

Syndemic Production of HIV Infection among Tanzanian MSM

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Abstract

Tanzanian men who have sex with men (MSM) experience HIV disparity and are disproportionately vulnerable to psychosocial health problems together called SAVID (Substance abuse, childhood and adolescent sexual Abuse [CSA], anti-gay Violence, Internalized homonegativity [IH], and Depression). We applied syndemic theory to assess additive effects of the SAVID problems on HIV seropositivity among 300 MSM from two Tanzanian cities, who provided demographic, psychosocial health–problem, and HIV-status information. Prevalence rates of the problems were substance abuse during condomless sexual intercourse (37.3%), a history of CSA (35.3%), anti-gay violence (22%), high IH (52.7%), and depression (58%). Bivariate analysis showed a significantly positive “dose-response” relationship between the SAVID-problem count and HIV seropositivity: SAVID problems significantly increased the odds of HIV seropositivity (odds ratio, 1.42). This is the first study in sub-Saharan Africa to use syndemic theory to explore additive effects of coexisting psychosocial health problems on HIV seropositivity among Tanzanian MSM. Our results underscore the need for comprehensive HIV interventions targeting MSM.

Keywords: Men; MSM; HIV/AIDS; Syndemic; Sub-Saharan Africa; SAVID

Introduction

The devastating impact of HIV and its inextricable association with emerging psychosocial health problems among men who have sex with men (MSM) in sub-Saharan Africa (SSA) require a broad explanatory model rooted in the sociopolitical construction of the disease that extends beyond the existing biomedical HIV research paradigm.

The concept of “syndemic” was introduced to advance theoretical understanding of three essential elements of disease in biosocial contexts [1-25]. First, diseases tend to cluster among socially disadvantaged populations. Second, diseases interact to produce additive effects, and third, these additive effects have a negative impact on the health of marginalized people.

The utility of this theory has been explored in studies conducted among MSM in United States, China, Thailand, and recently among socially marginalized women in South Africa [5,8,11,13,17]. For example, Mustanski et al. documented high rates of clustering of regular binge drinking, violence, and substance abuse that significantly increase odds of HIV positivity (odds ratio [OR], 1.42) among sampled young American MSM [13]. However, an extensive search of the literature failed to find any study that has explored the utility of this theory among MSM in SSA.

Compelling evidences suggest existence of a disproportionate prevalence of HIV among Tanzanian MSM [3,18,26-29]. For example, in 2008, HIV prevalence in Zanzibarian general population was 0.20% but 12.3% among the MSM population [30,31].

Beyond disproportionate clustering of HIV prevalence, independent associations are found between HIV infection and IH depression substance abuse and between anti-gay violence and depression among Tanzanian MSM [2,9,15,18,20]. Although childhood sexual abuse (CSA) has been implicated in HIV transmission among behaviorally heterosexual men, there are no published reports of the rate of CSA or its syndemic potential specifically among Tanzanian MSM [21-28].

Syndemic theory is thus well suited for application in SSA MSM

who are disproportionately affected by HIV and exposed to syndemic-related adverse conditions. This study was designed to explore the prevalence, clustering, and additive effects of Substance abuse, CSA, Violence, IH, and Depression (SAVID) on HIV seroprevalence among sampled Tanzanian MSM.

We hypothesized that: (1) psychosocial health problems cluster positively and significantly to produce SAVID syndemic; (2) dose-response relationship exists between SAVID syndemic and HIV seropositivity; and (3) that SAVID syndemic variable has an additive effect on HIV seropositivity in the sampled Tanzanian MSM.

Methods

This study used data collected from surveys conducted in Dar es Salaam (2012) and Tanga (2013), Tanzania. Dar es Salaam has a population of about 3 million and Tanga (midway between Dar es Salaam and Mombasa), about 280,000.

Two hundred MSM from Dar es Salaam and 100 MSM from Tanga were recruited to participate using respondent-driven sampling (RDS) [21,23]. RDS, a snowball sampling method, employs ‘seed’ individuals to refer who they know; the latter then refer individuals they know using a predetermined number of coupons throughout the network [7]. RDS is strategically used to collect data from hard to reach people like MSM whose homosexual behavior is stigmatized and categorized as illegal in Tanzania.

