International Journal of Infectious Diseases 14 (2010) e881–e887

Contents lists available at ScienceDirect

International Journal of Infectious Diseases

journal homepage: www.elsevier.com/locate/ijid

High HIV knowledge relates to low stigma in pharmacists and university health science students in Guyana, South America

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ARTICLE INFO

Article history:
Received 17 April 2009
Received in revised form 10 March 2010
Accepted 11 March 2010

Corresponding Editor: Mark Holodniy, California, USA

Keywords:
HIV/AIDS
Knowledge
Stigma
Education
Guyana
Prevention

SUMMARY

Objectives: The objective of this study was to investigate HIV knowledge and its relation to HIV stigma among health science students and pharmacists in Guyana, South America. This study also evaluated how the Public Health Strengthening in Guyana Project's (PHSGP) HIV/AIDS/STI educational initiatives influenced HIV knowledge levels among health science students at the University of Guyana.
Methods: A total of 119 individuals, consisting of pharmacists ($n = 42$) and health science students ($n = 77$) participated in this cross-sectional study. All participants completed validated measures of HIV knowledge and HIV stigma.
Results: Overall, health science students scored high on knowledge about HIV risk factors and modes of HIV infection, but were less knowledgeable about more complex HIV treatment issues such as adherence and drug resistance. Students who had received educational HIV training had significantly higher levels of HIV knowledge than those who had not received training. Pharmacists had excellent knowledge regarding HIV risk factors and modes of infection, but had some important gaps in knowledge regarding the importance of HIV medication adherence and drug resistance. Overall, low levels of HIV stigma were endorsed, and those with higher HIV knowledge reported lower HIV stigma.
Conclusions: Although the HIV curriculum has enhanced HIV knowledge, gaps in HIV knowledge remain, such as complex HIV treatment issues. The results of this study are discussed within the context of the challenges of HIV capacity building in resource-poor countries.
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1. Introduction

Despite widespread media attention on HIV/AIDS, substantial misconceptions and gaps in HIV knowledge still exist in the general public and among health care workers. To date, most of the research on HIV knowledge levels among health care workers (e.g. pharmacists, dentists, physicians) has been conducted in Western world contexts such as the USA[1] and Europe.[2,3] Only recently have researchers begun to explore HIV knowledge among health care workers in more diverse countries such as Nigeria,[4] Vietnam,[5] Pakistan,[6] Iran,[7] and India.[8] Examining the types of HIV knowledge gaps that exist in diverse countries and exploring culturally sensitive ways of addressing these gaps is critical given that the HIV epidemic is widespread in many developing countries.[4] Most developing countries also have seriously under-funded public health care systems, which only exacerbates the harmful impact of the HIV/AIDS epidemic.

Existing research findings must be within the context of the post-highly active antiretroviral therapy (HAART) era, characterized by complex treatment issues such as optimal HIV medication adherence and drug resistance. Previous studies assessing HIV knowledge ignored these more complex treatment issues. Furthermore, these studies did not use psychometrically validated HIV knowledge scales. Recently, a validated HIV treatment knowledge scale was developed that allows for a reliable assessment of current HIV treatment knowledge among individuals.[9]

Guyana, which lies on the South American mainland, is a part of the Caribbean Community (CARICOM), with a small population of approximately 751 000 (United Nations, 2007). Guyana is one of the poorest countries in the world, with a gross domestic product (GDP) per capita of US$1219 in 2006.[10] Guyana also has the second

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doi:10.1016/j.ijid.2010.03.021

highest AIDS prevalence rate among countries in the Caribbean region and is one of the few Caribbean countries whose HIV/AIDS epidemic has entered the general population.[11] The estimated prevalence of HIV infection in Guyana is 2.4% (range 1.0–4.9%), and an estimated 1200 Guyanese died of HIV/AIDS in 2005.[11] AIDS and AIDS-related complications are currently the leading cause of death in the 25–44 years age group in Guyana.[12]

Economically and socially, Guyana is struggling to recover from decades of under-development. HIV/AIDS is therefore a considerable drain on the human and health resources of Guyana, and it threatens the country's economic development. As in most developing countries, HIV/AIDS affects the most productive age group (20–49 years), hence HIV/AIDS contributes to the poverty and vulnerability of people living with HIV/AIDS (PHA) and their families in Guyana.

