eHealth for all? Towards usable and effective ehealth services in different health care settings

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Direct access for patients to diagnostic testing and results: A systematic review on eHealth and diagnostics

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Abstract

Background: The number of people with chronic diseases and the subsequent pressure on health care is increasing. eHealth technology for diagnostic testing can contribute to more efficient health care and lower workload.

Objective: This systematic review examines the available methods for direct web-based access for patients to diagnostic testing and results in the absence of a health care professional in primary care.

Methods: We searched the PubMed, Embase, Web of Sciences, Cochrane Library, Emcare, and Academic Search Premier databases in August 2019 and updated in July 2021. The included studies focused on direct patient access to web-based triage leading to diagnostic testing, self-sampling or testing, or web-based communication of test results. A total of 45 studies were included. The quality was assessed using the Mixed Methods Appraisal Tool.

Results: Most studies had a quantitative descriptive design and discussed a combination of services. Diagnostic test services mainly focused on sexually transmitted infections. Overall, the use was high for web-based triage (3046/5000, >50%, who used a triage booked a test), for self-sampling or self-testing kits (83%), and the result service (85%). The acceptability of the test services was high, with 81% preferring home-based testing over clinic-based testing. There was a high rate of follow-up testing or treatment after a positive test (93%).

Conclusions: The results show that direct access to testing and result services had high use rates, was positively evaluated, and led to high rates of follow-up treatment. More research on cost-effectiveness is needed to determine the potential for other diseases. Direct access to diagnostic testing can lower the threshold for testing in users, potentially increase efficiency, and lower the workload in primary care.

Keywords: eHealth;systematic review;diagnostic testing;home-based test;self-test

Introduction

Background

As the population ages and the number of people with chronic diseases increase, the pressure on the health care system continues to rise [1,2]. This increased pressure is particularly noticeable in primary care where, over the years, the workload had already increased because of health care transformations. Primary care physicians, for example, are required to perform more preventive and complex care, work more according to evidence-based guidelines, and focus on person-centered care delivery [3,4]. Thus, physicians are required to do more in less time, and this increased workload can negatively affect the quality of patient care [4,5] and result in lower levels of job satisfaction of health care professionals (HCPs) [6,7]. Care delivery needs to be reformed to meet the needs of an aging population.

eHealth has been identified as a potential method to make health care delivery more efficient and can thereby help to decrease the workload [8,9]. eHealth can be defined as "health services and information delivered or enhanced through the Internet and related technologies" [10,11]. Currently, different eHealth applications are used to different extents in primary care. The advantage of eHealth applications is that health care delivery can be more efficient and can operate partially, or even completely, independent of the HCP. Gaining more insight into how eHealth is used in primary care can help to identify promising approaches that may help to lower the workload in primary care and contribute to better health care quality.

Requesting laboratory diagnostic testing, which refers to testing to determine the presence of a disease, and the communication of the results has shown promise for digitization. Indeed, eHealth technology has been applied successfully in the three stages of laboratory diagnostic testing. The first stage is *triage and advice on diagnostic testing*, where typically an HCP asks the patient a set of questions to determine whether and what diagnostic tests are relevant. An example of web-based triage was provided by Polilli et al [12], who used a web-based questionnaire (ie, triage) to determine an individual's risk for HIV and sexually transmitted infections (STIs). On the basis of the calculated risk, individuals were automatically linked to nearby testing and counseling facilities. The second stage is the actual *testing* (eg, a blood test is performed to determine the presence of an infection). There have now been initiatives where laboratory tests can be ordered on the internet and are shipped to the individual for self-testing or self-sampling [13,14]. Self-testing refers to an approach in which individuals can collect their specimen (eg, blood) and interpret the results using a rapid diagnostic test. In self-sampling, individuals collect their specimens, but the specimen is tested elsewhere (eg, laboratory). The third stage is the *communication of test results* to the patient. A course of action is then determined based on the results. Instead of having the HCP communicate the results, it can also be communicated on the web or via an app, independent of the professional. Automated SMS text messages can be used to

deliver tuberculosis testing results [15] or negative HIV test results can be automatically reported using the internet or a voicemail system. To our knowledge, a comprehensive overview of the different methods used to provide patients with direct web-based access to laboratory diagnostic testing and results is not yet available.

Objective

The aim is to conduct a systematic review to identify and summarize the available methods for direct web-based access for participants to diagnostic testing and results in the absence of an HCP in primary care. The available reviews show promise (eg, suggesting that self-tests are acceptable and can increase the uptake and frequency of testing) [16,17], but are limited to self-sampling and self-testing and do not include other forms of digitization. Moreover, the existing reviews focus on specific populations such as men who have sex with men (MSM) [18,19] or on specific health conditions such as HIV or chlamydia [20,21]. To widen the scope, this systematic review will include studies focusing on digitization in one or more phases of laboratory diagnostic testing. Specifically, studies that focus on direct access for patients to (1) web-based triage that leads to diagnostic testing, (2) self-sampling or testing, or (3) the test results are included (or both). The review was not restricted to specific populations or health conditions. Identification and summary of possible methods for direct access to diagnostic testing and result services will help identify usable and effective methods that can potentially increase the accessibility and cost-effectiveness of health care and simultaneously reduce the workload of primary care professionals.

Methods

The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines for reporting systematic reviews were used [22]. The systematic review was not registered, but a strict protocol was used to search and select studies and to select data.

Search Strategies

PubMed, Embase, Web of Science, Cochrane Library, Emcare, and Academic Search Premier were searched on August 16, 2019, to identify publications about digitization in the laboratory diagnostic setting (ie, web-based triage that leads to laboratory testing, self-sampling or testing, or web-based communication of laboratory test results). The search was updated on July 21, 2021. Search terms related to laboratory diagnostics and eHealth were combined (see Multimedia Appendix 1 for the full search strings). The search was limited to peer-reviewed publications. The reference lists of relevant reviews and the selected publications were also searched.

Study Selection

The titles and abstracts of the identified publications were screened for relevance. The full text was screened when it concerned potentially relevant publications or when there was insufficient information in the abstract to adequately assess the relevance. Several inclusion criteria were used to select the relevant publications. First, the publication should focus on a *specific* web-based laboratory diagnostic service. The service could be (1) a web-based questionnaire or triage that directs users to a laboratory test (in the clinic or at home), (2) an ordered self-sampling or testing kit, or (3) a system for web-based communication of laboratory test results to users. Second, the laboratory diagnostic service should be (partly) independent of an HCP (eg, the questionnaire or triage should not be administered over the phone by the HCP; the test kit should not be provided in-person; administering the test should not require assistance from an HCP; and the test results should not be communicated through a phone call). Regarding the latter, the publication was included when it discussed a result service that was partly independent of an HCP (ie, negative test results were automatically communicated and, in case of positive test results, there was contact between the HCP and patient). Third, the publication should focus on primary care settings; however, this exclusion criterion was omitted for studies conducted in Africa (as there is no clear distinction between primary and secondary care). Fourth, the study outcomes should specifically examine the laboratory diagnostic service (ie, the triage, test, or web-based communication of the test results) and not the surrounding procedures (eg, the acceptability of the consent procedure or the development of the service). Relevant outcomes included actual use or uptake, feasibility and acceptability, and effectiveness (eg, the time taken to test for diagnosis, understanding of test results, and the accuracy of triage). Publications were excluded if the laboratory diagnostic service focused on (national) screening campaigns, the monitoring of disease progression, or retesting or increasing retesting rates. Reviews, trial protocols, non–peer-reviewed papers, non-English papers, and publications without data or with only hypothetical data were also excluded. AV screened all the titles, and AV and ET independently screened the abstracts and full-text publications. For the second search, which was used to update the data, KS screened all the titles. The screening of abstracts was performed independently by AV and KS, and full-text publication screening was performed independently by KS and ET. Discrepancies were resolved through discussion.

Coding

A standardized coding form was used to extract all relevant information from the identified publications. The following information was extracted: (1) the first author and publication year, (2) the country in which the study was conducted, (3) the type of study design (using the classification by Hong et al [23]), and (4) sample characteristics (ie, target group, sample size, age, and gender). It was then determined which laboratory diagnostic service was studied (ie, web-based triage, self-sampling or test-

ing, web-based result service, or any combination of the former three options). The names of the web-based laboratory diagnostic service and the recruitment method were also coded. The different recruitment methods were categorized as social marketing (eg, media, social media, magazines, flyers, advertisements, or promotion in target groups), community outreach (eg, face-to-face recruitment and community events), health service recruitment (ie, direct recruitment by the service provider in past service users), and other recruitment strategies. Details of the laboratory diagnostic services were extracted. Different data were collected based on what services or combinations of services were studied. For the web-based triage service, the aim of the triage was extracted, and it was determined whether it resulted in clinic- or home-based testing (ie, self-sampling or self-testing). For the self-sampling or self-testing service, the following information was extracted when applicable: (1) type of test (ie, self-sampling or self-testing); (2) for what disease; (3) type of specimen (eg, urine specimen); (4) method of how the test kit was ordered, delivered, and how the specimen could be returned; (5) method of instruction (ie, written or video); and (6) costs. For the web-based result service, we coded the method of result notification (eg, on the web or email), whether the notification was entirely or partially independent from an HCP, the average number of days before results were communicated, and whether individuals with positive results were linked to follow-up confirmatory testing or treatment. Results were then extracted, specifically results related to the service evaluation (see the Study Selection section) and not, for example, the characteristics of the service users. AV carried out the coding, and ET independently coded a subsample. There was substantial agreement between the 2 authors (ie, 77%). For the second search, the update, coding was done by KS.

Quality Assessment

The quality of the included studies was assessed using the valid Mixed Method Appraisal Tool (MMAT) [23]. This tool was able to assess the quality of different study designs. The MMAT was chosen because it can be used to assess the methodological quality of 5 different study designs, specifically qualitative, randomized controlled, nonrandomized, quantitative descriptive, and mixed methods studies. The design was determined for each publication, and 5 corresponding quality criteria were rated. The criteria are shown in Multimedia Appendix 2. Each item was rated with yes (ie, indicative of good quality), no (ie, indicative of poor quality), or can't tell (ie, insufficient evidence to determine the quality). Furthermore, a numeric score was calculated to provide insight into the overall quality of each study. The AV conducted the complete quality assessment, and ET assessed a 10% subsample. The average Cohen κ was 0.80, indicating strong interrater reliability [24]. For the second search, KS completed the quality assessment of the studies (n=6).

Data analysis

Data were extracted from the results sections of the studies, as described in the coding paragraph. Relevant outcome measures were extracted verbatim and added to the database, enabling the clustering of different outcome measures. The main findings are presented separately for the different service types. A detailed description of the findings of the included studies is provided in Multimedia Appendix 3 [12-15,25-65].

Results

Study selection

As shown in Figure 1, the 2 search strategies resulted in 1671 publications after removing duplicates. The titles and abstracts were screened for relevance, and the full texts of 141 publications were checked. A total of 96 publications were excluded, most frequently, because the publication did not report on a (web-based) diagnostic laboratory service (n=36), it concerned a national screening campaign (n=19), or the service was not independent of an HCP (n=15). Finally, 45 publications were included in the qualitative synthesis, and 6 studies were included in the second search.

