Fully Integrated e-Services for Prevention, Diagnosis, and Treatment of Sexually Transmitted Infections: Results of a 4-County Study in California

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Objectives. We examined the acceptability, feasibility, and cost of a fully integrated online system (eSTI) for sexually transmitted infection (STI) testing, treatment, and linkage to care with 4 Northern California health departments.

Methods. In April 2012, we implemented the eSTI system, which provided education; testing of self-collected vaginal swabs for chlamydia, gonorrhea, and trichomoniasis; e-prescriptions; e-partner notification; and data integration with clinic electronic health records. We analyzed feasibility, acceptability, and cost measures.

Results. During a 3-month period, 217 women aged 18 to 30 years enrolled; 67% returned the kit. Of these, 92% viewed their results online. STI prevalence was 5.6% (chlamydia and trichomoniasis). All participants with STIs received treatment either the same day at a pharmacy (62%) or within 7 days at a clinic (38%). Among participants completing follow-up surveys, 99% would recommend the online eSTI system to a friend, and 95% preferred it over clinic-based testing within a study.

Conclusions. The fully integrated eSTI system has the potential to increase diagnosis and treatment of STIs with higher patient satisfaction at a potentially lower cost. (*Am J Public Health.* 2014;104:2313–2320. doi:10.2105/AJPH.2014.302302)

The Centers for Disease Control and Prevention (CDC) has reported more than 20 million new sexually transmitted infections (STIs) in the United States each year, costing the US health care system nearly $16 billion in direct medical costs.[1] Transmission is fueled by the high proportion of people with asymptomatic infections and low levels of STI screening. Untreated chlamydia or gonorrhea can lead to pelvic inflammatory disease, infertility, ectopic pregnancy, and chronic pelvic pain. Untreated trichomoniasis can increase a woman's risk of premature delivery. All 3 infections can increase a woman's risk of acquiring HIV.[2] New and more acceptable strategies are needed to improve diagnosis and treatment of women with STIs. Recognized barriers to STI clinic–based services include long waiting times, cost, inconvenient clinic hours, stigma, and judgmental staff behavior.[3] A home specimen collection and e-prescription treatment service linked to public health and clinical care may overcome many barriers to STI detection and treatment while ensuring the ability to provide effective linkage to care and clinical follow-up when needed.

Studies have shown that, compared with clinician-collected endocervical specimens, self-collected vaginal specimens for chlamydia nucleic acid amplification testing have equivalent sensitivity (96.5% vs 97.1%, respectively),[4] can identify more infected women,[5] and are preferred by female testers.[6] Home specimen collection programs for STIs have demonstrated the potential to reach populations at risk,[7,8] with better success than clinic referral for primary detection (risk ratio = 1.55)[9] and retesting (odds ratio = 2.9).[10] In addition, modeling studies have suggested that these programs may result in cost savings.[11] However, before widespread dissemination can be recommended, additional research is needed to measure the comparative effectiveness of online services for STI detection and treatment compared with clinic-based services to determine the impact on detection of STIs, patient satisfaction with care, and health care costs. Before embarking on a large comparative effectiveness trial, it was necessary to demonstrate that home testing programs can be studied and longitudinal data collected.

The purpose of our study was to determine the feasibility, acceptability, and potential cost of an integrated Web-based system that educates young women about STI prevention, diagnoses women using home-collected vaginal swabs, provides e-prescriptions for infected women with asymptomatic STIs, identifies women in need of referral for clinical examinations, and improves continuity of care through optional integration of test results into the referral clinic electronic health record (EHR). We conducted a demonstration of an integrated e-STI system in preparation for a future comparative effectiveness study. We present findings on the feasibility and acceptability of eSTI and the comparative cost of a variety of recruitment methods. In a subsequent article, we provide findings regarding a model of the relative cost of the eSTI system compared with clinical care.

METHODS

We conducted this study in English and Spanish from April 2012 through June 2012 in 4 San Francisco Bay area counties in California: Alameda, Contra Costa, San Francisco, and San Mateo. Participants provided electronic informed consent through the online study Web site. Participants were recruited via Internet advertising, bus and train media, free radio, newspaper, word of mouth, outreach

workers, and display material. Advertisement materials were adapted from the "I Know" campaign materials developed for Latina and African American populations in Los Angeles, California. The media included an image of a young woman, the phrase "I know," a statement about STIs, the Web site address, and telephone number for a free home test kit. All clients found the Web site and enrolled without staff support, with the exception of those high-risk women who were targeted through street outreach in drug treatment centers and high-prevalence neighborhoods. We collected data to determine the relative effectiveness and cost of each of the recruitment strategies.

