

# Effectiveness of Game-Based Health Education on Female Adolescents' Knowledge and Attitudes Toward HPV Vaccination: A Quasi-Experimental Study

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## Abstract

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**Background:** Insufficient knowledge of reproductive health among female adolescents contributes to inadequate prevention and early detection of cervical cancer. Cervical cancer frequently develops in early adulthood, despite being preventable through the timely administration of the Human Papillomavirus (HPV) vaccine. This study evaluates the effectiveness of health education media in improving female adolescents' knowledge and attitudes toward the HPV vaccine.

**Methods:** A quasi-experimental quantitative design with a pretest-posttest control group was employed. The sample consisted of 66 participants selected via probability sampling with stratified sampling.

**Result:** Statistical analysis indicated that both the engklek and crossword puzzle intervention groups demonstrated significant improvements in knowledge and attitudes following the intervention ( $p < 0.05$ ), while the control group showed no significant changes ( $p < 0.05$ ). One-way ANOVA revealed significant differences in knowledge and attitudes among the engklek, crossword, and control groups ( $p = 0.000$ ). Post hoc and N-gain analyses indicated that crossword puzzles were the most effective in enhancing adolescents' knowledge.

**Conclusion:** Crossword puzzle media can serve as an effective tool for disseminating information about the HPV vaccine. Enhanced dissemination is anticipated to increase HPV vaccine coverage and reduce cervical cancer risk.

**Keywords:** Engklek Game, HPV Vaccine, Knowledge



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## BACKGROUND

Cervical cancer, a largely preventable sexually transmitted infection (STI), can have its global incidence substantially reduced through targeted education, screening, and appropriate interventions (1). Recent data indicate an increasing trend in cervical cancer incidence among young women, particularly in countries such as China. This trend is associated with high estrogen levels and increased sexual activity, which elevate the risk of persistent Human Papillomavirus (HPV) infection (2). In Indonesia, a similar pattern has been observed, with approximately 10.87% of HIV-positive women, especially in Bali, also exhibiting abnormal cervical cytology (3). The Indonesian Demographic and Health Survey (IDHS) reports a rise in premarital sexual activity among adolescents compared to 2012 (4). Additional studies indicate that approximately 15 million female adolescents aged 15–19 give birth each year, and around 15–20% of school-aged adolescents in Indonesia have engaged in sexual intercourse outside of marriage (5). Early sexual intercourse, particularly before the age of 20, has been shown to significantly increase the risk of developing cervical cancer.

HPV vaccination has been available Since 2006, HPV vaccination has been available as a preventive measure against cervical cancer. The vaccine has demonstrated effectiveness in reducing cancer-related mortality, particularly in populations with high mortality rates and in developing countries with limited resources for routine screening (1). Despite this, participation in cervical cancer screening remains low in developing countries, with coverage rates ranging from 5% to 59.7% (6). In Indonesia, HPV vaccination coverage among 15-year-old girls in 2020 was only 7%, well below the World Health Organization's (WHO) global target of 90% (7). Additionally, self-funded HPV vaccination coverage among women of reproductive age remains low, at only 1.1% of more than 52 million women in 2019 (8,9). These data highlight a significant gap in reaching the target population. Implementation of HPV vaccination programs has been identified, including the high cost of the HPV vaccine. Although vaccination programs in several cities such as Surabaya, Makassar, and Manado have demonstrated success, the overall cost remains a significant obstacle to broader implementation (10,11). In addition, baseline awareness and knowledge regarding HPV and its vaccine among female adolescents remain generally low. Studies indicate that only 2.5% of female adolescents have ever heard of the HPV vaccine (12). Other research reports that only 15.1% of students have heard of HPV, while 34.3% are aware of cervical cancer (13). Further evidence shows that only approximately 24.9% of adolescents are aware of HPV (14), and 9.9% have heard of the HPV vaccine (15), highlighting the low level of basic knowledge among female adolescents regarding HPV and the importance of vaccination. Additionally, the Health Belief Model effectively explains adolescent girls' perceptions of HPV vaccination awareness. Adolescents who consider themselves more vulnerable to HPV infection and understand the severity of the disease (e.g., the risk of cervical cancer) are more likely to accept vaccination. For example, there are vaccinated adolescents who perceive HPV infection as more severe and have a greater awareness of vulnerability compared to their unvaccinated peers (16). However, some adolescents show low vulnerability perception, which can be a barrier to vaccination (17). These findings are further supported by preliminary study results showing that female students at Senior High School and MA Pondok Pesantren Raudhatul Ulum had never received information or health education related to HPV vaccination. Moreover, in-depth interviews revealed that 6 out of 11 students expressed willingness to receive the HPV vaccine after obtaining more information, and 9 out of 11 students stated that parental influence plays a major role in their decision-making regarding HPV vaccination. Notably, HPV vaccination is highly effective in preventing cancer, with no cases of carcinoma or precancerous lesions detected and sustained high seropositivity rates (>90%) up to 13 years post-vaccination, thereby significantly reducing the incidence of cervical cancer Several factors influence the initiation and continuation of HPV vaccination, including individual awareness, healthcare professional recommendations, and environmental support (19). Consequently, comprehensive and effective public