Study characteristics

Most of the included studies had a quantitative descriptive design (n=28) [12,13,15,25-50]. In the remaining studies, a (quantitative) nonrandomized design was reported 6 times [32,51-55], a randomized controlled design was reported 5 times [56-60], a mixed methods design was reported 3 times [14,61,62], and a qualitative design was reported 3 times [63-65]. In 29 studies, a combination of services was offered; specifically, triage, testing, and a result service in 14 studies [13,28,40,42,46,49,51-53,56,57,59,60,63], triage and testing in 9 studies [26,27,29-33,35,37], and testing and a result service in 6 studies [41,44,45,48,61,64]. Furthermore, 8 studies discussed a testing service [14,25,34,38,43,47,58,62], 7 discussed a result service [15,35,39,50,54,55,65], and 1 discussed a triage service [12]. In the included studies, the testing service was evaluated most often (ie, 82% of the studies). Triage was evaluated in 2 studies [12,29] and the result service, in 11 studies [15,35,39-41,44,46,50,54,55,65]. The services were evaluated in the United States (n=15), the United Kingdom (n=9), Canada (n=6), Australia (n=2), Sweden (n=2), the Netherlands (n=2), and China (n=2). The remaining studies took place in Belgium, Brazil, Denmark, Estonia, France, Italy, and Uganda (ie, all n=1). The sample sizes ranged from 10 to 37 in the qualitative studies, with a mean of 21.60 (SD 9.7). The sample size ranged from 102 to 1736, with a mean of 2205.90 (SD 3514.0) in the quantitative studies. Almost half of the studies included both men and women (n=22) [12,13,25,29,36,38,39,48,50-57,59-62,64,65], 11 studies included

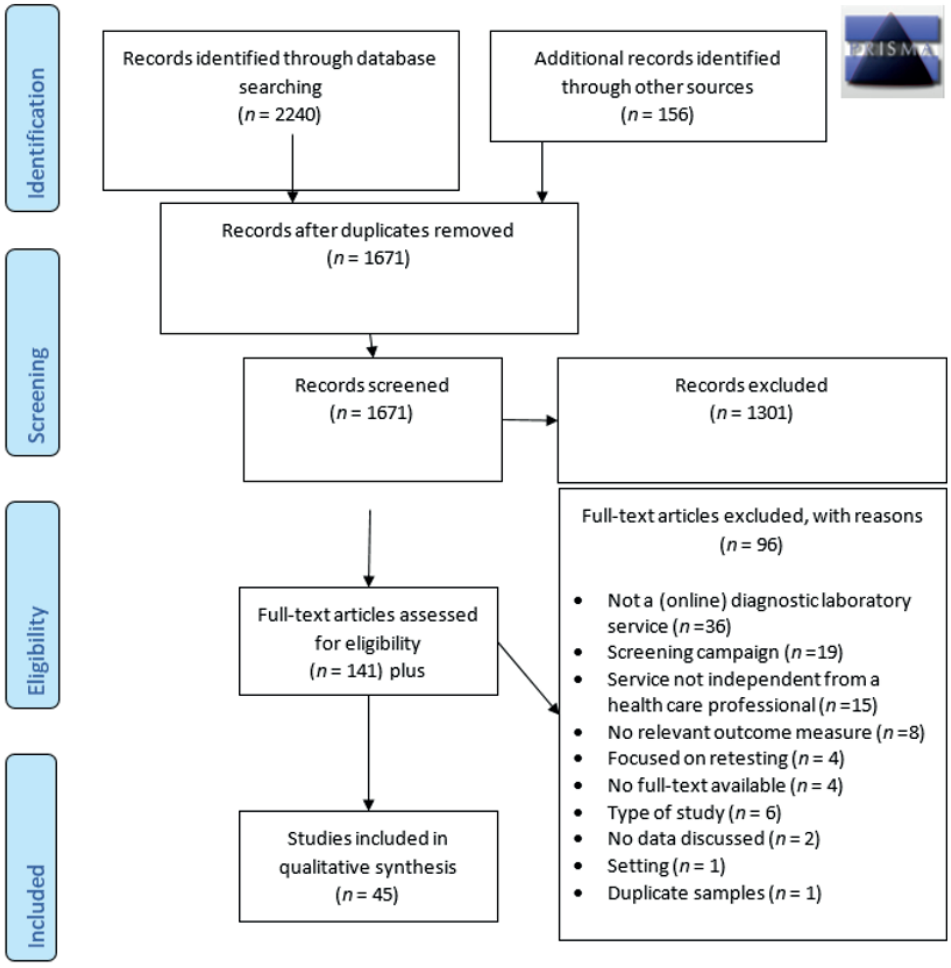

Figure 1. PRISMA (Preferred Reporting Item for Systematic Reviews and Meta-Analyses) flow diagram for study inclusion.

MSM [27,28,34,35,41-43,45,47,49,63], 7 studies included only women [30-33,37,44,46], 2 studies included only men [26,58], 1 study included both MSM and transgender people [14], 1 study included adults with presumptive tuberculosis [15], and 1 study included past service users [40]. The mean percentage of male participants was 62.34% (SD 35.1%), and the mean age was 27.37 years (SD 4.7 years) (the average across the 15 studies that reported a mean) and ranged from 20.70 to 37.90 years. The study characteristics are shown in Table 1.

Table 1. Study characteristics.

First author, year, and country	Study design	Study population	Sample size, n	Males, n(%)	Age (years)	Service type
Ahmed-Little, 2015 [61] UK	Mixed-methods	Persons aged ≥16 years	2247	1043 (46.41)	Mean 22.60	Testing[a] Result
Andersen, 2001 [25] Denmark	Quantitative descriptive	Persons aged 21-23 years	183	64 (34.9)	-[b]	Testing
Babirye, 2019 [15] Uganda	Quantitative descriptive	Adults with presumptive tuberculosis	233	114 (48.9)	IQR 27 - 50	Result
Barnard, 2018 [51] UK	Quantitative non-randomized	Persons aged ≥16 years	5747	2489 (43.31)	IQR 23 - 32	Triage Testing[a] Result
Brown, 2018 [56] UK	Quantitative RCT[c]	High-risk persons ≥16 years of age	8999	7015 (77.95)	72% aged between 16-34	Triage Testing[a] Result
Chai, 2010 [26] US	Quantitative descriptive	Men aged ≥14 years	501	501 (100.00)	IQR 21 - 30	Triage Testing[a]
de Boni, 2019 [27] Brazil	Quantitative descriptive	MSM[d] aged≥18 years	3218	3218 (100.00)	IQR 22 - 31	Triage Testing[a]
Dulai, 2019 [49] Canada	Quantitative descriptive	Men who are gay, bisexual, and MSM aged ≥18 years	1272	1272 (100.00)	53% aged between 18 – 39	Triage Testing[a] Result
Elliot, 2016 [28] UK	Quantitative descriptive	MSM	17361	17361 (100.00)	-	Triage Testing[a] Result
Grandahl, 2020 [64] Sweden	Qualitative	Persons aged ≥15 years	20	9 (45)	Mean 30.8	Testing[a] Result
Grandahl, 2020 [48] Sweden	Quantitative descriptive	Persons aged ≥15 years	1785	546 (30.58)	Mean 27.3	Testing[a] Result
Gaydos, 2016 [30] US	Quantitative descriptive	Women	102	0 (0)	64% aged between 18-29	Triage Testing[a]
Gaydos, 2016 [29] US[e]	Quantitative descriptive	Persons aged ≥ 14 years	1394	558 (40.02)	Mean 28.13	Triage[a] Testing

Table 1. Continued

First author, year, and country	Study design	Study population	Sample size, n	Males, n(%)	Age (years)	Service type
Gaydos, 2011 [32] US[e]	Quantitative non-randomized	Women aged ≥ 14 years	1171	0 (0.00)	Mean 25.00	Triage Testing[a]
Gaydos, 2009 [31] US[e]	Quantitative descriptive	Women aged ≥ 14 years	1203	0 (0.00)	Median 23	Triage Testing[a]
Gaydos, 2006 [33] US	Quantitative descriptive	Women aged ≥ 14 years	400	0 (0.00)	Mean 26.10	Triage Testing[a]
Gilbert, 2019 [52] Canada	Quantitative non-randomized	Persons aged ≥ 14 years	381	270 (70.86)	Range 18 – 74	Triage Testing[a] Result[a]
Gilbert, 2017 [13] Canada	Quantitative descriptive	Persons aged ≥ 14 years	868	619 (71.31)	Median 32	Triage Testing[a] Result
Jin, 2019 [34] China	Quantitative descriptive	MSM aged ≥ 16 years	879	879 (100.00)	IQR 24 – 34	Testing
Kersaudy-Rahib, 2017 [57] France	Quantitative RCT	Persons aged 18-24 years	11075	5152 (46.52)	Mean 20.70	Triage Testing[a] Result
Knight, 2018 [63] Canada	Qualitative	MSM aged ≥ 15 years	37	37 (100.00)	Mean 37.90	Triage Testing[a] Result
Koekenbier, 2008 [35] Netherlands	Quantitative descriptive	MSM	898	898 (100.00)	-	Result
Kuder, 2015 [53] US	Quantitative non-randomized	Persons aged ≥ 14 years	1211	484 (39.97)	Mean 27.47	Triage Testing[a] Result
Kwan, 2012 [36] Australia	Quantitative descriptive	Persons aged ≥ 16 years	377	206 (54.64)	71% were aged <30	Triage Testing[a]
Ladd, 2014 [37] US[e]	Quantitative descriptive	Women	205	0 (0.00)	Mean 25.80	Triage Testing[a]

Ling, 2010 [54] US	Quantitative non-randomized	Men and women	9056	5196 (57.37)	85% were aged ≥ 20	Result
Mák, 2015 [55] Canada	Quantitative non-randomized	Persons aged ≥ 18 years	3292	1244 (37.79)	62% were aged ≥ 55	Result
Martin, 2009 [38] Australia	Quantitative descriptive	Persons aged 16-24 years	413	224 (52.24)	67% aged between 16-24	Testing
Morris, 2010 [39] US	Quantitative descriptive	Persons aged ≥18 years	3138	2563 (81.67)	62% aged between 25-44	Result
Nadarzynski, 2018 [40] UK	Quantitative descriptive	Service users	115	-	-	Triage Testing Result*
Platteau, 2015 [41] Belgium	Quantitative descriptive	MSM aged ≥18 years	1071	1071 (100.00)	Mean 33.82	Testing Result[a]
Polilli, 2016 [12] Italy	Quantitative descriptive	Men and women	5000	-	-	Triage
Reagan, 2012 [58] US	Quantitative RCT	Men aged 18-45 years	200	200 (100.00)	Mean 30.75	Testing
Ricca, 2016 [42] US	Quantitative descriptive	MSM aged ≥18 years	896	896 (100.00)	Mean 30.00	Triage Testing[a] Result
Robinson, 2019 [65] Canada	Qualitative	No inclusion criteria	21	12 (57.14)	38% aged between 60-69	Result
Rosengren, 2016 [43] US	Quantitative descriptive	Black and Hispanic MSM aged ≥18 years	125	125 (100.00)	63% aged between 18-30	Testing
Rotblatt, 2013 [44] US	Quantitative descriptive	Women aged 12-25 years	2659	0 (0.00)	Median 22.3	Testing[a] Result[a]
Rüütel, 2015 [45] Estonia	Quantitative descriptive	MSM aged ≥18 years	265	265 (100.00)	53% were aged ≥30	Testing[a] Result
Spielberg, 2014 [46] US	Quantitative descriptive	Women aged 18-30 years	217	217 (100.00)	Median 25	Triage Testing[a] Result[a]

Table 1. Continued

First author, year, and country	Study design	Study population	Sample size, n	Males, n(%)	Age (years)	Service type
Talboom-Kamp, 2020 [50] NL	Quantitative descriptive	No inclusion criteria	354	-	-	Result
Wilson, 2019 [60] UK	Quantitative RCT	Persons aged 16-30 years whom had never had an STI test	528	254 (48.11)	Mean 21.30	Triage Testing[a] Result
Wilson, 2017 [59] UK	Quantitative RCT	Persons aged 16-30 years	2063	846 (41.01)	Mean 23.00	Triage Testing[a] Result
Witzel, 2019 [14] UK[g]	Mixed-methods	MSM and transgender people aged ≥16 years	1035 / 10	1035 (100.00)/ 10 (100.00)	IQR 26 - 42 or 60% aged between 26-40	Testing
Witzel, 2021[62] UK[g]	Mixed-methods	Transgender people aged ≥16 years	118/20	94 (79.66)/12 (60)	IQR 22 -37 or 35% aged between 16-25	Testing
Zhong, 2017 [47] China	Quantitative descriptive	MSM aged ≥18 years	380	380(100.00)	54% aged between 25-34	Testing

[a]When multiple services were discussed in a study, footnote a identifies the service for which data was reported.
[b]—: data not available.
[c]RCT: randomized controlled trial.
[d]MSM: men who have sex with men.