Women living in these counties aged 18 to 30 years were eligible for enrollment. Women who saw the ads or were recruited went to the Web site and clicked on the link to get study information and complete the online consent. The Web site included education on common STIs, prevention, testing, and treatment that women could access at will through self-directed learning. Interested women completed an online eligibility survey. Eligible women were asked to complete a 15-minute enrollment survey, order a home collection kit, and create a secure password. The baseline and follow-up surveys contained questions to understand women's STI risk behaviors in order to measure the impact of the education provided on the Web site on subsequent behaviors, clinical symptom questions to automate referrals for clinical evaluation for pelvic inflammatory disease and pregnancy, drug allergy questions to guide drug selection, and questions to determine the acceptability of the eSTI system and preferences for future STI testing. Women who had symptoms of pelvic inflammatory disease or who were pregnant received individualized education about the importance of testing and follow-up for clinical care.

Testing and Result Notification

Enrolled women were subsequently mailed a vaginal specimen collection kit in a brown envelope with no identifying features to suggest the contents. Participants self-collected vaginal swabs, placed them in a preaddressed postage-paid return envelope, and mailed them to the Johns Hopkins University International STD and Biothreat Research Laboratory for testing for chlamydia, gonorrhea, and trichomoniasis (Gen-Probe Hologic, San Diego, CA). The laboratory posted the results in the secure study portal, and participants were automatically sent a text message, e-mail, or both notifying them to log onto the Web site to view their results. After entering their password, women viewed their test results on the Web site.

Those with positive results who were asymptomatic were able to choose to have a prescription faxed to a local pharmacy or to click on a link to find a local clinic for follow-up. Participants who had drug allergies or STI symptoms or who were pregnant were required to seek clinical care and were provided additional individualized education on the importance of STI treatment, partner treatment, and clinical follow-up. If a participant had gonorrhea, she was referred to a clinic for a ceftriaxone injection as part of recommended treatment. Anonymous e-cards were available for infected women to send to partners to notify them of the need to seek treatment.

Feasibility

Participants residing in San Mateo County could select to have their test results integrated into the county clinic system's EHR. Because of the cost of integrating test results into referral EHRs ($20 000/county EHR), we initially only offered this option in 1 county to determine the potential feasibility. At 3 months, all participants who returned kits were sent a text message and an e-mail notifying them that it was time to complete their online follow-up survey. Those who completed the follow-up survey received a $20 gift certificate as compensation for their time.

The eSTI system included a patient portal for clients to access test results, treatment options, and referrals; a clinical staff portal to enable support staff to track participants who needed treatment; a portal for staff to enter cost data and follow-up data; a laboratory portal for laboratory staff to upload test results; and a portal for study staff to download unlinked data for evaluation.

