CHAPTER 2

OBSTETRIC DECISION-SUPPORT SYSTEM: AN INFORMATIONAL MODEL FOR MATERNAL AUTONOMY TOWARDS THE AGENDA 2030 HEALTH GOALS

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ABSTRACT

This study proposed an obstetric decision-support system with the objective of strengthening maternal autonomy and advancing the health objectives of Agenda 2030, with a particular focus on Sustainable Development Goal 3. The research employed a

qualitative, applied, and exploratory approach, integrating digital health, evidence-based care, and epistemological perspectives to formulate a structured environment tailored to pregnant women. The objective of this study was to address critical informational asymmetries in obstetric care through a digitally enabled, evidence-based model that empowered pregnant individuals in clinical decision-making. The methodological approach entailed a comprehensive review of the extant literature, requirement engineering, and the application of Unified Modeling Language diagrams to formalize system functionalities. The results of the study included a multilayer informational infrastructure comprising a dynamic layer for adaptive learning via algorithmic curation of scientific evidence and lived experiences, enabling personalized recommendations, and a static layer for birth planning and scenario simulation, integrating validated guidelines to reduce uncertainty. The integration of scientific evidence with user experiences facilitated the translation of World Health Organization guidelines into comprehensible and implementable information, thereby reducing informational asymmetries and enhancing the gestational decision-making process. The architecture prioritized intelligibility, traceability, and user-centric navigation, ensuring alignment with maternal profiles and preferences. The findings suggested that the formal modeling process facilitated the conversion of normative content into a computable and auditable structure, thereby promoting autonomy without compromising clinical safety. The study's findings indicated that a digitally mediated informational base, conceptualized at the nexus of health, information, and technology, served as a pivotal infrastructure for ensuring dignified, equitable, and humanized obstetric care. This contributed structurally to high-quality health systems by bridging evidence–practice gaps.

KEYWORDS: information systems, evidence-based care, health humanization, UML modeling, obstetric decision

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1 INTRODUCTION

According to the World Health Organization (WHO), health is defined as a state of complete physical, mental, and social well-being that transcends the mere absence of disease or infirmity (WHO, 1946). This conception serves to expand the understanding to a biopsychosocial perspective, which is fundamental in the formulation of the Sustainable Development Goals (SDGs), especially SDG 3: "Ensure healthy lives and promote well-being for all at all ages" (UN, 2015, p. 23). Examples of this evolution include telemedicine and telehealth approaches (Macedo et al., 2015; Puel et al., 2014; Soares et al., 2013; Souza Inácio et al., 2014). Despite the potential of technological advancements to enhance health promotion, extend life expectancy, alleviate suffering, and promote cellular restoration, healthcare systems have historically fallen short in providing universal, safe, and high-quality care (Institute of Medicine US, 2001, pp. 2–3). Facilities equipped with structural and human resources, including health professionals, potable water, electricity, and medications, are essential for the realization of quality care. However, the isolated presence of these factors does not guarantee excellence in care (Kruk et al., 2018, p. 1197). Despite the availability of adequate tools, adverse scenarios persist, reflecting a series of failures. These failures include the increase in inappropriate, unnecessary, or out-of-context actions, which highlight significant gaps in areas such as user experience, competence, and trust in the system, as well as people's well-being.

In the domain of obstetrics, the Global Strategy for Women's, Children's, and Adolescents' Health (WHO, 2015) emphasizes the reduction of preventable mortality in addition to promoting well-being and psychological safety. This strategy is consistent

with the objectives outlined in SDG 3, which aims to ensure that "women and babies not only survive childbirth complications, should they occur, but also thrive and realize their potential for health and life" (PAHO, 2019, p. 1). This approach is intrinsically linked to human rights, as recognized in Resolution 18/2 of the Human Rights Council, which legitimizes women as active agents in decision-making regarding their sexual and reproductive health (OHCHR, 2012, p. 5). Despite the advancements in reducing maternal and neonatal mortality associated with access to facilities for high-risk cases, there has not been commensurate progress in the humanization of care, as evidenced by the proliferation of obstetric violence. This reality indicates that, during periods of heightened physical and emotional vulnerability (e.g., pregnancy, childbirth, and the postpartum period), many women encounter adverse experiences in healthcare settings, including mistreatment, disrespect, and neglect (D'Oliveira et al., 2002). The consequences of these experiences can persist not only for the affected women but also for their family units.

Moreover, the pervasive medicalization of childbirth has eroded women's capacity to autonomously manage their labor. This phenomenon is evidenced by the fact that a substantial proportion of healthy pregnant women are subjected to a range of routine clinical interventions, the efficacy of which is often questionable, and whose potential adverse effects should not be overlooked (Coulm et al., 2012; EURO-PERISTAT, 2013; Renfrew et al., 2014). The absence of a universal consensus on the definition and measurement of these issues, in conjunction with the insensitivity of interventionist methodologies to women's needs, values, and preferences, undermines informational equity and exacerbates disparities in accessing adequate care (PAHO, 2019, pp. 1, 8). It is imperative to acknowledge that all women possess an inherent right to the pinnacle of attainable well-being, encompassing dignified and respectful care, along with safeguards against violence and discrimination. Substandard practices, therefore, represent egregious violations of fundamental human rights (WHO, 2014, pp. 1–2). As indicated by the Royal College of Obstetricians and Gynecologists (2017) and Downe et al. (2015), a positive experience is contingent upon the presence of certain essential elements. These elements include the maintenance of physical normality for both the mother and the infant, as well as the prevention and treatment of risks, diseases, and death. Additionally,

the maintenance of psychosocial normality is imperative, ensuring a pregnancy characterized by self-esteem, competence, and autonomy. In this regard, the WHO has underscored the significance of imparting efficacious communication concerning physiological, biomedical, behavioral, and sociocultural concerns, along with the provision of comprehensive support, encompassing social, cultural, emotional, and psychological dimensions, to expectant mothers in a manner that respects their dignity (WHO, 2015). However, studies demonstrate that in low- and middle-income countries, adherence to evidence-based guidelines remains suboptimal, with professionals exhibiting an average compliance rate of 47% in complying with care recommendations (Kruk et al., 2018, p. 1203).

