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# Exploring Pregnant Women's Perceptions of Non-Invasive Drug Delivery Systems in Clinical Care

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**ABSTRACT**

Biopharmaceutics and drug delivery systems have evolved to improve therapeutic effectiveness and patient adherence through non-invasive delivery routes. However, among pregnant women, treatment acceptance is influenced not only by clinical considerations but also by perceptions of fetal safety and maternal responsibility. This study explores how pregnant women experience and interpret non-invasive drug delivery systems and how these perceptions shape treatment acceptance. Using an interpretive phenomenological approach, data were collected through semi-structured interviews with pregnant women who had experience using non-invasive drug delivery systems and analyzed thematically. Findings indicate that acceptance is influenced by four interconnected factors: perceived fetal safety, embodied comfort, trust in healthcare communication, and compatibility with daily life. Participants were more likely to accept non-invasive delivery systems when they perceived them as safe, comfortable, and aligned with their pregnancy experiences. These findings highlight the importance of incorporating patient experiences into the design and communication of drug delivery innovations to enhance treatment acceptability and support patient-centered care.



## INTRODUCTION

The field of biopharmaceutics and drug delivery systems has experienced rapid advancement in recent decades, driven by the need to optimize therapeutic efficacy, improve patient adherence, and minimize treatment-related burden (Awunyo et al., 2025). Innovations such as non-invasive drug delivery systems including oral, transdermal, nasal, and other mucosal routes have been increasingly developed as alternatives to invasive administration methods. These systems are often designed to enhance patient comfort, reduce procedural risks, and support long-term treatment adherence, particularly in populations requiring continuous or sensitive care (Bardoe, Hayford, Bio, & Osei, 2025). However, existing evaluations of these systems remain largely dominated by biomedical and quantitative indicators, such as pharmacokinetics, bioavailability, clinical efficacy, and adherence rates.

This emphasis has left an important research gap: limited attention has been given to how patients, particularly pregnant women, experience and interpret non-invasive drug delivery systems in their everyday lives. Pregnancy represents one such context, where the body is experienced not only as a biological system but also as a space of vulnerability, responsibility, and relational meaning (Bardoe, Hayford, Bio, & Yar, 2025). Pregnant women often navigate complex decisions regarding medical treatments, balancing concerns about personal health with perceived risks to the unborn child. In this setting, non-invasive drug delivery systems may carry meanings that extend beyond their clinical function, encompassing perceptions of safety, comfort, trust, and maternal responsibility (Barry et al., 2025). Existing literature has acknowledged that patient-centered care and treatment acceptability are critical determinants of therapeutic success; however, these constructs are often operationalized through standardized measures that may not fully capture the depth and complexity of subjective experience.

The relevance of this phenomenon becomes particularly evident when considering the role of subjective experience in shaping treatment acceptance and adherence (Bayuo et al., 2025). For pregnant

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women, the decision to accept or reject a therapeutic intervention is rarely based solely on clinical information; rather, it is influenced by embodied perceptions, emotional responses, social expectations, and interactions with healthcare providers. Non-invasive drug delivery systems, while technologically advantageous, are interpreted within this experiential framework. Understanding how these systems are perceived and lived by pregnant women is therefore essential not only for improving clinical communication but also for informing the design of more acceptable and context-sensitive therapeutic strategies. The subjective dimension of treatment experience, including feelings of reassurance, uncertainty, or discomfort, plays a crucial role in determining whether a medical innovation is truly integrated into patient care.

Given these considerations, there is a clear need to move beyond outcome-oriented evaluations and toward a deeper exploration of how non-invasive drug delivery systems are experienced in real-life contexts. A phenomenological approach offers a valuable framework for addressing this need, as it focuses on uncovering the meaning and structure of lived experience from the perspective of those directly involved (Bogale et al., 2025). By attending to how pregnant women perceive, interpret, and respond to non-invasive drug delivery within the context of their daily lives and maternal identity, this approach enables a richer and more nuanced understanding of treatment acceptance. Such insight is essential for bridging the gap between technological innovation and patient-centered care, and for ensuring that advances in drug delivery systems align with the lived realities of those they are intended to serve.

Research on patient experience within healthcare interventions has increasingly been recognized as a critical domain for understanding the real-world effectiveness and acceptability of medical innovations. In the field of biopharmaceutics and drug delivery systems, this shift has begun to extend toward exploring how patients perceive, interpret, and adapt to different modes of drug administration (Bogler et al., 2025). Within this evolving landscape, pregnancy represents a particularly sensitive and complex context, where treatment decisions are embedded in a dual concern for maternal and fetal well-being. Studies have highlighted that pregnant women often engage in heightened risk assessment and emotional evaluation when confronted with therapeutic options, suggesting that their experiences of treatment cannot be reduced to clinical indicators alone. As a result, understanding how non-invasive drug delivery systems are experienced in this context has emerged as an important sub-area of inquiry.