Acceptability

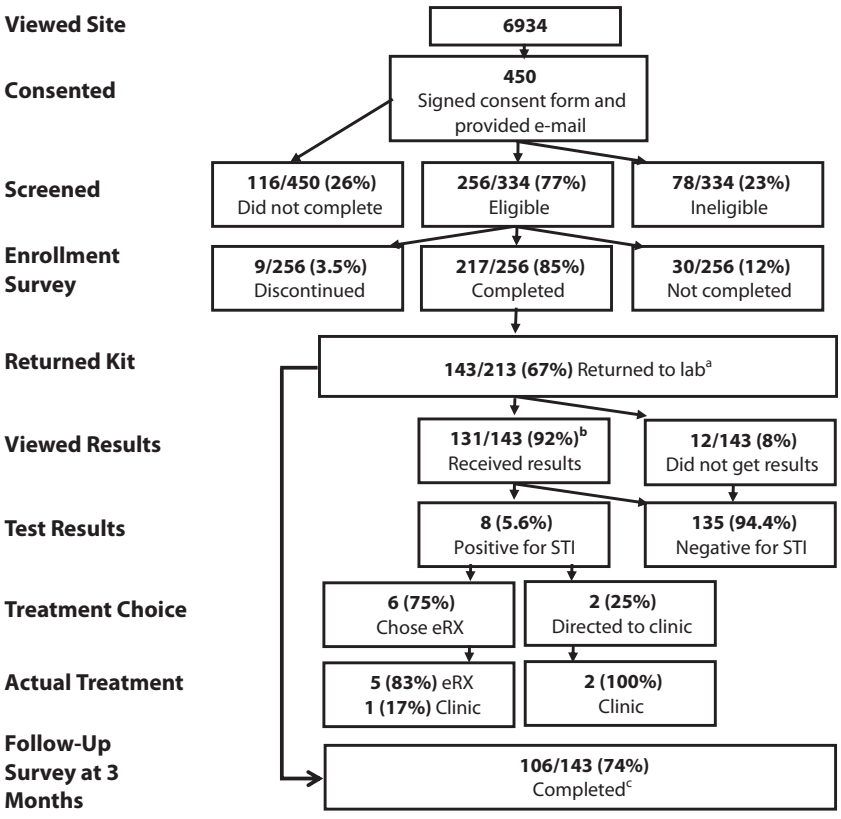
We downloaded data without participant identifiers from the study portal and analyzed it using SAS version 9.3 (SAS Institute, Cary, NC). As a part of evaluating acceptability of this e-STI system, we analyzed participant characteristics associated with acceptance, as characterized by test kit return and change in STI risk behaviors. We examined statistical comparisons of participant characteristics according to tested versus not tested with the χ^2 or exact χ^2 test for categorical data, trend test for ordinal data, and Kruskal–Wallis test for continuous data. We made paired comparisons between enrollment and follow-up responses using the McNemar test.

To examine predictors of test kit return, we applied multivariable logistic regression by initially entering univariate variables that were found to be at the $\alpha = 0.1$ level. We retained those remaining at the $\alpha = 0.1$ level in the final model. P values less than .05 were deemed statistically significant.

RESULTS

During the 3-month demonstration project (Figure 1, Table 1), we had 6934 hits (6180 English, 754 Spanish) on the Web site, with 450 people clicking through to sign the consent—a click-through rate of 6.5%. Among those who completed the eligibility survey, 256 (77%) were eligible. Ineligibility was the result of age outside of the 18 to 30 years range, zip code not in the 4 participating counties, or nonfemale gender. Among those who were eligible, 217 (85%) completed the 15- to 20-minute enrollment survey and ordered a kit. Of the kits ordered, 213 (98%) had valid addresses and were mailed. Among those who were mailed a kit, 143 (67%) returned the kit to the lab. When test results were posted online, 131 (92%) viewed their results, with 115 (88%) viewing results the same day they were posted.

Eight women tested positive for new STIs (6 for chlamydia and 2 for trichomoniasis), which resulted in a prevalence of 5.6% (95% CI = 2.5, 10.7). Of the 8 positives (Figure 1), 6 chose to receive treatment at a local pharmacy (e-prescription). Of the 2 infected participants who did not choose e-prescription, 1 was traveling abroad and received treatment at a local clinic; 1 pregnant woman, who was recruited in a drug treatment outreach setting, received her results by telephone and was linked to clinical services. One woman with an STI initially chose pharmacy treatment but was



Note. eRX = electronic prescription; eSTI = online system for STI testing, treatment, and linkage to care; STI = sexually transmitted infection.
[a]Four of the 217 who completed enrollment surveys could not be mailed a kit because of an invalid address, so the denominator is 213.
[b]One positive received results by telephone. The rest accessed results online.
[c]Those who did not return a home test kit did not have access to the follow-up survey.

FIGURE 1—eSTI participant flow: Alameda, Contra Costa, San Francisco, and San Mateo Counties, CA; April 2012–June 2012.

referred to a clinic for free treatment when she disclosed that she could not afford the pharmacy fee. Among those women tested, 106 (74%) completed follow-up surveys online at 3 months after enrollment. Participants reported no adverse outcomes.

