

*Full Length Research Paper*

# Impact of menstrual hygiene management on adolescent health: The Effect of Go! Pads on rate of urinary tract infection in adolescent females in Kibogora, Rwanda

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To determine urinary tract infection (UTI) rates in adolescent menstrual pad users versus non-users in a rural area of Rwanda. Two hundred and forty adolescent participants in rural Western Rwanda were assigned to two cohorts; 120 received menstrual pads for six months and the other 120 did not use pads. Baseline symptoms and urine cultures were obtained. Symptoms and methods of menstrual hygiene management (MHM) were assessed and urine cultures were obtained every 2 months. The primary outcome was the presence of urinary tract infection diagnosed by positive urine culture. Secondary outcomes were UTI symptoms, vulvovaginal symptoms, sexual activity, dyspareunia and self-reported sexually transmitted infection. Associations of pad use with study outcomes was assessed by employing generalized estimating equations (GEEs) with nesting to account for the possibility of within school clustering as well as within participant correlation. Two hundred and nine participants completed the study. There was no difference in rates of positive urine culture. A decreased odds of vulvovaginal symptoms was found in self-reported "always" vs. "never" pad users (OR: 0.65 95% CI 0.44 to 0.97;  $p=0.04$ ). Despite not finding any difference in rates of UTI, our study showed a decreased rate of vulvovaginal symptoms in menstrual pad users. Further research investigating rates of genital infections in this population is thus necessary.

**Keywords:** Menstrual hygiene, adolescent health, urinary tract infection.

## INTRODUCTION

Menstrual health is a key component of comprehensive reproductive health that is known to be associated with poor outcomes such as school absenteeism and transac-

tional sex, but is often overlooked in the global context (Boosey, et al., 2014; Mason et al., 2013; Sommer and Sahin, 2013; Sommer et al., 2015; Sumpter and Torondel, 2013). Menstrual hygiene management (MHM) is defined as "using a clean menstrual management material to absorb or collect blood that can be changed in privacy as often as necessary for the duration of the

menstruation period, using soap and water for washing the body as required, and having access to facilities to dispose of used menstrual management materials” (Summer and Sahin, 2013). Schools in resource-limited settings often are unable to provide safe and clean environments for MHM, and adequate facilities are often unavailable at home as well (Mason et al., 2013). One challenge to adequate menstrual hygiene is access to MHM products. In rural western Kenya, for example, pads are a “preferred and valued item” for girls but are often unaffordable or rationed. Many girls use alternatives like cloth, grass or leaves, which cause them pain or embarrassment. This results in some girls participating in transactional sex for money to buy pads (Mason et al., 2013).

In Rwanda, the two most common brands of menstrual pads are “Always,” which is \$1.43 for a pack of ten, and “Everytime” which is \$1 for a pack of ten. These prices are unaffordable for many girls, and many ends up using cloth or other homemade alternatives. Sustainable Health Enterprises (SHE) is a Rwandan-based NGO that produces biodegradable pads made from banana fibers. The “Go!” pads produced by SHE are sold for \$0.67 for a pack of 10 and are distributed in resource limited and rural areas of Rwanda.

In addition to social outcomes of MHM, a few studies have also looked at MHM and reproductive health outcomes. A systematic review found no clear association between MHM and reproductive tract infections (RTI), however the quality of the studies was noted to be poor (Sumpter and Torondel, 2013). In addition, most of the included studies studied the incidence of bacterial vaginosis as their primary reproductive tract infection outcome, and only one evaluated rate of UTI. A recent study in India evaluated the incidence of bacterial vaginosis and/or UTI in women aged 18 to 45 years using disposable pads versus reusable absorbent pads, and found reusable pads were strongly associated with symptoms of bacterial vaginosis or UTI (Das et al., 2015). Women using reusable pads were also twice as likely to have a positive urine culture. However, there are no published studies examining the incidence of reproductive health outcomes and MHM in young women in Sub-Saharan Africa, a population disproportionately affected by poverty and lack of access to adequate MHM. In addition, there is a need for more methodologically consistent research in the area. We therefore sought to add to the sparse body of literature on this subject and specifically address the question of incidence of UTI in this population.

