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Increase in Sexual Risk Behavior and Prevalence of Chlamydia trachomatis *Among Adolescents in Northern Thailand*

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Background: **Monitoring changes in adolescent sexual risk behaviors and sexually transmitted infections is critical for evaluating the effectiveness of human immunodeficiency virus and other prevention programs, but population-based data on adolescents in Thailand are limited. We report findings from 2 cross-sectional surveys conducted in 1999 and 2002 among 15-to 21-year-old vocational students.**

Methods: **In 1999 and 2002, 1725 and 966 students, respectively, were interviewed using computer-assisted self-interview methods. Urine samples were collected and tested for *Chlamydia trachomatis* and *Neisseria gonorrhoeae* by polymerase chain reaction.**

Results: **From 1999 to 2002 *C. trachomatis* prevalence increased from 3.2% to 7.5% ($P < 0.001$) in women and from 2.5% to 6.0% ($P < 0.001$) in men. There was an increase in the reported mean lifetime number of steady sexual partners among both men (3.4–4.7, $P = 0.01$) and women (2.5–3.3, $P < 0.001$), and in the mean lifetime number of casual partners among men (1.1–2.1, $P < 0.001$) and women (0.3–1.1, $P = 0.04$). Reported consistent condom use decreased significantly among women with casual partners (43%–19%, $P = 0.03$) but not among men (25%–31%, $P = 0.31$).**

Conclusions: **Our study identified important increases in the prevalence of chlamydial infection and in sexual risk behaviors among Thai adolescents over a 3-year period. These findings are consistent with other studies suggesting profound social changes are changing norms of adolescent sexual behavior in Thailand, and highlight the need for adolescent sexual health services and prevention programming.**

MONITORING ADOLESCENT SEXUAL RISK behaviors and sexually transmitted infections (STIs) is necessary to identify risk populations and evaluate the effectiveness of human immunodeficiency virus (HIV) and other prevention programs. In Thailand, as in many other countries, the popular press carries almost daily polls or news about how traditional values are eroding, adolescents have sex at younger ages, and STIs among adolescents are rising.[1] However, data on the prevalence of STI and changing patterns of risk behavior among young people are limited. Obtaining reliable information about sensitive behaviors is challenging, especially among adolescents, and few prevalence surveys of STI have been conducted.

The value of computer-assisted methods for improving the reporting of sensitive behaviors, and validating behavioral surveys with biomarker data, has been demonstrated among adolescents and other populations.[2–5] We report on findings from 2 cross-sectional surveys conducted 3 years apart in similar populations using computer-assisted self-interview methods and collection of urine samples for STI testing. The surveys were conducted in Thailand's northernmost province of Chiang Rai, the epicenter of the Thai HIV epidemic in the early 1990s.[6]

Materials and Methods

Study Population and Enrollment

Two study populations were included in this analysis. Methods were the same in both studies except where specified. In the first study in 1999, students aged 15 to 21 years old attending 3 vocational schools in Chiang Rai province were invited to participate in a cross-sectional study of the prevalence of HIV, STI, drug use, and risk behaviors (PHRAYA study). In the second study in 2002, students aged 15 to 21 years attending 2 vocational schools (one of which was included in the first study) were invited to participate in a similar study (PalmPHRAYA study). In both studies, students were given an explanation of the study in classroom-based sessions and were asked for written informed consent. Consenting participants completed a survey instrument and provided a urine sample. All survey questions included in this analysis were the same in both studies. No names or personal identifiers were collected. The study protocols were approved by the Ethical Review Committee of the Thai Ministry of Public Health (MOPH) and an institutional review board of the US Centers for Disease Control and Prevention (CDC). Full descriptions of each study have been reported in detail elsewhere.[2,7]

Data Collection and Instruments

In the PHRAYA study, all students completed a questionnaire by audio-computer-assisted self-interview (ACASI). In the Palm-

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PHRAYA study, students were randomized to complete 1 of 4 survey instruments: palmtop-assisted self-interview (PASI), ACASI, self-administered paper questionnaire, or face-to-face interview conducted by trained interviewers aged 21 to 25 years matched to the gender of the interviewee. Questions included sociodemographic characteristics, sexual experience and behaviors, contraceptive practices, and drug-use behaviors. All questionnaires and interviews were in the central Thai language.

