HIV risk, risk perception and uptake of HIV testing and counseling among youth men who have sex with men attending a gay sauna

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Abstract

Background: Men who have sex with men (MSM) are amongst populations at-risk for HIV acquisition in Thailand. In youth MSM (aged 15–24 years), the incidence of HIV infection has substantially increased. However, data on HIV risk, risk perception and HIV testing and counseling (HTC) uptake among youth MSM in hotspots are limited.

Methods: A subanalysis of a prospective study among Thai MSM attending a gay sauna was conducted. HIV risk and risk perception were assessed by an anonymous survey. The MSM were categorized as having actual “low-risk”, “moderate-risk” and “high-risk” for HIV acquisition based on the validated study risk categorization tool. HTC was provided on-site with result notification within 1 h. HIV care establishment appointment was arranged by the counselors for HIV-infected participants. Care engagement within 1 year of diagnosis was subsequently assessed.

Results: There were 358 MSM participants; 87 (24%) were youth MSM. Comparing to other MSM, youth MSM had significantly higher median number of lifetime sexual partners [2 (IQR 1–9) vs. 1 (IQR 0–1); P < 0.001], were more-likely to ever exchange sex for money (44% vs. 9%; P < 0.001) and have sexual partner who exchanged sex for money (8% vs. 1%; P < 0.001). Rates of consistent condom use in the past 3 months for anal, oral and vaginal sex were low and not significantly different between youth and other MSM (51% vs. 61%, 26% vs. 35% and 72% vs. 61%, respectively). By using the study risk categorization tool, there were 68 youth MSM with moderate or high-risk for HIV acquisition, of which 43 (63%) had false perception of low HIV risk. Youth MSM were more likely than other MSM to accept HTC [68% vs. 33%, P < 0.001] and to be first-time testers (42% vs. 28%, P = 0.07). By HTC, the rates of HIV infection tended to be higher among youth MSM comparing to other MSM [14/59 (24%) vs. 11/89 (12%); P = 0.07]. Among the 14 youth MSM newly-diagnosed with HIV infection, only 6 (43%) showed-up for continuity care after 1-year follow-up.

Conclusions: Youth MSM had substantial high HIV risk, false perception of low HIV risk and low rate of care engagement but demonstrated considerable rate of HTC uptake. Strategies to improve access to HTC, risk perception and linkage to care are needed for HIV prevention and management among the youth MSM.

Keywords: Human immunodeficiency virus, Testing and counseling, Risk perception, Linkage to care, Youth, Men who have sex with men, Thailand

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Background

Men who have sex with men (MSM) have been significantly affected by HIV infection in Thailand. Despite the overall decline in the prevalence of HIV infection in Thai general population, the HIV prevalence of Thai MSM has increased from 8.0% in 2010 to 9.2% in 2015 [1]. Unawareness of own HIV status and risk behaviors including having multiple sexual partners, high rates of partner change, unprotected sexual intercourse and drug use for sex pleasure were shown to be associated with the ongoing HIV transmission among the MSM population [2]. In the recent observational cohort study [3], young MSM (aged 15–22 years old) were reported to have highest risk for HIV infection among the participating MSM in Bangkok, Thailand with the estimated HIV incidence increasing from 4.1 in 2003 to 7.6 per 100 person-years in 2014. Playing receptive anal sex role and drug use with sex have increased overtime while the rates of consistent condom use and prior HIV test were lower than 50% [3]. These findings suggest the need for more determined and rigorous HIV prevention efforts to stop the HIV epidemic among these young MSM.

The United States Centers for Disease Control and Prevention (CDC) has recommended targeted HIV testing for persons at high-risk for HIV infection including MSM [4]. However, a study from the US revealed that only 28% of young MSM received HIV tests despite that they accounted for 83% of new diagnoses of HIV infection among all youths in non-health care facilities [5]. In addition, another study demonstrated that the rate of HIV-infected young MSM who were unaware of their infection was 52% compared to the rate of 15% among other HIV-infected persons [6]. In Thailand, targeted HIV interventions for MSM including HIV testing and counseling (HTC) and referral for HIV care, condom promotion and distribution, and sexually transmitted infection (STI) treatment, have been implemented nationwide for the past decade. However, the uptake of such interventions and preventive services has been less than 50% since 2010 [1]. The low-level uptake may be partly due to the unmet need for different approaches to reach the MSM, especially those in venue-based settings or those require peer-outreach and social network approaches. These suggest that strategic and innovative approaches to reach and recruit the diverse groups of MSM are required for HIV case finding and prevention. Nonetheless, studies on HIV risk perception and feasibility and uptake of HTC, HIV care referral and preventive services are currently limited among Thai MSM and have not specifically focused on young MSM from hotspots [2, 3].

This study was conducted to assess HIV risks, risk behaviors, HIV transmission prevention knowledge, HIV risk perception, HTC uptake, HIV infection and care engagement among youth MSM in comparison to other MSM from a hotspot.

Methods

Study design, population and setting

A subanalysis of the 3-year prospective cohort study among MSM aged at least 18 years old who attended a gay sauna in Thailand was conducted. The original study period was from 1 November 2013 to 31 October 2016 [7]. This study was approved by the Human Ethics Committee of Faculty of Medicine, Thammasat University.

Study protocol

The original study aims to assess active targeted HTC and linkage to care after known HIV infection among MSM visiting a gay sauna in Thailand [7]. The research team consisted of an Infectious Diseases physician, two HIV counselors, two laboratory technicians, and two volunteers from a gay community-based organization. All MSM attending the gay sauna were approached and asked to participate in the study by the research team upon entering the sauna. Informed consent was obtained from the MSM for both anonymous survey and HTC participation. Study identification numbers derived from the MSM’s initials and year of birth were used to prevent repeat enrollment. Knowledge about HIV infection and transmission prevention was assessed via a survey form which required the MSM to answer “true”, “false” or “do not know” in response to the statements about HIV infection. The knowledge was quantified by the proportion of MSM who responded to each statement correctly. Demographics, HIV risks, risk behaviors and risk perception were collected via a survey form completed by the MSM in a private room.