Service provider characteristics

Within the 45 studies included in this review, 31 different providers were examined. The characteristics of the service providers are shown in Table 2, and more details are provided in Appendix 4 [12-15,25-65]. About half of the service providers offered a combination of services. A total of 9 providers offered a triage, testing, and result service, 5 offered a testing and result service, and 2 offered a triage and testing service. The remaining providers offered a single service (ie, testing [n=7], result [n=7], or triage [n=1]). Social marketing was most often used to recruit service users or study participants, with 16 providers using it as the sole recruitment strategy and 5 providers combining it with community outreach. The health service recruited 7 providers, and 3 studies reported no information on the applied recruitment strategy.

Triage was offered by 12 different service providers, either alone or in combination with other services. Triage aimed to estimate the risk of having a disease and identify individuals who need to test. The aim of the triage, however, was not specified for 5 providers. In most cases, web-based triage directed users to home-based testing (83%). A total of 23 providers offered testing as a service (alone or in combination with other services); 12 providers offered testing for 1 disease, and 11 offered testing for >2 diseases (ie, ranging from 2 to 6). Testing was most often available for chlamydia (n=13), HIV (n=12), and gonorrhea (n=10). Providers also tested for trichomonas (n=3), syphilis (n=3), hepatitis B (n=1), hepatitis C (n=1), lymphogranuloma venereum (n=1), and mycoplasmosis (n=1). Most of the tests were performed with a self-sampling test (n=18), whereby the samples were returned to the laboratory and analyzed according to the gold standard. All laboratories provided high-quality analysis with accredited and certified equipment. Self-testing was offered by 5 providers and targeted HIV (n=5) and syphilis (n=1). The testing service was almost always free of charge (87%). A small shipping fee was charged by 1 provider, and 1 provider charged US $23 that would be refunded after the user had shared the test results with the staff. A result service was offered by 20 providers (alone or in combination with other services). Different methods were used to communicate the test results, with 8 providers relying on a single method and 10 providers using different methods for result communication. Test results were most often accessible on the internet (n=12) or communicated over the phone (n=10). The results could also be communicated using SMS text messaging (n=6) or email (n=2). The communication of the test results was, in most cases, not completely independent from an HCP (70%). Often, the results were presented on the web, but users were called by the HCP when they had a positive result [39,63], or users were called when they had not checked their results on the internet [41].

Table 2. A description of the diagnostic testing and result service provider.

		Triage	Testing			Result	
Service provider	**Recruitment methoda**	**Type of follow-up testing**	**Disease(s)**	**Type of home-based test**	**Cost**	**Method**	**Independent HCP**
Triage service							
Fai il test anche TU project [12]	Social	Clinic	HIV, hep B and C, syphilis	-[b]	-	-	-
Testing service							
C-project [38]	Social	-	Chlamydia	Self-sampling	Free	-	-
Easy test [34]	Social Community	-	HIV	Self-testing	$2-3	-	-
UCLA free HIV self-test program [43]	Social	-	HIV	Self-testing	Free	-	-
Social entrepreneurship testing [47]	··	-	HIV Syphilis	Self-testing	$23 (refunded)	-	-
SELPHI [14, 62]	Social	-	HIV	Self-testing	Free	-	-
Unknown [25]	Social	-	Chlamydia	Self-sampling	Free	-	-
Unknown [58]	Social Community	-	Chlamydia Gonorrhea	Self-sampling	Free	-	-
Unknown [48, 64]	Health service	-	Chlamydia Gonorrhea	Self-sampling	Free	-	-
Result service							
GxAlert [15]	Health service	-	Tuberculosis	-	-	SMS	Yes
Syfilistest.nl [35]	Social	-	Syphilis	-	-	Online	Yes
Early test [39]	Social	-	HIV	-	-	Online Phone	Partly
Result system of Denver Metro Health Clinic [54]	Health service	-	Chlamydia, gonorrhea	-	-	Online	Partly
Excelleris [55]	Health service	-	Not limited to a specific disease	-	-	Online	Yes
Patient portal [50]	Health service	-	Not limited to a specific disease	-	-	Online	Partly
myCARE [65]	Health service	-	Not limited to a specific disease	-	-	Online	Partly
Triage & testing service							
A hora é Agora [27]	Social	Home	HIV	Self-testing	Free	-	-
Online Chlamydia Testing program [36]	Social	Home	Chlamydia, gonorrhea	Self-sampling	Free	-	-

Testing & result service							
Swab2Know [41]	Social	-	HIV	Self-sampling	Free	Online Email Phone	Partly
Don't think, know [44]	Social Community	-	Chlamydia, gonorrhea	Self-sampling	Free	Online Phone	Partly
Testikodus [45]	Social	-	Chlamydia, gonorrhea, trichomonas, LGV[c], mycoplasmosis	Self-sampling	Free	Online	Yes
RUClear [61]	-	-	HIV	Self-sampling	-	Phone SMS Letter	Partly
Triage, testing & result service							
DS@H [28]	Social	Home	HIV	Self-sampling	Free	SMS Phone	Partly
GetCheckedOnline [13, 49 52, 63], [d]	Social	Home Clinic	Chlamydia, gonorrhea	Self-sampling	Free	Online Phone	Partly
Let's talk about it NHS [40]	Health service	Home	Chlamydia, gonorrhea, HIV, syphilis, hep B and C	Self-sampling	Free	SMS Phone	Partly
Checking In [42]	Social	Home	HIV	Self-sampling	Free	Phone	Partly
eSTI [46]	Social Community	Home	Chlamydia, gonorrhea, trichomonas	Self-sampling	Free	Online	Yes
SH:24 [48, 59, 60][d]	Social Community	Home	Chlamydia, gonorrhea, HIV, syphilis	Self-sampling	Free	SMS Phone	Partly
Freetesting.hiv [56]	-	Home	HIV	Self-sampling	Free	SMS Phone	Partly
Chlamyweb [57]	Social	Home	Chlamydia	Self-sampling	Free	Email Postal service	Partly
I Want The Kit [26, 29-33, 37, 53][d]	Social	Home	Chlamydia, gonorrhea, trichomonas	Self-sampling	Free	Online	Yes

[a]The methods used to recruit participants or service users was reported; specifically, social=social marketing, community=community outreach, and health service=health service recruitment.

[b]Data not available.

[c]Lymfogranuloma venereum.

[d]The service provider was investigated in multiple studies. The specific characteristics of each study are presented in Multimedia Appendix 3.

Table 3. Quality assessment of the included studies using the Mixed Method Appraisal Tool (MMAT).

	MMAT quality criteria[a]					
Included studies	**1**	**2**	**3**	**4**	**5**	**MMAT scores[b]**
Qualitative						
Knight et al. [63]	+[c]	+	+	+	+	5
Grandahl et al. [64]	+	+	+	+	+	5
Robinson et al. [65]	+/-[d]	+	+	+	+	4
Average MMAT score						4.67
Quantitative randomised controlled trials						
Brown et al. [56]	+	+	+	+/-	+	4
Kersaudy-Rahib et al. [57]	+	+	-[e]	+/-	+	3
Reagan et al. [58]	+	+	-	+	+	4
Wilson et al. [59]	+	+	+	+	+	5
Wilson et al. [60]	+	+	+	+	+	5
Average MMAT score						4.20
Quantitative non-randomised						
Gaydos et al. [32]	+	+	+	+/-	+	4
Barnard et al. [51]	+	+	-	+	+	4
Gilbert et al. [52]	-	+	+/-	+	+	3
Kuder et al. [53]	+	+	-	-	+	3
Ling et al. [54]	+	+	+	+	+	5
Mák et al. [55]	-	+	+	+	+	4
Average MMAT score						3.83
Quantitative descriptive						
Polilli et al. [12]	+	+	+	+/-	+	4
Gilbert et al. [13]	+	+	+	+/-	+	4
Babirye et al. [15]	+	+	+	+	+	5
Andersen et al. [25]	+	+	+	+/-	+	4
Chai et al. [26]	+	+	+	+/-	+	4
de Boni et al. [27]	+	+	+	+/-	+	4
Elliot et al. [28]	+	+	+	+/-	+/-	3
Gaydos et al. [29]	+	+	+	+/-	+	4
Gaydos et al. [30]	+	+	+	+/-	+	4
Gaydos et al. [31]	+	+	+	+/-	+	4
Gaydos et al. [33]	+	+	+	+/-	+	4
Jin et al. [34]	+	+	+	+/-	+	4
Koekenbier et al. [35]	+	+	+	+/-	+	4
Kwan et al. [36]	+	-	+	+/-	+	3
Ladd et al. [37]	+	+	+	+/-	+	4
Martin et al. [38]	+	-	+	+/-	+	3
Morris et al. [39]	+	+	+	+/-	+	4
Nadarzynski et al. [40]	+	+/-	+	+/-	+	3
Platteau et al. [41]	+	+	-	+/-	+	3
Ricca et al. [42]	+	+	+	+/-	+	4
Rosengren et al. [43]	+	+	+	+/-	+	4

	MMAT quality criteria[a]					
Included studies	**1**	**2**	**3**	**4**	**5**	**MMAT scores[b]**
Rotblatt et al. [44]	+	+	+	+/-	+	4
Rüütel et al. [45]	+	-	+	-	+	3
Spielberg et al. [46]	+	+	+	+/-	+	4
Zhong et al. [47]	+/-	+	+	+/-	+	3
Grandahl et al. [48]	+	+	+	-	+	4
Dulai et al. [49]	+	+	+	-	+	4
Talboom-Kamp et al. [50]	+	+	+	-	+	4
Average MMAT score						3.78
Mixed-methods						
Witzel et al. [14]	+	+	+	+	-	4
Ahmed-Little et al. [61]	+/-	-	+	+	-	2
Witzel et al. [62]	+	+	+	+/-	+	4
Average MMAT score						3.33
Average MMAT score across all designs						3.86

[a]The criteria differed according to the design. A description of the criteria is provided in Multimedia Appendix 2.
[b]The average Mixed Method Appraisal Tool score across all designs is 3.86. The overall grade is the sum of the number of quality criteria that were assessed as good.
[c]Good quality.
[d]Insufficient evidence to determine the quality.
[e]Poor quality.

Quality assessment

Quality assessment using the MMAT of the studies is shown in Table 3. The quality of the included studies was good, with an average score of 3.86 (SD 0.6; on a scale from 0 to 6). The average quality score ranged from 3.33 (SD 1.5) for mixed methods studies to 4.67 (SD 0.57) for qualitative studies. A shortcoming was that, in the studies using a quantitative descriptive design, the nonresponse was not clearly reported in 23 of the 25 studies. Therefore, it is unclear if these studies were at risk of nonresponse bias.

Findings by type of service

The findings are discussed separately for triage, testing, and result service. For clarity, the findings of follow-up testing and treatment are jointly discussed for the testing and result service. A more detailed description of the findings is provided in Multimedia Appendix 4.

Triage service

A total of 2 studies evaluated the triage service, which showed that the use of web-based triage services could be quite high with those completing the web-based triage and booking an appointment for a test (more than 50%). Notably, most of the individuals who tested positive were also linked to treatment. Furthermore, the predic-

tive value of triage showed a prediction of STI positivity in women. For more detailed information, see Table 4.

Testing service

For the test service, different outcome measures were found with different objectives. Studies with outcomes focusing on the test services, which were home-based (eg, self-testing or self-sampling), were discussed. The test use was reported to be high (above 50%), and test uptake was higher among those offered home-based tests than clinic-based tests. The number of returned specimens was discussed frequently and showed very different results with a wide range of percentages of returned specimens. The acceptability and usability of the test service scored high on the convenience of performing home-based tests with easy instructions. The cost-effectiveness of home-based tests showed lower or similar prices compared with clinic-based testing. Furthermore, motivations for self-testing were discussed. Ease of use, privacy, and anonymity were identified as reasons to perform these tests. Important barriers for these services were potential costs, accuracy, unreliable postal service, insecurity about handling data, and self-interpreting the results. For more detailed information, see Table 4.