In Brazil, public policies such as the National Program for the Humanization of Childbirth (2000), the Companion Law (2005), and the "Stork Network" (Rede Cegonha, in Portuguese) (2011) were implemented in an effort to address these challenges. However, the official exclusion of the term "obstetric violence" from policy guidelines in 2019 (Leite, 2014, 2021) compromised progress in measuring and addressing these practices. In this scenario, access to qualified information is configured not only as a right but as an indispensable condition for the empowerment of pregnant women (Targino, 1991, p. 155), thereby shifting them from passive recipients to active protagonists in their healthcare (Almeida Junior, 2009). Consequently, effective information, as a foundational element, empowers the pregnant woman to assume a central role in her gestational cycle. This empowerment enables her to seek answers that can support decisions regarding actions and interventions with a minimal degree of uncertainty, fostering the potential for argumentation and inquiry. Consequently, the dissemination of accurate information has emerged as a strategic element to mitigate vulnerabilities and enhance the humanization of obstetric care. This underscores the necessity for robust informational infrastructures that facilitate knowledge sharing and the monitoring of care quality. While equity transcends the technological sphere, digital solutions have the potential to reduce informational gaps in care for pregnant women, thereby promoting the empowerment of patients, families, and communities (Guimarães & Silva, 2011, p. 3553).

In light of this necessity, it is acknowledged that the daily engagement in health-promoting practices is contingent upon

the availability of information through communication channels, with technological advancements playing a progressively pivotal role in facilitating these activities. It is therefore emphasized that the establishment of robust foundations for an advanced health scenario necessitates not only physical tools, such as equipment, medications, and materials, but also novel attitudes, competencies, and behaviors, predicated on the capacity and propensity to learn from data (Kruk et al., 2018, p. 1202). In an era marked by accelerated digital transformation, propelled by the interplay between technological advancements and sociocultural shifts, there emerges a pronounced imperative for seamless integration of the health sector with information and communication technologies (ICTs). This integration is pivotal in attaining the objectives of paramount quality and ensuring individualized safety measures. Moreover, it is essential for fulfilling the obligations of investigation, notification, and humanitarian action in the context of public health (WHO & ITU, 2012). Digital health, defined as the systematic use of ICTs to strengthen informed decisions and promote well-being, has consolidated itself as an essential tool in care delivery (WHO, 2019). This initiative has garnered recognition from the World Health Assembly (2018), underscoring its significance in promoting universal coverage and enhancing service quality. However, the implementation of these technologies faces challenges, such as subjectivity in interpretation by developers and the absence of systematized documentation, which complicates replication and monitoring (WHO, 2021).

Accordingly, this study is guided by the following central question: By what means may an informational proposal be developed that would enhance the empowerment of those involved in obstetric care through the dissemination of evidence-based information? Answers are sought for the translation of scientific knowledge into accessible language, the prioritization of the most relevant themes for building maternal knowledge, and the integration of necessary components to ensure effective and optimized access to information. The objective of this study is to contribute to obstetric care that is more humane, equitable, and centered on women's autonomy. The study will articulate structural, social, and technological dimensions to strengthen health systems in facing contemporary challenges. In light of contemporary demands for integrated solutions between health and technology, this study proposes an obstetric informational model.

This model constitutes a structured and specialized channel. The purpose of this channel is to foster the autonomy of pregnant women. It does so by providing access to information that has been rigorously validated and updated. The model is supported by the WHO international regulations and articulated on the foundations of digital health. It adopts an informational empowerment approach, prioritizing the strengthening of the user's decision-making capacity throughout pregnancy.

The objective of this study is to develop a structured obstetric information base through an autonomous digital learning system, with the aim of promoting informational empowerment and the generation of maternal knowledge. This objective is intended to strengthen the autonomy of pregnant women and reduce uncertainty related to the relevance, consistency, and adequacy of health practices. To this end, this study seeks to analyze the specific informational demands of pregnant women, their impacts on the care process, and the necessary actions to minimize difficulties faced during pregnancy. This analysis will consider the importance of accessible and evidence-based information to transform users into active protagonists (Almeida Junior, 2009; Targino, 1991). This analysis proposes the development of a digital platform to centralize and organize content in accordance with scientific guidelines. This platform is intended to complement, rather than replace, medical guidance, in alignment with the principles of digital health and the humanization of care (Kruk et al., 2018; WHO & ITU, 2012). The successful establishment of a high-quality healthcare system is contingent upon the implementation of universal rights through the meticulous execution of evidence-based practices, disseminated by means of reliable informational flows. In the field of obstetrics, achieving excellence entails more than merely providing advanced technologies; it necessitates a gestational journey founded on the principles of women's autonomy and active engagement in clear communication processes unencumbered by biases or distractions that might compromise information integrity. The proposal's scope extends beyond the mere reduction of recognized violations, aiming to transform the health field by minimizing informational failures with the support of digital technologies.

High-quality health systems should consider individuals, families, and communities as active partners whose needs and preferences should shape institutional responses (Kruk et al.,

2018). In the context of obstetrics, the asymmetrical distribution of power and information between healthcare professionals and pregnant individuals underscores the urgency of this centrality. This dynamic functions as a moral and practical mechanism for empowerment and accountability (Kruk et al., 2018). Consequently, there is an explicit demand for informational bases that not only expand sharing networks but also translate and clarify content in an accessible way, promoting the empowerment of pregnant women. As Araújo (1992) emphasizes, the dissemination of information and knowledge has the capacity to disrupt historically discriminatory power relations. This vision is consistent with the 2030 Agenda, which emphasizes obstetrics centered on the woman as an active agent of her own health. In the subsequent section, an examination of extant literature will be conducted to explore the informational bases in health and their relationship with the humanization of obstetric care.

