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**OBSTETRIC INFORMATION BASE: A MULTI-LAYERED SYSTEM FOR
AUTONOMOUS EVIDENCE-BASED LEARNING**

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Certificamos que esta é a versão original e final do trabalho de conclusão que foi julgado adequado para obtenção do título de Bacharel em Ciência da Informação.

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Florianópolis, 2024

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To my father I dedicate this work and all the effort of a lifetime. Who I have become and will become is the fruit of his love, dedication, generosity and courage. No words will be able to fully express the gratitude for his existence, no action will heal the pain of his passing, no effort will diminish the longing in his absence.

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*This work is dedicated to the memory of Paulo Guilherme de Souza.
For all the love shared,
for all the struggle faced,
for the injustice of his passing.*

ABSTRACT

Contemporary health, redefined in terms of the balance between physical, mental and social dimensions, reveals a new panorama anchored by the 2030 Agenda, which articulates reformulation actions and demonstrates interdisciplinary dependencies to achieve the Sustainable Development Goals (SDGs) through the insertion of humanized approaches in health. In this scenario, the field of obstetrics presents one of the most sensitive and emblematic demands for the construction of high-quality systems: reconciling technological advances with the strengthening of patients' autonomy, ensuring that they enjoy the right to respectful, safe and evidence-based care. Although technological advances offer new possibilities to minimize maternal mortality and morbidity, obstetric practice globally is marked by the prevalence of inappropriate interventions that perpetuate information injustice and disregard the decision-making role. In view of this, global guidelines, such as the WHO recommendations, emphasize the urgency of promoting care focused on the individual needs and particularities of each patient. In response to these demands, this work presents an Obstetric Information Base structured as a multilayer digital system for informational empowerment that promotes qualified access to information and autonomous learning based on information. Based on global guidelines, the integration of Information and Communication Technologies (ICTs) and health, and human rights principles, this study proposes a platform that centralizes personalized information, using a hierarchical approach of layers that operate in a complementary manner: the dynamic layer enables navigation through adapted scientific content and accumulated experiences for continuous monitoring, while the static layer guides strategic planning of decisions for childbirth. The methodology is detailed in the construction of the system, covering the identification of demands, the survey of informational needs, the description of conceptual and physical components, and the development of the prototype interface. The subsequent evaluation of the screens conducted with potential users around usability and effectiveness issues provides a preliminary overview of the adequacy of the solution to the empowerment guidelines and the optimization of the informational flow. In a global scenario where access to high-quality information has a direct impact on well-being, this research contributes to the future of contemporary obstetric care based on humanization and human rights, fruits of information security and democratization of scientific knowledge, aligning with the objectives of universalizing quality health care.

Keywords: Informational empowerment, Obstetric humanization, Information and Communication Technologies

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LIST OF ABBREVIATIONS AND ACRONYMS

- APIs - Application Programming Interfaces
- BCSQ - Birth Companion Support Questionnaire
- CAPES - Coordination for the Improvement of Higher Education Personnel
- CAQ - Childbirth Attitudes Questionnaire
- CBSEI - Childbirth Self-Efficacy Inventory
- CINAHL - Cumulative Index to Nursing and Allied Health Literature
- DeSC - Health Sciences Descriptors
- HIS - Hospital Information Systems
- ICTs - Information and Communication Technology
- LGPD - General Data Protection Law
- LILACS - Latin American and Caribbean Literature on Health Sciences
- MeSH - Medical Subject Headings
- NCSDH - National Commission on Social Determinants of Health
- NHSAP - National Health Services Assessment Program
- OHCHR - Office of the United Nations High Commissioner for Human Rights
- SciELO - Scientific Electronic Library Online
- SDGs - Sustainable Development Goals
- SUS - Brazilian Unified Health System
- UML - Unified Modeling Language
- UN - United Nations
- VBA2C - Vaginal Birth After Two Cesareans
- WHO - World Health Organization

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1. INTRODUCTION

The World Health Organization (WHO) conceptualizes health as a state of complete physical, mental and social well-being, beyond the mere absence of disease or disability - a definition constructed in the preamble to the Constitution of the World Health Assembly, signed in 1946 by the representatives of 61 states present. Despite questions about its possible utopian nature, it is undeniable that this manifestation was a step forward in proposing to overcome the health-illness dichotomy. By understanding health as a structure that takes into account biopsychosocial factors, the debate was broadened beyond the promotion of physical integrity. In 2015, an agreement signed by the member states of the United Nations (UN) promoted Agenda 2030 as a global action plan, bringing together 17 Sustainable Development Goals (SDGs) and 169 targets that balance the economic, social and environmental dimensions of sustainable development, fundamental to the health of humanity and the planet, whose third goal aims to “ensure healthy lives and promote well-being for all at all ages” (UN, 2015, p. 23).

In fact, with the expansion of new technologies, a horizon of possibilities has emerged for achieving advanced results in health promotion. Longevity, pain relief and cell restoration are among the promises resulting from a scientific revolution that would meet all the demands of the area (INSTITUTE OF MEDICINE US, 2001, p. 2). The care delivery system, however, has failed in its holistic capacity to provide quality for all, at all levels. Despite the necessary recognition of significant improvements also in low- and middle-income countries, in recent decades we have seen a reality with changing demands, expectations and objectives that lead to new prioritizations.

When thinking about a health system for the 21st century, the Committee on Quality of Health Care in America pointed out that between existing health care and the care that could exist there is not just a gap, but an abyss. Global research into the quality of care has revealed that current approaches, in many cases, fall short of the ability to translate knowledge into practice in a safe and appropriate manner (INSTITUTE OF MEDICINE US, 2001, p.3). It can be said that the discussion about safety associated with satisfactory clinical results is on the agenda of actions in local and global contexts that seek to reduce mortality. On the other hand, reflecting on appropriate practices includes, at the same time, seeking evidence for responses to physiological events and evidence about the very need to give any response, distancing oneself from involuntary and arbitrary practices.

In addition to modeling a rigid structure with a final body delimited by a high-quality health system, it is essential to think of a complex structure made up of interconnected layers that work to optimize care in response to the dynamic needs of the population. As dynamism is tangentialized by attributes from the open borders of different areas, health needs to be guided by its generated impacts. Thus, as part of the purposes within the perinatal approach spectrum, the Global Strategy for Women's, Children's and Adolescents' Health (WHO, 2015), in addition to pointing to the reduction of preventable mortality, highlights the need to promote well-being and psychological safety, seeking alignment with the goals established in SDG 3 to focus on ensuring that "women and babies not only survive the complications of childbirth, if they occur, but also develop their health and life potential" (PAHO, 2019, p.1).

Having this new approach in mind, it is possible to talk about an approach based on evidence and human rights, whose consideration does not focus on isolated pathologies, and whose main premise is to think about empowering the user to claim their rights and not just avoid death or morbidity. Thus, in its resolution 18/2, the Human Rights Council asked the Office of the United Nations High Commissioner for Human Rights (OHCHR) to prepare concise technical guidelines on the application of legislation aimed at implementing policies to reduce preventable maternal mortality and morbidity. Working with the bias of patient autonomy, a framework is formalized to legitimize women as active agents who have the right to participate in decisions that affect their sexual and reproductive health (OHCHR, 2012 p.5).

Therefore, understanding that this participation must precede physiological responses, it was considered valid to see the very notion of a positive pregnancy experience in the understanding of women as agents of the obstetric system. With this in mind, a scoping review was carried out by the Royal College of Obstetricians and Gynecologists (2016) and demonstrated what matters to pregnant women. It concluded that a high-quality approach needs to provide an impactful product that leads to a positive pregnancy experience, which can be achieved by ensuring essential elements, namely maintaining the physical normality of mother and baby - including prevention and treatment of risks, illnesses and death; and maintaining psychosocial normality, with a pregnancy permeated by self-esteem, competence and autonomy (DOWNE et al, 2015). This indication is based on the assumption that most women want not only to have a labor, but an experience with fulfillment achieved by participating in decision-making, allowed and necessary, even when medical interventions are required (PAHO, 2019, p.1).

