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Non-Pharmacological Interventions to Support Maternal-Fetal Attachment Among Pregnant Women: A Scoping Review

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ABSTRACT

Introduction: Maternal-fetal attachment (MFA) is an important psychological process during pregnancy that influences a mother's emotional condition and early bonding with her baby. However, not all women develop this attachment in the same way, especially when facing challenges such as unintended pregnancy or previous pregnancy loss.

Objective: This scoping review aimed to map and describe non-pharmacological interventions used to support maternal-fetal attachment among pregnant women in antenatal care settings.

Methods: Scoping review following the Arksey and O'Malley framework. Data Sources: Searches were conducted in PubMed, Scopus, ScienceDirect, Google Scholar, and Cochrane Library. Search dates: 2015–2025. Study selection followed PRISMA-ScR guidelines using the PCC framework. Dual independent reviewers screened all records using Rayyan. JBI critical appraisal tools were applied.

Results: A total of 1,301 articles were identified; 13 studies from 9 countries met the inclusion criteria. Three main intervention categories were identified: (1) education- and training-based interventions (38%), (2) psychological and emotional support-based interventions (31%), and (3) technology-assisted interventions (31%). Educational and psychosocial interventions demonstrated the most consistent improvements in MFA. Technology-based approaches improved specific dimensions, such as mother-fetus interaction, but not overall MFA scores.

Conclusion: Non-pharmacological interventions, particularly those integrating educational and psychosocial components, play an important role in supporting maternal-fetal attachment. Antenatal care programs should be multidimensional, culturally responsive, and routinely integrated into midwifery practice.

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INTRODUCTION

Maternal-fetal attachment (MFA) refers to the emotional relationship that develops between a pregnant woman and her unborn baby and represents an important psychological process during pregnancy (Alhusen et al., 2021; Purwati et al., 2025). The development of MFA occurs progressively as women become increasingly aware of the fetus through physical sensations, perceptions of fetal movement, and emotional experiences. Thus, pregnancy represents not only a biological process but also an important psychological transition toward motherhood (Costa et al., 2021). Stronger maternal-fetal attachment has been associated with greater emotional closeness, affection, and engagement with the fetus, reflecting the development of the prenatal mother–fetus relationship (Wulff et al., 2021).

Despite its importance, the development of MFA is not uniform across pregnant women. Maternal psychological conditions, social support, and previous reproductive experiences may influence the extent to which women establish an emotional connection with their fetus (Abasi et al., 2023; Ghasemi Nasab et al., 2023; Baghdari et al., 2016). Women experiencing unintended pregnancy, anxiety, depressive symptoms, or previous pregnancy loss may face greater challenges in developing a strong maternal-fetal bond (Ekrami et al., 2020). Similarly, inadequate support from partners or family members may further limit women's emotional and psychological adjustment during pregnancy. These circumstances highlight the need for antenatal care that addresses not only physical health but also the emotional and relational dimensions of pregnancy (Wulff et al., 2021; Shen & Chen, 2021).

Various non-pharmacological approaches have therefore been explored to support the development of MFA during pregnancy. These approaches include antenatal education, psychological and emotional support, partner-involved interventions, and technology-assisted strategies such as ultrasound and digital applications (Akbarzadeh et al., 2017; Lee et al., 2023; Pulliainen et al., 2025; Westerneng et al., 2022). Educational interventions may enhance women's understanding of fetal development and promote active engagement with pregnancy, while psychosocial approaches may address emotional difficulties and strengthen coping and relational support. Partner involvement may further reinforce the social and emotional environment surrounding pregnancy. Technology-assisted approaches, meanwhile, have been investigated as additional means of facilitating maternal-fetal interaction and visualization of the fetus.

However, the available evidence remains heterogeneous in terms of intervention characteristics, delivery methods, target populations, duration, and outcome measures. The findings also suggest that different interventions may influence different dimensions of maternal-fetal attachment rather than producing consistent improvements in overall MFA. For example, some technology-assisted interventions have demonstrated benefits for specific aspects of mother-fetus interaction, whereas their effects on overall attachment have been less consistent (Lee et al., 2023; Pulliainen et al., 2025; Westerneng et al., 2022). This variation makes it difficult to obtain a comprehensive understanding of the range of non-pharmacological interventions available and the ways in which they have been implemented in antenatal care.