1.1 Literature review

In recent decades, there has been a growing consensus that sustainable health advancements require not only specific technological innovations but systemic transformations that integrate social, political, economic, and cultural aspects in favor of biopsychosocial well-being. While the millennium development goals (MDGs) have been acknowledged to have promoted significant advancements, such as a 45% reduction in global maternal mortality between 1990 and 2015 (Brizuela & Tunçalp, 2017), the current 2030 Agenda has been regarded as an expansion of this scope by incorporating equity as a structuring axis. This incorporation ensures not only access but also the quality and adequacy of care. Consequently, it is acknowledged that high-performance health systems must be cognizant of individual, cultural, and contextual variations, providing ethical and effective responses to the population's demands. This global movement is exemplified by initiatives such as the Commission on High Quality Health Systems in the SDG Era, which delineates four strategic fronts: governance with a focus on quality, redesign of service delivery, transformation of the workforce, and stimulation of demand for quality by users (Kruk et al., 2018). Concurrently, the Institute of Medicine proposes six fundamental dimensions for patient-centered care:

safety, effectiveness, timeliness, efficiency, equity, and respect for individual preferences (Institute of Medicine US, 2001). By underscoring the imperative for the user experience to inform all clinical decisions, this framework underscores the pressing need to reconfigure systems to prioritize technique, active listening, and the establishment of mutual trust.

This paradigm shift is also expressed in the 10 rules for redesigning care systems proposed by the same committee. These rules include recognizing the patient as the source of control, the unrestricted sharing of information, and evidence-based decision-making (Institute of Medicine US, 2001). These guidelines underscore the notion that information is not merely an adjunct to care, but rather a fundamental element that provides a framework for, substantiates, and evaluates the quality of care. In this context, obstetrics emerges as a field replete with tensions and possibilities. The WHO has outlined guidelines for maternal and neonatal care, proposing a theoretical model based on Donabedian's (2005) structure-process-outcome triad, which is distributed into eight domains that articulate technical quality and subjective experience (WHO, 2018). Consequently, the concept of excellence in health is understood to encompass two fundamental aspects: clinical competence and the communicational and relational capacity of healthcare professionals. In this scenario, the evaluation of quality must extend beyond objective outcomes, incorporating criteria such as the adequacy, integrity, and intelligibility of the information conveyed to the user. The necessity for mechanisms that translate scientific knowledge into comprehensible language is underscored by the incorporation of information as an axis of guidance and the maturation of care. This process restores the right of pregnant women to comprehend, interrogate, and determine. As Kruk et al. (2018) assert, the establishment of a quality system is predicated on the presence of informed, engaged, and respected subjects. However, the transfer of decision-making to professionals and institutions engenders an informational asymmetry that impedes free and informed choices, particularly regarding the type of birth and interventions performed (Zorzam, 2013). This context is further exacerbated by a pathologizing conception of the female body, which transforms childbirth into a risk to be controlled by often unnecessary procedures, contradicting evidence-based recommendations (Diniz, 2009; Zorzam, 2013).

The persistence of obsolete practices, such as episiotomies, inductions without clinical indication, and risky maneuvers, further compromises the quality of obstetric care and produces deleterious effects on maternal health and well-being (Diniz, 2009). The dearth of lucid and sufficient information regarding procedures undermines autonomy, as evidenced by the finding that a mere one-third of women feel adequately informed about the exams or medications administered during childbirth (Domingues et al., 2004). Moreover, the challenge of comprehending medical counsel affects over 70% of pregnant women receiving primary care (Mota et al., 2015). This predicament engenders a milieu of uncertainties and trepidations, thereby impeding women's capacity to engage proactively in decision-making processes concerning their health. It is important to acknowledge that the absence or distortion of information can be considered a form of informational violence. This type of violence undermines the dignity and rights of pregnant women, impeding their capacity to identify abusive practices (Russo & Carrara, 2015). Confronting this predicament necessitates the establishment of obstetric informational ecosystems that integrate the equitable distribution of resources with policies that promote women's active engagement in shaping digital infrastructures, thereby facilitating communicative processes that elucidate the biological, psychological, and social dimensions involved in the construction of care (Souza et al., 2011).

2 METHODOLOGY

This study is configured as an Application or Technological Adaptation Project, as it is directed towards the creation of innovation assets through the generation of products, processes, devices, and services based on scientific knowledge and formatted as technological systems subject to testing and evaluation (Fuck & Vilha, 2011). Its classification as an applied investigation is predicated on its objective of achieving practical applications, with the aim of resolving specific problems (Silva & Menezes, 2001, p. 20). In the context of this work, the application manifests itself in the proposition of a model intended to generate knowledge and to instrumentalize the exchange of information about obstetric care, seeking to solve demands and fill concrete informational

gaps. With respect to its objectives, this study is exploratory in nature, as it seeks to meticulously examine facts, phenomena, or new knowledge about which there is a paucity of information (Tobar & Romano Yalour, 2001). Concurrently, it is descriptive in nature, by presenting a series of information about the object of analysis, detailing the facts and phenomena of a particular reality (Triviños, 1987). In terms of methodology, the study is classified as qualitative. This is due to the fact that the research is characterized by an inductive approach to data analysis, whereby the researcher derives concepts, ideas, and understandings from patterns identified in the studies (Reneker, 1993). The qualitative approach is applicable to the entire development process of the proposed model, encompassing its definition, conception, and subsequent model evaluation stage.

The research methodology encompasses a bibliographic survey and the development of Unified Modeling Language (UML) diagrams (Hamilton & Miles, 2006). The scientific literature provided the conceptual basis on health, information, and technology, which was crucial for identifying the problem, defining objectives, and constructing the theoretical framework. To develop the model, we utilized the Digital Adaptation Kit for Antenatal Care, the Digital Implementation Investment Guide, and the recommendations on digital interventions for health system strengthening from the WHO. These resources were complemented by principles of Requirements Engineering and Design Science Research. In the context of the investigation, the initial focus was on assessing the informational needs of pregnant women, taking into account the challenges they encounter in accessing reliable and current healthcare guidance. This preliminary diagnosis was predicated on informal data collection on digital platforms, such as social networks, and in direct conversations with pregnant women, who shared authentic accounts of their difficulties in finding information. This preliminary understanding proved to be pivotal in delineating the scope of this study, which focused on understanding a scenario characterized by uncertainties and an abundance of conflicting information.

