on-line*).ti,ab.	73 563
84	podcast*.ti,ab.	435
85	reddit.ti,ab.	46

86	social network* site*.ti,ab.	2 571
87	sms.ti,ab.	1 324
88	snapchat.ti,ab.	53
89	social-medi*.ti,ab.	8 502
90	software.ti,ab.	23 092
91	telecomm*.ti,ab.	2 172
92	text messag*.ti,ab.	1 848
93	texting.ti,ab.	708
94	twitter.ti,ab.	2 094
95	video-based.ti,ab.	1 236
96	virtual*.ti,ab.	32 178
97	vlog*.ti,ab.	48
98	web*.ti,ab.	46 520
99	www.ti,ab.	414
100	youtube.ti,ab.	928
101	or/64-100 [SOFTWARE OR MEDIA]	207 480
102	48 or 63 or 101 [ALL E-HEALTH]	377 363
103	mass screening.ti,ab.	116
104	incentiv*.ti,ab.	19 229
105	triage.ti,ab.	1 312
106	outreach.ti,ab.	6 811
107	crowdsourc*.ti,ab.	514
108	or/103-107 [OTHER STRATEGIES]	27 863
109	((strateg* or approach*) adj3 (collection* or sampl* or specimen* or test* or kit)).ti,ab.	12 030
110	27 or 30 or 35 or 102 or 108 or 109 [ALL STRATEGIES & APPROACHES]	720 537
111	23 and 110 [ALL STIs & STRATEGIES/APPROACHES]	819
112	limit 111 to yr=‘2012 -Current’	305

Ebsco CINAHL Plus. 1595, 02/11/2018

#	Searches	Results
S1	(MH 'Chlamydia+')	1 725
S2	(MH 'Chlamydia Infections+')	3 904
S3	(TI Lymphogranuloma venereum) OR (AB Lymphogranuloma venereum)	153
S4	(TI Chlamydia trachomatis) OR (AB Chlamydia trachomatis)	1 732
S5	(TI Chlamydia infection*) OR (AB Chlamydia infection*)	292
S6	(TI LGV) OR (AB LGV)	68
S7	(MH 'Gonorrhea')	2 417
S8	(MH 'Neisseria')	942
S9	(TI Gonorrhea) OR (AB Gonorrhea)	1 761
S10	(TI Neisseria gonorrhoeae) OR (AB Neisseria gonorrhoeae)	1 100
S11	(TI Gonococcal urethritis) OR (AB Gonococcal urethritis)	78
S12	(TI Gonococci) OR (AB Gonococci)	65
S13	(MH 'Syphilis+')	3 142
S14	(TI Syphilis) OR (AB Syphilis)	3 180
S15	(TI Treponema pallidum) OR (AB Treponema pallidum)	335
S16	(TI Chancre) OR (AB Chancre)	33
S17	(TI Condylomata lata) OR (AB Condylomata lata)	2
S18	(MH 'Trichomonas Infections+')	777
S19	(TI Trichomonas vaginalis) OR (AB Trichomonas vaginalis)	542
S20	(TI Trichomonas Infections*) OR (AB Trichomonas Infections*)	4
S21	(TI Trichomoniasis*) OR (AB Trichomoniasis*)	371
S22	(MH 'Mycoplasma Infections')	446
S23	(TI Mycoplasma genitalium) OR (AB Mycoplasma genitalium)	253
S24	S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8 OR S9 OR S10 OR S11 OR S12 OR S13 OR S14 OR S15 OR S16 OR S17 OR S18 OR S19 OR S20 OR S21 OR S22 OR S23	11 376
S25	(MH 'Diagnosis, Computer Assisted+') OR (MH 'Diagnostic Tests, Routine') OR (MH 'Home Diagnostic Tests') OR (MH 'Self Diagnosis+')	31 976
S26	(MH 'Health Screening+')	73 523
S27	(MH 'Decision Making, Clinical')	25 011
S28	(TI (detect* N5 (tests or test or testing or tool* or technique* or method* or technolog* or advance* or assay* or device*))) OR (AB (detect* N5 (tests or test or testing or tool* or technique* or method* or technolog* or advance* or assay* or device*)))	24 394
S29	(TI (diagnos* N5 (tests or test or testing or tool* or technique* or method* or technolog* or advance* or assay* or device*))) OR (AB (diagnos* N5 (tests or test or testing or tool* or technique* or method* or technolog* or advance* or assay* or device*)))	52 300
S30	(TI (deliver* N5 (tests or test or testing or tool* or technique* or method* or technolog* or advance* or assay* or device*))) OR (AB (deliver* N5 (tests or test or testing or tool* or technique* or method* or technolog* or advance* or assay* or device*)))	11 393
S31	(TI (screen* N5 (tests or test or testing or tool* or technique* or method* or technolog* or advance* or assay* or device*))) OR (AB (screen* N5 (tests or test or testing or tool* or technique* or method* or technolog* or advance* or assay* or device*)))	28 611
S32	(TI (sample N1 collect*)) OR (AB (sample N1 collect*))	11 425
S33	(TI (home* N3 (collection* or sampl* or specimen* or test* or kit))) OR (AB (home* N3 (collection* or sampl* or specimen* or test* or kit)))	3 193
S34	(TI (self* N3 (collection* or sampl* or specimen* or test* or kit))) OR (AB (self* N3 (collection* or sampl* or specimen* or test* or kit)))	5 848
S35	(TI (mail* N3 (collection* or sampl* or specimen* or test* or kit))) OR (AB (mail* N3 (collection* or sampl* or specimen* or test* or kit)))	917
S36	(MH 'Point-of-Care Testing')	2 986
S37	(MH 'Clinical Information Systems')	5 677
S38	(TI (near N5 (patients or patient))) OR (AB (near N5 (patients or patient)))	1 825
S39	(TI point of care) OR (AB point of care)	5 673
S40	(TI (rapid N1 test*)) OR (AB (rapid N1 test*))	2 292
S41	(TI (real N1 time)) OR (AB (real N1 time))	22 005
S42	(MH 'Telehealth+')	17 201
S43	(TI ccbt) OR (AB ccbt)	84

S44	(TI (ehealth OR e-health OR electronic health*)) OR (AB (ehealth OR e-health OR electronic health*))	10 116
S45	(TI (etherap* OR e-therap* OR electronic therap*)) OR (AB (etherap* OR e-therap* OR electronic therap*))	107
S46	(TI (eportal OR e-portal OR electronic portal)) OR (AB (eportal OR e-portal OR electronic portal))	142
S47	(TI telehealth*) OR (AB telehealth*)	2 657
S48	(TI telemed*) OR (AB telemed*)	3 916
S49	(TI telemonitor*) OR (AB telemonitor*)	622
S50	(TI telepsych*) OR (AB telepsych*)	297
S51	(TI teletherap*) OR (AB teletherap*)	61
S52	(TI icbt) OR (AB icbt)	154
S53	(TI (mhealth OR m-health)) OR (AB (mhealth OR m-health))	1 079
S54	MH 'Computer Hardware'	1 006
S55	MH 'Computer Peripherals+'	9 621
S56	MH 'Computer Processor+'	84
S57	MH 'Computer Types+'	7 818
S58	(MH 'Cellular Phone')	1 259
S59	(MH 'Wireless Local Area Networks')	125
S60	(TI cellphone) OR (AB cellphone)	139
S61	(TI computer*) OR (AB computer*)	50 024
S62	(TI (ipad OR i-pad)) OR (AB (ipad OR i-pad))	743
S63	(TI (iphone OR i-phone)) OR (AB (iphone OR i-phone))	475
S64	(TI (ipod OR i-pod)) OR (AB (ipod OR i-pod))	207
S65	(TI mobile*) OR (AB mobile*)	14 003
S66	(TI phone*) OR (AB phone*)	12 487
S67	(TI smartphone) OR (AB smartphone)	3 063
S68	(TI technolog*) OR (AB technolog*)	90 154
S69	(TI telephon*) OR (AB telephon*)	24 787
S70	(TI wifi) OR (AB wifi)	50
S71	(TI wireless) OR (AB wireless)	2 455
S72	MH 'Instant Messaging'	146
S73	MH 'Internet+'	118 354
S74	MH 'Text Messaging'	1 714
S75	MH 'Videoconferencing+'	1 876
S76	MH 'Wireless Communications'	9 752
S77	(MH 'Electronic Mail')	0
S78	MH 'Mobile Applications'	4 080
S79	MH 'Multimedia'	1 804
S80	MH 'Operating Systems'	285
S81	MH 'Decision Making, Computer Assisted'	1 131
S82	MH 'Diagnosis, Computer Assisted+'	14 862
S83	MH 'Therapy, Computer Assisted+'	14 326
S84	MH 'Virtual Reality+'	3 407
S85	(TI android) OR (AB android)	552
S86	(TI (app OR apps)) OR (AB (app or apps))	5 258
S87	(TI blog*) OR (AB blog*)	2 171
S88	(TI cyber*) OR (AB cyber*)	2 939
S89	(TI (email* OR e-mail*)) OR (AB (email* OR e-mail*))	7 650
S90	(TI facebook) OR (AB facebook)	2 550
S91	(TI instagram) OR (AB instagram)	230
S92	(TI instant messag*) OR (AB instant messag*)	174
S93	(TI internet*) OR (AB internet*)	23 803
S94	(TI media-based) OR (AB media-based)	166
S95	(TI media-deliver*) OR (AB media-deliver*)	16
S96	(TI messag* service?) OR (AB messag* service?)	64
S97	(TI (multimedia or multi-media)) OR (AB (multimedia or multi-media))	2 015
S98	(TI new-media) OR (AB new-media)	310
S99	(TI (online* OR on-line*)) OR (AB (online* OR on-line*))	178 543
S100	(TI podcast*) OR (AB podcast*)	603

S101	(TI reddit) OR (AB reddit)	38
S102	(TI social network* site*) OR (AB social network* site*)	743
S103	(TI sms) OR (AB sms)	1 018
S104	(TI snapchat) OR (AB snapchat)	33
S105	(TI social-medi*) OR (AB social-medi*)	6 162
S106	(TI software) OR (AB software)	32 809
S107	(TI telecomm*) OR (AB telecomm*)	873
S108	(TI text-messag*)) OR (AB text-messag*)	1 846
S109	(TI texting) OR (AB texting)	488
S110	(TI twitter) OR (AB twitter)	1 721
S111	(TI video-based) OR (AB video-based)	709
S112	(TI virtual*) OR (AB virtual*)	16 409
S113	(TI vlog*) OR (AB vlog*)	22
S114	(TI web) OR (AB web)	37 403
S115	(TI www) OR (AB www)	257
S116	(TI youtube) OR (AB youtube)	599
S117	(TI mass screening) OR (AB mass screening)	349
S118	(TI incentiv*) OR (AB incentiv*)	11 086
S119	(MH 'Triage')	8 035
S120	(TI outreach) OR (AB outreach)	6 862
S121	(TI crowdsourc*) OR (AB crowdsourc*)	352
S122	(TI (strateg* N3 (collection* or sampl* or specimen* or test* or kit))) OR (AB (strateg* N3 (collection* or sampl* or specimen* or test* or kit)))	4 095
S123	(TI (approach* N3 (collection* or sampl* or specimen* or test* or kit))) OR (AB (approach* N3 (collection* or sampl* or specimen* or test* or kit)))	4 592
S124	S25 OR S26 OR S27 OR S28 OR S29 OR S30 OR S31 OR S32 OR S33 OR S34 OR S35 OR S36 OR S37 OR S38 OR S39 OR S40 OR S41 OR S42 OR S43 OR S44 OR S45 OR S46 OR S47 OR S48 OR S49 OR S50 OR S51 OR S52 OR S53 OR S54 OR S55 OR S56 OR S57 OR S58 OR S59 OR S60 OR S61 OR S62 OR S63 OR S64 OR S65 OR S66 OR S67 OR S68 OR S69 OR S70 OR S71 OR S72 OR S73 OR S74 OR S75 OR S76 OR S77 OR S78 OR S79 OR S80 OR S81 OR S82 OR S83 OR S84 OR S85 OR S86 OR S87 OR S88 OR S89 OR S90 OR S91 OR S92 OR S93 OR S94 OR S95 OR S96 OR S97 OR S98 OR S99 OR S100 OR S101 OR S102 OR S103 OR S104 OR S105 OR S106 OR S107 OR S108 OR S109 OR S110 OR S111 OR S112 OR S113 OR S114 OR S115 OR S116 OR S117 OR S118 OR S119 OR S120 OR S121 OR S122 OR S123	794 308
S125	S24 AND S124	3 239
S126	S125 Limiters - Published Date: 20120101-20181231	1595

Cochrane Library. 673, 02/11/2018.

#	Searches	Results
#1	MeSH descriptor: [Diagnosis, Computer-Assisted] this term only	702
#2	MeSH descriptor: [Diagnostic Techniques and Procedures] this term only	30
#3	MeSH descriptor: [Diagnostic Self Evaluation] this term only	149
#4	MeSH descriptor: [Diagnostic Tests, Routine] this term only	203
#5	MeSH descriptor: [Direct-To-Consumer Screening and Testing] this term only	1
#6	MeSH descriptor: [Mass Screening] this term only	2 891
#7	MeSH descriptor: [Symptom Assessment] this term only	176
#8	MeSH descriptor: [Clinical Decision-Making] explode all trees	134
#9	MeSH descriptor: [Point-of-Care Systems] this term only	387
#10	((detect* or diagnos* or deliver* or screen*) near/5 (tests or test or testing or tool* or technique* or method* or technolog* or advance* or assay* or device*)) or (sample near/1 collect*) or ((home* or self* or mail*) near/3 (collection* or sampl* or specimen* or test* or kit)) or ('near' near/5 (patients or patient)) or 'point of care' or (rapid near/1 test*) or (real near/1 time)	76 885
#11	MeSH descriptor: [Telemedicine] explode all trees	1 950
#12	MeSH descriptor: [Cell Phone] this term only	589
#13	MeSH descriptor: [Wireless Technology] this term only	33
#14	MeSH descriptor: [Microcomputers] explode all trees	646
#15	MeSH descriptor: [Electronic Mail] this term only	293
#16	MeSH descriptor: [Text Messaging] this term only	584
#17	MeSH descriptor: [undefined] explode all trees	0
#18	MeSH descriptor: [Internet] explode all trees	3 372
#19	MeSH descriptor: [Mobile Applications] this term only	324
#20	MeSH descriptor: [Virtual Reality] this term only	47
#21	MeSH descriptor: [Cell Phone Use] this term only	1
#22	(ccbt OR ehealth OR 'e-health' OR 'electronic health*' OR etherap* OR 'e-therap*' OR 'electronic therap*' OR eportal OR 'e-portal' OR 'electronic portal' OR telehealth* OR telemed* OR telemonitor* OR telepsych* OR teletherap* OR icbt OR mhealth OR 'm-health' OR cellphone OR computer* OR ipad OR 'i-pad' OR iphone OR 'i-phone' OR ipod OR 'i-pod' OR mobile* OR smartphone OR technolog* OR telephon* OR wifi OR wireless OR android OR app OR apps OR blog* OR cyber* OR email OR 'e-mail' OR facebook OR instagram OR 'instant messag*' OR internet* OR 'media-based' OR 'media-deliver*' OR 'messag* service*' OR multimedia OR 'multi-media' OR 'new-media' OR online* OR 'on-line*' OR podcast* OR reddit OR 'social network* site*' OR sms OR snapchat OR 'social medi*' OR software or telecomm* OR 'text-messag*' OR texting OR twitter OR 'video-based' OR virtual* OR vlog* OR web* OR www OR youtube):ti,ab,kw	127 243
#23	MeSH descriptor: [Triage] this term only	257
#24	'mass screening' or incentiv* or outreach or crowdsourc* or ((strateg* or approach*) near/3 (collection* or sampl* or specimen* or test* or kit))	10 480
#25	#1 or #2 or #3 or #4 or #5 or #6 or #7 or #8 or #9 or #10 or #11 or #12 or #13 or #14 or #15 or #16 or #17 or #18 or #19 or #20 or #21 or #22 or #23 or #24	191 881
#26	MeSH descriptor: [Chlamydia] this term only	28
#27	MeSH descriptor: [Chlamydia trachomatis] this term only	297
#28	MeSH descriptor: [Chlamydia Infections] explode all trees	610
#29	MeSH descriptor: [Gonorrhea] explode all trees	445
#30	MeSH descriptor: [Syphilis] explode all trees	126
#31	MeSH descriptor: [Trichomonas] this term only	6
#32	MeSH descriptor: [Trichomonas vaginalis] this term only	50
#33	MeSH descriptor: [Trichomonas Infections] explode all trees	174
#34	MeSH descriptor: [Mycoplasma genitalium] explode all trees	11
#35	'Lymphogranuloma venereum' OR 'Chlamydia trachomatis' OR 'Chlamydia infection*' OR LGV OR Gonorrhea OR 'Neisseria gonorrhoeae' OR 'Gonococcal urethritis' OR Gonococci OR Syphilis OR 'Treponema pallidum' OR Chancre OR 'Condylomata lata' OR 'Trichomonas vaginalis' OR 'Trichomonas Infections*' OR Trichomoniasis* OR 'Mycoplasma genitalium'	2 468
#36	#26 or #27 or #28 or #29 or #30 or #31 or #32 or #33 or #34 or #35	2 722
#37	#25 and #36	673

Epistemonikos. 108, 07/11/2018.

