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Use of a risk quiz to predict infection for sexually transmitted infections: a retrospective analysis of acceptability and positivity

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Abstract

Background—Individuals who are sexually active may want to make a decision as to whether they are at risk for having a sexually transmitted infection (STI) such as *Chlamydia trachomatis*, *Neisseria gonorrhoeae* and *Trichomonas vaginalis*. Our goal was to develop and evaluate a simple self-taken sexual risk quiz for participants, ordering an online STI self-collection test kit to determine whether the score predicted infection status.

Methods—As part of the IWantTheKit programme for home sample self-collection for STIs, 2010–2013, the programme asked male and female users to voluntarily take a risk quiz. The six-question quiz was about risk behaviour and included an age question. Data analyses were stratified by gender as determined a priori. Scores 0–10 were stratified into risk groups for each gender based on similar risk score-specific STI prevalence. Retrospective analyses were performed to assess whether risk group predicted aggregate STI positivity. Urogenital/rectal mailed samples were tested by nucleic acid amplification tests.

Results—More females (N=836) than males (N=558) provided voluntary risk scores. The percentage of eligible participants who submitted scores was 43.9% for both females and males. There was a higher STI infection rate in females (14.0%) than in males (7.0%) for having any STI ($p<0.001$). Multivariate logistic analysis for females, which controlled for age and race, demonstrated that a higher risk score group independently predicted risk for having an STI (OR of

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2.2 for risk scores 5–7 and 4.2 OR for scores of 8–10). For males, the multivariate model, which controlled for race, indicated that no risk score group was associated having an STI.

Conclusions—Results of a participant's own sexual risk quiz score independently predicted STI positivity for women, but not for men. Further study of this simple risk quiz is required.

INTRODUCTION

Sexually transmitted infections (STIs) are a significant health burden in the USA, having an estimated prevalence of >110 million, with approximately 19 million incident cases annually.[1] The most common bacterial infection of these is caused by *Chlamydia trachomatis* with 1 401 906 cases reported to the Centers of Disease Control and Prevention (CDC), followed by infections caused by Neisseria gonor-rhoeae with 333 004 cases reported in 2013.[2] *Trichomonas vaginalis* is not reportable to CDC, but incidence is estimated at over one million new cases per year.[1] Direct medical costs just for chlamydial infections exceed $500 million per year.[3] Since STIs and altered vaginal microbiota are likely to influence the transmission of HIV, control of STIs is imperative.[4–6] IWantTheKit (IWTK) is an internet recruitment and educational outreach programme that tests for chlamydia, gonorrhoea and trichomoniasis from self-collected genital and rectal swabs obtained at home and mailed to the laboratory for molecular testing.[7–10] The educational component of IWTK informs users about STIs and uses a short online quiz for sexually active individuals to estimate their risk of having an STI. Other researchers have used risk scores or prediction rules to determine who should be selectively screened in clinical settings.[11–15] However, our risk quiz score for IWTK was directed towards the individual user to assist in determining their own risk of having an STI based on their self-report, which culminated in a 'risk score'. Little is known about whether an individual can determine his/her own risk for having an STI. Our objective was to retrospectively evaluate the risk quiz score results to ascertain whether the score predicted positivity for an individual for a urogenital/rectal STI infection caused by chlamydia, gonorrhoea or trichomoniasis. We hypothesised that a higher risk score category ('medium' or 'high') compared with low risk score category ('low') would correlate with STI positivity.

METHODS

Study design

We performed a retrospective analysis of risk scores reported by individuals to ascertain whether the risk score category independently predicted positivity for an STI. We were interested to demonstrate the correlation so that in the future a higher quiz score might be used to help an individual decide whether to order a test kit.

Setting and population—From November 2010 to August 2013, the IWTK programme for home collection of samples for STI testing asked its male and female participants to voluntarily take the risk quiz, which was available on the website and also in the mailed kit.