The theoretical framework of the study was developed through an extensive review of the extant literature. The survey provided the conceptual foundation for the subsequent development of the work, in addition to delineating the general and specific objectives that guided the subsequent phases. A

documentary mapping of past and current guidelines on health, information, and obstetrics was carried out, with a special focus on reports issued by the WHO in the last decade, prioritizing the most recent documents. In addition, a comprehensive exploration was conducted of prominent databases, including Latin American and Caribbean Health Sciences Literature (LILACS), Nursing Databases (BDENF), Scientific Electronic Library Online (SciELO), ScienceDirect, Cumulative Index to Nursing and Allied Health Literature (CINAHL), and the US National Library of Medicine—National Institutes of Health (PubMed). The utilization of standardized descriptors, as delineated by DeCS (Health Sciences Descriptors) and MeSH (Medical Subject Headings), such as "health," "obstetrics," "information," "technology," and "mobile applications," was employed to conduct a comprehensive and precise data prospection. This approach was designed to encompass the multidimensional complexity of the object under analysis. Complementary searches were conducted in national repositories, such as the portal of the Coordination for the Improvement of Higher Education Personnel (CAPES), and in normative documents, manuals, guidelines, and legislation pertaining to prenatal care in Brazil, originating from the Ministry of Health. Thus, the technical-legislative aspects were articulated with the practical and informational requirements of pregnant women.

The technical specification phase was guided by the guidelines of the Digital Adaptation Kit for Antenatal Care (WHO, 2021), implemented sequentially according to the digital structuring stages recommended in said document. The functional design of the proposed system was realized using the Figma tool, grounded in the precepts of Requirements Engineering and the guidelines of Design Science Research. This approach aimed to ensure integration between functional requirements and the specificities of the obstetric domain. The modeling employed UML notation to delineate both the behavioral and structural aspects of the system, through use case, activity, sequence, class, and component diagrams. These diagrams enabled the graphical representation of the static topology of the involved entities, their interrelations, attributes, and operational flows, culminating in a logical architecture congruent with the proposition of informational empowerment through access personalization and adaptive navigability.

3 RESULTS

In light of the multifaceted nature of contemporary obstetric demands, a systemic proposal has been formulated with the objective of developing a multifaceted instrument capable of translating evidence and experiences into operational resources. The delineated structure is predicated on stratified modeling, conceived from an interdependent logic of distributed networks, in which each element coexists in a collaborative regime, favoring both automated learning and evidence-based decision-making. This architecture was organized into two main navigation layers: the dynamic layer and the static layer. These layers are intercomplementary in guiding the gestational journey. Consequently, they establish a modular, responsive, and evolutionary system that accommodates distinct degrees of autonomy and complexity, according to the user's informational needs and gestational stage.

3.1 Dynamic layer: Monitoring by science–experience

This layer, which constitutes the active core of the system, functions as an adaptive learning interface. It is fed by scientific sources and empirical records, thereby enabling the automated screening, curation, and categorization of recommendations, rights, and narratives. This dynamism is operationalized by algorithmic extraction and filtering technologies, resulting in responsive personalization of guidance according to the user's progress on the platform. Its functional flows are structured into four axes:

1. Profile segmentation: It performs user classification based on clinical–contextual variables, allowing for accurate contextualization of recommendations.

2. Evidence mining and translation: It promotes the automated collection of clinical data and guidelines, with subsequent conversion into accessible language, maintaining scientific rigor.

3. Experience curation: It enables the sharing of experiences among users by similarity, constituting an empirical support environment.

4. Guidance personalization: It aggregates data from previous modules, promoting adapted recommendations that evolve according to the pregnant woman's journey.

3.2 Static layer: Planning for decision-making

The static layer facilitates long-term planning by means of the organization of birth plans and outcome simulation. Notwithstanding the existence of non-digital records, its integration with scientifically validated guidelines enhances decision-making and reinforces user autonomy. This layer is composed of:

1. Birth plan: An interactive interface allows for detailed configuration of birth preferences, with automated recommendations based on previously mined guidelines.

2. Scenario simulation: It generates representations of the potential outcomes of choices made, accompanied by risk–benefit analysis with a clinical, logistical, and emotional focus.

3.3 System details

To facilitate the integration of clinical guidelines into digital public health environments, the WHO has developed a set of digital adaptation kits. These kits are designed to standardize the translation of recommendations into operational structures that have been validated for their effectiveness (Tamrat et al., 2022). In accordance with the eight proposed structuring components delineated by the WHO (2021, p. 7), this study examines two of these components in particular. The following elements are of particular relevance in this context: operational processes and workflows and the main dataset. The inherent complexity of system development, irrespective of whether the development is for a mobile application or a corporate-scale initiative, poses challenges regarding the definition of components, their functions, and relationships. In this sense, modeling can be regarded as a

method of abstraction, with the objective of elucidating fundamental principles and facilitating technical comprehension that is amenable to critical scrutiny (Hamilton & Miles, 2006, p. 23). To ensure precise formal representation, the UML was adopted, given its capacity for modular adaptation according to the project context. In this investigation, two dimensions were prioritized: the behavioral, focusing on inter-object flows in the context of operational processes and workflows, and the structural, dedicated to the topology of intra-object data in the main dataset.

3.3.1 Operational processes and workflows

Operational processes encompass the systemic logic of the application's functioning in its temporal, distributed, and interactional dimensions. It entails the formalization of connections between actors, functional modules, and computational mechanisms. When articulated under defined conditions, these connections organize the solution's behavior throughout usage cycles. The following diagrams illustrate the articulation in question, meticulously unfolding the system's behavior into its constituent sublayers. This approach facilitates a comprehensive and nuanced visualization of systemic interactions (OMG, 2011).

3.3.1.1 UML use case diagram

The use case diagram elucidates the core functionalities attributed to the user and the system, delineating the contact points between them through interaction flows. The model employs dashed lines to symbolize the bidirectional transit of data and events, conceptualizing the user as an agent of actions such as navigation, data insertion, and birth plan construction. In response, the system executes tasks of data verification, mining, and validation, as well as the organization and storage of plans and experiences. The capacity for scenario simulation and access to reports is also integrated into the represented functional matrix (Figure 1).