education initiatives are critical to increasing HPV vaccination uptake and motivating women to participate in cervical cancer screening. Health education interventions have demonstrated significant improvements in female adolescents' knowledge and attitudes toward HPV vaccination. For example, one study reported a 94% increase in the proportion of students correctly answering questions about the HPV vaccine, with positive attitudes toward HPV infection risk and appropriate vaccination age increasing by 78.5% and 48%, respectively, after educational interventions (12). School-based research corroborates the effectiveness of these interventions in enhancing knowledge, perceptions, and acceptance of HPV vaccination among adolescents aged 15–17 years (20). A systematic review further confirms that educational interventions improve knowledge and foster positive attitudes toward HPV vaccination (21). Additionally, peer-led health education has been shown to significantly improve knowledge scores following intervention (22).

The choice of methods and media in health education is critical for enhancing adolescents' knowledge. Educational games have demonstrated effectiveness in creating engaging and enjoyable learning environments, thereby increasing adolescents' attention and motivation (23). These games can enhance motivation and engagement, making students more interested and enthusiastic compared to traditional teaching methods (24). Educational games have also been shown to improve adolescents' knowledge of HPV vaccination. For instance, the interactive game "*Vaccination Vacation*" influenced perceptions of the HPV vaccine, although it was not more effective than standard educational methods (25). Accordingly, this study utilizes an educational game-based approach, incorporating the Engklek game and crossword puzzles. Engklek, a traditional game, can enhance cognitive skills and discipline (26), while crossword puzzles stimulate the brain and promote learning in an enjoyable setting (27).

Previous studies have identified a lack of educational game-based media specifically designed to address knowledge and attitudes toward HPV vaccination. Therefore, innovative, game-based educational media have the potential to improve female adolescents' knowledge and attitudes regarding HPV vaccination and contribute to future cervical cancer prevention efforts. Based on these considerations, the present study aims to analyze the effects of Engklek and crossword puzzles on adolescent girls' knowledge and attitudes regarding HPV vaccination.

## METHODS

### *Study Design*

A quantitative quasi-experimental design with a pretest–posttest control group was utilized. The research was conducted at Senior High School IT Raudhatul Ulum. The primary objective was to assess differences in the effectiveness of health education media on female adolescents' knowledge and attitudes regarding HPV vaccination. Three groups were established: an engklek game group, a crossword puzzle group, and a control group.

### *Sample/Participants*

Probability sampling with a stratified technique ensured representation from grades 11 and 12. The population was divided into six strata: XI IPA 1, XI IPA 2, XI IPS 1, XII IPA 1, XII IPA 2, and XII IPS 1. In the intervention group, there were 125 students. The sample size was 44 respondents, allocated proportionally: XI IPA 1: 9; XI IPA 2: 6; XI IPS 1: 4; XII IPA 1: 9; XII IPA 2: 11; XII IPS 1: 5. The intervention group was split into two treatment groups, the hopscotch group and the crossword puzzle group, each with 22 respondents. The control group had 117 students, with a sample of 22 respondents. Proportional allocation for the control group was XI IPA 1: 3; XI IPA 2: 3; XI IPS 1: 3; XII IPA 1: 4; XII IPA 2: 3; XII IPS 1: 6. The total sample for all groups was 66. Inclusion criteria: female students in grades 11 and 12, aged 15–18, who had not received HPV vaccination education, were willing to participate, and agreed to complete the study. Exclusion criteria: illness or extremity injuries.

