Using computer-assisted survey instruments instead of paper and pencil increased completeness of self-administered sexual behavior questionnaires

Simone Spark[a,*], Dyani Lewis[a], Alaina Vaisey[a], Eris Smyth[a], Anna Wood[a], Meredith Temple-Smith[b], Rebecca Lorch[c], Rebecca Guy[c], Jane Hocking[a]

[a]*Centre for Epidemiology and Biostatistics, Faculty of Medicine, Dentistry & Health Sciences, Melbourne School of Population and Global Health, The University of Melbourne, 207 Bouverie St, Melbourne 3010, Australia*
[b]*Department of General Practice, Faculty of Medicine, Dentistry and Health Sciences, The University of Melbourne, 200 Berkeley Street Melbourne 3010, Australia*
[c]*The Kirby Institute, UNSW Medicine, The University of NSW, Botany St, Kensington, Sydney 2033, Australia*

Abstract

Objectives: To compare the data quality, logistics, and cost of a self-administered sexual behavior questionnaire administered either using a computer-assisted survey instrument (CASI) or by paper and pencil in a primary care clinic.

Study Design and Setting: A self-administered sexual behavior questionnaire was administered to 16–29 year olds attending general practice. Questionnaires were administered by either paper and pencil (paper) or CASI. A personal digital assistant was used to self-administer the CASI.

Results: A total of 4,491 people completed the questionnaire, with 46.9% responses via CASI and 53.2% by paper. Completion of questions was greater for CASI than for paper for sexual behavior questions: number of sexual partners [odds ratio (OR), 6.85; 95% confidence interval (CI): 3.32, 14.11] and ever having had sex with a person of the same gender (OR, 2.89; 95% CI: 1.52, 5.49). The median number of questions answered was higher for CASI than for paper (17.6 vs. 17.2; $P < 0.01$). CASI was cheaper to run at \$8.18 per questionnaire compared with \$11.83 for paper.

Conclusion: Electronic devices using CASI are a tool that can increase participants' questionnaire responses and deliver more complete data for a sexual behavior questionnaire in primary care clinics. © 2015 Elsevier Inc. All rights reserved.

Keywords: Survey design; Electronic devices; Sexual health behavior questionnaires; Paper and pencil questionnaire; CASI; Chlamydia

1. Introduction

Sexual behavior questionnaires are important in understanding how sexual risk practices change over time. Some studies have shown that the method of delivery may encourage or discourage the validity of responses of sexual behavior questions [1–3]. Traditionally, self-administered paper and pencil questionnaires (referred to from here on as paper) have been used to collect such questionnaire data. In recent years, electronic devices called computer-assisted survey instruments (CASIs) have become an alternative

way of collecting questionnaire data and can be administered using handheld computer technology such as personal digital assistants (PDAs), tablet computers, iPads, and laptop computers [4–6]. These devices have been used in diverse settings including developing countries, remote areas, schools, universities, and primary care clinics [4,7–11].

CASIs administered using PDAs or tablet computers (including iPads) are useful tools as they can streamline the questionnaire process from development to analysis. CASIs can be further split into two groups, those that rely on the Internet to administer the questionnaire and those that can be done without an Internet connection and downloaded into a database later. The questionnaire is designed on a computer using a questionnaire development program and then transferred onto the PDA or tablet computer or uploaded to a Web site application. Web-based questionnaires require an Internet connection to complete, but PDAs

What is new?

- Computer-assisted survey instruments (CASIs) can be an affordable method of obtaining good quality sexual behavior data, especially for questions of a more socially sensitive nature, in a large-scale study.

- Data completeness is greater for sexual behavior questionnaires delivered with CASIs compared with paper questionnaires.

- Using CASIs to implement a sexual behavior questionnaire can increase participants' questionnaire responses and deliver better quality data.

and some iPad applications can complete the questionnaire offline and do not require an Internet connection. Completing the questionnaire offline is an advantage when administering the questionnaire in the field where Internet connection may be unreliable.