Therefore, a systematic mapping of the existing evidence is needed to clarify the types, characteristics, and reported outcomes of non-pharmacological interventions targeting MFA. This scoping review aims to

map and describe non-pharmacological interventions used to support maternal-fetal attachment among pregnant women in antenatal care settings, including their intervention characteristics, delivery approaches, and reported effects on maternal-fetal attachment.

METHOD

Study Design

This study employed a scoping review design to systematically map non-pharmacological interventions aimed at supporting maternal-fetal attachment among pregnant women in antenatal care settings (Arksey & O'Malley, 2005). The review process was guided by the methodological framework proposed by Arksey and O'Malley, which consists of five key stages: (1) identifying the research question, (2) identifying relevant studies, (3) selecting eligible studies, (4) charting the data, and (5) collating, summarizing, and reporting the results (Arksey & O'Malley, 2005). The reporting of this review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) guidelines to enhance transparency and methodological rigor (Tricco et al., 2018).

Review Registration and Protocol

This scoping review was registered on the Open Science Framework (OSF), Registration DOI 10.17605/OSF.IO/8W47P. No major amendments were made to the original protocol during the review process.

Identifying the Research Question

This scoping review applies the Population–Concept–Context (PCC) framework. The central research question is: "What non-pharmacological interventions have been used to support maternal-fetal attachment among pregnant women within antenatal care settings?"

Table 1. PCC Framework

Population	Concept	Context
Pregnant women	Non-pharmacological interventions to support maternal-fetal attachment	Antenatal and midwifery and community-based care settings

Identifying Relevant Studies

Literature was retrieved from PubMed, Scopus, ScienceDirect, and Cochrane Library, with additional gray literature from Google Scholar. Keyword combinations were developed using Boolean operators AND/OR. The search was limited to articles published between 2015 and 2025, written in English.

Table 2. Search Keywords

Population	Concept	Context
"pregnant women" OR "pregnancy" OR "gravida" OR "primigravida" OR "prenatal" OR	maternal-fetal attachment" OR "maternal fetal attachment" OR "prenatal attachment" OR	"antenatal care" OR "prenatal care" OR "midwifery care" OR "maternity care" OR "primary

"antenatal" OR "women with unintended pregnancy" OR "perinatal loss" OR "pregnancy loss" OR "psychosocial vulnerability"	"antenatal attachment" OR "mother-fetus bonding" OR "prenatal bonding" OR "fetal attachment" OR "MFA" OR "maternal bonding" OR "object attachment"[MeSH] OR "mother-infant bonding"[MeSH]	health care" OR "community-based care" OR "online intervention" OR "digital health" OR "perinatal care"

Eligibility Criteria

Studies were included when they: (1) involved pregnant women, including those with unintended pregnancy, history of pregnancy loss, or psychosocial vulnerability; (2) examined non-pharmacological intervention programs aimed at supporting MFA; (3) were conducted in antenatal care settings; (4) were original empirical studies; (5) were published between 2015 and 2025 and (6) were written in English. Studies were excluded if they were study protocols, systematic reviews, meta-analyses, editorials, commentaries, or conference abstracts, or if they did not explicitly report MFA as an outcome.

Table 3. Eligibility Criteria

Criteria	Inclusion	Exclusion
Population	Pregnant women, including those with unintended pregnancy, history of pregnancy loss, or psychosocial vulnerability	Non-pregnant women, postpartum women (unless MFA measured during pregnancy), infants, or children
Concept	Non-pharmacological intervention programs aimed at supporting, enhancing, or improving maternal-fetal attachment (MFA/prenatal attachment), including educational, counseling, psychological, behavioral, digital, and psychosocial interventions	Pharmacological interventions; studies not reporting MFA as an outcome; studies focused solely on postpartum bonding without antenatal component
Context	Antenatal care settings, including hospitals, primary health care centers, community-based programs, and digital or online intervention settings, across various countries	Settings unrelated to antenatal care (Purely postnatal or neonatal care settings)
Study Design	Original empirical studies (RCT, quasi-experimental, clinical trial)	Study protocols, systematic reviews, meta-analyses, editorials, commentaries, conference abstracts
Publication	Articles published between 2015–2025, written in English	Articles published before 2015 or not written in English

Study Selection

Study selection was conducted in several stages and is presented using a PRISMA flow diagram (Tricco et al., 2018). All retrieved records were imported into a reference management system and duplicates removed. Titles and abstracts were independently screened by two reviewers based on predefined inclusion and exclusion criteria, followed by full-text review. Disagreements were resolved through discussion until consensus was reached. The Rayyan web-based platform was used to facilitate the screening and selection process.