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We recruited first wave of participants by identifying in each city, five seeds of different ages from different areas in order to achieve better representativeness. Each seed was given three coupons to recruit three other MSM. Each coupon had unique identification numbers linking it to the referring seed. To determine sampling equilibrium for age and education, characteristics of recruited participants were repeatedly compared to those of seeds. As we approached closing any seed, the number of coupons was reduced to two and coupons were not given to the last respondents in each seed. We attained equilibrium for education and age and targeted sample size of 200 in Dar es Salaam and 100 in Tanga after seven waves.

We used Mombasa HIV rates of 40% in exclusively gay and 10% in bisexual men [23]. With 40% in Dar es Salaam group and 20% in Tanga group, a minimum of 80 men was required in each group. However, anticipating that between group differences may be smaller-in the order of 25% in Dar es Salaam and 13% in Tanga-than in Mombasa, we calculated a total sample of 310 to obtain a power of 80% in each city.

The institutional review boards at The University of Texas Health Science Center (HSC-SPH-10-0033) and the Tanzanian National Institute for Medical Research (NIMR/HQ/R.8a/Vol.IX/1088) reviewed and approved this study.

Measures

Dependent variable is HIV seroprevalence, determined by testing biologic samples provided by participants. Two testing methods were used: Determine (Abbot Laboratories, USA), and Unigold (Trinity Biotech PLC, Ireland) for initial and confirmatory testing respectively.

Independent variables

Sociodemographic characteristics; age, employment status, income, educational attainment, age at sexual debut, status as identifying as gay but still having a meaningful sexual relationship with women, and importance of religion to the participant.

Syndemic factors

Substance abuse during condomless sexual intercourse: Participants who answered 'Yes' to, "How many of those times that you received anal sex and/or had insertive anal sex with all partners, and did not use a male condom, were you high or drunk?" determined the sum score of participants under the influence of substance use during condomless sexual intercourse.

- **Childhood sexual abuse:** CSA was defined by using the developmental classification system of Doll and colleagues [4]. This schema classifies an experience as abusive contingent on age of the child or adolescent, age difference between partners, whether anal penetration occurred, and whether force was involved. Age difference between partners was used to distinguish between peer and non-peer contacts. Any contact involving use of force was considered sexual abuse regardless of age. Participants were asked several questions: "Have you ever been forced or coerced to have sex with someone?" "How old were you when you were forced or coerced into having sexual contact with someone?" "How old was the person who first forced you or coerced you into having sexual contact?" "Was your first sex partner a man or woman?" "How old was your first sex partner?" 'Yes' answers to these questions were summed and used to determine whether participant experienced CSA.
- **Level of anti-gay violence:** To determine levels of violence,

responses to questions about the four types of abuse were considered. Responses to, "Have you been the victim of physical violence or abuse, verbal abuse, moral abuse, and/or sexual abuse?" were dichotomized according to number of 'Yes' responses to each separate question, so a maximum score of 4 was possible. Level of violence was characterized as High-level if there were three or four 'Yes' answers and as Low-level if there were one or two 'Yes' answers. Cronbach's alpha score for this sample was 0.714.

- **Stigma (defined by IH score):** IH is acceptance and internalization of negative attitudes toward one's own sexual orientation [24]. For this measure, an eight-item short version of the 28-item Reactions to Homosexuality Scale was used [19,27]. The short version uses a six-point Likert response scale ranging from 0 (strongly disagree) to 5 (strongly agree); total score will range from 0 to 40. Use of this scale has been found reliable and valid in MSM populations in SSA [20,22].
- **Depression:** Depression was measured using Patient Health Questionnaire-9 (PHQ-9), a validated instrument for measuring the nine diagnostic criteria that constitute depressive disorders according to the Diagnostic and Statistical Manual of Mental Disorders, 4th Edition (DSM-IV) definition [1]. PHQ-9 has proven reliable and valid for diagnosing depression and measuring its severity; its reliability and validity have also been shown among SSA populations [10,12]. Subjects scored each of the nine diagnostic symptoms of DSM-IV depression on a scale from 0 (not present at all) to 3 (present nearly every day); total score ranges from 0 to 27. Cronbach's alpha score for this sample is 0.867.
- **SAVID syndemic:** This variable is the cluster consisting of the five individual psychosocial factors. SAVID syndemic was created by categorizing each subject into one of the following four mutually exclusive groups: (1) no reported experience of any of the five psychosocial factors, (2) one factor reported, (3) two factors reported, and (4) three or more factors reported. This is consistent with groupings employed by Stall et al. [28-31].