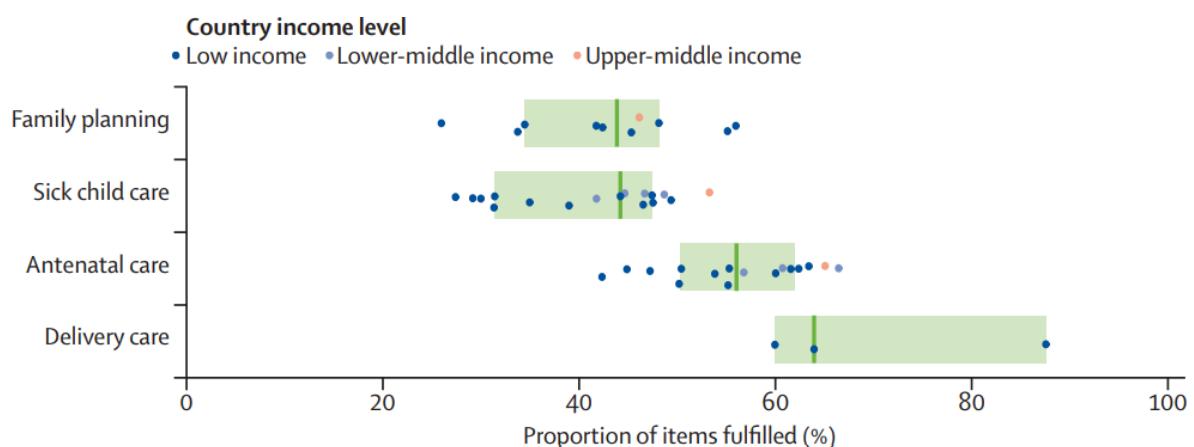
Understanding high-quality systems from a multifaceted perspective shows that they need to be developed on the basis of actions that are equitable, resilient, efficient and for

people (KRUK et al., 2018, p. 1197). To enhance the achievement of optimal people-centered outcomes, the received experience of obstetric care needs to be judged as just as important as the provision of clinical care. To this end, in the process of developing recommendations on antenatal care, the WHO highlighted the importance of providing effective communication on physiological, biomedical, behavioral and sociocultural issues, and effective support, including social, cultural, emotional and psychological support to pregnant women in a respectful manner (WHO, 2016).

However, despite their low implementation costs, these measures are not considered a priority in many scenarios. In studies carried out by KRUK et al. (2018), several sources were compiled, including data from 10 years of surveys in health facilities, households, telephone, internet, results of global estimates, systematic reviews and individual studies to present a comprehensive picture of the state of the quality of health care addressed by the SDGs in several low- and middle-income countries.

Using WHO guidelines, essential elements of reproductive, maternal and child health care were analyzed according to quality indices. According to figure 1, the observation of 81,856 consultations in 18 countries showed that adherence to evidence-based guidelines is not widespread, and that, on average, providers fulfilled only 47% of the recommended care - with a performance of high variation that suggests the possibility of improving the quality of care in several countries (KRUK et al., 2018, p. 1203).

Figure 1 - Overall health picture



Source: KRUK et al. (2018, p. 1203)

In fact, it is possible to see gains in the global debate, with health shifting away from the biological field and being thought of not only from the point of view of disease, but also

taking into account economic, political and historical-social aspects. With regard to prevention, there are some policies and programs in Brazil that contribute to this goal, such as the National Program for the Humanization of Childbirth and Birth (2000), the Accompanying Person Law (2005), the Stork Network - Maternal and Child Care Network (2011) and the National Guidelines for Pregnant Women's Care (2015/2016). In contrast to all these surveys, in May 2019, the Ministry of Health published an official letter (Official Letter No. 017/19 - JUR/SEC) judging the term obstetric violence to be inappropriate, banning its use in legal documents, public policies and official texts, favoring a current scenario that continues not to address the issue (LEITE, 2021). In view of this, and as a result of the lack of consensus on definition and terminology, there is no validated instrument for measuring obstetric violence.

We can see how different layers overlap in order to improve the approach in the obstetric field, demonstrating the breadth of factors that are relevant to thinking about the development of a new health system linked to the millennium goals, which cannot ignore humanization. According to the Ministry of Health's Technical Manual (MINISTÉRIO DA SAÚDE, 2005), qualified and humanized puerperal care is provided through welcoming conduct and without unnecessary interventions, easy access to quality health services and actions that integrate all levels of care. Inserted in the arrangement for the completeness of this care is access to information, seen as a foundational aspect, since it is a right that legitimizes patient empowerment, generating knowledge and, consequently, enabling them to exercise their citizenship. It can be said that this element, in health, is a precondition for reducing vulnerability and increasing humanization. According to Targino (1991, p.155):

Information is therefore everyone's right. It is a common good that can and should act as a factor for integration, democratization, equality, citizenship, liberation and personal dignity. There is no exercise of citizenship without information. This is because, even in order to fulfill their duties and claim their rights, be they civil, political or social, citizens need to know and recognize them and this is information (TARGINO, 1991, p. 155)

According to Almeida Junior (2009), information mediation allows the user to move from the category of mere recipient to the central actor in the process of appropriation. In other words, user's empowerment transports them from the category of passive recipient of information to an active-participatory being, and therefore a citizen. Effective information, therefore, as a pillar element, allows pregnant women to be the protagonists of their prenatal care, labor and puerperium, seeking answers capable of supporting, with the least possible

degree of uncertainty, decisions about the actions and interventions to be triggered, with the possibility of argumentation and questioning.

Thus, in an attempt to bring up the debate on the scenario of violence, formally banned but still present in the reality of pregnant women, it can be seen that numerous studies are aimed at designating the best treatment by monitoring obsolete practices that are not recommended by the WHO recommendations. However, there is still a lack of previous work with proposals to minimize neglect of women by generating knowledge.

Faced with this gap, it is clear that day-to-day health activity depends on information through communication and, increasingly, the technologies that enable it. It should therefore be noted that building solid foundations for an advanced health scenario requires not only physical tools, such as equipment, medicines and materials, but also new attitudes, skills and behaviors, based on the ability and willingness to learn from data (Kruk et al., 2018, p. 1202).

In an increasingly digital world, stimulated by the interaction between technologies and socio-cultural changes, there is an inevitable recognition of the need for good integration between the health sector and Information and Communication Technologies (ICTs) in order to achieve high quality objectives and personalized individual safety, as well as fulfilling the obligations of investigation, notification and humanitarian action in public health (WHO; ITU, 2012). When thinking about the proper functioning of the link between the population, their needs and expectations; governance and partnerships between sectors; care delivery mechanism; tools and resources, it becomes essential to create channels that promote patient autonomy using the possibilities of digital health as support.

Based on an understanding of these contemporary demands for integrated solutions between health and technology, this work proposes a structured and specialized obstetric information system as a channel designed to foster the autonomy of pregnant women through targeted access to rigorously validated and up-to-date information. Based on WHO international standards and articulated on the foundations of digital health, the system adopts an informational empowerment approach, prioritizing the strengthening of the user's decision-making capacity during pregnancy.

This study arises from the unfolding of theoretical contributions, in which the bibliographic survey and critical analysis of the state of the art in obstetric information systems are the structuring guide. Initially, the mapping contextualizes the investigation and articulates a line of reasoning that outlines the conceptual terrain and the relevance of evidence-based information for maternal empowerment. Based on this theoretical foundation,

the methodology was outlined and chosen to respond to the research needs centered on conceptual and functional systematization.

At the core of the work, the proposal is consolidated as a system that centralizes and translates information, but does so in a personalized and contextualized way, allowing intuitive navigation that respects user autonomy. To this end, the prototype presented is modeled as a digital artifact that would work as a tool to minimize uncertainties and provide a reliable information experience, anchored in the best practices recommended by the WHO. The subsequent evaluation seeks to understand usability, accessibility and effectiveness criteria, indicating whether the objectives outlined in the proposal were measurable and whether the prototype would be able to meet the expectations generated.

The results obtained, analyzed and discussed in the light of the objectives set, demonstrate the viability of the system and also its potential for transformation in the context of the global obstetric reality. In a scenario where accessibility to quality information can have a direct impact on health and well-being, the relevance of innovative, user-centered solutions is unquestionable. This study therefore offers a significant contribution to the field of Information Sciences, configuring itself not just as an academic exercise, but as a concrete response to the demands of society, promoting a future in which knowledge is an instrument of transformation and empowerment.