However, investigating such experiences presents significant methodological challenges. Much of the existing literature in drug delivery research relies heavily on quantitative designs, clinical trials, or pharmacological assessments that prioritize measurable outcomes such as efficacy, bioavailability, and adherence rates (Bouqoufi et al., 2023). While these approaches provide essential scientific evidence, they often lack the capacity to capture the nuanced, subjective dimensions of patient experience, particularly in contexts involving vulnerability, uncertainty, and emotional complexity. Even when patient-reported outcomes are included, they are frequently constrained by structured instruments that limit the depth of expression and fail to uncover the meanings individuals assign to their experiences. In the case of pregnant women, this limitation becomes more pronounced, as their treatment experiences are shaped by deeply personal interpretations of safety, bodily integrity, and maternal responsibility.

These methodological constraints suggest that existing approaches remain insufficient for fully understanding the essence of how non-invasive drug delivery systems are experienced during pregnancy (Camones-Huerta et al., 2025). The reliance on standardized measures and outcome-driven frameworks may obscure critical aspects of lived experience, such as how women negotiate trust in medical advice, interpret the perceived gentleness or invasiveness of treatment, and integrate therapeutic routines into their daily lives (Mukhlis, Suradi, et al., 2023; Mukhlis, 2025b). Consequently, there is a need for research designs that allow participants to articulate their experiences in their own terms and reveal the underlying meanings that shape their decisions and perceptions. Without such approaches, the field risks overlooking key experiential factors that influence treatment acceptance and ultimately limit the effectiveness of otherwise advanced drug delivery innovations.

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Current approaches to understanding the acceptance of drug delivery systems, including non-invasive modalities, are predominantly grounded in practical and outcome-oriented frameworks. These approaches often rely on clinical indicators, pharmacological performance, and structured patient-reported measures to evaluate treatment effectiveness and adherence. In the context of pregnancy, such frameworks typically focus on safety profiles, therapeutic efficacy, and compliance rates, which are essential for clinical decision-making (Chari et al., 2025). While these methods provide valuable evidence for optimizing drug delivery technologies, they tend to prioritize measurable variables over experiential understanding. As a result, the complex and deeply personal dimensions of how pregnant women perceive, interpret, and emotionally respond to non-invasive drug delivery systems remain insufficiently addressed.

The limitation of these conventional approaches lies in their inability to capture the richness of subjective experience, particularly in a context characterized by vulnerability, bodily transformation, and heightened responsibility (Chaurasia et al., 2025). Structured instruments and quantitative designs often reduce patient experience to predefined categories, thereby overlooking the meanings that individuals construct in relation to treatment. For pregnant women, acceptance of a drug delivery system is not solely determined by clinical reassurance but is also shaped by lived experiences of trust, uncertainty, comfort, and perceived impact on the unborn child. These dimensions are dynamic, context-dependent, and embedded in everyday life, making them difficult to access through standardized methodologies. Consequently, existing research may offer a partial understanding of treatment acceptance, leaving critical experiential aspects unexplored.

Given these gaps, there is a clear need for an alternative approach that allows for a more holistic and in-depth exploration of the phenomenon. A phenomenological perspective provides a valuable pathway to address this limitation by focusing on the essence of lived experience as articulated by participants themselves. Through this approach, it becomes possible to uncover how pregnant women make sense of non-invasive drug delivery systems within the broader context of their bodily, emotional, and social realities. By moving beyond surface-level evaluation and engaging with the meanings underlying acceptance, phenomenology can generate a richer and more nuanced understanding that complements existing clinical knowledge. This shift is essential for bridging the gap between technological innovation and patient-centered care, and for ensuring that advancements in drug delivery systems are aligned with the lived experiences of those they are intended to serve.

Previous studies have explored patient experiences in healthcare, especially in relation to treatment adherence, perceived safety, and therapeutic outcomes. Research in drug delivery systems has largely focused on clinical effectiveness, pharmacokinetics, and technological innovation, while fewer studies have examined how patients experience these systems in daily life. Some qualitative studies have highlighted that patient perception, trust in healthcare providers, and emotional responses play an important role in treatment acceptance. In the context of pregnancy, existing literature shows that women often interpret medical interventions through the lens of maternal responsibility and fetal safety. However, these studies remain limited in capturing the depth of lived experience related specifically to non-invasive drug delivery systems.