Risk quiz—The voluntary quiz was designed by a committee of STI experts in adolescent sexual health care, clinicians and researchers, by a thorough analysis of many previously

published sexual risk behaviour analyses, with a desire to keep the quiz simple and fast. The quiz was planned after study and discussion by several key opinion leaders in STI behavioural research, but was also data driven and based on data relating to age, condom use, concurrency and previous diagnosis of an STI from several large data sets from individuals deciding to be screened for STIs. Two behavioural categories (condom use and number of sexual partners) were weighted since previous data often associated higher risk of these behaviours with infection.[7–10] The quiz consisted of six questions, which included an age demographic question of being 25 years old or younger and five other quiz questions regarding STI diagnostic history, concurrency, number of partners and condom use (table 1). The quiz could be taken on the website or the user could take the quiz later using a paper-based version in the kit. For quizzes taken online, the website calculated and presented the risk score to the participant. If the kit user calculated the score by paper in the kit, the participant was asked to provide the 'total' score on the user's Contact Form that was returned with the specimen for testing. Answers to individual questions were never reported or recorded.

IWTK internet programme—This programme invited males and females 14 years and older from Maryland and Washington, DC to request an STI testing kit at the IWTK website (http://www.iwantthekit.org) and offered public health testing for STIs. The mailed kit provided at-home self-collected penile, vaginal and rectal swabs for direct mail to a laboratory for testing for detection of chlamydia, gonorrhoea and trichomoniasis. The use of penile samples is off-label, but was compared to urine samples as a validation method in an earlier report.[1016] The kits were free and were mailed to an address provided by the participant online, with enclosed collection instructions, as well as a pre-addressed, postage-paid return mailer for returning the swabs to the laboratory. Testing was free and was performed with the US Food and Drug Administration-cleared nucleic acid amplification tests, Aptima Combo2 (AC2) for chlamydia and gonorrhoea and Aptima TV for trichomoniasis (Gen-Probe/Hologic, San Diego, California, USA). This study was a programme evaluation, all data were completely de-identified and it met the requirements for being human subjects' research exempt.

Statistical analysis

Since prevalences of an STI and high-risk sexual behaviour vastly differed between genders as documented in the literature, all data analyses were stratified by gender as determined a priori. In order to calculate sample size for this study, we assumed that participants who were in 'medium' risk score category would have 50% higher odds to have STIs (ie, OR 1.5) compared with those who were in 'low' risk score category, and the participants who were in 'high' risk score category would have 50% higher odds to have STIs compared with those who were in 'medium' risk score category. We also assumed that age group and race were two significant covariates with an OR of 1.5 respectively when we performed the multivariate logistic regression analysis to determine the association between risk score category and the presence of STIs. We would need at least a sample of 170 participants to have a power of 80% to detect an OR of 1.5 in the association of risk score category and presence of STIs, assuming a prevalence of STIs of 10% and the significance level of 0.05. Since we explored the association between risk score category and STI for each gender, the

sample size was for female and male participants, respectively. Descriptive data analyses were first performed to depict the characteristics of study population by risk scores and gender. Since the prevalence of STIs and high-risk sexual behaviour was significantly different by gender, we separated risk scores into three categories ('low', 'medium', and 'high') for each gender based on similar risk score category-specific prevalence of STIs (see online supplementary figure S1). Based on behavioural risk and differing prevalence by gender, we did not use uniform cut-offs of risk scores to define risk group because this would have led to bias in the group designations. Therefore, based on STI prevalence, for females, risk scores 0–4 were designated as 'low risk', 5–7 as 'medium risk' and 8–10 as 'high risk'; for males, risk scores 0–2 were designated as 'low risk', 3–6 as 'medium risk' and 7–10 as 'high risk'. Potential covariates in this study included age (<20, 20–29, ≥30 years), race (white, African American, other) and ethnicity (Hispanic, non-Hispanic). We used χ^2 test to perform bivariate analysis. If a covariate had a p value <0.2 in the bivariate analysis, it was included in the multivariate regression analysis subsequently. Multivariate logistic regression analysis was performed to determine the association between risk score category and an STI infection after adjusting for covariates. p Values of <0.05 were considered significant. SAS V.9.3 (SAS Institute, Cary, North Carolina, USA) was used for all statistical analyses.