### ***Instruments***

The research instruments included a knowledge questionnaire with 15 statements addressing the definition, objectives, benefits, administration methods, and potential side effects of the HPV vaccine. Each correct answer received a score of 1, while incorrect answers were scored as 0, yielding a possible score range of 0 to 15. An attitude questionnaire regarding the HPV vaccine comprised 14 statements measured on a Likert scale. For positively worded statements, scores ranged from 4 (strongly agree) to 1 (strongly disagree). For negatively worded statements, the scoring was reversed. The attitude questionnaire had a maximum score of 56 and a minimum of 14. Both instruments underwent validity testing. The knowledge questionnaire demonstrated item-total correlation coefficients ranging from 0.335 to 0.563, all exceeding the acceptable threshold ( $r > 0.30$ ), indicating validity. The attitude questionnaire showed item-total correlation coefficients from 0.354 to 0.736, also above the minimum acceptable value. Reliability coefficients were 0.705 for the knowledge questionnaire and 0.652 for the attitude questionnaire, confirming both instruments as valid and reliable.

### ***Data Collection***

The research was conducted by coordinating with IT Senior High School and MAN at Pondok Pesantren Raudhatul Ulum, selecting respondents according to the inclusion criteria, and assigning them to intervention and control groups using stratified random sampling by grade level and academic major. Group allocation was conducted using the Wheel of Names web-based tool. Respondents received explanations about the study's objectives, benefits, and procedures, and informed consent was obtained. The first intervention group participated in the engklek game for 45 minutes, beginning with a random selection to determine playing order. Participants threw a marker and hopped across squares on one foot, pausing at designated squares to read information cards about HPV. Those who completed the course without violations answered questions about HPV; correct answers earned them a "house" point. The participant with the most "houses" was declared the winner and received a reward. The second intervention group engaged in a crossword puzzle for 45 minutes, divided into five groups of four to five members. Each group collaboratively completed the puzzle, then answered questions related to HPV. Groups that answered quickly and correctly were awarded points, and the group with the highest score received a reward. The control group participated in alternative activities, including snacks, discussions, and watching videos unrelated to HPV vaccination, for 45 minutes. All respondents completed knowledge and attitude questionnaires before and after the intervention. To uphold research ethics, the control group received the intervention later.

### ***Data Analysis***

Data were processed and analyzed using paired t-tests, one-way ANOVA, post hoc tests, and N-gain analysis, with  $p < 0.05$  as the criterion for significance.

### ***Ethical Considerations***

Ethical approval was obtained from the Medical and Health Research Ethics Committee (KEPKK) of the Faculty of Medicine, Universitas Sriwijaya, protocol number 301-2022.

## RESULT AND DISCUSSION

### Respondent Characteristics

**Table 1.** Respondent Characteristics (n = 66)

Respondent Characteristics	Engklek Game		Crossword Puzzle		Control Group	
	(n)	(%)	(n)	(%)	(n)	(%)
<b>Age</b>						
15 years	4	18.2%	1	4.5%	0	0.0%
16 years	6	27.3%	11	50%	11	50%
17 years	12	54.5%	10	45.5%	10	45.5%
18 years	0	0%	0	0%	1	4.5%
<b>Grade</b>						
Grade 11	10	45.5%	9	40.9%	9	40.9%
Grade 12	12	54.5%	13	59.1%	13	59.1%
<b>Family History of Cervical Cancer</b>						
Yes	0	0%	0	0%	0	0%
No	22	100%	22	100%	22	100%

Note : n (sample); % (percentage)

The results indicate that Table 1 shows differences in characteristics among the engklek game, crossword puzzle, and control groups. The majority of participants in the engklek group were female adolescents aged 17 (54.5%), while those in the crossword and control groups were largely aged 16 (50% each). Most respondents across all groups were twelfth-grade students (54.5–59.1%), and none had a family history of cervical cancer.

