



# Self-collected vaginal swabs for HPV screening: An exploratory study of rural Black Mississippi women

Richard A. Crosby<sup>a,\*</sup>, Michael E. Hagensee<sup>b</sup>, Rebecca Fisher<sup>b</sup>, Lindsay R. Stradtman<sup>a</sup>, Tom Collins<sup>a</sup>

<sup>a</sup> Department of Health, Behavior & Society, College of Public Health, University of Kentucky, Lexington, KY, USA

<sup>b</sup> Department of Microbiology, Immunology & Parasitology, School of Medicine, Louisiana State University Health Sciences Center, New Orleans, LA, USA

## ARTICLE INFO

### Article history:

Received 15 August 2016

Received in revised form 12 December 2016

Accepted 17 December 2016

Available online 23 December 2016

### Keywords:

Cervical cancer screening

HPV testing

Self-collection

Rural

## ABSTRACT

**Objectives.** To determine the post-procedure acceptability of self-collecting a vaginal swab for HPV testing among a highly impoverished and geographically isolated population of medically underserved Black women residing in the Mississippi Delta. Further, to test correlates of reporting that self-collection is preferred over Pap testing. Finally, to determine the prevalence of any of 13 high-risk HPV types among this population and the correlates of testing positive.

**Methods.** Eighty-eight women were recruited from two churches located in different towns of the Mississippi Delta. After completing a survey, women were provided instructions for self-collecting a cervico-vaginal swab and completing a post-collection survey. Specimens were tested for 13 oncogenic HPV types. Due to the exploratory nature of the study, significance was defined by a 0.15 alpha-level.

**Results.** Comfort levels with self-collection were high: 78.4% indicated a preference for self-collecting a specimen compared to Pap testing. Overall, 24 women (28.7%) tested positive for one or more of the 13 HPV types. Significant associations with testing positive were found for women having sex with females ( $P = 0.09$ ), those never having an abnormal Pap ( $P = 0.06$ ), younger women ( $P = 0.10$ ), those with greater fatalism scores ( $P = 0.006$ ), and those having less trust in doctors ( $P = 0.001$ ).

**Conclusions.** Black rural women from the deep-south are generally comfortable self-collecting cervico-vaginal swabs for HPV testing. Given that nearly 30% tested positive for oncogenic HPV, and that fatalism as well as a lack of trust in doctors predicted prevalence, a reasonable screening alternative to Pap testing may be community-based testing for HPV using self-collected vaginal swabs.

© 2017 The Authors. Published by Elsevier Inc. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

## 1. Introduction

Cervical cancer mortality is largely preventable if women and providers follow Pap-testing guidelines (Centers for Disease Control and Prevention and Department of Health and Human Services). The recently approved the Cobas® Human Papillomavirus (HPV) Test (to detect HPV types 16 and 18 and 12 other high-risk types) represents an additional screening method (Simon and American Cancer Society, 2014). These tests can be performed on vaginal swabs and evidence suggests that self-collection is easy to perform, provides privacy, and is less embarrassing and more comfortable than physician-collected samples (Igidbashian et al., 2011; Schmeink et al., 2011; Barbee et al., 2010; Arriba et al., 2010; Huynh et al., 2010; Anhang et al., 2005; Dzuba et al., 2002; Vanderpool et al., 2014).

The ability for women to self-collect vaginal swabs in a community setting raises the question of whether cervical cancer screening

programs could transcend clinic boundaries. This may be useful in medically underserved areas, including rural counties isolated from services. However, taboos on genital self-touching and collecting vaginal swabs in public places may preclude this type of screening. This study sought to determine the post-procedure acceptability of self-collecting a vaginal swab for HPV testing among a highly impoverished and geographically isolated population of medically underserved Black women residing in the Mississippi Delta. The intent was to test this non-clinical method of screening among women who had not been recently screened. Further, the study tested possible correlates of reporting that self-collection is preferred over Pap testing. Also the study determined the prevalence of high-risk HPV types and the correlates of testing positive.

## 2. Methods

### 2.1. Study sample

Two churches located in different towns of the Mississippi Delta served as recruitment sites. Two female research assistants obtained

\* Corresponding author at: College of Public Health, 111 Washington Ave., Lexington, KY 40506-0003, USA.