Participant Characteristics

The median age of enrolled participants was 25 years (range = 18–30; Table 2). Non-Hispanic White women made up the largest racial/ethnic group (37%); 12% were African American, 24% were Latina/Hispanic, and 27% were of another race. Approximately half of the enrolled women completed college or had an advanced degree, and half had a high school degree or less. Although 36% of participants made less than $10 831 annually, only 10% of participants made more than $43 321 annually. Most of the participants were unmarried (90%), but approximately half were in a steady relationship (53%). Almost all (94%) used the Internet daily. Those participants who enrolled did not differ significantly from those who did not complete enrollment for almost all characteristics (county, language, age, STI testing history, and number of sex partners in the past 12 months; data not shown). Those who did not enroll more frequently reported current STI symptoms (63% vs 39%; OR = 2.63; 95% CI = 1.22, 5.88).

Compared with a population-based sample aged 18–30 years (the Behavioral Risk Factor Surveillance System),[12] our study population was older (24.9 vs 24.3 years; $P < .001$), more likely to be African American (12% vs 5%; $P = .062$), less likely to have completed college (53% vs 63%; $P = .044$), and more likely to be unmarried (90% vs 80%; $P = .063$; see Appendix A, available as a supplement to the online version of this article at http://www.ajph.org).

Recruitment

Internet advertising resulted in the recruitment of the highest percentage of participants (47%), followed by bus or train media (16%) and free radio and newspaper (16%; Table 1). The recruitment

TABLE 1—Recruitment and Testing Outcomes: Alameda, Contra Costa, San Francisco, and San Mateo Counties, CA; April 2012–June 2012

Outcomes	Internet	Word of Mouth	Free Press	Bus or Train Media	Shop Displays	Outreach Worker	Total[a]
Enrolled, no.	100	24	34	34	7	17	217
Kit return rate, no. (%)	63 (63.0)	17 (70.8)	27 (79.4)	23 (67.7)	5 (71.4)	8 (47.1)	143 (65.9)
Cost of recruitment and returned test, $	263	0	0	1219	1698	403	395
Test results receipt (for returned kits), no. (%)	58 (92.1)	15 (88.2)	26 (96.3)	21 (91.3)	5 (100)	6 (75.0)	131 (91.6)
STI rate of tested, no. (%)	0	0	2 (7.4)	5 (21.7)	0	1 (12.5)	8 (5.6)
Cost of recruitment and STI, $	NA	NA	0	5120	NA	2419	6470

Note. Free press = free radio and newspaper; NA = not applicable; STI = sexually transmitted infection.
[a]Recruitment strategy was missing for 1 participant, who was therefore not included in the by-strategy calculations but was included in the total.

TABLE 2—Baseline Characteristics, Clinical Symptoms, Testing, and Risk Behaviors of Participants, Did Not Test vs Tested for STIs: Alameda, Contra Costa, San Francisco, and San Mateo Counties, CA; April 2012–June 2012

	Univariate Analyses				Multivariable Analyses	
Variable	All Enrolled (n = 217), No. (%)	Did Not Test (n = 70),[a] No. (%)	Tested (n = 143),[a] No. (%)	*P*[b]	OR (95% CI)[c]	*P*
County				.041		
Alameda	82 (38)	25 (36)	56 (39)		0.27 (0.07, 0.90)	.044
San Francisco	72 (33)	24 (34)	48 (34)		0.14 (0.04, 0.48)	.003
Contra Costa	35 (16)	17 (24)	17 (12)		0.19 (0.04, 0.68)	.016
San Mateo	28 (13)	4 (6)	22 (15)		1.00 (Ref)	
Language of survey				.724		
English	208 (96)	68 (97)	137 (96)		. . .	
Spanish	9 (4)	2 (3)	6 (4)			
Age, y				.147		
18–21	47 (22)	19 (27)	28 (20)		. . .	
22–25	71 (33)	17 (24)	53 (37)			
26–30	99 (46)	34 (49)	62 (43)			
Race/ethnicity				.002		
Non-Hispanic White	81 (37)	22 (31)	59 (41)		1.00 (Ref)	
Non-Hispanic African American	26 (12)	17 (24)	9 (6)		0.29 (0.09, 0.82)	.023
Latina/Hispanic	51 (24)	16 (23)	33 (23)		1.04 (0.44, 2.51)	.922
Other	59 (27)	15 (21)	42 (29)		1.28 (0.55–3.03)	.571
Education (highest degree)				< .001		
≤ high school	116 (53)	53 (76)	60 (42)		0.22 (0.10, 0.44)	< .001
College or advanced degree	101 (47)	17 (24)	83 (58)		1.00 (Ref)	
Income, $				.955		
< 10 831	78 (36)	26 (37)	51 (36)		. . .	
10 832–43 320	87 (40)	28 (40)	57 (40)			
> 43 320	22 (10)	8 (11)	14 (10)			
No answer	30 (14)	8 (11)	21 (15)			
Relationship status				.062	. . .	
Married	22 (10)	9 (13)	12 (8)			
In a relationship	115 (53)	43 (61)	71 (50)			
No steady relationship	80 (37)	18 (26)	60 (42)			
Internet use				.097		
Daily	204 (94)	64 (91)	136 (95)		. . .	
Weekly	8 (4)	3 (4)	5 (3)			
Monthly	4 (2)	2 (3)	2 (1)			
Hardly ever	1 (< 1)	1 (1)	0 (0)			
Primary care provider seen in past year	117 (54)	37 (53)	79 (55)	.742	. . .	
STI symptoms[d]	85 (39)	32 (46)	52 (36)	.19	. . .	
Vaginal discharge	59 (27)	26 (37)	32 (22)	.023	. . .	
Genital ulcer or sore	10 (5)	6 (9)	4 (3)	.079	. . .	
Vaginal warts	9 (4)	6 (9)	3 (2)	.035	. . .	
Pain during sex	24 (11)	10 (14)	13 (9)	.34	. . .	
Pain with urination	13 (6)	8 (11)	5 (4)	.034	. . .	
Abdominal or pelvic pain	23 (11)	10 (14)	13 (9)	.251	. . .	
Abnormal vaginal bleeding	12 (6)	8 (11)	4 (3)	.016	. . .	
Pregnant	3 (1)	3 (4)	0 (0)	.033	. . .	

