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Factors Affecting Knowledge of Sexually Transmitted Infection Transmissibility in Healthcare Providers: Results From a National Survey

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Objectives: **The objectives of this study were to examine healthcare providers' knowledge of the transmissibility of sexually transmitted infections (STIs) and identify knowledge determinants.**

Study: **Questionnaires were completed March through May 2004 by a representative sample of Canadian healthcare providers, yielding a corrected response rate of 50.8% for physicians. STI workers returned 236 questionnaires.**

Results: **For physicians, the distribution of HIV estimates was positively skewed (mode = 10%), whereas chlamydia estimates were widely dispersed. STI workers showed a trimodal (0%, 50%, and 100%) distribution of HIV estimates and a negatively skewed distribution of chlamydia estimates (mode = 100%). Overall, 1.4% (HIV) and 5.8% (chlamydia) of respondents gave estimates close to the actual transmission probabilities. More years of medical experience and higher estimates of STI prevalence predicted higher transmissibility estimates (95% confidence intervals).**

Conclusions: **That only a small percentage of healthcare providers are aware of the actual transmissibility of HIV and chlamydia has implications for improving medical and sexual health training.**

SEXUALLY TRANSMITTED INFECTIONS (STIs) warrant continued research because rates are steadily increasing in North America.[1,2] Adverse consequences of untreated STIs include pelvic inflammatory disease[3] and increased susceptibility to (and transmission of) HIV.[4] STIs can also heighten stress and have a deleterious effect on interpersonal relationships.[5]

The transmission probabilities of different STIs vary considerably. Transmissibility can be influenced by the infectiousness of the disease depending on the stage of the infection, the susceptibility of the exposed person, which can be increased by other genital tract infections,[6] and the site of exposure.[7] When unaffected by these cofactors, the transmissibility of a specific STI varies little for a particular sexual act. The estimated probability of transmitting HIV from an infected man to a woman through one act of unprotected vaginal intercourse is 0.1%[8,9] and for chlamydia, 35%.[10]

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Current research examining perceived transmissibility of STIs has been limited and has focused mainly on HIV and student samples[11,12] because students are the age group most affected by STIs[13] and HIV is a high-profile infection salient in the media. For example, a recent study investigating students' knowledge of HIV transmissibility[11] found that mean and median estimates exceeded the true values by a factor of at least 10. Similar to previous reports,[12] the researchers suggested that participants were overestimating transmission probabilities.

Knäuper and Kornik,[14] however, found that students' probability estimates were evenly distributed across the entire range from 0% to 100% for both HIV and chlamydia. Given the large variability of estimates, reporting means or medians of such distributions and interpreting them as systematic overestimations, as previous work has done,[11,12] would be futile. Rather, the distributions showed that students do not know the transmission probabilities of HIV and chlamydia and do not distinguish between HIV and chlamydia in their probability estimates.[14]

This apparent lack of knowledge among students prompted us to investigate whether those who are involved professionally in educating individuals on sexual health possess better knowledge. The first objective of this study was to extend the research of Knäuper and Kornik to a nationally representative sample of those who work in the sexual health field in different capacities: family physicians (FPs), obstetrician–gynecologists (OBs), and employees and volunteers of STI clinics (STI workers). STI workers were composed of volunteers, employed counselors, and positions not otherwise specified. Respondents indicating "other" were asked to provide a description of their position and descriptions were reviewed to ensure all respondents were in positions to disseminate transmissibility information. The STIs HIV and chlamydia were chosen as exemplars for a low and high contagious infection, respectively. It is hypothesized that OBs will have the most accurate knowledge of transmission probabilities because of their formal medical background and sexuality-related specialty, whereas STI workers will have the least accurate knowledge, with FPs in between.

The second objective was to investigate the influence of the following factors on transmissibility knowledge: 1) gender, 2) years of medical experience (years of experience in the sexual health field for STI workers), 3) area of practice (urban/rural), 4) perception of STIs as physically threatening, 5) estimated prevalence of STI in Canada, 6) attitudes toward STIs, and 7) perceived knowledge about the transmissibility of STIs.

Materials and Methods

Sampling of Physicians and Sexually Transmitted Infection Workers

Random samples of FPs and OBs were drawn stratified by region: Maritimes (Newfoundland, Nova Scotia, New Brunswick, and Prince Edward Island), Quebec, Ontario, Prairies (Manitoba, Saskatchewan, and Alberta), and British Columbia. Physicians from the Yukon, North West Territories, and Nunavut, representing 3.7% and 1.9% of the total populations of FPs and OBs respectively, were excluded because the number of practitioners was too small to maintain anonymity.