In response to the HIV/AIDS crisis in Guyana, the governments of Canada and Guyana developed the Public Health Strengthening in Guyana Project (PHSGP) in 2004. The PHSGP was funded by the Canadian Government through the Canadian International Development Agency (CIDA), and was designed and implemented by the Canadian Society for International Health (CSIH). One goal of the PHSGP was to build and strengthen the national capacity to implement, provide, and sustain HIV/AIDS prevention and management. As such, the PHSGP developed training and mentoring programs on the clinical management of HIV/AIDS/sexually transmitted infections (STI) as part of the training for health care students. The project developed and implemented a core course on HIV/AIDS/STI for the Faculty of Health Sciences at the University of Guyana. The University of Guyana is the only publicly funded university in the country of Guyana. The University of Guyana has a student body of approximately 5000 students/year with an average of 297 students registered in the Faculty of Health Sciences in the programs of medical technology ($n = 85$), pharmacy ($n = 82$), school of medicine ($n = 94$), and public health ($n = 56$) (www.uog.edu.gy/administration/vice-chancellor/ormp/fte).

In addition, within the context of its long-term goals, the PHSGP has offered continuing education sessions and mentoring in HIV/AIDS for health professionals throughout Guyana.

A secondary goal of the PHSGP was to reduce HIV-related stigma among health care workers and the general population through education. Negative social stigma about HIV/AIDS is a significant obstacle to the successful uptake of programs for HIV prevention, testing, and treatment.[13] Stigma can take the form of blatant and extreme forms of discrimination, as well as more subtle forms of stigma expressed through non-verbal communication, body language, and tone of voice. Only recently, have researchers begun to examine systematically the impact of HIV stigma in developing world contexts. For example, a 2007 study conducted in Pakistan showed that in a sample of 291 medical students, 34% said they would avoid someone if they had AIDS and 23% believed that PHAs should not be allowed to attend government schools.[6] In Vietnam, 40% of physicians reported feeling somewhat uncomfortable touching HIV/AIDS patients during examination or treatment and 73% worried that they might contract HIV from their HIV patients.[5] It is encouraging that 83% of Belize physicians and nurses ($n = 230$) in 2008 reported feeling comfortable providing health services to PHAs. However, 45% of these same health care workers felt more sympathy for those who had acquired AIDS from blood transfusions than from intravenous drug use, and 21% felt "little sympathy for people who get AIDS from sexual promiscuity".[14] To date, no research has examined HIV stigma in Guyana or the relationship between HIV-related education and reductions in HIV-related stigma.

The main goal of this study was to examine levels of HIV awareness and gaps in HIV knowledge among health care students and pharmacists, and to examine how gaps in knowledge may relate to HIV stigma in Guyana. We expected that pharmacists would have higher HIV knowledge scores than students. Medical and pharmacy students were expected to have higher HIV knowledge scores than medical technology students.

A second goal was to assess the relationship between HIV knowledge and stigma among Guyanese pharmacists and health science students. We hypothesized that lower levels of HIV knowledge would be related to higher levels of HIV stigma.

A third goal of this study was to evaluate the utility of the PHSGP education initiative. To do so, we compared HIV knowledge levels among University of Guyana students who had received HIV training as part of the PHSGP to students who had not yet received this targeted HIV educational training. Students who received the PHSGP training in HIV were expected to have higher HIV knowledge scores than students without the training.

This study employed psychometrically validated measures to assess both general HIV knowledge and complex HIV treatment knowledge issues. To date, no research has examined HIV knowledge in Guyana, nor has research evaluated the impact of HIV training programs on students' HIV knowledge. This study aimed to identify the gaps in HIV knowledge that need to be addressed in tailoring new HIV educational training programs in Guyana and other developing countries.

2. Methods

2.1. Participants and procedures

Participants were university health science students and pharmacists in Georgetown, Guyana recruited from January 2007 through February 2007. First, second, and third year undergraduate students from the health sciences degree program (e.g., medicine, pharmacy, and medical technology students) were recruited during a health seminar series at the University of Guyana, Georgetown, and all students who attended the health seminar series participated in the study. Pharmacists were recruited during a continuing education workshop. Of the 45 pharmacists attending the continuing education workshop, 93% ($n = 42$) agreed to participate in this study. The three pharmacists who did not participate were late arrivals at the workshop. Although the 42 pharmacists who participated in this study were a convenience sample, these pharmacists provide a fairly good representative sample of the entire population of practicing pharmacists ($n = 133$) in the entire country of Guyana at the time of data collection (communication between the Registrar, The Pharmacy Council of Guyana and Dr Wallis Best Plummer). Pharmacists were chosen in this study because in Guyana pharmacists are frontline health care workers who typically have contact with HIV patients. The main language spoken in Guyana is English and all study participants were fluent in English.