Result service

For the result service, different types of outcome measures were found with different objectives. The use of the result service exceeded 69%. Research showed that most participants viewed their results on the same day as they were posted on the web, and comprehension of these web-based results was high (above 75%). The acceptability of direct access to results using the website was high, and the participants were satisfied with this process. Direct access to diagnostic results led to shorter waiting times for the results than for participants who did not receive their results on the web. Limited access to the internet was a reason for preferring to call the clinic for the results. For more detailed information, see Table 5.

Test and result services: follow up testing and treatment

Follow-up testing and treatment have been discussed in several studies. These studies showed that receiving web-based results led to high treatment rates (mean 93%, SD 9.9%), and the frequency of confirmatory testing after a self-test was above 68%. For more details, see Table 5.

Table 4. Results of the triage and test services per specific outcome measure.

Service and general outcome	Specific outcome measure	Results
Triage		
-[a]	Use	• Use of web-based triage services can be quite high; more than 50% (3046/5000) of those who completed the web-based triage also booked an appointment for HIV clinic-based testing. Notably, the majority also presented for testing (87%), and most of the individuals who tested positive were also linked to treatment (93% [12]
	Predictive value	• Gaydos et al. [29] found that the score on the risk assessment predicted STI[b] positivity for females but not males
Test		
Usage		
	Return specimen	• The percentage of returned tests or specimens for analyses was frequently reported [13, 25, 26, 28, 37, 38, 42, 44-46, 48, 51, 56, 61] • Range: 24 [45] to 85% [42, 48], with an average of 52.8%(SD = 19.6%)
	Used tests	• In 4 studies, the percentage of used home-based tests was given [14, 36, 43, 47]. • Range: 56 [36] to 100% [43], with an average of 83% (SD = 19.3%) • The highest percentage might be an overestimation of the actual use because people had to self-report the usage of the tests in a follow-up survey [43]
	Comparison home-based testing versus clinic-based testing	• In four studies, home-based testing was compared to clinic testing [57-60]. • The average percentage of test usage was higher among those who were offered a home test compared to those who were offered a test at the clinic (respectively 49% [SD = 17.8] vs 27% [SD = 16.1%).
	Other	• Home-based test uptake was highest when the results would be presented through the internet [53] • When users received primers before the arrival of the test kit at home (eg, set aside a time to complete the test) and behavioral insight reminders [56]
Acceptability /usability	Home-based testing versus clinic-based testing	• Eight studies examined whether there was a preference for home-based or clinic-based testing [26, 30, 32, 33, 43, 46, 63] • Range: 62 [30] to 95% [46], with an average of 81% (SD = 12.7%) who preferred home-based testing • One study reported a barrier to clinic-based testing: that it was easier to stay at home than go to the clinic [49]
	Easy to perform	• Seven studies reported how easy it was to perform home-based testing [14, 26, 30, 32, 33, 36, 43]. • Range: 88 [26] to 97% [14, 32], with an average of 94% (SD = 3.5%).
	Acceptability instructions	• Five studies examined the acceptability of the instructions for home-based testing [14, 27, 30, 58, 61] • On average, 93% (SD = 5.3%) considered the instructions to be easy.

Table 4. Continued

Service and general outcome	Specific outcome measure	Results
	Acceptability in general	• In 3 studies, the acceptability of the home-based test service, in general, was reported [59-61] • Mean 75% (SD = 4.5)
	Recommendation	• The percentage of participants who would recommend the service of testing at home to a friend was 98 percent in two studies [36, 46], and in Gaydos et al., it was 77% [30]
	Other	• The perceived reliability of the test results was reported in Gaydos et al. [30]: 97% of the users trusted the results of the home-based test service • Chai et al. [26] found that 85% found it a safe way of testing • Witzel et al. [14]. found that 97% had an overall good experience with the home-based test service • Chai et al., Gaydos et al. and Dulai et al. [26, 32, 49] both reported that around 90%would use the home-based test service again • Gaydos et al. [33] report that 86% would use this home-based testing method in daily life • De Boni et al. [27]. reported that 91% found it (very) easy to use the website • Grandahl et al.[48] reported that more than 90% found the overall home-based test service good or very good. • Grandahl et al. [64] reported that most users highly appreciated the service and found the service easy to use, convenient and confidential. They would use the service again in the future, even if the costs were higher.
Cost-effectiveness	Cost-effectiveness	• Kersaudy-Rahib et al. [57] reported that the price for home-based testing was three times lower compared with clinic-based testing • Ahmed-Little et al. [61] showed that the costs for HIV testing per person were around €27 (US $ 30.45), which is in line with testing costs in national HIV testing pilots
Other outcomes	-	• Reasons to self-test were that it reduced HIV testing barriers, desire to use new technology, and altruistic motivation [14]. • Other reasons mentioned for HIV self-testing were inaccessible and inappropriate clinical services[62]. In Martin et al. [38] users reported that they did the test because it was easy and it was for free • Zhong et al. [47] reported convenience and to save time, protection of privacy, ease of use and accuracy as reasons to perform a home-based self-test. *Facilitators* were ease of use, anonymity, and the ability to test alone. *Barriers* were concerns about accuracy, potential costs, and concerns about self-interpreting the results • Dulai et al. [49] reported that 20% were *worried* about their online information privacy, and 5% had low trust in this service. • Some *barriers* mentioned in Grandahl et al. [64] were the use of complicated language, uncertainty about the procedure, unreliable postal service, and insecure data handling.

[a]No general outcome measure.
[b]STI: sexually transmitted infection.

Table 5. Results of the test and result services per specific outcome measure.

Service and general outcome	Specific outcome measure	Results
Result		
Usage	Retrieved results online	• The usage of a result service was assessed in six studies [35, 39, 41, 44, 46, 54] • The percentage of people who retrieved their results online varied from 69 [39] to 97% [35], with an average of 85% (SD 11.2%) • The service with the lowest retrieval rate called all users with a positive test result and, if users were not called within 2 weeks they could access their results online • Spielberg et al. [46] found that 88% viewed their test results on the same day they were posted • Platteau et al. [41] showed that significantly more people collected their test results when the test was ordered online compared to testing during outreach activities
	Waiting time	• Gilbert et al. [52] showed significantly shorter waiting times for those who used an online platform compared to clinic clients
Comprehension	-[a]	• Babirye et al. [15] found that everyone could accurately relay the content of an SMS that contained the tuberculosis test result • Comprehension was slightly lower in the other 2 studies: 75% and 87% understood the content of the test result message (respectively [55,40]) • Mák et al. [55] showed that comprehension was significantly higher in the group that did not receive their results online • Robinson et al.[65] showed that comprehension of the results differed from difficulty with the understanding of the results to no difficulty. However, when difficulties were there, the users pointed out that the reference range was helpful.
Acceptability	Comfortable with online results	• Acceptability was examined in 4 different studies [39, 41, 46, 54] • Only 1 study specifically examined how comfortable users were with receiving their results online, and 87% was (very) comfortable with this process [39]
	Ordering a test and receiving results online	• Two studies examined the acceptability of ordering a test kit online and receiving the web-based results • Platteau et al. [41] found that 96% of the users were satisfied with this process • Spielberg et al. [46] reported that 98% of the users found the service website easy to use
	Reasons	• The two main reasons for choosing to receive web-based results were having access to the results any time of the day and the belief that results would be communicated faster via the internet • A preference to call the clinic for results and limited access to the Internet were reasons to opt-out of web-based results[54] • Reasons for having web-based results were reported by Robinson et al. [65] as: better communication with the HCP[b], convenience, and being a steward of own health care

Table 5. Continued

Other outcomes	-	• The *feasibility* of using SMS to communicate tuberculosis test results was examined in Uganda and scored relatively low; (ie, an SMS text message was online transmitted to 62% of those who were eligible to receive an SMS text message with test results [15]). • One study found that users waited significantly shorter for web-based results than users who did not have web-based access [55]. Furthermore, this study showed that the majority (ie, 86%) experienced no or low *anxiety* after receiving their test results, and the level of anxiety was not different between those with or without internet access • Another study examined *user preferences* for the content of text messages conveying the test results, and the majority preferred that the results of all tested STIs[c] were discussed in one message and that the names of the STIs tested should be included in the message [40] • One study reported that patients feel more *comfortable and engaged* with their health care when they see the results themselves [65]. Besides, they reported that it had no adverse effects. • Two domains of the eHIQ[d] were researched in one study to determine patient's attitude towards an online results service [50]. This eHIQ showed positive results for the criteria easy to use, trustworthy and appropriate.
Test and result		
Follow up testing and treatment	Confirmatory testing	• The frequency of confirmatory testing for positive or uncertain/invalid test results was described in 4 studies [27, 35, 43, 61] • Range from 68 [27] to 100% [43, 61], with an average of 85% (SD 17.7%)
	Follow up after positive result	• Follow up treatment after a positive test result was described in 10 studies [26, 31, 32, 34, 36, 41-44, 46] • Receiving online test results led to high treatment rates, with an average of 93% (SD 9.9%)
	Confirmatory testing and treatment	• In 2 studies, confirmatory testing and treatment were described [28, 47] • In Elliot et al. [28], 67% of the reactive samples were confirmed, and all received treatment. For 10% of the reactive samples, treatment could not be confirmed • In Zhong et al. [47], everyone with a reactive test did confirmatory testing and was linked to treatment
	Other	• In 3 studies, different groups were compared to each other. It was shown that the treatment rate was higher when users (1) had the option to receive their results web-based versus communicated over the phone (not significant) [54], (2) received their test kit at home instead of at the primary care setting [57], and (3) received their results through an automated result access system compared to service were participants had to call for their test result [53]

[a]Data not available.
[b]HCP: health care professional.
[c]STI: sexually transmitted infection.
[d]eHIQ: e-Health Impact Questionnaire.

Discussion

Principal Findings

This systematic review aimed to gain insight into the available methods for direct web-based access to patients for diagnostic testing and results. A total of 45 studies were included. Most of the studies used a quantitative descriptive design. Most of the studies investigated a test or result service related to STIs. In the 45 studies, 31 different providers were discussed. Half of the providers offered a combination of services. Of the 3 different services, the test service was most often evaluated. This review showed that direct patient access to testing and result services was positively evaluated. The use of triage, test, and result services was high, and the acceptability among patients was high. Moreover, follow-up confirmatory testing and treatment rates were high with home-based testing.

An update of the literature search was performed after the third wave of the COVID-19 pandemic. However, no studies were found regarding direct access to diagnostic testing and results services for this disease. This could be because free tests were often offered by the governments of countries. There have been commercial companies offering tests for SARS-CoV-2; however, scientific research has not yet been performed.

This review found that the use rates of home-based tests were high and that direct web-based access to results was appreciated and generally well-understood. An overall preference for home-based testing versus clinic-based testing was found. Importantly, follow-up treatment after a positive home-based test was high and, in some studies, was even higher when tests were performed at home compared with the clinic. The overall positive findings of this systematic review contradict earlier voiced concerns about self-testing and self-sampling, such as that users would be insufficiently linked to follow-up testing or treatment [66,67]. It was reported in 1 study that 70% of participants were afraid to carry out the self-test properly [67]. This contrasted with our findings, which indicated that users found self-tests easy to use and that the instructions were clear and reliable. Nevertheless, it is important to include end users in the design phase when setting up such services to ensure usability and acceptability [68]. In addition, although most studies reported high acceptability and comprehension of test results communicated on the web, 1 study reported that interpreting the results was easier when they were communicated in person (vs via the internet). This contradictory finding might be because this study discussed a general result service portal and not a portal specifically for STI results. To minimize the risk of misunderstanding, it is important that future research examine the content and how this content can best be presented to users [50].

Furthermore, the quality of the laboratory tests used in these studies was high. Therefore, this review disproves the aforementioned concerns about home-based diagnostic tests [66,67] and shows that these tests with direct access to web-based result services could contribute to easily accessible diagnostic testing [69].