Electronic questionnaires can increase usability for participants and accuracy of responses. This is particularly the case where a questionnaire does not require every question to be answered, and skip options are used to direct participants' responses to relevant portions of the questionnaire. This is very relevant in sexual behavior questionnaires when participants may not need to answer all questions, depending on their sexual practices. They can also be programmed with internal checks to ensure consistency with previous answers [1,4,11]. Electronic questionnaires can also deliver questions tailored to specific subgroups within a study, such as men and women, thereby removing the necessity for separate questionnaires to be designed [4,7]. Once a questionnaire is completed, the data can be transferred into a database for analysis, eliminating the need for manual data entry and minimizing the introduction of inaccuracies that can arise with multiple data-handling steps [4,11].

We undertook a large sexual behavior questionnaire of 16- to 29-year-old men and women attending primary care clinics in Australia as part of a large clinical trial [12]. We used both paper and CASIs to self-administer the questionnaire. This article aims to investigate whether the mode of delivery (self-administered CASI vs. paper) resulted in any differences in terms of completeness of the sexual behavior data obtained and to assess the logistics and costs of using CASIs or paper in the primary care setting.

2. Methods

2.1. Recruitment

Further details on recruitment are described elsewhere [13], but in brief, men and women aged 16—29 years were recruited from 134 general practice clinics in 54 rural and regional towns in four Australian states (Victoria, New South Wales, Queensland, and South Australia) as part of a large cluster randomized controlled trial of a chlamydia testing intervention in primary care clinics between May 2010 and December 2012. Participants were eligible for participation if they were attending the clinic for a consultation for their own health and had ever had vaginal or anal sex. A University of Melbourne—employed research staff member was placed in each clinic for up to 6 weeks and invited consecutive eligible patients to participate. A total of 80 University of Melbourne—employed research staff were used to conduct this study. Participants were asked to sign a consent form, complete a self-administered questionnaire using either a CASI or paper, and provide a urine specimen for chlamydia testing. Our CASI was administered on a PDA. Wherever possible, the questionnaire was completed before the participants' consultation with the general practitioner. The choice of whether the questionnaire was administered by CASIs or paper depended on the situation at the clinic or the research staffs' preference. In a number of larger clinics, it was not possible to have sufficient numbers of CASIs (most clinics had one or two PDAs only) for the number of potential participants. In these situations, paper questionnaires were used as a backup if a PDA was unavailable at the time. Factors influencing the research staff's use of paper rather than CASIs included them being uncomfortable using the technology or poor Internet or IT facilities in the rural location limiting the use of the CASIs. CASIs only were used in 34 clinics, paper only in 35 clinics, and both CASIs and paper were used in 65 clinics.

2.2. Questionnaire content

The questionnaire was divided into three sections: part A—demographic questions; part B—sexual practice questions; and part C—questions about health care access, sexual health, and some general knowledge questions about sexually transmitted infections (STIs). Part A included nine demographic questions to be answered by all participants. Part B included questions about the three most recent sexual partner of the opposite sex and the three most recent same sex partners, including frequency of sexual activity and condom use. Questions for subsequent partners were identical to the first partner questions and were not included in the analysis. Some questions in part B were skipped depending on a participant's previous answer. These questions were excluded from the analysis. Part C asked about different medical and sexual health issues, as well as general knowledge questions about sexual health issues. Any questions that relied on memory, such as name of an antibiotic or when they had a test, were excluded from the analysis.

2.3. Research staff training

A total of 40 one-day training sessions were held to train 80 research staff on patient recruitment and how to

administer the questionnaire. The training session included 30 minutes to cover administration and management of the paper questionnaire and 2 hours covering the administration and operation of the CASI (PDAs). This included using the PDA, how to transfer the data off the PDA, and how to e-mail these data to the study center. The CASI training was completed by 58 research staff members who used PDAs; the other 22 staff administered the survey by paper only and had no need for CASI training.