Physicians' demographic and professional data, including their mailing addresses, were obtained using MDSelect, the CD-ROM version of the *Canadian Medical Directory*. Using these listings, required sample sizes per region were calculated based on a 95% confidence level. A total required sample size of 1560 (of 11,019) FPs and 793 (of 1594) OBs was determined. These numbers were inflated according to region to account for an expected response rate of 60%. Thus, 2496 FPs and 1222 OBs were randomly drawn, stratified by region, using a random number generator, and were mailed questionnaires. Note that some regions had fewer physicians than required after the inflation; thus, all were sampled in these regions.

The number of employees and volunteers working in STI clinics across Canada is much smaller; thus, we fully sampled this target population. A listing of HIV/AIDS organizations across Canada was obtained from the Canadian AIDS Society because no listing exists of STI clinics specifically. Each organization was contacted by telephone to inquire how many employees/volunteers currently worked at the clinic so that the appropriate number of questionnaires could be sent. Many receptionists were uncertain of the exact number of people working at their clinic because the number fluctuates heavily and therefore likely requested more questionnaires than was required. A total number of 938 questionnaires were requested and mailed. Note that we have no way of establishing to what extent this number is an accurate reflection of the number of employees/volunteers at STI clinics in Canada, and therefore the response rate for this subgroup cannot be determined.

Questionnaire Format

The one-page, double-sided questionnaire consisted of 14 questions and was pilot-tested with healthcare researchers and providers. The final version was translated into French to accommodate Francophone participants.

The 2 transmissibility questions were asked first and were counterbalanced to guard against responses being influenced by subsequent questions and by order. These questions were posed as: "Based on your current knowledge, what do you think is the probability (in %) of a woman becoming infected with HIV [chlamydia] from one unprotected act of vaginal intercourse with an HIV[chlamydia]-infected man?" The remaining questions addressed the underlying determinants of transmissibility knowledge. Attitudes toward STIs were assessed using endorsements of the statement "Compared with diseases such as cardiovascular disease or cancer, too many healthcare dollars are currently being spent on the prevention and treatment of HIV [chlamydia]" (from 1, strongly disagree, to 7, strongly agree). Perception of threat of HIV/chlamydia was assessed using the question "In your opinion, how threatening is HIV [chlamydia] in terms of its physical consequences?" (from 1, no threat at all, to 7, very large threat). Perceived knowledge of transmission probabilities was assessed using the question "How would you describe your knowledge about the transmission of HIV [chlamydia] from one person to another?" (from 1, not very knowledgeable, to 7, very knowledgeable). To test the impact of estimated disease prevalence on transmissibility estimates, participants were asked the open-ended question "What percent of the Canadian population do you think is infected with HIV [chlamydia]?" Basic demographic information assessed included gender, years of medical experience, province, and area of practice (urban/rural setting).

Procedure

Participants were mailed a package consisting of a cover letter, a self-administered questionnaire, a preaddressed, stamped return envelope, and a preaddressed, stamped postcard to be returned for entry into a draw to win a prize in the value of $500 Canadian. Participants were informed that their responses would be completely anonymous.

A second mailing to physicians was carried out in April 2004. Nonrespondents were sent a questionnaire asking only the 2 transmissibility questions and basic demographic information. Note that it was important to obtain a high response rate to the transmissibility questions because they are the main outcome measures of the study.

Results

Response Rate

Of the 3824 physicians who were mailed questionnaires, 202 were excluded because questionnaires were undeliverable as a result of a wrong address (n = 183) or the surveyed physician was retired, deceased, not practicing in the specified region, or practicing a nonspecified specialty (n = 19). Of the remaining 3622 physicians, 1665 responded, yielding an uncorrected response rate of 46.0%. We undertook a procedure to ensure the accuracy of the addresses provided by the *Canadian Medical Directory*. A representative sample size of 368 was calculated based on a 95% confidence level. Physicians were randomly drawn and contacted by telephone to confirm correct addresses. Fifty-six (15%) phone numbers were not correct and were replaced with new physicians by the same procedure. Of the 368 physicians, 318 (86.4%) addresses were confirmed. Assuming 86.4% of the original surveys reached the intended respondents, a corrected response rate, now excluding only the 19 physicians who were retired, deceased, not practicing in the specified region, or practicing a nonspecified specialty, yielded a response rate of 50.6%, which is consistent with previous response rate reports of mail surveys completed by physicians.[15]

As noted previously, the response rate for STI workers could not be determined. Two hundred thirty-six STI workers responded to the survey. STI workers were composed of volunteers (33.9%) and employed counselors (17.8%). The remaining 48.3% marked the "other" category in the survey and were asked to provide a description of their position. The descriptions were reviewed and all respondents were found to be in positions to disseminate transmissibility information (e.g., "educators," "program coordinators") and were thus included in our analyses. No respondents identified themselves as being in the medical profession (i.e., no nurses, physicians, medical students).