Definition of Variables

Sexual contact was defined as erotic stimulation of the genitals including oral sex, but not vaginal or anal penetration. Sexual intercourse was defined as penile-vaginal or penile-anal penetrative sex. A steady partner was defined as someone the respondent knew for at least 2 months, had sex with regularly, and with whom they felt an emotional bond. A casual partner was one with whom the respondent had sex, without meeting the definition of a steady partner, and without an exchange of money. Consistent condom use was defined as reporting "always" using condoms with sexual intercourse.

Sample Collection and Laboratory Tests

Urine specimens were collected immediately after survey completion in a plastic urine collection cup fitted with a temperature indicator strip to detect possible substitution. A multiplex polymerase chain reaction (PCR) test (Roche Molecular Systems, Branchburg, NJ) was used to detect *C. trachomatis* and *N. gonorrhoeae* DNA. Testing was done at the Thailand MOPH-US CDC Collaboration HIV/STI laboratory in Bangkok. Specimens testing positive for *C. trachomatis* were genotyped by sequencing a fragment of the *C. trachomatis* outer surface membrane protein A gene (*ompA*). The *ompA* gene was amplified by a nested PCR method described previously by Lysen et al.,[8] and the products were sequenced using the CEQ8000 (Beckman Coulter, Fullerton, CA). Genotyping was done at the US CDC, Atlanta, GA.

Data Analysis

We estimated the prevalence of behaviors and chlamydial infection for the 2 study populations, and assessed sex-specific differences using 2-sided *t* tests for continuous variables and by χ^2 test for categorical variables. For variables related to the reported

TABLE 1. Sociodemographic Characteristics and Reported Sexual Risk Behavior of Vocational School Students in Chiang Rai, Thailand in 1999 and 2002

	N (%) or Other Value					
	Male			Female		
Characteristic	1999 (n = 893*)	2002 (n = 486*)	$P^\dagger$	1999 (n = 832*)	2002 (n = 480*)	$P^\dagger$
Age in yr, mean (median)	18.5 (18)	19.3 (20)	<0.001	18.4 (18)	18.2 (18)	0.03
Live with parents	552 (62)	304 (62)	0.79	153 (57)	348 (72)	<0.001
Parent(s) working in agriculture	592 (66)	319 (66)	0.81	552 (66)	269 (56)	<0.001
Sexual experience						
Total						
No sexual contact or intercourse	302 (34)	97 (20)	<0.001	346 (42)	205 (43)	0.69
Sexual contact only	160 (18)	54 (11)	<0.001	127 (15)	58 (12)	0.11
Sexual intercourse	431 (48)	322 (66)	<0.001	359 (43)	212 (44)	0.72
Age 15–17	(n = 260*)	(n = 56*)		(n = 231*)	(n = 189*)	
No sexual contact or intercourse	139 (53)	21 (36)	0.02	130 (56)	115 (60)	0.42
Sexual contact only	53 (20)	11 (19)	0.81	50 (22)	24 (13)	0.01
Sexual intercourse	68 (26)	24 (41)	0.02	51 (22)	50 (26)	0.33
Age 18–19	(n = 388*)	(n = 163*)		(n = 375*)	(n = 145*)	
No sexual contact or intercourse	128 (33)	34 (20)	0.002	143 (38)	50 (34)	0.38
Sexual contact only	73 (19)	13 (8)	0.001	54 (14)	19 (13)	0.66
Sexual intercourse	187 (48)	116 (69)	<0.001	178 (47)	76 (52)	0.38
Age >19	(n = 245*)	(n = 248*)		(n = 226*)	(n = 135*)	
No sexual contact or intercourse	35 (14)	42 (16)	0.57	73 (32)	40 (28)	0.40
Sexual contact only	34 (14)	30 (11)	0.42	23 (10)	15 (11)	0.91
Sexual intercourse	176 (72)	182 (70)	0.60	130 (58)	86 (61)	0.56
Lifetime no. steady partners, mean (median)	3.4 (2)	4.7 (3)	0.05‡	2.5 (1)	3.3 (2)	0.01‡
Ever had a casual partner	233 (26)	185 (38)	<0.001§	75 (9)	47 (10)	0.51§
Lifetime no. casual partners, mean (median)	1.1 (0)	2.1 (1)	<0.001‡	0.32 (0)	1.1 (0)	0.05‡
Ever pregnant (self or partner)	79 (9)	55 (11)	0.14	100 (12)	49 (10)	0.32
Ever bought sex	55 (6)	46 (9)	0.02	1 (0)	7 (1)	0.01
Ever sold sex	19 (2)	31 (6)	<0.001	23 (3)	24 (5)	0.03
Consistent condom use‖						
Steady partner	31 (11)	40 (17)	0.04	16 (5)	20 (10)	0.4
Casual partner	27 (25)	58 (31)	0.31	10 (43)	9 (19)	0.03