Search strategy
(title:((((detect* OR diagnos* OR deliver* OR screen*) AND (tests OR test OR testing OR tool* OR technique* OR method* OR technolog* OR advance* OR assay* OR device*)) OR (sample AND collect*) OR ((home* OR self* OR mail*) AND (collection* OR sampl* OR specimen* OR test* OR kit)) OR ('near' AND (patients OR patient)) OR 'point of care' OR 'rapid test*' OR 'real time' OR (ccbt OR ehealth OR 'e-health' OR 'electronic health*' OR etherap* OR 'e-therap*' OR 'electronic therap*' OR eportal OR 'e-portal' OR 'electronic portal' OR telehealth* OR telemed* OR telemonitor* OR telepsych* OR teletherap* OR icbt OR mhealth OR 'm-health' OR cellphone OR computer* OR ipad OR 'i-pad' OR iphone OR 'i-phone' OR ipod OR 'i-pod' OR mobile* OR smartphone OR technolog* OR telephon* OR wifi OR wireless OR android OR app OR apps OR blog* OR cyber* OR email OR 'e-mail' OR facebook OR instagram OR 'instant messag*' OR internet* OR 'media-based' OR 'media-deliver*' OR 'messag* service*' OR multimedia OR 'multi-media' OR 'new-media' OR online* OR 'on-line*' OR podcast* OR reddit OR 'social network* site*' OR sms OR snapchat OR 'social medi*' OR software OR telecomm* OR 'text-messag*' OR texting OR twitter OR 'video-based' OR virtual* OR vlog* OR web* OR www OR youtube 'mass screening' OR incentiv* OR outreach OR crowdsourc* OR ((strateg* OR approach*) AND (collection* OR sampl* OR specimen* OR test* OR kit))) AND ('Lymphogranuloma venereum' OR 'Chlamydia trachomatis' OR 'Chlamydia infection*' OR LGV OR Gonorrhea OR 'Neisseria gonorrhoeae' OR 'Gonococcal urethritis' OR Gonococci OR Syphilis OR 'Treponema pallidum' OR Chancre OR 'Condylomata lata' OR 'Trichomonas vaginalis' OR 'Trichomonas Infections*' OR Trichomoniasis* OR 'Mycoplasma genitalium'))) OR abstract:((((detect* OR diagnos* OR deliver* OR screen*) AND (tests OR test OR testing OR tool* OR technique* OR method* OR technolog* OR advance* OR assay* OR device*)) OR (sample AND collect*) OR ((home* OR self* OR mail*) AND (collection* OR sampl* OR specimen* OR test* OR kit)) OR ('near' AND (patients OR patient)) OR 'point of care' OR 'rapid test*' OR 'real time' OR (ccbt OR ehealth OR 'e-health' OR 'electronic health*' OR etherap* OR 'e-therap*' OR 'electronic therap*' OR eportal OR 'e-portal' OR 'electronic portal' OR telehealth* OR telemed* OR telemonitor* OR telepsych* OR teletherap* OR icbt OR mhealth OR 'm-health' OR cellphone OR computer* OR ipad OR 'i-pad' OR iphone OR 'i-phone' OR ipod OR 'i-pod' OR mobile* OR smartphone OR technolog* OR telephon* OR wifi OR wireless OR android OR app OR apps OR blog* OR cyber* OR email OR 'e-mail' OR facebook OR instagram OR 'instant messag*' OR internet* OR 'media-based' OR 'media-deliver*' OR 'messag* service*' OR multimedia OR 'multi-media' OR 'new-media' OR online* OR 'on-line*' OR podcast* OR reddit OR 'social network* site*' OR sms OR snapchat OR 'social medi*' OR software OR telecomm* OR 'text-messag*' OR texting OR twitter OR 'video-based' OR virtual* OR vlog* OR web* OR www OR youtube 'mass screening' OR incentiv* OR outreach OR crowdsourc* OR ((strateg* OR approach*) AND (collection* OR sampl* OR specimen* OR test* OR kit))) AND ('Lymphogranuloma venereum' OR 'Chlamydia trachomatis' OR 'Chlamydia infection*' OR LGV OR Gonorrhea OR 'Neisseria gonorrhoeae' OR 'Gonococcal urethritis' OR Gonococci OR Syphilis OR 'Treponema pallidum' OR Chancre OR 'Condylomata lata' OR 'Trichomonas vaginalis' OR 'Trichomonas Infections*' OR Trichomoniasis* OR 'Mycoplasma genitalium'))))

Web of Science. 3366, 07/11/2018

#	Searches	Results
# 1	TOPIC: (((detect* or diagnos* or deliver* or screen*) near/5 (tests or test or testing or tool* or technique* or method* or technolog* or advance* or assay* or device*)) or (sample near/1 collect*) or ((home* or self* or mail*) near/3 (collection* or sampl* or specimen* or test* or kit)) or ('near' near/5 (patients or patient)) or 'point of care' or (rapid near/1 test*) or (real near/1 time) or ccbt OR ehealth OR 'e-health' OR 'electronic health*' OR etherap* OR 'e-therap*' OR 'electronic therap*' OR eportal OR 'e-portal' OR 'electronic portal' OR telehealth* OR telemed* OR telemonitor* OR telepsych* OR teletherap* OR icbt OR mhealth OR 'm-health' OR cellphone OR computer* OR ipad OR 'i-pad' OR iphone OR 'i-phone' OR ipod OR 'i-pod' OR mobile* OR smartphone OR technolog* OR telephon* OR wifi OR wireless OR android OR app OR apps OR blog* OR cyber* OR email OR 'e-mail' OR facebook OR instagram OR 'instant messag*' OR internet* OR 'media-based' OR 'media-deliver*' OR 'messag* service*' OR multimedia OR 'multi-media' OR 'new-media' OR online* OR 'on-line*' OR podcast* OR reddit OR 'social network* site*' OR sms OR snapchat OR 'social medi*' OR software or telecomm* OR 'text-messag*' OR texting OR twitter OR 'video-based' OR virtual* OR vlog* OR web* OR www OR youtube or 'mass screening' or incentiv* or outreach or crowdsourc* or ((strateg* or approach*) near/3 (collection* or sampl* or specimen* or test* or kit)))	5 990 772
# 2	TOPIC: ('Lymphogranuloma venereum' OR 'Chlamydia trachomatis' OR 'Chlamydia infection*' OR LGV OR Gonorrhea OR 'Neisseria gonorrhoeae' OR 'Gonococcal urethritis' OR Gonococci OR Syphilis OR 'Treponema pallidum' OR Chancre OR 'Condylomata lata' OR 'Trichomonas vaginalis' OR 'Trichomonas Infections*' OR Trichomoniasis* OR 'Mycoplasma genitalium')	48 122
# 3	#2 AND #1	8 282
# 4	#2 AND #1 Refined by: PUBLICATION YEARS: (2018 OR 2017 OR 2016 OR 2015 OR 2014 OR 2013 OR 2012)	3 366

Scopus. 4798, 08/11/2018

Search strategy
(TITLE-ABS-KEY ((detect* W/5 tests) OR (detect* W/5 test) OR (detect* W/5 testing) OR (detect* W/5 tool*) OR (detect* W/5 technique*) OR (detect* W/5 method*) OR (detect* W/5 technolog*) OR (detect* W/5 advance*) OR (detect* W/5 assay*) OR (detect* W/5 device*) OR (deliver* W/5 tests) OR (deliver* W/5 test) OR (deliver* W/5 testing) OR (deliver* W/5 tool*) OR (deliver* W/5 technique*) OR (deliver* W/5 method*) OR (deliver* W/5 technolog*) OR (deliver* W/5 advance*) OR (deliver* W/5 assay*) OR (deliver* W/5 device*) OR (screen* W/5 tests) OR (screen* W/5 test) OR (screen* W/5 testing) OR (screen* W/5 tool*) OR (screen* W/5 technique*) OR (screen* W/5 method*) OR (screen* W/5 technolog*) OR (screen* W/5 advance*) OR (screen* W/5 assay*) OR (screen* W/5 device*) OR (sample W/1 collect*) OR (home* W/3 collection*) OR (self* W/3 collection*) OR (mail* W/3 collection*) OR (home* W/3 sampl*) OR (self* W/3 sampl*) OR (mail* W/3 sampl*) OR (home* W/3 specimen*) OR (self* W/3 specimen*) OR (mail* W/3 specimen*) OR (home* W/3 test*) OR (self* W/3 test*) OR (mail* W/3 test*) OR (home* W/3 kit) OR (self* W/3 kit) OR (mail* W/3 kit) OR ('near' W/5 patients) OR ('near' W/5 patient) OR 'point of care' OR (rapid W/1 test*) OR (real W/1 time) OR ccbt OR ehealth OR 'e-health' OR 'electronic health*' OR etherap* OR 'e-therap*' OR 'electronic therap*' OR eportal OR 'e-portal' OR 'electronic portal' OR telehealth* OR telemed* OR telemonitor* OR telepsych* OR teletherap* OR icbt OR mhealth OR 'm-health' OR cellphone OR computer* OR ipad OR 'i-pad' OR iphone OR 'i-phone' OR ipod OR 'i-pod' OR mobile* OR smartphone OR technolog* OR telephon* OR wifi OR wireless OR android OR app OR apps OR blog* OR cyber* OR email OR 'e-mail' OR facebook OR instagram OR 'instant messag*' OR internet* OR 'media-based' OR 'media-deliver*' OR 'messag* service*' OR multimedia OR 'multi-media' OR 'new-media' OR online* OR 'on-line*' OR podcast* OR reddit OR 'social network* site*' OR sms OR snapchat OR 'social medi*' OR software OR telecomm* OR 'text-messag*' OR texting OR twitter OR 'video-based' OR virtual* OR vlog* OR web* OR www OR youtube OR 'mass screening' OR incentiv* OR outreach OR crowdsourc* OR (strateg* W/3 collection*) OR (approach* W/3 collection*) OR (strateg* W/3 sampl*) OR (approach* W/3 sampl*) OR (strateg* W/3 specimen*) OR (approach* W/3 specimen*) OR (strateg* W/3 test*) OR (approach* W/3 test*) OR (strateg* W/3 kit) OR (approach* W/3 kit))) AND (TITLE-ABS-KEY ('Lymphogranuloma venereum' OR 'Chlamydia trachomatis' OR 'Chlamydia infection*' OR lgv OR gonorrhea OR 'Neisseria gonorrhoeae' OR 'Gonococcal urethritis' OR gonococci OR syphilis OR 'Treponema pallidum' OR chancre OR 'Condylomata lata' OR 'Trichomonas vaginalis' OR 'Trichomonas Infections*' OR trichomoniasis* OR 'Mycoplasma genitalium')) AND (PUBYEAR > 2011)

Annex 4. Screening tool for all stages: title, abstract, and full-text

Title Stage Eligibility Criteria Interpretation Tool

1. Was this paper published after January 2012?
   a. No, exclude.
   b. Yes or uncertain, go to step 2
2. Does this paper involve humans?
   a. No (animal or in vitro; lab-only diagnostics), exclude.
   b. Yes or uncertain, go to step 3
3. Is the paper in English? OR Is the paper in any European language AND from an EU/EEA/Switzerland country?
   a. No, exclude.
   b. Yes or uncertain, go to step 4
4. Does this paper assess genital and extra-genital (rectal and pharyngeal) sexually transmitted infection?
   a. No (other extra-genital, non-sexually transmitted infection – e.g. trachoma, congenital STIs like congenital syphilis or chlamydial conjunctivitis or pneumonia), exclude.
   b. Yes or uncertain, go to step 5
5. Does this paper focus on testing strategies or approaches for infections with *C. trachomatis*, *N. gonorrhoeae*, *T. pallidum*, *M. genitalium* or *T. vaginalis*?
   a. No (e.g. HIV, HCV, BV, HSV), exclude.
   b. Yes or uncertain, go to step 6
6. Does this paper assess testing strategies or approaches for initial diagnosis of the index case?
   a. No (e.g. studies on test of cure, partner notification, or retesting), exclude.
   b. Yes or uncertain, go to step 7
7. Does this paper assess testing strategies or approaches for complications of infection only?
   a. Yes (PID, tubal infertility, neurosyphilis, etc.), exclude.
   b. No or uncertain, go to step 8
8. Does this paper assess testing strategies or approaches to improve access to testing, testing coverage, or linkage to care?
   a. No, (e.g. descriptive epidemiology only, risk factor/association studies, laboratory diagnostic accuracy study, basic science leading to test development, prevention studies e.g. condom uptake, counselling, prep), exclude.
   b. Yes (e.g., service evaluations) or uncertain, include.

Abstract Stage Eligibility Criteria Interpretation Tool

1. Is the paper reporting primary data?
   a. No (systematic reviews, guidelines, organisational reports, abstract booklets, mathematical modelling studies), exclude
   b. Yes, go on to step 2
2. Is this paper reporting on AMR testing only e.g. it doesn't include diagnosis of the infection itself?
   a. Yes, exclude

b. No, go on to step 3

3. Is the paper reporting 'population collected' data for testing coverage, access to testing, and linkage to care i.e. without identifying a service utilizing a specified strategy or approach

   a. Yes, exclude

   b. No, include

Full article Stage Eligibility Criteria Interpretation Tool

1. Does the paper present evidence of impact of novel testing strategies & approaches on Testing coverage, Linkage to care, or Access to testing through use of one or more comparative or baseline group [e.g., multiple arms in traditional RCT, clusters in SWT, cohort data before & after intervention]

   a. Yes, go on to step 2.

   b. No, exclude.

2. Is the paper providing data on access to testing by presenting levels of:

   Physical (geographic/time e.g., waiting time in clinic, distance to testing location)

   Economic (e.g., direct or indirect cost to consumer)

   Socio-psychological (e.g., acceptability/'comfort' of an intervention being used, stigma)

   barriers to testing in each comparative group, including data collected from HCW & service users.

   a. Yes, include

   b. Do not necessarily include, go on to step 3

3. Is the paper providing data on testing coverage as proportion tested in each comparative group with a specified denominator for comparable population: e.g. denominator may be total population covered by service, clinic attendees, patients referred for testing:

   a. Yes, include

   b. Do not necessarily include, go on to step 4

4. Is the paper providing data on linkage to care by presenting:

   a. Proportion in each comparative group diagnosed as positive [by test implemented in strategy or gold standard]: referred for, asked to return for, returned for, or undergoing, management [e.g. with antibiotic therapy or behavioural intervention]

      i. Yes, include

      ii. Do not necessarily include, go on to step 4b.

   b. Time in each comparative group from diagnosis or testing to: referral for, request to return for, return for, or provision of, management

      i. Yes, include

      ii. No, exclude

Annex 5. Adapted Cochrane Risk of Bias Tool [Randomised-Control-Trials]

On the basis of the points in each section, consider (+), (-), or if insufficient information, (?).

Bias due to issues with Random Sequence Generation

- Consider if an appropriate method for assignment of intervention was specified[1]. If the design involved intentionally unequal numbers, was the randomisation ratio reported?

Bias due to issues with Allocation Concealment

- Consider if an appropriate method for concealment of allocation was specified[2].

Bias due to issues with Blinding of Participants, Personnel, & Outcome Assessment

- Did the methodology clearly state which patient, personnel, and outcome assessor groups, were blinded and how, and where blinding was not possible for a patient subgroup, personnel group, or assessor group, were reasons adequately made clear? (e.g., surgeons performing interventions).
- How may the 'subjective/objective' nature of the outcome have affected the impact of lack of blinding?

Bias due to issues with Missing Outcome Data

- Was >10% of data missing for any outcomes?
    - Is it possible this may have introduced bias due to change of group or compliance/loss- to-follow-up being associated with prognosis?
- For missing data, was an 'as treated' analysis [including 'complete/available case/pairwise deletion'?], or an imputation method (e.g., 'last observation carried forward') used?
- Was number of missing patients balanced between intervention groups and might this have introduced bias due to loss to follow-up being associated with prognosis?
- Were reasons for dropout/exclusion (e.g., effect, lack of effect) presented and balanced between intervention groups? [Was there the possibility of dropout/exclusion due to effect in one group and lack of effect in the other?].

Bias due to issues with Selective Reporting

- Could selection from multiple recorded outcomes have led to biased conclusions?

Other Sources of Bias

Design Specific Biases:

- In a cluster randomized design, was there differential recruitment or baseline variations between clusters, loss of clusters, or inappropriate analysis used for the cluster-randomized design?
- In a 'crossover' design, was use of this suitable, and analysis suitable for this design?
    - Is it possible there was a carry-over effect post cross or was only first period data collected?
- In both cases, how do the results of this study compare to results found in parallel group trials?

Baseline imbalance:

- Did baseline characteristics vary between intervention group with enough statistical significance to suggest non-randomized allocation?

Differential diagnostic activity:

- Is it possible that diagnosis of outcomes may have differed between intervention groups (e.g., increased assessment due to related adverse effects; diarrhoea and prostate cancer)

Other:

- Was there any evidence of:
    - Recruitment of additional participants following interim result?
    - Post-hoc stepping up of drug doses beyond those applicable to clinical practice?
    - Any interventions before randomization?
    - Contamination (pooling of drugs between intervention groups, etc.)?
    - Null bias (e.g., due to excessively wide inclusion criteria)?
    - Insensitive instrument use?
    - Fraud?