1.1 Research problem

Facilities equipped with structural and human resources, including health professionals, running water, electricity and medicines, are fundamental to materialize good quality care, but a focus limited to the presence of these production factors is not, in itself, a measure of high quality care (KRUK et al., 2018, p. 1197) - negative scenarios often follow in the presence of adequate tools. At this stage, a major flaw has been seen in recent decades by the considerable increase in inappropriate, unnecessary, irrelevant or out-of-context actions, exposing the existence of major blind spots in areas such as user experience, system competence, trust in the system and people's well-being.

In the obstetric context, it is worth highlighting gains in terms of reducing maternal and neonatal mortality as a result of access to facilities for high-risk cases, but the incentives for this have not accompanied significant results in terms of humanization, such as the increase in cases of obstetric violence. Although these events can occur at any time during pregnancy, physiological and emotional vulnerability in childbirth and the postpartum period

is not supported by welcoming environments and, globally, women and their families are affected by experiences of abuse, disrespect, mistreatment and neglect with direct and indirect consequences (D'OLIVEIRA; DINIZ; SCHRAIBER,2002).

It is important to note that many practices designed to initiate, accelerate and regulate a physiological process have been linked to a growing stream of medicalization that tends to weaken women's ability to actively give birth. Studies show that a considerable percentage of healthy pregnant women undergo at least one routine clinical intervention, often ineffective and potentially harmful, during labor, such as instrumentation, induction, acceleration with oxytocin, episiotomy, perineal hair removal, enemas, amniotomy, intravenous fluids, antispasmodic drugs and antibiotics for uncomplicated vaginal births (COULM et al., 2012; EURO-PERISTAT, 2013; RENFREW et al., 2014).

Currently, there is no international consensus on how these problems can be scientifically defined and measured, and as a result, their prevalence and impact on well-being are not effectively highlighted. Approaches focused on intervention are not sufficiently sensitive to women's personal needs, values and preferences and, when carried out without clear indications, violate the indications of informational equity (PAHO, 2019, p.1). In addition, the questionable use of technologies in environments with abundant resources, even when the clinical benefits are unclear, increases the equity gap in disadvantaged groups and populations (PAHO, 2019, p.8).

Knowing that all women have the right to the highest attainable standard of health, including the right to dignified and respectful care throughout pregnancy and childbirth, as well as the right to be free from violence and discrimination, it can be said that inappropriate approaches amount to a violation of fundamental human rights (WHO, 2014, p. 1-2). Starting from this legitimate context, a biopsychosocial problem is revealed from the perspective of urgency, since it exposes a historically inadequate framework for what is understood as citizenship.

In order to estimate possible solutions, the fifth WHO recommendation for the prevention and elimination of abuse, disrespect and mistreatment during childbirth in health institutions (2014) is taken as a basis, considering the need to involve all stakeholders, including women, in efforts to improve the quality of care and eliminate disrespect and abusive practices (WHO, 2014, p. 3). This raises the question of how to analyze, materialize and encourage this involvement. Therefore, understanding information as a precondition in health for reducing vulnerability and increasing humanization, there is a demand for a solid

obstetric information base that makes it possible to promote knowledge to pregnant women and monitor the quality of care, so that abusive practices can be measured and prevented.

Although equity does not only concern a technological perspective, it is necessary to reflect on solutions that use the digital channel at the service of health to minimize information gaps (GUIMARÃES, MC; SILVA, CH; 2011 p 3553). A central question was defined as a guiding element for the research: "How can we develop a proposal that empowers patients, families and communities involved in the obstetric care process through the dissemination of evidence-based information?". Additionally, secondary questions were established:

- How can scientific knowledge be translated into user's language through a flow that allows a broad and sustainable understanding?
- What are the subjects of significant relevance and which of them should be prioritized for building maternal knowledge?
- Which components does the system need to integrate to enable effective and optimized information retrieval?

1.2 General objective

To develop an obstetric information base structured through a digital autonomous learning system for the informational empowerment and the generation of maternal knowledge aiming to enhance autonomy and mitigate uncertainty about the relevance, uniformity and appropriateness of health approaches.

1.3 Specific objectives

- Analyze information demands, their impacts and essential actions to mitigate the difficulties faced by pregnant women during pregnancy;
- Propose a digital platform to centralize and organize relevant information based on evidence-based guidelines that complement care without replacing medical advice;
- Prototype structures of information based on international standards and integrate functionalities for effective information retrieval and translation of essential scientific knowledge for decision-making;
- Validate the system's quality by testing a prototype from the point of view of potential users.

1.4 Justification

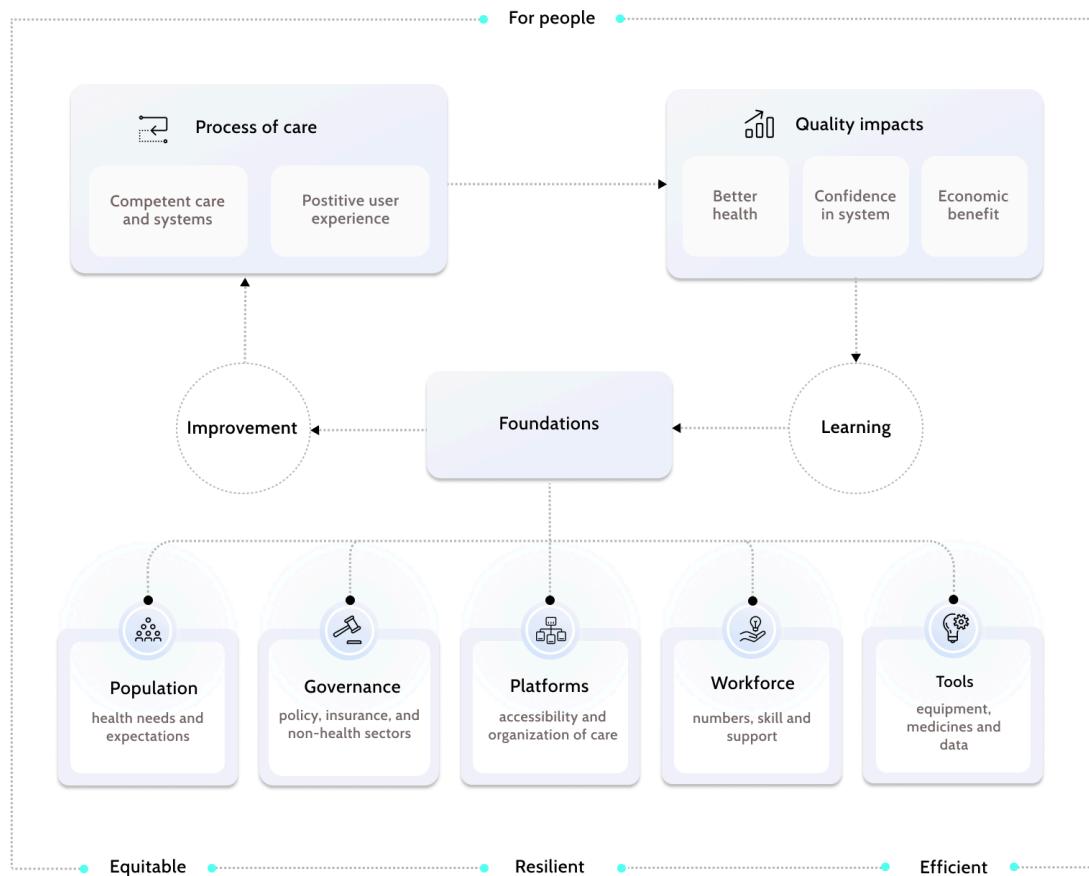
To discuss the achievements of the goals set to build high-quality healthcare is, first and foremost, to address the guarantees of basic universal rights in the application of evidence-based practices that are disseminated in the information flow. High-level obstetrics goes beyond state-of-the-art technologies: it is essential to enable a gestational path supported by maternal autonomy and active involvement. This participation needs to be part of the communication process, from receiving information to sending it through a channel that is free from biases and interest noise.