## **MATERIALS AND METHODS**

An interventional prospective cohort study was conducted at four secondary schools in the Western Province of Rwanda from April to October 2017. Meetings were held

with teachers, students, administration and parent groups at each school to assess the cultural appropriateness of the study prior to enrollment. The participating schools’ headmasters and the study coordinator determined together which schools would be intervention schools and which would be control schools based on their existing knowledge of the prevalence of pad use among their adolescent students. The study coordinator provided an educational session on menstrual hygiene and an explanation of the study at each school. Inclusion criteria were female students aged 18-24 who were menstruating and volunteered to participate in the study. Exclusion criteria were students at control schools who were already using pads at baseline.

Those eligible students who attended the educational sessions and volunteered to participate were consented by study staff in their chosen language (French, Kinyarwanda, or English). Two hundred and forty adolescent women were assigned to two separate cohorts. One hundred and twenty participants were assigned to receive menstrual pads provided by SHE for six months, and the other 120 enrolled participants were not provided pads, were not currently using menstrual pads, and planned not to change their menstrual hygiene management during the study period. Intervention group participants received two months’ worth of menstrual pads at a time. Participants were offered a waiver of written consent if they preferred to avoid documentation of their name in association with the study. No single school had participants in both arms of the study to avoid contamination.

Baseline survey data and urine samples were collected in April 2017 and follow up collections took place at 2-month intervals after the day of enrollment in June, August and October 2017.

Our primary outcome was presence of UTI, defined as a single isolated bacterial strain on urine culture. Secondary outcomes included presence of UTI symptoms without confirmation by urine culture, presence of vulvovaginal symptoms, self-reported sexual activity and self-reported sexually transmitted infections. Baseline and follow up surveys were developed in English by the study authors based on similar studies previously published in the literature. A licensed translator translated the surveys into Kinyarwanda, the participants’ primary language. Surveys were administered in writing by the study coordinator and identified by a unique study ID that only the coordinator had access to. All data were anonymous and de-identified.

Participants were taught how to collect clean catch urine samples. The study coordinator transported the urine samples immediately after collection in an iced cooler to a private lab for analysis. Participants diagnosed with an infection were provided with free antibiotic treatment. Specific UTI incidence rates are not available for adolescent girls in Rwanda. Based on the scant published

**Table 1.** Characteristics of the population at baseline.

Characteristic	Total (n=240)	Pad Use (n=120)	Pad non-use (n=120)	P-value
Age, Mean (SD)	19.1 (1.5)	18.8 (1.3)	19.5 (1.6)	0.001
Household 1. No parents 2. At least one parent 3. At least one parent and relatives and/or friends	10% 82.4% 8%	12% 79.0% 9%	8% 85.8% 6%	0.37
Father's education 0. No education 1. Primary school 2. Secondary school 3. College diploma and above NA	22% 45% 5% 2% 27%	18% 47% 8% 3% 24%	26% 43% 2% 1% 29%	0.07
Mother's education 0. No education 1. Primary school 2. Secondary school 3. College diploma and above NA	25% 58% 5% 2% 10%	24% 56% 8% 3% 8%	26% 61% 2.5% 0% 11%	0.08
Father's occupation 0. None 1. Farmer 2. Paid work NA	0% 51% 22% 27%	1% 48% 27% 24%	0% 54% 17% 29%	0.16
Mother's occupation 1. Housewife only 2. Farmer 3. Paid work NA	8% 60% 23% 9.6%	11% 55% 25% 9.2%	5% 65% 20% 10%	0.23

data from India, adolescent girls in resource poor settings have approximately a 13% prevalence rate of UTI. Additional data from India reported that of 181 girls studied, those using unsanitary cloth as a menstrual pad had a UTI

prevalence of 19% versus a 0% prevalence rate in those using sanitary pads (Ahmed and Avasarala, 2009). Using this scant information, we conservatively estimated that menstrual pad use would reduce the UTI rate