Table 1 presents the characteristics of the sample and determinants of transmissibility knowledge for each healthcare provider group.

TABLE 1. Characteristics of Sample Populations

	FPs (n = 1199)	OBs (n = 456)	STI Workers (n = 236)
Transmissibility of HIV	10.0	10.0	50.0
Transmissibility of chlamydia	50.0	50.0	80.0
Gender (male), percent	53.3	62	39.1
Years of experience	15.0	24.0	3.0
Area of practice (urban), percent	73.9	83.3	82.1
Province of practice, percent			
British Columbia	21.4	18.1	25.5
Prairies	18.9	17	10.4
Ontario	23.5	31.2	35.1
Quebec	19.6	26.1	16.9
Maritimes	16.6	7.5	12.1
HIV	(n = 723)	(n = 294)	(n = 236)
Physical threat	7.0	7.0	7.0
Prevalence	1.0	1.0	2.0
Attitudes	3.0	3.0	1.0
Knowledge	5.0	5.0	7.0
Chlamydia	(n = 723)	(n = 294)	(n = 236)
Physical threat	5.0	5.0	5.0
Prevalence	5.0	5.0	10.0
Attitudes	2.0	2.0	2.0
Knowledge	5.0	5.0	5.0

Note: Values are medians unless noted otherwise.
FPs indicates family physicians; OBs = obstetrician–gynecologists; STI = sexually transmitted infection.

Accuracy of Transmissibility Estimates

Transmissibility estimates were not influenced by question order ($P > 0.05$). Figures 1 and 2 present the distribution of estimates for HIV and for chlamydia separately for physicians (FPs and OBs) and STI workers, showing that estimates ranged from 0% to 100% for both STIs. For physicians, the distribution of HIV transmissibility estimates was positively skewed with more than half of the participants giving low estimates between 0% and 10% and a modal response of 10%. Estimates of chlamydia transmissibility were widely dispersed ranging from 1% to 100% with no apparent dominant response. This dispersion illustrates that, parallel to the findings of Knäuper and Kornik,[14] no significant portion of physicians knew the true transmission rates of chlamydia and there was no systematic trend in the estimates. In contrast, STI workers showed the opposite pattern: a wide distribution of HIV estimates with multiple peaks at 0%, 50%, and 100% and a negatively skewed distribution of chlamydia estimates with a modal response of 100%.

Overall, only a small portion of respondents, 1.4% (HIV) and 5.8% (chlamydia), gave estimates close to the actual transmission

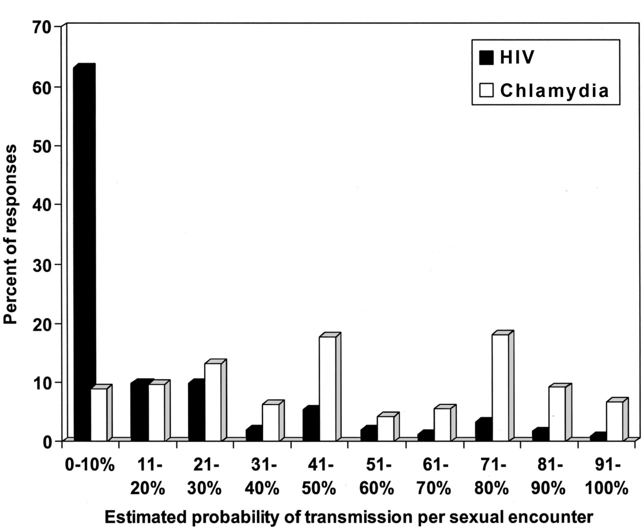

Fig. 1. Distribution of estimates for physicians for HIV and chlamydia for one act of unprotected vaginal intercourse with an infected man.