Thus, in order to go beyond mitigating the gaps that only potentialize recognizable violations, there is a need to contribute to the transformation of the health domain, aiming to minimize informational violations through the support of technology. Broadly defined as the systematic application of ICTs to support informed decision-making and strengthen well-being, digital health is increasingly becoming an indispensable facilitating tool in the provision of care. Its value was recognized in a resolution passed unanimously at the World Health Assembly (2018), which demonstrated collective and international recognition of digital technologies to contribute to advances in universal health coverage (WHO, 2019).

In this sense, evidence-based recommendations, mainly in guidelines from organizations such as the WHO, are establishing standards and offering references for thinking about the content of digital systems. However, their availability is subject to subjective interpretations by implementers and software providers, which can lead to inconsistencies and unforeseen effects. Furthermore, even with the existence of a system, content documentation may often not be available, generating dependency or difficulty in monitoring the attributes used, which cannot be scaled and easily replicated (WHO, 2021).

In order not only to minimize possible failures, but also to create purposeful digital products, it is necessary to consider that the foundations of high-quality health systems include the populations they serve: individuals, families and communities. Necessary partners, seen not only as the main beneficiaries, determine the needs, knowledge and preferences that should shape the health system's response. This is demonstrated in the conceptual framework (Figure 2) from The Lancet Global Health Commission (2018) that incorporates user experience and how people benefit from healthcare.

Figure 2 - High-quality health system framework



Source: Adapted from Kruk et al. (2018, p. 1200)

It should also be noted that the emphasis on people-centeredness is especially crucial in healthcare due to the asymmetry of power and information between the provider and the patient. People-centeredness functions not only as a moral imperative to protect against the adverse effects of this power imbalance, but also as a corrective action that reduces the imbalance through patient empowerment and improved accountability (Kruk et al., 2018, p. 1200).

In the obstetric environment, the demand for an information base that not only increases the number of networks for sharing information, but also enables the clear translation and preventive elucidation of content that enables patient empowerment is even more notorious, since, as Araújo (1992) points out, “[...] both information and knowledge can transform power relations, which subordinate and discriminate against women [...]”. Only in this way, by prioritizing the user as a central active agent, can obstetrics be designed in line with the aims of the 2030 Agenda.

1.5 Document structure

The research started with the identification of a problem through the baseline study, which identified the need for a tool to help obstetric services promote quality of care through the promotion of knowledge. This led to the development of a prototype of a digital platform called the Obstetric Information Base, proposed to help pregnant and postpartum women to learn, supporting active participation in decision-making.

Chapter 2 begins by articulating the conceptual foundations that outline the global and informational context pertinent to the subject. This theoretical framework is necessary to establish the assumptions that underpin the problems identified, allowing for a critical and accurate analysis of the gaps in the scope of the knowledge addressed. The subsequent investigative stage in Chapter 3, of a methodological nature, establishes the technical apparatus that will be used to deal with the issues raised, with the selection of appropriate techniques and precise detailing of the processes that will be followed, always anchored in scientificity and appropriate to the proposed purpose.

The technical-operational proposition emerges in chapter 4 as the logical manifestation of the previous investigation, being outlined in multiple layers that not only segregate, but also hierarchize dynamic and static functionalities within the same systemic architecture. The configuration of these layers was designed to ensure a fluid transition between strategic planning and scientific operationalization, allowing implementation to be monitored and ensuring informed decision-making. Each component of this proposal was designed to maximize the efficiency of the system, based on a detailed analysis of workflows, usage scenarios and possible interactions between the agents involved.

The subsequent development of a prototype in chapter 5 materializes the concepts explored, providing a reference model for empirical validation. The prototyping phase allows the theoretical ideas to be extrapolated to a pragmatic dimension, giving greater tangibility to the proposals developed throughout the study. The design of the architecture and user interface follows robust software engineering principles, with a view to maximizing usability and process integration.

Finally, the formal evaluation of the proposal is carried out in Chapter 6 in order to provide a thorough analysis of the results obtained, using specific metrics to verify the suitability of the proposed solution in relation to the parameters previously defined. As well as offering objective verification, this analysis provides substantial insights for the continuous refinement of the system.

The adoption of this structure, marked by increasing levels of abstraction and complexity, is justified by the need to guarantee a substantial deepening of the issues analyzed, while at the same time allowing ideas to progress gradually until they are fully technically consolidated. The sequential and hierarchical arrangement of content provides a flow of development that tries to ensure cohesion and coherence to offer a logical and articulated path between theory and practice.

2. THEORETICAL APPROACHES

The main concepts needed to understand the ecosystem of technology, information and health will then be presented to support the construction of the proposal. Firstly, global guidelines for achieving development are highlighted, followed by an imperative scenario of information needs in health, as well as the global and national state of guarantees that define the construction of fair health care, as well as the gaps that limit a coherent approach and how this leads to a gap in support mechanisms in the obstetric ecosystem.

2.1 Global actions for biopsychosocial development

The diversity of possibilities that research has incorporated, whether pioneering or more recent, shows that there is a qualitative and quantitative set of ideas that are potentially useful for rethinking the path that has already been traveled and that still needs to be traveled towards sustainable development. It is accepted that the dissemination of new technological solutions is essential for the advancement of humanity, but it is important to consider that an innovation, formatted as a product or process, needs to generate impact. For this to happen, the vision of innovation at the highest level, or systemic, needs to travel along a path of diffusion carrying different ideas, skills, knowledge, information and signals from various areas, since the channels through which these elements circulate are inserted in a larger context that integrates social, political, economic and cultural layers (ORGANIZATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT, 1997, p 35).

We can see that, in addition to highlighting priority objects that need to be created, shaping a way forward must aim to meet the demands of the population and move, first and foremost, towards building renewed assets that guarantee the availability of basic rights. In this sense, many of the demands for solutions resulting from the acquisition of new knowledge exhibit the characteristics of a public good, since the costs of making them available are low in comparison to the returns from their development (ORGANIZATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT).

By highlighting the prioritization of actions for the new millennium with a view to ensuring high-quality processes, the Millennium Development Goals (MDGs) were one of the breakthrough initiatives that resulted in the reduction of poverty and the improvement of people's lives around the world. With regard to maternal and newborn health, a significant 45% reduction in global mortality has been achieved since 1990, a greater proportion of births

were attended by technically qualified professionals by 2015, and increased access to contraceptives has been realized (BRIZUELA; TUNÇALP, 2017, p. 21).

The Sustainable Development Goals (SDGs) now propose a broader agenda that goes far beyond what was established for the MDGs, recognizing the progress made while pointing to items not achieved. There is thus a renewed agenda that matures the debate on inequality, present not only in access to services, but also in the responses that the health system gives to citizens. The focus then shifts to self-improvement of actions aimed at improving general well-being, based on an understanding of the need to move towards more equitable health systems that provide the highest possible quality of care (BRIZUELA; TUNÇALP, 2017, p. 22).

With actions that are guided by the successes and failures of various countries in the practice of high performance health systems, research, evaluation and the experience of specialists, the Commission on High Quality Health Systems in the SDG Era points to the future of universal actions that improve and achieve this renewed concept of quality of care. The recommendation revolves around 4 cores: governing for quality, redesigning service delivery to optimize quality, transforming the health workforce and awakening people's demand for quality (KRUUK et al., 2018, p. 1231).

In line with this direction, the Committee on Quality of Health Care in America proposes six improvement objectives to address key dimensions in which the current health system can and should function, defining that medical care should be: safe, effective, timely, efficient, equitable and user-centered, with this last element considering the guarantee that the patient's values guide all clinical decisions (INSTITUTE OF MEDICINE (US) COMMITTEE ON QUALITY OF HEALTH CARE IN AMERICA, 2001). Among the dimensions that determine this patient-centered care, Gerteis et al. (1993) identify: respect for patients' values, preferences and expressed needs; coordination and integration of care; information, communication and education; physical comfort; emotional support, relief of fear and anxiety; and involvement of family and friends. This demonstrates the plural and consequently complex nature of this objective, which should not be seen as a secondary need.