HIV testing and counseling procedures

The participating MSM were asked whether they would like to be tested for HIV infection. Reasons for accepting or declining HIV testing were recorded. MSM who accepted HTC were pre-test counseled and asked about their previous HIV status. Known HIV-infected MSM were excluded. Anti-HIV test was performed on-site and all testers were informed of the results within 1 h. Post-test counseling was conducted by the HIV counselors in the team. In order to make follow-up calls for HIV-infected MSM, the primary contact information was recorded. The counselors subsequently discussed with HIV-infected MSM about their plans for HIV continuity care. For follow-up, the counselors called the HIV-infected MSM every month for 1-year period to assess HIV care establishment. Further support and
advice for care establishment were provided to those who had not yet established HIV care.

**Study definition**
Youth MSM was defined as MSM who were 15–24 years old [8]. Since we included MSM who were 18 years old and older, the youth MSM in this study were 18–24 years old. Sexual orientation and HIV risk perception were self-identified by the MSM within the survey.

If the MSM reported having sex with only male, they were classified as homosexual MSM while those who reported having sex with both sexes were classified as bisexual MSM. The MSM identified their own HIV risks by choosing “low-risk”, “moderate-risk” and “high-risk” in the survey. The investigators then assessed the participants’ risk as “low-risk”, “moderate-risk” and “high-risk” based on the pre-specified risk characteristics and behaviors reported in the survey (Table 1). Only one characteristic or behavior that met the certain risk level was required to classify the participants into that risk level. The participants were classified to have the highest risk level they had. This risk categorization tool was validated among in the previous study for use in differentiating participants with different levels of HIV risks [9]. MSM who had false perception of low HIV risk were those who had moderate or high-risk by the risk categorization tool but perceived their risks as low risk.

**Data analyses**
Characteristics, HIV risks and risk behaviors, knowledge about HIV infection and transmission prevention, HIV risk perception, HTC acceptance and linkage to care were compared between youth and other MSM. All statistical analyses were performed using SPSS version 15.0 (SPSS, Chicago, Illinois). Categorical variables were compared using Pearson’s χ² or Fisher’s exact test as appropriate. Continuous variables were compared using Mann–Whitney U test. All P values were 2 tailed; P values less than 0.05 were considered statistically significant. Variables associated with declining HTC and HIV infection with a significance level of P < 0.20 were entered into multivariable logistic regression model in stepwise backward fashion. Significant variables that were thought to be covariates were grouped, and only one variable from each group was chosen for model entry. The model’s overall robustness was confirmed by Hosmer–Lemeshow goodness-of-fit statistic. Adjusted odd ratios (aORs) and 95% confidence intervals (CIs) were calculated for risk factors associated with declining HTC and HIV infection.

### Table 1 Human immunodeficiency virus (HIV) risk stratification according to the pre-specified reported characteristics and behaviors of the men who have sex with men participants

| Characteristics and behaviors | HIV risk |
|------------------------------|----------|
|                              | Low | Moderate | High |
| Number of different sexual partners within 30 days | | | |
| 0–1                          | ✓   |          |      |
| 2–3                          |     | ✓        |      |
| > 3                          |     |          | ✓    |
| Number of new sexual partners within 30 days | | | |
| 0–1                          | ✓   |          |      |
| 2–3                          |     | ✓        |      |
| > 3                          |     |          | ✓    |
| Using condom with vaginal sex | | | |
| Always                       | ✓   |          |      |
| Most of the time             |     | ✓        |      |
| About a half of time         |     |          | ✓    |
| Sometimes                    |     | ✓        |      |
| Never                        |     |          |      |
| Using condom with oral sex   | | | |
| Always                       | ✓   |          |      |
| Most of the time             |     | ✓        |      |
| About a half of time         |     |          | ✓    |
| Sometimes                    |     | ✓        |      |
| Never                        |     |          |      |
| Using condom with anal sex   | | | |
| Always                       | ✓   |          |      |
| Most of the time             |     | ✓        |      |
| About a half of time         |     |          | ✓    |
| Sometimes                    |     | ✓        |      |
| Never                        |     |          |      |
| Exchanging sex for money     | | | |
| No                           | ✓   |          |      |
| Yes                          |     |          |      |
| Drinking alcohol with sex within 30 days | | | |
| Never                        | ✓   |          |      |
| Sometimes                    |     | ✓        |      |
| About a half of time         |     |          | ✓    |
| Most of the time             |     | ✓        |      |
| Always                       |     | ✓        |      |
| Using drug with sex within 30 days | | | |
| Never                        | ✓   |          |      |
| Sometimes                    |     | ✓        |      |
| About a half of time         |     |          | ✓    |
| Most of the time             |     | ✓        |      |
| Always                       |     | ✓        |      |
| Ever injected drug with needles | | | |
| No                           | ✓   |          |      |
| Yes                          |     |          |      |
Results

Characteristics and HIV knowledge of the study participants

A total of 358 MSM participated in the original study. Demographics characteristics of the participating MSM are shown in Table 2. Most of the MSM were company workers, single, and originally from Bangkok, had highest education of bachelor degree or higher and had monthly household income of $US 1800 or less. Of the 358 MSM, 87 (24%) were youth MSM. Comparing between youth and other MSM, youth MSM were more likely to be college or university students, originally from outside Bangkok, had lower highest education level and monthly household income (Table 2). In regards to knowledge about HIV, most of the MSM (≥ 80%) responded to the survey statements correctly (Table 3), except for the statements “you can get HIV from oral sex” and “a vaccine that can prevent HIV is currently available”. Significantly less proportion of the youth MSM compared to other MSM correctly responded to the statements “a mosquito can transmit HIV”, “you can get HIV from dining with an infected person”, “getting high by using drugs increases risk of getting HIV”, “you can get HIV from tattooing” and “a vaccine that can prevent HIV is currently available” (Table 3).

HIV risks, risk behaviors and risk perception of the study participants (Table 4)

Of the 358 MSM, 58% were homosexual and 17% reported history of exchanging sex for money. The rates of consistent condom use for vaginal, oral and anal sex were 64%, 33% and 59%, respectively. Among the 151 MSM who reported drinking alcohol within 30 days, 75 (50%) reported drinking alcohol with sex. Twenty-two MSM reported having STIs within the past year, of which 12 (55%) had gonorrhea. Compared to other MSM, youth MSM had significantly higher median number of new and different sexual partner within the last month (2 vs. 1; P < 0.001), were more-likely to exchange sex for money (44% vs. 9%; P < 0.001) and have sexual partner who exchanged sex for money (8% vs. 1%; P < 0.001). By using the study risk categorization tool, 262 of the 358 MSM had moderate or high risk for HIV acquisition, of which 172 (66%) had false perception of low HIV risk. The rates of false perception of low HIV risk were not significantly different between youth MSM and other MSM (63% vs. 66%). Among MSM with low HIV risk, only 1 of 19 (5%) youth MSM and none of other MSM perceived themselves at high-risk for HIV acquisition.