### Respondents' Knowledge and Attitudes

**Table 2.** Differences in Respondents' Knowledge and Attitudes Before and After Intervention in the Engklek Game Group, Crossword Puzzle Group, and Control Group (N=66)

Group	n	Min	Max	Mean ± SD	Mean Difference	p-value*	Cohen's d	95% CI
<i>Knowledge</i>								
Engklek Game Intervention Group								
Pretest	22	7	12	9.41 ± 1.501	-1.733	0.001	0.78	[-2.778 ; -0.768]
Posttest	22	8	14	11.18 ± 1.500				
Crossword Puzzle Group								
Pretest	22	4	12	9.45 ± 2.110	-2.909	0.000	1.10	[-4.077 ; -1.741]
Posttest	22	10	14	12.36 ± 1.093				
Control Group								
Pretest	22	6	14	9.77 ± 1.950	0.727	0.233	0.26	[-0.506 ; 1.960]
Posttest	22	6	13	9.05 ± 1.704				
<i>Attitude</i>								
Engklek Game Intervention Group								
Pretest	22	34	47	41.05 ± 3.671	-3.682	0.002	0.76	[-5.843 ; -1.521]
Posttest	22	39	50	44.73 ± 3.439				
Crossword Puzzle Group								
Pretest	22	36	50	40.18 ± 3.634	-3.455	0.026	0.51	[-6.458 ; -0.451]
Posttest	22	31	53	43.64 ± 4.746				
Control Group								
Pretest	22	31	50	40.50 ± 4.362	0.955	0.374	0.19	[-1.232 ; 3.142]
Posttest	22	33	45	39.55 ± 2.874				

Table 2 shows that in the engklek game intervention group, pretest scores ranged from 7 to 12, and posttest scores ranged from 8 to 14. The paired t-test results in the engklek game group indicated a significant difference between pretest and posttest knowledge scores ( $p = 0.001$ ). Furthermore, in the crossword puzzle intervention group, pretest scores ranged from 4 to 12, and posttest scores ranged from 10 to 14. The paired t-test results in the crossword puzzle group also showed a significant difference between pretest and posttest knowledge scores ( $p = 0.000$ ). In contrast, in the control group, the pretest scores ranged from 6 to 14, while the posttest scores ranged from 6 to 13. The paired t-test results for the control group showed no significant difference between pretest and posttest knowledge scores ( $p = 0.233$ ).

Furthermore, in the engklek game intervention group, the pretest attitude scores ranged from 34 to 47, while the posttest scores ranged from 39 to 50. The paired t-test results in the engklek game group showed a significant difference between pretest and posttest attitude scores among female adolescents ( $p = 0.002$ ). In the crossword puzzle intervention group, the pretest scores ranged from a minimum of 36 to a maximum of 50, while the posttest scores ranged from a minimum of 31 to a maximum of 53. The paired t-test results in the crossword puzzle group also indicated a significant difference between pretest and posttest attitude scores among female adolescents ( $p = 0.026$ ). In the control group, the pretest scores ranged from 31 to 50, while the posttest scores ranged from 33 to 45. The paired t-test results for the control group showed no significant difference in attitude scores between the pretest and posttest for adolescent girls ( $p = 0.233$ ).

**Table 3.** ANOVA Tests Between Group on Female Adolescents' Knowledge and Attitudes Toward HPV Vaccination

	Group	Mean Difference	p-value
<b>Knowledge</b>			
Engklek Game	Crossword Puzzle	-1.182	0.024
	Control Group	2.136	0.000
Crossword Puzzle	Engklek Game	1.182	0.024
	Control Group	3.318	0.000
Control Group	Engklek Game	-2.136	0.000
	Crossword Puzzle	-3.318	0.000
<b>Attitude</b>			
Engklek Game	Crossword Puzzle	1.091	0.605
	Control Group	5.182	0.000
Crossword Puzzle	Engklek Game	-1.091	0.605
	Control Group	4.091	0.002
Control Group	Engklek Game	-5.182	0.000
	Crossword Puzzle	-4.091	0.002