All participants completed a socio-demographic questionnaire, HIV knowledge questionnaires, and an HIV stigma questionnaire. At the beginning of the seminar or workshop, participants were informed about the study goals and issues of confidentiality. All participants provided written informed consent prior to participating. The questionnaire package required about 15 minutes to complete. All aspects of the study were approved by the Institutional Review Board at the Ministry of Health, Guyana.

2.2. Measures

Socio-demographic characteristics were collected through a self-report measure which assessed participant gender, ethnicity, education, employment, and HIV training experience.

The HIV Brief Knowledge Questionnaire[15,16] was used to assess knowledge of HIV disease (e.g., transmission, progression, and

Table 1
HIV risk factor, transmission, and prevention knowledge (% correct) among students and pharmacists

Scale item[a]	Students %		Pharmacists % ($n = 42$)
	No PHSGP HIV training ($n = 23$)	PHSGP HIV training ($n = 54$)	
1. Coughing and sneezing DO NOT spread HIV. (T)	100	89	88
2. A person can get HIV by sharing a glass of water with someone who has HIV. (F)	96	89	98
3. Pulling out the penis before a man climaxes/cums keeps a woman from getting HIV during sex. (F)	83	93	100
4. A woman can get HIV if she has anal sex with a man. (T)	96	93	91
5. Showering, or washing one's genitals/private parts, after sex keeps a person from getting HIV. (F)	100	98	100
6. All pregnant women infected with HIV will have babies born with AIDS. (F)	74	85	86
7. People who have been infected with HIV quickly show serious signs of being infected. (F)	96	94	95
8. There is a vaccine that can stop adults from getting HIV. (F)	87	89	95
9. People are likely to get HIV by deep kissing, putting their tongue in their partner's mouth, if their partner has HIV. (F)	65	57	50
10. A woman cannot get HIV if she has sex during her period. (F)	91	96	100
11. There is a female condom that can help decrease a woman's chance of getting HIV. (T)	70	83	91
12. A natural skin condom works better against HIV than does a latex condom. (F)	48	63	74
13. A person will NOT get HIV if she or he is taking antibiotics. (F)	96	91	100
14. Having sex with more than one partner can increase a person's chance of getting infected with HIV. (T)	100	96	98
15. Taking a test for HIV one week after having sex will tell a person if she or he has HIV. (F)	74	85	93
16. A person can get HIV by sitting in a hot tub or a swimming pool with a person who has HIV. (F)	91	98	98
17. A person can get HIV from oral sex. (T)	74	70	62
18. Using Vaseline/baby oil with condoms lowers the chance of getting HIV. (F)	74	80	95

Note. Percentages are rounded to the nearest whole number. Correct responses appear in brackets, F, false; T, true. PHSGP, Public Health Strengthening in Guyana Project.
[a] Items from the Brief HIV Knowledge Questionnaire (Carey and Schroder, 2002).[16]

testing), with a response format of 'true', 'false', or 'don't know' (see Table 1 for scale items). A total score is calculated by summing the number of correct responses and dividing by the total number of scale items. This yields a percentage of correct responses, with higher scores indicating greater general HIV knowledge. The measure demonstrated good internal consistency across samples, with coefficient alphas ranging from 0.75 to 0.89.[9,16] This scale is reliable and well-validated.[15,16]

The validated 21-item self-report HIV Treatment Knowledge Scale[9] was used to assess knowledge about complex HIV treatment issues such as adherence, side-effects, and drug resistance (see Table 2 for scale items). Participants indicated whether each knowledge item was 'true' or 'false', or, if they 'don't know' the answer. A total score is calculated by summing the number of correct responses and dividing by the total number of scale items. This yields a percentage of correct responses, with higher scores indicating greater HIV treatment knowledge. This scale demonstrated good internal consistency (alpha = 0.90), test–retest reliability ($r = 0.81$), and validity in a number of samples, including HIV patients, health care workers, and university students in Canada.[9]