To address this limitation, the present study adopts an interpretive phenomenological approach to explore the lived experiences of pregnant women in accepting non-invasive drug delivery systems. This approach is selected because it allows for an in-depth understanding of how individuals interpret and assign meaning to their experiences within a specific context. Through phenomenology, the study seeks to uncover how perceptions of safety, comfort, trust, and daily integration shape treatment acceptance. This approach directly responds to the identified knowledge gap by moving beyond outcome-based evaluation toward a richer exploration of subjective meaning. In doing so, the study provides a more holistic understanding of how non-invasive drug delivery systems are experienced during pregnancy.

This article is structured to guide the reader through a coherent and systematic exploration of the phenomenon. The introduction presents the general and specific background, followed by the identification of the knowledge gap and the rationale for the study (Mukhlis, Arifin, Ridwan, & Zulbaidah, 2025; Mukhlis, Arifin, Ridwan, Zulbaidah, et al., 2025). The method section explains the

phenomenological approach, participant characteristics, data collection process, and analytical procedures. The results section presents the main themes derived from participants' lived experiences, supported by direct quotations. The discussion interprets these findings in relation to existing literature, followed by a conclusion that highlights key implications for research and clinical practice.

## RESEARCH METHODS

### Study Design

A phenomenological design was employed to explore the lived experiences of pregnant women in accepting non-invasive drug delivery systems in clinical care. This design was considered appropriate because the research question was concerned not with measuring treatment outcomes or comparing intervention efficacy, but with understanding how treatment acceptance was experienced, interpreted, and given meaning within the embodied and emotionally sensitive context of pregnancy. Phenomenology is particularly suitable for inquiries that seek to illuminate how individuals perceive, feel, and interpret a phenomenon as it is encountered in everyday life. In the present study, the phenomenon of interest was the acceptance of non-invasive drug delivery systems as experienced by pregnant women who had direct exposure to such therapeutic options.

An interpretive phenomenological orientation was adopted to capture not only descriptive accounts of treatment experiences but also the meanings participants attached to those experiences. This approach was relevant because acceptance during pregnancy is not a purely technical or behavioral matter; rather, it is shaped by fear, trust, bodily awareness, maternal responsibility, and the practical realities of daily life (Lutz & Knox, 2014; McNabb, 2015). Through this design, attention was directed to the subjective, relational, and contextual dimensions of treatment acceptance, allowing the essential structure of the phenomenon to emerge from participants' narratives. The phenomenological framework therefore enabled a deep exploration of how non-invasive drug delivery systems were understood and experienced within the broader horizon of pregnancy, clinical interaction, and maternal decision-making.

### Participants

Participants consisted of pregnant women who had experience receiving, being offered, or being informed about non-invasive drug delivery systems as part of clinical care. A purposive sampling approach was used to identify information-rich participants who were able to provide detailed reflections on the phenomenon under study. Participants were recruited from antenatal care services at the participating clinical site through clinician referral and direct invitation by the research team. Eligible women were first identified by healthcare providers based on the inclusion criteria, after which the researcher approached potential participants, explained the study objectives, procedures, voluntary nature of participation, confidentiality arrangements, and the right to withdraw at any time without consequences for their clinical care. Written informed consent was obtained prior to interview participation.

The inclusion criteria comprised pregnant women aged 18 years or older, currently undergoing pregnancy or having very recent experience of pregnancy-related treatment, having direct experience with a non-invasive drug delivery modality such as oral, topical, transdermal, nasal, or other comparable non-invasive therapeutic systems, and being able to communicate their experiences clearly in an in-depth interview setting. Participants were also required to be in a sufficiently stable physical and emotional condition to take part in the interview process (Hillman & Radel, 2018; Migdal, 2018). Exclusion criteria included severe medical instability, inability to provide informed consent, substantial communication barriers, or lack of direct experience relevant to the phenomenon being examined.

Phenomenological studies generally prioritize depth of meaning over breadth of coverage; therefore, sample adequacy was determined by richness of narrative data and thematic sufficiency. A sample of approximately 10 to 15 participants was considered appropriate for achieving in-depth exploration while maintaining analytic depth. Relevant demographic and contextual characteristics were documented to support interpretive understanding of the findings, including age range, gestational stage, parity, type of clinical condition or therapeutic indication, and form of non-invasive drug delivery

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experienced. These characteristics were not treated as variables for statistical comparison, but as contextual elements that shaped participants' lived experiences.

**Data Collection**

Data were collected through in-depth semi-structured interviews, which allowed participants to describe their experiences in their own words while ensuring that all interviews remained focused on the central phenomenon. A semi-structured interview guide was used to explore key domains related to treatment acceptance, including perceived safety, bodily comfort, concerns about fetal well-being, trust in healthcare providers, treatment-related uncertainty, and the extent to which the drug delivery system fit into everyday life during pregnancy. The interview guide was designed to elicit both descriptive and reflective accounts, thereby supporting a rich phenomenological understanding of participants' experiences.