HIV testing and counseling acceptance

Of the 358 MSM in this study, 210 declined HTC. Significantly less proportion of youth MSM than other MSM declined HTC (32% vs. 67%; P < 0.001). The three most common reasons for declining HTC for youth MSM were prior HIV test within 6 months (50%), not ready (36%) and considering the gay sauna as an inappropriate place for HIV testing (7%), while the three most common reasons for other MSM were prior HIV test within 6 months (47%), not ready (16%) and perceiving no risk for HIV infection (13%) (Table 5). Other reasons for declining HTC are shown in Table 5. When excluding MSM who reported having prior HIV test within 6 months, youth MSM were more likely than other MSM to accept HTC (68% vs. 33%) and to be first-time testers (42% vs. 28%). In multivariable logistic regression analysis adjusted by education level, birthplace and monthly household income, self-perceived low HIV risk (aOR 2.18; 95% CI 1.11–4.29; P = 0.02) and low HIV risk as defined by the study risk categorization tool (aOR 2.33; 95% CI 1.17–4.62; P = 0.02) increased the likelihood of MSM to decline HTC, while being youth reduced that chance (aOR 0.31; 95% CI 0.15–0.62; P = 0.01) (Table 6). Other characteristics including occupation, marital status and

Table 1 (continued)

| Characteristics and behaviors | HIV risk |
|------------------------------|---------|
|                              | Low     | Moderate | High    |
|------------------------------|---------|----------|---------|
| Ever shared needle to inject drugs | √       |          |         |
| Sometimes                    |         | √        |         |
| About a half of time         |         | √        |         |
| Most of the time             |         | √        |         |
| Always                       |         | √        |         |
| Ever been in a jail or a prison | √       |          |         |
| History of STIs within the past year | √       |          |         |
| Yes                          |         |          |         |
| No                           |         |          |         |
| Yes/not sure                 |         |          |         |
| Sexual partner had STIs within the past year | √       |          |         |
| No                           |         |          |         |
| Yes/not sure                 |         |          |         |
| Sexual partner had exchanged sex for money or drugs within 30 days | √       |          |         |
| No                           |         |          |         |
| Yes/not sure                 |         |          |         |
| Sexual partner had used drug within 30 days | √       |          |         |
| No                           |         |          |         |
| Yes/not sure                 |         |          |         |
| Sexual partner had been in a jail or a prison | √       |          |         |
| No                           |         |          |         |
| Yes/not sure                 |         |          |         |

STIs, sexually transmitted infections
sexual orientation were not associated with declining HTC.

**HIV test outcomes and linkage to care**

Of the 148 MSM accepting HTC, 50 were first-time testers and 25 (17%) had HIV infection (Table 7). There was a trend toward significance of higher proportion of first-time testers and HIV-infected persons among youth MSM compared to other MSM [(42% vs. 28%; \(P = 0.07\)) and (24% vs. 12%; \(P = 0.07\), Table 7). In multivariable logistic regression analysis adjusted by HIV risk determined by the study tool, education level and MSM group, factors associated with HIV infection were false perception of low HIV risk (aOR 3.81; 95% CI 1.37–10.62; \(P = 0.01\)) and monthly household income of less than $US 450 (aOR 3.16; 95% CI 1.03–9.67; \(P = 0.04\)) (Table 8). Of the 25 MSM who were newly diagnosed with HIV infection, 12 (48%) established HIV continuity care within 1 year of the diagnosis at a median (interquartile range) time from diagnosis to HIV care of 24 (6–71) days. There was no significant difference between youth MSM and other MSM in proportion of persons who established HIV continuity care (Table 7). Given the small number of MSM who could be assessed for linkage to care (N = 25), we did not analyze and determine factors association with linkage to care.

**Discussion**

The study findings indicated that significantly higher proportion of youth MSM than other MSM accepted HTC during our outreach program to promote HIV “Test and Treat” and HIV prevention at the gay sauna and being youth MSM was identified as an independent factor associated with HTC acceptance in our multivariable

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**Table 2 Demographic characteristic of men who have sex with men (MSM) participants**

| Characteristic                              | All (N = 358) | Youth MSM (N = 87) | Other MSM (N = 271) | \(P^a\) |
|---------------------------------------------|---------------|-------------------|---------------------|--------|
| Occupation                                  |               |                   |                     | <0.001 |
| Company worker                              | 203 (57)      | 35 (40)           | 168 (62)            |        |
| Merchant                                    | 54 (15)       | 1 (1)             | 53 (20)             |        |
| College/University student                  | 51 (14)       | 42 (48)           | 9 (3)               |        |
| Government officer                          | 39 (11)       | 4 (5)             | 35 (13)             |        |
| Unemployed                                  | 10 (2.7)      | 5 (6)             | 5 (1.7)             |        |
| Housemaid                                   | 1 (0.3)       | 0 (0)             | 1 (0.3)             |        |
| Birthplace                                  |               |                   |                     | 0.03   |
| Bangkok                                     | 169 (47)      | 31 (36)           | 138 (51)            |        |
| Central Western and Eastern Thailand        | 73 (20)       | 16 (19)           | 57 (21)             |        |
| Northeastern Thailand                       | 60 (17)       | 22 (25)           | 38 (14)             |        |
| Northern Thailand                           | 42 (12)       | 28 (16)           | 28 (10)             |        |
| Southern Thailand                           | 14 (4)        | 10 (5)            | 10 (4)              |        |
| Marital status                              |               |                   |                     | 0.78   |
| Single                                      | 264 (74)      | 67 (77)           | 197 (73)            |        |
| Living separate with partner                | 49 (13)       | 11 (13)           | 38 (14)             |        |
| Living with domestic partner                | 31 (9)        | 7 (8)             | 24 (9)              |        |
| Married                                     | 14 (4)        | 2 (2)             | 12 (4)              |        |
| Highest education                           |               |                   |                     | <0.001 |
| Less than primary school                    | 7 (2)         | 5 (6)             | 2 (0.7)             |        |
| Primary school                              | 8 (2)         | 7 (8)             | 1 (0.3)             |        |
| High school                                 | 101 (28)      | 40 (46)           | 61 (23)             |        |
| Bachelor’s degree                           | 177 (50)      | 33 (38)           | 144 (53)            |        |
| Higher than bachelor’s degree               | 65 (18)       | 2 (2)             | 63 (23)             |        |
| Monthly household income                    |               |                   |                     | <0.001 |
| Less than $US 450                           | 37 (10)       | 23 (26)           | 14 (5)              |        |
| $US 450–$US 1800                            | 182 (51)      | 48 (55)           | 134 (49)            |        |
| $US 1801–$US 4500                           | 84 (24)       | 6 (7)             | 78 (29)             |        |
| More than $US 4500                          | 55 (15)       | 10 (12)           | 45 (17)             |        |