E-mail address: [crosbyr3@gmail.com](mailto:crosbyr3@gmail.com) (R.A. Crosby).

permission and support from church ministers to recruit women after Sunday services. As opposed to the research assistants approaching women, women were told to find and talk with the research assistant after services to learn about the study. Because print information had been circulated relative to the study inclusion criteria, all women who presented themselves to the research assistant were eligible. In the course of five Sunday afternoon sessions (both churches combined) 88 women meeting the eligibility requirements volunteered and were enrolled. We limited the recruitment to five Sundays based on a need not to overstay our welcome at these churches.

Eligibility criteria were: 1) being 30–65 years old, 2) not having a Pap test in the past three years, 3) not currently pregnant, 4) never testing HPV-positive, and 5) sexual activity in the past 12 months. This final criterion was included based on evidence that the median time to HPV clearance in women is approximately 10 months (Winer et al., 2010). Also, regarding the criterion of never testing HPV-positive, we were content with reliance on women's self-report of this for two reasons: 1) HPV testing is a rare occurrence in the MS Delta and 2) asking permission to access women's medical records for this information would have led to a strong possibility of sample bias. Collectively, these criteria provided a sample of women at-risk of HPV infections that may have persisted to the point of undiagnosed cervical dysplasia or invasive cancer. The second criterion provided a sample of women who otherwise would be considered non-compliant with public health screening guidelines for cervical cancer. The third and fourth criteria were included to help ensure a relatively naïve sample regarding current medical care and past HPV. Recruitment occurred from March through June of 2015.

## 2.2. Procedures

All study procedures were approved by the Office of Research Integrity at the sponsoring university. Women were informed that the study involves four sequential tasks: 1) providing written informed consent, 2) answering questions in a short survey, 3) self-collecting a vaginal specimen, and 4) completing a brief post-collection survey. Thus, women began by completing a paper-and-pencil survey instrument prior to receiving instructions for specimen collection. Survey questions collected demographic and health information, as well as beliefs about sexual health and HPV. Next, research assistant read aloud a specimen collection instruction sheet, before providing a hard copy. Women took the instructions into church restrooms. The instructions included an illustration showing the insertion of the swab into the vagina and the rotating motion of the swab to collect an adequate specimen. After self-collecting, women then swirled the collection brush 40 times in a specimen vial containing Preservcvt®, a fixing solution. They then sealed the specimen vial, placed it in a pre-labeled bag, and returned the sealed bag. Last, women completed a post-survey regarding their self-collection experience. Women received \$20 to compensate their time. Samples were stored in a temperature-controlled environment (30 °F or –1 °C) until they were shipped on dry ice to the participating university laboratory.

## 2.3. Pre-collection measures

These measures included basic demographic variables and various measures such as women's history of Pap testing, ever having HPV or other sexually transmissible infections, whether friends or family members were diagnosed with cervical cancer, and the number of male sex partners (past 12 months). Two scale measures were included. A 6-item scale assessed fatalism relative to cervical cancer (obtained Cronbach's alpha = 0.80). A sample item from that scale is, "Getting cervical cancer is beyond my control."

Also, a 5-item scale assessed trust in doctors (obtained Cronbach's alpha = 0.82). A sample item from that scale is, "I trust doctors' judgment about my medical care."

## 2.4. Post-collection acceptability measures

After women self-collected the vaginal swabs, they were asked five questions via paper-and-pencil survey (response options were "yes" and "no" unless otherwise specified): 1) Did you feel that you understood the directions for collecting the specimen?; 2) On a 5-point scale with 5 being "comfortable" to 4 being "somewhat comfortable," to 3 being "slightly comfortable" to 2 being "neither comfortable nor uncomfortable," to 1 being "uncomfortable"; 3) Did you experience any pain during the collection process?; 4) Did you experience any bleeding during the collection process, and 5) Would you be more likely to do this test on a regular basis compared to having a regularly scheduled Pap test?

## 2.5. Laboratory analysis

HPV was detected by Polymerase Chain Reaction analysis. Cellular DNA was extracted from the swabs using a Qiagen DNA extraction kit. The DNA was extracted from BSC cells as an extraction control with every 20 samples (Chaturvedi et al., 2005). HPV DNA was amplified and genotyped using the Roche reverse line blot system (Chaturvedi et al., 2005; Gravitt et al., 1998). This assay used the extended-spectrum and biotin-labeled L1 consensus (PGMY09/11, amplicon 450 bp) and biotin-labeled  $\beta$ -globin primers (PC04, GH20, amplicon 250 bp). Samples demonstrating the 450 bp L1 amplicon were genotyped using the 37 types contained on the reverse line blot: the 13 high-risk HPV types were 16, 18, 31, 33, 35, 39, 45, 51, 52, 56, 58, 59, and 68. Any bands more intense than the low  $\beta$ -globin band intensity were scored as positive.