*Column totals do not always add up to the total n because of missing values for some variables.
†*P* value for 2002 vs. 1999 by χ^2 test for categorical variables and by *t* test for continuous variables.
‡Age-adjusted using linear regression.
§Age-adjusted using Mantel-Haenszel χ^2.
‖Among those reporting sexual intercourse.

number of sex partners, *P* values were age-adjusted using linear regression for continuous variables and Mantel Haenszel test for dichotomous variables. Associations between demographic and risk behavior variables and *C. trachomatis* infection were summarized with univariate odds ratios (OR) and 95% confidence intervals (95% CI). Variables with a *P* value <0.10, in addition to age as a potential confounder identified a priori, were entered into a stepwise multivariate logistic regression procedure to identify independent associations with *C. trachomatis* infection.

The PalmPHRAYA study showed that face-to-face interview was inferior to ACASI for some sensitive questions, and that PASI and self-administered paper questionnaire were noninferior to ACASI; there were no significant differences in sociodemographic characteristics of participants randomized to each method.[7] We therefore excluded respondents who completed the survey by face-to-face interview from all analyses related to reported sexual behaviors. They were included for *C. trachomatis* genotyping findings only.

RESULTS

Study Population

In the PHRAYA study, 1725 (89.6%) of 1924 eligible students were available and consented to enroll, including 893 men and 832 women (Table 1). In the PalmPHRAYA study, 1283 (83.8%) of 1531 eligible students were available and consented to enroll; after excluding 317 students who completed the face-to-face interview, 486 men and 480 women remained. The age distribution changed somewhat between the 2 study populations, with men having a higher mean age in the 2002 study compared with 1999 (19.3 vs. 18.5, $P < 0.001$) and women having a lower mean age (18.2 vs. 18.4, $P = 0.03$). There were significant differences between the study population in the proportion of women living with their parents (57.1% in 1999 vs. 72.5% in 2002; $P < 0.001$), and whose parents worked in agriculture (66.3% in 1999 vs. 56.0% in 2002; $P < 0.001$).

Sexual Behavior

Because there was a significant difference in the ages of the 2 study populations, sexual experience was stratified by age group. Among men, there was a significant decrease overall in the proportion who had no history of sexual contact or intercourse (34% in 1999 vs. 20% in 2002; $P < 0.001$). This decrease was also seen in the younger age strata (age 15–17 and age 18–19 years); among those >19 years old, there was no significant change. A corresponding increase in the proportion with a history of sexual intercourse was seen in the younger age strata. Among women, there was no significant change in sexual experience by time period, overall, or by age stratum, other than a decrease in 15 to 17 years olds reporting a history of sexual contact only.

There was an increase in the mean lifetime number of steady partners among both men (3.4 in 1999, 4.7 in 2002; $P = 0.05$) and women (2.5 in 1999, 3.3 in 2002; $P = 0.01$), as well as an increase in the mean lifetime number of casual partners among both men (1.1 in 1999, 2.1 in 2002; $P < 0.001$) and women (0.32 in 1999, 1.1 in 2002; $P = 0.05$). The proportion of both sexes who reported ever having bought or sold sex also increased significantly, although the absolute numbers were small. There was no difference in the history of pregnancy for women or in history of a partner having been pregnant for men. Consistent condom use with steady partners increased as reported by men (11% in 1999, 17% in 2002; $P = 0.04$), whereas consistent condom use reported by women

TABLE 2. Trend in Prevalence of *Chlamydia trachomatis* by Sex and Reported Sexual Experience Among Vocational School Students in Chiang Rai, Thailand in 1999 and 2002