Data are in numbers (%) unless otherwise indicated

* Comparison between youth MSM and other MSM
In addition, a significant number of these youth MSM were first-time testers. These findings suggest the feasibility and opportunity to scale up HTC, linkage to care and HIV transmission prevention programs among at-risk youth MSM in hotspot settings in Thailand. Being unready to be tested was the main reason among MSM who declined and had not had HTC in the past 6 months. This lack of readiness could be related to issues regarding the need for more time to prepare themselves in order to know and accept their HIV test results. This reason was reported more among youth MSM. Thus, strategies such as spending more time in activities to prepare and educate youth MSM for HTC during the outreach program may be necessary. Other factors previously reported to be associated with HTC declining among young MSM were non-employment status, high HIV stigma score, low education level and low knowledge about HIV transmission prevention [10–12] while barriers to HTC included lack of awareness or knowledge about HIV testing, fear of result, fear of rejection, fear of disclosure, limited access to HTC, and unfriendly environment of HIV testing places [13, 14]. Altogether, the associated factors and reasons for HTC declining as well as barriers to HTC need to be considered for implementing HTC and transmission prevention program among youth MSM. Our HTC outreach program could serve as a model to bring out the awareness of and access to friendly HTC services to MSM.

Our study revealed that most of the youth MSM correctly responded to the survey statements indicating general high level of knowledge about HIV infection. However, there were specific topics (proportion of correct responses to the statements) that youth MSM had less knowledge than other MSM. These included routes of HIV transmission (69–77%), drug use and risk of HIV acquisition (74%) and HIV vaccine (29%). Education emphasized on these specific topics should be provided for youth MSM during the outreach program. Despite the high level of knowledge of HIV infection, several HIV risks and risk behaviors among youth MSM were reported in this study. The rates of consistent condom use for oral and anal sex were about 50% or less and were not significantly different between youth and other MSM. Nonetheless, youth MSM had significantly more different and new sexual partners within the past month and higher proportion of them exchanged sex for money and had sexual partner who exchanged sex for money compared to other MSM. The low rate of consistent condom use for oral and anal sex were about 50% or less and were not significantly different between youth and other MSM. Nonetheless, youth MSM had significantly more different and new sexual partners within the past month and higher proportion of them exchanged sex for money and had sexual partner who exchanged sex for money compared to other MSM. The high number of sexual partner and the high rate of exchanging sex for money were consistent with the results from a Thai study among MSM recruited from gay entertainment sites and community-based organizations [11]. These findings suggest the need for interventions to reduce HIV risk behaviors among youth MSM.

## Table 3 Knowledge about HIV infection among the men who have sex with men (MSM) participants

| Statement (correct answer) | All (N = 358) | Youth MSM (N = 87) | Other MSM (N = 271) | \( P^a \) |
|---------------------------|--------------|-------------------|---------------------|------|
| HIV infection causes by a virus (True) | 350 (98) | 84 (97) | 266 (98) | 0.41 |
| A mosquito can transmit HIV (False) | 286 (80) | 60 (69) | 226 (83) | 0.003 |
| You can get HIV from dining with an infected person (False) | 309 (86) | 67 (77) | 242 (89) | 0.004 |
| You can get HIV from vaginal sex (True) | 336 (94) | 84 (97) | 252 (93) | 0.31 |
| You can get HIV from anal sex (True) | 343 (96) | 83 (95) | 260 (96) | 0.77 |
| You can get HIV from oral sex (True) | 275 (77) | 65 (75) | 210 (78) | 0.59 |
| Having multiple sexual partners increases risk of getting HIV (True) | 348 (87) | 84 (97) | 264 (97) | 0.71 |
| Consistent condom use with sex decreases risk of getting HIV (True) | 353 (99) | 86 (99) | 267 (99) | 1.00 |
| Exchanging sex for money increases risk of getting HIV (True) | 340 (95) | 82 (94) | 258 (95) | 0.72 |
| Getting high by using drugs increases risk of getting HIV (True) | 294 (82) | 64 (74) | 230 (85) | 0.02 |
| You can get HIV from tattooing (True) | 320 (90) | 72 (83) | 249 (92) | 0.02 |
| You can get HIV from using a shared needle (True) | 349 (98) | 85 (98) | 264 (97) | 1.00 |
| An HIV-infected person can be asymptomatic for many years (True) | 327 (91) | 79 (91) | 248 (92) | 0.84 |
| An asymptomatic HIV-infected person can transmit HIV (True) | 336 (94) | 84 (97) | 252 (93) | 0.31 |
| A blood test is required for HIV diagnosis (True) | 292 (82) | 68 (78) | 224 (83) | 0.35 |
| A vaccine that can prevent HIV is currently available (False) | 151 (42) | 25 (29) | 126 (37) | 0.004 |
| Antiretroviral therapy can increase lifespan of an HIV-infected person (True) | 304 (85) | 71 (82) | 233 (86) | 0.32 |