## 2.6. Data analysis

To identify correlates of indicating that self-collection is preferred over Pap testing bivariate tests of association (chi-squared tests or independent groups *t*-tests) were conducted. To identify correlates of testing positive for HPV bivariate tests of association were applied to nine single-item measures and the two scale measures. Because of the exploratory nature of this study, a less conservative standard was used to define significance ( $P < 0.15$ ) and effect size estimates were calculated for dichotomous outcomes (using the risk ratio) and continuous outcomes (using the percent relative difference).

## 3. Results

Average age of the sample was 46.5 years (standard deviation = 9.0 years). All women identified as non-Hispanic Black. A monthly household monthly income of less than \$2000 was reported by 40.9%, with 28.4% reporting incomes between \$2000 and \$3000, and 30.7% reporting incomes above \$4000. Just over one-half of the sample (55.7%) indicated not having children who lived with them, 22.7% reported having one child living with them, and the remainder had two or more living with them. Less than one-half (44.3%) were married at study enrollment.

### 3.1. Acceptance of the self-collection process

Only one woman of the 88 enrolled, reported she did not understand the directions for self-collecting the specimen. When asked "how comfortable were you with collecting the specimen," 35.2% selected the option of "comfortable," 19.3% selected "somewhat comfortable," 22.7% selected "slightly comfortable," 13.0% selected "neither comfortable nor uncomfortable," and 8.0% selected "uncomfortable." Seventeen percent reported experiencing some pain during the collection process, and 12.5% reported bleeding during the collection process. A majority (78.4%) reported they would be more likely to do this test on a regular basis compared to having Pap tests.

**Table 1**  
Dichotomous bivariate associations of reporting that self-collection is preferred over Pap testing (N = 88).

Variable	n(%) preferring self-collection	RR <sup>a</sup>	P
Some pain during self-collection <sup>b</sup>			
No (n = 72)	59 (81.9)		
Yes (n = 15)	10 (66.7)	0.81	0.18
Some blood during self-collection <sup>b</sup>			
No (n = 76)	58 (76.3)		
Yes (n = 11)	10 (90.9)	1.19	0.27
Friend/family members diagnosed w/ cervical cancer <sup>b</sup>			
No (n = 69)	52 (75.4)		
Yes (n = 18)	16 (88.9)	1.18	0.22
Ever had an abnormal Pap test result			
No (n = 65)	51 (78.5)		
Yes (n = 23)	18 (78.3)	0.99	0.98
Ever had a Pap test <sup>b</sup>			
No (n = 23)	18 (78.3)		
Yes (n = 64)	50 (78.1)	0.99	0.87
Ever diagnosed with a sexually transmitted infection <sup>c</sup>			
No (n = 61)	48 (78.7)		
Yes (n = 25)	19 (76.0)	0.96	0.78
Likelihood of having next scheduled Pap test <sup>b</sup>			
Not likely (n = 20)	17 (85.0)		
Likely (n = 67)	50 (76.1)	0.89	0.40
More than one male sex partner, past 12 months			
No (n = 75)	61 (81.3)		
Yes (n = 13)	8 (61.5)	0.76	0.11*
"I would feel dirty if a doctor examined me for HPV"			
Disagree (n = 70)	74 (77.1)		
Agree (n = 18)	15 (83.3)	1.08	0.57

<sup>a</sup> Risk ratio.<sup>b</sup> Data from one woman was missing from this variable.<sup>c</sup> Data from two women were missing from this variable.

\* Significant based on the exploratory level of 0.15.

### 3.2. Correlates of reporting that self-collection is preferred

Table 1 displays associations between 9 dichotomously assessed variables and whether women indicated that self-collection is preferable over Pap testing. As shown, of the 9 variables tested only one (i.e., having multiple male partners) was significant using the exploratory alpha of 0.15. Additionally, 6 variables assessed at the continuous level were tested (Table 2). As shown, two measures met the exploratory level of significance. First, women expressing a preference for self-collection had a higher mean score on the post-collection measure of comfort during the self-collection process. Second, the scale measure of trust in medical doctors produced means differing significantly between women not expressing a preference for self-collection and those expressing this preference.