	N (%, 95% CI)					
	Male			Female		
Sexual History	1999	2002	*P*	1999	2002	*P*
No sexual contact	3/302 (1.0, 95% CI, 0.2–2.9)	1/97 (1.0, 95% CI, 0.0–5.6)	1.0	4/346 (1.2, 95% CI, 0.3–2.9)	7/205 (3.4, 95% CI, 1.3–6.9)	0.13
Sexual contact only	3/160 (1.9, 95% CI, 0.4–5.4)	2/54 (3.7, 95% CI, 0.4–2.7)	0.8	1/127 (0.8, 95% CI, 0.0–4.3)	4/58 (6.7, 95% CI, 1.9–16.7)	0.06
Sexual intercourse	16/431 (3.7, 95% CI, 2.1–6.0)	26/322 (8.1, 95% CI, 5.3–11.6)	0.01	22/359 (6.1, 95% CI, 3.9–9.1)	25/212 (11.8, 95% CI, 7.8–16.9)	0.02
Total	22/893 (2.5, 95% CI, 1.5–3.7)	29/486 (6.0, 95% CI, 4.2–8.7)	<0.001	27/832 (3.2, 95% CI, 2.1–5.0)	36/480 (7.5, 95% CI, 5.3–10.2)	<0.001

with casual partners decreased (43% in 1999, 19% in 2002; $P = 0.03$) but this was based on small numbers.

Sexually Transmitted Infections

There were 5 cases of gonococcal infection identified in the 1999 study and 2 in 2002. The prevalence of *C. trachomatis* infection among men increased from 2.5% in 1999 to 6.0% in 2002 ($P < 0.001$), and among women from 3.2% in 1999 to 7.5% in 2002 ($P < 0.001$) (Table 2). Most, but not all, cases were among students who reported a history of sexual intercourse.

Risk Factors for C. trachomatis *Infection in 2002*

Univariate analysis of risk factors for chlamydial infection in 2002 was conducted among 534 students who reported a history of sexual intercourse and who had a total of 51 infections (Table 3). Among men, the only factor significantly associated with infection was a lifetime history of 4 or more steady partners (OR, 2.8; 95% CI, 1.1–7.5). Among women, chlamydial infection was more common among those who smoked in the previous three months (OR, 3.9; 95% CI, 1.3–11.7), reported ever having a casual partner (OR, 3.2; 95% CI, 1.1–9.0), reported 4 or more lifetime casual partners (OR, 9.0; 95% CI, 1.7–47.5), or reported every having been pregnant (OR, 2.7; 95% CI, 1.0–7.1).

Variables that were entered into the multiple logistic regression model for men were age, smoking status, number of casual partners, and number of steady partners. No factors remained significant after adjustment, although a lifetime history of 4 or more steady partners suggested an association (OR, 2.6; 95% CI, 1.0–6.6). Variables that were entered into the model for female students were age, smoking status, number of casual partners, number of steady partners, and ever having been pregnant. The only factor that remained significant after adjustment was a lifetime history of 4 or more casual partners (OR, 1.6; 95% CI, 1.3–43.4).

TABLE 3. Risk Factors for Infection With *Chlamydia trachomatis* (CT^+) Among 534 Vocational Students Who Reported Having Had Sexual Intercourse, by Sex, Chiang Rai, Thailand, 2002