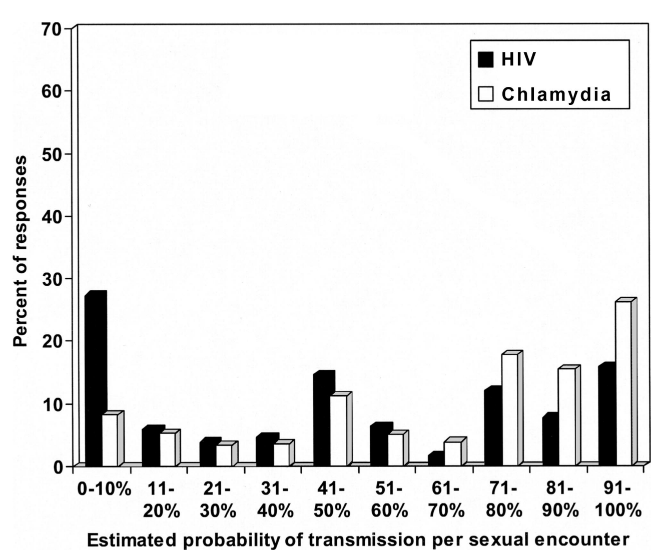

Fig. 2. Distribution of estimates for sexually transmitted infection workers for HIV and chlamydia for one act of unprotected vaginal intercourse with an infected man.

TABLE 2. Correlations of HIV and Chlamydia Transmissibility Estimates With Psychological Determinants

Determinant	Transmissibility of HIV	Transmissibility of Chlamydia
Family Physicians (n = 723)		
Gender	0.13*	0.06
Years medical experience	0.04	0.05
Area	−0.03	−0.00
Physical threat	−0.03	0.14*
Prevalence	0.36*	0.15*
Attitudes	−0.04	−0.06
Knowledge	−0.04	0.14*
Obstetricians–gynecologists (n = 294)		
Gender	0.02	0.05
Years medical experience	0.06	−0.07
Area	0.15†	0.08
Physical threat	0.08	0.18*
Prevalence	0.24*	0.10
Attitudes	−0.05	−0.13†
Knowledge	−0.10	0.06
STI workers (n = 236)		
Gender	0.03	0.04
Years sexual health experience	0.05	0.14†
Area	0.06	0.06
Physical threat	0.03	0.21*
Prevalence	0.41*	0.18*
Attitudes	−0.02	−0.11
Knowledge	0.01	0.19*

*Correlation is significant at the 0.01 level (2-tailed).
†Correlation is significant at the 0.05 level (2-tailed).
STI indicates sexually transmitted infection.

probabilities, defined as less than 0.5% for HIV and between 30% and 40% for chlamydia. A total of 88.7% of respondents correctly estimated that chlamydia has a higher transmission probability than HIV. A total of 3.7% incorrectly estimated that HIV has a higher transmission probability than chlamydia, and 7.6% of respondents gave the same estimate for both STIs. STI workers were 5.7 times more likely to estimate HIV as having a higher or equal transmission probability than chlamydia compared to FPs (95% CI, 4.0–8.1) and 4 times more likely compared with OBs (95% CI, 2.6–6.0).

Determinants of Transmissibility Knowledge

Determinants of transmissibility knowledge were collected in the first mailing only, yielding an uncorrected response rate for physicians of 28.5% and a corrected response rate of 31.4%. Thus, analyses on the determinants of knowledge were performed using data from the first mailing only. There were no significant differences among the mailings for gender, province, and transmissibility estimates; however, respondents to the second mailing were older (mean age = 45.52) than respondents to the first mailing (mean age = 43.72) (t[1,896] = −3.49, P <0.05).

Table 2 presents the nonparametric bivariate correlations (Spearman's rank correlation) between transmissibility estimates and the determinants of knowledge. All factors significantly related to estimates of HIV or chlamydia transmissibility were entered into a linear regression analysis. These are: 1) gender, 2) years of medical experience (years of experience in sexual health field for STI workers), 3) area of practice, 4) perception of each STI as physically threatening, 5) estimated prevalence of STI in Canada, 6) attitudes toward STIs, and 7) perceived knowledge about the transmissibility of STIs.