Interviews were conducted individually in a setting intended to ensure privacy, comfort, and minimal disruption. Depending on participants' preferences and clinical feasibility, interviews were carried out either in a private room within the clinical setting or through a secure remote platform when face-to-face interaction was impractical (Carreiras & Castro, 2012; Iosifides, 2016). Each interview lasted approximately 45 to 75 minutes, with flexibility maintained to accommodate participants' physical condition and emotional comfort. A calm and supportive atmosphere was maintained throughout the interview process, and participants were encouraged to pause, clarify, or elaborate on their accounts whenever necessary.

All interviews were audio-recorded with participants' permission and subsequently transcribed verbatim. Field notes were also prepared to capture contextual impressions, nonverbal cues when observable, emotional expressions, and immediate analytic reflections that could support deeper interpretation during later stages of analysis. Data collection continued until sufficient thematic depth had been achieved and no substantially new experiential dimensions were emerging across interviews. This process supported a comprehensive understanding of the phenomenon while remaining consistent with the logic of phenomenological inquiry.

**Data Analysis**

Data were analyzed using an interpretive phenomenological thematic procedure aimed at identifying the essential meanings embedded in participants' accounts. Analysis began with repeated reading of each transcript to achieve immersion in the data and to preserve the integrity of each participant's narrative before cross-case comparison was undertaken. Attention was directed not only to what participants experienced, but also to how those experiences were understood, emotionally framed, and situated within pregnancy and clinical care.

Meaning units relevant to the phenomenon were identified from the verbatim transcripts and then coded inductively (Daly, 2007; Longhofer et al., 2012). These codes were gradually clustered into categories reflecting recurrent experiential patterns, such as perceptions of safety, comfort, trust, uncertainty, and routine integration. Through an iterative and reflexive process, categories were further refined into broader themes that captured the shared structure of the phenomenon while still preserving the distinctiveness of individual accounts. Interpretive movement between individual narratives and the developing thematic structure was used to ensure that the themes remained grounded in participants' words and contexts.

Thematic development was supported, when necessary, by qualitative data management software such as NVivo to facilitate coding organization, retrieval of text segments, and comparison across interviews. However, the analytic focus remained on interpretive engagement with meaning rather than software-based categorization. Direct participant quotations were retained throughout the process to anchor each theme in the lived realities expressed during the interviews (Fife, 2020; Kawamura, 2020). The final thematic structure was derived through careful synthesis of recurring patterns, tensions, and experiential meanings, resulting in findings that reflected the essential nature of pregnant women's acceptance of non-invasive drug delivery systems in clinical care.

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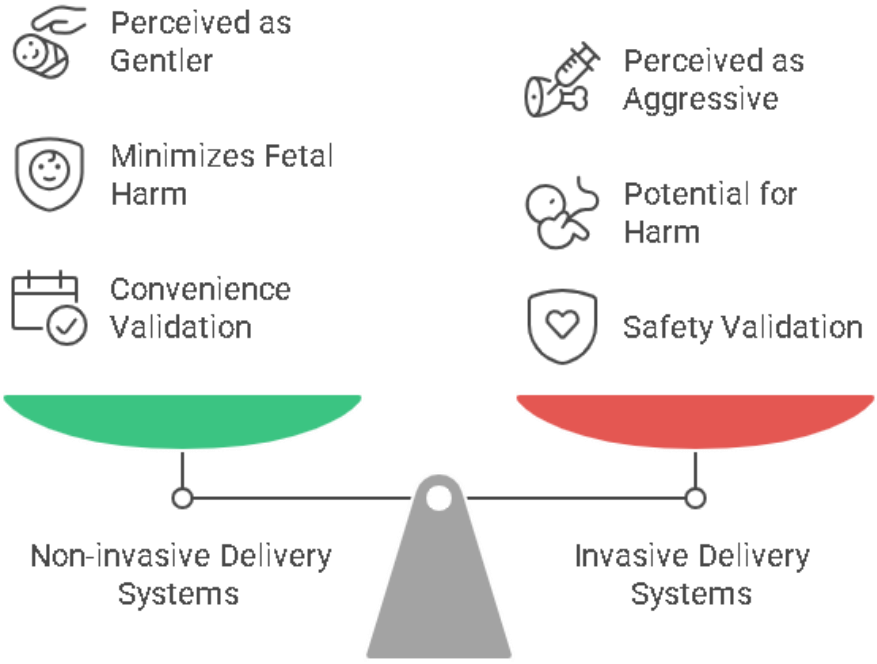
To enhance analytic rigor, the emerging interpretations were reviewed repeatedly against the original transcripts, and thematic boundaries were refined until internal coherence and conceptual distinctiveness were achieved. Interpretive credibility was further strengthened through reflexive attention to assumptions, maintenance of analytic notes, and documentation of the progression from raw text to thematic construction.