**Table 1. Cont.**

TV and/or Radio 0. No 1. Yes NA	36% 62% 1.7%	34% 65% 1%	38% 59.2% 2.5%	0.48
Electricity 0. None 1. Yes, all or most of the time 2. Yes, some of the time NA	48% 38% 13% 1%	43% 42% 14% 2%	53% 35% 12% 0%	0.21
Running water 0. No 1. Yes- always 2. Yes- sometimes NA	79% 14% 5% 2.5%	76% 15% 7.5% 1.7%	82% 13% 2.5% 3.3%	0.24
Pocket money 0. No 1. Yes- regularly 2. Yes- Sometimes NA	22% 7.1% 68% 3.8%	18% 7.5% 71% 3.3%	25% 7% 64% 4%	0.60
Earning money 0. No 1. Yes- regularly 2. Yes- sometimes NA	89% 0% 7.5% 3%	85% 0% 11% 4%	93% 0% 4.2% 3%	0.12

by 75%. Assuming an alpha of 0.05, within school intra-class correlation coefficient (ICC) of 0.01, and power of 80%, we calculated a total sample size of 240 (120 in each group) to detect a minimum of 75% reduction in UTI rate.

UTI was defined as a positive urine culture and data was recorded as “positive” or “negative.” Continuous variables were summarized as mean (SD) or median (interquartile range, IQR) depending on the nature of their empirical distribution and discrete variables were summarized as frequencies (%). Participant data were grouped into “users” versus “non-users” to assess associations of menstrual pad use with study outcomes. Comparison of baseline characteristics between assigned pad users and non-users was carried out using t-test or non-parametric equivalent for continuous covariates and Chi-squared test or Fisher exact test for discrete covariates. Associations of pad use with study outcomes was assessed by employing generalized estimating equations (GEEs) with nesting to account for the possibility of within school clustering as well as within participant correlation (Zeger et al., 1988). Analysis was done by considering pad use in two ways: as a fixed covariate (i.e., per protocol) as well as treating it as a time-dependent covariate (i.e., per actual/self-reported use) to capture the more realistic possibility that study participants might change their pad use status during the follow-up period. All analyses assessing the association of pad use with study outcomes were adjusted for a priori specified potential confounders. Results are summarized as effect estimate (odds ratio) and corresponding 95% confidence interval (CI). A computed  $p$ -value  $\leq 0.05$  (two-sided) was considered statistically significant. Statistical analysis was performed using the SAS 9.4 software package (SAS Institute Inc., Cary, NC, USA).

## RESULTS

We enrolled 52 students at Groupe Scolaire Frank Adamson de Kibogora (a private boarding school), 68 students at St. Paul, 97 students at St. Nicholas and 23 students at Groupe Scolaire Makoko (public day schools). Four to 20 (3-17%) participants in either group were absent on at least one collection day and we were unable to obtain and process samples for these participants for at least one collection. A total of 209(87%) of the enrolled participants completed the study.

Baseline and socioeconomic characteristics were similar in each group. Of note, 48% of participants reported having no electricity and 79% reported no running water at home. Eighty two percent of participants endorsed negative feelings towards their first period with an additional 6% reporting mixed feelings. Twenty four percent of participants reported not having received any information about menstruation prior to menarche. Once information was received, 34% of participants obtained

information from sources outside formal education (Table 1 and 2). Only 32% of participants reported using a commercial sanitary pad for MHM, with another 32% using cloth, a cloth pad or napkins and the remaining 36% using a combination of methods (Table 3).

There was no difference in the primary outcome of UTI in the intervention and control group (OR 2.11 95% CI 0.90 to 4.93;  $p=0.09$ ). We did find a significant decrease in rates of vulvovaginal symptoms (defined as bothersome discharge and/or odor) in both the unadjusted (OR: 0.62 95% CI 0.40 to 0.97;  $p=0.04$  for per-protocol pad use and OR: 0.66 95% CI 0.44 to 0.98;  $p=0.04$  for self-reported always users of pads) and adjusted analyses, however the effect remained significant in the adjusted analysis only for the self-reported always users of pads (OR: 0.65 95% CI 0.44 to 0.97;  $p=0.04$ ) and not for the sometimes users of pads nor for the per-protocol (fixed) pad use analysis (Table 4). We found no correlation between UTI and sexual history variables (Table 5) nor MHM and sexual history variables (Table 6).

## DISCUSSION

Our study found no difference in the rate of UTI with and without menstrual pad use. We did find a decreased risk of vulvovaginal symptoms in girls who used menstrual pads during the study. In addition, we were able to characterize the knowledge, attitudes and practices surrounding menstruation in a vulnerable and poorly studied population. We found that a significant percentage of our participants had received little to no education or knowledge about menstruation before menarche. In addition, only a third of participants used menstrual pads as their form of MHM.