2.3.1. Paper questionnaire

Separate male and female questionnaires were used and given to participants before their consultation. A prepaid return address envelope was provided to participants who did not have time to complete the questionnaire at the time of their appointment. Questionnaires completed at the clinic were returned to the research staff and sent to the study center at the University of Melbourne in a tracked overnight express envelope. Participants, who completed the questionnaire away from the clinic, returned the questionnaire directly to the study center using the reply paid envelope provided. After the paper questionnaires were received, the responses were entered into a CASI (PDA) by study staff and then transferred to a computer database for analysis. Costs associated with using the paper survey were formatting of the survey by a graphic designer, printing costs, postage costs (which included costs for the research staff to return completed questionnaires to the study center), reply paid postage costs (for when the participant returned the questionnaire to the study center), and staff costs for data entry.

2.3.2. CASI (PDA)–based questionnaire

HP IPAQ 112 PDAs (Hewlett-Packard, Palo Alto, CA, USA) were used to conduct the survey using the Questionnaire Development Studio (NOVA Research Company, Bethesda, MD, USA) suite of programs. Research staff showed participants how to use the CASI and then left the participant to answer the questionnaire on their own. Participants could respond to questions via text fields or by selecting the correct answer from multiple choices. Participants were required to address every question; however, they could choose to refuse to answer a question and move to the next question by selecting the "refuse to answer" option. CASI questionnaires were commenced in the clinic before a participant's consultation and completed at that time or resumed after the consultation. To minimize any data loss, research staff were required to download all CASI completed questionnaires onto a computer at the end of each day and e-mail the files to the study center at the University of Melbourne. This required access to an Internet connection. Costs associated with using the CASI were the PDA itself, the PDA program, staff costs for writing the program, and the time taken to train the staff.

2.4. Data analysis

StataIC 12 statistical software package (StataCorp, TX, USA) was used to analyze the questionnaire results. Questions were recorded as "answered" if the participant provided an answer or responded "Don't know." Questions were recorded as unanswered on the CASI if the participant responded "refuse to answer" or "not applicable." Questions were recorded as unanswered on the paper questionnaires if there was no response. To investigate any selection bias, the demographic characteristics of those completing CASIs or paper questionnaires were compared using a chi-squared test. The mean and median were calculated for specific sexual behavior variables and compared using linear regression. Logistic regression was used to investigate any differences in questionnaire response by method of administration, accounting for any potential intracluster correlation within town. Because it was not possible to randomly allocate the choice of paper vs. CASIs and the choice depended on the research staff member and the clinic, our logistic regression adjusted for any differences in demographic characteristics between the two groups. To compare questionnaire completeness, the number of questions answered was compared between the two groups using a Wilcoxon rank sum (Mann–Whitney). Overall completion of the questionnaire was also assessed by comparing the number of participants who answered the first and last question. CASI questionnaires were classified as incomplete if a survey was exited before completing the final question.

3. Results

3.1. Demographic characteristics

A total of 4,491 agreed to participate in the study with a response rate of 74%; 2,104 (46.9%) undertook the questionnaire via the CASI (PDAs) and 2,387 (53.2%) using paper questionnaires. There were significant demographic differences between the CASI and paper participants (Table 1). Differences were found in gender, age, Australian born, English as their first language, and Aboriginal or Torres Strait Islander status (Table 1).

3.2. Sexual practices

Multivariate analysis showed that those completing the questionnaire on CASI were more likely to answer questions about the number of sexual partners [odds ratio (OR), 6.9; 95% confidence interval (CI): 3.3, 14.1], the number of new sexual partners in the last 12 months (OR, 2.7; 95% CI: 2.2, 3.5), the number of times they had sex (OR, 6.1; 95% CI: 3.4, 11.0), the month when they last had sex (OR, 1.4; 95% CI: 1.1, 1.8), when they first had sex with their most recent partner (OR, 1.5; 95% CI: 1.2, 1.8), and whether they have ever had sex with a person of the same sex (OR, 2.9; 95% CI: 1.5, 5.5; Table 2). There

Table 1. Demographic characteristics of study participants by method of questionnaire administration