In its recommendations, the same Committee elaborates on the practical nature of patient-centered care, indicating that private and public purchasers, healthcare organizations, clinicians and patients themselves should work together to redesign healthcare processes according to 10 rules listed in the table below:

Table 1 - New Rules to Redesign and Improve Care

Rule	What the system should provide
1. Care based on continuous healing relationships	Patients should receive care whenever they need it and in many ways, not just in face-to-face visits.
2. Individualization and personalization based on the patient's needs and values	The care system should be designed to meet the most common types of needs, but have the capacity to respond to individual patient choices and preferences.
3. The patient as a source of control	Patients must be given the information they need and the opportunity to exercise the degree of control they choose over the healthcare decisions that affect them. The healthcare system must be able to accommodate differences in patient preferences and encourage shared decision-making.
4. Shared knowledge and free flow of information	Patients must have unrestricted access to their own medical information and clinical knowledge. Clinicians and patients must communicate effectively and share information.
5. Science with evidence-based decision-making	Patients should receive care based on the best available scientific knowledge. Care should not vary illogically from clinician to clinician or from place to place.
6. Security as a property of the system	Patients must be safe from injuries caused by the care system. Reducing risks and ensuring safety requires greater attention to systems that help prevent and mitigate errors.
7. The need for transparency	The healthcare system must make information available to patients and their families that allows them to make informed decisions when selecting a health plan, hospital or clinical practice, or choosing between alternative treatments. This should include information describing the system's performance in safety, evidence-based practice and patient satisfaction.
8. Anticipating needs	The healthcare system must anticipate patients' needs, rather than simply reacting to events.
9. Increasing value and continuously reducing waste	The health system must not waste resources or patient time.
10. Cooperation between clinicians	Clinicians and institutions must actively collaborate and communicate to ensure appropriate exchange of information and coordination of care.

Source: Adaptado de Institute Of Medicine (US) Committee On Quality Of Health Care in America (2021)

These ten rules readily translate into a set of new patient expectations for health care and summarize ten essentially simple transitions that must be implemented to achieve a high-level 21st century health system. In the table below, each rule is described and contrasted with the corresponding current approach.

Table 2 - Contrast of rules

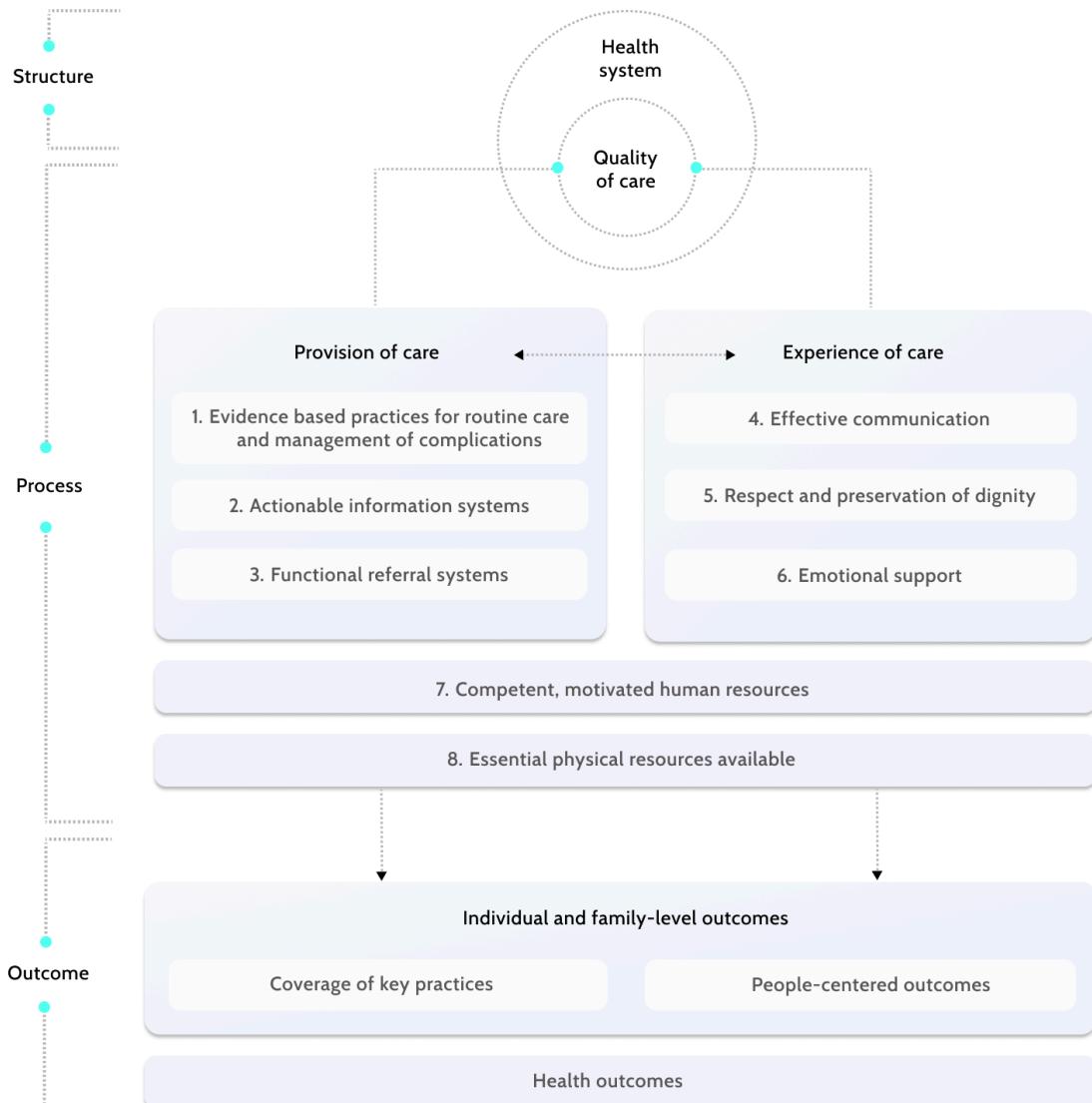
Current Approach	New Rule
Care is based primarily on visits.	Care is based on continuous healing relationships.
Professional autonomy drives variability.	Care is customized according to patient needs and values.
Professionals control care.	The patient is the source of control.
Information is a record.	Knowledge is shared and information flows freely.
Decision making is based on training and experience.	Decision making is evidence-based.
Do no harm is an individual responsibility.	Safety is a system property.
Secrecy is necessary.	Transparency is necessary.
The system reacts to needs.	Needs are anticipated.
Cost reduction is sought.	Waste is continuously decreased.
Preference is given to professional roles over the system.	Cooperation among clinicians is a priority.

Source: Adapted from Institute Of Medicine (US) Committee On Quality Of Health Care in America (2021)

In this new scenario, quality assessment is included as a system response, but many problems are present at this fundamental level as it is a remarkably complex attribute to define. Although some results are objectively measurable, attitudes of the clinical staff, patient satisfaction and rehabilitation are, on the other hand, more difficult to measure. The outcome of medical care, in terms of recovery, restoration of function and maintenance of survival, has often been used as an indicator of quality, so since development goals are directed not only at advances in medical technology but also at how it is applied, a trendy approach to evaluation is to examine the process of care itself, rather than its outcomes.

In the obstetric field, this perception would consider the clinical conditions during prenatal care, childbirth and the puerperium, as well as the woman's experience of the care received. In line with this proposal, the new WHO recommendations for maternal and newborn care propose the theoretical model (WHO, 2018, p.12) that organizes quality into eight domains segmented into the structure-process-outcome triad proposed in the quality assessment by Donabedian (2005), as illustrated below.

Figure 3 - WHO quality of care framework for maternal and newborn health



Source: Adapted from WHO (2018)

This approach requires attention to the variety and specificity of the relevant dimensions, values and standards to be used in the evaluation. At the same time as working on the axis of technical competence and maximizing resources for carrying out high-level diagnostic and therapeutic procedures, it looks at the justification of the diagnosis and the need for interventions, preventive management of impacts, coordination of continuity of care and acceptability of the recipient. From this framework, judgments are then based on considerations such as the adequacy, completeness and redundancy of the information obtained through the clinical history, physical examination, diagnostic tests and also

communication with the user. If, on the one hand, the quality estimates obtained are less stable than those derived from measuring results, on the other hand, we obtain assets that enhance the maturity of measuring the degree of quality and humanization of health actions (DONABEDIAN, 1996, p. 694).