RESULTS

From November 2010 to August 2013, females and males who participated in internet recruitment in Maryland and the District of Columbia for home sampling for STI testing were offered to take a risk quiz and report the composite score; 836/1905 (43.9%) females and 558/1270 (43.9%) males provided voluntary risk scores (table 2); *96.1% of males and 96.1% of females reported the quiz score by paper in the kit.* There were no statistical differences between those who took a risk quiz and those who did not in age, race, ethnicity and presence of STIs in both genders. From those who reported scores, there was a higher STI infection rate in females (14.0%) than in males (7.0%) for having any STI (p<0.001). For females, the mean age was 26.9 ±7.5 years, median age 25.0 (interquartile age 22–30 years), with most (36.4%) being age 20–24 years, and 9.8% being 13–19 years (table 2). For males, the mean age was 30.0 ±10.0 years, median age was 27.0 years (IQR 23–34 years), with most males being 20–24 years (28.1%) and 26.7% being 25–29 years (table 2). More female participants were African-American (51.6%), as were most male subjects (47.3%). Chlamydial infections were the most common STI (7.8%) among females and males (5.4%), while gonorrhoea infections were low: 1.0% and 1.1% in females and males, respectively. The prevalence of trichomoniasis infections was 6.6% in females and 1.3% in males (table 2).

Prevalence data for a STI by risk category by gender included: female—low risk, 8.7% (31/355); medium risk, 16.3% (70/430); high risk, 31.4% (16/51); male—low risk, 2.9% (2/70); medium risk, 5.7% (21/367); high risk, 13.2% (16/121). See online supplementary appendix for individual gender-based risk score (1–10) prevalence.

Female analysis

The distribution for risk scores indicated that most scores for females clustered between scores of 5–7 (51.4%); with lower scores of 0–4 comprising 42.5%, and with higher scores of 8–10 comprising 6.1% of the responses (table 2). Hispanic ethnicity was the only variable that did not show potential association with an STI infection in the bivariate analysis; thus, it was not included in the multivariate regression analysis. Multivariate logistic analysis for females, which controlled for age group (<20 years, 20–29 years and >29 years) and race, demonstrated that a higher risk score group independently predicted risk for having an STI with an OR of 2.2 for risk scores 5–7 and 4.2 OR for scores of 8–10 (table 3). Younger age, <20 years (OR 3.2), and black race (OR 2.6) also were associated with having an STI (table 3).

Male analysis

The distribution for male scores indicated that most clustered between scores of 3–6 (ie, medium-risk group) (65.8%); with lower scores of 0–2 (low-risk group) comprising 12.5%, and with higher scores of 7–10 (high-risk group) comprising 21.7% of the responses (table 2). Hispanic ethnicity and age did not show potential association with an STI infection in the bivariate analysis; thus, they were not included in the multivariate regression analysis. For males, the multivariate model, which controlled for race, indicated that no risk score group was associated with being positive for an STI. Scores of 7–10 had an OR of 3.9, but it was not statistically significant. Black race was associated with having an STI, OR of 5.7 (table 3).

DISCUSSION

We evaluated whether higher scores on a sexual risk quiz were able to predict whether a participant would be more likely to have an STI. When detailed analyses were performed, we found that higher risk scores provided by female participants taking the risk quiz appear to predict the likelihood of her having an STI. Higher risk scores did not independently predict positivity for male users, however. Our present analysis was tailored to determine whether the higher risk scores independently predicted positivity for having an STI.

The design of our risk quiz was based on published studies of factors that independently predicted risk and expert opinion of researchers in the field.[7][10–15] Young age, as well as history of an STI, condom use and numbers of recent sex partners, often predicts positivity for STIs. We desired a simple non-judgemental set of questions. We specifically avoided asking about race in our quiz, which has been predictive of increased risk. We and many others believe that to target and screen individuals based on race may be stigmatising to the black individual, and that if other factors work well, then it is best to avoid race as a screening risk question.

Our findings that high-risk scores predict STI positivity for women, but not men, are interesting. We have no way to ascertain whether participants answered the questions truthfully or reported their scores accurately. The distribution of scores was very different by sex, and this may explain the difference. Other reasons may include a lack of power for the

smaller size of the male population and the lower STI prevalence in males, especially for gonorrhoea and trichomoniasis, which would have added to the total STI prevalence. The overall prevalence for any STI in women was 14% and for men it was 7%, and this may have been a large contributor to the different results.