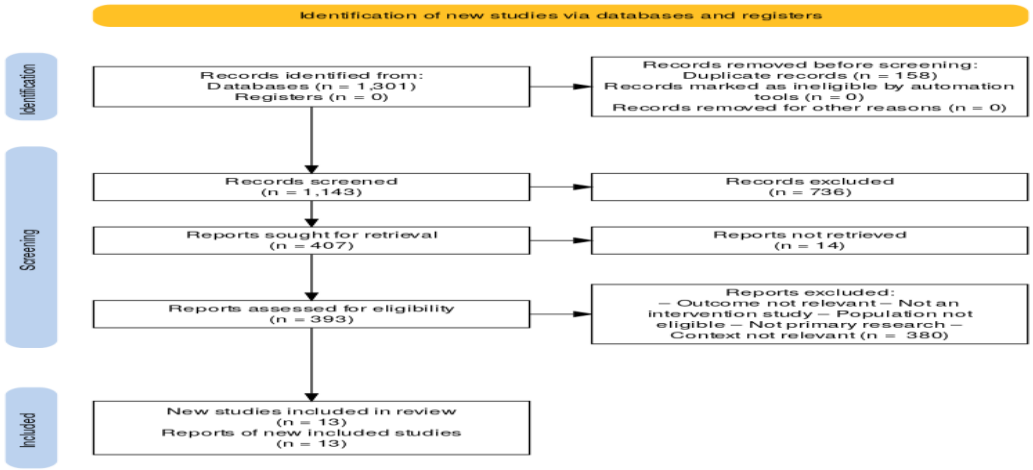


Figure 1. PRISMA Flow Diagram

Charting the Data

Data were extracted using a standardized charting form (Arksey & O'Malley, 2005). Extracted data included: author(s), year of publication, country, study design, participant characteristics, type of intervention, duration and frequency, mode of delivery, outcome measures related to MFA, and key findings. Data charting was performed independently by two reviewers to enhance reliability.

Table 4. Characteristics and main findings of included studies

Author (Year)	Country; Design (n)	Intervention	Main findings
Alhusen et al. (2021)	USA; Pilot RCT (60)	Group-based perinatal depression intervention	Improved MFA, depressive symptoms, and postpartum maternal sensitivity.
Purwati et al. (2025)	Indonesia; Quasi-experimental (107)	Prenatal attachment education	Significantly improved MFA compared with control ($p < 0.05$).
Costa et al. (2021)	Brazil; RCT (19)	Fetal-bonding workshops	Increased maternal–fetal interaction practices ($p = 0.024$).
Abasi et al. (2023)	Iran; RCT (100 couples)	Online couple-based training	Increased MFA compared with control (3.75 vs. 3.21; $p < 0.001$).
Pulliainen et al. (2025)	Finland; RCT (105)	Interactive 4D ultrasound	No significant additional effect on maternal attachment.
Akbarzadeh et al. (2017)	Iran; Quasi-experimental (100)	BASNEF-based education	Significantly improved MFA ($p < 0.001$).
Lee et al. (2023)	South Korea; RCT (80)	VR-based fetal visualization	Improved fetal interaction, but not overall MFA.
Shen and Chen (2021)	Taiwan; RCT (140)	Home-based aerobic exercise	MFA scores increased during follow-up in the intervention group.
Ghasemi Nasab et al. (2023)	Iran; RCT (60)	Cognitive-behavioral counseling	Significantly improved MFA ($p < 0.05$).
Hasanzadeh et al. (2025)	Iran; RCT (84)	MFA skills training	Improved MFA compared with control (66.43 vs. 57.14; $p < 0.0001$).
Westerneng et al. (2022)	Netherlands; Cluster RCT (1,275)	Third-trimester ultrasound	No significant overall effect on maternal–infant bonding.
Wulff et al. (2021)	Germany; Three-arm RCT (172)	Music and singing interventions	No significant between-group difference in overall MFA; singing improved perceived closeness.