Both Tables 1 and 2 additionally display the obtained effect sizes.

**Table 2**  
Continuous bivariate associations of reporting that self-collection (SC) is preferred over Pap testing (N = 88).

Correlate	Women not preferring SC (19)	Women preferring SC (69)	t	PRD <sup>a</sup>	P
Mean age (years)	45.1	46.8	0.74	3.77	0.46
Level of agreement <sup>b</sup>					
"Pap test is a hassle" <sup>b</sup>	5.79	5.42	0.49	6.39	0.62
"Past test too expensive"	6.31	6.18	0.66	2.06	0.51
Level of comfort in SC <sup>c</sup>	2.21	2.72	1.51	23.07	0.14*
Level of fatalism <sup>d</sup>	9.89	10.27	0.24	3.84	0.81
Level of trust in doctors <sup>e</sup>	17.36	15.36	2.05	11.52	0.046*

<sup>a</sup> Percent relative difference.<sup>b</sup> Assessed on visual analogue scale ranging from 1 ("agree") to 9 ("disagree").<sup>c</sup> Assessed on scale ranging from 0 ("uncomfortable") to 4 ("comfortable").<sup>d</sup> Assessed with a 6-item scale with scores ranging from 0 (no fatalism) to 24 (high fatalism).<sup>e</sup> Assessed with a 5-item scale with scores ranging from 1 (no trust) to 25 (complete trust).

\* Significant based on the exploratory level of 0.15.

**Table 3**  
Dichotomous bivariate associations of testing HPV positive (N = 88).

Variable	% testing positive	RR <sup>1</sup>	P
Married			
No (n = 46)	28.3		
Yes (n = 39)	28.2	0.99	0.82
Income < \$2000 per month			
No (n = 50)	28.0		
Yes (n = 36)	27.8	0.99	0.98
More than one male sex partner, past 12 months			
No (n = 74)	27.0		
Yes (n = 12)	33.3	1.23	0.65
Sex with females, past 12 months			
No (n = 80)	25.0		
Yes (n = 5)	60.0	2.40	0.09*
Ever had an abnormal Pap test result			
No (n = 63)	33.0		
Yes (n = 23)	13.0	0.39	0.06*
Ever diagnosed with a sexually transmitted infection			
No (n = 59)	23.7		
Yes (n = 25)	36.0	1.52	0.25
"I would feel dirty if a doctor examined me for HPV"			
Disagree (n = 69)	24.6		
Agree (n = 17)	41.2	1.67	0.17
Penile-vaginal sex, past 12 months			
No (23)	17.4		
Yes (62)	31.7	1.82	0.19

\* Significant based on the exploratory level of 0.15.

### 3.3. Prevalence and correlates of testing positive for HPV

Overall, 24 women (28.7%) tested positive for one or more of the 13 HPV types. Thirteen of these tested positive for one type, 5 tested positive for two types, 4 tested positive for three types, and 2 tested positive for four types.

Table 3 displays associations between 8 dichotomously assessed variables and testing positive for HPV. As shown, 2 of the 8 associations were significant at the exploratory level, i.e., sex with females in the past 12 months (risk ratio = 2.40) and ever having an abnormal Pap test result (risk ratio = 0.39).

Table 4 displays associations between 3 continuously assessed variables and testing positive for HPV. As shown, age was also significantly associated with testing positive for HPV. Women testing HPV positive were younger compared to those testing negative for HPV. Also, both scale measures were significantly associated with testing positive for HPV. The mean score on the measure of fatalism was 13.0 among those testing positive compared with 9.05 among those testing negative. The range on this measure was 0 to 24, with higher scores representing greater level of fatalism, thus the observed difference of ~4.0 represents a substantially greater level of fatalism in those testing positive. The percent relative difference for this measure of fatalism was large (43.64). The mean score on the measure of trust in doctors

**Table 4**  
Bivariate associations between variables assessed at the continuous level and testing HPV positive (N = 86).