Data are in numbers (%) of participants with a correct answer for each statement

* Comparison between youth and other MSM
Table 4 HIV risk, risk behaviors and risk perception of all men who have sex with men (MSM) participants

| Characteristics                                      | All (N = 358) | Youth MSM (N = 87) | Other MSM (N = 271) | P^a |
|------------------------------------------------------|---------------|--------------------|--------------------|-----|
| Sexual orientation                                   |               |                    |                    | 0.50|
| Homosexual                                           | 207 (58)      | 53 (61)            | 154 (57)           |     |
| Bisexual                                             | 151 (42)      | 34 (39)            | 117 (43)           |     |
| Number of different sexual partners for the last 1 month (median, IQR) | 1 (1–3)       | 2 (1–9)            | 1 (0–2)            | <0.001|
| Number of new sexual partners for the last 1 month (median, IQR) | 1 (1–2)       | 2 (1–9)            | 1 (0–2)            | <0.001|
| Having vaginal sex                                   | 135 (38)      | 32 (37)            | 103 (38)           | 0.84|
| Condom use with vaginal sex                          |               |                    |                    | 0.04|
| Always                                               | 86/135 (64)   | 23/32 (72)         | 63/103 (61)        |     |
| Most of the time                                     | 25/135 (19)   | 3/32 (9)           | 22/103 (21)        |     |
| About a half of time                                 | 9/135 (7)     | 5/32 (16)          | 4/103 (4)          |     |
| Sometimes                                            | 8/135 (6)     | 1/32 (3)           | 7/103 (7)          |     |
| Never                                                | 7/135 (5)     | 0/32 (0)           | 7/103 (7)          |     |
| Having oral sex                                      | 316 (88)      | 77 (89)            | 239 (88)           | 0.94|
| Condom use with oral sex                             |               |                    |                    | 0.10|
| Always                                               | 103/316 (33)  | 20/77 (26)         | 83/239 (35)        |     |
| Most of the time                                     | 66/316 (21)   | 20/77 (26)         | 46/239 (19)        |     |
| About a half of time                                 | 40/316 (13)   | 13/77 (17)         | 27/239 (11)        |     |
| Sometimes                                            | 62/316 (20)   | 18/77 (23)         | 44/239 (18)        |     |
| Never                                                | 45/316 (14)   | 6/77 (8)           | 39/239 (16)        |     |
| Having anal sex                                      | 345 (96)      | 87 (100)           | 258 (95)           | 0.04|
| Condom use with anal sex                             |               |                    |                    | 0.32|
| Always                                               | 202/345 (59)  | 44/87 (51)         | 158/258 (61)       |     |
| Most of the time                                     | 68/345 (20)   | 18/87 (21)         | 50/258 (20)        |     |
| About a half of time                                 | 37/345 (11)   | 14/87 (16)         | 23/258 (9)         |     |
| Sometimes                                            | 28/345 (8)    | 8/87 (9)           | 20/258 (8)         |     |
| Never                                                | 10/345 (3)    | 3/87 (3)           | 7/258 (3)          |     |
| Exchanging sex for money                             | 62 (17)       | 38 (44)            | 24 (9)             | <0.001|
| Drinking alcohol with sex within 30 days              |               |                    |                    | 0.40|
| Never                                                | 76/151 (50)   | 26/46 (57)         | 50/105 (48)        |     |
| Sometimes                                            | 42/151 (28)   | 12/46 (26)         | 30/105 (29)        |     |
| About a half of time                                 | 17/151 (11)   | 5/46 (11)          | 12/105 (11)        |     |
| Most of the time                                     | 12/151 (8)    | 1/46 (2)           | 11/105 (11)        |     |
| Always                                               | 4/151 (3)     | 2/46 (4)           | 2/105 (4)          |     |
| Using drug with sex within 30 days                   |               |                    |                    | 0.61|
| Never                                                | 3/13 (23)     | 1/4 (25)           | 2/9 (22)           |     |
| Sometimes                                            | 7/13 (54)     | 3/4 (75)           | 4/9 (44)           |     |
| About a half of time                                 | 2/13 (15)     | 0/4 (0)            | 2/9 (22)           |     |
| Most of the time                                     | 0/13 (0)      | 0/4 (0)            | 0/9 (0)            |     |
| Always                                               | 1/13 (8)      | 0/4 (0)            | 1/9 (11)           |     |
| History of STIs within the past year                 |               |                    |                    | 0.94|
| Yes                                                  | 22 (6)        | 6 (7)              | 16 (6)             |     |
| Not sure                                             | 13 (4)        | 3 (3)              | 10 (4)             |     |
| No                                                   | 323 (90)      | 78 (90)            | 245 (90)           |     |
| Type of STIs within the past year^b                  |               |                    |                    |     |
| Gonorrhea                                            | 12/22 (55)    | 4/6 (67)           | 8/16 (50)          | 0.65|
| Herpes simplex infection                             | 6/22 (27)     | 2/6 (33)           | 4/16 (25)          | 1.00|
| Genital wart                                         | 4/22 (18)     | 0/6 (0)            | 4/16 (25)          | 0.54|
| Syphilis                                             | 1/22 (5)      | 0/6 (0)            | 1/16 (7)           | 1.00|
| Unknown                                              | 1/22 (5)      | 0/6 (0)            | 1/16 (7)           | 1.00|
Table 4 (continued)