Baghdari et al. (2016)	Iran; Quasi-experimental (60)	Pregnancy-adaptation training	Improved MFA and pregnancy adaptation among women with a history of infant loss.

Critical Appraisal of Included Studies

Although critical appraisal is not a mandatory component of scoping reviews, it was conducted in this study to provide an overview of the methodological quality of the included articles and to support the interpretation of findings (Arksey & O'Malley, 2005). The Joanna Briggs Institute (JBI) Critical Appraisal Tools were used, with specific checklists selected according to each study design (Joanna Briggs Institute, 2020). Quality assessment was performed independently by two reviewers. Any disagreements were resolved through discussion. The results of the appraisal were not used as exclusion criteria but were considered in the interpretation of the findings.

Data Synthesis

The extracted data were synthesized using a descriptive and thematic approach, as recommended for scoping reviews (Arksey & O'Malley, 2005). First, a numerical summary was produced to describe the characteristics of the included studies, such as country of origin, study design, and type of intervention. Second, a thematic analysis was conducted to identify recurring patterns, similarities, and differences among the interventions. Themes were developed inductively based on shared characteristics, objectives, and implementation strategies of the interventions. This approach enabled the categorization of interventions into broader conceptual groups and facilitated the identification of dominant trends and research gaps within the existing literature.

RESULTS AND DISCUSSION

Results

Article Characteristics

In this scoping review, the 13 included studies were conducted across a range of countries. Most originated from Iran, with the remaining studies from the United States, Indonesia, Brazil, Finland, South Korea, Taiwan, the Netherlands, and Germany. Ten studies (77%) used a randomized controlled trial design, while three (23%) used quasi-experimental designs (see Figure 1 for the PRISMA flow diagram).

Methodological Quality Assessment

All 13 included studies underwent methodological quality assessment using JBI Critical Appraisal Tools. Of the 13 studies, 10 were classified as high methodological quality (Grade A, ≥75%) and 3 as moderate quality (Grade B, 50–74%). No study was excluded on the basis of quality, consistent with the aims of scoping reviews.

Thematic Analysis

Three main intervention approaches were identified: (1) education- and training-based interventions, (2) psychological and emotional support-based interventions, and (3) technology-assisted interventions.

Theme 1: Dominance of Educational and Psychosocial Interventions in Supporting MFA

Among all the intervention types identified in this review, educational and psychosocial approaches stand out as both the most common and the most consistently effective (Akbarzadeh et al., 2017; Lee et al., 2023). Their dominance reflects something fundamental about how prenatal attachment actually works: it is built through maternal knowledge, emotional awareness, and the ability to adapt psychologically to pregnancy not through passive observation or technology alone. What these interventions share is an active, reflective engagement with the pregnancy experience that appears to be at the heart of attachment formation.

Culturally-Based Approaches

A particularly interesting finding within this theme is the effectiveness of culturally embedded practices. Music, singing, and culturally familiar rituals were shown to enhance maternal emotional engagement in ways that more clinical interventions sometimes cannot (Wulff et al., 2021). The likely reason is that these approaches meet women where they are emotionally and culturally rather than imposing a standardized program, they tap into existing channels of meaning and expression. Singing actively, for example, produced stronger effects on perceived closeness and emotional regulation than passive music listening (Wulff et al., 2021), pointing to the importance of participation rather than mere exposure. These findings matter for practice because they suggest that effective MFA support does not always require sophisticated resources or complex clinical infrastructure.

Group-Based Interventions

Group-based delivery formats added another layer of effectiveness to educational interventions. Being in a group allows women to share experiences, hear that their anxieties and uncertainties are not unusual, and receive genuine peer support rather than just professional advice. This normalization of the emotional experience of pregnancy appears to benefit both maternal well-being and prenatal attachment (Akbarzadeh et al., 2017; Lee et al., 2023).