Continued

TABLE 2—*Continued*

Tested before for STIs				.078		
Never tested before	56 (26)	23 (33)	31 (22)		1.00 (Ref)	
Tested before	161 (74)	47 (64)	112 (78)		2.17 (1.05, 4.51)	.037
Last STI test location[d]						
Home collection	4 (2)	1 (1)	3 (2)	> .999	. . .	
STI clinic	14 (6)	7 (10)	7 (5)	.235	. . .	
Planned Parenthood	28 (13)	10 (14)	18 (13)	.73	. . .	
Private primary care	32 (15)	7 (10)	25 (17)	.151	. . .	
Community clinic	25 (12)	5 (7)	19 (13)	.183	. . .	
OB/GYN clinic	31 (14)	7 (10)	24 (17)	.187	. . .	
School	14 (6)	2 (3)	11 (8)	.228	. . .	
Emergency room or urgent care	4 (2)	2 (3)	2 (1)	.543	. . .	
Stigma (embarrassed if someone found out tested for STIs)	106 (49)	39 (56)	64 (45)	.133	. . .	
STI test past 3 mo	37 (17)	11 (16)	26 (18)	.655	. . .	
History of unprotected sex without STI test	183 (84)	52 (74)	127 (89)	.01	. . .	
STI history						
Chlamydia	33 (15)	14 (20)	19 (13)	.203	. . .	
Gonorrhea	11 (5)	4 (6)	7 (5)	> .999	. . .	
Trichomoniasis	8 (4)	2 (3)	6 (4)	.723	. . .	
STI retest since last STI	5/21 (24)	2/8 (25)	3/13 (23)	> .999	. . .	
Never tested for HIV	77/210 (37)	28/66 (42)	47/140 (34)	.218	. . .	
HIV test past 3 mo	22/208 (11)	7/66 (11)	14/138 (10)	> .999	. . .	
History of unprotected sex without HIV test	181/211 (86)	51/68 (73)	127/139 (89)	.001	. . .	
Partner likely to have STI	43 (20)	14 (20)	28 (20)	.942	. . .	
New sex partner, 3 mo	82 (38)	20 (29)	61 (43)	.047	. . .	
Always condom use with new partner	92 (42)	31 (44)	59 (41)	.674	. . .	
Always condom use with steady partner	21 (10)	7 (10)	14 (10)	.962	. . .	
No. sexual partners in the past 12 mo				.063		
1–2	127 (60)	48 (69)	79 (55)		0.53 (0.26, 1.05)	.074
≥ 3	86 (40)	22 (31)	64 (45)		1.00 (Ref)	

Note. CI = confidence interval; OB/GYN = obstetrician/gynecologist; OR = odds ratio; STI = sexually transmitted infection. Ellipses indicate that the variable was not included in the multivariable model. Percentages may not add to 100 because of rounding.