| Characteristics                                                                 | All (N = 358) | Youth MSM (N = 87) | Other MSM (N = 271) | P^a |
|---------------------------------------------------------------------------------|---------------|--------------------|---------------------|-----|
| Sexual partner had STIs within the past year                                    |               |                    |                     | 0.86|
| Yes                                                                             | 18 (5)        | 4 (5)              | 14 (5)              |     |
| Not sure                                                                        | 107 (30)      | 28 (36)            | 79 (29)             |     |
| No                                                                              | 233 (65)      | 55 (63)            | 178 (66)            |     |
| Type of STIs within the past year of sexual partnerb                            |               |                    |                     |     |
| Gonorrhea                                                                       | 8/18 (44)     | 3/4 (75)           | 5/14 (36)           | 0.25|
| HIV                                                                             | 6/18 (33)     | 0/4 (0)            | 6/14 (43)           | 0.25|
| Genital wart                                                                    | 2/18 (11)     | 0/4 (0)            | 2/14 (14)           | 1.00|
| Herpes simplex infection                                                        | 1/18 (6)      | 1/4 (25)           | 0/14 (0)            | 0.22|
| Syphilis                                                                        | 1/18 (6)      | 0/4 (0)            | 1/14 (7)            | 1.00|
| Unknown                                                                         | 8/18 (44)     | 3/4 (75)           | 5/14 (36)           | 1.00|
| Sexual partner had exchanged sex for money within 30 days                        |               |                    |                     | <0.001|
| Yes                                                                             | 9 (3)         | 7 (8)              | 2 (1)               |     |
| Not sure                                                                        | 89 (25)       | 24 (28)            | 65 (24)             |     |
| No                                                                              | 260 (72)      | 56 (64)            | 204 (75)            |     |
| Sexual partner had used drug within 30 days                                      |               |                    |                     | 0.31|
| Yes                                                                             | 6 (2)         | 3 (2)              | 3 (1)               |     |
| Not sure                                                                        | 87 (24)       | 51 (35)            | 36 (17)             |     |
| No                                                                              | 265 (74)      | 62 (71)            | 203 (75)            |     |
| Perceiving own HIV risk as                                                      |               |                    |                     | 0.33|
| No or low risk                                                                  | 267 (74)      | 61 (70)            | 206 (76)            |     |
| Moderate risk                                                                   | 73 (20)       | 22 (25)            | 51 (19)             |     |
| High risk                                                                       | 18 (5)        | 4 (5)              | 14 (5)              |     |
| HIV risk determined by the study tool                                           |               |                    |                     | 0.14|
| Low risk                                                                        | 96 (27)       | 19 (22)            | 77 (28)             |     |
| Moderate risk                                                                   | 56 (16)       | 10 (12)            | 46 (17)             |     |
| High risk                                                                       | 206 (58)      | 58 (67)            | 148 (55)            |     |
| False perception of low HIV risk                                                | 172/262 (66)  | 43/68 (63)         | 129/194 (66)        | 0.63|
| Correct risk perception among MSM with low HIV risk                             | 95/96 (99)    | 18/19 (95)         | 77/77 (100)         | 0.20|

Data are in numbers (%) unless otherwise indicated

HIV, human immunodeficiency virus; IQR, interquartile range; STI, sexually-transmitted infection

* Comparison between youth and other MSM

b One participant could have more than one type of STIs

Table 5 Reasons for declining HIV testing and counseling among the men who have sex with men (MSM) participants

| Reason                              | All (N = 210) | Youth MSM (N = 28) | Other MSM (N = 182) | P^a |
|-------------------------------------|---------------|--------------------|---------------------|-----|
| Prior HIV test within 6 months      | 100 (48)      | 14 (50)            | 86 (47)             | 0.79|
| Not ready                           | 40 (19)       | 10 (36)            | 30 (16)             | 0.002|
| Perceiving no risk for HIV infection| 23 (11)       | 0 (0)              | 23 (13)             | 0.05|
| Inappropriate testing place         | 18 (9)        | 2 (7)              | 16 (9)              | 1.00|
| Time constraints                    | 15 (7)        | 1 (4)              | 14 (8)              | 0.70|
| Being afraid to know test result    | 8 (4)         | 1 (4)              | 7 (4)               | 1.00|
| Being afraid of needle              | 5 (2)         | 0 (0)              | 5 (3)               | 1.00|
| Being healthy                       | 1 (0.5)       | 0 (0)              | 1 (0.5)             | 1.00|

Data are in numbers (%)

* Comparing between youth and other MSM
and to improve application of their existing knowledge to reduce risk behaviors. Potential effective interventions may include culturally-relevant role model stories, peer outreach, and highly-interactive group-level behavioral interventions tailored to youth MSM [16–18].

In this study, the rate of false perception of low HIV risk among moderate and high-risk youth MSM was high (63%) and was comparable to that of other MSM. The high rates of false perception of low HIV risk were also reported among youth MSM from the US studies [19, 20].

In addition, we identified false perception of low HIV risk as an independent factor associated with HTC declining and HIV infection among youth MSM. These findings underlie the need for HIV risk perception assessment during the outreach program and the

### Table 6 Factors associated with declining HIV testing and counseling (excluding participants reporting prior HIV test within 6 months)

| Risk factors                                      | Univariable analysis | Multivariable analysis |
|---------------------------------------------------|----------------------|------------------------|
|                                                   | OR (95% CI)          | P                      | aOR (95% CI)     | P          |
| Youth MSM                                         | 0.23 (0.12–0.43)     | < 0.001                | 0.31 (0.15–0.62) | 0.01       |
| Perceiving own HIV risk as low risk               | 3.14 (1.70–5.82)     | < 0.001                | 2.18 (1.11–4.29) | 0.02       |
| Low HIV risk by the study tool                    | 3.24 (1.75–6.00)     | < 0.001                | 2.33 (1.17–4.62) | 0.02       |
| Having highest education of bachelor degree and higher | 2.35 (1.39–3.98)     | < 0.001                | 1.35 (0.74–2.46) | 0.34       |
| Being from Bangkok                                | 2.14 (1.30–3.54)     | 0.003                  | 1.72 (0.99–2.99) | 0.06       |
| Monthly household income more than $US 4500       | 2.37 (1.10–5.11)     | 0.03                   | 1.67 (0.71–3.92) | 0.24       |

*aOR, adjusted odds ratio; CI, confidence interval; HIV, human immunodeficiency virus; MSM, men who have sex with men; OR, odds ratio

### Table 7 HIV testing and counseling, test results and linkage to care among the men who have sex with men (MSM) participants

| Characteristic                                      | All (N = 358) | Youth MSM (N = 87) | Other MSM (N = 271) | \( P^a \) |
|-----------------------------------------------------|---------------|--------------------|---------------------|----------|
| HIV voluntary testing and counseling accepting participants | 148 (41)     | 59 (68)            | 89 (33)             | < 0.001  |
| First-time tester                                   | 50/148 (34)   | 25/59 (42)         | 25/89 (28)          | 0.07     |
| Repeat tester                                       | 98/148 (66)   | 34/59 (58)         | 67/89 (72)          |          |
| HIV test result                                     |               |                    |                     | 0.07     |
| Reactive                                            | 25/148 (17)   | 14/59 (24)         | 11/89 (12)          |          |
| Non-reactive                                        | 123/148 (83)  | 45/59 (76)         | 78/89 (88)          |          |
| Linkage to HIV care                                 |               |                    |                     | 0.65     |
| Yes                                                 | 12/25 (48)    | 6/14 (43)          | 6/11 (55)           |          |
| No                                                  | 13/25 (52)    | 8/14 (57)          | 5/11 (45)           |          |

Data are in numbers (%)