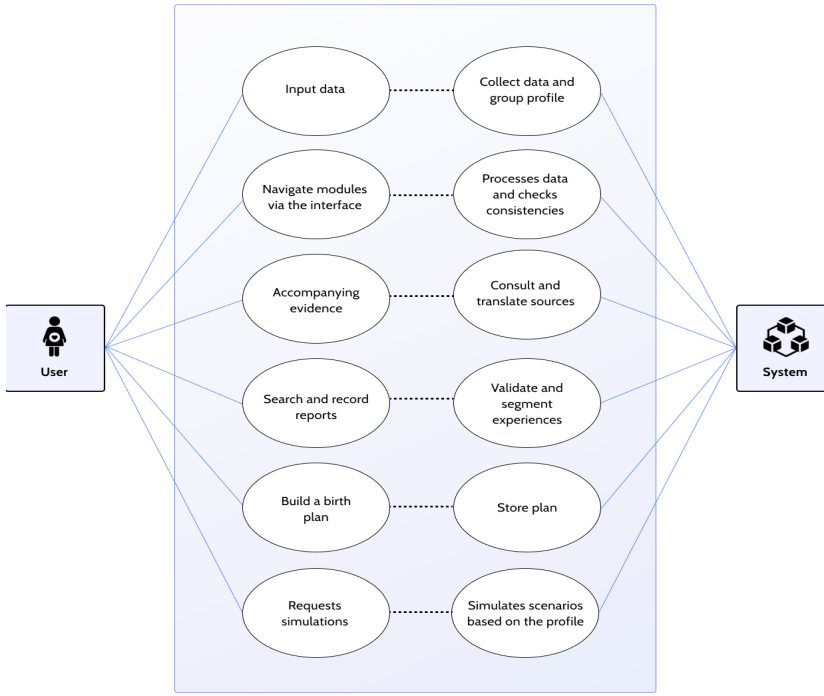

Figure 1. UML use case diagram. **Source**. Author.

3.3.1.2 UML activity diagram

The diagram organizes the user's and system's activity modules into horizontal pools, subdivided into specific lanes for operations such as data verification, plan construction, evidence classification, and scenario analysis. The sequence of actions commences with user authentication and unfolds according to the user's choices. In this process, data are encrypted and directed to analytical engines that apply rules for generating personalized recommendations. The model also incorporates feedback cycles and continuous reconfiguration of guidance, ensuring dynamic adherence to inserted data (Figure 2).

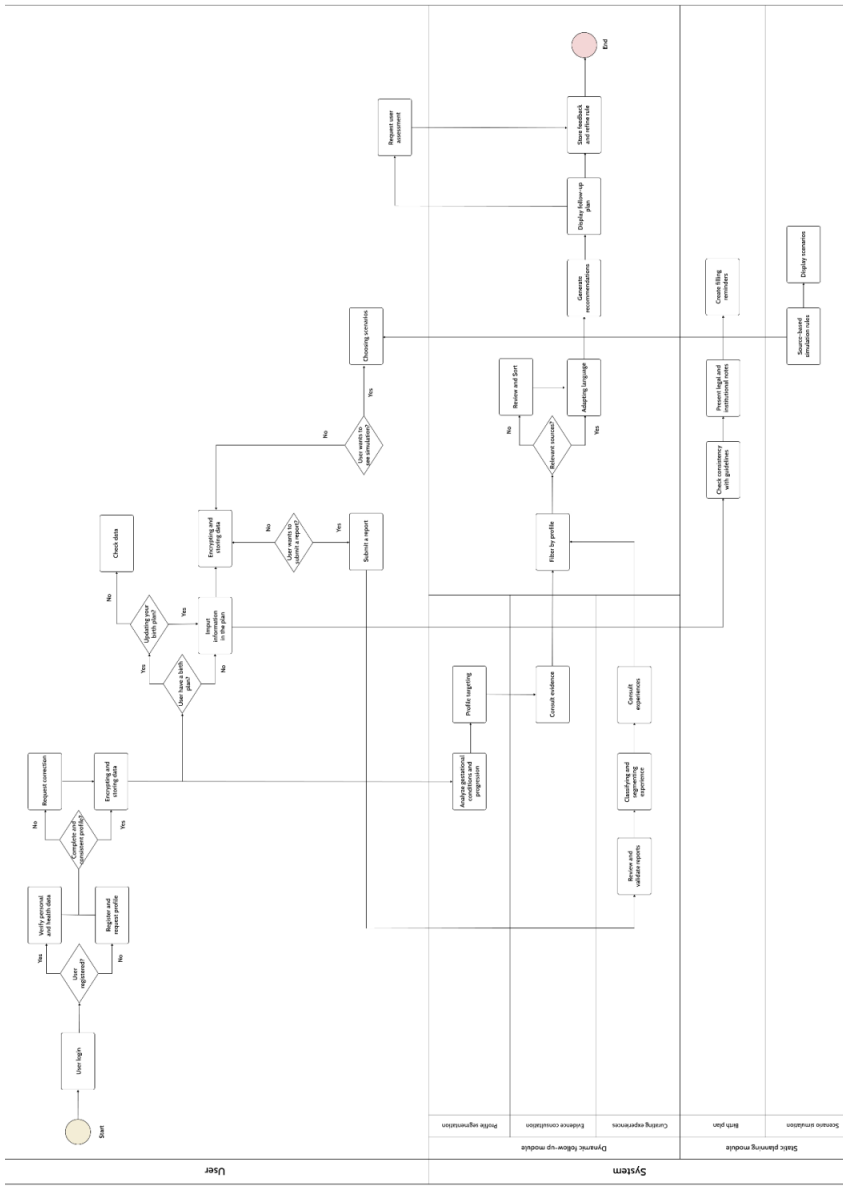

Figure 2. UML activity diagram. **Source**. Author.

3.3.1.3 *UML sequence diagram*

The sequence diagram, which is organized vertically into "lifelines," portrays the interaction among five main entities: user, interface, database, application, and rules engine. The user inputs data, which traverses the technical circuit from the interface to the database, undergoing encryption, grouping, and validation. The application processes the profiles, and the rules engine acts in the semantic verification of sources and in the classification of reports. This results in specific recommendations and iterative simulations that feed back into the system (Figure 3).