## RESULTS

### Seeking safety for the unborn child as the primary horizon of acceptance

The most dominant concern across participant accounts was not the technology itself, but whether the system was perceived as safe for the fetus. Participants consistently framed treatment decisions through maternal responsibility, often expressing that their acceptance of any drug delivery option depended on whether they believed it would minimize harm to the unborn child. In this sense, non-invasive delivery systems were often viewed positively because they were associated with being gentler, less aggressive, and less physically threatening than invasive alternatives. However, this acceptance was rarely automatic. Participants described a constant internal evaluation in which the promise of convenience had to be morally and emotionally validated through the question of fetal safety.

**Balancing Convenience and Fetal Safety in Treatment Decisions**




Several women explained that their comfort with non-invasive delivery increased when they perceived the route of administration as less likely to "disturb the baby" or "put chemicals directly into the body in a harsh way." For many, the body during pregnancy was no longer experienced as solely their own, but as a shared space requiring heightened caution. This altered bodily perception shaped their interpretation of treatment. One participant explained, "When I was told it would not involve injections, I felt relieved, but my first thought was still whether it would be safer for my baby, not just easier for me" (P3). This statement shows that acceptance was rooted in maternal vigilance rather than convenience alone.

Another participant described how even medically recommended therapy was filtered through a protective emotional lens: "During pregnancy, you become more careful with everything. Even if the doctor says it is fine, I still think again and again about what enters my body because it also reaches my baby" (P7). This repeated reflection suggests that the meaning of non-invasive delivery cannot be separated from the lived experience of pregnancy as a state of heightened ethical and bodily responsibility.

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Participants also linked safety perception with route familiarity. Systems that resembled common and socially normalized forms of treatment, such as oral or topical administration, were more easily accepted because they felt less foreign and less invasive. By contrast, unfamiliar systems, even when classified as non-invasive, could still generate hesitation if participants felt they lacked sufficient understanding of how the system worked. Thus, safety was not only a biomedical concept but an interpreted and emotionally mediated experience grounded in maternal embodiment.

**Experiencing comfort as a form of therapeutic reassurance**

Participants frequently described physical and emotional comfort as central to their willingness to accept non-invasive drug delivery systems. Comfort was not discussed merely in terms of the absence of pain, but as a broader sense of bodily ease, emotional calmness, and reduced treatment burden. For many women, pregnancy had already altered their sensory tolerance, energy levels, and daily functioning. In this context, non-invasive systems were appreciated when they reduced additional physical stress and allowed treatment to feel more manageable.

Several participants contrasted non-invasive systems with previous experiences of unpleasant medication use, especially when treatment had been associated with nausea, discomfort, anxiety, or clinical intimidation. The appeal of non-invasive delivery lay partly in its ability to reduce these negative associations. One participant stated, “I was already dealing with nausea and fatigue, so I did not want something that made treatment feel heavier. A non-invasive option felt more humane for me” (P1). Her statement illustrates that therapeutic acceptability was closely connected to the lived condition of pregnancy, in which even minor discomfort could become psychologically significant.

Comfort also carried symbolic meaning. Participants described feeling calmer when the treatment process appeared simple, gentle, and compatible with their vulnerable physical state. In this sense, comfort was experienced as reassurance. One woman explained, “If the treatment feels gentle, I feel more at peace. It makes me think that my condition is being handled carefully” (P5). This indicates that comfort functioned not only as a sensory experience but also as a sign that care was attentive and respectful.

At the same time, comfort did not always guarantee full acceptance. Some participants noted that a comfortable route could still be questioned if it was perceived as less effective or less controlled than conventional medical procedures. Therefore, comfort became meaningful when accompanied by confidence in therapeutic benefit. Nevertheless, the findings suggest that non-invasive systems gained an important advantage when they minimized bodily strain and contributed to a sense of emotional stability during pregnancy.

**Negotiating uncertainty through trust, explanation, and professional guidance**

Although participants generally responded positively to the idea of non-invasive delivery, their narratives revealed a persistent layer of uncertainty. Much of this uncertainty centered on efficacy, absorption, side effects, and whether a less invasive route could truly provide sufficient therapeutic benefit. Participants often lacked detailed technical knowledge about drug delivery mechanisms, yet they were highly aware of the consequences of uncertainty during pregnancy. Acceptance, therefore, depended greatly on whether healthcare professionals were able to transform unfamiliarity into trust.