Data analysis

First, we examined prevalence of all variables. Second, because data on all psychosocial health problems were dichotomized, Pearson's chi-squared test of association was employed to assess whether psychosocial health problems cluster to form the hypothesized SAVID syndemic. Bivariate relationships between each psychosocial health problems and HIV seropositivity were examined. Third, to test the hypothesis that there is a dose-response relationship between psychosocial health problems and HIV seroprevalence, chi-squared testing for associations was carried out to determine levels and significance of HIV status with different counts of SAVID syndemic factors (0, 1, 2 and 3 or more). Fourth, to test for synergistic effect of SAVID syndemic, logistic regression was employed, with SAVID syndemic as independent variable, HIV status as dependent variable, and with all other factors examined (age, employment, education level, importance of religion, and identifying as gay but still having a meaningful sexual relationship with women) included as control variables. Finally, a set of multivariate logistic regression models was employed to examine factors associated with higher levels of SAVID.

Because all models contained the same dichotomized independent variables, each model was used each time to predict outcomes of each psychosocial health problems and HIV infection. However, whenever a particular model predicted a health problem, measures of that health

problem were excluded from the list of psychosocial health problems (3). For instance, measures of depression were excluded from the model when the model predicted an association between depression and other psychosocial health problems. The criteria of $\alpha=0.05$ and two-tailed statistical significance were used. All analyses were carried out using Statistical Package for the Social Sciences (SPSS) version 23 software.

Results

Table 1 summarizes characteristics of sampled 300 Tanzanian MSM. Slightly more than half (51.3%) were younger than 23 years old. Literacy level among was high, with 62% reporting post-primary school educational and 38%, primary school education. Employment rate was

high, at 81%. 58.3% self-identified as homosexual; 36% bisexual; 4% undecided; and 1.7% straight or heterosexual. However, of the straight, only 32.7% reported having sexual relationships and 67.3% never had sexual relationships with women. 14% of participants opted out from HIV rapid testing. Of those tested, 30.2% in Dar es Salaam and 11% in Tanga were HIV positive.

Psychosocial problems were prevalent. 37.3% reported being high or drunk while having condomless sexual intercourse, 35.3% history of CSA, 22% high level of violence, 52.7% positive for high level of IH, and 42% high level of depressive symptoms.

Table 2 presents unadjusted ORs of bivariate relationships between psychosocial problems and HIV seropositivity. Degree of clustering

| Characteristics | N*(%) |
|--|------------|
| Demographic Variables | |
| Age, years | |
| <23 | 154 (51.3) |
| ≥ 23 | 146 (48.7) |
| Educational level | |
| Primary | 114 (38.0) |
| Post primary | 186 (62.0) |
| Employment status | |
| Employed | 56 (18.7) |
| Unemployed | 243 (81.0) |
| Income level | |
| <150,000 TZS | 87 (29.0) |
| ≥ 150,000 TZS | 64 (21.3) |
| Self-identified sexual orientation | |
| Gay/homosexual | 175 (58.3) |
| Straight/heterosexual | 5 (1.7) |
| Bisexual | 108 (36.0) |
| Outcome | |
| HIV infection | |
| Negative | 200 (66.7) |
| Positive | 62 (23.7) |
| Syndemic Conditions | |
| Substance use during condomless sex | |
| Absent | 118 (62.7) |
| Present | 112 (37.3) |
| History of childhood and adolescent sexual abuse | |
| No | 194 (64.7) |
| Yes | 106 (35.3) |
| Experience of anti-gay violence | |
| Low | 234 (78.0) |
| High | 66 (22.0) |
| Internalized homonegativity level | |
| Low | 142 (47.3) |
| High | 158 (52.7) |
| Depression | |
| Low | 174 (58.0) |
| High | 126 (42.0) |

| | |
|---|------------|
| Number of syndemic conditions | |
| None | 28 (9.3) |
| One | 94 (31.3) |
| Two | 94 (31.3) |
| Three or more | 84 (28.0) |
| Sociocultural Factors of Sexuality | |
| Age at sexual debut, years | |
| <15 | 112 (37.3) |
| ≥ 15 | 118 (62.7) |
| Identifying as gay but still have a meaningful sexual relationship with women | |
| Yes | 98 (32.7) |
| No | 202 (67.3) |
| Level of importance of religion | |
| Low | 10 (3.3) |
| High | 288 (96.0) |
| *These are the total sample sizes with the number of participants that have data on variables; Abbreviations: MSM: Men who have sex with men; TZS: Tanzanian shilling; HIV: Human immunodeficiency virus. | |