**Table 4.** Effectiveness of Educational Media on Female Adolescents' Knowledge and Attitudes Toward HPV Vaccination

Group	N-gain	Interpretation	N-gain(%)	Interpretation
<b>Knowledge</b>				
Engklek Game	0.33	Moderate	33.21	Not Effective
Crossword Puzzle	0.60	Moderate	60.27	Moderately Effective
Control Group	0.00	Low	0.12	Not Effective
<b>Attitude</b>				
Engklek Game	0.21	Low	21.43	Not Effective
Crossword Puzzle	0.18	Low	18.87	Not Effective
Control Group	-0.12	Low	-12.79	Not Effective

Table 4 shows that the N-Gain score was highest in the crossword puzzle group, at 60.27, which falls into the moderate category, indicating that the medium was moderately effective in improving knowledge. In contrast, for female adolescents' attitudes, none of the educational media were effective in improving attitudes toward HPV vaccination, as evidenced by N-Gain values  $< 40$ .

## DISCUSSION

The study included respondents from the engklek game group, the crossword puzzle group, and the control group, each exhibiting varied characteristics. All participants were female adolescents aged 15–18 years. Middle adolescence is marked by pronounced emotional development, with physical growth closely linked to emotional changes that foster increased intimacy, the emergence of sexual desire, and the formation of deeper relationships with the opposite sex (28,29). Additionally, adolescents in this age range experience significant cognitive development, including enhanced abstract thinking, systematic reasoning, and decision-making abilities (30–32). Given these developmental characteristics, middle adolescence (15–18 years) represents an appropriate period for delivering health education on the Human Papillomavirus (HPV) vaccine through engklek and crossword puzzle game-based media.

The majority of respondents across all groups were twelfth-grade students, with grades 11 and 12 representing higher grade levels. Notably, none of the participants reported a family history of cervical cancer. Personal experience has been shown to influence knowledge and attitudes; for example, a family history of cancer significantly affects risk perception and screening behavior, as women without such a history tend to perceive a lower risk of cervical cancer and exhibit lower screening intentions (33). The absence of a family history of cervical cancer among respondents may have contributed to their pretest knowledge and attitude scores.

The study found that knowledge increased following educational interventions in both the engklek game and crossword puzzle groups, while no improvement was observed in the control group. Knowledge acquisition is empirically grounded in sensory experiences, which facilitate understanding (34). This aligns with the pretest and posttest questionnaire results, as respondents exposed to health education via engklek and crossword puzzle games absorbed information about the HPV vaccine through visual and auditory modalities. In contrast, the control group, which did not engage with the material through these senses, showed no knowledge gain. The effective absorption of information may be attributed to the adolescents' capacity for competent and systematic thinking (31,32).

The respondents' age likely facilitated their ability to absorb information, which was further enhanced by the use of engaging educational media. The engklek and crossword puzzle games actively involved participants in the health education process. Active engagement in health education has been shown to stimulate adolescent curiosity (35). Games contribute to emotional regulation and the development of emotional intelligence, both of which are vital for adolescent mental well-being. Additionally, games often require strategy, problem-solving, and decision-making, thereby supporting cognitive development and knowledge enhancement (36,37). In the engklek game, participants read information cards, answered questions, and listened to peers' responses, integrating visual and auditory modalities to improve information delivery and comprehension. While direct evidence linking engklek to knowledge levels is limited, the game has demonstrated positive effects on cognitive skills, character education, and motor development (38–40).

The main barriers to HPV vaccination are a lack of knowledge and misconceptions about the vaccine's safety and necessity (41). Targeted health education is essential for increasing awareness and knowledge regarding HPV and the HPV vaccine. These programs can address misconceptions and promote participation in vaccination (42). As knowledge increases, future barriers are expected to

diminish, supporting the sustainability of HPV vaccination programs as a preventive strategy against cervical cancer, especially among female adolescents.

Analysis of pre- and post-intervention scores revealed attitude changes among female adolescents in the engklek game and crossword puzzle groups, while no change was observed in the control group. These changes are likely attributable to the health education interventions. Health education aims to influence individuals to adopt attitudes aligned with health-related values, and its effectiveness is enhanced when delivered through engaging media tailored to the target audience. Several studies have shown that engklek games and crossword puzzles effectively improve adolescents' attitudes (39,43).