Trust emerged as a relational process. Participants were more likely to accept a non-invasive system when explanations were clear, individualized, and delivered with reassurance. They wanted more than a brief statement that the intervention was safe; they wanted to understand why it was suitable for pregnancy and how it would affect both mother and baby. One participant remarked, “I could accept it when the doctor explained not only that it was safe, but also how it works and why it was better for my condition” (P4). This indicates that understanding was a key mediator between medical recommendation and subjective acceptance.

Another participant described hesitation in the absence of adequate information: “At first, I thought if it is not injected or something more direct, maybe it is weaker. I needed someone to explain why this method was still effective” (P8). Her account shows that non-invasive systems could be

interpreted ambivalently: they were attractive because they seemed gentler, but also potentially doubted because they did not fit conventional assumptions about medical strength or seriousness.

Trust was also shaped by continuity of care. Participants who reported positive relationships with healthcare providers were more likely to describe acceptance as a gradual but stable process. In contrast, where communication felt rushed or impersonal, uncertainty persisted longer. These findings suggest that the success of non-invasive drug delivery in pregnancy is inseparable from the communicative environment in which it is introduced. Acceptance was not formed solely through pharmaceutical design, but through explanation, responsiveness, and clinical credibility.

**Integrating treatment into the rhythm of pregnancy and daily life**

Participants emphasized that treatment acceptability was strongly influenced by how well the delivery system fit into the changing rhythm of pregnancy and everyday responsibilities. Pregnancy was described as a period of fluctuating energy, bodily unpredictability, emotional sensitivity, and increased domestic or occupational adjustment. In this context, non-invasive drug delivery systems were often valued because they were perceived as more adaptable to daily life, less disruptive, and easier to incorporate into routine.

Women described practical ease as an important component of acceptance, particularly when treatment could be managed without repeated procedural stress or disruption of mobility. One participant explained, “I preferred something that I could use without making my day more complicated, because during pregnancy even small tasks can feel exhausting” (P2). This illustrates that convenience was not superficial; it was tied to the lived experience of conserving physical and emotional energy.

Another participant highlighted the importance of maintaining a sense of normality: “What I liked was that it did not make me feel like a sick person all the time. I could still continue my routine and feel more like myself” (P6). This statement shows that non-invasive systems supported not only practical adherence but also identity preservation. Participants did not want treatment to dominate their pregnancy experience. Systems that allowed care to blend into ordinary life were more likely to be accepted because they preserved dignity, autonomy, and continuity.

However, routine integration also depended on personal circumstances. Some participants noted that ease of use had to be balanced with timing, symptom patterns, and forgetfulness, especially when pregnancy-related discomfort affected concentration or daily regularity. Thus, while non-invasive systems were often perceived as more lifestyle-compatible, their effectiveness in practice still depended on how well they aligned with the realities of women’s lived routines. Acceptance was strongest when treatment felt both manageable and meaningful within the broader experience of pregnancy.

## DISCUSSION

This study shows that pregnant women’s acceptance of non-invasive drug delivery systems is not a simple matter of convenience, but a layered experience shaped by fetal safety concerns, bodily comfort, trust in professional guidance, and the fit of treatment within everyday life. In relation to the broader question raised in the Introduction, the findings suggest that acceptance during pregnancy is best understood as an embodied and relational meaning-making process rather than a purely technical response to a therapeutic option.

The findings contribute to the research question by clarifying how pregnant women make sense of non-invasive drug delivery systems within the specific moral and emotional horizon of pregnancy. The Results indicate that women do not assess such systems only in terms of clinical effectiveness or procedural ease; instead, they interpret them through the intertwined meanings of maternal responsibility, bodily vulnerability, and protection of the unborn child (Cheung & Barrett, 2023). This is an important contribution because it shows that treatment acceptance in pregnancy is not merely a matter of willingness to use a medicine, but of whether the delivery system can be experienced as sufficiently safe, gentle, and compatible with the woman’s lived reality. In this respect, the study adds a phenomenological depth to existing knowledge by revealing that “non-invasive” is not automatically understood as acceptable. Its acceptability must first be translated into an emotionally credible and ethically reassuring experience for the pregnant woman herself.

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A further contribution lies in the identification of comfort as a meaningful therapeutic experience rather than a secondary product attribute. In many pharmaceutical and clinical discussions, comfort is often treated as an auxiliary issue associated with adherence or patient preference. The present findings suggest a more substantial role. Participants described comfort as a sign that care was being delivered with attentiveness to their bodily sensitivity during pregnancy. In other words, comfort functioned as reassurance (Darlis, 2022). This insight helps answer the research question by demonstrating that women's acceptance of non-invasive systems is shaped not only by what these systems do pharmacologically, but by what they communicate experientially about gentleness, control, and protection (Mukhlis et al., 2024; Mukhlis, Maryam, et al., 2023). That interpretation is especially relevant in pregnancy, where the body is not experienced in an individual sense alone, but as a shared site of maternal-fetal responsibility.