The provision of internet recruitment of men and women for collection of urogenital samples at home with mailing to a test site has been demonstrated to be feasible, acceptable, accurate and efficient.[7–1016] The provision of a risk quiz to the IWTK home collection programme was added to encourage participants to take a look at their own risk for having an STI, perhaps with gaining knowledge as to their own risk. Self-management of one's own reproductive health is becoming more popular; and improvement in the efficiency and delivery of sexual health care with a focus on innovation may popularise 'Do it yourself' sexual healthcare.[17] Baraitser *et al*[18] have reported on the user experience for patients collecting their own samples, reporting that "clients were grateful for the service and preferred the autonomy, privacy and speed that their programme offered". This type of individual-driven testing for self and home collection of specimens also has been postulated to be cost-effective as measured in several reports.[19–22]

Other studies that have used risk to predict who should be screened have shown promise in saving resources by not screening persons who are at very low risk of having an STI. Falasinnu *et al*[12] reported a review of 16 publications reporting on STI prediction rules, concluding that very few have been validated. They indicated that eight studies attained a performance benchmark of testing <60% of the population with achieving 90% sensitivity. Their own validation of their risk estimation tool in Canada achieved a sensitivity of 91% and 83% of cases for screening for chlamydia and gonorrhoea, with only screening 68% and 68% of the derivation and validation populations, respectively, by using a cut-off point of at least 6 on their scale.[11] Their sum scores were added similarly to the method used by Gotz *et al*[15] and were derived from regression coefficients of a multivariable logistic regression model using visits between 2000 and 2006 and included younger age, non-white ethnicity, multiple sexual partners and previous infection. They showed reasonable performance in the derivation (area under the receiver operating characteristic curve=0.74) in the evaluation from 2007 to 2012.[11] Our expert panel similarly used risk factors previously estimated from our earlier IWTK and other studies, which indicated independent associations with young age, lack of condom use, concurrency, number of partners and previous diagnosis of an STI to design our risk quiz and scoring algorithm.[78] We intentionally did not include race in our score estimation since the quiz was designed for the participant to take themselves. A similar study from Australia evaluated a risk scoring tool for chlamydial infection in >4500 sexual health attendees.[14] Their prediction model included inconsistent condom use, increased number of partners, genital or anal symptoms, presenting for STI screening and being a sexual contact. Similar to our method, they created integer weights for each variable, characterising participant-specific probabilities based on cut-off points of the probability distribution, with a cut-point score of ≥20 distinguishing an increased risk group with a sensitivity of 95%, 67% and 70% among heterosexual men, women and men who have sex with men, respectively. Stratifying by population type obviously adds to a clinician's

decision to screen, but may not be practical for participants to use ahead of time, as in our study.

Our study has several limitations. There may have been bias in answering quiz questions or reporting score results. As our quiz was voluntary, only approximately half of the IWTK participants during the study period participated in the risk quiz, which may have influenced the generalisability of our findings. However, the STI prevalence ascertained for participants who reported and did not report a risk score was very similar. We also had no method to capture scores for potential participants who may have taken the quiz online and then decided not to order a test kit. Most of them were likely not have an STI and perhaps had very low risk score, which led them not to submit their specimens for STI testing. This would have diluted the observed association between risk score and presence of STI.

In summary, we demonstrated that results of a participant's own sexual risk quiz score independently predicted STI positivity for women, but not for men for the IWTK programme. Further study of this simple risk quiz, which would require participants to take the quiz before being tested, may further demonstrate its usefulness. We hope that others will evaluate this tool in other settings such as clinics and emergency departments. The risk assessment tool could be used in family planning clinics or primary care clinics where STI prevalence would be expected to be low, but where it might motivate an astute clinician to order a screening test based on a personalised risk score. We anticipate that the quiz score taken in a waiting room may influence a patient to discuss with their clinician as to whether to be tested for an STI. Future research could evaluate this approach.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Key messages

- Patients using an internet site to order home collection kits will take a sexual risk quiz.
- The summary risk score independently predicted sexually transmitted infection (STI) positivity for women, but not for men.
- Sexual risk quiz scores may be used to aid patients and clinicians determine risk for individuals of having an STI, but may not work well for males.