The high acceptability of the test and result services and the high rates of follow-up for treatment create opportunities for primary care. The workload for primary care is high [3,4]. eHealth technologies can make health care delivery more efficient, and therefore, the adoption of eHealth is being stimulated worldwide [9]. By providing patients with direct access to web-based testing and results, patients would not need to visit their HCP, potentially lowering the number of consultations in primary care. Consequently, it would leave HCPs with more time to focus on complex health care and consultations that cannot be executed via the internet. Another reason for home-based diagnostic testing is to lower the testing threshold. Patients can experience feelings of embarrassment or shame for tests such as STI, which can result in delays in testing [70]. Allowing individuals to order tests on the web can make it more convenient for them to get tested and may help diagnose and treat diseases sooner. However, future research should investigate whether these types of test services lead to excessive use. At the same time, it is important to emphasize that this review identified that direct access to diagnostic testing exhibited benefits for patients, such as comfort, ease, and time-saving. A few barriers should be addressed to allow home-based diagnostic testing in practice. An important barrier to eHealth adoption in primary care is, for example, the cost [71]. In the Netherlands, diagnostic tests ordered by a primary care physician are covered by health insurance. However, home-based diagnostic testing has not yet been covered by insurance. To stimulate home-based testing, the costs of home-based diagnostic testing should be covered by an individual's health care insurance. Therefore, it would be useful to investigate the cost-effectiveness of home-based diagnostic testing compared with clinic-based testing. In this review, only 2 studies discussed cost-effectiveness, more insight into how valuable home-based diagnostic testing could be in the future could be provided. Furthermore, home-based diagnostic testing could work more efficiently in primary care if implemented for a variety of conditions [72]. However, more research is needed to elaborate on home-based diagnostic test services for diseases other than STIs.

Strengths and Limitations

The strengths of this review lie in several aspects. First, the study search strategy was comprehensive and not limited to a specific disease or population. Second, a quality assessment was performed for all included studies, and the quality of the included studies appeared to be relatively high. However, it is essential to consider that the MMAT was scored using a yes or no score without nuances. Third, a comprehensive overview of the study and service characteristics provided detailed insight into the included studies.

This review has several limitations. First, there was heterogeneity in the included outcome measures, which resulted in a low number of studies reporting the same outcome. Therefore, it was not possible to examine the pooled effect using a meta-analysis. As the field advances quickly, more studies are likely to become available soon, and a meta-analysis might be possible. Second, almost all studies focused on STIs. For

that reason, it was unknown whether the findings regarding usability and acceptability would generalize to test and result services that target diseases other than STIs. Nevertheless, our review provided insight into the potential of direct web-based access to diagnostic testing, which could translate to other diseases. Even for test results that were not dichotomous, which was the case in STI testing, test results could be presented in a web-based portal, for example, the identification of abnormal and normal values for a test result with an option to contact a physician [50]. A third limitation was that the mean age in the included studies was relatively low, which could have led to bias because a different, older population could have evaluated these services differently [73]. Although eHealth services have shown good use and result in older adult populations, it remains to be determined whether this is also the case for web-based diagnostic testing and results services [74]. There was a large portion of the quantitative descriptive design studies (28/45, 62%) that constituted the fourth limitation to this review. Only 5 studies had a randomized controlled trial design. Therefore, selection bias cannot be ruled out, including sample representativeness. Nevertheless, all studies underwent quality assessment and scored relatively high.

Conclusion

Home-based testing showed higher use rates and follow-up treatment rates compared with clinic-based testing. It was demonstrated to be acceptable, safe, and convenient for users, which could lower the threshold for testing. Future research on diagnostic testing for diseases other than STIs and cost-effectiveness evaluation is needed. To conclude, this review showed that eHealth technologies for diagnostic testing could contribute to easy direct access to high-quality diagnostic testing for patients and has the potential to increase efficiency and possibility to reduce workload in primary care. In conclusion, direct web-based access to diagnostic testing showed promising results.

Conflicts of Interest

None declared.

List of abbreviations

HCP = health care professional
MMAT = Mixed Method Appraisal Tool
MSM = men who have sex with men
PRISMA = Preferred Reporting Items for Systematic Reviews and Meta-Analyses
STI = sexually transmitted infection

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Appendix 1

Search terms for this systematic review.

PubMed

http://www.ncbi.nlm.nih.gov/pubmed?otool=leiden

(((("Clinical Laboratory Techniques"[majr:noexp] OR "Laboratory Technique"[tw] OR "Laboratory Techniques"[tw] OR "laboratory diagnosis"[tw] OR "Clinical Laboratory Tests"[tw] OR "Laboratory Test"[tw] OR "Laboratory Testing"[tw] OR "lab test"[tw] OR "lab tests"[tw] OR "lab testing"[tw] OR "Laboratory Examination"[tw] OR "diagnostic tool"[tw] OR diagnostic tool*[tw] OR "diagnostic assessment"[tw] OR diagnostic assessment*[tw] OR "diagnostic system"[tw] OR diagnostic system*[tw] OR "diagnostic test"[tw] OR diagnostic test*[tw] OR "self-test"[tw] OR self test*[tw] OR "home-based test"[tw] OR home-based test*[tw] OR "self-sampling"[tw] OR postal test*[tw] OR test kit*[tw] OR testing kit*[tw] OR tests kit*[tw] OR STI test*[tw] OR STD test*[tw] OR testing program*[tw] OR "HIVST"[tw] OR "self-swabbing"[tw]) AND ("health information technology"[ti] OR "health information systems"[ti] OR "interactive health communication"[ti] OR "patient portal"[ti] OR "Telemedicine"[majr] OR web portal*[ti] OR telemed*[ti] OR "ehealth"[ti] OR "e-health"[ti] OR "mhealth"[ti] OR "m-health"[ti] OR "mobile health"[ti] OR "telehealth"[ti] OR "tele-health"[ti] OR "tele health"[ti] OR "webbased"[ti] OR "web-based"[ti] OR "telemedicine"[ti] OR "tele-care"[ti] OR "telecare"[ti] OR "website"[ti] OR "websites"[ti] OR "webpage"[ti] OR "webpages"[ti] OR "web application"[ti] OR "web applications"[ti] OR "web access"[ti] OR "Internet"[majr] OR "internet"[ti] OR "online communication"[ti] OR "on-line communication"[ti] OR "on line communication"[ti] OR text message*[ti] OR "sms"[ti] OR "smart message service"[ti] OR "short message service"[ti]) NOT ("Animals"[mesh] NOT "Humans"[mesh])) **OR** "DirectLab"[all fields] OR "swab2know"[all fields] OR "getcheckedonline"[all fields] OR "e-STI"[all fields] OR "WeTest"[all fields] OR "SELPHI"[all fields] OR "eSexual"[all fields] OR "chlamyweb"[all fields]**)**

Embase

http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=main&MODE=ovid&D=oemezd

((("Laboratory Technique".ti,ab OR "Laboratory Techniques".ti,ab OR exp *"laboratory diagnosis"/ OR "laboratory diagnosis".ti,ab OR "Clinical Laboratory Tests".ti,ab OR "Laboratory Test".ti,ab OR "Laboratory Testing".ti,ab OR "lab test".ti,ab OR "lab tests".ti,ab OR "lab testing".ti,ab OR "Laboratory Examination".ti,ab OR "diagnostic tool".ti,ab OR diagnostic tool*.ti,ab OR "diagnostic assessment".ti,ab OR diagnostic assessment*.

ti,ab OR "diagnostic system".ti,ab OR diagnostic system*.ti,ab OR exp *"diagnostic test"/ OR "diagnostic test".ti,ab OR diagnostic test*.ti,ab OR "self-test".ti,ab OR self test*.ti,ab OR "home-based test".ti,ab OR home-based test*.ti,ab OR "self-sampling".ti,ab OR postal test*.ti,ab OR test kit*.ti,ab OR testing kit*.ti,ab OR tests kit*.ti,ab OR STI test*.ti,ab OR STD test*.ti,ab OR testing program*.ti,ab OR "HIVST".ti,ab OR "self-swabbing".ti,ab) AND ("health information technology".ti OR "health information systems".ti OR "interactive health communication".ti OR "patient portal".ti OR exp *"Telemedicine"/ OR exp *"Telehealth"/ OR "web portal*".ti OR telemed*.ti OR "ehealth".ti OR "e-health".ti OR "mhealth".ti OR "m-health".ti OR "mobile health".ti OR "telehealth".ti OR "tele-health".ti OR "tele health".ti OR "webbased".ti OR "web-based".ti OR "telemedicine".ti OR "tele-care".ti OR "telecare".ti OR "website".ti OR "websites".ti OR "webpage".ti OR "webpages".ti OR "web application".ti OR "web applications".ti OR "web access".ti OR exp *"Internet"/ OR "internet".ti OR "online communication".ti OR "on-line communication".ti OR "on line communication".ti OR text message*.ti OR "sms".ti OR "smart message service".ti OR "short message service".ti) NOT (exp "Animals"/ NOT exp "Humans"/)) **OR** "DirectLab".af OR "swab2know".af OR "getcheckedonline".af OR "e-STI".af OR "WeTest".af OR "SELPHI".af OR "eSexual".af OR "chlamyweb".af**)**

NOT (conference review or conference abstract).pt

Web of Science

http://isiknowledge.com/wos

((TS=("Laboratory Technique" OR "Laboratory Techniques" OR "laboratory diagnosis" OR "laboratory diagnosis" OR "Clinical Laboratory Tests" OR "Laboratory Test" OR "Laboratory Testing" OR "lab test" OR "lab tests" OR "lab testing" OR "Laboratory Examination" OR "diagnostic tool" OR "diagnostic tool*" OR "diagnostic assessment" OR "diagnostic assessment*" OR "diagnostic system" OR "diagnostic system*" OR "diagnostic test" OR "diagnostic test" OR "diagnostic test*" OR "self-test" OR "self test*" OR "home-based test" OR "home-based test*" OR "self-sampling" OR "postal test*" OR "test kit*" OR "testing kit*" OR "tests kit*" OR "STI test*" OR "STD test*" OR "testing program*" OR "HIVST" OR "self-swabbing") AND TI=("health information technology" OR "health information systems" OR "interactive health communication" OR "patient portal" OR "Telemedicine" OR "Telehealth" OR "web portal*" OR telemed* OR "ehealth" OR "e-health" OR "mhealth" OR "m-health" OR "mobile health" OR "telehealth" OR "tele-health" OR "tele health" OR "webbased" OR "web-based" OR "telemedicine" OR "tele-care" OR "telecare" OR "website" OR "websites" OR "webpage" OR "webpages" OR "web application" OR "web applications" OR "web access" OR "Internet" OR "internet" OR "online communication" OR "on-line communication" OR "on line communication" OR "text message*" OR "sms" OR "smart message service" OR "short message service")

NOT ti=("veterinary" OR "rabbit" OR "rabbits" OR "animal" OR "animals" OR "mouse" OR "mice" OR "rodent" OR "rodents" OR "rat" OR "rats" OR "pig" OR "pigs" OR "porcine" OR "horse" OR "horses" OR "equine" OR "cow" OR "cows" OR "bovine" OR "goat" OR "goats" OR "sheep" OR "ovine" OR "canine" OR "dog" OR "dogs" OR "feline" OR "cat" OR "cats")) **OR** ts=("DirectLab" OR "swab2know" OR "getcheckedonline" OR "e-STI" OR "WeTest" OR "SELPHI" OR "eSexual" OR "chlamyweb")**)**

Cochrane Library

https://www.cochranelibrary.com/advanced-search/search-manager

((("Laboratory Technique" OR "Laboratory Techniques" OR "laboratory diagnosis" OR "laboratory diagnosis" OR "Clinical Laboratory Tests" OR "Laboratory Test" OR "Laboratory Testing" OR "lab test" OR "lab tests" OR "lab testing" OR "Laboratory Examination" OR "diagnostic tool" OR "diagnostic tool*" OR "diagnostic assessment" OR "diagnostic assessment*" OR "diagnostic system" OR "diagnostic system*" OR "diagnostic test" OR "diagnostic test" OR "diagnostic test*" OR "self-test" OR "self test*" OR "home-based test" OR "home-based test*" OR "self-sampling" OR "postal test*" OR "test kit*" OR "testing kit*" OR "tests kit*" OR "STI test*" OR "STD test*" OR "testing program*" OR "HIVST" OR "self-swabbing"):ti,ab,kw AND ("health information technology" OR "health information systems" OR "interactive health communication" OR "patient portal" OR "Telemedicine" OR "Telehealth" OR "web portal*" OR telemed* OR "ehealth" OR "e-health" OR "mhealth" OR "m-health" OR "mobile health" OR "tele-health" OR "tele-health" OR "tele health" OR "webbased" OR "web-based" OR "tele-medicine" OR "tele-care" OR "telecare" OR "website" OR "websites" OR "webpage" OR "webpages" OR "web application" OR "web applications" OR "web access" OR "Internet" OR "internet" OR "online communication" OR "on-line communication" OR "on line communication" OR "text message*" OR "sms" OR "smart message service" OR "short message service"):ti) **OR** ("DirectLab" OR "swab2know" OR "getcheckedonline" OR "e-STI" OR "WeTest" OR "SELPHI" OR "eSexual" OR "chlamyweb"):ti,ab,kw**)**