Strengths of the study include a prospective design and a relatively large sample size. We received buy-in from a difficult-to-reach population due to previous work by the principal investigator in this area of Rwanda and collaboration with key stakeholders within each school and the district. We found that, at each of the schools, there was a “female confidant” teacher who was viewed as trustworthy by the female students and knowledgeable about the menstrual practices of the girls at each school. These “female confidant” teachers served as the connection between the girls and the school administration and were key for facilitating our study. We consider such teachers essential components of any effort to distribute menstrual pads or conduct further research in this area in the educational setting.

A limitation of this study was lack of randomization at the individual participant level due to the concern for crossover contamination. Participants who received pads as part of the study could potentially share pads with their classmates and friends who had not received pads, so we deemed it necessary to assign all participants in one school to either control or intervention. There was also the risk that participants who attend the same school

**Table 2.** Menstrual Characteristics at baseline.

<b>Menstrual Characteristics</b>	<b>Total (n=240)</b>	<b>Pad Use (n=120)</b>	<b>Pad non-use (n=120)</b>	<b>P-value</b>
Menarche, mean (SD)	14.6 (1.3)	14.6 (1.3)	14.5 (1.3)	0.51
Feelings about first period?				0.20
0. Negative	82%	79%	85%	
1. Positive	12%	15%	8%	
2. Mixed feelings	6%	6%	6%	
3. Other	0%	0%	1%	
Menstrual frequency				0.01
0. Regular (20-35 days)	69%	61%	77%	
1. Irregular	31%	39%	23%	
Menstrual length, mean (SD)	4.4 (1.2)	4.5 (1.2)	4.4 (1.3)	0.29
How heavy is menstrual bleeding?				0.25
1. Minimal				
2. Moderate	5%	5%	5%	
3. Heavy	73%	68%	77%	
	22%	27%	18%	
Menstrual problems				0.24
0. None	4%	5%	3%	
1. Headache	2%	2%	2%	
2. Nausea and/or Vomiting	0%	0%	0%	
3. Weakness	5%	7%	3%	
4. Anorexia	2%	2%	2%	
5. Abdominal and/or back pain	32%	36%	28%	
6. More than one problem listed above	56%	49%	63%	
7. Other (Specify)	0%	0%	0%	
Medications used:				0.53
0. No	82%	82%	83%	
1. Yes- used every cycle	6%	8%	4%	
2. Yes- used occasionally	12%	11%	13%	

**Table 2. Cont.**

If yes, what medication? 0. Unknown name or unspecified 1. Ibuprofen or other NSAID 2. Paracetamol 3. Traditional botanical medicines 4. Combination of 1 and 2 5. Other	42% 28% 7% 12% 7% 5%	57% 17% 4% 4% 13% 4%	25% 40% 10% 20% 0% 5%	0.0499
What is menstruation? 0. Don't know 1. Normal 2. Disease 3. Curse 4. Other	10% 74% 4% 1% 11%	16% 66% 3% 2% 13%	4% 82% 5% 1% 8%	0.01
Which organ does menstrual blood come from? 0. Don't know 1. Uterus 2. Vagina 3. Bladder 4. Abdomen 5. Other	3% 43% 46% 1% 7% 0%	3% 43% 49% 0% 5% 0%	2% 43% 44% 3% 8% 1%	0.31
Did you receive information about menstruation before menarche? 0. No 1. Yes	24% 76%	21% 79%	28% 72%	0.26
Source of information regarding menstruation: 0. No one 1. Mother 2. Teacher 3. Friends 4. Books 5. Media (TV, Radio) 6. Others 7. Multiple sources including mother and/or teacher 8. Multiple sources not including mother and/or teacher	1% 16% 16% 10% 3% 1% 1% 50% 3%	0% 16% 14% 15% 3% 0% 1% 48% 3%	2% 16% 18% 5% 3% 2% 1% 51% 4%	0.20