Variable	Mean of those HPV +	Mean of those HPV –	t-Value <sup>a</sup>	PRD <sup>b</sup>	P-value
Age	43.9 years	47.4 years	1.66	7.38	0.10
Fatalism <sup>c</sup>	13.0	9.05	2.80	43.64	0.006*
Trust in doctors <sup>d</sup>	12.7	17.1	3.64	25.73	0.001*

<sup>a</sup> Each independent groups *t*-test had 84 degrees of freedom.

<sup>b</sup> Percent relative difference.

<sup>c</sup> Assessed with a 6-item scale with scores ranging from 0 (no fatalism) to 24 (high fatalism).

<sup>d</sup> Assessed with a 5-item scale with scores ranging from 1 (no trust) to 25 (complete trust).

\* Significant at the exploratory level of 0.15.

(range 1 to 25, with higher scores representing greater levels of trust) was 12.75 among those testing positive compared with 17.11 among those testing negative. The percent relative difference for this variable was also large (25.73).

#### 4. Discussion

Because the consent process included the point that women would be asked to self-collect a cervico-vaginal swab, the study was not designed to describe or quantify the refusal to self-collect. Instead, the study was designed to determine women's acceptance of the self-collection procedure after they had performed it. That more than three-quarters of the sample indicated, in the post-collection survey, they preferred this method of cervical cancer screening to Pap testing is an important finding and one that is consistent with similar research with populations of urban women (Igidbashian et al., 2011; Schmeink et al., 2011; Barbee et al., 2010; Arriba et al., 2010; Huynh et al., 2010; Anhang et al., 2005; Dzuba et al., 2002; Vanderpool et al., 2014). Finding that the 17% reporting some pain during self-collection were less likely to express this preference was not surprising, but it does suggest that practice-based programs using self-collection should provide instructions to women such that any pain in self-collection is minimal. As found in this study, comfort in self-collecting is a strong correlate of preferring this method of screening (the percent relative difference for this association was 23.07). Further, it is noteworthy that the percent relative difference in mean scores for the scale measure of trust in doctors was 11.5, indicating that women lacking this trust are potentially more likely to prefer self-collection over Pap testing. That women with recent multiple male sex partners were less likely to express this preference may be a consequence of their greater presumed risk and thus their sense of a need for added protection may compel them to traditional care. Of note, neither age nor the measure of fatalism was associated with preferring this method of screening.

The observed prevalence of oncogenic HPV approached 30%. Although the majority of these infections are unlikely to ever progress to cervical dysplasia and cervical cancer, the relatively high rate suggests the utility of screening women, in this population, for HPV who have not had a Pap test within the past 3 years (a study inclusion criterion). The ubiquitous nature of HPV makes it difficult to identify markers of likely infection; however, we did identify two markers of interest. First, women never having an abnormal Pap result were more likely to test positive. This may be due to persistent and untreated HPV infection, or due to greater vigilance in self-protection on the part of women having an abnormal Pap. Second, HPV infection was more likely among those also having female sex partners. This may be an artifact of the low number of women reporting sex with other women ( $n = 5$ ) or it may be very much a consequence of labia to labia/vaginal HPV transmission, digital to labia/vaginal transmission, or oral to labia/vaginal transmission.

#### 4.1. Limitations

Findings are limited by the use of a convenience sample and by the validity of the self-reported data. As an exploratory study, findings are also limited by the very small sample size and the corresponding lack of statistical power. Further, from an external validity standpoint, it should be noted that the compensation provided to women for completing the assessment may have motivated them to agree to self-collection thus whether similar results would occur in the absence of this compensation is not known. As an addition limitation, it is noteworthy that the inclusion criterion of not having a Pap test in the past 3 years may have nonetheless included women who were compliant with screening guidelines (given the extended interval of up to 5 years for women screened by co-testing). Also, it must be noted that women were selected for this sample based on lack of Pap testing in the past three years, thereby precluding generalization to all rural Black women residing in this part of the Mississippi Delta. Finally, based on the point that these women had not had a Pap test in at least three years, the finding regarding women's preference of self-collected swabs over Pap testing is limited by this large gap in time that elapsed.

#### 5. Conclusions

Findings suggest the possibility that optimizing community-based screening for cervical cancer among rural Black women in the Deep South may be achieved, in part, through church-based programs offering HPV testing via the option of self-collecting a vaginal swab. That women self-collected in their church is an important finding in this regard as it suggests that such programs could be faith-based. Black rural women from the Deep South are generally comfortable self-collecting cervico-vaginal swabs for HPV testing. Given that nearly 30% tested positive for oncogenic HPV, the utility of this screening method appears feasible and practical. Future studies should test strategies that navigate rural, underserved Black women who do test positive for HPV to colposcopy or Pap testing.