Overall bias

Given the results of the six sections above:

1. If two or more sections are scored (-):
   Score the study (-), at high risk of bias overall.
   2. If one or fewer section is scored (-):

and

a. If the majority of remaining sections (three or more) is scored (?), score the study (?), with insufficient information to determine risk of bias overall.

b. If the majority of the remaining sections (three or more sections), is scored (+), score the study (+), at low risk of bias overall.

[1]A random number table, computerised random number generator, or minimisation, or any other method to generate randomly assigned equal numbers.

[2] External/'third-party'/centralised technique such as a pharmacy or central telephone assignment, or automated assignment; or an internal concealed technique such as drug containers [sequentially numbered, identical], or envelopes [sequentially numbered, opaque, sealed, opened after participant details written on envelope]

Annex 6. Adapted ROBINS-I [Non-Randomised Studies of Interventions]

On the basis of the points in each section, consider (+), (-), or if insufficient information, (?).

Bias due to confounding

- Where confounders were present, was there a valid and reliable measurement of confounding domains and an analysis method controlling for all the important confounding domains?
- Where the analysis split participants' follow up time according to intervention received & discontinuations/switches were likely to be related to factors prognostic for outcome, did the authors use an appropriate analysis method controlling for time-varying confounding?
- Did the authors control for any post-intervention variables that could have been affected by the intervention?

Bias in selection of participants into the study

- Was selection of participants into the study (or into the analysis) based on participant characteristics observed after the start of intervention?
    - Were these likely to be associated with intervention?
    - Were these likely to be associated with outcome?
- Do start of follow-up and start of intervention coincide for most participants?[1].
- Were adjustment techniques used that are likely to correct for the presence of selection bias?

Bias in classification of interventions

- Were intervention groups clearly defined with information used to define intervention groups recorded at the start of the intervention?
- Could classification of intervention status have been affected by knowledge of the outcome or risk of the outcome?

Bias due to deviations from intended interventions (Intention to treat analyses assumed)

- Were there deviations from the intended intervention beyond what would be expected in usual practice, that may have been unbalanced between groups and likely to have affected the outcome?

Bias due to missing data

- Were outcome data available for all, or nearly all, participants? [90/95%]
    - Were participants excluded due to missing data on intervention status or other variables needed for the analysis?
- Are the proportion of participants and reasons for missing data similar across interventions?
- Is there evidence that results were robust to the presence of missing data?

Bias in measurement of outcomes

- Could the outcome measure have been influenced by knowledge of the intervention received or were any systematic errors in measurement of the outcome related to intervention received?
- Were outcome assessors aware of the intervention received by study participants and methods of outcome assessment comparable across intervention groups?

Bias in selection of the reported result

- Is it likely the reported effect estimate was selected from multiple outcome measurements within the outcome domain, multiple analyses of the intervention-outcome relationship, or different subgroups?

Overall bias

- Given the 7 sections above what is your overall bias judgement?

[1] *Was it impossible for individuals with outcome soon after intervention to be excluded; as with use of prevalent vs. incident cases?*

Annex 7. Publications reporting testing

Table 1a. Initiatives in primary care settings (N=28)

First author, publication year (ref no.)	Country	Study design	Study population and setting	STIs[1]	Intervention[2]	Outcome [3]	Result	Sample number
Wood, 2018 [53]	United States	Prospective cohort	15-19-year-old females attending primary care clinics.	CT	**Quality Improvement Electronic Medical Records** Arm 1: Pre-QI intervention universal screening, Arm 2: Post QI intervention to increase coverage; dual registration to streamline test ordering, labelled specimen cups before history taking /examination, signs communicating universal adolescent urine policy, EMR prompts based on sexual history.	ATT, TC	Median visit length (minutes). Arm 1: 79.2 IQR (59.5-103.3), Arm 1: 80.4 IQR (61.7=102.8). Proportion of clinic attendees referred for testing. Arm 1: 41.2%, Arm 2: 50.0% (p=0.001).	ATT. Arm 1 + Arm 2 N=750. TC. Arm 1 N=757, Arm 2 N=793.
Dhar, 2016 [30]	United States	Before/ After	Female aged 15-19 years attending urban primary care clinic	CT	**Quality Improvement Electronic Medical Records Screening and Triage** Arm 1: Pre-intervention, Arm 2: Universal Screening in non-STI clinic setting, Provider Education, telephone number collection for linkage to care, systematic reminder system	TC	Proportion of total population covered by service undergoing urine STI testing. Arm 1 52.0%, Arm 2 59.3%.[4]	NA
Hocking, 2018 [31]	Australia	Cluster-randomised controlled trial	Sexually active 16-29-year-olds attending rural primary care clinics	CT	**Quality Improvement Electronic Medical Records Screening and Triage** Arm 1: Universal screening in primary care, Arm 2: Universal screening + Multifaceted QI project involving education, computer alert, reminder to recall, partner notification.	TC	Proportion of clinic attendees tested per year during trial. Arm 1: 12.9% 95%CI (11.2%-14.5%), Arm 2: 20.1% 95%CI (18.4%-21.8%). [4]	Arm 1: n=86527, Arm 2: n=93828.
DiVasta, 2016 [32]	United States	Before/ After	Sexually active 16-24-year-old females attending paediatric primary care.	CT	**Quality Improvement Electronic Medical Records** Arm 1: Non-Learning-Collaborative Practices with electronic medical record (EMR) system, Arm 2: Learning collaborative (LC) 1 [12 hours of	TC	Proportion of at-risk female subjects with paid claim for CT screening test Pre/Post-EMR-Pre-LC/ Post-EMR-LC: Arm 1: 58.3%/66.1%, Arm 2: 52.8%/54.5%/66.7% , Arm 3: 57.8%/61.5%/69.3%. [4]	NA

First author, publication year (ref no.)	Country	Study design	Study population and setting	STIs[1]	Intervention[2]	Outcome [3]	Result	Sample number
					targeted content] + EMR, Arm 3: LC 2 + EMR.			
Bryant, 2018 [33]	United States	NA	'Clinical site' attendees	CT, NG, TP	**Quality Improvement Electronic Medical Records** Arm 1: Pre-intervention, Arm 2: Rapid-cycle QI methodology with health information technology	TC	Proportion of eligible patients receiving screening. **Arm 1: Males** Syphilis 2.94% NG, 2.94% **Females** Syphilis 5.26% NG 13.16%, **Arm 2: Males** Syphilis 28.89% NG 28.26% **Females** Syphilis 22.06% NG 22.06%[4]	Syphilis/NG Arm 1: n=72/113 Arm 2: n=72/114
Burstein, 2018 [34]	United States	Before/ After	13-24-year-olds attending paediatric primary care.	CT	**Quality Improvement Electronic Medical Records** Arm 1: Pre-intervention, Arm 2: During QI intervention; targeting interventions including EMR changes, universal urine collection or sexual history, informing of confidentiality, alone-time with teens, Arm 3: Post-QI.	TC	Proportion of attendees with record of CT testing on EMR. Arm 1: 72%, Arm 2: 95%, Arm 3: 85%. [4]	NA
Karas, 2018 [35]	United States	Before/ After	13-21-year-old asymptomatic females primary care clinic attendees	CT	**Quality Improvement Electronic Medical Records** Arm 1: Pre-intervention. Arm 2: Physician education, Triage algorithm followed by alert on tablet for GP to recommend testing	TC	Proportion tested of Females 13-21 seen for 'well care'. Arm 1: 2.40%. Arm 2: 5.01% (p<0.01). odds ratio = 2.143, 95% confidence interval = [1.833-2.504])	Arm 1: N=9671, Arm 2: N= 11,195
Patton, 2016 [36]	United States	Before/ After	Asymptomatic 14-45-year-old Native American Medical Centre attendees	NG	**Quality Improvement Electronic Medical Records** Arm 1: Pre-intervention, Arm 2: Electronic Health Record prompts, posters, bundled lab order sets, provide education.	TC	Proportion of clinic attendees undergoing NG testing. Arm 1: 20.8%, Arm 2: 37.8%. [4]	Arm 1: N=23244, Arm 2: N=22672.
Callander, 2018 [37]	Australia	Before/ After	MSM attending primary care clinic	CT, NG, TP HIV	**Electronic Medical Records** Arm 1: Passive recruitment in STI clinic Arm 2: Passive recruitment in STI clinic, computerised decision support system, electronic prompts	TC	Proportion of total population covered by service undergoing comprehensive testing. Arm 1: 26.32%, Arm 2: 48.83% (SRR 1.38, 95%CI 1.28-1.46 p<0.001)	Arm 1 n=1159, Arm 2 n=1413
Rudd, 2013 [38]	United States	Before/After	American Indian and Alaska Native people attending an Indian Health Service clinic	CT, HIV	**Electronic Medical Records**	TC	Proportion of active clinical patients undergoing CT testing	NA

First author, publication year (ref no.)	Country	Study design	Study population and setting	STIs[1]	Intervention[2]	Outcome [3]	Result	Sample number
					Arm 1: Pre-intervention, Arm 2: EMR CT testing reminder for eligible patients.		during period. Arm 1: 14.0%, Arm 2: 48.9%. [4]	
Field, 2014 [39]	United Kingdom	Ecological	Asymptomatic sexually active 15-24-year-olds attending primary care.	CT, NG	**Novel Testing Technology** Arm 1: Local authority using a CT/NG dual test, Arm 2: Local authority not using CT/NG dual test.	TC	Tests performed in community based and GUM setting in local authority per 100k population per year. Arm 1: 28600, Arm 2: 26200 (p=0.24).	64% (98/152) of LAs responded to this national survey;
Migliorini, 2015 [40]	United Kingdom	Before/After	Men attending HIV services (Not MSM specific) intervention.	CT, NG	**Novel Testing Technology** Arm 1: Pre-intervention, Arm 2: Post-introduction of dual probe testing.	TC	Proportion of MSM undergoing CT/NG testing. Arm 1: 26%, arm 2: 40%. (p=0.02*)	Arm 1: N=127, Arm 2: N=135.
Bogler, 2015 [41]	Canada	Retrospective chart review	Asymptomatic 19-25-year-old women attending primary care.	CT, NG, TP, HIV, HCV	**Screening and Triage** Arm 1: Pre-guidelines update, Arm 2: Post-update of cervical testing guidelines.	TC	Proportion of clinic attendees undergoing CT/NG screening. Arm 1: 40%, arm 2: 20.0%. OR of undergoing STI screening under the 2012 guidelines compared with the 2005 guidelines was 0.38 (95% CI 0.19 to 0.74; P = .003).	Arm 1: N=100, Arm 2: N=100.
Den Ouden, 2014 [42]	United States	Before/ After	Asymptomatic 16-25-year-old women attending an 'internal medicine office'	CT	**Screening and Triage** Arm 1: Clinical judgement-based recruitment to testing, Arm 2: Universal screening.	TC	Proportion of clinic attendees referred to CT testing. Arm 1: 8.5%, Arm 2: 28.8% p<0.001.	Arm 1: N=47, Arm 2: N=59.
Callander, 2013 [43]	Australia	Before/ After	MSM living with HIV attending primary care.	TP	**Screening and Triage** Arm 1: 3-4 monthly viral load testing (2005), Arm 2: 4-6 monthly viral load testing with opt out/automatic tests ordering (2007 and after).	TC	Proportion of MSM who switched from 4 monthly to 6 monthly viral load testing meeting targets of 3 TP tests per year. Arm 1 10%, Arm 2 41% (p<0.001). Proportion who had TP test done on same day as viral load test. Arm 1: 50%, Arm 2: 88% (p=0.001)	Arm 1: N=877, Arm 2: N=691.
Mckee, 2018 [3]	United States	Prospective cohort	Sexually active 13-19-year-olds attending primary care clinics	CT, NG, HIV	**Quality Improvement Patient Recruitment** Arm 1: Pre-intervention, Arm 2: Learning collaborative involving multidisciplinary teams, monthly clinical data feedback, pay for quality feedback, infrastructure, books for outreach programs, maintenance of certification credit.	TC	Proportion of healthcare management visit clinic attendees screened for CT or NG. Arm 1: 67%, 67%, Arm 2: 79.4%, 81% [4]	NA

First author, publication year (ref no.)	Country	Study design	Study population and setting	STIs[1]	Intervention[2]	Outcome [3]	Result	Sample number
Fine, 2017 [6]	United States	Before/ After	Men attending a primary care clinic.	CT	**Patient Recruitment Quality Improvement** Arm 1: Pre-QI intervention screening in primary care, Arm 2: Post QI intervention to increase coverage; in-reach [providers trained to encourage women to reach partners, friends, family community members mobilised to reach men in waiting rooms], community outreach, flow analyses to help program managers, training on 'culture of men', male appropriate brochures and materials.	TC	Arm 1: 34.8%, Arm 2: 41.8% (p<0.001).	Arm 1: N=4004, Arm 2: N=8385.
Zenner, 2012 [44]	United Kingdom	Case-control	15-24-year-old primary care attendees.	CT	**Patient Recruitment** Arm 1: Primary care trusts not using patient financial incentives, Arm 2: Primary care trusts using patient financial incentives.	TC	Proportion of eligible population undergoing testing before and during intervention. Arm 1: 2.4%, 2.7%, Arm 2: 2.5%, 3.4%. Average screening rate change 0.43% greater in PCTs using incentives compared to those not (p = 0.03).	Average eligible population per PCT. Arm 1: N=46,883, Arm 2: N=41,267. 42 pairs of PCTs.
McNulty, 2014 [45]	United Kingdom	RCT	15-24 -year-olds attending primary care clinics	CT	**Patient Recruitment** Arm 1: Passive recruitment, Arm 2: Recruitment by poster, television, and email.	TC	Average rate/100 15-24-year-olds undergoing CT screening Pre/During/Post-intervention. Arm 1: 2.61/100, 3.00/100, 2.82/100, Arm 2: 2.43/100, 4.34/100, 3.46/100. During intervention period, testing in intervention practices was 1.76 higher than in control practices (CI 1.24 to 2.48, p<0.011) (ITT).	NA
Graham, 2015 [46]	Australia	Before/ After	Primary care clinic attendees aged 15-29 years	CT, NG	**Quality Improvement** Arm 1: Pre-intervention, Arm 2: Quality Improvement Program (1. EMR data extraction, 2. Indicator development based on national guidelines, 3. Unconditional monetary	TC	Proportion of 15-29-year-olds attending ACCHS testing for CT and NG. Arm 1: CT 9%, NG 6%, Arm 2: CT 22% (p<0.001 Odds Ratio 1.43 95%CI 1.22-1.67), NG 20% (p<0.001)	Arm 1 n=1881, Arm 2 n=2259

First author, publication year (ref no.)	Country	Study design	Study population and setting	STIs[1]	Intervention[2]	Outcome [3]	Result	Sample number
					payments not based on performance, 4. systems assessment tool for STI program, 5. Coordinator follow-up 4-6-monthly for feedback and documentation.)			
Burstein, 2016 [47]	United States	Cross-sectional	Primary care clinic attendees	CT	**Quality Improvement** Arm 1: Pre-intervention, Arm 2: Triage algorithm, QI training on CT screening strategy recommendations	TC	Proportion of patients referred tested. Arm 1: 82%, Arm 2: 98%.[4]	NA
Carmona, 2015 [48]	United States	Case-control study	16-24-year-olds attending primary care.	CT	**Quality Improvement** Arm 1: Pre-intervention, Arm 2: Patient recruitment post-HCW training on minors rights, adolescent friendly services, screening/treatment guidelines.	TC	Proportion of clinic attendees undergoing CT testing in previous 12 months. Arm 1: 34%, Arm 2: 41%. [4]	Arm 1: N=NA, Arm 2: N=25430.
Howard, 2016 [49]	United States	Before/ After	Asymptomatic primary care clinic attendees aged 12-19 years	CT	**Quality Improvement** Arm 1: Pre-intervention. Arm 2: Physician education (one week rapid-QI event).	TC	Proportion tested of patients referred for testing. Arm 1: Annual screening rate 44%, Same day screening rate 26%. Arm 2: Annual screening rate 77% (p=0.04), Same day screening rate 59% (p=0.02).	Arm 1 n=240, Arm 2 n=106.
Park, 2017 [50]	United States	Cross-sectional Before/After	MSM living with HIV attending a primary care clinic	CT, NG, TP	**Quality Improvement** Arm 1: Pre-intervention, Arm 2: Quality improvement scheme, self-collection of swabs in clinic	TC	Proportion of eligible patients screened for NG/CT at any site. Arm 1: 45.2%, Arm 2: 58.3% (Ptrend <0.0001), Proportion of tested patients screened for NG/CT extra-genitally. Arm 1: 48.4%. Arm 2: 58.1%. (Ptrend <0.0001). Proportion of eligible patients screened for TP Arm 1: 73.6%, Arm 2: 76.8% (Ptrend= 0.0002).	Arm 1: n=4499, Arm 2: n=5866.
Washburn, 2014 [51]	United States	Before/ After	<25-year-old females attending primary care clinics.	CT	**Quality Improvement** Arm 1: Pre-intervention, Arm 2: Post-intervention; technical assistance, aggregation/analysis of data, recommendations, provider training, access to webinars, materials on guidelines.	TC	Proportion of clinic attendees undergoing CT screening. Arm 1: 41%, Arm 2: 55.8% (p<0.001)	Arm 1: N=4564, Arm 2: N=6011.