Academic Search Premier (full text search)

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(TI("Laboratory Technique" OR "Laboratory Techniques" OR "laboratory diagnosis" OR "laboratory diagnosis" OR "Clinical Laboratory Tests" OR "Laboratory Test" OR "Laboratory Testing" OR "lab test" OR "lab tests" OR "lab testing" OR "Laboratory Examination" OR "diagnostic tool" OR "diagnostic tool" OR "diagnostic assessment" OR "diagnostic assessment" OR "diagnostic system" OR "diagnostic system" OR "diag-

nostic test" OR "diagnostic test" OR "diagnostic test" OR "self-test" OR "self test" OR "home-based test" OR "home-based test" OR "self-sampling" OR "postal test" OR "test kit" OR "testing kit" OR "tests kit" OR "STI test" OR "STD test" OR "testing program" OR "HIVST" OR "self-swabbing") AND TI("health information technology" OR "health information systems" OR "interactive health communication" OR "patient portal" OR "Telemedicine" OR "Telehealth" OR "web portal" OR telemed OR "ehealth" OR "e-health" OR "mhealth" OR "m-health" OR "mobile health" OR "telehealth" OR "tele-health" OR "tele health" OR "webbased" OR "web-based" OR "telemedicine" OR "tele-care" OR "telecare" OR "website" OR "websites" OR "webpage" OR "webpages" OR "web application" OR "web applications" OR "web access" OR "Internet" OR "internet" OR "online communication" OR "on-line communication" OR "on line communication" OR "text message" OR "sms" OR "smart message service" OR "short message service") NOT TI("veterinary" OR "rabbit" OR "rabbits" OR "animal" OR "animals" OR "mouse" OR "mice" OR "rodent" OR "rodents" OR "rat" OR "rats" OR "pig" OR "pigs" OR "porcine" OR "horse" OR "horses" OR "equine" OR "cow" OR "cows" OR "bovine" OR "goat" OR "goats" OR "sheep" OR "ovine" OR "canine" OR "dog" OR "dogs" OR "feline" OR "cat" OR "cats")) **OR** TI("DirectLab" OR "swab2know" OR "getcheckedonline" OR "e-STI" OR "WeTest" OR "SELPHI" OR "eSexual" OR "chlamyweb") **OR** KW("DirectLab" OR "swab-2know" OR "getcheckedonline" OR "e-STI" OR "WeTest" OR "SELPHI" OR "eSexual" OR "chlamyweb") **OR** SU("DirectLab" OR "swab2know" OR "getcheckedonline" OR "e-STI" OR "WeTest" OR "SELPHI" OR "eSexual" OR "chlamyweb") **OR** AB("DirectLab" OR "swab-2know" OR "getcheckedonline" OR "e-STI" OR "WeTest" OR "SELPHI" OR "eSexual" OR "chlamyweb")**)**

Appendix 2

Mixed Method Appraisal Tool (MMAT)

In this table specific criteria per study design are described to assess the quality of study based on the MMAT.

Study designs	Quality criteria
Screening for all types	1.Are there clear research questions?
	2.Do the collected data allow to address the research questions?
Qualitative	1.Is the qualitative approach appropriate to answer the research questions?
	2. Are the qualitative data collection methods adequate to address the research question?
	3. Are the findings adequately derived from the data?
	4. Is the interpretation of results sufficiently substantiated by data?
	5.Is there coherence between qualitative data sources, collection, analysis and interpretation?
Quantitative randomized controlled (trials)	1.Is randomization appropriately performed?
	2.Are the groups comparable at baseline?
	3.Are there complete outcome data?[a]
	4.Are outcome assessors blinded to the intervention provided?
	5.Did the participants adhere to assigned intervention?
Quantitative non randomized	1.Are the participants representative of the target population?[b]
	2.Are the measurements appropriate regarding both the outcome and intervention (or exposure)?
	3.Are there complete outcome data? [a]
	4.Are the confounders accounted for in the design and analysis? [c]
	5.During the study period, is the intervention administered (or exposure occurred) as intended?[d]
Quantitative descriptive	1.is the sampling strategy relevant to address the research question?
	2.Is the sample representative of the target population?[e]
	3.Are the measurements appropriate?
	4.Is the risk of nonresponse bias low?
	5.IS the statistical analysis appropriate to answer the research question?
Mixed-methods	1.Is there an adequate rationale for using a mixed methods design to address the research question?
	2.Are the different components of the study effectively integrated to answer the research question?
	3.Are the outputs of the integration of qualitative and quantitative components adequately interpreted?
	4.Are divergences and inconsistencies between quantitative and qualitative results adequately addressed?
	5.Do the different components of the study adhere to the quality criteria of each tradition of the methods involved?

[a] The study scored a 'no' when the attrition or dropout is higher or equal to 20% (23)

[b] The study could have scored a 'no' for two reasons. First, when clear description of target population of target population and sample is given (by describing in and exclusion criteria), but reasons why people choose not to participate were not described. Second, the collected sample is not in line with target population (e.g., target population was 20-24 years old but a large proportion of sample is older than 24 years).

[c] The study scored a 'yes' if age, ethnicity and sexual orientation is taken into consideration.

[d] The study scored a 'yes' if the intervention or test kit was delivered in experimental group. The study scored a 'no' if the intervention or test kit was not properly delivered.

[e] The study could have scored a 'no' for two reasons. First, clear description target population or sample is missing and reasons are not discussed for why eligible participants choose not to participate. Second, collected sample is not in line with target population (e.g., target population was 20-24 years old but a large proportion of sample is older than 24 years).

Appendix 3

Service provider characteristics per study

		Testing					Result			
Service name	**Studya**	**Disease(s)**	**Type of home-based test**	**Type specimenb**	**Order, deliver, and return methodc**	**Instruction method**	**Method of notifi-cation**	**Independent HCP**	**Average delivery time in days**	**Linked to care or follow -up testingd**
Triage service										
Fai il test anche TU project	Polilli et al. [12]	HIV, hepatitis B and C, syphilis								
Testing service										
C-project	Martin et al. [38]	Chlamydia	Self-sampling	Urine	O: Online D: Postal service R: In-person	..				
Easy test	Jin et al. [34]	HIV	Self-testing	Blood	O: Online D: Postal service R: n/a	Written				
UCLA free HIV self-test program	Rosengren et al. [43]	HIV	Self-testing	Oral	O: Online D: Postal service or pick-up R: n/a	..				
Social entre-preneurship testing	Zhong et al. [47]	HIV Syphilis	Self-testing	Blood	O: Online D: Postal service R: Postal service[e]	..				

SELPHI	Witzel et al. [14]	HIV	Self-testing	Blood	O: Email D: Postal service R: n/a	Written, online videos			
	Witzel et al. [62]	HIV	Self-testing	Blood	O: Email D: Postal service R: n/a	Written, online *videos*			
Unknown name	Andersen et al. [25]	Chlamydia	Self-sampling	Vaginal (F) Urine (M)	O: Email or phone D: Postal service R: Post service	Written			
Unknown name	Reagan et al. [58]	Chlamydia Gonorrhea	Self-sampling	Urine	O: Phone D: Postal service R: Post service	Written			
Unknown name	Grandahl et al. [48]	Chlamydia Gonorrhea	Self-sampling	..	O: online D: Postal service R: ..	..			
	Grandahl et al. [64]	Chlamydia Gonorrhea	Self-sampling	..	O: online D: Postal service R: ..	..			
Result service									
GxAlert	Babirye et al. [15]	Tuberculosis				SMS	Yes	..	Yes
Syfilistest.nl	Koekenbier et al. [35]	Syphilis				Online	Yes	7 days	Yes
Early test	Morris et al. [39]	HIV				Online Phone	Partly	2-7 days	Yes

Table Continued

		Testing					Result			
Service name	**Studya**	**Disease(s)**	**Type of home-based test**	**Type specimenb**	**Order, deliver, and return methodc**	**Instruction method**	**Method of notifi-cation**	**Independent HCP**	**Average delivery time in days**	**Linked to care or follow -up testingd**
Result system of Denver Metro Health Clinic	Ling et al. [54]	Chlamydia, gonorrhea					Online	Partly	7 days	Unclear
Excelleris	Mák et al. [55]	Not limited to a specific disease					Online	Yes	..	No
Patient portal	Talboom-Kamp et al. [50]	Not limited to a specific disease					Online	Partly	..	Yes
myCARE system	Robinson et al. [65]	Not limited to a specific disease					Online	Partly	..	Yes
Triage & testing service										
A hora é Agora	De Boni et al. [27]	HIV	Self-testing	Oral	O: Online D: Postal service or pick-up R: n/a	Written				
Online Chlamydia Testing program	Kwan et al. [36]	Chlamydia, gonorrhea	Self-sampling	Vaginal (F) Urine (M)	O: Online D: Pick-up service R: In-person	Online				
Swab2Know	Platteau et al. [41]	HIV	Self-sampling	Oral	O: Online D: Postal service R: Post service	Online video	Online Email Phone	Partly	7 days	Yes

Don't think, know	Rotblatt et al. [44]	Chlamydia, gonorrhea	Self-sampling	Vaginal	O: Online, phone D: Postal service R: Post service	Written, online video	Online Phone	Partly	7 days	Yes
Testikodus	Rüütel et al. [45]	Chlamydia, gonorrhea, tricho-monas, LGV, myco-plas-mosis	Self-sampling	Urine	O: Online D: Postal service R: Post service, in-person	..	Online	Yes	5 days	Yes
RUClear	Ahmed-Little et al. [61]	HIV	Self-sampling	Blood	O: Online D: Postal service R: Post service	Written, online video	Phone SMS Letter	Partly	..	Yes
Triage, testing & result service										
DS@H	Elliot et al. [28]	HIV	Self-sampling	Oral, blood	O: Online D: Postal service R: Post service	Written	SMS Phone	Partly	1 day after sample received	Yes
GetChecked Online	Gilbert et al. [13]	Chlamydia, gonorrhea	Self-sampling	Urine, oral, rectal	O: Online D: Pick-up R: In-person	Written	Online Phone	Partly	7-14 days	Yes
	Gilbert et al. [52]	Chlamydia, gonorrhea	Self-sampling	Urine, oral, rectal	O: Online D: Pick-up R: In-person	Written	Online Phone	Partly	7-14 days	Yes
	Knight et al. [63]	Chlamydia, gonorrhea	Self-sampling	Urine, oral, rectal	O: Online D: Pick-up R: In-person	Written	Online Phone	Partly	7-14 days	Yes
	Dulai et al. [49]	Chlamydia, gonorrhea	Self-sampling	Urine, oral, rectal	O: Online D: Pick-up R: In-person	Written	Online Phone	Partly	7-14 days	Yes

Table Continued

		Testing					Result			
Service name	**Studya**	**Disease(s)**	**Type of home-based test**	**Type specimenb**	**Order, deliver, and return methodc**	**Instruction method**	**Method of notifi-cation**	**Independent HCP**	**Average delivery time in days**	**Linked to care or follow -up testingd**
Let's talk about it NHS	Nadarzynski et al. [40]	Chlamydia, gonorrhea, HIV, syphilis, hepatitis B and C	Self-sampling	Vaginal (C&G), blood (S, H, HepB/C)	O: Online, phone D: Postal service R: Post service	Written, online video	SMS Phone	Partly	7 days	Yes
Checking In	Ricca et al. [42]	HIV	Self-sampling	Blood	O: Online D: Postal service R: Post service	..	Phone	Partly	7 days	Yes
eSTI	Spielberg et al. [46]	Chlamydia, gonorrhea, trichomonas	Self-sampling	Vaginal	O: Online D: Postal service R: Post service	..	Online	Yes	..	Yes
SH:24	Barnard et al. [51]	Chlamydia, gonorrhea, HIV, syphilis	Self-sampling	Blood (S&H), vaginal (C&G in F), urine (C&G in M), and oral, rectal, and urine (C&G in MSM)	O: Online D: Postal service R: Post service	Written, online video	SMS Phone	Partly	7 days	Yes