Table 1

Risk score

Questions	Score*
1. Are you ≤25 years old?	Yes=1 point. No=0 points
2. Have you had a new sex partner, or multiple partners, in the last 90 days?	Yes=1 point. No=0 points
3. Do you have more than one current sex partner at the present time?	Yes=1 point. No=0 points
4. Have you ever been told you had, or been treated for, an STI in the past?	Yes=1 point. No=0 points
5. How many sex partners have you had in the last 90 days?	10 or more=3 points. 5–9=2 points. 2–4=1 point. 0–1=0 points
6. When you have sex, do you use a condom?	Never=3 points. Sometimes=3 points. Always=0 points

Points were assigned to the responses for each question, and scores were calculated by adding the value of each response to obtain the score.

*Possible scores were 0–10. Higher scores were hypothesised to be of higher risk of having an STI.

STI, sexually transmitted infection.

Table 2

Demographics and status of sexually transmitted infections (STIs) of female and male IWTK participants who provided risk score information, November 2010–September 2014

		Number (%)	
Characteristics	**Category**	**Female N=836**	**Male N=558**
Age (years)	13–19	82 (9.8)	37 (6.6)
	20–24	304 (36.4)	157 (28.1)
	25–29	224 (26.8)	149 (26.7)
	30–34	110 (13.2)	72 (12.9)
	35–39	49 (5.9)	45 (8.1)
	≥40	64 (7.7)	92 (16.5)
	Missing	3 (0.4)	6 (1.1)
Race	White	259 (31.0)	215 (38.5)
	African-American	431 (51.6)	264 (47.3)
	Other	146 (17.5)	79 (14.2)
Hispanic ethnicity	Yes	53 (6.3)	34 (6.1)
Chlamydial infection	Yes	65 (7.8)	30 (5.4)
Gonococcal infection	Yes	8 (1.0)	6 (1.1)
Trichomoniasis infection	Yes	55 (6.6)	7 (1.3)
Any of three STIs above	Yes	117 (14.0)	39 (7.0)
risk score	0	9 (1.1)	15 (2.7)
	1	32 (3.8)	25 (4.5)
	2	35 (4.2)	30 (5.4)
	3	101 (12.1)	82 (14.7)
	4	178 (21.3)	110 (19.7)
	5	157 (18.8)	78 (14.0)
	6	165 (19.7)	97 (17.4)
	7	108 (12.9)	68 (12.2)
	8	38 (4.6)	36 (6.5)
	9	6 (0.7)	14 (2.5)
	10	7 (0.8)	3 (0.5)

IWTK, IWantTheKit.

Table 3

Multivariate logistic regression analysis on the association of IWanttheKit (IWTK) risk score and prevalence of sexually transmitted infections (STIs) (chlamydia, gonorrhoea and trichomoniasis) by gender

		OR (95% CI) in the final model	
Characteristics	**Categories**	**Female**	**Male***
Age (years)	<20	3.15 (1.58 to 6.30)	N.S.
	20–29	1.56 (0.92 to 2.66)	N.S.
	≥30	1.00	N.S.
Race	White	1.00	1.00
	African-American	2.63 (1.52 to 4.58)	5.69 (1.96 to 16.59)
	Other	2.92 (1.52 to 5.62)	4.01 (1.09 to 14.68)
Risk score category†	'Low risk'	1.00	1.00
	'Medium risk'	2.23 (1.41 to 3.52)	1.84 (0.42 to 8.11)
	'High risk'	4.22 (2.08 to 8.58)	3.88 (0.85 to 17.69)

*Variable 'risk score' in the model for male participants was not statistically significant in the multivariate regression model. This variable was forced in the model for male participants.

†Risk score category: defined by prevalence of STIs for each gender. Risk score of 0–4 was categorised as 'low risk', risk score of 5–7 as 'medium risk' and risk score of 8–10 as 'high risk' for female participants; risk score of 0–2 was categorised as 'low risk', risk score of 3–6 as 'medium risk' and risk score of 7–10 as 'high risk' for male participants.

N.S., not included in the model since it was not statistically significant.