Table 2
HIV treatment knowledge (% correct) among students and pharmacists

Scale item[a]	Students %		Pharmacists % ($n = 42$)
	No PHSGP HIV training ($n = 23$)	PHSGP HIV training ($n = 54$)	
1. Once the HIV viral load results are 'undetectable', HIV medications should be stopped. (F)	65	70	88
2. If HIV medications are not taken at the right time of day, HIV drug resistance can occur. (T)	35	54	74
3. HIV is cured when the HIV viral load blood test result is 'undetectable'. (F)	61	83	100
4. Condoms during sex are not needed when the HIV viral load blood test results are at 'undetectable' levels. (F)	83	96	100
5. It is better to take a half dose of HIV medications than stopping the HIV combination medications completely. (F)	26	44	76
6. One can get infected with a drug-resistant type of HIV. (T)	48	57	71
7. HIV medications can cause unpleasant side effects (e.g., nausea, diarrhea, vomiting). (T)	74	83	95
8. If sexual partners are both HIV-positive condoms are no longer needed. (F)	78	94	95
9. Treatments are available to reduce HIV medication side effects. (T)	44	61	71
10. Recreational drugs (e.g., ecstasy) can affect the effectiveness of HIV medications. (T)	30	52	52
11. Providing HIV medications to a pregnant woman reduces the baby's risk of being infected with HIV. (T)	91	83	93
12. There currently exists an HIV vaccine that prevents HIV infection. (F)	57	65	76
13. HIV medications can be taken at a different time of day on weekends or holidays. (F)	52	52	86
14. Over-the-counter herbal pills (e.g., St. John's Wort) could make HIV medications less effective. (T)	26	15	50
15. It is best to stop HIV medications as soon as you feel better. (F)	100	96	100
16. Missing a few doses of HIV pills can increase the amount of HIV virus in the body. (T)	52	70	81
17. After a few months, it becomes less important to take HIV medications at the right time of day. (F)	78	91	98
18. HIV medications help the body's immune system get stronger (CD4 increase). (T)	70	80	81
19. When HIV medications work well, the HIV viral load increases. (F)	78	69	86
20. Taking antibiotic medication protects a person from getting infected with HIV. (F)	83	94	98
21. Physical exercise (e.g., yoga, tai chi) can help reduce stress levels in HIV patients. (T)	91	93	95

Note. Percentages are rounded to the nearest whole number. Correct responses appear in brackets, F, false; T, true. PHSGP, Public Health Strengthening in Guyana Project.
[a] Items from the HIV Treatment Knowledge Scale (Balfour et al., 2007).[9]

HIV stigma was assessed using an adaptation of the AIDS-related Stigma Scale.[17] The AIDS-related Stigma Scale is a brief, 12-item self-report measure that assesses attitudes in the general population regarding HIV stigma beliefs (e.g., repulsion, avoidance, and persecution) about individuals living with HIV/AIDS. The instrument is rated on a 4-point Likert-type scale (0 = strongly disagree to 3 = strongly agree), with higher scores indicating greater perceived HIV stigma. This scale was used in South African communities, and demonstrated good reliability (alpha = 0.72) and validity.[17–19]

2.3. Data analysis

All analyses were conducted using SPSS v.15 (SPSS Inc., Chicago, IL, USA). Data were initially screened in accordance with procedures outlined by Tabachnick and Fidell (2001), and statistical assumptions were evaluated.[20] Descriptive statistics were used to evaluate the percentage of correct responses on the HIV knowledge scales for each sample and to evaluate the responses to the individual scale items. One-way analysis of variance (ANOVA) was used to compare the percentage of correct responses to the HIV knowledge scales among the different student groups (e.g., medical vs. pharmacy vs. medical technology students). Independent samples *t*-tests were used to compare: HIV knowledge scores of students versus pharmacists, HIV knowledge scores of students who received the PHSGP training in HIV versus those who did not receive the PHSGP training in HIV, and the HIV stigma scores of students who received the PHSGP training in HIV versus those who did not receive the PHSGP training in HIV. Levene's test for equality of variances was used to assess for the assumption of homogeneity of variances. When this assumption was violated, a *t*-test for unequal variances was used, which accounts for heterogeneous variances. Effect sizes were calculated using Cohen's *d*, indicating small (>0.20), medium (>0.50), and large (>0.80) effects, and partial eta squared (η_p^2), indicating small (>0.01), medium (>0.06), and large (>0.14) effects.[21] Pearson product moment correlations were conducted to evaluate the relationship between HIV knowledge scores and HIV stigma.