Table 1: Demographic, HIV prevalence and social characteristics of the 300 Tanzanian MSM in the study population: Tanzanian men's study: Dar es Salam, Tanga, 2012-2013.

of psychosocial problems among participants was high, as evidenced by eight of ten ORs being positive and statistically significant. For example, participants who reported being targets of anti-gay violence had 2.56 higher odds of experiencing IH ($p < 0.001$) than those who did not report being targets of violence.

Two bivariate relationships were not statistically significantly different, but their ORs were still positive – (1) MSM who reported being drunk or high while having condomless sexual intercourse and those with histories of IH; and (2) MSM with histories of CSA and those who reported being drunk or high while having condomless sexual intercourse.

Bivariate relationships between all psychosocial health problems and HIV infection were positive and statistically significant except – the relationship between substance use while having condomless sexual intercourse and HIV infection (OR, 0.80).

Table 3 presents significant relationships between number of psychosocial health problems and HIV infection. 28% of participants scored zero on the syndemic variable, 14.9% scored one, 18.5% scored two, and 39.1% scored three or more. Thus, having a greater number of coexisting psychosocial health problems was significantly and positively associated with a higher proportion of HIV seropositivity.

Table 4 presents outcomes of logistic regression models that examined relationship between SAVID and HIV seropositivity while controlling for sociodemographic variables. SAVID increased odds of HIV positivity (OR, 1.42; $p = 0.01$), but among all sociodemographic variables in the model, only one – a lower educational level – related with an increased risk of HIV positivity (OR, 2.04; $p = 0.01$).

In Table 5, predictors of each of the five SAVID syndemic conditions were examined by using multivariate logistic regression models. Six positive and significant ($p < 0.05$) regression models based on Hosmer and Lemeshow test for goodness of fit were generated.

Whereas, Table 2 revealed that each syndemic condition was independently associated with one another, Table 5 reveals specified SAVID component uniquely and significantly associated with a given

health problem after controlling for other factors in the model. For example, younger age, identifying as gay but still having a meaningful sexual relationship with women, younger age at sexual debut, high level of importance of religion, and violence were all positively and significantly related to a higher likelihood of having experienced CSA.

Discussion

Our results revealed a high degree of coexistence of SAVID psychosocial problems among this sample of Tanzanian MSM, evidenced by eight of ten bivariate associations being positive and statistically significant. The results also revealed the additive effect of SAVID, shown by the significant “dose-response” relationship between number of psychosocial health problems and HIV infection. Among our sampled participants, greater numbers of psychosocial problems were significantly associated with HIV seropositivity. Further, we found a significant and positive relationship between SAVID and HIV (OR, 1.42) while controlling for sociodemographic factors. A lower level of education was also significantly associated with HIV positivity (OR, 2.04). Hence, those who reported more psychosocial health problems were more likely to have been diagnosed with HIV infection. These findings are consistent with previous studies conducted among MSM in the United States, China, Thailand and among socially marginalized women in South Africa [5,8,11,17].

Younger age and lower educational attainment were the only demographic factors found to be positively and significantly associated with violence and HIV positivity, respectively. However, among contextual factors examined, identifying as gay but still having a meaningful sexual relationship with women was significantly and positively related to CSA. Interestingly after controlling for demographic factors and other psychosocial health problems, IH was significantly associated with identifying as gay but still having a meaningful sexual relationship with women, depression, and violence. This supports evidence from previous studies which suggested that discordance between sexual behavior and sexual identity may be greatest among MSM who report a high level of stigma [6]. Notwithstanding controlling for other factors in the model predicting HIV seropositivity, the odds of being diagnosed with HIV infection