**Table 3.** MHM characteristics at baseline.

Characteristic	Total (n=240)	Pad Use (n=120)	Pad non-use (n=120)	P-value
Is material used to soak up blood: 0. No 1. Yes	6% 94%	5% 95%	6% 94%	0.78
If yes, what is used to soak up blood? 1. Commercially made sanitary pad 2. Napkin 3. Rag made pad 4. Cloth 5. Commercially made sanitary pad in combination with one or more of the other methods listed 6. A combination of one or more of the other non-commercially made sanitary pad methods listed	32% 1% 9% 22% 32% 4%	59% 2% 6% 9% 21% 3%	5% 0% 13% 35% 43% 5%	<.0001
If you use cloth, how is it cleaned? 0. None 1. Soap & water 2. Only water 3. Other	16% 81% 3% 1%	33% 65% 0% 1%	4% 91% 5% 0%	<.0001
If you use cloth, how is it dried? 0. Not dried 1. Sunlight 2. Inside the house 3. Other	1% 50% 47% 2%	0% 63% 33% 4%	1% 44% 54% 1%	0.02
Times per day pad/cloth is changed: 0. None 1. Three and more 2. Once 3. Twice	1% 24% 21% 54%	1% 28% 23% 48%	2% 19% 18% 61%	0.18



**Table 3. Cont.**

Method of disposal: 0. N/A (not disposed) 1. Dustbin 2. Drain 3. Toilet 4. Open field 5. Multiple methods	20% 5% 6% 59% 0% 10%	5% 9% 3% 68% 1% 15%	35% 0% 10% 50% 0% 4%	<.0001
Materials used to dispose: 0. N/A (not disposed) 1. Wrapped in Paper 2. In a plastic bag 3. I do not wrap it 4. Multiple method or other	4% 15% 6% 74% 1%	3% 15% 8% 73% 1%	5% 15% 4% 75% 1%	0.77
Number of underwear changes per day when menstruating, median (IQR) <sup>1</sup>	2 (1-2)	2 (2-3)	2 (1-2)	0.02
Frequency of school absenteeism due to menstruation: 0. Never 1. One day every cycle 2. Two days every cycle 3. Three days every cycle 4. Four days every cycle 5. Other	41% 37% 9% 5% 7% 1%	45% 29% 11% 3% 10% 2%	37% 44% 7% 8% 3% 1%	0.02
Method of self-hygiene during menstruation: 0. None 1. Water and soap 2. Only with water 3. Paper 4. Towel 5. Multiple methods (including soap) 6. Multiple methods (without soap)	0% 71% 16% 0% 1% 9% 2%	0% 61% 24% 1% 0% 11% 3%	1% 81% 9% 0% 3% 7% 0%	0.0004

**Table 4.** Urine Culture Results.

	Pad Use (n=120)	Pad non-use (n=120)	Unadjusted Analysis (fixed pad use)		Adjusted analysis (fixed pad use)		Unadjusted Analysis (time dependent pad use)		Adjusted analysis (time dependent pad use)	
			Odds Ratio (95% CI)	p-value	Odds Ratio (95% CI)	p-value	Odds Ratio (95% CI): always vs no; and sometimes vs no	p-value: always vs no; and sometimes vs no	Odds Ratio (95% CI): always vs no; and sometimes vs no	p-value: always vs no; and sometimes vs no
Positive urine culture	5%	3%	1.60 (0.79, 3.25)	0.19	2.11 (0.90, 4.93)	0.09	0.92 (0.29, 2.91); 1.51 (0.47, 4.87)	0.89 0.49	0.96 (0.32, 2.93); 1.56 (0.51, 4.80)	0.95 0.44
Urinary symptoms	52%	57%	0.84 (0.58, 1.23)	0.37	1.04 (0.67, 1.61)	0.86	1.00 (0.64, 1.56); 1.25 (0.84, 1.86)	0.99 0.27	0.99 (0.63, 1.58); 1.24 (0.82, 1.87)	0.98 0.31
Vulvo-vaginal symptoms	47%	51%	0.62 (0.40, 0.97)	0.04	0.92 (0.54, 1.56)	0.75	0.66 (0.44, 0.98); 1.22 (0.88, 1.69)	0.04 0.23	0.65 (0.44, 0.98); 1.21 (0.86, 1.68)	0.04 0.27