3. Results

3.1. Participant characteristics

Ninety-three percent of pharmacists and 100% of students approached to participate in the study agreed to enroll in the study. The final sample (n = 119) consisted of health science students (n = 77) and pharmacists (n = 42). Socio-demographic characteristics for both samples are presented in Table 3. Over a third of the students (38%) were medical students, 33% were pharmacy students, and 30% were medical technology students, which parallels the proportion of students enrolled in each of these respective disciplines in the Health Sciences Program at The University of Guyana. Seven percent of students were in their first year at university, over half of the students (64%) were in their second year, and 30% were in their third year. Thus, most of the students sampled in this study were in the second and third years of their university degree programs in their respective health sciences disciplines, because the health seminar series was directed at second and third year university students.

Table 3
Demographics for health science students and pharmacists in Guyana

Variable	Health science students (n = 77)	Pharmacists (n = 42)
Age (mean ± SD)	20.80 ± 2.34[a]	34.18 ± 9.09
Sex		
Male	22 (28.9%)[a]	18 (42.9%)
Female	54 (71.1%)	24 (57.1%)
Ethnic background		
East Indian	39 (50.6%)	22 (52.4%)
African	16 (20.8%)	10 (23.8%)
Mixed (African/East Indian)	21 (27.3%)	8 (19.0%)
Amerindian	1 (1.3%)	1 (2.4%)

SD, standard deviation.
[a] Data missing for one participant.

Seventy percent (n = 54) of the students had received the PHSGP training in HIV while 30% (n = 23) of the students had not.

3.2. HIV and risk factor knowledge

The distribution of the Brief HIV Knowledge Scale was moderately negatively skewed, and a square root transformation corrected this violation of normality. Independent samples *t*-tests and one-way ANOVAs were conducted using the transformed Brief HIV Knowledge variable.

The mean scores on general HIV knowledge (Brief HIV Knowledge Scale) are presented in Table 4. As predicted, pharmacists (n = 42) reported significantly higher HIV knowledge (89.55% ± 7.28) than health science students (n = 77; 85.50% ± 10.36), $t(117) = 2.11$, $p < 0.05$, and the effect size was $d = 0.45$.

When the percentages of correct responses to the Brief HIV Knowledge Scale were compared across student groups (e.g., medical vs. pharmacy vs. medical technology students), no significant overall effect was observed, $F(2,74) = 2.46$, $p = 0.09$. An independent samples *t*-test revealed that, contrary to expectation, there was no statistically significant difference between students with PHSGP training in HIV and students without PHSGP training in HIV in terms of their general HIV knowledge, $t(75) = 0.568$, $p = 0.57$. The effect size, $d = 0.13$, was small.

The responses of students (with and without PHSGP training in HIV) and pharmacists to individual general HIV knowledge scale items are presented in Table 1.

3.3. HIV treatment knowledge

The mean scores on the HIV Treatment Knowledge Scale are presented in Table 4. As predicted, pharmacists (n = 42) reported significantly higher HIV treatment knowledge (84.13% ± 11.31)

Table 4
Mean percentage of correct responses to the HIV knowledge scales

Sample	n	Brief HIV Knowledge Scale, % ± SD	HIV Treatment Knowledge Scale, % ± SD	HIV Stigma Scale, mean ± SD
Students with no PHSGP HIV training	23	84.06 ± 11.88	62.94 ± 20.60[c]	1.64 ± 1.28
Students with PHSGP HIV training	54	86.11 ± 9.70	71.60 ± 16.49[c]	1.74 ± 1.60
Total students	77	85.50 ± 10.36[a]	69.02 ± 18.13[b]	1.67 ± 1.37
Total pharmacists	42	89.55 ± 7.28[a]	84.13 ± 11.31[b]	1.31 ± 1.28

Note. SD, standard deviation; PHSGP, Public Health Strengthening in Guyana Project. Means with same subscript are significantly different.
[a] Significant difference at $p \leq 0.05$.
[b] Significant difference at $p \leq 0.001$.
[c] Significant difference at $p \leq 0.05$.