The study also contributes by showing that uncertainty remains central even when a system is framed as safer or easier to use. Participants did not simply welcome non-invasive options as inherently preferable. Instead, they continued to question efficacy, fetal implications, and the adequacy of less invasive routes unless these were explained clearly and convincingly. This clarifies that trust is not a static attitude but an interpretive bridge between biomedical recommendation and personal acceptance. The findings therefore suggest that the clinical value of non-invasive drug delivery systems depends not only on formulation or route design, but also on communicative practices that help women understand why a system is appropriate for their condition during pregnancy. This addresses the question raised in the Introduction by showing that the acceptance of therapeutic innovation depends on how it is made meaningful in practice.

These interpretations are broadly consistent with prior literature showing that medication-related decision making in pregnancy is shaped by fear, responsibility, and uncertainty rather than by evidence alone (Dube et al., 2025). Qualitative work on psychotropic medication use in pregnancy has shown that women often engage in complex decision making under conditions of incomplete certainty, and that they may rely on personal judgment or experiential reasoning when professional advice feels limited or ambiguous. Conflicting or insufficient guidance has also been shown to weaken confidence in treatment and increase decisional burden. The present findings align with that body of work, but extend it by demonstrating that similar dynamics operate not only in relation to medication use in general, but in relation to the mode of drug delivery itself. In this study, route acceptability became part of the woman's moral and emotional assessment of treatment, not merely its technical form.

The findings also resonate with literature emphasizing the importance of trust, information sources, and institutional credibility in medication decisions during pregnancy. Previous reviews have noted that pregnant patients often seek reassurance from healthcare professionals while also struggling with uncertainty about medication risks and benefits. The current study supports that observation by showing that professional explanation can transform unfamiliarity into acceptability when it addresses both safety and meaning. However, the findings go beyond information deficit explanations alone. They suggest that women do not simply need more information; they need information that speaks to their lived concerns as pregnant women, including bodily sensitivity, maternal identity, and everyday burden. This nuance complements earlier work on institutional trust by highlighting the experiential conditions under which trust becomes effective.

The discussion of comfort and routine integration also complements research on patient acceptability more broadly. Reviews and qualitative studies have shown that acceptability is influenced by factors such as burden, understanding, opportunity costs, and perceived appropriateness. Studies on dosage-form preferences likewise indicate that product handling, ease of use, and route-specific perceptions matter to patients (Emmanuel et al., 2025). The present findings support those insights, yet they also show that in pregnancy these dimensions take on a more existential quality. Ease of use was not valued merely because it improved compliance; it was valued because it preserved normality, reduced emotional strain, and allowed treatment to coexist with the fragile and changing rhythm of pregnancy. In that sense, this study deepens the concept of acceptability by placing it within the lived temporality and embodied vulnerability of maternal experience.

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Finally, the findings complement prior qualitative research on antibiotic use and medication safety during pregnancy, which has shown that pregnant women often interpret medical treatment through a protective orientation toward the fetus and may evaluate interventions based on both perceived necessity and perceived harm. The present study is in line with that literature in showing that treatment decisions are filtered through maternal caution. At the same time, it adds a more focused understanding of how this caution is applied specifically to non-invasive drug delivery systems. What emerges is not simple resistance or acceptance, but an ongoing effort to reconcile therapeutic need with the desire to preserve safety, control, and moral certainty (Mukhlis, Janwari, et al., 2023; Mukhlis & Abdullah, 2025). This deepens current understanding by showing that the lived meaning of the delivery route itself becomes part of pregnancy-related decision making.

The findings carry important practical implications for both clinical care and the broader field of biopharmaceutics and drug delivery systems. First, they suggest that the success of a non-invasive drug delivery system in pregnancy cannot be judged only by pharmacological performance or route-related convenience. It must also be evaluated in relation to how pregnant women interpret safety, gentleness, and moral responsibility toward the fetus. This point is especially relevant because pregnancy-related medication decisions are often shaped by uncertainty, variable risk perception, and reliance on professional guidance rather than by evidence alone. Existing literature similarly shows that pregnant patients' attitudes toward medicines are strongly influenced by knowledge sources, institutional trust, and perceived fetal risk.