These attempts at standardization demonstrate the search for a common set of actions needed to redesign healthcare, while at the same time showing a new direction based on seeing patients as non-identical subjects who demand a system that is responsive to individual differences, preferences and needs (INSTITUTE OF MEDICINE (US) COMMITTEE ON QUALITY OF HEALTH CARE IN AMERICA, 2001). It can thus be seen that high quality health systems respond to people's expectations, but if these expectations have been dampened by a history of disempowerment and poor quality care, this response will not translate into better health care (KRUUK et al., 2018, p. 1237).

Moving towards a scenario of user's personalization means to understand their internal demands and the external layer that touches them. Physiological vulnerabilities need to be seen through the lens of socioeconomic, cultural and intellectual vulnerabilities. Based on the inclusion of this multifactorial approach, it is understood that patient-centeredness will reach a stage of maturity when, based on information, it seeks to guide the best choices, knowing that the user is an active agent who participates in decision-making.

2.2 Health information needs

Pondering the intricacies of the information process brings us back to the historical need of human beings to communicate something to the community. Transmitting information about one's state of health is also a convenient way of maintaining one's experience, and can be understood as an exercise in individual and collective development. It is possible to say that, from the 19th century onwards, with the maturing of epidemiology studies, the need to communicate and debate conditions related to the health of populations generated a movement to disseminate knowledge in the area. In the following century, it is worth highlighting the development of computer science, which, in addition to studies in medical informatics, provided fundamental tools for promoting accessibility to health databases that would enable more effective management.

As a component of the current century, it is important to highlight what is known as the “knowledge-based economy”, which describes the tendencies, seen in the most advanced economies, towards greater dependence on information and high levels of competence

associated with a growing need for ready access to all of this. From a macro perspective, discussions around access to information from ICTs make them explicit as a tool that can both include and exclude. And talking about inequalities in the processes of production, distribution and use of information is nothing new. The ideal of a society interconnected by layers of complex networks has generated the expectation of mass expansion of access to intellectual goods. ICTs were - and still should be - seen as a means of social justice, but considering that the history of human civilization has always been marked by differences, equal access has not guaranteed access to quality information.

Research has already shown that inequality can be observed through “information poverty” (SWEETLAND, 1993), modeled on information deprivation due to absence, abundance or imposition. This prompts reflections on the ethical role that certain elements can play, going beyond the conventional view of traditional information retrieval strategies since different users retrieve different information in different ways. Knowing that the mere existence of an advanced channel cannot result in quality, there is currently a scenario in which it is not enough just to have access to information - and often to have to pay for it - but to have the intellectual capital to make an appropriate assessment of the source (GUIMARÃES, MC; SILVA, CH; 2011, p 3554).

It is mainly because of ethics and universality that, in the case of health, information inequities can be considered an important determinant of health inequities, insofar as limited access hinders the user's actions in relation to changes in structures, behaviors and policies. This would imply the need for solutions that take into account a subjective perspective of the value of information and that account for the way in which people decide whether or not to access and use information (GUIMARÃES, MC; SILVA, CH; 2011, p 3555).

In view of this, understanding the link between informational maturity and effects on well-being provides some relevant insights. The National Commission on Social Determinants of Health (CNDSS) defines SDH as the social, economic, cultural, ethnic/racial, psychological and behavioral factors that influence the occurrence of health problems and their risk factors in the population. The same CNDSS recognizes, however, that access to information is a little-discussed social determinant which, for this reason, should not be taken as a discrete action or an act, but should rather be thought of as a practice resulting from a learning process, implicated in a larger scenario of power relations (GUIMARÃES, MC; SILVA, CH; 2011, p 3552-3553).

A universal reach of health that brings the benefits of research results to all users requires that different information dissemination strategies be put into practice. To strengthen

this goal, the 2004 World Health Report, Knowledge for Better Health (WORLD HEALTH ORGANIZATION, 2004) emphasizes that equitable access to scientific information, both published and unpublished, is a priority action. Thus, over many years, a wide range of proposals have emerged to create and refine new information dissemination processes: virtual communities, exchange networks, blogs, virtual libraries, digital libraries, portals, electronic journals, institutional repositories. Despite this movement, there is a gap in prioritization aimed at understanding real health information needs.

According to Cândido, Valentim and Contani (2005, p. 37), “as an instrument for survival in decision-making, the need for information has been shaping proposals for solutions both inside and outside the decision-making sphere in all sectors of knowledge”. In light of the above, it is possible to evaluate the need for health information as the lack of information that the user must fill in order to carry out a personal update that allows for better decision-making in a specific context. This is because information, as well as having evidence, needs to be adapted to the scenario that makes up the subject's experience. According to Pereira and Lima (2008, p. 252) “[...] although information is intrinsic to its potential for fabrication, design or conception, it (health information) in itself has no meaning on an island.

Having access to the informational artifact is one of the layers that make up a complex structure that goes from the encounter of knowledge to the understanding that must meet a demand, develop competencies with participation and then guide decision-making. As in other domains, an autonomous patient needs to be able to make use of concepts and use them in dialogues about their health and the health of the community, in public and private contexts. It should be emphasized, therefore, that the construction of informational empowerment in health is more than a one-off condition; it is also an integral process woven together with demographic, socio-political, psychosocial and cultural dimensions (GUIMARÃES, MC; SILVA, CH; 2011, p 3560). From this multiple perspective, it is valid to consider health information, i.e. the user's right to be informed about all aspects involving conduct and approaches in care units, as part of the broad spectrum of intentions for developing citizenship.

2.3 Overview of guarantees

In the 20th century, in the face of political and social restructuring, the World Health Organization (WHO) was created in 1946 as a means of universalizing health proposals,

based on norms that organized actions for the full realization and recognition of health as a legitimate right to be legally protected in modern states. Nationally, health as a social concession became effective with the 1988 Constitution of the Republic (CRFB/88), which established it as a fundamental human right, defining guidelines for its operationalization, namely: decentralization, community participation and comprehensive care. Article 5, item XIV also mentions access to information as an individual right. In relation to the right to health information, specifically, São Paulo State Law No. 10.241 of 1999, art. 2, item VI and the Charter of Health Users' Rights, published by Ordinance GM/MS 675 of March 30, 2006, provide for users' rights, including their information, in specific paragraphs (MINISTÉRIO DA SAÚDE, 2007).

However, when it comes to women's health, even with the existence of international and national parameters that authenticate the right to informed choice and negotiation with professionals in obstetric care, over time, gender archetypes have limited the actual projection of legal determinations.

In light of this, in 2014, the WHO, in the publication "Prevention and elimination of abuse, disrespect and mistreatment during childbirth in health institutions", points out that "[...] every woman has the right to the best attainable standard of health, which includes the right to dignified and respectful health care" (WHO, 2014, p. 1). In 2018, the organization promoted new recommendations in "Intrapartum care for a positive childbirth experience", including 56 evidence-based recommendations on the care needed for childbirth and postpartum, aimed at avoiding unnecessary interventions, encouraging women, ensuring privacy and providing adequate information about the process.

Still, even in the face of these efforts and despite the substantial progress made, countries need to consolidate and increase their progress and broaden their agendas beyond survival in order to maximize the health and potential of their populations" (WHO, 2016, p. 1).

2.4 Informational gaps in obsolete practices

To rigorously analyze the current scenario of obstetric care worldwide requires recovering the extensive dimension of socio-economic particularities of each region. However, considering this vast amount, it is possible to visualize, in general, a reality with imbricated gender inequalities. In a chronological-historical context, the possibility of having care in health centers, with professionals and structure, emerged as a worldwide gain for

obstetric care. In Brazil, history has been built through dialogue with governmental apparatuses, aiming for public policies based on autonomy, bodily integrity and equality. However, despite the existence of these policies, women's access to quality information that favors their choices and decisions in care still encounters barriers. According to Zorzam (2013) "this difficulty is imbricated in social, economic, cultural and gender factors that transfer decision-making power over the type of delivery and interventions in normal childbirth to medical professionals and their institutions."