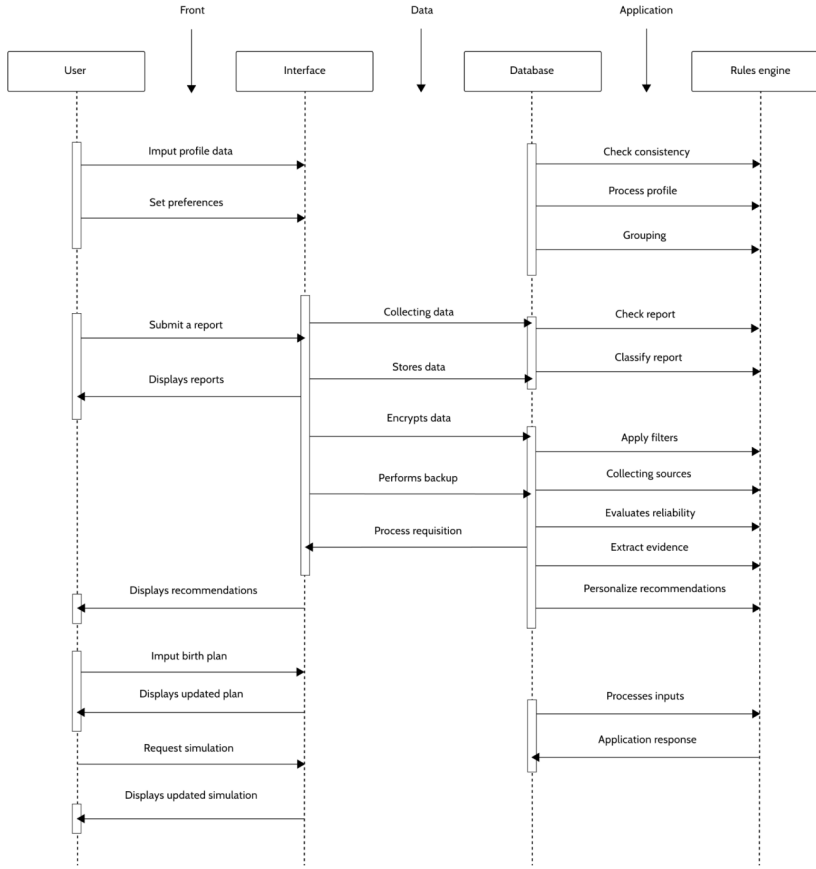

Figure 3. UML sequence diagram. **Source**. Author.

3.3.2 Main dataset

The formal description of data objects enables the capture of the logical structure that underlies the coherence of flows and the emergent behavior of the system. The decision to represent these components through three structural diagrams—class, object, and component—was made under the assumption that all functionality stems from structural entities (OMG, 2011).

3.3.2.1 UML class diagram

The class diagram illustrates the structural framework of the object-oriented system, delineating the fundamental classes, their attributes, and associated methods, as well as the composition, aggregation, and dependency links between them. The central class ProfileSegmentation encapsulates four entities: PersonalData, HistoryHealth, AccessCare, and Lifestyle, whose data are collected, validated, and encrypted before storage. The BirthPlan class is a comprehensive program designed to facilitate the aggregation of a pregnant woman's preferences, thereby enabling the generation and verification of personalized plans. The ObstetricInformationalBase is a comprehensive repository that consolidates profile data, birth plans, and evidences, thereby serving as a centralized information hub for the system. SimulationScenarios are models of decision scenarios. CuratingExperiences and PersonalizationRecommendations are concerned with empirical accounts and individualized recommendations, respectively. The data flow is enabled by the ProcessingData and Preprocessing classes, which are responsible for critical operations such as normalization, backup, linguistic adaptation, and pre-conditional verification. This modular, cohesive, and extensible structure facilitates the application's maintenance and evolution (Figure 4).

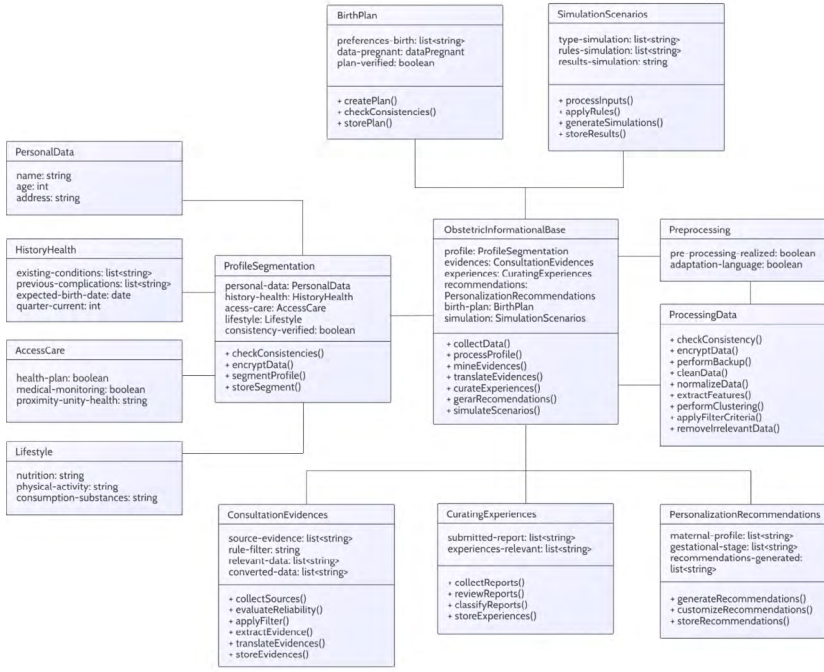

Figure 4. UML class diagram. **Source**. Author.

3.3.2.2 UML object diagram

The object diagram instantiates the previously defined classes, thereby enabling the observation of the system in a real execution state. Each class is represented by an object that contains values derived from user input. For instance, the Patient Profile section includes specific data elements such as the patient's name, age, and clinical history. In contrast, the Birth Plan component reflects validated and adapted preferences. Objects such as Data Processing and Personalization of Recommendations operate with transformed and filtered data, delivering specific recommendations. In the Sources layer, clinical evidence and shared experiences are instantiated as Evidence Consultation and Curating Experiences, containing real data, such as scientific

articles and birth narratives. The model provides a precise view of the operational interdependencies and dynamic data flow between the system's objects (Figure 5).