Structured discussions, experiential activities, and opportunities for reflection within group settings create space for emotional engagement with pregnancy that is harder to achieve individually (Lee et al., 2023). Women experiencing anxiety, social isolation, or uncertainty about their pregnancies seem to benefit most from this format the sense of shared experience and mutual validation appears to offer a form of emotional security that supports attachment development.

Theme 2: The Role of Partner and Family Involvement in Supporting MFA

Running through several of the reviewed studies is a clear signal MFA does not develop in a relational vacuum (Hasanzadeh et al., 2025). While partner and family involvement was rarely the central focus of an intervention, its presence as a supporting element consistently strengthened outcomes. This pattern reinforces a view of prenatal attachment as something shaped not just by the individual woman, but by the social and emotional environment that surrounds her pregnancy.

When partners participated in antenatal education and attachment-focused sessions, women reported feeling more supported, better understood, and more able to share the emotional weight of pregnancy (Hasanzadeh et al., 2025). This sense of shared responsibility appears to free up psychological space for

MFA to develop when women feel less alone in navigating the demands of pregnancy, they may be more emotionally available to form a connection with the fetus.

Theme 3: Technology-Assisted Interventions — Potential Benefits and Limited Effectiveness in Supporting Maternal-Fetal Attachment

Technology-based interventions are relatively new in MFA research and have been tested mainly in countries with well developed healthcare systems (Pulliainen et al., 2025; Westerneng et al., 2022). However, technology tends to focus on what women can see rather than what they feel and attachment is fundamentally an emotional process, not a visual one. This may explain why technology, when used alone, has not shown consistent improvements in overall MFA scores.The studies in this group used interactive ultrasound, virtual reality fetal visualization, and digital antenatal applications. The underlying assumption across all of them was that giving women a clearer, more tangible sense of the fetus would bring them emotionally closer to it.

In some respects, this assumption held. Women who saw the fetus in greater detail through high-resolution ultrasound or VR showed stronger recognition of it as a real, developing person, and some studies reported gains in mother fetus interaction scores (Pulliainen et al., 2025; Westerneng et al., 2022). Having something concrete to connect with appeared to matter.

Discussion

Based on the thirteen included studies, this scoping review identified several important patterns regarding non-pharmacological interventions to support maternal-fetal attachment (MFA). Educational and psychosocial interventions were the most frequently represented approaches and demonstrated the most consistent improvements in MFA across the included studies. These findings suggest that maternal-fetal attachment is not simply a spontaneous emotional response to pregnancy but may be strengthened through interventions that enhance maternal knowledge, emotional engagement, and adaptation to pregnancy (Akbarzadeh et al., 2017; Lee et al., 2023). Educational interventions were particularly prominent and generally demonstrated positive effects on maternal-fetal attachment. Providing information about fetal development and encouraging women to engage with and reflect on their pregnancy may help make the fetus more psychologically salient and strengthen the mother's emotional connection with the fetus (Akbarzadeh et al., 2017; Lee et al., 2023). This may be particularly relevant for first-time mothers, who may have greater informational and emotional needs during pregnancy. Accordingly, antenatal care provides an important opportunity to integrate structured education with activities that promote emotional readiness and maternal-fetal interaction.

The findings further suggest that the benefits of education may be enhanced when educational interventions are accompanied by psychosocial support. Interventions incorporating structured midwifery counseling and mindfulness-based approaches demonstrated improvements in maternal-fetal attachment and pregnancy adaptation (Gheibi et al., 2020; Arasteh et al., 2020). This pattern indicates that providing information alone may not adequately address the emotional processes involved in attachment

development. Counseling and reflective activities can provide pregnant women with opportunities to process concerns, develop coping strategies, and establish a more positive emotional relationship with the pregnancy. Thus, interventions that address both cognitive and emotional dimensions may be more appropriate than approaches that focus exclusively on knowledge acquisition. This interpretation is also supported by findings showing that psychological well-being is closely related to maternal-fetal attachment. Improvements in maternal psychological conditions, including reductions in depressive symptoms and improvements in sleep or emotional well-being, were accompanied by improvements in aspects of maternal-fetal attachment (Wulff et al., 2021; Shen & Chen, 2021). These findings emphasize that supporting maternal emotional well-being should be considered an integral component of antenatal strategies aimed at strengthening MFA.