[a]Four participants, who requested but were not sent kits because of invalid address, were not included in the tested vs not-tested results, so these 2 groups totaled 213, not 217.

[b]The χ^2 test for categorical data or trend test for ordinal data. Exact test used when expected counts were less than 5.

[c]Odds ratios indicate the odds of testing for the given category as compared with the reference category.

[d]Participants could select more than 1 category, so results are not mutually exclusive.

cost per test completed was highest for shop displays ($1698) and bus or train media ($1219).

Bus or train media, although more expensive than Internet or outreach recruitment, were most effective at reaching those with STIs. None of the STI cases were recruited through the Internet even though that strategy was found to be most effective at reaching participants to enroll and test.

Test Results and Their Integration Into Electronic Health Records

Of enrolled women, 39% had at least 1 STI symptom (Table 2). Vaginal discharge, reported by 27% of enrolled women, was most common. One quarter had never been tested before for STIs. Thirty-eight percent reported a new sex partner in the past 3 months. Eighty-four percent had not had an STI test since their last unprotected sex. Forty-two percent reported always using a condom with new partners, 10% with long-term or steady partners. Enrolled women reported a previous diagnosis of chlamydia (15%), gonorrhea (5%), and trichomoniasis (4%).

When a subset of participants (San Mateo County) were offered the opportunity to have their test results integrated into the EHR of the referral clinic, only 17% (5/29) elected to have this service.

Pharmacy and Medication for Treatment

We also captured data on feasibility from the pharmacy perspective through the computer-generated e-prescriptions and by sharing study consents via automated e-fax follow-up for patients who filled their STI treatment prescriptions. We found no barriers to implementation of either of these activities.

The only barrier to treatment occurred when women did not have health insurance and could not afford the price of the medications. In that case, we had to refer them back to public health STI clinics that offered free treatment. In the future, we will consider collaborations

with health department programs to cover the medication costs for women who are uninsured.

Acceptability

Table 2 lists variables associated with testing in the univariate analysis. In the final multiple logistic regression model (Table 2), the odds of completing testing were significantly lower for Alameda, San Francisco, and Contra Costa Counties than for San Mateo County. African Americans were 71% less likely to complete testing than Whites. Participants with less than a high school or a high school education were 78% less likely to test than those with college or advanced degrees. Those who tested before were 2.2 times more likely to test than those who had never tested. Those with 1 to 2 partners were 47% less likely to test than those with 3 or more partners. Several variables did not retain significant associations at the $\alpha = 0.1$ level after adjusting for other variables and were excluded from the final model, including relationship status, pregnancy, having an STI/HIV risk without testing, and having a new sex partner in the past 3 months.

Only those who tested were able to complete the follow-up survey. We found no statistically significant differences in any of the characteristics of participant who followed up compared with those who did not (data not shown).

At follow-up (data not shown), participants were less likely to report STI symptoms than at enrollment (19% vs 33%; $P = .004$), and the trend was for more women to have had an HIV test in the past 3 months (17% vs 10%; $P = .06$).

Over time, risk behaviors for STIs/HIV decreased significantly, including STI/HIV risk since last test (51% vs 90%; $P < .001$), risky partners in the past 3 months (6% vs 21%; $P = .001$), and new partners in the past 3 months (34% vs 45%; $P = .046$), and condom use with new partners increased (55% vs 43%; $P = .029$). Additionally, stigma for STI testing decreased significantly between baseline and follow-up surveys (32% vs 44%; $P = .005$).

Among those who tested, 98% (104/106) thought the Web site was easy or very easy to use; 99% would recommend the study to a friend; 95% (101/106) would prefer eSTI over clinic testing in a study, and 80% (85/106) would rather test through eSTI than go to a clinic for future STI testing (Table 3). If eSTI were delivered as a self-pay service, 93% would test at $10, 83% would test at $20, 43% would test at $40, and only 19% would test at $80 (the cost of lab testing).