Variable	CASI, n (%)	Paper, n (%)	Chi-square P-value[a]
Gender			
Male	657 (31.2)	678 (28.4)	
Female	1,447 (68.8)	1,709 (71.6)	*
Age group (yr)			
16–20	658 (31.3)	822 (34.4)	
21–25	862 (41.0)	887 (37.2)	
26–30	584 (27.7)	678 (28.4)	*
Australian born			
Yes	1,897 (90.2)	2,283 (96.0)	
No	205 (9.8)	95 (4.0)	**
English as a first language			
Yes	2,025 (96.3)	2,351 (98.9)	
No	77 (3.7)	35 (1.1)	**
Aboriginal or Torres Strait Islander			
No	2,023 (96.4)	2,163 (92.1)	
Yes	75 (3.6)	185 (7.9)	**

Abbreviation: CASI, computer-assisted survey instrument.
[a] *P*-values: $P > 0.05$ (NS), $P < 0.05$ (*), and $P < 0.01$ (**).

were no differences in the likelihood of responses to questions about still being in a relationship with the most recent sexual partner or condom use at last encounter. There were no differences when analyzing by sex or age.

3.3. STI knowledge questions

Multivariate analysis found that those completing the questionnaire on CASIs were more likely to answer the STI knowledge questions as true or false (OR, 1.42; 95% CI: 1.17, 1.74)

than don't know (Table 3). Multivariate analysis also found that STI knowledge questions answered on the CASI were more likely to be answered than coded as "refused," or "not applicable" (OR, 2.3; 95% CI: 1.3, 4.3) (Table 3). There were no differences when analyzing by sex or age.

3.4. Overall questionnaire completeness

The median number of questions answered was higher for CASI than for paper questionnaires (17.6 vs. 17.2, $P < 0.01$). Overall, 34 people (1.6%, 95% CI: 1.1%, 2.2%) did not answer the final question on CASI compared with 89 people on paper (3.7%, 95% CI: 3.0%, 4.5%; $P < 0.01$).

3.5. Comparison of sexual behavior data

There was no difference in number of life sexual partners reported by CASIs vs. paper ($P = 0.161$) when adjusted for age and gender of participants, but those completing using the CASI reported a greater number of sexual partners in the last 12 months ($P = 0.002$). There were no differences in condom use ($P = 0.139$) or reporting ever had sex with a person of the same sex ($P = 0.364$) between CASI and paper (Table 4).

3.6. Cost and logistics of administration

A comparison of the costing of the CASIs and paper questionnaires showed that for a study of this size, the cost of a single questionnaire was approximately $8.18 using the

Table 2. Sexual behavior questions comparing data completeness from each questionnaire tool (adjusted for postcode clusters)

Variable	CASI, n (%)	Paper, n (%)	Unadjusted OR (95% CI)	P-value[a]	Adjusted OR (95% CI)[b]	P-value[a]
How many partners have you had?						
Unanswered	20 (1.0)	121 (5.3)	1.00		1.00	
Answered	2,084 (99.0)	2,266 (94.7)	5.56 (2.95–10.50)	**	6.85 (3.32–14.11)	**
How many were new partners in the last 12 mo?						
Unanswered	151 (7.2)	413 (17.4)	1.00		1.00	
Answered	1,942 (92.8)	1,957 (82.6)	2.71 (2.10–3.51)	**	2.74 (2.16–3.48)	**
How many times did you have vaginal sex?						
Unanswered	10 (0.5)	68 (3.0)	1.00		1.00	
Answered	1,864 (99.5)	2,179 (97.0)	5.82 (3.16–10.72)	**	6.12 (3.40–11.01)	**
Which month was the last time you had sex?						
Unanswered	122 (5.2)	185 (7.8)	1.00		1.00	
Answered	1,968 (94.2)	2,182 (92.2)	1.37 (1.07–1.75)	*	1.40 (1.10–1.77)	**
When was the first time you had sex with this partner?						
Unanswered	116 (5.5)	186 (7.9)	1.00		1.00	
Answered	1,974 (94.5)	2,178 (92.1)	1.45 (1.14–1.85)	**	1.46 (1.17–1.84)	**
Are you still in a sexual relationship with this person?						
Unanswered	117 (5.6)	152 (6.4)	1.00		1.00	
Answered	1,972 (94.4)	2,212 (93.6)	1.16 (0.91–1.47)	NS	1.19 (0.95–1.49)	NS
Did you use a condom last time you had sex?						
Unanswered	119 (5.7)	143 (6.1)	1.00		1.00	
Answered	1,969 (94.3)	2,218 (93.9)	1.07 (0.83–1.36)	NS	1.11 (0.88–1.39)	NS
Have you had sex with a person of the same sex?						
Unanswered	20 (1.0)	63 (2.7)	1.00		1.00	
Answered	2,065 (99.0)	2,286 (97.3)	2.85 (1.50–5.41)	**	2.89 (1.52–5.49)	**