Another important finding concerns the contribution of partner and family support. Maternal-fetal attachment develops within a broader social environment, and the emotional support available to pregnant women may influence their ability to engage positively with pregnancy. Although partner involvement was not the primary focus of all interventions, studies involving partners or incorporating partner support demonstrated favorable outcomes for maternal-fetal attachment (Hasanzadeh et al., 2025). Similarly, interventions involving couples have indicated that greater partner engagement may contribute to improved attachment-related outcomes and reduced psychological burden during pregnancy (Dhanalakshmi et al., 2022). Partner involvement may therefore provide an additional source of emotional security and shared responsibility, allowing pregnant women to experience pregnancy as a supported rather than an individual process. These findings reinforce the importance of considering MFA within a relational context rather than viewing attachment solely as an individual maternal psychological process.

The review also identified a different pattern for technology-assisted interventions. Interactive ultrasound, virtual reality, and other technology- or behavior-based approaches demonstrated potential benefits for particular aspects of maternal-fetal interaction, but their effects on overall MFA were less consistent (Pulliainen et al., 2025; Westerneng et al., 2022; Delaram et al., 2018). For example, interactive ultrasound did not demonstrate a significant additional effect on overall maternal-fetal attachment compared with standard care, while virtual reality fetal visualization improved the interaction-with-the-fetus dimension without significantly increasing total MFA scores (Pulliainen et al., 2025; Westerneng et al., 2022). Similarly, fetal movement counting has been investigated as a behavioral strategy to facilitate maternal-fetal interaction (Delaram et al., 2018). These findings suggest that technology and behavior-based approaches may be more effective in facilitating specific forms of maternal-fetal interaction than in independently producing broader changes in attachment.

The relatively limited effect of technology-assisted interventions may be understood in relation to the multidimensional nature of maternal-fetal attachment. Visualization, fetal monitoring, or other technology-mediated experiences may increase awareness of the fetus and create opportunities for interaction, but attachment also involves emotional processing, maternal adaptation, psychological well-being, and social support. Consequently, technology may be more appropriately positioned as a

complementary component of antenatal care rather than as a stand-alone strategy. This interpretation is consistent with the finding that interventions combining educational, psychological, and relational components tended to address a broader range of factors associated with maternal-fetal attachment than interventions relying primarily on technological stimulation.

Taken together, the findings indicate that maternal-fetal attachment is influenced by multiple interconnected dimensions, including maternal knowledge, emotional well-being, psychological adaptation, social support, and opportunities for interaction with the fetus. The most consistent evidence in this review was observed among interventions that actively engaged women in understanding their pregnancy and processing their emotional experiences, while partner involvement provided an important relational dimension (Akbarzadeh et al., 2017; Gheibi et al., 2020; Arasteh et al., 2020; Hasanzadeh et al., 2025). Technology-assisted interventions may provide additional opportunities for fetal interaction but appear to have more limited effects on overall MFA when used independently (Pulliainen et al., 2025; Westerneng et al., 2022). Therefore, antenatal care programs seeking to strengthen maternal-fetal attachment should consider multidimensional approaches that integrate education, psychosocial support, partner involvement, and, where appropriate, technology-assisted activities rather than relying on a single intervention modality.

CONCLUSION

This scoping review shows that non-pharmacological interventions can support the development of maternal-fetal attachment during pregnancy. Among the various approaches identified, interventions that combine educational and psychosocial components appear to provide the most consistent benefits. These approaches help women not only understand their pregnancy but also process their emotional experiences, which are essential in building attachment. Partner and family involvement also plays an important role in strengthening maternal-fetal attachment. Technology-based interventions such as ultrasound or virtual reality tend to provide limited effects when used alone, although they may still be useful as complementary tools when combined with other approaches.

LIMITATIONS

This scoping review was designed to map and describe the available evidence on non-pharmacological interventions for MFA, not to evaluate their effectiveness. As such, conclusions about cause and effect cannot be drawn from the findings. The included studies differed considerably in design, sample characteristics, intervention type, duration, and how outcomes were measured, which made direct comparison across studies difficult. The use of different attachment scales added to this difficulty. Several studies focused on specific groups of women, which means the findings may not apply equally to all pregnant women. Nearly all studies measured outcomes only during pregnancy, and the search was limited to English-language articles.

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