**Table 5.** Sexual Activity and MHM.

	Pad Use (n=120)	Pad non-use (n=120)	Unadjusted Analysis (fixed pad use)		Adjusted analysis (fixed pad use)		Unadjusted Analysis (time dependent pad use)		Adjusted analysis (time dependent pad use)	
			Odds Ratio (95% CI)	p-value	Odds Ratio (95% CI)	p-value	Odds Ratio (95% CI): always vs no; and sometimes vs no	p-value: always vs no; and sometimes vs no	Odds Ratio (95% CI): always vs no; and sometimes vs no	p-value: always vs no; and sometimes vs no
Sexual activity	2%	4%	0.43 (0.13, 1.43)	0.17	0.36 (0.09, 1.46)	0.15	1.56 (0.65, 3.74); 0.98 (0.55, 1.75)	0.32 0.95	1.68 (0.59, 4.79); 0.95 (0.42, 2.15)	0.33 0.90
Presence of dyspareunia	11%	12%	1.10 (0.32, 3.78)	0.88	2.10 (0.56, 7.85)	0.27	1.12 (0.35, 3.59); 0.56 (0.17, 1.82)	0.84 0.33	1.04 (0.33, 3.32); 0.53 (0.17, 1.60)	0.95 0.26
History of STI	6%	3%	1.20 (0.45, 3.19)	0.71	1.86 (0.67, 5.20)	0.24	2.80 (0.80, 9.87); 2.26 (0.67, 7.66)	0.11 0.19	2.79 (0.85, 9.18); 2.44 (0.70, 8.44)	0.09 0.16

**Table 6.** Sexual Activity and Risk of Urinary Tract Infection.

	Positive urine culture	Negative urine culture	Unadjusted Analysis (fixed pad use)		Adjusted analysis (fixed pad use)		Unadjusted Analysis (time-dependent pad use)		Adjusted analysis (time-dependent pad use)	
			Odds Ratio (95% CI)	p-value	Odds Ratio (95% CI)	p-value	Odds Ratio (95% CI)	P-value	Odds Ratio (95% CI)	P-value
Sexually active	5%	3%	1.82 (0.37, 8.98)	0.46	2.43 (0.57, 10.30)	0.23	1.84 (0.37, 9.19)	0.45	2.48 (0.58, 10.62)	0.22
Presence of dyspareunia	22%	11%	2.29 (0.48, 10.99)	0.30	2.08 (0.52, 8.25)	0.30	2.54 (0.52, 12.38)	0.25	2.44 (0.60, 9.94)	0.21
History of STI	10%	4%	1.51 (0.58, 3.97)	0.40	1.46 (0.51, 4.14)	0.48	1.47 (0.57, 3.79)	0.43	1.45 (0.52, 4.01)	0.47

would share similar baseline characteristics and therefore the participants in the two arms of the study would be different at baseline. There was no difference in baseline participant characteristics, however, and our observed decrease in vulvovaginal symptoms persisted after adjusting for potential confounders. In addition, we over-estimated the rate of UTI in our population based on scant previously published data in a similar socioeconomic setting, which reported a UTI rate of 13% (Ahmed and Avasarala, 2009). We found a 3-5% prevalence of UTI in our study population, and as a result, may have been underpowered to detect a small difference in the UTI rate. In addition, our study did not assess the presence of bacterial vaginosis, vulvovaginal candidiasis or other reproductive tract infections via physical exam or laboratory analysis, so we are unable to draw any conclusions as to the cause of these symptoms.

This study adds to the very limited body of literature regarding reproductive health outcomes, specifically UTI, in populations with limited access to MHM.

To our knowledge, this is the first study addressing this question in Africa, and specifically, Sub-Saharan Africa. Many non-governmental organizations, businesses and governments are now recognizing the importance of menstrual hygiene for young women's health and education, and there are multiple efforts underway, such as SHE and Afri-pad in Uganda, that are aiming to produce and distribute menstrual pads for these populations ((Crofts and Fisher, 2012). In addition to menstrual pads, however, many other factors have been identified as necessary for improved menstrual hygiene, including access to a reliable and clean water supply, a private place to change during menstruation, and a hygienic way to dispose of pads (Rheinländer et al., 2018). The complex nature of providing comprehensive menstrual hygiene in low resource settings needs to be recognized. Research efforts that address each of these components, in addition to reproductive health outcomes, will allow directed and informed public health efforts in the future.

## Non-standard abbreviations:

Reproductive tract infection (RTI)  
Sustainable Health Enterprises (SHE)  
Menstrual hygiene management (MHM)

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