Abbreviations: CASI, computer-assisted survey instrument; OR, odds ratio; CI, confidence interval, NS, not significant.
[a] *P*-values: $P > 0.05$ (NS), $P < 0.05$ (*), $P < 0.01$ (**).
[b] Adjusted for age, gender, Australian born, English as a first language, and Aboriginal or Torres Strait Islander status.

Table 3. General knowledge questions comparing data completeness from each questionnaire tool (adjusted for postcode clusters)

Variable	CASI, *n* (%)	Paper, *n* (%)	Unadjusted OR (95% CI)	*P*-value[a]	Adjusted OR (95% CI)[b]	*P*-value[a]
You can be tested for all STDs with just a blood test (answer: false)						
True	799 (38.6)	643 (27.9)	1.00			
False	1,234 (59.6)	988 (42.9)	1.01 (0.82–1.22)	NS	1.02 (0.84–1.25)	NS
Don't know	37 (1.8)	672 (29.2)	0.04 (0.03–0.08)	**	0.04 (0.03–0.07)	**
Unanswered	34 (1.6)	84 (3.5)	1.00		1.00	
Answered	2,070 (98.4)	2,303 (96.5)	2.22 (1.14–4.33)	*	2.31 (1.25–4.28)	**
About 5% of men and women aged under 25 years are infected with chlamydia (answer: true)						
True	1,596 (77.1)	1,120 (48.7)	1.00			
False	373 (18.0)	186 (8.1)	1.41 (1.16–1.71)	**	1.42 (1.17–1.74)	**
Don't know	101 (4.9)	992 (43.2)	0.07 (0.04–0.11)	**	0.07 (0.04–0.10)	**
Unanswered	34 (1.6)	89 (3.7)	1.00		1.00	
Answered	2,070 (98.4)	2,298 (96.3)	2.36 (1.20–4.62)	*	2.46 (1.32–4.56)	**

Abbreviations: CASI, computer-assisted survey instrument; OR, odds ratio; CI, confidence interval, NS, not significant.
[a] *P*-values: $P > 0.05$ (NS), $P < 0.05$ (*), and $P < 0.01$ (**).
[b] Adjusted for age, gender, Australian born, English as a first language, and Aboriginal or Torres Strait Islander status.

CASI- and $11.83 for paper (Table 5). The numbers of hours training staff were approximately 2.5 times longer to train for the CASI compared with the paper. A high cost was associated with data entry of the paper surveys with nearly half of the paper costs being attributable to data entry (Table 1).

4. Discussion

We compared responses between CASI and paper questionnaires and found that participants were more likely to

answer questions about sexual behavior, less likely to have missing data, more likely to finish the questionnaire, and more likely to answer STI knowledge questions when using CASI compared with paper questionnaires. We also found that the cost per questionnaire completed was considerably lower for CASI.

Participants responding via CASI were more likely to answer questions on their current sexual behavior than by those responding on paper. There were fewer differences in responses between the two modes of delivery for