| Psychosocial Problem | Substance Use during Condomless Sex | Childhood and Adolescent Sexual Abuse | Experience of Anti-Gay Violence | Internalized Homonegativity | Depression | HIV Infection |
|---------------------------------------|-------------------------------------|---------------------------------------|---------------------------------|-------------------------------|-------------------------------|---------------|
| Substance use during condomless sex | - | | | | | |
| Childhood and adolescent sexual abuse | 1.10 (0.81-1.48) [†] | - | | | | |
| Experience of anti-gay violence | 1.82 (1.38-2.41) [§] | 1.75 (1.30-2.36) [‡] | - | | | |
| Internalized homonegativity | 1.00 (0.75-1.34) [‡] | 1.40 (1.03-1.90) [‡] | 2.56 (1.60-4.11) [§] | - | | |
| Depression | 1.48 (1.11-1.99) [§] | 1.61 (1.18-2.18) [‡] | 2.76 (1.75-4.40) [§] | 1.60 (1.26-2.02) [§] | - | |
| HIV infection | 0.80 (0.56-1.14) [†] | 1.34 (1.04-1.78) [‡] | 1.26 (1.04-1.52) [§] | 1.68 (1.17-2.43) [§] | 1.62 (1.12-2.23) [§] | - |

Abbreviations: HIV: Human immunodeficiency virus; MSM: Men who have sex with men; *Data are presented as odds ratios (95% confidence intervals); [†]p<0.1; [‡]p<0.05; [§]p<0.01

Table 2: Bivariate associations between psychosocial problems and HIV infection among the 300 Tanzanian MSM in the study population*: Tanzanian men's study: Dar es Salam, Tanga, 2012-2013.

| Number of Syndemic Conditions per MSM (N=300) | | | | | |
|---|----------|----------|----------|------------|-----------------------|
| HIV infection (n=62)* | 0 (n=28) | 1 (n=94) | 2 (n=94) | ≥ 3 (n=84) | χ ² (df=3) |
| | 28.0% | 14.9% | 18.5% | 39.1% | 14.245* |

Abbreviations: HIV: Human immunodeficiency virus; MSM: Men who have sex with men; df: Degrees of freedom; *p<0.01.

Table 3: Percentages of HIV infection by number of syndemic conditions among the 300 Tanzanian MSM in the study population: Tanzanian men's study: Dar es Salam, Tanga, 2012-2013.

| HIV Positivity | | |
|---|------------|-------------------------|
| Predictor | Odds Ratio | 95% Confidence Interval |
| Age | 1.08 | 0.59-1.99 |
| Employment | 1.13 | 0.51-2.49 |
| Education | 2.04* | 1.04-4.02 |
| Importance of religion | 4.90 | 0.57-42.27 |
| Identifying as gay but still having a meaningful sexual relationship with women | 0.55 | 0.30-1.03 |
| SAVID syndemic | 1.42* | 1.04-1.96 |

Abbreviations: HIV: Human immunodeficiency virus; MSM: Men who have sex with men; SAVID syndemic, count of psychosocial health problems (range, 0-4); R², Nagekerke R-squared statistic. p<0.01.

Table 4: Logistic regression models to evaluate the associations between the syndemic conditions and HIV Infection, controlling for demographic factors, among the 300 Tanzanian MSM in the study population: Tanzanian men's study: Dar es Salam, Tanga, 2012-2013.