A second implication concerns the design and implementation of patient-centered therapeutic strategies. The present study indicates that non-invasive systems may be more acceptable when they are introduced not merely as technically advanced options, but as forms of care that reduce bodily burden and preserve everyday functioning during pregnancy. This interpretation aligns with broader work on healthcare acceptability, which shows that acceptability is tied to perceived effectiveness, burden, emotional response, and ethical fit. It also resonates with research on user experience in drug delivery, where the acceptability of a delivery system depends not only on the drug itself but also on how the route and use conditions are experienced by the patient. In practical terms, these findings support more careful counseling, clearer explanation, and more context-sensitive communication when non-invasive systems are offered to pregnant women.

The findings also have a wider social and professional meaning. They show that treatment acceptance during pregnancy is embedded in a social world where women are expected to protect fetal well-being while also managing their own symptoms, uncertainty, and daily responsibilities. Because pregnancy is often accompanied by heightened perceptions of risk, even a clinically favorable intervention may remain emotionally difficult unless it is made meaningful within the woman's lived reality. This helps explain why trust in healthcare professionals becomes central: professional communication does not simply transfer information, but helps women interpret whether a therapeutic option is compatible with maternal care, bodily safety, and ordinary life. In that sense, the study reinforces the value of integrating experiential knowledge into the development and clinical use of non-invasive drug delivery systems, especially in vulnerable populations.

This study has several limitations that should be considered when interpreting the findings. As a phenomenological inquiry, it was designed to generate depth of understanding rather than statistical generalization, so the findings should be read as context-specific insights into lived experience rather than universal patterns. The sample was limited to pregnant women with direct exposure to or knowledge of non-invasive drug delivery in clinical care, which means that the themes may not fully reflect the experiences of other patient groups, other treatment contexts, or all forms of non-invasive delivery. In addition, perceptions of safety, comfort, and trust are likely to be shaped by local healthcare systems, provider communication styles, and cultural meanings of pregnancy, all of which may differ across settings. These limitations do not weaken the value of the study, but they do indicate that transferability depends on contextual similarity rather than broad representativeness.

A further limitation lies in the broader evidence base surrounding pregnancy and drug exposure. The literature indicates that pregnant populations have historically been underrepresented in clinical research, which has contributed to persistent uncertainty about maternal-fetal safety and efficacy for

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many therapies. That wider uncertainty may also shape how participants interpret non-invasive drug delivery systems, even when such systems are designed to be patient-friendly. In other words, some of the concerns expressed in this study may reflect not only the delivery route itself but also the larger epistemic limits that characterize medication use in pregnancy. Future interpretation of these findings should therefore remain attentive to the interaction between individual lived experience and the structural limits of available evidence.

Future research could extend these findings in several directions. Comparative phenomenological studies could examine whether similar meanings of safety, comfort, and trust emerge across different non-invasive delivery routes, such as oral, transdermal, nasal, or other mucosal systems, or across different therapeutic indications in pregnancy. Research could also explore how healthcare professionals understand and communicate the acceptability of such systems, since acceptability is increasingly recognized as a multidimensional construct and not simply a patient preference measure. In addition, mixed qualitative designs may help connect lived experience with questions of implementation, adherence, and counseling practices in clinical settings (Mukhlis, 2025a; Mukhlis & Saidah, 2025). Such work would deepen the contribution of this study by linking the experiential dimension of acceptance to the future development of more responsive and context-sensitive drug delivery strategies.

## CONCLUSION

This study examined the lived experiences of pregnant women in accepting non-invasive drug delivery systems within clinical care, addressing the need to understand treatment acceptance beyond clinical and pharmacological perspectives. The findings reveal that acceptance is shaped by an interconnected experience of perceived fetal safety, bodily comfort, trust in professional guidance, and the ability to integrate treatment into daily life. These results demonstrate that non-invasive systems are not automatically accepted as preferable, but must be interpreted as safe, meaningful, and compatible with maternal identity and lived reality. The study contributes to the field by addressing the limitation of prior outcome-focused research and providing a deeper phenomenological understanding of how drug delivery systems are experienced in sensitive contexts such as pregnancy. This insight supports the development of more patient-centered drug delivery strategies that align with both clinical effectiveness and experiential acceptability. For clinical practice, the findings highlight the importance of healthcare professionals providing clear communication, individualized counseling, and continuous support to enhance pregnant women's confidence and acceptance of non-invasive drug delivery systems. Such patient-centered approaches may improve treatment adherence and overall maternal care experiences. However, this study has several limitations. The findings are based on the experiences of a specific group of participants within a particular healthcare context and may not be transferable to all pregnant populations or clinical settings. In addition, the qualitative phenomenological design emphasizes depth of understanding rather than broad generalizability. Future research can extend these findings by exploring similar experiences across different populations, delivery routes, and healthcare contexts to strengthen the integration of experiential knowledge into pharmaceutical innovation.

## CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this article.

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