Bootstrap procedures were used to obtain the empirical standard errors and 95% empirical confidence intervals for the regression

TABLE 3. Summary of Bootstrapped Linear Regression Analysis

Variable	β	Standard Error β	95% Confidence Interval
General practicioners (n = 723)			
Transmissibility of HIV			
Gender	0.03	0.02	0.00–0.06*
Years medical experience	0.00	0.00	0.00–0.00*
Area	0.00	0.02	−0.03–0.03
Physical threat	0.01	0.01	−0.01–0.03
Prevalence	0.02	0.00	0.01–0.03*
Attitudes	−0.00	0.00	−0.01–0.00
Knowledge	0.01	0.00	−0.00–0.02
Transmissibility of chlamydia			
Gender	0.03	0.02	−0.00–0.07
Years medical experience	0.00	0.00	−0.00–0.00
Area	0.03	0.02	−0.01–0.06
Physical threat	0.03	0.01	0.01–0.04*
Prevalence	0.00	0.00	0.00–0.01*
Attitudes	−0.01	0.01	−0.01–0.00
Knowledge	0.02	0.01	0.01–0.04*
Obstetrician–gynecologists (n = 294)			
Transmissibility of HIV			
Gender	0.03	0.02	0.00–0.07*
Years medical experience	0.00	0.00	0.00–0.00*
Area	0.00	0.01	−0.02–0.03
Physical threat	0.01	0.01	−0.01–0.03
Prevalence	0.02	0.00	0.01–0.03*
Attitudes	−0.00	0.00	−0.01–0.00
Knowledge	0.01	0.00	−0.00–0.02
Transmissibility of chlamydia			
Gender	0.03	0.02	−0.00–0.07
Years medical experience	0.00	0.00	−0.00–0.00
Area	0.03	0.02	−0.01–0.06
Physical threat	0.03	0.01	0.01–0.04*
Prevalence	0.00	0.00	0.00–0.00*
Attitudes	−0.01	0.01	−0.03–0.00
Knowledge	0.02	0.01	0.01–0.03*
STI workers (n = 236)			
Transmissibility of HIV			
Gender	−0.03	0.05	−0.13–0.07
Years experience sexual health	0.00	0.00	−0.01–0.01
Area	0.01	0.07	−0.18–0.14
Physical threat	0.04	0.04	−0.02–0.12
Prevalence	0.01	0.00	0.01–0.01*
Attitudes	−0.02	0.02	−0.06–0.03
Knowledge	0.01	0.03	−0.04–0.06
Transmissibility of chlamydia			
Gender	−0.01	0.04	−0.09–0.08
Years experience sexual health	0.01	0.00	0.00–0.01*
Area	0.01	0.06	−0.10–0.13
Physical threat	0.03	0.01	0.00–0.05*
Prevalence	0.00	0.00	−0.00–0.00
Attitudes	−0.01	0.02	−0.04–0.10
Knowledge	0.02	0.01	−0.01–0.04

*indicates a significant factor. A factor is said to be significant if zero is NOT included in the 95% confidence interval obtained by nonparametric bootstrap method.
STI indicates sexually transmitted infection.

parameter estimates.[16] Statistical significance of the regression estimates was detected by determining if the value of zero was included in the confidence interval. The bootstrap is a resampling technique with which the sampling distribution of a statistic (in our case, the regression coefficient) is established empirically by drawing successive samples from an observed dataset with replacement.[17,18] The regression coefficient estimate is usually assumed to follow a *t* distribution when the data are normally distributed. In our case, the data were not normally distributed, thus, the bootstrap technique was used because it provides an empirical sampling distribution of the test statistic regardless of the distribution of the data (for details on bootstrapping, see Efron and Efron and Tibshirani).[16–19]

The linear regression model was applied to FPs, OBs, and STI workers separately to identify possible significant factors for each group (Table 3). For both FPs and OBs, women gave higher HIV transmissibility estimates than men. Additionally, the more years of medical experience physicians had and the higher they estimated the prevalence of HIV in Canada, the higher they estimated the transmissibility of HIV. For chlamydia, the higher physicians estimated the prevalence of chlamydia in Canada, the more they perceived chlamydia to be physically threatening; and the higher they perceived their knowledge of chlamydia transmissibility, the higher they estimated the transmissibility of chlamydia. For STI workers, the higher they estimated the prevalence of HIV to be in Canada and the more they perceived chlamydia to be physically threatening, the higher their transmissibility estimates. Finally, the more years of experience STI workers had in the sexual health field, the higher they estimated the transmissibility of chlamydia.