	Wilson et al. [59]	Chlamydia, gonorrhea, HIV, syphilis	Self-sampling	Blood (S&H), vaginal (C&G in F), urine (C&G in M), and oral, rectal, and urine (C&G in MSM)	O: Online D: Postal service R: Post service	Written, online video	SMS Phone	Partly	7 days	Yes
	Wilson et al. [60]	Chlamydia, gonorrhea, HIV, syphilis	Self-sampling	Blood (S&H), vaginal (C&G in F), urine (C&G in M), and oral, rectal, and urine (C&G in MSM)	O: Online D: Postal service R: Post service	Written, online video	SMS Phone	Partly	7 days	Yes
Freetesting.hiv	Brown et al. [56]	HIV	Self-sampling	Blood	O: Online D: Postal service R: Post service	Written, online video	SMS Phone	Partly	7 days	Yes
Chlamyweb	Kersaudy-Rahib et al. [57]	Chlamydia	Self-sampling	Vaginal (F), urine (M)	O: Online D: Postal service R: Post service	..	Email Post	Partly	..	Yes
I Want The Kit[f]	Chai et al. [26]	Chlamydia, gonorrhea, trichomonas	Self-sampling	Penile, urine	O: Online D: Postal service R: Post service	Written	Phone	No	..	Yes

Table Continued

		Testing					Result			
Service name	**Studya**	**Disease(s)**	**Type of home-based test**	**Type specimenb**	**Order, deliver, and return methodc**	**Instruction method**	**Method of notification**	**Independent HCP**	**Average delivery time in days**	**Linked to care or follow-up testingd**
	Gaydos et al. [31]	Chlamydia, gonorrhea, trichomonas	Self-sampling	Vaginal	O: Online, phone D: Postal service, pick-up R: Postal service	Written	..	..	..	..
	Gaydos et al. [32]	Chlamydia	Self-sampling	Vaginal	O: Online, phone D: Postal service, pick-up R: Postal service	Written	..	..	..	..
	Gaydos et al. [33]	Chlamydia	Self-sampling	Vaginal	O: Online, phone D: Postal service, pick-up R: Postal service	Written	Phone	No	14 days	Yes
	Gaydos et al. [29]	Chlamydia, gonorrhea, trichomonas	Self-sampling	Urogenital, rectal	O: Online D: Postal service R: Postal service	Written	..	..	..	..
	Gaydos et al. [30]	Trichomonas	Self-testing	Vaginal	O: Online D: Postal service R: Postal service[g]	Written	..	..	..	Unclear

	Kuder et al. [53]	Chlamydia, gonorrhea, trichomonas	Self-sampling	Urogenital, rectal	O: Online, phone D: Postal service R: Postal service	Written	Online	Yes	··	Yes
	Ladd et al. [37]	Chlamydia, gonorrhea, trichomonas	Self-sampling	Rectal, vaginal	O: Online, phone D: Postal service R: Postal service	Written	SMS Email Phone Letter	Unclear	··	··

Note. HCP= health care professional. HIV = human immunodeficiency virus. SMS = short message service. MSM = men having sex with men. C&G = Chlamydia and Gonorrhea. S&H= Syphilis and human immunodeficiency virus. LGV = Lymphogranuloma venereum. ··= missing info

[a] Identifies the first author and publication year of the study examining the respective service.
[b] If the required type of specimen differed between sexes, an F behind the specimen indicated that it was for women and an M indicated it was for males. When a provider offered testing for different diseases, the required specimen per disease was specified.
[c] Identifies the method used for ordering (O), delivering (D) and receiving (R) the test kit.
[d] Identifies whether the individual is directly linked to care or to follow-up testing.
[e] If participants returned the test results to the laboratory, participants were refunded the money for the test.
[f] The service was listed as triage, testing and result service; however, the communication of test results was not independent from a health care professional in each of the studies that examined the service or it was unclear whether the communication of test results was independent from a health care professional.
[g] Returning the test kit was optional.

Appendix 4

Overview of the reported outcomes for the triage, testing, and result services

Outcome	Study	Servicea	Results
Triage service			
Usage	Polilli et al. [12]	Tr	About 6000 users visited the website, a little over 5000 users also completed the risk assessment, and nearly 3500 made an appointment for clinic-based testing.
Linkage to testing or treatment	Polilli et al. [12]	Tr	A total 3500 users scheduled a clinic-based test and 87% was present for testing. In total, 28 individuals (<1%) were tested positive for HIV, and 93% were linked to care.
Predictive value of risk assessment	Gaydos et al. [29]	Tr, Te, Re	In females, a higher risk assessment score predicted the risk for having a STI, independent of age and race. In males, the risk score did not significantly predict STI after controlling for race.
Testing service			
Acceptability/ usability	Ahmed-Little et al. [61]	Tr, Te	Among 2563 respondents, 97% (strongly) agreed that it was acceptable to order a HIV test kit online, 80% felt that this method of testing was easily accessible, 94% found the test instructions easy to understand.
	Chai et al. [26]	Tr, Te, Re	Among the 476 respondents, 75% preferred a self-test versus a clinic-based test, 85% believed it was safe, 88% found it (very) easy to use, and 89% would use internet-screening again.
	De Boni et al. [27]	Tr, Te	Among the 362 respondents, 91% found the website (very) easy to use, 72% had no difficulties navigating the website, 6% could not find the pages they were searching for, and 94% found the instructions for testing clear.
	Gaydos et al. [30]	Tr, Te, Re	Among the 102 respondents, 84% found it easy to follow the instructions for the STI test kit, 95% found it easy collect the specimen, 90% found it easy to interpret the results, and 97% (somewhat) trusted the results. Moreover, 62% preferred self-testing, 77% would recommend the test to a friend, and 80% would get the test if it were available of the counter.
	Gaydos et al. [32]	Tr, Te, Re	Of the 1171 respondents, 92% would use this program for STI tests kits again, 91% preferred self-collection specimens over the clinic, and 97% reported that it was (very) easy to use the kit.

	Gaydos et al. [33]	Tr, Te, Re	Of the 400 respondents, 89% preferred to collect a self-administered test sample, 88% believed it was safe, 90% thought it was (very) easy to use, 86% would use this method of online ordering and home testing again, and 73% preferred at-home delivery of the test kit compared to a pharmacy pickup.
	Knight et al. [63]	Tr, Te, Re	A total of 37 users of an online diagnostic service participated in qualitative interviews. Most users had a preference for this platform instead of clinic-based testing, because of convenience, privacy, and control over specimen collection. Users preferred receiving their results online via the platform compared to phone or email by a clinic staff.
	Kwan et al. [36]	Tr, Te	Among the 55 respondents, 96% reported that the Chlamydia testing program was easy to use and 98% would recommend it to a friend.
	Reagan et al. [58]	Te	Among the 129 respondents, 95% found it easy to follow the instructions for the STI test kit.
	Rosengren et al. [43]	Te	Among the 56 respondents, 93% found the HIV test kit (very) easy to use and 74% (somewhat) preferred the test kit over clinical testing.
	Spielberg et al.[46]	Tr, Te, Re	Among the 106 respondents, 95% prefer the online over clinical testing, 80% would rather test online than go to the clinic for future testing, and 98% would recommend the study to a friend.
	Wilson et al. [60]	Tr, Te, Re	Of the 84 respondents of the group that did online STI testing, 75% found the process of online ordering a STI test, at-home sampling and receiving results online acceptable.
	Wilson et al. [59]	Tr, Te, Re	Among 294 respondents of the group that did online STI testing, 71% found the process of online ordering a STI test, at-home sampling, and receiving the result via a SMS acceptable.
	Witzel et al. [14]	Te	Among the 375 respondents, 98% found the instructions of the HIV test kit easy to understand, 97% found the test kit simple to use and 97% reported an overall good experience.
	Dulai et al. [49]	Tr, Te, Re	Among the 1255 respondents who filled in the survey at this question, 33.1% reported that they found it easier to go to the clinic. Among those who used the service, 44 respondents of 1268, 90% would use the service again.
	Grandahl et al. [48]	Te, Re	Among the 1785 respondents, more than 90% found the service good or very good.

Table Continued

Outcome	Study	Servicea	Results
	Grandahl et al. [64]	Te, Re	A total of 20 users of an online diagnostic service participated in qualitative interviews. Most users highly appreciated the service and found the service easy to use, convenient and confidential. Some barriers they mentioned were language, uncertainty about the procedure, unreliable postal service and insecure handling of data. They would use the service again in the future, even if it was against some costs.
Cost-effectiveness	Ahmed-Little et al. [61]	Tr, Te	Overall costs for testing, per person, were £31-£32 (€26.47-€27.32), which is in line with testing costs in national HIV testing pilots.
	Kersaudy-Rahib et al. [57]	Tr, Te, Re	Home-based self-sampling for chlamydia was €32 per kit compared to €73 for clinical testing. The costs per positive tests were three times higher in the STI clinics than for home tests (€1123 versus €375).
Usage	Ahmed-Little et al. [61]	Te	In total 5179 HIV test kits that were send out and 59% were returned.
	Andersen et al. [25]	Te	The website was visited by 651 people of whom 9% ($n = 60$) ordered a chlamydia test kit online. Another 309 ordered a kit through an answering machine. In the end, 342 were sent a kit and 68% submitted a sample for analysis.
	Barnard et al. [51]	Tr, Te, Re	A STI kit was ordered by 3515 people whom 73% returned a sufficient sample.
	Brown et al. [56]	Tr, Te, Re	Of the 8999 who ordered a HIV self-sampling kit, 54% returned their kit. Kit return was highest in the group that received a primer text message prior to the kit's arrival and additional behavioral insight reminders (56% of $n = 2267$).
	Chai et al. [26]	Tr, Te, Re	In total 1644 STI home tests were ordered online, and 31% of the ordered tests were returned of which 98% as analyzed.
	De Boni et al. [27]	Tr, Te	The website had 17.786 unique visitors, 3885 HIV self-test kits were ordered of which 65% received the test. 21% of the users returned the self-test result online.
	Elliot et al. [28]	Tr, Te, Re	In total 17361 people completed the online risk assessment for a HIV self-sampling kit, 59% ordered a kit ($n = 10.323$). 55% returned the sample for analyses.
	Gaydos et al. [31]	Tr, Te, Re	In total, 3774 people ordered a chlamydia self-sampling test and 32% also returned the sample.
	Gilbert et al. [13]	Tr, Te, Re	In total 868 users created an account at the testing service, of whom 318 users submitted specimens (37%).
	Kersaudy-Rahib et al. [57]	Tr, Te, Re	In the group ($n = 5531$) offered a chlamydia self-sampling test, 2616 users received the test of whom 1616 returned the sample (62%). Test rates were higher in the group that received a self-sampling kit compared to the group that was invited to be screened in primary care (29 vs 9%).