First author, publication year (ref no.)	Country	Study design	Study population and setting	STIs[1]	Intervention[2]	Outcome [3]	Result	Sample number
Snow, 2013 [52]	Australia	Cohort, Before/ After	MSM attending primary or sexual health clinics without sexual health nurse	CT, NG, TP, HIV	**Quality Improvement** Arm 1: Clinic A, sexual health nurse introduced (period 1 before, period 2, during, period 3 after nurse introduced). Arm 2: Clinic B, no nurse introduced (periods 1, 2, 3 at same time as arm 1 but with no nurse introduced)	TC	Proportion of clinic attendees undergoing complete testing for TP/CT/NG/HIV. Arm 1: before 38.3%, during 41%, after 47%. (during to after p<0.01) Arm 2: before 20.6%, during 25.3%, after 23% (during to after p<0.01). HIV negative at clinic A: 41% to 47% (p<0.01). HIV positive at clinic A: 27% to 43% (p<0.001)	Period 1, 2, 3. Arm 1: N=1000, 1011, 1042; Arm 2: N=3664, 3836, 3870.
Guy, 2018 [54]	Australia	Cluster-randomised controlled trial	16-29-year-old users of health services serving predominantly indigenous regional, remote, or very remote communities.	CT, NG	**Novel Testing Technology** Arm 1: Triage algorithm; syndromic CT/NG or high-risk management, Arm 2: Syphilis Point-of-care test-based algorithm.	LTC	Proportion of individuals testing positive for CT/NG treated within 7 days. Arm 1: 47%, Arm 2: 76%. (RR 1·66, 1·41–1·93; p<0·0001	Arm 1: N=405, Arm 2: N=455.
Rodriguez-Hart, 2015 [55]	United States	Cross-sectional	Symptomatic 12-84-year-olds in county health department clinics.	CT, NG, TP	**Results Reporting** Arm 1: Patient results reporting by text, Arm 2: Patient results reporting by 'traditional notification', call back for information or home visits.	LTC	Proportion of total population testing positive treated within 10 days. Arm 1: 88%, Arm 2: 80% (p=0.015).	Arm 1: N=345, Arm 2: N=208.

1. STIs: CT=chlamydia; NG=gonorrhoea; TP: syphilis; HCV=Hepatitis C
2. Arm 1: Control [if standard of care] or Intervention 1, Arm 2: Intervention 1 [If control standard of care], or Intervention 2, Arm 3: Intervention…
3. Outcomes: ATT=Access to testing; TC=Testing coverage; LTC=Linkage to care
4. No p-value reported

NA=Data not available

Table 1b. Initiatives in sexual health clinic settings (N=28)

First author, publication year (ref no.)	Country	Study design	Study population and setting	STIs[1]	Intervention[2]	Outcome [TC/LTC/ATT][3]	Result	Sample number
Wallace, 2015 [56]	United Kingdom	RCT	17-57-year-old female sexual health clinic attendees.	CT, NG	**Self-sampling** Arm 1: Clinic based HCW collected swabs, Arm 2: Clinic based self-collected swabs	ATT	Proportion of tested individuals agreeing/strongly agreeing with preferring sample collection method. Arm 1: 42%, Arm 2: 34%. [4]	NA
Gratrix, 2015 [57]	Canada	Cross-sectional	Sexual health clinic attendees.	CT, NG, Syphilis, HIV	**Express testing** Arm 1: Standard of care clinic testing, Arm 2: Express testing without clinical examination [if eligible 'low risk']	ATT, LTC	Median time with RN (minutes) female & male. Arm 1: 38 (IQR 30-50), 20 (IQR 24-40), Arm 2: 25 (IQR 20-32) p<0.001, 21 (IQR 16-27) p<0.001. Median days to treatment from positive test result. Arm 1: 6 (IQR 5-9), Arm 2: 6 (IQR 5-8) p=0.86.	ATT. Arm 1: N=4789, Arm 2: N=2425. LTC. Arm 1: N=205, Arm 2: N=154.
Gamagedara, 2014 [4]	Australia	Before/ After	Sexual health clinic attendees	CT, HIV	**Express testing** Arm 1: Standard vs EPS, Arm 2: ETS vs non-ETS	ATT, TC	Median consultation time (minutes) Arm 1: 20 vs 17 (p<0.001), Median total mins spent in clinic 60 vs 43(p<0.001) Arm 2: Median consultation time (minutes) 6 ETS vs 20 non-ETS(p<0.001) Median total time in clinic (minutes): 29 ETS vs 50 non-ETS (p<0.001) Proportion of clinic attendees testing for CT. Arm 1: 68%, 70% (p<0.015). Arm 2: 97%, 64% (p=0.001)	Arm 1: pre/post: N=8774, N=28049, Arm 2: N=4387, N=23662.
Zou, 2013 [58]	Australia	Cohort, Before/After	MSM attending sexual health clinic.	CT, NG, TP, HIV	**Patient recruitment** Arm 1: Pre-intervention historic control, Arm 2: Concurrent control, Arm 3: Patient reminder in computer assisted self-interview system	TC	Proportion of patients attending testing at least once for a complete set of CT/NG /TP/HIV. Arm 1: 21.5%, Arm 2: 25.5%, Arm 3: 39.0%	Arm 1: N=1800, Arm 2: N=1382, Arm 3: N=3132.

First author, publication year (ref no.)	Country	Study design	Study population and setting	STIs[1]	Intervention[2]	Outcome [TC/LTC/ATT][3]	Result	Sample number
					to undergo TP testing + option to receive email/text reminders at 3/6/12 months.		(p<0.001 vs. historical control).	
Trubiano, 2015 [59]	Australia	Before/After	MSM living with HIV attending sexual health clinics.	TP	**Patient recruitment Quality Improvement** Arm 1: Pre-intervention, Arm 2: enhanced syphilis screening through physician/nurse education and reminders to perform TP testing with HIV viral load.	TC	Proportion of patients undergoing HIV viral load and syphilis testing during assessment period. Arm 1: 23%, Arm 2: 55% (p<0.0001).	Arm 1: N=574, Arm 2: N=574.
Parthasarathy, 2013 [60]	India	Before/ After	Key populations MSM and CSWs) using an HIV prevention service in high HIV prevalence states.	TP	**Novel testing technology** Arm 1: Pre-intervention [prior to introduction of Immunochromatographic Strip Test (ICST) [largely RPR based testing], Arm 2: following introduction of ICST based testing	TC	Proportion of clinic attendees receiving syphilis screening. Arm 1: 9.0%, Arm 2: 21.6% (p<0.001).	Arm 1: N=169612, Arm 2: N=286990. MSM=82000 (no denominator by arm for MSM).
Jesus, 2014 [61]	Brazil	Non-randomised intervention	Sexual health clinic attendees.	Syphilis	**Novel testing technology** Arm 1: Algorithm 1; Treponemal antibody, if positive VDRL (results in 10 working days), Arm 2: Treponemal Rapid Test (TPRT results in 15m) if positive VDRL, Arm 3: TPRT + VDRL, if TPRT positive VDRL results in one hour.	TC	Proportion of individuals undergoing testing with each algorithm for whom results were received for syphilis and STD testing. Arm 1: 62.8%, 32.1%, Arm 2: 64.0, 29.3%, Arm 3: 100%, 43.1%. (p<0.001 vs. arm 1 in all cases).	Arm 1: N=351, Arm 2: N=307, Arm 3: N=322.
Peterson, 2018 [62]	United States	Before/After	<25-year-olds attending family planning clinics.	CT	**Quality Improvement** Arm 1: Pre-intervention, Arm 2: 3 months post implementation of one of 3 screening coverage interventions (not described), Arm 3: 6 months post implementation.	TC	Proportion of clinic attendees undergoing CT testing. Arm 1: 45%, Arm 2: 85%, Arm 3: 88% [4]	Arm 1: NA, Arm 2: N=741, Arm 3: 612.

First author, publication year (ref no.)	Country	Study design	Study population and setting	STIs[1]	Intervention[2]	Outcome [TC/LTC/ATT][3]	Result	Sample number
Dowshen, 2015 [63]	United States	Before/ After	13-17-year-olds attending family planning clinics.	CT, NG, Syphilis, HIV	**Patient recruitment** Arm 1: Pre-intervention, Arm 2: Recruitment campaign; campaign website, outreach worker at campaign events, shirts/wristbands, public advertising with QR codes.	TC	Proportion tested for any STI tested for CT/NG, Syphilis. Arm 1: 5.4%, 5.4%, Arm 2: 94.8%, 18.8% (p<0.01).	Arm 1: N=4386, Arm 2: N=4628.
Barbee, 2016 [64]	United States	Before/ After	Asymptomatic MSM Living with HIV attending HIV care clinic	CT, NG, TP	**Patient recruitment** Arm 1: Baseline/passive HIV clinic recruitment. Arm 2: Clinician education + waiting room advertising + clinician or patient initiated recruitment + self testing in clinic	TC	Proportion tested of eligible for CT/NG any site Arm 1: 44.1% Arm 2: 51.0% (p<0.001). Proportion tested for CT/NG all three sites Arm 1: 16.0%, Arm 2: 30.9% (p<0.001). Proportion tested for syphilis Arm 1: 63.3%. Arm 2: 64.6% (p<0.44).	Arm 1: n=1520, Arm 2: n=1510.
Chow, 2012 [65]	United States	Cross-sectional	Family planning clinic attendees.	CT	**Funding and care delivery structures** Arm 1: Public funded clinics Arm 2: Private funded clinics Arm 3: Title X clinics	TC	Proportion of clinic attendees undergoing CT screening <25 years old, 26+ years old. Arm 1: 54.3%, 55%, Arm 2: 63.8%, 61%, Arm 3: 64.4% (p<0.001 t test for trend), 53.5%.	Arm 1: N=461, Arm 2: N=883, Arm 3: N=274.
Morgan, 2012 [66]	New Zealand	Before/After	Individuals recruited from a range of clinical sites (GP, sexual health, family planning, university health centre etc.	CT	**Quality Improvement** Arm 1: Pre-intervention, Arm 2: During QI intervention; 3 face to face provider continuing medical education sessions, Arm 3: Post-intervention period.	TC	Ratio of tests performed over population [crude estimate] in males and females. Arm 1: 1.4%, 6.3%, Arm 2: 1.5%, 6.4%, Arm 3: 1.4%, 6.3%[4]	Male/Female. Arm 1: 2450, 11404, Arm 2: 2621, 11676, Arm 3: 2441, 11765.
Muldrew, 2016 [67]	United States	Before/ After	MSM attending a municipal STD clinic.	CT, NG,	**Screen and triage** Arm 1: Triage algorithm; targeted TP testing based on clinical judgement (before), Arm 2: Universal TP screening (after)	TC	Proportion of visits in which universal screening took place. Arm 1: 60.6%, Arm 2: 67.1% p<0.001.	Arm 1: N=1346, Arm 2: N=1637.

First author, publication year (ref no.)	Country	Study design	Study population and setting	STIs[1]	Intervention[2]	Outcome [TC/LTC/ATT][3]	Result	Sample number
Forbes, 2014 [68]	United Kingdom	Cross-sectional	MSM attending sexual health clinics.	CT, NG, TP, HIV	**Funding and care delivery structures** Arm 1: Community-based Contraception and Sexual Health clinic. Arm 2: Standard of care 'GUM' Sexual health clinic.	TC	Proportion of clinic attendees accepting 'CT and NG testing only'. Arm 1: 11.3%. Arm 2: 7.8% (p=0.20*) 'CT/NG, TP, and HIV testing' Arm 1: 64.5%. Arm 2: 75.5% (p=0.01*)	Arm 1: N=124, Arm 2: N=592.
Scarborough, 2015 [69]	United States	Before/ After	MSM living with HIV attending HIV primary care.	CT, NG, TP	**Screen and triage** Arm 1: Baseline, o triage, Arm 2: Didactic clinician training. Universal risk assessment on registration with low and high risk eligible for annual and 3 monthly screening respectively.	TC	Proportion of HIV+ MSM clinic attendees screened for CT/NG at one or more sites. Arm 1: 31.6%, Arm 2: 40.1% p=0.01 at any anatomical site. Arm 1: 19.5%. Arm 2: 28.3%. p=0.003 at pharyngeal site. Proportion of HIV+ MSM clinic attendees screened for TP. Arm 1: 48.7% Arm 2: 58%, p = 0.009.	Arm 1: N=437, Arm 2: N=364.
Brook, 2014 [70]	United Kingdom	Before/ After	MSM under 28 years old using sexual health service.	CT, NG	**Patient Recruitment** Arm 1: Pre-intervention, Arm 2: Programme offering quadrivalent HPV vaccination with CT/NG testing.	TC	Rate of testing for CT/NG per person/year. Arm 1: 1.47, arm 2: 1.88 (p<0.05).	Arm 1: N=1203, Arm 2: N=793.
Creighton, 2014 [71]	United States	Before/After	People Living with HIV attending an HIV/AIDs primary care clinic.	CT, NG, TP	**Quality Improvement Screen and triage** Arm 1: Pre-intervention, Arm 2: Provider education, brief training, 2 champions identified, risk assessment tool introduced.	TC	Proportion of clinic attendees tested for CT/NG. Arm 1: 9.3% males and 8.9% females Arm 2: 9.5% males and 12.1% females[4]	Arm 1: N=521, Arm 2: N=557.
Nyatsanza, 2016 [72]	United Kingdom	Before/ After	High risk sexual health clinic attendees diagnosed with either CT or NG	CT, NG	**Self-sampling** Arm 1: Standard of Care, Arm 2: Routine self-taken extra-genital swab for CT and NG.	TC	Assessment of the detection rate of extra-genital infection after the introduction of self-collected swab sampling Self-taken: Before-4.4% vs After-19% (p<0.001), Rectal: 2% vs 9.9% (p<0.001)	Arm 1: n=408, Arm 2: n=404.

First author, publication year (ref no.)	Country	Study design	Study population and setting	STIs[1]	Intervention[2]	Outcome [TC/LTC/ATT][3]	Result	Sample number
							Pharyngeal: 2.45% vs 11.8% (p<0.001)	
Kettinger, 2013 [73]	United States	Before/ After	Sexually active women <26 years seeking annual preventive and routine reproductive care at a university health centre.	CT	**Quality Improvement Screen and triage** Arm 1: Pre-intervention, Arm 2: Post-implementation of provider (nurse and clinician) educational intervention and policy to flag and screen women <26 years old for CT.	TC	Proportion of eligible clinic attendees undergoing CT testing. Screening to assess CT risk Arm 1:53.4% Arm 2: 76.1% (p=0.021) Received testing Arm 1: 44.4%, Arm 2: 64.6%.	Arm 1: N=133, Arm 2: N=130.
Rukh 2014, [74]	United States	Service evaluation	Sexual health clinic attendees.	CT, NG	**Express testing** Arm 1: Sexual health clinic testing with PV and nurse/PA sampling, Arm 2: Express testing with medical assistant sampling.	LTC	Proportion of CT/NG infections treated within 1 day. Arm 1: 85.2%, Arm 2: 1.1%. Proportion of CT/NG infections treated. Arm 1: 98.8%, Arm 2: 94.3%	Arm 1: N= 6323, Arm 2: N= 527
Whitlock, 2018 [5]	United Kingdom	Service evaluation	Sexual health clinic attendees	CT, NG	**Express testing** Arm1: Standard of care sexual health clinic, Arm 2: Express testing of asymptomatic patients with self-collected samples	LTC	Mean time from clinic appointment to test result notification. Arm 1: 8.95 days (95% CI 8.91–8.99 days), Arm 2: 0.27 days (95% CI 0.26–0.28 days)[4]	Arm 1: N=40,982, Arm 2: N=102,060.
Snow, 2016 [75]	Australia	Before/ After	Attendees of a large urban sexual health clinic.	NG	**Novel testing technology** Arm 1: Gonococcal culture based testing algorithm, Arm 2: NAAT based testing algorithm.	LTC	Median time from results reporting to treatment (days). Arm 1: 3, Arm 2: 4 (p=0.4).	Arm 1: N=50, Arm 2: N=189.
Wingrove, 2014 [76]	United Kingdom	Cohort	Sexual health clinic attendees.	CT, NG	**Novel testing technology** Arm 1: Laboratory based testing (unspecified). Arm 2: Testing in Sexual health clinic with POC GeneXpert	LTC	Median time from testing positive to management. Arm 1: 10 days (IQR: 7-11 days). Arm 2: 2 days (IQR: 1-6 days)[4]	NA
Bartelsman, 2015 [77]	Netherlands	Before/ After	'High risk' patients: MSM, Symptomatic, notified partner, involved in CSW, uninsured Sub-Saharan African.	CT	**Screen and triage** Arm 1: Triage algorithm 1; Gram stain in all high risk, Arm 2: Triage algorithm 2; Gram stain in all high risk symptomatic.	LTC	Proportion of Aptima CT assay positive patients confirmed treated. Arm 1: 98.2%, Arm 2: 97.7% (p=0.26). Proportion of Aptima CT assay positive patients treated after delay. Arm 1: 10.5%, Arm 2: 22.8% (P<0.001).	Arm 1: N=901, Arm 2: N=2171.