Discussion

This study examined the accuracy of STI transmissibility estimates among healthcare providers and possible determinants of that knowledge. Although the accuracy of transmissibility estimates has been examined in the past among student populations,[11,14] this survey is the first to assess the transmissibility knowledge of healthcare providers involved in disseminating this information to the public. Additionally, this research examines possible predictors of transmissibility knowledge. HIV transmission estimates for both FPs and OBs were positively skewed with a modal response of 10% for HIV. Thus, physicians appear to know that HIV is not as easily transmitted, although they still overestimate the probability of transmission by a factor of 200. Estimates for chlamydia were widely and equally dispersed without any apparent dominate response. Thus, similar to what has been found for college students,[14] physicians as a group clearly lack knowledge regarding the transmissibility of chlamydia.

The opposite pattern was found for STI workers. HIV transmissibility estimates were widely dispersed and with multiple peaks at 0%, 50%, and 100%, and chlamydia estimates were negatively skewed with a modal response of 100%. The wide distribution of HIV estimates suggests that STI workers are uncertain about the true transmission probability of HIV, presumably because of the disproportionately high number of HIV cases they see on a daily basis. Our data support this assertion showing that STI workers reported seeing on average 38.96 individuals per month for issues related to STIs, whereas physicians reported only 5.5% of their patients per month are related to STIs (this translates into an average of 27 patients per physician based on data from The National Family Physician Workforce Survey, 2001).[20]

For chlamydia, the skewed distribution of estimates clearly indicates an overestimation of the transmission probability of chlamydia. This overestimation may originate from STI workers' exposure to many HIV-positive individuals who are also infected with chlamydia, because HIV increases the probability of contracting other STIs.[21] Overall, only a small portion of respondents in all 3 groups gave estimates that came close to the actual transmission probabilities of HIV and chlamydia.

Consistent with the initial hypothesis, STI workers were more likely than physicians to falsely estimate that HIV transmits easier than or as easily as chlamydia. This difference may be the result of physicians' more extensive medical knowledge, including a more general understanding of disease transmission and of statistical probabilities for transmitting infections. In addition, STI workers see comparably more HIV- and STI-infected people because STIs are more common among HIV-infected individuals than in the general population.[21] Thus, as a result of this increased exposure, STI workers may infer that the transmission probability of both STIs is high.

The estimated prevalence of HIV and chlamydia positively predicted transmissibility estimates in all 3 professional groups. There are 2 possible explanations for this association. First, people who believe that an STI is very prevalent may believe that this is because it is very contagious and thereby give higher transmissibility estimates; or second, an overestimation of the prevalence could lead to an overestimation of transmissibility because of the salience of the issue, particularly for HIV, leading to the perception that STIs transmit easily.

Physicians with more years of medical experience gave higher HIV transmissibility estimates and STI workers with more years of experience in the sexual health field gave higher chlamydia transmissibility estimates. In both cases, years of experience could mean more exposure over time to patients/clients with STIs and that this higher exposure has translated into higher saliency resulting in overestimations.

By surveying a nationally representative sample of healthcare providers, the results of this research provide insight into the level of knowledge about STI transmissibility among individuals who disseminate this information. That only a small percentage of healthcare providers knew the actual transmission probabilities is important information for planning medical and sexual health training programs. In addition, relaying accurate transmission probabilities could have a positive psychological impact on patients/clients when their doctors or counselors correctly share this information, for example, if the patient/client is concerned over a condom breaking or after a sexual assault.

Accurate information about transmission probabilities is also important to sexual health education so that individuals can better understand the risks involved in sexual activities and that certain STIs are easier to contract than HIV.[14] Furthermore, accurate knowledge of the risk involved in one sexual act forms the basis for estimating cumulative risk and is thereby essential to effective decision-making and to understanding one's own risk of contracting a disease.[22]

It could be argued that overestimating the risk of STI transmission has a positive influence on public health by increasing safer sexual practices and increasing feelings of vulnerability. According to this reasoning, there is little benefit to accurately educating healthcare providers about the correct transmission probabilities. This discussion raises a difficult ethical dilemma for risk communicators and public health workers alike: is the public's right to accurate information more important than the fact that this information could lead to potentially harmful health consequences?[12,22] On the other hand, although the transmission probability for HIV is very small for one act of unprotected vaginal intercourse, for an individual who indeed contracts the infection in one unprotected sexual encounter, the small probability of course no longer matters, and the consequences are severe.

Future research could examine whether inaccurate transmission probabilities are in fact being disseminated to the public, in other words, when and how healthcare providers acquire this information. Finally, it is essential to consider how accurate knowledge can be increased among healthcare providers in the future. This could be accomplished, for example, by examining the current medical or sexual health education and training curriculums to ensure transmission probabilities are adequately covered and by increasing awareness of current levels of inaccurate knowledge.

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