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SHORT REPORT

A study of human papillomavirus on vaginally inserted sex toys, before and after cleaning, among women who have sex with women and men

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ABSTRACT

Objectives The objective of the study was to determine the potential of human papillomavirus (HPV) transmission via shared sex toys, and determine whether cleaning practices implemented by the study participants were effective.

Methods Vibrator 1 was composed of thermoplastic elastomer. Vibrator 2 was composed of silicone. Twelve women, recruited from a university, used each vibrator on separate occasions and provided self-collected vaginal and vibrator samples (obtained from the vibrator shaft and handle), collected immediately after use, immediately after cleaning with a commercially available cleaner, and 24 h after cleaning. Vaginal and vibrator samples were assessed for HPV DNA by the Roche Linear Array HPV Genotyping Test.

Results HPV was detected in the vaginal samples of 9/12 (75%) women. Vibrator 1 shaft swabs were HPV positive before cleaning in 89% (8/9), immediately after cleaning in 56% (5/9), and 24 h after cleaning in 40% (2/5) of those that were HPV positive immediately after cleaning. Vibrator 2 shaft swabs were HPV positive before cleaning in 67% (6/9), immediately after cleaning in 44% (4/9), and 24 h after cleaning in none.

Conclusions HPV was detected on at least one vibrator immediately after use in the women with vaginal HPV. This supports the potential for HPV transmission via shared sex toy use, and is additionally supported by continued detection of HPV up to 24 h after standard cleaning. The data add to understanding of the range of sexual behaviours associated with HPV transmission, and the need for evidence-based recommendations for sex toy cleaning.

INTRODUCTION

Human papillomavirus (HPV) is one of the most common sexually transmitted infections (STI), with national population-based data demonstrating a prevalence rate of sexually transmitted HPV of 42.5% among women aged 14–59 years.[1] Although not well understood, HPV infections have been documented among women who have sex with women.[2–4] One potential mode of HPV transmission between women during a sexual encounter is through the sharing of sex toys. Over 50% of women aged 18–60 years report vibrator use, and over 65% of self-identified bisexual women report partnered sex toy use.[5] However, the potential for HPV transmission through sex toy use is not well understood, nor are the potential means to prevent transmission through cleaning. This study was designed to determine the potential of HPV transmission via shared sex toys, and whether cleaning practices implemented by study participants were effective.

METHODS

Participants, aged 18–29 years, were recruited from non-clinical sources as part of a larger study describing sexual behaviours associated with STI risk among women who have sex with women and men. Women were recruited through word of mouth, online ads, and through community groups. Participant kits were mailed in June 2013, and samples were returned within 2 weeks of kit receipt. Participants were biologically female, living as women, had engaged in genital contact with a male partner living as a man and a female partner living as a woman in the last 12 months. Participants were invited if they completed a baseline survey, completed an in-person interview, provided a vaginal sample, and consented to an online survey. Twenty-eight women met these criteria, and 20 consented to participate. Human participants' approval was obtained through the Indiana University-Bloomington IRB.

Participant kits contained two new, unopened vibrators designed for intravaginal use, a commercially available sex toy cleaning product, and swabs required to complete the protocol. Vibrator 1 was a typical 'Rabbit'-styled vibrator, in that it included a vibrating shaft for vaginal insertion and an arm for clitoral vibration, each composed of a soft jelly based thermoplastic elastomer material. Vibrator 2 was smooth surfaced, composed of a soft silicone material. Participants used the vibrators intravaginally and alone on different occasions, separated by at least 24 h. Participants were randomised to order of vibrator use. Participants were instructed to clean the vibrators using water and the supplied cleaning product (a liquid consisting of cocamidopropyl PG-dimonium, chloride phosphate, benzyl alcohol, disodium EDTA, citric acid, fragrance). Duration of time to cleaning was left to the discretion of the participant. Additionally, participants completed an online survey.

Participants were compensated with points that could be exchanged for a variety of prizes at the conclusion of the larger study. The approximate maximum value of the points for this portion of the study was US$25. Twelve (60%) participants provided samples for testing. The remaining eight

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were provided with kits, but did not return samples or complete the online survey.

Survey

Participants were asked questions addressing vibrator use, the context of vibrator use (ie, sharing the vibrator, body part on which the toy was applied/inserted), and items regarding the cleaning procedures for the vibrators.

Specimen collection

Participants were instructed to obtain a self-collected vaginal swab. Self-collected swabs for HPV testing are as sensitive as cervical swabs collected by physicians.[6 7] Additionally, participants obtained three sets of vibrator samples: immediately after self-use (prior to cleaning); immediately after cleaning; and 24 h after cleaning. For Vibrator 1, participants obtained swabs from the shaft, the clitoral vibration unit, and the space between the shaft and the clitoral stimulation unit. For Vibrator 2, participants obtained swabs from along the shaft. Participants swabbed the handle, where the on/off button was located, for both vibrators. Samples were obtained with Dacron swabs.