#### Human subjects protection

This study was approved by the institutional review board of the University of Kentucky.

#### Conflict of interest statement

Compliance with Ethical Standards: This study was funded by the Centers for Disease Control and Prevention (Cooperative Agreement Number 1U48DP001932-01). The authors declare that they have no conflict of interest.

#### Acknowledgements

This project was supported by Cooperative Agreement Number 1U48DP001932-01 from the Centers for Disease Control and Prevention (CDC). The findings and conclusions in this article are those of the authors and do not necessarily represent the official position of the CDC.

#### References

- Anhang, R., Nelson, J.A., Telerant, R., Chiasson, M.A., Wright Jr., T.C., 2005. Acceptability of self-collection of specimens for HPV DNA testing in an urban population. *J. Women's Health* 14 (8), 721–728.
- Arriba, L.N., Enerson, C.L., Belinson, S., Novick, L., Belinson, J., 2010. Mexican Cervical Cancer Screening Study II: acceptability of human papillomavirus self-sampler. *Int. J. Gynecol. Cancer* 20 (8), 1415–1423.
- Barbee, L., Kobetz, E., Menard, J., et al., 2010. Assessing the acceptability of self-sampling for HPV among Haitian immigrant women: CBPR in action. *Cancer Causes Control* 21 (3), 421–431.
- Centers for Disease Control and Prevention, Department of Health and Human Services, H. Cervical cancer screening guidelines for average at-risk women <http://www.cdc.gov/cancer/cervical/pdf/guidelines.pdf> (Accessed July 6th, 2015).

- Chaturvedi, A.K., Dumestre, A.M., Gaffga, A.M., et al., 2005. Prevalence of human papillomavirus genotypes in women from three clinical settings. *J. Med. Virol.* 75 (1), 105–113.
- Dzuba, I.G., Díaz, E.Y., Allen, B., et al., 2002. The acceptability of self-collected samples for HPV testing vs. the Pap test as alternatives in cervical cancer screening. *J. Womens Health Gen. Based Med.* 11 (3), 265–275.
- Gravitt, P.E., Peyton, C.L., Apple, R.J., Wheeler, C.M., 1998. Genotyping of 27 human papillomavirus types by using L1 consensus PCR products by a single-hybridization, reverse line blot detection method. *J. Clin. Microbiol.* 36 (10), 3020–3027.
- Huynh, J., Howard, M., Lytwyn, A., 2010. Self-collection for vaginal human papillomavirus testing: systematic review of studies asking women their perceptions. *J. Low. Genit. Tract Dis.* 14 (4), 356–362.
- Igdbashian, S., Boveri, S., Spolti, N., Radice, D., Sandri, M.T., Sideri, M., 2011. Self-collected human papillomavirus testing acceptability: comparison of two self-sampling modalities. *J. Women's Health* 20 (3), 397–402.
- Schmeink, C.E., Bekkers, R.L., Massuger, L.F., Melchers, W.J., 2011. The potential role of self-sampling for high-risk human papillomavirus detection in cervical cancer screening. *Rev. Med. Virol.* 21 (3), 139–153.
- Simon, S., American Cancer Society, 2014. FDA approves HPV test as first line screening for cervical cancer. <http://www.cancer.org/cancer/news/news/fda-approves-hpv-test-as-first-line-screening-for-cervical-cancer> (Accessed May 22, 2014).
- Vanderpool, R.C., Jones, M.G., Stradtman, L.R., Smith, J.S., Crosby, R.A., 2014. Self-collecting a cervico-vaginal specimen for cervical cancer screening: an exploratory study of acceptability among medically underserved women in rural Appalachia. *Gynecol. Oncol.* 132 (Suppl. 1), S21–S25.
- Winer, R.L., Hughes, J.P., Feng, Q., et al., 2010. Early natural history of incident type-specific human papillomavirus infections in newly sexually active young women. *Cancer Epidemiol. Biomark. Prev.* <http://dx.doi.org/10.1158/1055-9965.EPI10-1108> (Epub 2010/12/22. 1055-9965.EPI-10-1108 [pii]. PubMed PMID: 21173170).