Table 5
HIV-related stigma items endorsed by health sciences students and pharmacists

Scale item[a]	Students %		Pharmacists % ($n = 42$)
	No PHSGP HIV training ($n = 23$)	PHSGP HIV training ($n = 54$)	
1. People who have HIV/AIDS are cursed	0	0	0
2. It is safe for people who have HIV/AIDS to work with children	74	69	83
3. People who have HIV/AIDS should be ashamed	4	6	5
4. People who have HIV/AIDS have nothing to feel guilty about	65	65	76
5. People who have HIV/AIDS should be isolated	22	9	5
6. I do not want to be friends with someone who has HIV/AIDS	4	6	7
7. People who have HIV/AIDS should not be allowed to work	4	6	7
8. A person with HIV/AIDS must have done something wrong and deserves to be punished	0	2	2
9. People who have HIV/AIDS cannot be trusted	4	4	7
10. People with HIV/AIDS must expect some restrictions on their freedom	52	43	50
11. Most people become HIV-positive by being weak or foolish	22	26	7
12. People who have HIV/AIDS are dirty	0	0	0

Note. Percentages are rounded to the nearest whole number. PHSGP, Public Health Strengthening in Guyana Project.
[a] Items adapted from the AIDS-related Stigma Scale (Kalichman et al., 2005).[17]

than health science students ($n = 77$; 69.02% ± 18.13), $t(114.8) = 5.59$, $p < 0.001$. The effect size was large, $d = 1.0$.

The percentages of correct responses to the HIV Treatment Knowledge Scale were compared across student groups (e.g., medical students vs. pharmacy students vs. medical technology student). A one-way ANOVA indicated that the overall effect approached statistical significance, $F(2,74) = 2.98$, $p = 0.057$, and the effect size was medium, $\eta_p^2 = 0.07$. Post-hoc Tukey tests revealed that, as hypothesized, pharmacy students (74.48% ± 15.67) scored significantly higher on the HIV Treatment Knowledge Scale than medical technology students (62.11% ± 21.51), and the effect size was medium ($d = 0.66$). There was no statistically significant difference between the HIV Treatment Knowledge Scale scores of the medical students (69.79% ± 15.86) and pharmacy students, $p = 0.60$, nor between the medical students and medical technology students, $p = 0.27$, and the effect sizes were small, $d = 0.3$ and $d = 0.4$, respectively.

An independent samples *t*-test revealed, as expected, that students with PHSGP training in HIV (71.60% ± 16.49) had significantly higher HIV treatment knowledge scores than students without PHSGP training in HIV (62.94% ± 20.60), $t(75) = 1.96$, $p = 0.05$, and the effect size was $d = 0.46$.

Table 2 presents the responses to the HIV Treatment Knowledge Scale items for pharmacists, as well as students with and without PHSGP training in HIV.

3.4. HIV stigma levels

Overall, low levels of HIV stigma were endorsed by pharmacists and health science students (see Table 5). As expected, HIV stigma was significantly negatively correlated with general HIV knowledge among health science students ($n = 77$, $r = -0.23$, $p < 0.05$), and HIV stigma was significantly negatively correlated with HIV treatment knowledge among pharmacists ($n = 42$, $r = -0.49$, $p < 0.001$). Contrary to expectation, there was no statistically significant difference between students with PHSGP HIV training and students without PHSGP HIV training in terms of their HIV stigma, $t(75) = -0.30$, $p = 0.77$, and the effect size was small, $d = 0.07$.

4. Discussion

Overall, the level of general HIV knowledge regarding HIV risk factors, transmission, and prevention was high among both university health science students (85.50% correct) and pharmacists (89.55% correct). The main gaps in knowledge pertained to mother-to-child transmission, effective use of condoms, and the timeframe of HIV seroconversion. For example, more than 20% of students were unaware that using Vaseline with condoms increases the chance of HIV transmission. Further, many students and pharmacists were not aware that HIV could be transmitted through oral sex and 'natural skin' condoms. These results suggest that continuing HIV education initiatives need to be altered to specifically target these specific HIV transmission issues regarding sexual acts/behaviors which may not be easily discussed in Guyana due to cultural and religious beliefs.