First author, publication year (ref no.)	Country	Study design	Study population and setting	STIs[1]	Intervention[2]	Outcome [TC/LTC/ATT][3]	Result	Sample number
Cohen, 2017 [78]	United States	Before/ After	Men attending AIDS Healthcare Foundation Wellness Centres	CT, NG, Syphilis	**Results reporting** Arm 1: Results reporting by phone call, Arm 2: Patient results reporting through online patient engagement platform and smartphone application.	LTC	Mean days from test to treatment. Arm 1: 11.67 95%CI (10.63, 12.70), Arm 2: 10.15 95%CI (9.39, 10.91). OLS regression model found Healthvana implementation overall mean reduction of a little more than 2 days (coefficient = 2.36) from overall test to treatment (P = 0.127; 95% CI = –4.14, 0.57	Arm 1: N=424, Arm 2: N=493.
Anschuetz, 2018 [79]	United States	Before/ After	Sexual health clinic attendees	CT, NG	**Result reporting** Arm 1: Patient result reporting, Pre-texting Arm 2: Patient result reporting using a texting strategy reporting	LTC	Proportion of positive patients Referred for specialist treatment/documented treated. Arm 1: 71%/91%. Arm 2: 37%/92%. Mean days to treatment from diagnosis. Arm 1: (11.7 days, 95% CL 10.5 -12.9 days), Arm 2: 14.0 days, 95% CL 12.2-15.9 days).[4]	Arm 1: n=163, Arm 2: n=119.
Bilello, 2018 [80]	United States	Non randomised intervention	Sexual health clinic attendees	CT, NG, Syphilis	**Results reporting** Arm 1: Patient results reporting by text, Arm 2: Patient results reporting by appointment or phone.	LTC	Proportion testing positive treated within 1-4 days (per protocol) Arm 1: 56.9%, Arm 2: 40.8% p<0.001).	Arm 1: N=469, Arm 2: N=3385.
Alderton, 2018 [81]	United States	Before/ After	Sexual health clinic attendees	NG	**Results reporting** Arm 1: Patient reporting by online portal. Arm 2: Patient reporting by phone, Patient Education.	LTC	Proportion of cases testing positive treated within 7 days. [Pharyngeal/rectal/urethral] Arm 1: 63.1%/72.2%/82.4%. Arm 2: 79.4%/81.5%/90.9%.[4]	[Pharyngeal/rectal/urethral] Arm 1: (n=128/153/346). Arm 2: (n=313/291/580).

1. STIs: CT=chlamydia; NG=gonorrhoea
2. Arm 1: Control [if standard of care] or Intervention 1, Arm 2: Intervention 1 [If control standard of care], or Intervention 2, Arm 3: Intervention…
3. Outcomes: ATT=Access to testing; TC=Testing coverage; LTC=Linkage to care
4. No p-value reported

NA=Data not available

Table 1c. Initiatives in antenatal care settings (N=18)

First author, publication year (ref no.)	Country	Study design	Study population and setting	STIs[1]	Intervention[2]	Outcome [TC/LTC/ ATT][3]	Result	Sample number
Flores, 2015 [82]	Peru	Before/ After	Pregnant women attending hospital for antenatal care.	TP, HIV	**Novel testing technology** Arm 1: Standard of care, Arm 2: Point-of-care BIOLINE HIV 1/2 3.0 and BIOLINE Syphilis 3.0 tests.	ATT	Median testing time in clinic (Minutes). Arm 1: 111-140, Arm 2: 45. Time to result (days). Arm 1: 15-30, Arm 2: 0 (results on first appointment). [4]	Arm 1: HIV=819 Syphilis: 354 Arm 2: HIV N=387 Syphilis=398.
Kasaro, 2018 [83]	Zambia	Cross-sectional	18+ year-old pregnant women attending antenatal care.	TP, HIV	**Novel testing technology** Arm 1: Testing with Chembio Dual Path POC HIV/syphilis dual test, Arm 2: Testing with SD BIOLINE POC HIV/syphilis dual test.	ATT	Score/25 based on clarity of kit instructions, ease of use, ease of control of reading window time, ease of results interpretation, rapidity of test results, hands on time, training time. Arm 1: 20.1, Arm 2: 20.2 (p=0.69).	Arm 1: N=318, Arm 2: N=316.
Nnko, 2016 [84]	Tanzania	Before/ After	Pregnant women attending antenatal care.	TP	**Novel testing technology** Arm 1: RPR screening algorithm with return for results appointment Arm 2: RST screening algorithm with same-day appointment for results.	ATT, TC, LTC	Time to result. Psych sociological barriers. Arm 1: Results collection 2 days after testing with associated transport costs, syringe phlebotomy requires more blood/pain, Arm 2: results within 30m, lower transport cost, less blood/pain with finger-prick. Proportion of clinic attendees tested. Arm 1: 17.9%, Arm 2: 100% (p<0.01). Proportion testing positive undergoing antibiotic therapy. Arm 1: 46.3%, Arm 2: 94.8% (p<0.01).	TC. Arm 1: N=3561, Arm 2: N=7954. LTC. Arm 1: N=108, Arm 2: N=909.
Gaitan Duarte, 2016 [85]	Colombia	Cluster randomised open-label clinical trial	14+ year-old pregnant females attending first antenatal check.	TP, HIV	**Novel testing technology** Arm 1: Separate POC tests, SD BIOLINE syphilis 3.0 and the SD BIOLINE HIV 3.0, Arm 2: Dual POC test, SD BIOLINE HIV/Syphilis Duo.	ATT, TC, LTC	Proportion rating strategy acceptable. Arm 1: 99.8%, Arm 2: 99.6%. Proportion of population covered by service undergoing testing. Arm 1: 100%, Arm 2: 100%. Proportion testing positive treated for syphilis at any time. Arm 1: 82.5%, Arm 2: 100% (RR, 1.11; 95% CI: 1.01–1.21)	ATT: Arm 1: N=1048, Arm 2: N-1166. LTC: Arm 1: N=29, Arm 2: N=20.
Dassah, 2015 [86]	Ghana	Before/After	Pregnant women 18-46 years old attending antenatal care.	TP, HIV	**Novel testing technology** Arm 1: Pre-intervention, Arm 2: POC syphilis-based testing.	TC	Proportion attending antenatal testing receiving syphilis testing. Arm 1: 26.9%, (50% after multivariable adjustment) Arm 2: 18.1% (33.6% after multivariable adjustment) (p=0.47 for univariate).	Arm 1: N=4141, Arm 2: N=4141.

First author, publication year (ref no.)	Country	Study design	Study population and setting	STIs[1]	Intervention[2]	Outcome [TC/LTC/ ATT][3]	Result	Sample number
Young, 2018 [87]	Kenya	Before/ After	Pregnant women attending ANC at dispensaries.	TP, HIV	**Novel testing technology** Arm 1: Standard of care, no routine ANC syphilis testing, Arm 2: routine ANC syphilis testing with POC SD BIOLINE Syphilis 3.0.	TC	Proportion of clinic attendees tested for any STI. Arm 1: 4.3%, Arm 2: 97.6%.[4]	Arm 1: N=529, Arm 2: N=586.
Wang, 2018 [88]	China	Service evaluation	Pregnant women attending antenatal care.	TP, HIV	**Novel testing technology** Arm 1: 'Standard' syphilis blood testing assay-based testing, Arm 2: Rapid combined dual HIV/syphilis based testing.	TC	Proportion of clinic attendees undergoing syphilis testing. Arm 1: 76%, Arm 2: 90.1% (($\chi 2$ =197.1, p<0.001)	Arm 1: N=3269, Arm 2: N=1787.
Kamb, 2013 [89]	Kenya	Service evaluation	Pregnant women attending rural antenatal clinics.	TP	**Novel testing technology** Arm 1: Standard of Care prior to introducing RST, Arm 2: Rapid Syphilis Test.	TC	Proportion of clinic attendees undergoing syphilis testing, Arm 1: 18%, Arm 2: 70% (p<0.001).	Arm 1: N=1586, Arm 2: N=1614.
De Schacht, 2015 [90]	Mozambique	Quasi-experimental design	Pregnant women attending rural public health facilities.	TP	**Novel testing technology** Arm 1: Laboratory based (RPR) testing, Arm 2: Rapid HCW performed POC BIOLINE 3.0 Syphilis testing.	TC	Proportion of randomly selected women attending clinic undergoing syphilis testing Crude & Adjusted (multivariable). Arm 1 82.3%, 80.8%, Arm 2 85.5% (p=0.075), 87% (p=0.282).	Arm 1: N=865, Arm 2: N=808.
Pant Pai, 2018 [91]	India	Before/After	18+ year-old pregnant women using peripheral service units.	TP, TV, HIV, HBV, HCV	**Novel testing technology** Arm 1: Pre-intervention, Arm 2: Following introduction of AIDESMART 'app-based, cloud-connected, rapid screening strategy [offering] multiplex screening for STBBIs and anaemia at the point of care.'	TC	Proportion of service users estimated (lab confirmed) to undergoing syphilis or TV testing in the past 6 months [arm 1] or during intervention period [arm 2]. Arm 1: 42%, 0.4% Arm 2: 100%, 100%. [4]	Arm 1: N=510, Arm 2: N=510.
Smith, 2015 [92]	Guatemala	Before/After	Pregnant women attending antenatal care.	TP, HIV, HBV	**Novel testing technology** Arm 1: Standard of care HIV/syphilis testing in antenatal care, Arm 2: Universal triple testing (HIV/syphilis/HBV).	TC	Proportion of antenatal care attendees undergoing syphilis testing. Arm 1: 49.6%, Arm 2: 50.3%. (p=0.87)	Arm 1: N=901, Arm 2: N=1 793.
Oliveira-Ciabati, 2017 [93]	Brazil	Cluster randomised trial	Pregnant 18+ year-old women attending primary healthcare units and hospitals.	TP, HIV.	**Patient recruitment** Arm 1: Passive recruitment, Arm 2: Patient recruitment by posters, flyers, and PRENACEL weekly texting (including Q&A option).	TC	Proportion of clinic attendees undergoing 3 syphilis tests. Arm 1: 24.8%, Arm 2: 40.5%. p=0.03 (adjusted multivariate ITT).	Arm 1: N=440, Arm 2: N=116.
Severe, 2013 [94]	Haiti	Sequential time series.	Pregnant women attending primary care clinics for HIV testing.	TP	**Novel testing technology Quality Improvement** Arm 1: Pre-implementation of rapid test, Arm 2: During Rapid syphilis SD	TC, LTC	Proportion of clinic attendees undergoing syphilis testing. Arm 1: 91.5%, Arm 2: 95.9% (p<0.001 vs. 1), Arm 3: 95.8%, Arm 4: 96.8% (p<0.001 vs. 1). Proportion of	TC. Arm 1: N=34 776,

First author, publication year (ref no.)	Country	Study design	Study population and setting	STIs[1]	Intervention[2]	Outcome [TC/LTC/ ATT][3]	Result	Sample number
					BIOLINE based testing implementation, Arm 3: Post Rapid testing implementation, pre-implementation of QI initiative, Arm 4: Post Systems Based QI initiative implementation.		syphilis positive pregnant women treated. Arm 1: 70.3%, Arm 2: 74.7%, Arm 3: 70.2%, Arm 4: 84.3% (p<0.001 vs. 1).	Arm 2: N=16 025, Arm 3: N=14 137, Arm 4: N=16 435. ATT: Arm 1: N=1 397, Arm 2: N=652, Arm 3: N=543, Arm 4: N=630.
Strasser, 2012 [95]	Uganda, Zambia	Before/After	Pregnant women attending antenatal care.	TP, HIV	**Novel testing technology** Arm 1: Pre-intervention, Arm 2: Rapid syphilis SD BIOLINE Syphilis 3.0 based testing.	TC, LTC	Proportion of first ANC visit attendees tested for syphilis in Zambia and Uganda. Arm 1: 79.9, 1.7% Arm 2: 95.6% (p<0.001), 90.3% (p<0.001) . Proportion of syphilis positive pregnant women treated in Zambia and Uganda. Arm 1: 51.1%, 0%, Arm 2: 95.2% (p<0.001), 103.6% (p<0.001).	TC. Arm 1 N=15 967, N=8 475 Arm 2: N=11 985, N=14 540. LTC. Arm 1: N=523, N=72 Arm 2: N=1 050, N=690.
Garcia, 2013 [96]	Peru	Before/After	Pregnant women attending antenatal checks in hospitals and health centres for ANC, miscarriage, and labour.	TP, HIV	**Novel testing technology** Arm 1: RPR based algorithm, Arm 2: POC syphilis SD BIOLINE 3.0H based algorithm	TC, LTC	Proportion of women attending antenatal care undergoing screening in sites in group 1 or group 2. Arm 1: 35%, 68%, Arm 2: 93% (p<0.001), 95% (p<0.001).	Arm 1 + Arm 2: N=18 105.
Bonawitz, 2015 [97]	Zambia	Quasi-experimental design	Pregnant women attending antenatal checks.	TP	**Novel testing technology** Arm 1: Laboratory based (RPR) testing, Arm 2: Rapid HCW performed POC testing (assay not specified) [midline], Arm 3: Rapid test [endline]	TC, LTC	Proportion of pregnant women screened for syphilis at first ANC visit. Arm 1: 10.3%, Arm 2: 67.5% Arm 3: 56.3% (p<0.001 for midline and endline compared to baseline). Proportion of patients testing positive receiving penicillin (pre-intervention,	TC. Arm 1: N=1 365, Arm 2: N=1 446, Arm 3: N=1 337. LTC.

First author, publication year (ref no.)	Country	Study design	Study population and setting	STIs[1]	Intervention[2]	Outcome [TC/LTC/ ATT][3]	Result	Sample number
							endline). Arm 1: 50%, Arm 3: 13% (p=0.199).	Arm 1: N=2, Arm 2: N=23.
Betran, 2018 [98]	Mozambique	Pragmatic, stepped-wedge, cluster-randomised controlled trial	Pregnant women attending antenatal care services.	TP	**Novel testing technology** Arm 1: Pre-intervention, Arm 2: Post-intervention; antenatal care kits, supply cupboard, tracking sheet, training session.	TC, LTC	Proportion of clinic attendees undergoing testing for syphilis at first antenatal visit. Arm 1: 65.7%, Arm 2: 95.5% (p<0·0001). Proportion of syphilis positive cases undergoing treatment. Arm 1: 60.8%, Arm 2: 82.6% (p= 0·0001).	TC. Arm 1: N=37 826, Arm 2: N=30 772. LTC. Arm 1: N=1 106, Arm 2: N=807.
Wynn, 2018 [99]	Botswana	Prospective cohort	18+ year-old pregnant women attending antenatal care.	CT, NG, TV	**Results reporting** Arm 1: Same day appointment-based results reporting and treatment, Arm 2: Same day phone-based results reporting and treatment, Arm 3: Delayed results reporting and treatment (including one woman who didn't receive treatment).	LTC	Proportion testing positive for CT/NG and TV treated. Arm 1: 100%, Arm 2: 100%, Arm 3: 66.6%	Arm 1: N=40, Arm 2: N=8, Arm 3: N=6.

1. STIs: CT=chlamydia; NG=gonorrhoea; TV=trichomoniasis; HBV=hepatitis B; HCV=hepatitis C
2. Arm 1: Control [if standard of care] or Intervention 1, Arm 2: Intervention 1 [If control standard of care], or Intervention 2, Arm 3: Intervention…
3. Outcomes: ATT=Access to testing; TC=Testing coverage; LTC=Linkage to care
4. No p-value reported
NA=Data not available

Table 1d. Initiatives in emergency department and other hospital settings (N=12)

First author, publication year (ref no.)	Country	Study design	Study Population & Setting	STIs[1]	Intervention[2]	Outcome [TC/LTC/ATT]3	Result	Sample Number
Lewis, 2016 [100]	United States	Before/After	Female emergency department attendees.	TV	**Novel testing technologies** Arm 1: Pre-intervention, Arm 2: Introduction of self-collected trichomonas rapid test.	ATT	Proportion of women think self-testing was 'not at all hard'. Arm 1: 66%, Arm 2: 83% p<0.001.	N=150.
Postenrieder, 2016 [101]	United States	Before/After	14-20-year-old urban paediatric academic centre emergency department attendees.	TV	**Novel testing technologies** Arm 1: Testing set in EMR wet mount + TV culture Arm 2: Testing set in EMR wet mount + Rapid Antigen Test	LTC	Proportion testing positive treated during ED encounter. Arm 1: 69.8%, Arm 2: 96.8%, p<0.005.	Arm 1: N=43, Arm 2: N=31.
May, 2016 [102]	United States	RCT	>18-year-old symptomatic urban emergency department attendees	CT	**Novel testing technologies** Arm 1: ROCHE AMPLICOR PCR based testing, Arm 2: Rapid GeneXpert NAAT based testing.	LTC	Proportion of patients that tested negative prescribed antibiotics empirically. Arm 1: 55%, Arm 2: 21.6%, difference -33.4. 95% CI (−58.9 to -7.9) RR 0.39, 95% CI (0.19–0.82.)	Arm 1: N=20, Arm 2: N=37.
Rivard, 2016 [103]	United States (English)	Service Evaluation	15+ year-old emergency department attendees.	CT, NG	**Novel testing technologies** Arm 1: Hologic Gen-Probe Aptima Combo 2 NAAT, Arm 2: GeneXpert CT/Neisseria gonorrhoea	LTC	Proportion of patients testing positive receiving appropriate treatment. Arm 1: 60%, Arm 2: 72.5% (p = 0.008). Median time to patient notification of positive results (min-max). Arm 1: 17.4hours [0.0–93.0], Arm 2: 53.7 hours [26.9–79.9] (p=0.010).	Arm 1: n=200, Arm 2: n=200.
Gaydos, 2018 [104]	United States (English)	RCT	18-50-yearold female emergency department attendees undergoing pelvic examination as part of ED standard of care.	CT, NG	**Novel testing technologies** Arm 1: Deferred NAAT (2-3 days turn around time) , Arm 2: POC GeneXpert, testing (90-100 minutes turn around time).	LTC	Proportion of positive cases correctly managed for CT and NG according to arm. Arm 1: Ct: 53.8%, NG: 42.9%, Arm 2: CT:100%, NG:100%.[4]	Arm 1 n=127, Arm 2 n= 127.