DISCUSSION

This demonstration project successfully established the feasibility of an integrated Web-based testing and treatment system (eSTI) in the context of a study with high rates of participant test kit return, treatment, and follow-up. In addition, we demonstrated that the project had significant impacts on health care–seeking behaviors and risk-taking behaviors. The high rates of completion of enrollment surveys (85%), kit return (67%), and follow-up surveys (74%) likely reflect the motivation of participants to engage in STI home testing. The kit return rates were higher than anticipated, given prior experience in Baltimore, Maryland, and Los Angeles, where initial kit return rates were substantially lower at 32.4%[13] and 55.3%,[8] respectively. The high kit return rates and decreased risk behaviors that we observed over time may reflect the impact of the Web site and risk assessment to heighten risk awareness, decrease future risk behaviors, and increase motivation for testing. The changes in rates of unprotected sex, condom use with new partners, and decrease in number of risky partners and new partners was as high as reported by other STI prevention studies,[14] yet

TABLE 3—Acceptability and Preferences Among Women Who Tested: Alameda, Contra Costa, San Francisco, and San Mateo Counties, CA; April 2012–June 2012

Questions	Follow-Up Survey (n = 106), No. (%)
Easy-to-use Web site	104 (98)
Recommend study, with online testing to a friend	105 (99)
Recommend testing, online testing to a friend if no survey or follow-up	104 (98)
Prefer for future study	
Online	101 (95)
Clinic	5 (5)
Prefer for future testing	
Online	85 (80)
Clinic	21 (20)
Amount willing to pay for online testing,[a] $	
0	106 (100)
10	99 (93)
20	88 (83)
30	63 (59)
40	46 (43)
50	33 (31)
60	21 (20)
70	20 (19)
80	20 (19)
Prefer for future treatment	
Go to an STI clinic	2 (2)
Pick up at a pharmacy	37 (35)
Send it to my home	65 (61)
Pick it up at vending machine	2 (2)
Prefer for future HIV testing	
Clinic rapid test	20 (19)
Home specimen collection	18 (17)
Home self-test	68 (64)

Note. STI = sexually transmitted infection.
[a]Cumulative percentage presented.

the cost is likely to be much lower than for clinic-based services. We did not directly compare participants who got the intervention with those who did not, so the actual reason for high testing rates and behavior change is unclear. For the next generation of eSTI, integration of interactive computer counseling programs designed for low literacy populations such as the CARE tool[15–17] may further improve the impact of the eSTI program.

Regarding the integration of eSTI results data into a referral EHR, tested in San Mateo, our study showed only a minority of participants (17%) desired this functionality. These findings may have been different if patients had been offered this strategy directly from their clinic care managers, as could be done with clinic-based home testing programs. Future research should determine whether external home STI testing programs have higher rates of testing uptake than clinic-based home STI testing programs because of the privacy offered and whether offering STI testing in a clinic setting without mandatory integration of test results into the EHR would result in more women accepting and completing STI testing.

Although our demonstration was successful, our data showed that reaching a higher proportion of low-literacy and minority populations will take additional research to determine the most effective recruitment strategies. In our demonstration, we relied heavily on Internet recruitment, and although we found that the educational level (53% with college or more) among those enrolled was lower than in a weighted sample of the general population from the same geographic regions (63%),[18] we found that college education rates were higher among people who completed testing (58%) than among those who did not complete testing (24%). Similar to the Los Angeles demonstration project,[8] our program was offered in Spanish and English and used marketing that targeted African American and Latina women. Our recruitment efforts, however, resulted in more Whites testing. Our tested population consisted of only 23% Spanish-speaking Latina women and 6% African American women. Radio ads on stations listened to by African American and Latina women may better reach populations who may not see Internet ads.[19,20] Street outreach may be a more effective method to reach people of color and low literacy populations to assist them with completion of testing.[17] Because of our perception of the high costs of staffing street outreach, we spent a relatively small amount of time conducting street-based outreach to enroll high-risk clients (52 hours of staff time). However, in our cost analysis we found that street enrollment ($2419/STI) may be a relatively lower cost strategy than bus and train advertising ($5120/STI) for identification of women with STIs.