	Kuder et al. [53]	Tr, Te, Re	The kit return rate was 62% (691/1116) before an automated test-result service was implemented and was 66% (858/1303) after implementation. The experimental group (n=1303), after web design changes to order a STI test kit, 62% used the test. The control group (n=1116), before website design changes, 66% used the test.
	Kwan et al. [36]	Tr, Te	In total, 675 users completed an online risk assessment and requested a chlamydia self-sampling test. A total of 377 tests were performed (56%).
	Ladd et al. [37]	Tr, Te, Re	In total, 406 people ordered a test kit for rectal STIs of whom 51% returned specimen.
	Martin et al. [38]	Te	413 chlamydia test kits were ordered (48% via email, 49% during outreach events, 2% via phone). 195 samples (43%) were returned.
	Reagan et al. [58]	Te	STI kit return rate was higher in the group that received the self-sampling kit at home compared to those who received it at a clinic (resp. 72 vs 48%).
	Ricca et al. [42]	Tr, Te, Re	In total 896 users received a HIV self-sampling test kit, 82% returned the specimen for analysis.
	Rosengren et al. [43]	Te	The website received 4389 unique visitors and resulted in 333 request for a HIV test kit. In the group who completed the follow-up survey (n = 56), everyone used the kit.
	Rotblatt et al. [44]	Tr, Te	In total 2927 STI self-sampling kits were ordered online or via phone, of which 55% returned their specimen for analyses. The majority (95%) of the specimen were usable for analyses.
	Rüütel et al. [45]	Tr, Te	24% of those who ordered a self-sampling STI test, provided the specimen (65/265).
	Spielberg et al. [46]	Tr, Te, Re	In total 213 people ordered a STI self-sampling test kit, 67% returned the specimen.
	Wilson et al. [60]	Tr, Te, Re	People who were willing to do an STI test were randomized to receive a text message with referring them to a website with either an online test service or a list with the locations of clinics. In the group referred to online testing, the test rate was significantly higher (45 vs 24%) and there was a reduced time to test (29 vs 36 days).

Table Continued

Outcome	Study	Servicea	Results
	Wilson et al. [59]	Tr, Te, Re	In the group(n = 921) who received home tests and the results online, 50% did the STI test in comparison with 27% in the group(n = 818) who were offered a test and results at the clinic. This was a significant difference. The time from randomization in to the groups to completion of the STI test was shorter in the group who did home testing(28.8 days versus 36.5 days). This was a significant difference. The median time from diagnosis to treatment was for the group who did home testing group 2 days and for the control group 4 days
	Witzel et al. [14]	Te	In total 631 users were sent a HIV test kit. In the two-week follow-up survey, completed by n = 405, 95% indicated having received the kit and 83% had used it. People had not used it, if they planned to use it later (97%) or had tested elsewhere (3%).
	Zhong et al. [47]	Te	198 HIV self-test kits were ordered online, and 192 provided feedback. Of these, 178 (93%) had used the test.
	Grandahl et al. [48]	Te, Re	Among the 1785 users, 85% returned their sample. Reasons for not returning the kit were lack of time(22.5%) or they were no longer worried (12.1%).
Other outcomes	Martin et al. [38]	Te	Among the 195 respondents, a common reason for requesting a chlamydia test kit was that it was for free (49%) and easy to get (39%).
	Witzel et al. [14]	Te	Motivations of users to do HIV self-testing: (a) reduced HIV testing barriers (opportunity barriers such as convenience and ease of use and motivational barriers like confidentiality and stigma), (b) desire to use new technology, and (c) altruistic motivation.
	Zhong et al. [47]	Te	Among the 198 respondents, the two main reasons for doing a HIV self-test were convenience and to save time (46%), and privacy (40%). Facilitators to use the purchased HIV self-test were anonymity (56%), ease of use (49%), and ability to test alone (41%). Barriers were accuracy (43%), potential costs (40%), and concern about having to interpret the results (36%). Besides, 67% of the respondents reported that they would use the test kits in the future if it was free.
	Dulai et al. [49]	Tr,Te,Re	Among the 1247 respondents who filled in this question at the survey, 20 percent was worried the *privacy* of his online information and 5% had low trust in this service.
	Witzel et al. [62]	Te	Reasons for using HIV self-testing by trans men and women were inaccessible and inappropriate clinical services.

Result service			
Usage	Gilbert et al. [52]	Tr, Te, Re	Users of the online platform had significant shorter waiting time for the test results than clinic clients (respectively 1% versus 12% was still waiting on the test results at the time of the survey)
	Koekenbier et al. [35]	Re	Of all the 93 users, 97% obtained their results from the website
	Ling et al. [54]	Re	Test result retrieval was assessed in three periods. In period 1 (n=3624) results were communicated over the phone. In period 2 (*n* = 3931), online results were optional and 41% opted to receive their results online. In period 3 (*n* = 1501), online results was the standard. In period 2 and 3, significantly more users received their results in the group that opted for online results compared to the group that opted to receive their results over the phone. 74% of those in period 2 and 3 who opted or accepted online results also accessed their results. Yet the overall proportion of users who received their results was not significantly different before or after the online result option became available. The number of users who called for results did decrease significantly from period 1 (67%) to period 3 (36%).
	Morris et al. [39]	Re	Among the 3070 users, 69% obtained their results either by the Internet or via an automated voicemail service. Of this group, 65% used the Internet to look up their result.
	Platteau et al. [41]	Tr, Te	In total 1071 tests were done, 99% of results (1057/1071) were delivered through the website. Significantly more users collected their test results when the test was ordered online compared to tests performed during outreach activities (98% vs 87%).
	Rotblatt et al. [44]	Tr, Te	In total 1619 tests were done, 88% of the users retrieved their results on the website.
	Spielberg et al. [46]	Tr, Te, Re	In total 143 tests were done, of those 92% viewed their results online, with 88% who viewed their results the same day they were posted.
Comprehension	Babirye et al.[15]	Re	In total 123 respondents were reached via text message, 93% comprehended the text message with test result.
	Mák et al. [55]	Re	Among the 1852 respondents, 75% who had online access to their test results was confident that they fully understood the results. Among the 1119 respondents who had no online access to their results, the comprehension was significantly higher, namely 85%.

Table Continued

	Robinson et al. [65]	Re	Among the 21 respondents the comprehension of the results differed from difficulty with understanding of the results to no difficulty. However, users who mentioned that they had difficulties with understanding the result described that the reference range of their result was very helpful and this made it easier to use.
	Nadarzynski et al. [40]	Tr, Te, Re	Among the 100 respondents, 13% who received a text message with their results indicated that they did not understand its content, 92% of the respondents understood that no further action is required when a text message states that the STI test is "negative (clear)".
Acceptability	Ling et al.[54]	Re	In total 429 respondents filled in the questionnaire. Two main reason for opting for online results was (a) that test results could be accessed any time of the day (75%) and (b) because respondents believed that they would receive their results faster (37%). Two main reasons for declining online results was (a) that respondents preferred to call the clinic (43%) and (b) because of limited access to the internet (32%).
	Morris et al. [39]	Re	Among the 235 respondents, 87% was (very) comfortable with receiving their results online.
	Platteau et al. [41]	Tr Te	Among the 388 respondents, 96% were very satisfied with the process of ordering a test kit online and receiving the results online, 4% reported mixed feelings.
	Spielberg et al. [46]		Among the 106 respondents, 98% thought the website – that offered triage, testing and result service - was (very) easy to use.
Other outcomes	Babirye et al. [15]	Re	In Uganda, 233 users were eligible to receive an SMS with their tuberculosis test result. 152 of these users (correctly) entered their phone number (65%), with 145 messages being transmitted by the local SMS service provider to the phone network (95%). A total of 123 users were contacted of whom 93% confirmed having received the result.
	Mák et al. [55]	Re	Group 1 (n = 1856) received test results online, 84% of those received their results within a few days. Group 2 (n = 1087) had not online access to their results, 38% of those received their results in a few days. This difference in wait time was significant. Of 2990 questionnaire respondents, 86% reported no/low anxiety after results. This level differed not between users with online access versus those who had not.

	Nadarzynski et al. [40]	Tr, Te, Re	Of the 115 questionnaire respondents, 86% preferred text messages that included the names of the tested STI and that included the results of all STIs tested (in one message).
	Robinson et al. [65]	Re	Users felt feel more comfort and engaged with their health care when they see the results themselves. This service is not limited to a specific disease. Besides they reported that it had no negative effects on themselves, seeing the results. Besides, they thought that it would lead to better communication with the HCP. Reasons for the users to use this online result portal were this better communication, convenience and being a steward of own health care.
	Talboom-Kamp et al. [50]	Re	The questionnaire was completed by 354 of 13907 patients who viewed their results of their laboratory test online (not limited to a specific disease). In this questionnaire the Information and Presentation score was measured and scored a 67.70 (SD 13.12) and the mean Motivation and Confidence to Act score was 63.59 (SD 16.22). Those are two subscales of the eHIQ. These results showed that users found online viewing results easy to use, trustworthy and appropriate. The self-efficacy of users was also relatively high according to this score, but below the cutoff score for a positive attitude.
Test and result services			
Follow up testing and treatment[b]	Ahmed-Little et al. [61]	Tr, Te	3062 tests were done, seven infections were detected, and 100% did confirmatory testing.
	Chai et al. [26]	Tr, Te, Re	501 tests were done, 21% was tested positive, and 99% of those tested positive were treated.
	De Boni et al. [27]	Tr, Te	Among the 542 tests, 34 (6%) were positive or invalid. In total 37 users did a confirmatory tests: 30 were positive.
	Elliot et al. [28]	Tr, Te, Re	Among the 5249 unique tests, 2% tested positive for HIV. Of those, 67% were confirmed as new HIV diagnosis and received treatment, 11% were false reactive, 11% already diagnosed with HIV, and for 10% treatment was unconfirmed.
	Gaydos et al. [32]	Tr, Te, Re	Among the 1171 users, four (0.3%) had a positive test and all were treated.
	Gaydos et al. [31]	Tr, Te, Re	Among the 1203 tests, 9.1% was tested positive for chlamydia of which 96.5% was treated. Among the 496 tests for gonorrhea or trichomonas, everyone with a positive test for gonorrhea (3%) or trichomonas (7%) were treated.
	Jin et al. [34]	Te	Of the 879 people who were eligible for HIV self-testing and received the test kit. Among the 683 returned a photograph of the test result, 98(14%) had a positive test result and of those 72% received treatment.

Table Continued

Outcome	Study	Servicea	Results
	Kersaudy-Rahib et al. [57]	Tr, Te, Re	In the group (*n* = 5531) who received their chlamydia test kit at home 110 (7%) was tested positive and 91% visited a doctor. In the group who were invited to test in primary care setting, 30(6%) tested positive and 87% had seen a doctor.
	Koekenbier et al. [35]	Re	Among the 93 tests, 15% tested positive and, of those, 71% did confirmatory testing.
	Kuder et al. [53]	Tr, Te, Re	In the group that needed to call for their test result (n = 691), 11% tested positive and 58% of the positive tests received treatment. In the group(n= 858), with an website with automated test result service, 10% tested positive and 87% of the positive users received treatment
	Kwan et al. [36]	Tr, Te	Among the 377 tests, 18% of the users tested positive for chlamydia or gonorrhea and 100% of the positive tested users were treated and 94% was treated within 14 days.
	Ling et al. [54]	Re	When results were communicated over the phone (*n* = 193), 81% confirmed treatment within 30 days. When online results were optional (*n* = 240), 82% confirmed treatment and, when online results were the norm (*n* = 110), 71% confirmed treatment. The difference was not significant.
	Platteau et al. [41]	Tr, Te	Among the 1071 tests, 2% were HIV positive and 100% of the positive tested users were linked to care.
	Ricca et al. [42]	Tr, Te, Re	Among the 735 tests, 25 users tested positive for HIV (3%) 14 sought care, three had not and for eight it is unknown.
	Rosengren et al. [43]	Te	56 users reported the results of the HIV self-test (45%), of whom 4% tested positive. All positive tested users did confirmatory testing and had medical care.
	Rotblatt et al. [44]	Tr, Te	Among the 1619 tests, 8% tested positive for a STI. For 88% of the positive users, treatment was confirmed.
	Spielberg et al. [46]	Tr, Te, Re	Among the 143 tests, 6% were tested positive and all received treatment.
	Zhong et al. [47]	Te	Among the 178 tests, six tests were positive for STI and 8 were positive for HIV. All did confirmatory testing, where seven HIV positive results were confirmed and all received treatment.

Note. STI = sexually transmitted infection. HIV = human immunodeficiency virus. SMS = short message service.

[a] The abbreviations highlight the type of service: Tr= Triage service, Te= Test service, Re= Result service.

[b] Data related to follow up testing and treatment is discussed simultaneously testing and result services to avoid overlap because it referred to both outcome measures.