Table 4. Comparison of sexual behavior data between paper and CASI, by gender

Variable	CASI			Paper			Unadjusted *P*-value comparing overall value between CASI and paper[a]	Adjusted *P*-value comparing overall value between CASI and paper[a]
	Overall	**Male**	**Female**	**Overall**	**Male**	**Female**		
Median number (range of life partners), mean	5 (1–900), 9.2	6 (1–900), 13.3	4 (1–106), 7.4	5 (1–300), 7.6	6 (1–300), 11.2	4 (1–100), 6.2	*[b]	NS[c]
Median number (range of partners last 12 mo), mean	1 (1–800), 2.4	1 (1–800), 4.1	1 (1–30), 1.7	1 (1–30), 1.8	1 (1–30), 2.3	1 (1–15), 1.5	**[b]	**[c]
Number who used condoms last time they had sex (%)								
No	1,335 (63.9)	359 (55.2)	976 (67.9)	1,564 (66.2)	394 (59.8)	1,170 (68.7)	NS[d]	NS[e]
Yes	633 (30.3)	237 (36.4)	396 (27.6)	654 (27.7)	211 (32.0)	443 (26.0)		
Number who has ever had sex with a person of the same sex (%)								
No	1,934 (91.9)	624 (95.0)	1,310 (90.5)	2,212 (92.7)	661 (97.5)	1,551 (90.8)	NS[d]	NS[e]
Yes	170 (8.1)	33 (5.0)	137 (9.5)	175 (7.3)	17 (2.5)	158 (9.3)		

Abbreviations: CASI, computer-assisted survey instrument; NS, not significant.
[a] *P*-values: $P > 0.05$ (NS), $P < 0.05$ (*), and $P < 0.01$ (**).
[b] Data highly skewed, log-transformed. *P*-value calculated using linear regression accounting for intracluster correlation within clinics.
[c] Data highly skewed, log-transformed. *P*-value calculated using linear regression, adjusting for age and gender of participants and accounting for intracluster correlation within clinics.
[d] *P*-value calculated using unadjusted logistic regression accounting for intracluster correlation within clinics.
[e] *P*-value calculated using logistic regression adjusted for age and gender of participants and accounting for intracluster correlation within clinics.

Table 5. Logistic and pricing difference between CASI and paper questionnaire

CASI	Costs (estimate)	Paper	Costs (estimate)
PDA devices—new (6 units)	$1,920	Design	$500
PDA devices—second hand (14 units)	$1,750	Printing	$5,000
Program	$6,800	Prepaid envelopes	$5,500
Staff programming costs	$1,000	Return address envelopes	$500
		Staff data entry costs	$15,000
Training	$5,732	Training	$1,730
Total	$17,202	Total	$28,230
Cost per survey	$8.18	Cost per survey	$11.83
Logistics			**Logistics**
Staff training	Yes	Staff training	No
Computer necessary	Yes	Computer necessary	No
Internet necessary	Yes	Internet necessary	No
Loss of data	Yes	Loss of data	No
Loss of mail	No	Loss of mail	Yes
User error	Yes	User error	Yes

Abbreviations: CASI, computer-assisted survey instrument; PDA, personal digital assistant.

questions on matters that could be perceived to be associated with positive outcomes, such as condom usage. Sexual behavior questionnaires can be difficult to administer because of the potentially embarrassing and intimate nature of the questions asked. Providing a discrete way for individuals to answer and respond to questions may allow participants to answer the questionnaire more thoroughly [1]. CASIs have been perceived by participants as being more private as responses disappear from the screen once a question has been answered and skip patterns cannot be observed by others [1,2]. Studies have found that young adults may judge other participant's level of sexual activity based on the time taken to complete the questionnaire, so participants may falsely report sexual behavior to make it seem that they are either more sexually active than they are (by taking a longer time to fill out the questionnaire) or are not sexually active (by skipping questions to finish faster) [1].

We found that the CASI had either the same or better response rate and fewer errors (eg, failing to answer question) than paper questionnaires leading to superior data quality with CASIs. CASIs required that participants were forced to submit a response before moving on to the next question, and although there was the ability to select the response "refuse to answer" on the CASI, most participants did not choose to do this to move through the questionnaire, therefore reducing the number of missed questions. The CASI also made it easier for a participant to follow the sequence of questions, as the CASIs were programmed to move on to the next relevant question by automatically skipping questions [14]. This is consistent with others' experiences with a systematic review finding that electronic questionnaires decrease missing data and errors in participant response [2,3].