There were no significant differences in general knowledge about HIV risk factors between students with HIV training (86.11% correct) versus those without HIV training (84.06% correct) suggesting that health science students' baseline knowledge of general HIV transmission risk factors is fairly good. There were, however, significant differences in HIV treatment knowledge between students with HIV training (71.60% correct) as compared to those without training (62.94% correct). This suggests that the PHSGP HIV training curriculum did help increase HIV treatment knowledge among health science students. However, even with PHSGP training, important gaps in HIV treatment knowledge still need to be addressed, specifically in terms of complex HIV treatment and transmission issues. That is, many health science students lacked an appreciation of the need for optimal HIV medication adherence and how poor adherence could contribute to HIV drug resistance. Furthermore, approximately 40% of the total sample of health science students incorrectly believed that there is a preventative HIV vaccine, and many did not understand the importance of adhering to the HIV medication-dosing schedule (e.g., many incorrectly believed that it was better to take half a dose of HAART than stop completely). It should be noted, that although we would expect medical technology students to have lower HIV treatment knowledge scores (62.11% correct), as compared to medical students (69.79% correct) and pharmacy students (74.48% correct), overall the scores across all three groups of students are sub-optimal.

In terms of comparing HIV treatment knowledge levels between students and pharmacists, health science students had lower levels of HIV treatment knowledge (69.02% correct) as compared to pharmacists (84.13% correct), indicating that students were less informed about more complex HIV treatment issues such as adherence, side-effects, and drug resistance. Although, the average HIV treatment knowledge score for pharmacists (84.13%) might seem acceptable, there were several key gaps in knowledge of concern. For example, only 71% of pharmacists knew that "one can become infected with a drug-resistant type of HIV". The public health care implications of this gap in HIV treatment knowledge among pharmacists, who are frontline HIV workers, could be quite harmful.

Pharmacists and health science students also had very low levels of knowledge on the potential impact of recreational drugs (e.g., ecstasy) and over-the-counter herbal pills (e.g., St. John's Wort) on the effectiveness of HIV medications. Although previous research using the HIV Treatment Knowledge Scale has identified that Canadian health care workers and students also have low scores on these scale items,[9] the Guyanese sample scored lower, possibly due to differences in social and cultural contexts. That is, ecstasy and St. John's Wort may not be common in Guyana, and perhaps item examples such as 'ganja' or 'bush medicine' may have been more relevant. Thus, items on the HIV Treatment Knowledge Scale item examples may need to be tailored to different contexts and countries so that future research is more culturally relevant.

This Guyanese samples' lack of awareness about the need for optimal HIV medication adherence and the risk of HIV drug resistance is consistent with findings among health care workers and social science students in Canada,[9] pharmacists in Scotland,[22] and pharmacists in South Africa.[23] The results of this and previous studies suggest that these HIV treatment issues warrant particular attention in targeted training programs for both health care students and workers in both developed and developing countries.

One of the potential negative effects of low HIV knowledge is health care worker stigma with regard to their perception of PHAs. Stigma is defined as a complex, multidimensional social and psychological phenomenon that discredits, disqualifies, and denies an individual societal acceptance as a whole person.[24–26] Stigmatized people lose social status, as they are not viewed as full members of society; they are rejected and marginalized. HIV is particularly stigmatizing because it is infectious, with visible physical signs of illness (e.g., wasting, Kaposi's sarcoma, lipodystrophy), and HIV is associated with sexual behavior, perceived personal responsibility (e.g., victim blaming), and negatively regarded social groups (e.g., injection drug users).[26,27] Among PHAs, HIV stigma may increase feelings of social isolation and shame, which contributes to fears of accessing HIV health care services and poorer HIV treatment success rates.[13,27–29]

Consistent with international research,[8] results of this study showed that pharmacists in Guyana who are less knowledgeable about HIV endorse higher levels of HIV stigma. Stigma may negatively impact the uptake of HIV knowledge, thereby potentially increasing the spread of HIV. For example, in a sample of 162 Kuwaiti family physicians, 90% disapproved of condom use to protect against HIV, 70% believed homosexuality is a psychiatric illness, and 84% would quarantine PHAs to stop the spread of HIV infection.[30] Researchers consistently demonstrate that health care workers who receive HIV training and become more knowledgeable about HIV are less likely to hold exaggerated fears of contracting HIV and are less likely to refuse to work with PHAs.[8,30,31]

In the current study, pharmacists and health science students in Guyana did not report extreme levels of HIV stigma. That is, the samples did not report that PHAs are 'cursed', 'dirty', or 'deserve to be punished'. However, more subtle forms of HIV stigma were present. For example, almost 25% of pharmacists sampled in Guyana believed people with HIV/AIDS should feel guilty, and 50% believed that PHAs must expect some restrictions on their freedom. The results of the present study also suggest that more subtle forms of HIV stigma were related to HIV knowledge, and that these more subtle expressions of stigma need to be addressed in HIV educational curriculums.