First author, publication year (ref no.)	Country	Study design	Study Population & Setting	STIs[1]	Intervention[2]	Outcome [TC/LTC/ATT]3	Result	Sample Number
Ako, 2016 [105]	United States (English)	RCT	Female emergency department attendees undergoing pelvic exam and STI testing.	CT, NG	**Novel testing technologies** Arm 1: NAAT, Arm 2: POC GeneXpert.	LTC	Proportion of positive patients receiving antibiotics CT/NG. Arm 1: 41.7%/33.3%, Arm 2: CT 100%(p<0.017)/100%(p <0.061).	Arm 1: CT n=8 Neisseria gonorrhoea n=5, Arm 2: CT n=7 Neisseria gonorrhoea n=5.
Territo, 2016 [106]	United States	Before/After	Symptomatic female 13-20-year-old emergency department attendees.	TV	**Screening and Triage** Arm 1: Pre-intervention, Arm 2: Implementation of routine trichomonas testing into STI testing protocol.	TC, LTC	Proportion of individuals tested for any STI undergoing testing for TV. Arm 1: 13%, Arm 2: 99.5% (Chi2=5 p< .001.), Proportion of laboratory confirmed TV cases undergoing treatment. Arm 1: 100%, Arm 2: 95% (p=0.688).	TC. Arm 1: N=234, Arm 2: N=213. LTC. Arm 1: N=3, Arm 2: N=39.
Ahmad, 2014 [107]	United States	Before/After	15-21-year-old emergency department attendees.	CT, NG	**Electronic medical records** **Patient education** Arm 1: Pre-intervention, Arm 2: Post-implementation of provider education lectures, Arm 3: During implementation of Audio Computer Assisted Self Interview (ACASI) with provider ACASI education, Arm 4: Post-ACASI with ongoing provider education.	TC	Proportion of ED attendees offered testing. Arm 1: 9.7%, Arm 2: 9.3%, (95% CI difference -1.7%-2.4%) (p<0.001 vs arm 1), Arm 3: 17.8%, (95% CI difference 6.1%-10.8%) (p<0.001 vs arm 1), Arm 4: 12.4%. (95% CI difference 2.7%-7.9%) (p<0.001 vs arm 1).	Arm 1: 3 929, Arm 2: 982, Arm 3: 2 601, Arm 4: 909.
Goyal, 2017 [108]	United States	RCT	14-19-year-olds attending paediatric emergency department.	CT, NG	**Electronic medical records** Arm 1: Universal screening based on physician decisions with computerised sexual health screening, Arm 2: Universal screening based on physician decisions without computerised sexual health screening	TC	Proportion of high risk on sexual health screen tested. Arm 1: 52.3%, Arm 2: 42% aOR 2 [95% CI 1.1, 3.8]	Arm 1: N=367, Arm 2: N=353.
White, 2012 [109]	United Kingdom (English)	Before/After	Patients attending urban emergency department	CT, NG, TP	**Electronic medical records** Arm 1: Standard of care, Arm 2: STI laboratory order set.	TC	Proportion of NG/CT-Tested patients undergoing syphilis testing. Arm 1 41%. Arm 2 72%. Proportion of	Arm 1 n=1 263, Arm 2 n=1 241.

First author, publication year (ref no.)	Country	Study design	Study Population & Setting	STIs[1]	Intervention[2]	Outcome [TC/LTC/ATT]3	Result	Sample Number
							patient undergoing NG/CT testing. Arm 1: 5.6% Arm 2: 5.8% (absolute difference 31%, 95% CI 27% to 34%) (p = 0.57).	
McSorley, 2013 [110]	United Kingdom	Before/After	People living with HIV attending a district general hospital.	CT, NG, TP, HCV, LGV	**Electronic medical records** Arm 1: Pre-intervention (2009), Arm 2: Risk assessment and reminders for STI testing within EPR (2012).	TC	Proportion of cohort of people living with HIV attending care tested at least once per year. Arm 1: 90%, Arm 2: 97%.[4]	Arms 1: N=882, Arm 2: N=882.
Baird, 2014 [111]	United States	RCT	18-35-year-old females attending emergency department with non-STI complaints.	CT, NG	Education intervention Arm 1: Passive recruitment in ED, Arm 2: Patient brief educational/counselling intervention in ED.	TC	Proportion randomised to intervention accepting testing. Arm 1: 36% 95%CI (19%-53%), Arm 2: 48% 95%CI (32%-64%). [4]	Arm 1: N=90, Arm 2: N=81.

1. STIs: CT=chlamydia; NG=gonorrhoea; TV=trichomoniasis
2. Arm 1: Control [if standard of care] or Intervention 1, Arm 2: Intervention 1 [If control standard of care], or Intervention 2, Arm 3: Intervention…
3. Outcomes: ATT=Access to testing; TC=Testing coverage; LTC=Linkage to care
4. No p-value reported
NA=Data not available

Table 1e. Initiatives for outreach, community or home settings (N=31)

First author, publication year (ref no.)	Country	Study design	Study population and setting	STIs[1]	Intervention	Outcome [TC/LTC/ATT][3]	Result	Sample number
Sagor, 2016 [112]	United States	RCT	15-24-year-olds recruited at a youth centre and university.	CT	**Outreach** Arm 1: Pamphlet CT patient educational intervention, Arm 2: Website CT patient educational intervention.	ATT	Positive change in pre-intervention state of change. Arm 1: 67%, Arm 2: 56% p=0.46.	Arm 1: N=42, Arm 2: N=49.
Gourley, 2014 [113]	United States	Before/After	MSM outreach program users.	TP	**Outreach** Arm 1: Pre-intervention, Arm 2: 'Syphilis is Up' intervention	ATT	Proportion of MSM aware of testing service. Arm 1: 28%, Arm 2: 42%.[4]	NA
Wood, 2015 [114]	United Kingdom	Retrospective Cohort Service Evaluation	Asymptomatic MSM attending a local sauna or sexual health clinic.	CT, NG, TP, HIV	**Community-based testing** Arm 1: Monthly sauna outreach clinic, Arm 2: Health promotion worker supported self-collected home testing with mail in, Arm 3: Standard of care sexual health clinic testing.	TC	Proportion of first 30 tested patients accepting CT/NG or syphilis/HIV screening. Arm 1: 86.6%, 83.3%, Arm 2: 100%, 53.3%, Arm 3: 100%, (p=0.032 vs. arm 1), 100% (p<0.001 vs. arm 1).	Arm 1: N=30, Arm 2: N=30, Arm 3: N=30.
Lundgren, 2016 [115]	France (French)	RCT	Sexually active 18-24-year-olds attending primary care.	CT	**Self-sampling** Arm 1: Passive recruitment to testing, Arm 2: GP patient recruitment peer training intervention, distributing posters/flyers, Abbot multi-collect self-collection kits, condom.	TC	Proportion of consultations with a record of claim for CT test pre and post-intervention. Arm 1: 0.4%, 0.4%. Arm 2: 0.6%, 0.95%.[4]	Arm 1: N=55 080, N=54 777, Arm 2: N=5 697, N=5 981.
Van Den Broek, 2012 [116]	Netherlands	Step wedged RCT	16-29-year-olds listed in municipal registers	CT	**Self-sampling** Arm 1: Standard of care patient recruitment (passive recruitment), Arm 2: 3 year-long register-based programme of annual personalised invitations to eligible patient for annual CT screening through self-sampled home testing kits.	TC	Proportion of individuals randomised to intervention undergoing testing during trial period [arm 1] or following each invitation [arm 2]. Arm 1: 13.0%, Arm 2: 16.1%, 10.8%, 9.5%[4]	Total target population was 315 000 in 190 clusters, of which 39 were in the control group.

First author, publication year (ref no.)	Country	Study design	Study population and setting	STIs[1]	Intervention	Outcome [TC/LTC/ATT][3]	Result	Sample number
ten Hoor, 2014 [117]	Netherlands	RCT	16-29-year-olds using an online self-collected home-based testing service.	CT	**Self-sampling** Arm 1: Patient recruitment through original invitation letter to self-collected home-based testing, Arm 2: updated and improved invitation letter.	TC	Proportion randomised to intervention undergoing testing. Arm 1: 11.8%, Arm 2: 11.07%, p=0.82.	Arm 1: N=4 922, Arm 2: N=4 961.
Woodhall, 2015 [118]	United Kingdom	RCT	17-18-year-old primary care attendees.	CT	**Self-sampling** Arm 1: Patients given self-collected home-based testing kit in primary care, Arm 2: Patients given kit and voucher, Arm 3: Patients given access to online service to order self-collected home-based testing kit.	TC	Proportion randomised to intervention returning sample. Arm 1: 7.8%, Arm 2: 14% (p<0.001 vs. arm 1), Arm 3: 1.0%.	Arm 1: N=500, Arm 2: N=250, Arm 3: N=250.
Kersaudy-Rahib, 2016 [119]	France	RCT nested within non-randomised intervention	Sexually active 18-24-year-olds.	CT	**Self-sampling** Arm 1: Website directing patients to clinic-based sampling (GP, gynaecologist, screening centres) with 2/4 week reminders, Arm 2: Self collected home testing kits with return by mail [randomised group], Arm 3: as for Arm 2 [non-randomised group].	TC	Proportion of those randomised to intervention self-reporting testing [arm 1], or returning self-testing kit [arm 2]. Arm 1: 8.7%, Arm 2: 29.2%. RR 4.53 a multi-RR 4.55 (3.77 to 5.49) [4]	Arm 1: N=5 544, Arm 2: N=5 531.
Dolan, 2014 [120]	United Kingdom	Case-control	16-24-year-olds using an online and text chlamydia screening service.	CT	**Self-sampling** Arm 1: No incentive for return of self-collected sample returned by mail, Arm 2: £5 endowment, Arm 3: £5 voucher incentive on return, Arm 4: £10 voucher incentive, Arm 5: £10 endowment.	TC	Proportion using service returning samples within 30 days of request. Arm 1: 69.4%, Arm 2: 73.2% OR 1.17, Arm 3: 73.2% 1.20 Arm 4:, 72.5% OR 1.20, Arm 5: 68.0% OR 0.87 p>0.05 between incentive structures.	Total N= 2 988.

First author, publication year (ref no.)	Country	Study design	Study population and setting	STIs[1]	Intervention	Outcome [TC/LTC/ATT][3]	Result	Sample number
Bowden, 2012 [121]	Australia	Cross-sectional	16-30-year-olds.	CT	**Self-sampling** Arm 1: Patient outreach with self-collected sample implemented in college campuses, Arm 2: Health club, Arm 3: Aboriginal Youth Centre, Arm 4: Football club, Arm 5: Motorsports festival.	TC	Proportion reached by outreach undergoing CT testing. Arm 1: 47.3%, Arm 2: 59.4%, Arm 3: 64%, Arm 4: 77.1%, Arm 5: 31.6%[4]	Arm 1: N=1 711, Arm 2: N=180, Arm 3: N=50, Arm 4: N=70, Arm 5: N=1 000.
Niza, 2014 [122]	United Kingdom	RCT	18-24-year-olds in student halls.	CT	**Self-sampling** Arm 1: No incentive for return of self-collected sample, Arm 2: Certain (voucher) gain incentive, Arm 3: Uncertain (lottery) gain incentive, Arm 4: Certain (voucher) loss incentive, Arm 5: Uncertain (lottery) loss incentive.	TC	Proportion of individuals randomised to each intervention. Arm 1: 1.9%, Arm 2: 23.7%, Arm 3: 3.6%, Arm 4: 21.6%, Arm 5: 2%. Arm 2+3+4+5: 8.9% (p<0.001 compared to arm 1).	Total N=1 060.
Jenkins, 2012 [123]	United States	Cohort	Students 18+ years old recruited in a further education setting.	CT	**Self-sampling** Arm 1: Dorm/lounge student education and given home testing kit, Arm 2: Dorm/lounge student education and given home testing kit order details.	TC	Proportion of students in each intervention group returning kits. Arm 1: 3.5%, Arm 2: 1.2% (p=0.033)	Arm 1: N=343, Arm 2: N=253.
Kang, (2012) [124]	Australia	RCT	16-25-year-olds.	CT	**Outreach** Arm 1: Non-personalised email recruiting to clinic testing with reminders, Arm 2: personalised emails & Q&A contact.	TC	Proportion assigned to arm reporting self-reporting testing during intervention period. Arm 1: 31% 95%CI (24.8-37.2), Arm 2: 40.6 95%CI (30.7-51.1) (p=0.06).	Arm 1: N=216, Arm 2: N=96.
Mortimer, (2015) [125]	Australia	RCT	16-29-year-old university staff and students.	CT	**Outreach** Arm 1: Patient access to static website with clinic details, Arm 2: Access to website with appointment booking, medication details,	TC	Proportion of those randomised to intervention undergoing testing for any organism during study period. Arm 1: 7.6%, Arm 2: 15.3% (P=0.017.	Arm 1: N=225, Arm 2: N=150.

First author, publication year (ref no.)	Country	Study design	Study population and setting	STIs[1]	Intervention	Outcome [TC/LTC/ATT][3]	Result	Sample number
					reminders, health record, educational information.			
Garbers, 2016 [126]	United States	Before/After	Sexually active 15-25-year-olds attending LGBT community health centre or mobile van.	CT, NG	**Outreach** **Community-based testing** Arm 1: Pre-intervention, Arm 2: Ethnically targeted adapted 3 month 'Get Yourself Tested' campaign with extended van use	TC	Proportion tested for syphilis, CT/NG in van. Arm 1: 75%, 88.9% Arm 2: 60.6%, 78.8%. Proportion tested for syphilis, CT/NG in clinic. Arm 1: 75%, 70.5% Arm 2: 75%, 78.8% [4]	In Van. Arm 1: N=20, Arm 2 N=33. In Clinic. Arm 1: N=241, Arm 2 N=266.
Harmon, 2018 [127]	United States	Non-randomised comparison of interventions	18-35-year-old incarcerated females.	CT, NG	**Community-based testing** Arm 1: opt out screening at intake, sample collection in jail by nursing staff, test performed in jail by nursing staff. Arm 2: opt in testing weekly, sample collection & testing by local health jurisdiction health staff.	TC	Proportion tested of eligible patients. Arm 1: 86%, Arm 2: 8%.[4]	Arm 1 n=826, Arm 2 n=9 246.
Reagan, (2012) [128]	United States	RCT	18-45-year-olds.	CT, NG	**Self-sampling** Arm 1: Clinic based HCW collected samples, Arm 2: Self collected home testing kits with return by mail.	TC	Proportion of patients referred for testing undergoing testing. Arm 1: 48%, Arm 2: 72% ($p<0.01$).	Arm 1: N=100, Arm 2: N=100.
Myers, 2017 [129]	United States	Before/After	<25-year-olds living on a private residential university campus.	CT, NG	Arm 1: Pre-intervention [STI testing in routine gynae exam], Arm 2: Post intervention; education project for providers and health clinic staff members.	TC	Proportion of patients eligible tested for CT/NG. Arm 1: 7.9%, Arm 2: 17.86%.[4]	Arm 1: N=364, Arm 2: N=405.
Fuller, 2014 [130]	United Kingdom (English)	Pilot RCT	18+ Male football club attendees	CT, NG	**Outreach** Arm 1: Posters. Arm 2: Posters, Captain and poster screening promotion Arm 3: Health adviser and poster screening promotion	TC	Proportion tested of Football Players in Each Club. Arm 1 31/51 (60.8%). Arm 2: 28/56 (50.0%). Arm 3: 31/46 (67.4%).[4]	Arm 1 n=51, Arm 2 n=56, Arm 3 n=46.