To investigate social desirability bias, we examined the number of partners reported by participants, their condom usage, and sexual contact with the same sex partners. We found that those completing the CASI were more likely to report a greater number of sexual partners in the last 12 months on average compared with those completing paper questionnaires, but no other differences were observed. It is unclear whether this means that CASI users were being more honest with their answers, but it is consistent with other studies that have found that a greater number of sexual partners is reported using self-administered computer questionnaires rather than face-to-face interviews or paper-based questionnaires [2].

One of the perceived drawbacks of using CASI or hand-held computers in the field is the associated cost of the initial setup. The scale of this study of more than 4,000 participants reduced the overall cost of delivering the questionnaires by CASI by nearly a third of the cost of the paper questionnaires. An added benefit of the CASIs is that any follow-up questionnaire could use the same CASIs, thereby further reducing the cost per questionnaire [11].

Training the research staff to use the CASI was time consuming, and ongoing telephone technical support was needed for the staff when using the devices in the field, particularly with downloading the data onto a computer. Some staff were concerned about losing the data when downloading to a computer and e-mailing it to the study center, and they preferred the simpler option of paper. Either selecting research staff comfortable with technology or expanding our staff training would overcome this issue. Others have experienced similar logistical issues with the PDAs used by research staff out in the field, with staff finding transferring the data from PDA to computer to be the biggest challenge [9]. Most of our study was in rural areas, which also added to the logistical issues of using CASIs. Our research staff had poor Internet coverage and minimal IT support out in the field, but these could be overcome by improved staff training and provision of laptops with Internet dongles. There were rare occasions where a technical error on a CASI resulted in the loss of all questionnaires completed on that device over the course of the day, but an inbuilt backup system prevented substantial loss of data (total CASI questionnaires lost because of error:

$n = 7$). The number of questionnaires lost was approximately the same as for those administered by paper lost in the mail. Nevertheless, it is important to note that this technology has been successfully used in developing countries and following the protocols set up in these other studies may overcome some of the issues we encountered [7,11].

There are some limitations that need to be considered when interpreting these results; first, the method for administering the questionnaire was not randomized. Instead, the choice of using the CASI or paper was dependent on the research staff and the clinic situation, and we have not considered the participant's preferences at all. To account for this issue, the demographic characteristics of the sample were adjusted for in the analysis, and intracluster correlation was accounted for at the town level to adjust for any issues at the town level such as poor Internet coverage. Second, the accuracy of the participants' responses is not known. Questionnaires on sexual behavior completed in a group on paper or as a face-to-face interview have been shown to be less accurate than a computer-assisted questionnaire [1,2]. We did find that the median number of partners in the last 12 months was the same between the two groups (6.0 for PDAs and 6.0 for paper; $P < 0.01$). We did consider also examining the association between condom use at the last sex and chlamydia positivity as a biomarker for accuracy of sexual behavior reporting in our study, but as chlamydia can be of up to 4-year duration, condom use at last sexual encounter may not be a reliable biomarker [15]. Although our study shows that respondents are more likely to answer questions using CASIs, it remains unclear whether the data are any more accurate than those collected using paper. Finally, the timing of when the survey was administered (before or after a consultation) and where the survey was administered (at home, clinic, or elsewhere) is unknown as these data were not recorded. This may have introduced bias; however, we do know that about 95% of surveys were administered before a consultation, as participants were very difficult to get after a consult.

Improvements in technology will increasingly allow for different methods of administering research questionnaires, and the widespread use of smartphones will facilitate this [6,16,17]. Questionnaires can be accessed and completed via a mobile Web page, which would be saved on a secure server before being transferred to the study database. The benefits of this system include removing the need to download the completed questionnaire data to a computer, the ability to administer multiple questionnaires at the same time, and the flexibility for patients to finish the questionnaire at home. It would also reduce the need for complex training of staff as participants are likely to already be familiar with filling out forms on their own smartphone. For those that do not have a smartphone, the questionnaire could still be delivered via a tablet computer or PDA/paper.

In summary, administering questionnaires to a large population in primary care clinics costs less per questionnaire completed and results in fewer missing data when administered by an electronic device. Although they are more complex to run and maintain and the initial start-up costs can be expensive, the ability to use a participant's own smartphone via a mobile Web site in conjunction with the CASI will allow more flexibility in administering these questionnaires in the future.

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