	Male (n = 322*)			Female (n = 212*)		
		Univariate			Univariate	
Characteristic	CT^+ N (%)	OR	95% CI	CT^+ N (%)	OR	95% CI
Age						
15–17	2/24 (8)	1.0		8/50 (16)	1.0	—
18–19	6/116 (5)	0.6	0.1–6.5	6/76 (8)	0.4	0.1–1.6
≥20	18/182 (10)	1.2	0.3–11.4	11/86 (13)	0.8	0.3–2.3
Parents' occupation						
Not agriculture	9/121 (7)	1.0	—	12/96 (13)	1.0	—
Agriculture	16/201(8)	1.1	0.4–2.7	13/116 (11)	0.9	0.4–2.2
Methamphetamine use						
Never	14/199 (7)	1.0	—	18/162 (11)	1.0	—
Ever	12/123 (10)	1.4	0.6–3.4	7/50 (14)	1.3	0.5–3.6
Smoked last 3 mo						
No	11/162 (7)	1.0	—	18/188 (10)	1.0	—
Yes	15/160 (9)	1.4	0.6–3.4	7/24 (29)	3.9	1.3–11.7
Ever had a casual sex partner						
No	11/152 (7)	1.0	—	17/180 (9)	1.0	—
Yes	15/170 (9)	1.2	0.5–3.0	8/32 (25)	3.2	1.1–9.0
No. casual partners in lifetime						
0–3	18/255 (7)	1.0	—	20/200 (10)	1.0	—
≥4	8/62 (13)	2.0	0.7–5.1	4/8 (50)	9.0	1.7–47.5
No. steady partners in lifetime						
0–3	7/155 (5)	1.0	—	17/160 (11)	—	—
≥4	19/164 (12)	2.8	1.1–7.5	7/51 (14)	1.3	0.5–3.7
Condom use with steady partner						
Always	1/37 (3)	1.0	—	1/18 (6)	1.0	—
Sometimes	9/94 (10)	3.8	0.49–171	10/82 (12)	2.4	0.3–108
Never	10/96 (10)	4.2	0.6–185	11/90 (12)	2.4	0.3–108
Condom use with casual partner						
Always	4/57 (7)	1.0	—	3/9 (33)	1.0	—
Sometimes	6/53 (11)	1.7	0.4–8.6	3/8 (38)	1.2	0.1–13.5
Never	4/39 (10)	1.5	0.3–8.7	2/8 (25)	0.7	0.0–8.5
Ever sold sex						
No	24/294 (8)	1.0	—	21/190 (11)	1.0	—
Yes	2/28 (7)	0.9	0.0–3.8	3/19 (16)	1.5	0.3–5.9
Ever bought sex						
No	22/281 (8)	1.0	—	24/205 (12)	1.0	
Yes	4/40 (10)	1.3	0.3–4.2	0/4 (0)	—	0.0–12.0
Ever pregnant (self or partner)						
No	22/265 (8)	1.0	—	14/162 (9)	1.0	—
Yes	4/55 (7)	0.9	0.2–2.7	10/49 (20)	2.7	1.0–7.1

*Row totals do not always add up to the sample number because of missing values.

TABLE 4. DNA Sequence Analysis of *C trachomatis Omp1* Genotypes Among 105 Infections in Vocational School Students in Chiang Rai, Thailand, 1999 and 2002

	No. (%) Specimens*	
Chlamydia Type	1999	2002
B	1 (2)	0 (0)
D	15 (32)	13 (22)
E	8 (17)	17 (29)
F	16 (34)	17 (29)
G	2 (4)	3 (5)
Ia	1 (2)	0 (0)
J	3 (6)	7 (12)
K	1 (2)	1 (2)

*Among those specimens successfully amplified.

C. trachomatis *Genotypes*

Overall, 47 (89%) of 53 specimens from the 1999 study and 58 (74%) of 78 specimens from the 2002 study were successfully amplified. Among those amplified, the most common serovars identified were D (32% in 1999, 22% in 2002), E (17% in 1999, 29% in 2002), and F (34% in 1999, 29% in 2002), with no significant differences between the two periods (Table 4).

DISCUSSION

Our study identified important increases in the prevalence of chlamydial infection among Thai adolescents over a 3-year period, from 2.5% to 6.2% in men and from 3.2% to 7.5% in women. There were corresponding increases in sexual risk behaviors, including the lifetime number of steady and casual partners; consistent condom use was low with both steady and casual partners. Chlamydial infection was associated with reporting a higher number of sex partners.

These concerning findings add to other sources suggesting that the important gains in HIV and STD control achieved in Thailand in the 1990s may now be eroding.[9,10] HIV prevalence in the 1999 PHRAYA study population was 0.2%[11] but was not evaluated in the 2002 and therefore could not be compared directly in this study. Case-reporting data from the Thai MOPH indicate that youth aged 15 to 24 account for an increasing proportion of reported STD cases and newly reported HIV cases[12,13]; however, HIV prevalence among antenatal clinic attenders has continued to decrease among the youngest age groups.[13]