| Independent Variable | Substance Use during Condomless Sexual Intercourse | Childhood and Adolescent Sexual Abuse | Experience of Anti-Gay Violence | Internalized Homonegativity | Depression | HIV Infection |
|--|--|---------------------------------------|---------------------------------|-------------------------------|-------------------------------|--------------------------------|
| Age <23 years | 1.08 (0.61-1.91) | 1.70 (0.95-3.04) [†] | 2.23 (1.08-4.60) [‡] | 0.90 (0.53-1.60) | 0.69 (0.39-1.21) | 1.05 (0.55-2.01) |
| Employment | 0.62 (0.31-1.26) | 0.55 (0.26-1.18) | 0.87 (0.37-2.31) | 1.34 (0.68-2.66) | 1.31 (0.65-2.62) | 1.08 (0.47-2.45) |
| Education | 0.77 (0.43-1.38) | 1.27 (0.69-2.34) | 1.67 (0.75-3.69) | 1.32 (0.75-2.32) | 0.77 (0.43-1.38) | 1.84 (0.91-3.71) [†] |
| Identifying as gay but still having meaningful relationship with women | 0.95 (0.52-1.73) | 1.90 (1.02-3.53) [‡] | 1.27 (0.61-2.67) | 2.22 (1.23-3.99) [‡] | 0.96 (0.53-1.75) | 1.51 (0.78-2.91) |
| Age at sexual debut | 0.51 (0.23-1.14) | 8.13 (1.82-36.34) | 0.63 (0.19-2.09) | 1.40 (0.64-3.05) [†] | 2.38 (0.97-5.83) [†] | 1.42 (0.48-4.15) |
| High importance of religion | 1.03 (0.24-4.48) | 9.67 (2.1-42.78) [§] | 0.20 (0.04-0.97) [‡] | 1.05 (2.23-4.82) | 2.49 (0.51-12.22) | 7.12 (0.76-66.39) [†] |
| Substance use during condomless sexual intercourse | - | 0.93 (0.50-1.72) | 2.67 (1.34-5.29) [§] | 0.64 (0.36-1.14) | 1.40 (0.79-2.50) | 1.22 (0.63-1.58) |
| Childhood and adolescent sexual abuse | 0.92 (0.5-1.68) | - | 2.77 (1.36-5.66) [§] | 1.04 (0.58-1.87) | 1.46 (0.81-2.62) | 1.50 (0.77-2.89) |

| | | | | | | |
|---|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| Experience of anti-gay violence | 2.68 (1.35-5.30)‡ | 0.36 (0.18-0.74)§ | - | 2.46 (1.20-5.07)‡ | 1.85 (0.93-3.71)† | 1.56 (0.74-3.29) |
| Internalized homonegativity | 1.75 (0.95-3.22)† | 1.16 (0.61-2.19) | 2.38 (1.16-4.89)‡ | - | 2.09 (1.19-3.65)‡ | 0.54 (0.28-1.04)† |
| Depression | 1.41 (0.79-2.52) | 0.7 (0.40-1.31) | 1.18 (0.90-3.70)† | 2.06 (1.18-3.60)‡ | - | 1.98 (1.03-3.78)‡ |
| HIV infection | 0.92 (0.47-1.79) | 0.69 (0.35-1.33) | 1.43 (0.67-3.07) | 1.82 (0.95-3.49)† | 1.99 (1.05-3.79)‡ | - |
| Abbreviations: HIV: Human immunodeficiency virus; MSM: Men who have sex with men; *Data are presented as adjusted odds ratios (95% confidence intervals). Each column represents a single and independent regression model; †p<0.1; ‡p<0.01; §p<0.001 | | | | | | |

Table 5: Multivariate associations between intersecting psychosocial problems among the 300 Tanzanian MSM in the study population *: Tanzanian men's study: Dar es Salam, Tanga, 2012-2013.

were positive but not significantly associated with being gay but still having a meaningful sexual relationship with women.

The model predicting violence, revealed a significant association between the importance of religion to the subject and violence. Similarly, the model also showed those who rated their religion as being very important had lower odds of haven experienced anti-gay violence. The above confirm assertion by Opera and colleagues that the importance of religion could be an adaptive but not optimally healthy factor [14,16].

We acknowledge limitations regarding interpreting the findings from this study. Respondent-driven sampling is an unbiased but non-probabilistic sampling method and thus reduces generalizability of our findings. In addition, recall bias from obtaining information from incidents of 6 months ago cannot be ruled out. Finally, the cross-sectional nature of the study precludes making any temporal associations.

Conclusion

This study extended the utility of syndemic theory to reveal existence of co-occurrence of psychosocial health problems among sampled Tanzanian MSM. The stated hypotheses were supported with findings from this study. There is high prevalence of psychosocial health problems among Tanzanian MSM. These health problems clustered together positively and significantly to produce SAVID among these men. A significant and positive “dose-response” relationship existed between SAVID and HIV seropositivity in the sample. Intervention(s) that address one or two of the psychosocial health problems may synergistically reduce odds of HIV seropositivity among these disadvantaged Tanzanian MSM.

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