Health education utilizing engklek games and crossword puzzles provides distinct benefits that contribute to positive attitude changes among adolescents. Engklek, a traditional Indonesian game, fosters social skills such as honesty and interaction, as well as emotional skills like stress reduction and self-control (44). These outcomes suggest that engklek can cultivate positive character traits, including tolerance, discipline, and empathy (39). Consequently, participation in engklek may enhance social interaction and emotional regulation, leading to more positive attitudes and behaviors. Increased positive attitudes toward HPV vaccination are frequently associated with higher vaccine acceptance (45).

Despite these benefits, negative attitudes toward vaccination persist, including distrust in vaccine effectiveness and safety. For instance, a study in Bulgaria found that, despite high awareness of cervical cancer and HPV, dissatisfaction with the vaccine remained due to perceptions that it did not replace routine screening or protect against all HPV types (46). Game-based health education offers active learning experiences that can potentially change adolescents' attitudes. Engaging in engklek or health-related crossword puzzles on HPV and vaccination provides information that supports problem-solving, peer discussion, and effective feedback. These activities can shape social norms and enhance self-efficacy. This aligns with previous studies indicating that games can foster interest in and intention to receive HPV vaccination (47,48). Consequently, positive attitude changes resulting from game-based interventions are expected to encourage female adolescents to access health services, receive the HPV vaccine as a preventive measure, and increase awareness of diseases that pose significant risks to women globally.

In addition, our findings indicate that the intervention group receiving educational activities through crossword puzzle games was sufficiently effective in improving knowledge about the HPV vaccine. Crossword puThe findings indicate that educational activities involving crossword puzzle games were effective in improving knowledge about the HPV vaccine. Crossword puzzles make learning more engaging and enjoyable, which increases students' interest in the subject. They promote active recall by requiring participants to search for answers based on brief clues, and the repetition involved in gameplay has been shown to strengthen long-term memory more effectively than passive exposure (49). Additionally, crossword puzzles foster critical thinking and problem-solving, thereby enhancing cognitive abilities (50). The increase in respondents' knowledge may also be attributed to the appropriate selection of educational media and the participants' developmental stage, as adolescents typically possess strong memory capacity. These results are consistent with previous studies demonstrating that health education using crossword puzzles increases knowledge levels (51).increased vaccine acceptance (52). Female adolescents aged 9–14 years constitute the main priority group for HPV vaccination, as immunization during early adolescence—prior to the onset of sexual activity—provides higher protective effectiveness (53,54). Data from the United States further indicate that initiating vaccination during adolescence increases the likelihood of completing the full vaccination series, thereby supporting the optimization of vaccine benefits (55).

Crossword puzzles can be recommended as an educational strategy to support government programs aimed at increasing awareness and coverage of HPV vaccination, thereby contributing to a

reduction in cervical cancer incidence. Although crossword puzzles were most effective in improving knowledge, none of the educational methods demonstrated superior effectiveness in changing attitudes among the groups. This result may be influenced by respondent characteristics, such as the absence of a family history of cervical cancer. As a result, attitude changes in the hopscotch and crossword puzzle groups were not particularly significant, despite health education interventions. This hypothesis warrants further investigation in future research. Despite these limitations, such games remain effective promotional strategies for HPV vaccination within game-based health education, contributing to significant improvements in knowledge and attitudes (56).

These findings highlight that increased knowledge does not necessarily result in corresponding changes in attitudes. Further research is needed to examine additional factors that may mediate the relationship between knowledge and attitudes, such as personal experiences, family support, and sociocultural influences. A more comprehensive approach may enable game-based educational interventions to have a broader impact, fostering both knowledge acquisition and positive attitude changes among adolescents regarding HPV vaccination.

## **CONCLUSION**

Overall, game-based health education, especially through crossword puzzles, effectively increases female adolescents' knowledge of HPV vaccination, though it has a limited impact on attitudes. More comprehensive and sustained educational efforts are needed to promote positive attitudes toward HPV vaccination for cervical cancer prevention.

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## **AUTHOR'S CONTRIBUTION STATEMENT**

JN : Conceptualization, Writing- Original Draft, Review & Editing. AR: Conceptualization, Methodology, Manuscript review. KL: Formal analysis, Writing -Original draft, Manuscript review. UN: Validation, Manuscript review.

## **CONFLICTS OF INTEREST**

The authors declare no conflict of interest

## **DECLARATION OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN THE WRITING PROCESS**

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