*a Comparison between youth MSM and other MSM

### Table 8 Factors associated with having HIV infection among 148 participants undergoing HIV testing and counseling

| Risk factors                                      | Univariable analysis | Multivariable analysis |
|---------------------------------------------------|----------------------|------------------------|
|                                                   | OR (95% CI)          | P                      | aOR (95% CI)     | P          |
| False perception of low HIV risk                  | 4.05 (1.51–10.83)    | 0.005                  | 3.81 (1.37–10.62) | 0.01       |
| Monthly household income less than $US 450        | 3.51 (1.34–9.20)     | 0.01                   | 3.16 (1.03–9.67) | 0.04       |
| Having highest education less than bachelor degree | 2.63 (1.11–6.54)     | 0.04                   | 1.63 (0.57–4.66) | 0.37       |
| High HIV risk by the study tool                   | 3.16 (0.89–11.19)    | 0.07                   | 1.90 (0.50–7.20) | 0.08       |
| Youth MSM                                         | 2.21 (0.92–5.27)     | 0.08                   | 2.26 (0.90–5.66) | 0.34       |

*aOR, adjusted odds ratio; CI, confidence interval; HIV, human immunodeficiency virus; MSM, men who have sex with men; OR, odds ratio
importance of accurate perception of HIV risk in facilitating interventions to prevent HIV transmission.

The overall rate of HIV infection among MSM in this study was 17% which was higher than the prevalence of 9% in general Thai MSM population [1]. The higher rate of infection represents the higher risk for HIV acquisition among MSM attending the gay sauna. It should be noted that youth MSM had a higher rate of HIV infection than other MSM (24% vs. 12%). This result was consistent with previous studies that reported young MSM (aged 18–30 years) to be significantly associated with HIV infection [3, 21, 22]. The high prevalence of HIV among youth MSM could be due to higher HIV risks and risk behaviors among this population and lower level of knowledge about HIV transmission prevention and how to prevent self from getting HIV. The other factor associated with HIV infection was low monthly household income, consistent with another Thai study conducting among MSM who came for HIV testing at the Anonymous Clinic and two drop-in centers in Bangkok [22]. The finding suggests youth MSM with lower socioeconomic status to be prioritized for innovative approaches to promote awareness and uptake of HTC.

Despite the on-site face-to-face post-test counseling and advice on plan for long-term HIV care, and the subsequent follow-up calls, less than half of the HIV-infected MSM were established continuity care within 1 year of diagnosis, especially youth MSM. This finding was in accordance with another study that reported young MSM took longer time to entry HIV care after the diagnosis than other population groups [23]. Thus, reasons for no care establishment and barriers to linkage to care require further studies among these youth MSM. Effective strategies to improve linkage to HIV continuity care may include REMIND messaging via mobile phone and social media, case management, use of incentives for linkage to care, on-site point-of-care CD4 testing, on-site or same-day antiretroviral therapy and education with more emphasis on the importance of linkage to care, antiretroviral therapy adherence and care retention [24–27].

This is a single-site study aiming to represent a suburban hotspot setting in Thailand. The study results may not be generalizable to youth MSM who attend other saunas in Thailand. However, the findings are of importance and address critical issues on HIV risks and risk behaviors, HIV risk perception, HTC acceptance rate of HIV infection and barriers to HTC implementation and linkage to care. These issues need to be focused while implementing outreach programs for HIV prevention among youth MSM attending gay hotspots in other settings.

**Conclusions**

Youth MSM were at higher risk of HIV infection compared to other MSM due to their significant risk behaviors and false perception of low HIV risk. However, the higher rate of HTC uptake among youth MSM should provide a great opportunity to implement and scale up HTC and HIV transmission prevention programs among this population. The HIV transmission prevention programs should incorporate HIV risk perception assessment and interventions to correct the risk perception among the youth MSM. Further studies are needed to assess interventions to improve HTC acceptance, HIV and linkage to HIV care and to determine strategies to implement successful HIV transmission prevention programs among youth MSM attending gay hotspots in Thailand.

**Abbreviations**

AIDS: acquired immune deficiency syndrome; HIV: human immunodeficiency virus; HTC: HIV testing and counseling; MSM: men who have sex with men; STI: sexually-transmitted infection.

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**Authors’ contributions**

TK takes major responsibility for the integrity of the work and analyses, contributed to conceiving and designing the research, analyzing the data, writing the manuscript, and reading and approving the final version of the manuscript. SM contributed to conceiving the research, collecting data, reading and approving the final version of the manuscript. CN contributed to conceiving and designing the research, laboratory testing, reading and approving the final version of the manuscript. AA contributed to conceiving and designing the research, writing the manuscript, and reading and approving the final version of the manuscript. NP contributed to conceiving and designing the research, writing the manuscript, and reading and approving the final version of the manuscript. All authors read and approved the final manuscript.

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**Availability of data and materials**

All data generated or analysed during this study are included in this published article and its additional files.

**Ethics approval and consent to participate**

This study was conducted in accordance with the amended Declaration of Helsinki and was approved by the Faculty of Medicine, Thammasat University Ethics Committee. Informed consent was obtained from all study participants.

**Consent for publication**

Not applicable.

**Competing interests**

The authors declare that they have no competing interests.