In the process of parturition, women expect to receive information about their mode of participation, and the right to informed choice is the result of the historical development of sexual and reproductive rights. However, gender inequalities in the field of medical-scientific knowledge have led to a pessimistic view of the female body, which treats the experience of childbirth, a natural process, as a high-risk pathological event, dependent on technology and unnecessary interventions in care (ZORZAM, 2013). In many places, not only is the treatment not complete, but many procedures are carried out without the women having been informed of their need, violating human rights by carrying out a practice that is not respectful or dignified.

The model of medical authority often exposes mothers to movements that jeopardize the promotion of health in its entirety. While some places carry out few interventions, which arrive late, in others healthy women receive unnecessary interventions. Numerous obsolete practices that are not recommended by the WHO and the Ministry of Health continue to persist in childbirth care in most public and private hospitals. In addition to the unnecessary allocation of elective cesareans, in vaginal delivery, which is excessively medicalized and instrumental, women are accelerated with oxytocics, episiotomy, forceps and risky maneuvers such as Kristeller. The increased use of these and other interventions without clear indications is detrimental to achieving better results centered on women's well-being, based on a positive childbirth experience. "In Brazil, in childbirth care, we can live with the worst of both worlds: illness and death due to a lack of appropriate technology, and illness and death due to an excess of inappropriate technology" (DINIZ, 2009, p. 316).

In studies carried out by Zorzam (2013), the traditional model of approach deprioritized content, making it difficult for women to make informed choices about the route of delivery and the procedures analyzed in the work, and, on the few occasions when information was made available, it was transmitted in a biased way. "The status quo of medicine valued the typical model of care and induced some of the women in this study to

have false beliefs about the benefits and necessity of interventions, silencing the dialog for exercising informed choice in the dynamics of negotiations" (ZORZAM, 2013).

Domingues et al. (2004), in a cross-sectional study of 246 women users of a public maternity hospital in Rio de Janeiro, also highlighted the negligence of the information made available to women. When asked about information on procedures such as touch examinations, only 34% of pregnant women felt informed. When asked about information on medication during childbirth, the percentage was even lower: only 30% felt informed.

In a study on the information needs of pregnant women attending a UBS in the city of Maceió, Mota, Araujo and Santos (2015) reported that 72% of the participants admitted to having difficulty understanding the information given to them by doctors during their appointments. Pregnant women also listed their main fears, with childbirth being the most cited, with around 40% of women stating that they were unsure of the best route to take.

Given the panorama presented, we can see a context where factors of medical convenience, embedded in the health insurance system, influence women's opinions during their journey, creating reckless care. It is therefore possible to understand that the difficulties in achieving humanized care in obstetric health, in addition to the demands of infrastructure, concern the depersonalization of the professional/user relationship, producing gaps in the interpersonal relationship between the different actors in the care process. To the extent that information, or lack of it, has influenced preferences and produced incomplete and deficient knowledge, due to conflicts of interest, we are witnessing a situation of informational violence. As Russo and Carrara (2015) point out:

‘Informational non-violence’ is the absence of violence and refers to the choice not to cause harm through the ability to inform another individual of their choices and rights arising from the chosen option. Obstetric ‘informational non-violence’ would provide women with knowledge and combat the high levels of disrespect during childbirth in all regions and cultures. This would preserve one of the most crucial moments in a woman’s life - the day she welcomes her baby into the world. Obstetric ‘informational non-violence’ highlights the power of information “to interfere in the process of reframing internalized structures and expanding social rights” (RUSSO & CARRARA, 2015).

Generally speaking, even when information is shared, there is no guarantee of a humanized approach and the possibility of negotiation, since information alone does not represent success, given the various difficulties that professional and institutional mechanisms impose on women. Souza, Roecker and Marcon (2011, p. 12) point to health education “not only as a process of intervention in the disease, but so that the individual and the community

have the means to maintain or recover their state of health, relating organic, psychological and socio-economic factors”.

Considering that experience is as important as clinical activity, the importance of a treatment that enables the generation of greater knowledge for the pregnant protagonists and weighting based on evidence by those responsible for the medical team is emphasized, with adequate language so that the communicative transfer avoids lack of information.

2.5 Instruments supporting the obstetric ecosystem

If equity is a desirable social goal, it is necessary to operate along two lines to enable access to information. The widest distribution of resources, systems and sources of information must be complemented by a political determination aimed at fostering social capital and mobilizing individuals for greater participation in society. Furthermore, this policy must move towards the creation and implementation of strategies that increase collective participation in the meta-modeling of information actions and infrastructures.

This participation also calls for idealized solutions through the choices and decisions that make up people's cognitive and communicative daily lives, in order to shape literacy, in this case health literacy, as an element that defines the individual's degree of ability not only to find, but also to make better use of the information available to meet their needs (GUIMARÃES, MC; SILVA, CH; 2011, p 3560). Understanding the various dimensions of access is therefore a key point for the formulation of all systems.

It can be seen that access to information presupposes a retrieval system which, as a structure not unrelated to subjective tangents, has various dimensions. Systems can be defined as interconnected components that interact to form a cohesive whole, and their dimensions can be understood through different structures. In the preface to his book General Systems Theory, Ludwig von Bertalanffy (1901-1972) writes:

“What can be obscured in these developments - important though they are - is the fact that systems theory consists of a broad conception that far transcends technological problems and requirements, it is a reorientation that has become necessary in science in general and in the range of disciplines from physics and biology to the social sciences, and from behavior to philosophy. It is an operative conception, with varying degrees of success and accuracy, in diverse fields, and announces a new understanding of the world, of considerable impact [...]” (BERTALANFFY, 1975, p.11).

It is worth pointing out that among the non-static elements that make up the health system, and all the others, is the human agent. The embodiment of achievable goals aimed at

people is a market trend when it comes to competitive intelligence attributes, and it also needs to be found in the guiding sense of public actions. In health, this prioritization is within the scope of actions, rules, guidelines and standardizations, but getting beyond the theoretical and achieving practical results is one of the dilemmas of scientific practice.

Adopting the international indications of putting people, their differences and demands at the center of actions for collective progress, a look at the concrete experience of each agent in the system needs to be carried out. With regard to obstetrics, it is possible to see the interaction of actors at different levels, such as the patient level, the medical level, the institutional level, the community level, the stakeholder level and the educational level (ARABIN, 2017). In order to understand specifically how the informational cycle develops, it is possible to summarize three entities whose health systems focus on obstetrics: clinical staff, managers, researchers and patients.

With the aim of improving global results in preventable maternal death and morbidity, the WHO Checklist for Safe Deliveries (CVS) was designed so that its users, in this case clinical staff, can have knowledge support through the standardization of primary tasks based on evidence. Experience with other safety instruments, including the WHO Checklist for Surgical Safety, shows that simply providing a document to a health professional does not result in widespread and consistent use (WHO, 2017, p.6), yet it is inevitable to recognize it as an informational instrument that generates positive global results evaluated by teams around the world.

Studies conducted in India and Rwanda (MOLINA et al., 2022), Kenya and Uganda (ACHOLA et al., 2022), Sri Lanka (SENANAYAKE; PATABENDIGE; RAMACHANDRAN, 2018), Burkina Faso and Ivory Coast (KOUROUMA et al., 2020), Namibia (KABONGO et al., 2017), Indonesia (KAPLAN et al., 2023), Brazil (PRAXEDES et al., 2017) and many other countries at different socio-economic stages, the willingness of users to adopt the list was exposed. Training and the provision of supervision during the use of the Checklist, along with the involvement of local leadership, were important factors that helped facilitate initial implementation and successful adoption. Although doctors, nurses, technicians and midwives also identify various challenges, it is recognized that the CVS helps these professionals to carry out an approach that has been proven to reduce possible harm to mothers and newborns.

Starting from the perspective of management as the target axis, it is possible to analyze systems aimed at management in the obstetric area which, often integrated as specific modules within the broader context of hospital management systems (Hospital Information

Systems - HIS) and health information systems (SIS) for public and private units, are made up of diverse samples that offer functionalities aimed at operational efficiency, control of human and structural resources, monitoring of patients and medical records, business intelligence, among others. In the obstetric ecosystem, the solutions include everything from medical history and prenatal consultations as structured by e-SUS, to laboratory tests and ultrasounds, promoting continuous monitoring of gestational development, as well as management of admissions, planning of cesarean sections, organization of maternity beds and monitoring of labor, ensuring a more coordinated and safer process.