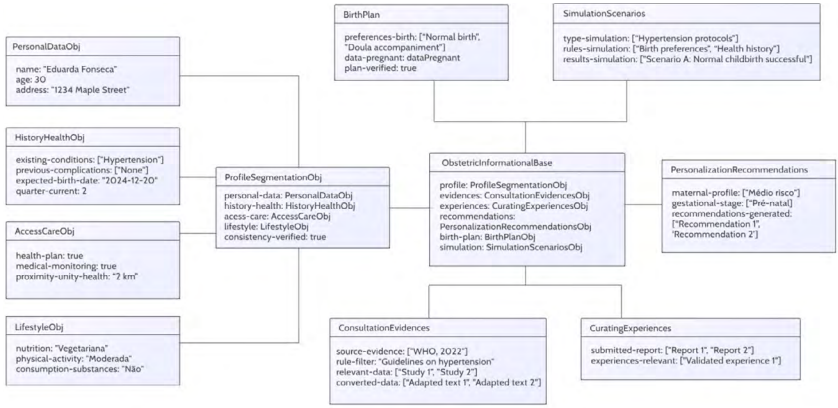

Figure 5. UML object diagram. **Source**. Author.

3.3.2.3 UML component diagram

The following diagram illustrates the application's modular architecture, which is structured into three layers: User, Data Transformation, and Sources. The first category comprises interface components, including Patient Profile and Birth Plan, which are responsible for data collection and submission. These data are processed in the intermediate layer by modules such as Data Processing and Personalization of Recommendations, which perform normalizations, groupings, and guidance generation. The Scenario Simulation component utilizes these data to assess potential outcomes. Within the Sources layer, the Evidence Consultation and Curating Experiences modules facilitate the access and organization of external content, which subsequently feeds back into the system. Each component is connected by explicit interfaces such as InputProfile, OutputVerifiedPlan, and AccessRecommendations, ensuring data integrity, interoperability, and traceability. The diagram offers a clear visualization of the technical responsibilities of each functional block and the

relationships between them, facilitating the solution's maintenance and scalability (Figure 6).

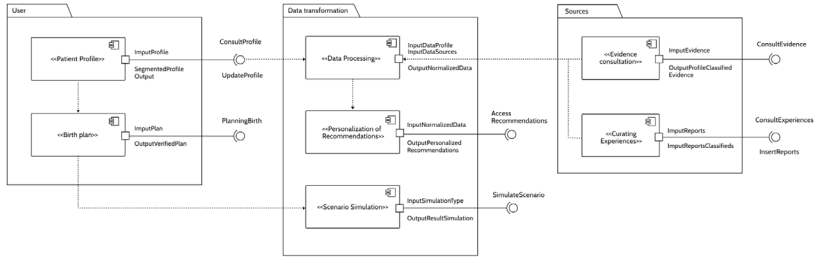

Figure 6. UML component diagram. **Source**. Author.

4 DISCUSSION

This study reflects the intersection between instances that are usually treated in a compartmentalized manner. It simultaneously articulates the three essential layers for its functioning: the health layer, anchored in clinical and biomedical guidelines; the informational layer, which structures data flow and its conversion into applicable knowledge; and the technological layer, which operationalizes these processes through digital solutions of algorithmic personalization. The model is predicated on the intricacy of contemporary obstetric care, endeavoring to transcend the mere dissemination of information and instead comprise a dynamic decision support ecosystem. In this ecosystem, scientific information is augmented by curation, with the objective of customizing guidance and interventions. The decision is founded on the objective of operationalizing the concept of patient-centered care within the paradigm of obstetric digital health, with a particular emphasis on empowering pregnant individuals and enhancing the quality of care. From this perspective, the multilayer system concept also allows for the articulation of the pregnant woman's local needs (specific, contextual, and individual) with the global requirements of best obstetric practices, based on scientific sources. The plurality applied here leverages the ability to

combine layers of micro- and macro-knowledge, optimizing the operationalization of personalized and evidence-based solutions within the same digital environment. Additionally, the concept of layers in health science alludes to the stratified structures of care needs—ranging from basic to highly specialized—and of knowledge dissemination itself, where raw data are transformed into information, and information, once processed and applied, becomes usable knowledge.

Another theoretical underpinning of this system is the integration of science and experience, grounded in the principles of practical epistemology (Sbissa et al., 2011) and evidence-based practice. This integration is further enriched by the incorporation of users' individual voices and narratives, a crucial element in transcending the conventional barriers encountered by health systems, which frequently exhibit a disconnect with contextual realities. The proposed system integrates these two levels, offering a balance between generalizable clinical recommendations and adaptation to each pregnant woman. This intersection is critical because it acknowledges that scientific knowledge, while robust, must always be contextualized by experience. This contextualization articulates subjective experiences with the universality of scientific evidence, thereby creating a dialogue between science and practice. The science layer ensures that recommendations are based on guidelines, while the experience layer adds the dimension of reality, promoting an interface where users can identify with similar stories and better assimilate recommendations.

Evidence-based recommendations, exemplified by the guidelines established by the WHO, serve as the foundation for regulatory frameworks that delineate care standards. These standards, in turn, function as a benchmark for the architecture of digital systems implemented by various nations. Conversely, the dissemination of these guidelines in an essentially textual format poses a series of challenges to their transposition into the social and digital environment, by requiring translation processes that, not infrequently, give rise to subjective interpretations by implementers and users. This subjectivity can compromise the uniformity of systems, which can lead to concrete risks of compromising content integrity. Such compromises can result in possible functional inconsistencies and limitations in the ability to audit technical and clinical compliance. This scenario has the potential to result in undesirable clinical outcomes and other adverse effects. In this

context, the transition from paper-based models to digital systems necessitates data standardization and the implementation of instruments to ensure technical interoperability, as well as the integrity and reliability of content integrated into systems. This mitigates risks associated with variability in guideline interpretation and safeguards the safety and effectiveness of healthcare.