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References

1. The Joint United Nations Program on HIV and AIDS (UNAIDS). Thailand AIDS response report progress. 2015. http://www.unaids.org/sites/default/files/country/documents/THA_narrative_report_2015.pdf. Accessed 6 Sept 2017.
2. van Griensven F, Thienkrua W, Chonwattana W, Wimonwate W, Chaikummao S, Chonwattana W, et al. Evidence of an explosive epidemic of HIV infection in a cohort of men who have sex with men in Thailand. AIDS. 2013;27:825–32.
3. van Griensven F, Holtz TH, Thienkrua W, Chonwattana W, Wimonwate W, Chaikummao S, et al. Temporal trends in HIV-1 incidence and risk behaviors in men who have sex with men in Bangkok, Thailand, 2006–13: an observational study. Lancet HIV. 2015;2:e64–70.
4. Branson BM, Handsfield HH, Lampe MA, Janssen RS, Taylor AW, Lyss SB, et al. Revised recommendations for HIV testing of adults, adolescents, and pregnant women in health-care settings. MMWR Recomm Rep. 2006;55:1–17.
5. Stein R, Song W, Marano M, Patel H, Rao S, Morris E. HIV testing, linkage to HIV medical care, and interviews for partner services among youths—61 Health Department Jurisdictions, United States, Puerto Rico, and the U.S. Virgin Islands, 2015. MMWR Morb Mortal Wkly Rep. 2017;66:239–45.
6. Singh S, Song R, Satcher Johnson A, McCray E, Hall I. HIV incidence, prevalence, and undiagnosed infections in men who have sex with men. http://www.hivdensity.org/CO10017/HIVIncidence.pdf. Accessed 6 Sept 2017.
7. Khawcharoenporn T, Apisarnthanarak A, Phanuphak N. Active targeted HIV testing and linkage to care among men who have sex with men attending a gay sauna in Thailand. AIDS Care. 2017;29:355–64.
8. United Nations. Definition of youth. http://www.un.org/esa/socdev/documents/youthfact-sheets/youth-definition.pdf. Accessed 1 Sept 2017.
9. Khawcharoenporn T, Kendrick S, Smith K. HIV risk perception and preexposure prophylaxis interest among a heterosexual population visiting a sexually transmitted infection clinic. AIDS Patient Care STDs. 2012;26:222–33.
10. Johnston LG, Steiniece MA, Sass J, Sirinurund P, Lee C, Benjarattanaporn P, et al. Recent HIV testing among young men who have sex with men in Bangkok and Chiang Mai: HIV testing and prevention strategies must be enhanced in Thailand. AIDS Behav. 2016;20:2023–32.
11. Logie CH, Newman PA, Weaver J, Roungkraphon S, Tepjan S. HIV-related stigma and HIV prevention uptake among young men who have sex with men and transgender women in Thailand. AIDS Patient Care STDs. 2016;30:92–100.
12. Berg RC. Predictors of never testing for HIV among a national online sample of men who have sex with men in Norway. Scand J Public Health. 2013;41:398–404.
13. Pharr JR, Lough NL, Ezeanolue EE. Barriers to HIV testing among young men who have sex with men (MSM): experiences from Clark County, Nevada. Glob J Health Sci. 2015;8:9–17.
14. Logie CH, Lacombe-Duncan A, Brien N, Jones N, Lee-Foon N, Levermore K, et al. Barriers and facilitators to HIV testing among young men who have sex with men and transgender women in Kingston, Jamaica: a qualitative study. J Int AIDS Soc. 2017;20:1–9.
15. Chennarisri T, Netwong T, Visarutratana S, Varangrat A, Li A, Phanuphak P, et al. Inconsistent condom use among young men who have sex with men, male sex workers, and transgenders in Thailand. AIDS Res Hum. 2010;22:100–9.
16. Lauby J, Zhu L, Milmanow M, Batson H, Bond L, Curran-Groome W, et al. Get real: evaluation of a community-level HIV prevention intervention for young MSM who engage in episodic substance use. AIDS Educ Prev. 2017;29:191–204.
17. Stein R, Shapattawa E, Williams W, Griffin T, Bell K, Lyons B, et al. Reduced sexual risk behaviors among young men of color who have sex with men: findings from the Community-Based Organization Behavioral Outcomes of Many Men, Many Voices (CBOP-3MV) project. Prev Sci. 2015;16:1147–58.
18. Hidalgo MA, Kuhns LM, Hotton AL, Johnson AK, Mustanski B, Garofalo R. The MyPEEPS randomized controlled trial: a pilot of preliminary efficacy, feasibility, and acceptability of a group-level, HIV risk reduction intervention for young men who have sex with men. Arch Sex Behav. 2015;44:475–85.
19. MacKellar DA, Valleroy LA, Secura GM, Behel S, Bingham T, Celentano DD, et al. Perceptions of lifetime risk and actual risk for acquiring HIV among young men who have sex with men. AIDS Behav. 2007;11:263–70.
20. MacKellar DA, Valleroy LA, Secura GM, Behel S, Bingham T, Celentano DD, et al. Unrecognized HIV infection, risk behaviors, and perceptions of risk among young men who have sex with men: opportunities for advancing HIV prevention in the third decade of HIV/AIDS. J Acquir Immun Defic Syndr. 2005;38:603–14.
21. Wirtz AL, Trapeze G, Kambda D, Gama V, Chalera R, Jumbe V, et al. Geographic disparities in HIV prevalence and care among men who have sex with men in Malawi: results from a multisite cross-sectional survey. Lancet HIV. 2017;4:e260–9.
22. Sapsirisavat V, Phanuphak N, Keadpudsa S, Egan JE, Pussadee K, Klaytong P, et al. Psychosocial and behavioral characteristics of high-risk men who have sex with men (MSM) of unknown HIV-positive serostatus in Bangkok, Thailand. AIDS Behav. 2016;20:386–97.
23. Rebeiro PF, Ivey KS, Craig KS, Hulgan T, Huaman MA, Nash R, et al. New faces of HIV infection: age, race, and timing of entry into HIV care in the southeastern United States. J Int Assoc Provid AIDS Care. 2017;16:347–52.
24. Tanner AE, Mann L, Song E, Alonzo J, Schafer K, Arellano E, et al. WeCARE: a social media-based intervention designed to increase HIV care linkage, retention, and health outcomes for racially and ethnically diverse young MSM. AIDS Educ Prev. 2016;28:216–30.
25. Oyewale TO, Ahmed S, Ahmed F, Tazreen M, Uddin Z, Rahman A, et al. The use of vouchers in HIV prevention, referral treatment, and care for young MSM and young transgender people in Dhaka, Bangladesh: experience from HIVM initiative. Curr Opin HIV AIDS. 2016;11(Suppl 1):S37–45.
26. McNairy ML, Gachchi AB, Lamb MR, Nwagagaga-Bibonwoha H, Burke S, Ehrenkranz P, et al. The Link4Health study to evaluate the effectiveness of a combination intervention strategy for linkage to and retention in HIV care in Swaziland: protocol for a cluster randomized trial. Implement Sci. 2015;10:101.
27. Koenig SP, Dorvil N, Dévieux JG, Hedt-Gauthier BL, Riviere C, Faustin M, et al. Same-day HIV testing with initiation of antiretroviral therapy versus standard care for persons living with HIV: a randomized unblinded trial. PLoS Med. 2017;14(7):e1002357. https://doi.org/10.1371/journ al.pmed.1002357.

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