Additional data on the relative cost-effectiveness of different recruitment strategies will also help us determine how best to increase the overall infection prevalence among eSTI testers. This demonstration project reached a lower prevalence (5.6%) population than that found in home testing demonstrations in Baltimore (10.3%)[13] and Los Angeles (8.5%).[8] However, the STI prevalence identified mirrors the 2011 reported chlamydia prevalence per 100 000 people in San Francisco and Oakland, Baltimore, and Los Angeles (432, 531, and 456, respectively).[2] Although our study suggested that specific recruitment methods may be more effective at identifying participants with infection, it did not provide adequate sample size to determine optimal recruitment strategies. Additional research comparing the success and cost-effectiveness of different recruitment strategies is needed to increase prevalence of infection detected and lower the cost per infection detected.

Ideally, the eSTI program would expand access to testing among people at high risk who are asymptomatic and unlikely to seek clinical care while encouraging those with symptoms to follow up with a clinical examination. Our initial data suggest that women who have symptoms are less likely to do home testing, which may be because they preferentially seek clinical care. Future studies of eSTI should seek information on follow-up for clinical care among participants who do not complete home specimen collection to determine whether women who need clinical care are accessing it appropriately.

Regarding new treatment strategies, this demonstration project did support the feasibility and acceptability of e-prescriptions for STI treatment among asymptomatic women with STI. In this demonstration project, we found that 6 of the 8 infected women chose to get prescriptions immediately at a pharmacy. The e-prescription method shows promise to increase program acceptability and to decrease time to treatment. However, another potentially more acceptable treatment option may be mailed medications because the majority of women indicated they would prefer this approach over clinic treatment or e-prescription. Future studies of eSTI should offer the option of treatment mailed to homes as well as e-prescriptions and referral to local STI clinics.

Another concern regarding home STI testing programs is the impact on HIV testing rates. The eSTI system recommended that clients follow up for HIV testing, but in this demonstration we were not able to offer home HIV testing. Although our intervention did result in a significant increase in HIV testing rates in the past 3 months from 10% to 17%, all people who test for STIs would ideally test for HIV. Given the strong preference for simple home HIV tests over clinic-based testing (64% vs 19%), the Food and Drug Administration–approved OraQuick kit should be included in the future comparative effectiveness study to determine whether the eSTI program also increases rates of HIV testing compared with clinic referral.

Limitations

This demonstration study may not be generalizable to geographic regions outside of Northern California. Given our study design, changes in STI risk behaviors cannot be solely attributed to this program. A larger national multisite comparative effectiveness trial will be necessary to determine the actual impact of home testing for STI. Furthermore, although this demonstration showed high acceptability among patients, in future comparative effectiveness studies it will be important to collect additional data from other stakeholders such as referral providers and pharmacists to ensure that no other barriers exist that could potentially affect patient testing, treatment, and follow-up for necessary clinical care.

Conclusions

Programs such as eSTI will likely figure prominently in health care systems of the future. If effective recruitment strategies are developed, this program may be efficiently taken to scale nationally. Providing home testing, counseling, and, for some conditions, Web-based treatment should improve accessibility and

acceptability of STI screening and testing and will save clinician time for higher acuity medical problems that require clinic facilities. This strategy is likely to be effective in reaching people who would not otherwise test in that it overcomes many known barriers to STI testing. To disseminate these types of strategies, they must be evaluated in comparative effectiveness trials designed to prove impact on health outcomes, patient experience, and cost. Equally as important will be establishing appropriate billing policies so that these types of interventions can be scaled up within health care systems while still being linked to public health. Our research demonstrated the feasibility and acceptability of the eSTI system; public health–home testing partnerships have the potential to dramatically and cost-effectively affect STI epidemics when taken to scale. ■

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Contributors

All authors contributed to, reviewed and approved the final article. F. Spielberg, V. Levy, P. Wolff, and C. A. Gaydos designed and developed the concept of the study and were involved with all aspects of the study. V. Levy served as the Clinical Lead for the San Mateo site. C. A. Gaydos provided all kits and testing for STIs. N. Padian contributed to study design and provided guidance on data analysis and interpretation. L. Venkatasubramanian led data management of study. N. Acevedo managed and coordinated operational aspects of study. S. Lensing led statistical analysis. I. Chattopadhyay was involved in project implementation and management. D. Callabresi led marketing and programming aspects of study. S. Philip and T. P. Lopez provided public health and sexually transmitted disease clinic perspective on study design and analysis, and S. Philip served as the Medical Director for the San Francisco site.

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Human Participant Protection

Methods were approved as a nonsignificant risk medical device study for home collection of vaginal swabs by institutional review boards at participating institutions.

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