The integration of formal modeling practices, particularly those facilitated by the UML, signifies a significant advancement in the conversion of technical-normative recommendations into operational artifacts. This integration provides a clear, auditable, and replicable computational structure, thereby enhancing the reliability and reproducibility of the research process. This conversion is not merely instrumental; it represents an effort of semantic transposition between clinical, informational, and computational domains. This transposition requires a multidimensional understanding of the interfaces between digital health, requirements engineering, and epistemology applied to care. The utilization of UML diagrams, encompassing use case, activity, sequence, class, object, and component, functions as a methodological axis to translate, with logical precision, the interaction flows between users, data, and decision engines. The model proposed here diverges from generic prescriptive approaches in that it is predicated on the articulation between the ontology of obstetric care and the algorithmic logic of informational personalization. This approach contributes to the modeling of a functional system and the construction of a normative-operational paradigm, in which the technical interface does not silence, but rather enhances the centrality of the gestational experience.

The technical dimension of the diagrams proved to be of particular strategic importance in delineating architectures oriented towards flow customization and profile segmentation. These stages, in turn, underpin information personalization and system responsiveness. The graphical materialization of components and processes ensures a formal representation that can be replicated, audited, and adapted to different institutional and cultural contexts. This mitigates the risks of interpretative ambiguity characteristic of exclusively textual guidelines. This assertion is particularly salient in light of the persistent challenges associated with the variability in the implementation of optimal obstetric practices, as highlighted by Kruk et al. (2018), and the opacity of numerous digital health systems with regard to the traceability

of decisions. The integration of an algorithmic layer that curates experiences and evidence establishes a hybrid knowledge framework that transcends technical rationality, thereby encompassing elements of practical epistemology and empathic listening. This integration of scientific evidence and subjective experience serves to revive the principle of informed autonomy, thereby transforming the care model from a hierarchical vertical structure to a dialogical paradigm that is responsive to individual needs. In this sense, the system proposes a technical–communicational mediation between biomedical knowledge and users' situated knowledge, reinforcing the notion of care as coproduction.

Nevertheless, the proposed modeling is not without limitations. Although UML allows for a robust formalization of systemic functionalities and flows, the system's real effectiveness depends on its validation in usage contexts. In such contexts, factors such as usability, health literacy, accessibility, and technological infrastructure can substantially interfere with the solution's performance. The absence of empirical validation, therefore, constitutes a relevant methodological limitation, which points to the need for future implementation studies, with an emphasis on analyzing user experience, clinical impact, and adherence to interoperability and information security guidelines (WHO, 2021). It is noteworthy that the proposed structure functions as a prospective catalyst for the reconfiguration of informational systems in maternal health. This reconfiguration involves the transformation of technical guidelines into interoperable computational architectures, with a focus on informational equity and the autonomy of pregnant women. The contribution of this study lies in demonstrating that diagrammatic modeling is not merely an illustrative supplement, but rather a structuring nucleus of an informational ecosystem that aims to enhance care quality through organizational intelligence and the technical translation of fundamental rights.

5 CONCLUSION

The analysis developed in this study highlights a significant discrepancy between the ideal design of obstetric care and its effective delivery. This discrepancy is evident in the practices of overuse, underuse, and inadequate use of resources, which persist

regardless of age categories, socioeconomic status, or health coverage configurations. Confronted with this structural predicament, which exposes inequalities and inadequacies in service delivery (Institute of Medicine US, 2001), there emerges a pressing need for instruments that overcome technological reductionism and digital determinism. In this sense, this study was dedicated to the conception and modeling of a multilayer Obstetric Informational Base, delineating a comprehensive proposal to address informational and humanization challenges in maternal care. The investigation's fundamental premise entailed the conceptual integration of two key elements: the humanization of obstetric care and the notion of informational empowerment. The overarching objective of this integration was twofold: first, to address and mitigate existing informational asymmetries within the healthcare system, and second, to empower pregnant individuals to become active participants in the decision-making process concerning their own healthcare. The adopted multilayer model, with its dynamic and static layers, reflects an intrinsic coherence with international guidelines for humanized health (WHO, 2015), aiming for adaptive care centered on individual needs.

The integration of ICTs and health was configured as a structuring axis of the proposal, conceived to overcome informational gaps and promote obstetric care based on human rights (WHO, 2012), democratizing access to validated scientific knowledge. The modeling diagrams developed for this proposal are instrumental in translating scientific knowledge into operational structures. These diagrams represent use cases, activities, sequences, classes, objects, and components. This diagrammatic approach provides a rigorous analysis and clear communication of the system's complexity, elucidating how informational empowerment and care personalization can be achieved and how each element contributes to a cohesive informational ecosystem. The objective of this modeling proposal is twofold: first, to contribute to the reduction of inappropriate obstetric practices, and second, to align with the recommendations of the WHO (2014, 2018) for a positive childbirth experience and the prevention of abuse. The conceptual model under discussion fosters care that is more respectful, safe, and values the pregnant woman's autonomy by grounding the provision of accessible and qualified information. Consequently, the modeled Obstetric Informational Base functions as a catalyst for transformation, promoting a culture of care grounded in

evidence and respect for human rights, in accordance with the biopsychosocial conception of health (WHO, 1946).

The project's primary objective was met through the development of a framework for an informational environment tailored to the needs of a particular audience within a complex ecosystem. This initiative aimed to address the biopsychosocial gap that hinders humanized approaches and the full exercise of citizenship within health, contributing to the field's advancement. It is acknowledged that, while the modeling of this platform signifies a significant advancement, its maximum impact on the comprehensive enhancement of obstetric health is contingent upon its strategic integration with other technologies and quality improvement initiatives, thereby constituting a multimodal intervention. The proposal's alignment with the 2030 Agenda (UN, 2015) and the SDGs, particularly SDG 3, is evident, as it aims to empower pregnant women with the knowledge necessary to manage their health. This study offers significant contributions to the fields of health management and public health. It proposes an innovative approach to restructuring obstetric care through the use of conceptual and diagrammatic modeling. This proposal delineates a range of opportunities for enhancing the quality of care, expanding the array of safe, effective, and equitable interventions, and shifting towards obstetric care that is more humane and centered on women's autonomy.

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Conflict of interest

The authors declare that there are no conflicts of interest related to this research.

Contribution statement

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Statement of data consent

The bibliographic data used in this study, including data from Web of Science and PubMed, have been processed and analyzed as described in "Methodology." The datasets generated during this research are available upon request and can be provided to interested researchers for further review.

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