First author, publication year (ref no.)	Country	Study design	Study population and setting	STIs[1]	Intervention	Outcome [TC/LTC/ATT][3]	Result	Sample number
Fisher, 2015 [131]	United Kingdom	Prospective Cohort	Asymptomatic MSM attending a GUM clinic requesting an STI screen (group 1, HIV+ MSM attending routine outpatient clinic (group 2), MSM attending community based rapid HIV testing service (group 3). Groups 2 and 3 compared to historical control	CT, NG, HIV	**Self-sampling** Arm 1: Self collected home based testing in GUM clinic, Arm 2: Self collected home basted testing in HIV outpatient clinic, Arm 3: Self collected home-based testing in community-based organization.	TC	Proportion of eligible MSM contacted who accepted home test kits. Arm 1: 63% (compared to 38% tested at GUM clinic), Arm 2: 81%, Arm 3: 66%; p<0.001, X^2=22.8. Proportion of accepted kits returned: Arm 1: 78%; Arm 2: 44%; Arm 3: 16%; p<0.001, X^2=51.4	Arm 1: N=128, Arm 2: N=362, Arm 3: N=84.
Sachdev, 2018 [132]	United States	Before/After	People Living with HIV.	CT, NG, TP	**Outreach** Arm 1: Passive patient recruitment to testing, Arm 2: Patients referred from primary care, sexual health clinics, and surveillance data generated lists to 'navigation team' offering support and testing.	TC	Proportion of patients covered by service tested for CT/NG or syphilis in previous 12 months (arm 1) or 90 days post enrolment (arm 2). Arm 1: 49%, 69%, Arm 2: 30%, 51%.[4]	Arm 1: N-355, Arm 2: N=355.
Wilson, 2017 [133]	United Kingdom	randomised single blind controlled trial	Sexually active 16-30-year olds	CT, NG, TP, HIV	**Self-sampling** Arm 1: Texted URL to website with details of sexual health clinics, Arm 2: Texted URL to online service to request self-testing kits, with patient reporting of CT/Neisseria gonorrhoea/syphilis by text and positive HIV by phone.	TC	Proportion of total population covered by service completing STI testing at 6 weeks. Arm 1: 26.6%, Arm 2: 28.8% relative risk [RR] 1.87, 95% CI 1.63 to 2.15, P < 0.001)	Arm 1: N=1 032, N=1 031.
Mark, 2017 [134]	Kenya	Cohort	Male partners of pregnant women in HOPE trial of partner education in Western Kenya	TP, HIV	**Outreach** Arm 1: Male partner invitation letter for clinic based HIV testing, followed by STI education and a first offer of syphilis, Arm 2: HOPE home-based partner education and HIV testing intervention, followed by repeat syphilis testing.	TC	Proportion of partners of women in trial arms undergoing syphilis testing at exit interview. Arm 1: 98%, Arm 2: 93% p=0.02.	Arm 1: N=230, Arm 2: N=80.

First author, publication year (ref no.)	Country	Study design	Study population and setting	STIs[1]	Intervention	Outcome [TC/LTC/ATT][3]	Result	Sample number
Van Rooijen, 2016 [135]	Netherlands	Cross-sectional	Asymptomatic 16-25-year-old sexual health clinic attendees	CT	**Self-sampling** Arm 1: Self-collected STI clinic based sampling, Arm 2: Self-collected home sampling kit with return by mail, Arm 3: Arm 1+sexual health counselling by nurse/doctor	TC, LTC	Attended for testing appointment or returned swab (home-sampling). Arm 1: 86.1%, Arm 2: 87.8% (p=0.45), Arm 3: 95.5% (p=0.45). Proportion testing positive treated for CT. Arm 1: 100%, Arm 2: 92%, Arm 3: 100%.[4]	TC. Arm 1: N=321, Arm 2: N=1 451, Arm 3: N=32. LTC. Arm 1: N=10, Arm 1: N=10, N=75, N=1.
Klovstad, 2013 [136]	Norway	RCT	Asymptomatic 18-25-year-olds.	CT	**Self-sampling** Arm 1: Passive recruitment in STI clinic with HCW sample collection, Arm 2: mail-based patient recruitment with self-collected home testing.	TC, LTC.	Proportion of clinic attendees tested for syphilis. Arm 1: 3.4%, Arm 2: 16.5% unadjusted risk ratio 4.9 (95% CI 4.5-5.2). Proportion of positive cases treated. Arm 1: 89%, Arm 2: 85% (p>0.05).	TC. Arm 1: N=31 519, Arm 2: N=10 000. LTC. Arm 1: 105, Arm 2: 125.
Estcourt, 2017 [137]	United Kingdom	Non-randomised intervention	16+ year-old primary care and sexual health clinic attendees and 16-24-year-old NCSP online service users.	CT	**Self-sampling** Arm 1: Sexual health clinic based HCW collected sampling with pharmacy delivered online treatment, Arm 2: NCSP online portal for online recruitment to self-sampling kit with return by mail.	LTC	Proportion of patients with treatment authorised through online system who collected treatment from chosen pharmacy. Arm 1: 97% 95% CI (91–99), Arm 2: 89%, 95% CI (81–9).	Arm 1: N=105, Arm 2: N=116.
Estcourt, 2015 [138]	United Kingdom	Non-randomised intervention	>16-year-olds using sexual health clinics or eSexual Health clinics.	CT	**Self-sampling** Arm 1: Sexual health clinic based HCW collected sampling, Arm 2: Online Sexual Health service recruiting Self collected home based sampling with return by mail & online results reporting service.	LTC	Proportion of patients testing positive treated. Arm 1: 98%, Arm 2: 88%.[4]	Arm 1: N=112, Arm 2: N=104.

First author, publication year (ref no.)	Country	Study design	Study population and setting	STIs[1]	Intervention	Outcome [TC/LTC/ATT][3]	Result	Sample number
Yussman, 2018 [139]	United States	Before/After	6th-12th grade students.	CT, NG	**Community-based testing** Arm 1: Pre-intervention, Arm 2: Post-implementation of universal STI screening >12yo regardless of complaint.	LTC	Proportion of 'those requiring care' receiving appropriate Abx management. Arm 1: 100%, Arm 2: 100%[4]	Arm 1: N=1 127.
Warren, 2016 [140]	United Kingdom	Case-control	Sexual health clinic attendees and home based self-collected testing service users.	CT, NG	**Self-sampling** Arm 1: Sexual health clinic based HCW collected sampling, Arm 2: Home based self-collected testing service, Arm 3: Sample collection in STI clinic OR self-collected samples	LTC	Proportion of positive cases managed. Arm 1: 90%, Arm 2: 60%, Arm 3: 90%.[4]	Arm 1 n=34 712, Arm 2 n=1 691, Arm 3 n=3 220
Banerjee, 2018 [141]	United Kingdom	Retrospective cohort	16+ year-olds attending sexual health clinics.	CT, NG	**Self-sampling** Arm 1: Sampling in sexual health clinic, Arm 2: Online questionnaire followed by self-testing kit with patient reporting by automated SMS, phone, or letter to patient/GP	LTC	Proportion of population testing positive undergoing treatment for CT or NG. Arm 1: 46%, Arm 2: 88% p<0.007 [adjusted]. Median time to treatment for CT or NG. Arm 1: 6 days (IQR 3–16), Arm 2: 3 days (IQR 0–7) (p<0.001), 0 day (IQR 0–6) (p<0.001)	Arm 1: n=362, Arm 2: n=1 985.
Obafemi, 2018 [142]	United States	Service evaluation	MSM attending nonclinical outreach settings (community based organizations, bathhouses, mobile van, and pharmacy).	TP	**Community-based testing** Arm 1: Those declining RST (RPR based algorithm), Arm 2: Universal Syphilis Health Check Rapid Syphilis Test based algorithm (accepting RST), Arm 3: Historical control group tested with RPR and reflex TPPA (RST not available).	LTC	Median time to treatment from testing (days). Arm 1: 9 (range 7-13), Arm 2: 1 (range 0-6), Arm 3: 9 (range 6-21). [4]	Arm 1: N=3, Arm 2: N=9, Arm 3: N=25.

1.STIs: CT=chlamydia; NG=gonorrhoea; TP: syphilis

2. Arm 1: Control [if standard of care] or Intervention 1, Arm 2: Intervention 1 [If control standard of care], or Intervention 2, Arm 3: Intervention…

3.Outcomes: ATT=Access to testing; TC=Testing coverage; LTC=Linkage to care

4.No p-value reported

NA=Data not available

Annex 8. Assessment of risk of bias

Table 2a. Non-randomised studies assessing testing strategies & approaches [Adapted ROBINS-I]

First author, publication year (ref no.)	Confounding:	Selection bias:	Classification of interventions:	Intended interventions:	Missing data:	Measurement of outcomes:	Selective reporting:	Overall risk of bias:
Alderton, 2018[81]	(-)	(?)	(?)	(?)	(?)	(?)	(?)	Insufficient
Banerjee, 2018 [141]	(-)	(-)	(+)	(?)	(?)	(-)	(+)	High
Barbee, 2016 [64]	(?)	(+)	(+)	(+)	(+)	(+)	(+)	Low
Bartelsman, 2015[77]	(?)	(+)	(+)	(-)	(-)	(-)	(+)	High
Bilello, 2018[80]	(-)	(?)	(+)	(+)	(+)	(+)	(+)	Low
Bogler, 2015 [41]	(?)	(-)	(+)	(+)	(?)	(+)	(+)	Insufficient
Bonawitz, 2015 [97]	(-)	(+)	(+)	(+)	(?)	(+)	(+)	Low
Brook, 2014 [70]	(?)	(?)	(?)	(?)	(?)	(?)	(?)	Insufficient
Bryant, 2018 [33]	(?)	(?)	(?)	(?)	(?)	(?)	(?)	Insufficient
Burstein, 2018 [34]	(?)	(?)	(?)	(?)	(?)	(?)	(?)	Insufficient
Burstein, 2016 [47]	(?)	(+)	(?)	(?)	(?)	(+)	(?)	Insufficient
Callander, 2013 [43]	(+)	(+)	(+)	(+)	(?)	(+)	(?)	Low
Carmona, 2015 [48]	(?)	(?)	(?)	(?)	(?)	(+)	(+)	Insufficient
Chow, 2012 [65]	(+)	(+)	(+)	(+)	(?)	(?)	(+)	Low
Cohen, 2017 [78]	(-)	(?)	(+)	(+)	(?)	(-)	(+)	Low
Creighton, 2014 [71]	(?)	(?)	(?)	(?)	(?)	(?)	(?)	Insufficient
Dassah, 2015 [86]	(?)	(+)	(+)	(+)	(?)	(+)	(+)	Low
De Schacht, 2015 [90]	(?)	(-)	(+)	(-)	(-)	(-)	(+)	High
Den Ouden 2014 [42],	(?)	(+)	(+)	(?)	(?)	(?)	(+)	Insufficient
Dhar, 2016 [30]	(-)	(-)	(+)	(+)	(+)	(-)	(+)	Insufficient
DiVasta, 2016 [32]	(-)	(-)	(-)	(+)	(-)	(+)	(+)	High
Dowshen 2015 [63],	(?)	(+)	(-)	(+)	(+)	(-)	(+)	Insufficient
Estcourt 2017 [137]	(-)	(-)	(+)	(-)	(-)	(+)	(+)	High
Estcourt, 2015 [138]	(?)	(?)	(?)	(?)	(?)	(?)	(?)	Insufficient

First author, publication year (ref no.)	Confounding:	Selection bias:	Classification of interventions:	Intended interventions:	Missing data:	Measurement of outcomes:	Selective reporting:	Overall risk of bias:
Field, 2014 [39]	(-)	(+)	(-)	(?)	(?)	(-)	(-)	High
Fine, 2017 [6]	(?)	(?)	(?)	(?)	(?)	(?)	(+)	Insufficient
Fisher, 2015 [131]	(+)	(+)	(+)	(+)	(-)	(?)	(-)	Insufficient
Flores, 2015 [82]	(?)	(+)	(+)	(?)	(?)	(-)	(?)	Insufficient
Forbes, 2014 [68]	(-)	(?)	(?)	(?)	(?)	(?)	(?)	Insufficient
Gamagedara, 2014 [4]	(?)	(+)	(?)	(?)	(-)	(?)	(+)	Insufficient
Garbers, 2016 [126]	(?)	(-)	(+)	(+)	(?)	(+)	(?)	Insufficient
Garcia, 2013 [96]	(?)	(?)	(-)	(+)	(?)	(-)	(+)	Insufficient
Gourley, 2014 [113]	(?)	(-)	(-)	(-)	(?)	(?)	(?)	High
Graham, 2015 [46]	(-)	(-)	(?)	(+)	(?)	(-)	(-)	High
Gratrix, 2015[57]	(-)	(+)	(+)	(-)	(?)	(+)	(+)	High
Harmon, 2018 [127]	(-)	(-)	(+)	(?)	(?)	(?)	(+)	Insufficient
Howard, 2016 [49]	(-)	(-)	(?)	(?)	(+)	(-)	(?)	Insufficient
Jenkins, 2012 [188]	(+)	(+)	(+)	(-)	(-)	(?)	(+)	Insufficient
Jesus, 2014 [61]	(?)	(?)	(+)	(?)	(?)	(-)	(?)	Insufficient
Kamb, 2013 [88]	(?)	(?)	(?)	(+)	(?)	(-)	(?)	Insufficient
Karas, 2018[35]	(?)	(+)	(+)	(?)	(?)	(-)	(+)	Low
Kasaro, 2018 [83]	(?)	(+)	(+)	(+)	(-)	(+)	(+)	Low
Kettinger, 2013	(?)	(-)	(?)	(+)	(+)	(-)	(+)	High
Lewis, 2016 [100]	(?)	(+)	(+)	(?)	(?)	(?)	(?)	Insufficient
Mark, 2017 [134]	(-)	(+)	(+)	(-)	(-)	(+)	(+)	High
Mckee, 2018[3]	(-)	(-)	(+)	(?)	(?)	(-)	(?)	High
McSorley [110] 2013	(?)	(+)	(+)	(?)	(?)	(-)	(?)	Insufficient
Migliorini, 2015 [40]	(?)	(+)	(?)	(?)	(?)	(-)	(?)	Insufficient
Morgan, 2012 [66]	(+)	(-)	(+)	(+)	(+)	(+)	(+)	Low
Muldrew, 2016 [67]	(?)	(+)	(+)	(?)	(?)	(?)	(?)	Insufficient
Myers, 2017 [129]	(-)	(-)	(+)	(+)	(-)	(-)	(?)	High
Nyatsanza, 2016 [72]	(-)	(+)	(?)	(?)	(?)	(?)	(+)	Low
Obafemi, 2018 [142]	(?)	(?)	(+)	(+)	(+)	(-)	(+)	Low

First author, publication year (ref no.)	Confounding:	Selection bias:	Classification of interventions:	Intended interventions:	Missing data:	Measurement of outcomes:	Selective reporting:	Overall risk of bias:
Pant Pai, 2018 [91]	(?)	(?)	(?)	(+)	(+)	(-)	(+)	Insufficient
Park, 2017 [50]	(?)	(?)	(?)	(?)	(?)	(?)	(?)	Insufficient
Parthasarathy, 2013 [60]	(?)	(?)	(+)	(+)	(-)	(+)	(+)	Insufficient
Patton, 2016 [36]	(-)	(+)	(+)	(+)	(-)	(+)	(+)	Low
Peterson, 2018 [62]	(?)	(?)	(?)	(?)	(?)	(?)	(?)	Insufficient
Postenrieder, 2016 [101]	(-)	(+)	(+)	(+)	(?)	(-)	(-)	High
Rivard, 2016 [103]	(?)	(+)	(+)	(+)	(?)	(?)	(+)	Low
Rodriguez-Hart, 2015 [55]	(-)	(?)	(+)	(+)	(+)	(+)	(+)	Low
Rudd [38], 2013	(?)	(+)	(+)	(?)	(-)	(-)	(+)	Insufficient
Rukh [74], 2014	(?)	(?)	(?)	(?)	(?)	(?)	(?)	Low
Sachdev [132], 2018	(?)	(?)	(?)	(?)	(?)	(?)	(?)	Insufficient
Scarborough, 2015 [69]	(?)	(+)	(+)	(+)	(+)	(+)	(+)	Low
Smith [92], 2015	(?)	(?)	(?)	(+)	(-)	(?)	(+)	Insufficient
Snow [52] , 2013	(?)	(?)	(?)	(?)	(?)	(?)	(?)	Insufficient
Snow [75], 2016	(?)	(?)	(+)	(?)	(+)	(?)	(+)	Insufficient
Nnko, 2016 [84]	(?)	(?)	(+)	(+)	(?)	(+)	(?)	Insufficient
Territo, 2016 [106]	(?)	(+)	(+)	(+)	(-)	(-)	(+)	Low
Trubiano, 2015 [59]	(-)	(+)	(+)	(?)	(?)	(+)	(+)	Low
Van Den Broek, 2012 [116]	(?)	(-)	(+)	(+)	(?)	(?)	(?)	Insufficient
Van Rooijen, 2016 [135]	(-)	(-)	(+)	(+)	(-)	(+)	(?)	High
Wang, 2018 [88]	(?)	(-)	(+)	(?)	(+)	(-)	(+)	Insufficient
Warren, 2016 [140]	(-)	(?)	(+)	(+)	(?)	(-)	(+)	Insufficient
Washburn, 2014 [51]	(?)	(+)	(?)	(?)	(?)	(?)	(+)	Insufficient
White, 2012 [109]	(-)	(+)	(?)	(?)	(?)	(?)	(+)	Insufficient
Whitlock [5] 2018	(-)	(-)	(+)	(?)	(?)	(+)	(+)	High
Wingrove, 2014 [189]	(?)	(?)	(?)	(?)	(?)	(?)	(?)	Insufficient

First author, publication year (ref no.)	Confounding:	Selection bias:	Classification of interventions:	Intended interventions:	Missing data:	Measurement of outcomes:	Selective reporting:	Overall risk of bias:
Wood, 2018 [53]	(+)	(?)	(+)	(+)	(?)	(+)	(+)	Low
Wood, 2015 [114]	(-)	(-)	(-)	(-)	(-)	(+)	(-)	High
Wynn [99], 2018	(+)	(+)	(?)	(+)	(+)	(?)	(+)	Low
Young [87], 2018	(?)	(+)	(+)	(?)	(+)	(-)	(+)	Insufficient
Yussman [139], 2018	(?)	(?)	(+)	(?)	(+)	(-)	(?)	High
Ahmad [107], 2014	(+)	(-)	(+)	(+)	(?)	(+)	(+)	Low
Bowden [121], 2012	(?)	(?)	(+)	(+)	(?)	(+)	(+)	Low
Dolan, 2014 [120]	(?)	(?)	(+)	(+)	(?)	(+)	(+)	Insufficient
Severe [94], 2013	(?)	(?)	(+)	(+)	(+)	(+)	(+)	Low
Strasser [95], 2012	(?)	(?)	(+)	(+)	(?)	(-)	(+)	Insufficient
Zenner [44], 2012	(?)	(+)	(+)	(+)	(?)	(-)	(-)	High
Zou [58], 2013	(-)	(-)	(+)	(-)	(?)	(-)	(+)	High

(+) = meets the criterion; (-) = Doesn't meet the criterion; (?) = Insufficient information provided in the publication to assess criterion.
If two or more sections are scored (-), then the study was scored at high risk of bias overall. If one or fewer section is scored (-), and the majority of remaining sections (three or more sections) is scored (?), then the study was scored insufficient information to determine risk of bias overall. If one or fewer section is scored (-), and the majority of the remaining sections (three or more sections), is scored (+), then the study was scored a low risk of bias.