HPV screening

Samples were mailed directly to the HPV laboratory at Indiana University School of Medicine in Indianapolis, Indiana, USA, where they were processed for storage using standard transport media and stored at −70°C until processed for HPV DNA using the Roche Linear Array HPV Genotyping Test (Roche Diagnostics, Indianapolis, Indiana, USA). This is a type-specific HPV genotyping PCR assay which tests for 37 HPV types, including HPV 6, 11, 16, 18, 26, 31, 33, 35, 39, 40, 42, 45, 51, 52, 53, 54, 55, 56, 58, 59, 61, 62, 64, 66, 67, 68, 69, 70, 71, 72, 73, 81, 82, 83, 84, CP6108 and IS 39. HPV DNA testing is sensitive and specific. All vaginal samples were tested for HPV. Vibrator (before and immediately after cleaning) samples were tested in those women whose vaginal samples were HPV positive. Only those samples that were HPV positive immediately after cleaning were tested in the 24 h after cleaning group.

Data analysis

A priori, proof of concept was considered established if HPV DNA is detected on ≥10% of postsexual event vibrator samples obtained prior to cleaning. Additional feasibility analyses included assessment of cleansing effectiveness and duration of HPV detection on sex toys. Survey data is presented using descriptive statistics. All participant identifiers were removed during data analysis.

RESULTS

HPV was detected in the vaginal samples of 75% (9/12) of the women who provided samples. All participants reported inserting the study-supplied vibrators into their vagina. Vibrator samples were tested only from the women who tested HPV positive. There were two vibrators given to each participant, and two swabs sent from each vibrator for each time period (total of 54 swabs submitted for each vibrator type). All participants used the provided cleaning product. One participant used the provided product plus a liquid antibacterial soap. Sixty-seven per cent (8/12) women reported cleaning the vibrators within 5 min of use.

The frequency of HPV DNA detection on the two vibrators for the different collection sites and time frames is shown in table 1. Vibrator 1 had increased frequency of HPV detection at every collection time frame, which was especially notable in the 24 h after cleaning collection.

Table 1 Frequency of human papillomavirus (HPV) detection on the vibrators

	Vibrator 1		Vibrator 2	
	Shaft (n=9)	Handle (n=9)	Shaft (n=9)	Handle (n=9)
Before cleaning (%)	8/9 (89)	7/9 (78)	6/9 (67)	6/9 (67)
Immediately after cleaning (%)	5/9 (56)	4/9 (44)	4/9 (44)	3/9 (33)
24 h after cleaning* (%)	2/5 (40)	2/4 (50)	0/4 (0)	0/3 (0)

Vibrator 1 (TPE material); Vibrator 2 (silicone material).
*Only samples HPV positive immediately after cleaning were tested (TPE shaft n=5, handle n=4; Silicone shaft n=4, handle n=3).
TPE, thermoplastic elastomer.

β Globin positivity (typically used as a marker of specimen adequacy) decreased markedly immediately after cleaning. Vibrator 1 was β globin positive prior to cleaning in 83% (15/18 swabs), which decreased to 33% (6/18 swabs) immediately after cleaning. Vibrator 2 was β globin positive prior to cleaning in 89% (16/18 swabs), which decreased to 17% (3/18 swabs) immediately after cleaning. Twelve samples were β globin negative, but HPV positive.

DISCUSSION

In this study, HPV was detected on at least one of the vibrators immediately after use in all women with vaginal HPV. This suggests that in sexual events involving shared sex toy use (in which both partners are using the same sex toy during the same sexual event), HPV transmission via sex toys may be feasible. This potential is additionally supported by evidence of HPV on the vibrators after standard cleaning, even up to 24 h later. Sex toy material and shape may play a role in postcleaning HPV detection after use, and potentially as a mode of transmission for HPV. The theory that transmission of HPV may occur through the use of sex toys is supported by research on the detection of HPV on other surfaces. A recent study showed that HPV can be detected from clean toilet seats.[8] This suggests that HPV is a relatively stable virus on environmental surfaces that may survive some cleaning solutions. For this study, we were unable to assess the full range of toys, materials or conditions/patterns of sex toy use, nor were we able to completely assess the cleaning conditions (ie, water temperature, time and effort by the participants).

These data support additional research to guide consumer practices for safe use and cleaning, given the extent of sex toy use for sexual pleasure and satisfaction. The current data suggest that cleaning a vibrator may effectively reduce the frequency of HPV detection, although further research is needed to understand how factors related to sex toy material, sex toy design, cleaning ingredients, and cleaning practices affect this likelihood. For example, in this study, swabs from Vibrator 1 (composed of a more porous material than Vibrator 2) were more often HPV positive than swabs from Vibrator 2, and 24 h after cleaning, none of the swabs from Vibrator 2 were HPV positive. We also need improved understanding regarding cleaning practices, such as optimal time spent cleaning, whether certain ingredients are more effective for cleaning than others, and how vibrators should be stored after cleaning (eg, should they be towel dried, left to air dry, or immediately stored). Subsequent research might also investigate the presence and

duration of other organisms that may be transmitted on vibrators and other sex toys.

Given evidence that HPV can remain infectious on environmental surfaces for up to 7 days after deposition,[9] the need exists to develop evidence-based recommendations for sex toy cleaning to reduce transmission of HPV and other STI.

Key messages

- Human papillomavirus (HPV) has been detected in women who have sex with women.
- HPV was detected on sex toys after use in women with HPV detected on vaginal swabs.
- HPV was detected on sex toys after cleaning, even up to 24 h, depending on vibrator type.
- HPV transmission may be feasible via sex toys, in sexual events involving shared sex toy use.

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Contributors All authors contributed to the project concept. TAA, VS and JDF contributed to project design and implementation. VS initiated participant recruitment. TAA and VS analysed the data. All authors contributed to manuscript preparation.

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