C. trachomatis is one of the most common bacterial STI in adolescents worldwide and can have serious long-term sequelae including pelvic inflammatory disease, ectopic pregnancy, and infertility.[14] Chlamydial infections are frequently asymptomatic, and even when symptoms are present, no diagnostic test is routinely available in Thai public health facilities. Because syndromic approaches to the management of vaginal discharge and cervicitis are both insensitive and nonspecific in women, the need for an affordable and rapid diagnostic test for chlamydial infection is acute.[15]

A total of 22% of urine specimens PCR-positive for *C. trachomatis* were identified among adolescents who reported no sexual experience or sexual contact only. These may represent either false-positive laboratory tests or false-negative reports of sexual experience. The published specificity of the assay was 96.5% (package insert for Cobas Amplicor, Roche Molecular Systems, Branchburg, NJ), but the positive predictive value of any test decreases in a population with low or modest prevalence. Because of the likelihood these represent false-positive tests, they were excluded from the analysis of risk factors for *C. trachomatis* infection.

The assessment of *C. trachomatis* serovars in this adolescent population showed that D, F, and E were the most common, similar to those found in Western countries and in a previous evaluation of serovars in pregnant women in Thailand.[16] A recent study among STD clinic attendees in Japan and Thailand showed a broadly similar distribution, although serovar K was identified more frequently than D or E in Thai commercial sex workers in that survey.[17] The similarity in serovar distribution between this largely asymptomatic, screened population and that found in studies among symptomatic STD clinic attendees supports previous findings that there is no strong relationship between *C. trachomatis* type and clinical manifestations or virulence.[18]

Several recent studies suggest that the profound social changes currently occurring in Thai society include important changes in sexual norms among young people.[1,19–22] Traditional patterns of male sexual initiation through commercial sex and female ideals of virginity until marriage are shifting to a pattern of sexual relationships between adolescent peers.[19,20] These changes have important implications for the sexual health education needs of young people[1] and for the focus of HIV and STD prevention programs. Thailand's celebrated "100% Condom program" of the 1990s focused almost exclusively on promoting condom use in commercial sex establishments. Our findings confirm that condom use among adolescents is low with noncommercial (i.e., steady and casual) partners, whereas the number of reported steady and casual partners rose over a 3-year period. The targeting of appropriate safer sex messages may therefore need to be adjusted.

Our study has several limitations. The 2 cross-sectional study populations were sampled from similar but not identical populations. We cannot exclude the possibility that changes in behavior and chlamydial prevalence were due to a different underlying population rather than to a real change in adolescent behavior. However, the largest of the 3 vocational schools was the same in both surveys. When we restricted the analysis to that school, the findings were essentially unchanged for girls; for boys, the changes in behavior and infection prevalence were in the same direction but somewhat smaller in magnitude (data not shown). We cannot exclude possible bias associated with the somewhat lower response rate in the second survey (83.8% vs. 89.6% in the first survey).

Our study population consisted of vocational school students only in 1 geographic area, and cannot be extrapolated to all Thai adolescents. Although ACASI and PASI improve the reporting of sensitive or proscribed behaviors, under-or overreporting may still remain, and changes in social expectations rather than changes in behaviors themselves could account for some of the self-reported changes. For the analysis of risk factors associated with chlamydial infection in the 2002 survey, cell sizes were often too small to allow differences to be assessed. Because HIV prevalence was assessed only in the earlier study, it was not possible to evaluate whether changes in risk behaviors and *C. trachomatis* prevalence were also associated with any change in HIV prevalence.

The use of PASI to improve the reliability of adolescent risk behavior reporting has now been incorporated into the routine behavioral risk surveillance among vocational students conducted annually by Thailand's MOPH.[23] The availability of such data longitudinally collected in a consistent manner provides an opportunity for a much clearer understanding of the changes in youth risk behavior over time, and the factors influencing these changes. The periodic addition of noninvasive biomarker assessment such

as STI testing of urine samples in these annual surveys would further enhance the utility of the data for monitoring both risk and the success of prevention programs.

Our findings highlight the need for adolescent sexual health services and prevention programming in the study region. The concerning finding of a significant increase in the prevalence of chlamydial infection among these vocational students warrants further assessment in more recent cohorts and in other regions of Thailand. The high chlamydial prevalence also highlights the need for inexpensive, rapid STI diagnostics as a critical aspect of STI control programs.

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