While the backbone of comprehensive HIV educational programs must always focus on up to date medical knowledge about HIV risk factors, modes of transmission, clinical symptoms, and HIV treatment options, it is also important to highlight the emotional impact of subtle forms of HIV stigma. Unfortunately, most HIV educational training programs neglect the emotional aspects of working with people who are living with HIV (PHAs). Training initiatives are needed to raise health care workers' awareness of how PHAs experience social rejection, emotional isolation, depression, discrimination, fears of abandonment, and stigma. As well, sensitivity training to help health care workers reflect on their own conscious and unconscious feelings, attitudes, and comfort level in discussing topics such as anal sex, oral sex, sex for money, condom use, street drug use, and pregnancy attempts among HIV-positive couples is important. Discomfort in discussing any of these topics could influence the full scope of how health care providers approach, assess, and counsel their patients. In Barbados, 76% of physicians felt that they lacked the skills to counsel HIV-positive patients.[32] Thus, it is imperative that HIV educational programs provide training workshops on strategies to facilitate more open communication and dialogues with PHAs regarding sensitive topics, such as sex and drug use.

There are several limitations to this study. First, the PHSGP curriculum on HIV knowledge in health science students was evaluated using a cross-sectional design, not a controlled pre–post design. However, no prior studies have evaluated the impact of such initiatives on HIV knowledge levels in Guyana. The current study provides a much-needed indication of the effectiveness of the PHSGP educational initiative. Future longitudinal studies should assess health science students' HIV knowledge levels before and after the PHSGP course at the University of Guyana. We recommend that program outcome evaluation using psychometrically validated instruments like those in this study be considered from the outset when planning and developing future HIV educational initiatives.

A second limitation is that the sample size is small, thus potentially reducing the reliability of the results. As well, the current study used a convenience sample of pharmacists and it is unclear how results obtained from these pharmacists would generalize to other health care workers in Guyana (e.g., nurses, physicians). Nonetheless, given the low base rates of total pharmacists practicing in Guyana ($n = 133$), the participants sampled in this study were reasonably representative of practicing pharmacists in Guyana. Future research could assess HIV knowledge and stigma in a broader sample of health care workers in both urban and more remote rural communities in Guyana.

Another limitation is that the HIV knowledge scales used in the study were developed and validated in North America.[9,15,16] In addition, the AIDS-related stigma scale used in the study was developed and validated in South Africa.[17–19] As noted earlier, some of the scale items may not be as culturally relevant in Guyana. Thus, future research needs to validate and adapt the HIV knowledge items and HIV stigma items to ensure greater cross-cultural sensitivity and relevance.

In conclusion, the PHSGP curriculum significantly enhanced HIV knowledge in health sciences students in Guyana, yet some gaps in HIV knowledge still need to be addressed. Educational initiatives for pharmacists and health science students aimed at increasing HIV knowledge and reducing HIV stigma are important steps towards reducing fears of treating HIV, enhancing HIV prevention efforts, improving medical access to HIV care, and ultimately improving HIV treatment outcomes. Addressing HIV knowledge and psychosocial aspects of HIV stigma are cornerstones to optimizing the fight against HIV worldwide.

Acknowledgements

We would like to acknowledge Ms R. Benedict and Dr Curtis Lafleur for providing valued assistance in coordinating this study. We would also like to thank Dr Karam Ramotar as our group leader in this project and collaboration. In addition, we would like to thank the wonderful pharmacy students who assisted with data collection.

Funding: This study was partially supported by the Public Health Strengthening in Guyana Project – a bilateral project between the governments of Guyana and Canada, managed by the Canadian Society for International Health (CSIH), and undertaken with the financial support of the Government of Canada, provided through the Canadian International Development Agency (CIDA). D.W. Cameron is supported as a Career Scientist of the Ontario Ministry of Health (Ontario HIV Treatment Network). P.A. MacPherson is supported by a CIHR New Investigator Award. This study was also supported by a capacity building grant from the Canadian Institute of Health Research (CIHR). The investigators had full autonomy in the study conceptualization, design, data collection, data analysis, interpretation of results, writing of the manuscript, and in the decision to submit the manuscript for publication.

Ethical approval: All aspects of the study were approved by the Institutional Review Board at the Ministry of Health, Guyana.

Conflict of interest: No competing interest declared.

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