Table 2b. Randomised studies assessing testing strategies and approaches [Adapted Cochrane-Collaboration Risk-of-Bias Tool]

First author, publication year (ref no.)	Random Sequence Generation	Allocation Concealment	Blinding	Missing data	Selective reporting	Other Sources of Bias	Overall Risk of Bias
Ako, 2016 [105]	(?)	(?)	(?)	(?)	(?)	(?)	Insufficient
Anschuetz, 2018 [79]	(?)	(?)	(?)	(?)	(?)	(?)	Insufficient
Baird, 2014 [111]	(+)	(+)	(-)	(+)	(+)	(?)	Low
Betrán , 2018 [98]	(-)	(-)	(-)	(+)	(+)	(+)	High
Callander, 2018 [37]	(?)	(?)	(?)	(+)	(?)	(-)	Insufficient
Fuller, 2014 [130]	(+)	(+)	(-)	(?)	(-)	(?)	High
Gaitan Duarte, 2016 [85]	(?)	(-)	(-)	(+)	(+)	(+)	High
Gaydos, 2018 [104]	(+)	(+)	(-)	(?)	(?)	(?)	Insufficient
Goyal, 2017 [108]	(+)	(?)	(+)	(+)	(+)	(+)	Low
Guy, 2018 [54]	(+)	(+)	(+)	(-)	(+)	(?)	Low
Hocking, 2018 [31]	(+)	(+)	(+)	(-)	(+)	(+)	Low
Kang [124] (2012) [115]	(-)	(-)	(+)	(-)	(-)	(?)	High
Kersaudy-Rahib, 2016 [119]	(+)	(+)	(-)	(-)	(+)	(?)	High
Klovstad, 2013 [136]	(+)	(?)	(-)	(?)	(?)	(?)	Insufficient
Lundgren, 2016 [115]	(-)	(-)	(-)	(?)	(+)	(?)	High
May, 2016 [102]	(+)	(+)	(?)	(-)	(?)	(?)	Insufficient
McNulty, 2013 [45]	(?)	(+)	(+)	(?)	(?)	(+)	Insufficient
Mortimer, 2015 [125]	(+)	(?)	(-)	(?)	(+)	(-)	High
Oliveira-Ciabati, 2017 [93]	(+)	(+)	(?)	(+)	(+)	(-)	Low
Reagan, 2012 [128]	(-)	(+)	(?)	(?)	(?)	(?)	Insufficient
Sagor, 2016 [112]	(+)	(?)	(?)	(+)	(+)	(?)	Insufficient
Wallace, 2015 [56]	(?)	(?)	(-)	(?)	(?)	(?)	Insufficient
Wilson, 2017 [133]	(+)	(+)	(-)	(-)	(+)	(+)	Low
Niza 2014 [122]	(+)	(?)	(-)	(?)	(+)	(?)	Insufficient
Ten Hoor, 2014 [117]	(?)	(-)	(?)	(?)	(+)	(+)	Insufficient
Woodhall, 2015 [118]	(-)	(-)	(?)	(+)	(+)	(?)	High

(+) = meets the criterion; (-) = Doesn't meet the criterion; (?) = Insufficient information provided in the publication to assess criterion. Given the six sections, each study judged as high, low or insufficient information to determine risk of bias.

Table 3. Risk of bias summary by setting and intervention type

Setting	Intervention	Outcome	Number of publications		
			Low risk of bias	High risk of bias	Insufficient information
Testing initiatives in primary care settings	Quality improvement interventions	ATT:	1	0	0
		TC:	4	3	9
		LTC:	0	0	0
	Electronic medical record interventions	ATT:	1	0	0
		TC:	4	1	5
		LTC:	0	0	0
	Patient recruitment interventions	ATT:	0	0	0
		TC:	0	2	2
		LTC:	0	0	0
	Screening and triage interventions	ATT:	0	0	0
		TC:	2	0	3
		LTC:	0	0	0
	Novel testing technologies	ATT:	0	0	0
		TC:	0	1	1
		LTC:	1	0	0
	Results reporting interventions	ATT:	0	0	0
		TC:	1	0	0
		LTC:	1	0	0
Testing initiatives in sexual health clinic settings	Patient recruitment interventions	ATT:	0	0	0
		TC:	2	1	1
		LTC:	0	0	1
	Quality improvement interventions	ATT:	0	0	0
		TC:	2	1	1

		LTC:	0	0	0
	Express testing interventions	ATT:	0	1	1
		TC:	1	0	1
		LTC:	2	1	0
	Screening and triage interventions	ATT:	0	0	0
		TC:	1	1	2
		LTC:	0	1	0
	Novel testing technologies	ATT:	0	0	0
		TC:	0	0	2
		LTC:	0	0	2
	Results reporting interventions	ATT:	0	0	0
		TC:	0	0	0
		LTC:	2	0	1
	Self-sampling interventions	ATT:	0	0	1
		TC:	1	0	0
		LTC:	0	0	0
Testing initiatives in antenatal care setting	**Novel testing technologies**	ATT:	1	1	2
		TC:	3	2	8
		LTC:	2	1	3
	Quality improvement interventions	ATT:	0	0	0
		TC:	1	1	0
		LTC:	1	1	0
	Patient recruitment interventions	ATT:	0	0	0
		TC:	1	0	0
		LTC:	0	0	0

	Results reporting interventions	ATT:	0	0	1
		TC:	0	0	1
		LTC:	1	0	1
Testing initiatives in emergency department and other hospital settings	**Novel testing technologies**	ATT:	0	0	1
		TC:	0	0	0
		LTC:	1	1	3
	Electronic medical record interventions	ATT:	0	0	0
		TC:	2	0	2
		LTC:	0	0	0
	Screening and triage interventions	ATT:	0	0	0
		TC:	1	0	0
		LTC:	1	0	0
	Patient education interventions	ATT:	0	0	0
		TC:	1	0	0
		LTC:	0	0	0
Testing initiatives in community settings	**Self-sampling interventions**	ATT:	0	0	0
		TC:	2	9	7
		LTC:	0	3	4
	Outreach recruitment to clinic-based testing	ATT:	0	1	1
		TC:	0	4	2
		LTC:	0	0	0
	Community-based testing	ATT:	0	0	0
		TC:	0	1	2
		LTC:	1	1	0
Total:	**All interventions**	All Outcomes:	30	28	59

ATT=Access to testing
TC=Testing coverage
LTC=Linkage to care

Annex 9. Expert Interview Consent Form

Title of Project: Novel testing technologies, strategies and approaches for testing populations at high risk of sexually transmitted infections in EU/EEA countries.

Name of PI/Researcher responsible for project: Dr. Aura Andreasen

Statement	Please initial each box
I confirm that I have read the information sheet dated 4th March 2019.(version 2) for the above named study. I have had the opportunity to consider the information, ask questions and have these answered satisfactorily.	
I understand that my participation is voluntary and that I am free to withdraw at any time up to publication without giving any reason, without my legal rights being affected.	
I understand that relevant sections of data collected during the study may be looked at by authorised individuals from ECDC, PHE, and the LSHTM investigative team where it is relevant to my taking part in this research. I give permission for these individuals to have access to the audio recordings and transcribed data.	
I understand that the anonymized transcription data may be shared directly with other researchers, and that I will not be identifiable from this information.	
I consent to having interview audio recorded. [PLEASE DO NOT INITIAL IF YOU DO NOT CONSENT TO HAVING AUDIO RECORDINGS MADE]	
I consent in the absence of audio recording being acceptable to me to have a written transcription taken at the time of interview [PLEASE INITIAL IF YOU HAVE NOT INITIALLED THE BOX ABOVE]	
I understand that all audio recordings of interviews will be stored at LSHTM and PHE on secure servers following LSHTM archiving policies and then destroyed 6 months following final publication of the technical report	
I understand that all transcriptions of interviews will be stored at LSHTM and PHE on secure servers following LSHTM archiving policies and then destroyed according to LSHTM archiving policies.	
I am happy for my participation to be acknowledged in the final report and all subsequent publications	
I agree that I will securely transmit either a physical or electronic copy of this completed consent form to the research team, destroying all completed copies in my possession for the purposes of data protection.	
I agree to take part in the above-named study.	

I attest that I have explained the study information accurately in English to _____ and was understood to the best of my knowledge by the participant and that they have freely given their consent to participate:

Printed name of participant	Signature of participant	Date

Printed name of person obtaining consent	Signature of person obtaining consent	Date

Annex 10. Expert Interview Information Sheet

PARTICIPANT INFORMATION SHEET

V2, 4th March 2019

Novel testing technologies, strategies and approaches for testing populations at high risk of sexually transmitted infections in EU/EEA countries

In this systematic literature review, we aim to follow up on the 2012 European Centre for Disease Prevention and Control (ECDC) report by identifying new developments in STI technologies, strategies, and approaches applicable to testing high risk groups in EU/EEA countries. Please read this information sheet, which outlines the goals of the project in more detail, and explores ways in which we hope you may be able to contribute your knowledge and experience to the study. Feel free to ask any questions which we have not addressed. Thank you for your time and kind participation.

What is the purpose of the project?

This project aims to identify the impact of novel testing strategies and approaches that have been in use since 2012, on access-to-testing, testing-coverage and linkage-to-care for populations at-risk to curable STIs (*Chlamydia trachomatis*, *Neisseria gonorrhoeae, Treponema pallidum, Mycoplasma genitalium,* and *Trichomonas vaginalis*) in EU/EEA countries.

This will primarily be achieved by conducting a systematic literature review of peer-reviewed literature published since 1st January 2012. The findings of this review will be synthesized into a technical report, which will describe what testing technologies are used in these novel strategies and approaches; outline the impact of novel testing technologies, strategies and approaches on public health surveillance programmes; highlight quality assurance needs and risks; and explore their feasibility and acceptability.

The report will be contextualised within countries' routine surveillance system characteristics, and by pathogen. We further aim to identify and fill gaps in the literature available as a whole, and where possible, to highlight key public health and research priorities.

The target audience of the final report is policy-makers, national programme coordinators, public health or clinical experts and civil society organisations involved in STI prevention and control in EU/EEA countries.

The inclusion of interviewed experts like yourself, aims to identify where the systematic literature review has failed to find all relevant published and unpublished information.

Do I have to take part?

Participation in this project is voluntary. If you agree to take part, you will be given a copy of the information sheet and asked to sign a consent form. If you do not feel comfortable with conducting the interview process in English, a suitable interviewer fluent in a language in which you are comfortable will be identified, and translated information sheets provided. You may stop the interview process at any point and may request for all recordings or other data collected from you to be destroyed. No questions will be asked if you wish to stop.

Participation and the Interview Process:

If you agree to take part and sign the consent form, you will be sent a copy of the preliminary report of the systematic review prior to the interview, as well as a copy of the topic guide, in order to prepare your answers. During the interview, you will be asked to provide your feedback on the report, and in particular the sections related to inclusion and exclusion criteria, the summary of findings from the articles included in the final study, and identified information gaps in the current literature.

Interview Procedure:

There will be a short interview, which should last between 30 and 60 minutes. All conversations will take place in a private location; either in person, or on the phone/online (on speaker phone) depending on your location and preference. This interview will be recorded using a digital recorder. The interview will be conducted by an MSc student from the London School of Hygiene & Tropical Medicine (LSHTM). There will be a series of open-ended questions, as well some more specific questions. These will relate to the preliminary report, any studies that the literature search failed to identify, and gaps in the current literature more generally. You will be sent a copy of the topic guide prior to the interview to provide some guidance for when you are reading the preliminary report, and to guide preparation for interview.

Options for withdrawal from the interview process

If at any point after you have signed the consent form you decide that you would like to withdraw from the study at any point up to publication, all recordings, transcriptions of recordings, and any written communications from you can be destroyed at your request. Following publication of the report (which will not be published until written verification is received), it may not be possible to retract the information contained in your interview. At the time of providing consent, you are given the option for your participation to be acknowledged in the final report and all subsequent publications, or not.

Post-interview processing

All interviewees will be given a unique identifier which will be used in relation to recordings. Your name on the consent forms will be kept confidential and not attached to any electronic recordings or transcriptions. Data will be archived according to LSHTM procedures and will be stored on secure LSHTM and Public Health England servers, and will only be accessed by the investigators leading this project. After the interview recordings are transcribed, they will be destroyed. The conclusions of each interview will be summarized and sent to each expert interviewee for written verification. The conclusions will then be incorporated into the final written report. All transcriptions will be destroyed 6 months following final publication of the technical report. If you are willing to be acknowledged in the final report, please initial the relevant section of the consent form.

Ethical review:

This study has received ethical approval from the London School of Hygiene & Tropical Medicine Ethics Committee and MSc Research Ethics Committee, reference: [16338, 16209]. If you have any complaints, please contact the LSHTM Ethics Committee: Ethics@lshtm.ac.uk If you have any questions at all, please do not hesitate to contact Arun Parajuli (LSHTM), Dr Aura Andreasen (PHE) (Contact details at the end of the sheet) or the LSHTM Ethics Committee.

Financial Arrangements:

Participants will not be offered any financial incentives or inducements for participation in the study.

Research Direction & Funding:

This research is being funded by the European Centre for Communicable Disease Prevention and Control. The research will be carried out by a postgraduate student from LSHTM who is working in fulfilment of a Masters Degree with Dr. Aura Andreasen from Public Health England, Dr. Emma Harding-Esch from LSHTM, Dr. Suzanna Francis from LSHTM, and Dr Otilia Mardh from ECDC.

Annex 11. Interview Topics for Expert Interviews

Interview Topics with Experts

Objectives

1. To identify published and unpublished data on novel STI testing technologies, strategies, and approaches in at-risk populations meeting the inclusion criteria that were not identified through the literature review.

2. To identify gaps in the current literature in the area of STI diagnostics technology, approaches, or strategies that may impact on access to testing, testing coverage, and linkage to care for populations at-risk for curable STIs such as chlamydia, gonorrhoea, syphilis, trichomoniasis, and *M. genitalium* infection.

3. To attempt to fill these gaps and allow unpublished advances in the field, following written expert verification, to be incorporated into the technical report

Participants

Experts in the area of novel STI testing, identified through the systematic literature review and professional networks in relation to particular areas of the report. They will be briefed on the findings of the report in relation to this area.

Topic 1: Professional experience and work in this area.
Please tell me about yourself and your history of working with STI Diagnostics and [Current Affiliated Organisation].

Probe [briefly, for a few minutes] along lines of questioning related to previous relevant publications, projects, clinical work related to STI diagnostics, any other information the expert would like to communicate regarding their experience in the area.

Topic 2: Expert assessment of the findings of the report.

1. If your work has been included in the systematic literature review, do you have any comments on the report's:

a. Summary of findings in the study/abstract?
b. Interpretation of its results?
c. Use of bias assessment tools to assess the study?
d. Do you have any other general comments regarding the way the report has incorporated/used your findings?

2. *In relation to any of the other documents included through the systematic literature review, do you have any comments on the report's:*

a. Summary of findings in the included studies?
b. Interpretation of results?
c. Use of bias assessment tools?
d. Do you have any other general comments regarding the way the report has incorporated/used studies/abstracts identified through the systematic literature review?

Topic 3: Identifying published and unpublished data not picked up through literature review.

1. *Through the systematic literature review … studies/abstracts were identified as meeting the specified inclusion criteria. Having examined the preliminary report, are you aware of any other published data matching the inclusions and exclusion criteria specified that were not identified in this systematic literature review? [Provide section of report with inclusion/exclusion criteria and list of included papers highlighted]*

2. Are you aware of any unpublished data meeting the specified inclusion/exclusion criteria?

Topic 4: Filling information gaps identified through literature review.

Through the process of the systematic literature review, we identified some gaps in the literature surrounding novel STI testing technologies, strategies, and approaches. These have been summarised in the preliminary report [Provide section of report with information gaps highlighted].

***1.** We would like to explore with you the information gap areas identified to gather your views*

Probe each of the information gaps and encourage experts to communicate their knowledge of published or unpublished data that may answer the identified open questions.

Discuss potential approaches and areas of future research that may fill these information gaps.

2. *Can you identify any other areas of information gap; currently unanswered questions in the area of STI diagnostics technology, approaches, or strategies that may impact on access-to-testing, testing-coverage, and linkage-to-care for populations at-risk to curable STIs?*

Again, **Probe** each of the information gaps and encourage experts to communicate their knowledge of published or unpublished data that may answer the identified open questions.

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