The complementary implementation of connections between professional and management support systems has proved invaluable to policymakers during the COVID-19 pandemic as it has promoted strategies to minimize infection risks, streamline screening, control admissions and prioritize resources according to updated demand (CHEN et al., 2020). This highlights the need to involve local leadership to ensure local relevance and acceptability.

If the perspective is directed towards informational demands among specialists and researchers from various fields, we can consider not only the construction of facilities for storing clinical and administrative data, but also the generation of reports and statistics that are fundamental for decision-making. The ability to generate key performance indicators and, in addition, formulate predictive systems that are emerging as promising technological interventions in the advancement of diagnostics and prediction of risk conditions and complications in pregnant women (MUNAWAROH et al., 2022), constitutes a complementary approach that connects with data needs for management and its application to improving clinical practice.

On the other hand, since an advanced health system, not only in the obstetric context, has the patient and their demands as its main agent, local and global mobilizations have been designed using instruments that measure the adequacy of the approach, understanding of satisfaction and indicators of the quality of childbirth. Among the proposals is the Mackey Childbirth Satisfaction Assessment Scale, created in the United States with 34 items divided into six subscales arranged into self, baby, nurse, partner, doctor and a general assessment of labor and childbirth (MACKEY; GOODMAN; TAVAKOLI, 2004). In the same vein, the Childbirth Experience Questionnaire, developed in Sweden and later validated in Spain (SORIANO-VIDAL et al, 2016), the United Kingdom (WALKER et al, 2015), Iran (ABBASPOOR et al, 2019) and China (ZHU et al, 2019) also appears as a multidimensional

instrument but with four domains: self-capacity, professional support, perceived sense of safety and women's participation in labor and childbirth.

Based on data collected in Europe aimed at directly monitoring dissatisfaction, five main thematic axes were revealed: compliance with the birth plan, obstetric problems, mother-baby bonding, emotional wounds and perinatal experiences, most of whose responses were associated with failure to share information, lack of support, disrespect, objectification, fear, loneliness, traumatic stress and depression (RODRÍGUEZ-ALMAGRO et al., 2019).

Nationally, the National Program for the Evaluation of Health Services (PNASS) seeks to monitor all specialized health care establishments, outpatient and hospital, in terms of structure, process, outcome, care production, risk management and user satisfaction in relation to the care received (BRASIL, 2015). In order to find out specifically about quality from the perspective of puerperal women, the Technical Chamber of Obstetric Nursing of the Federal District took the lead in drawing up a preliminary evaluation measure (ALVES JUNIOR et al., 2023). It is also possible to point out that active health ombudsmen have worked to promote active spaces to get closer to users in order to collect their demands and seek their opinions about services using tools such as social control questionnaires (ALMEIDA et al., 2018, p.2). It should be noted, however, that qualitative formulations on women's satisfaction with childbirth care are often aimed at a particular institution and, despite the Stork Network's strategy of Humanizing Prenatal Care, Childbirth and Pregnancy, which is part of a broader investigation, mechanisms are in place that do not cover all the specific needs of pregnant women in depth.

Among the models used to evaluate satisfaction is the discrepancy theory, which levels satisfaction by the difference between expectations and perceptions of the experience. However, recent studies have shown that high levels of user satisfaction can be reported with a previous layer of dissociation from the real quality of health services due to the absence of information, low expectations of the service and possible biases, such as courtesy or gratitude, which hinder a critical view of the service (ALMEIDA et al., 2018, p.7).

The previous results show that the information in high-quality instruments that measure attitudes, behavior and self-efficacy needs to be improved, strongly suggesting the need for adequate policies, procedures, training and support to minimize the negative consequences of childbirth. In view of this, it is essential to consider that quality promotion must go beyond post-experience evaluation. In a scenario of systematic interference where the actions of other agents have an impact on patients' physiological, psychological and social

outcomes, there is a clear lack of instruments, mechanisms and support systems that seek to enable the active participation of women, not just the provision of testimonies.

Understanding information as a fundamental foundation in health, not only as a mechanism for reducing vulnerability, but also as a pillar for the true humanization of care, the need arises to direct efforts towards filling information gaps through instruments that seek to disseminate knowledge in an accurate and accessible way to pregnant women, but which also function as an instrument for redesigning the quality of care. By indirectly enabling the prevention of abusive practices, this structure should contribute to the transformation of the obstetric scenario, promoting care that transcends mere compliance with protocols and moves towards a truly ethical practice.

3. METHODOLOGY

Methodological rigor not only guides researchers in their approach, but also ensures that the results can be replicated and are reliable, which leads to its consideration as a facilitator of the transition from concepts to execution (SCHLATTMANN; SEIBEL, 2021). This section presents the methodological procedures adopted to carry out this work, with the aim of answering the research question and meeting the objectives of the proposal.

The studies for the specific objectives of this work were carried out in methodological sections, with a bibliographic study and literature review for the first objective, use of the World Health Organization's (WHO) Digital Adaptation Kit for Prenatal Care as a tool to guide the systematization of the second objective, use of the Figma tool to construct the third objective and validation by questionnaire implemented and disseminated digitally for the fourth objective. The details of each stage are described in the sections below, first addressing the characterization of the research, followed by the details of the methodological procedures.

3.1 Research characterization

The format of this research fits into the type of Technological Application or Adaptation Project as it is aimed at creating innovation assets through the generation of products, processes, devices and services based on scientific knowledge and which are formatted into technological systems that can be tested and evaluated (FUCK; VILHA, 2011). (options that work - technological application or adaptation projects; prototypes for the development or production of instruments, equipment and kits; technological innovation projects).

In terms of its nature, this research project is classified as applied, since it aims at practical applications aimed at solving specific problems (SILVA; MENEZES, 2001, p. 20). In this study, applied research is present in the proposal to develop a model with the aim of generating knowledge and being a necessary part of the exchange of information on obstetric care, with the aim of solving demands and filling real information gaps.

From the point of view of the objectives, this research is exploratory and descriptive. Exploratory, since it seeks to explore, investigate facts, phenomena or new knowledge about which there is still little information (TOBAR; ROMANO YALOUR, 2001). On the other hand, it is descriptive because it presents a series of information about what it wishes to research by describing the facts and phenomena of a given reality (TRIVINOS, 1987). This

mixed exploratory and descriptive aspect aims to provide more familiarity with the problem and make it more explicit by describing guidelines, cases and approaches related to the obstetric informational context.

With regard to the approach, this study is classified as qualitative since the work consists of data analysis carried out in an inductive manner, in which the researcher develops concepts, ideas and understandings based on patterns found in studies (RENEKER, 1993). The qualitative approach relates to the entire process of developing the proposed model, from its definition to its conception and then the model evaluation stage.

In terms of procedures, this research is classified as bibliographical, experimental and will use user survey evaluation. Scientific bibliographies were used to understand concepts related to health, information and technology, which made it possible to identify the problem to be solved, formulate the general and specific objectives, and build the theoretical framework. The Digital Adaptation Kit for Antenatal Care, the Digital Implementation Investment Guide and the World Health Organization's Recommendations on digital interventions for health system strengthening were used as references to build the prototype, as well as the principles of Requirements Engineering and Design Science Research. To evaluate the results, the decision was made to understand the technical and cognitive elements of the instruments according to the evaluation criteria defined using semi-structured questionnaires with potential users.

3.2 Methodological procedures

Firstly, the investigation took shape from an assessment of pregnant women's information needs, considering the difficulties they face when seeking safe and up-to-date guidance on health care. This initial analysis was based on an informal survey of digital contexts such as social networks and contact with pregnant women based on real accounts of their information needs. This perspective was necessary to define the lines of action of the research, which focused on understanding a scenario of uncertainty and mismatched information overload.

Starting with the construction of the research, an exhaustive review of the bibliographic reference was carried out, which provided the theoretical basis for the development of the work and outlined the general and specific objectives that guided each subsequent phase. A documental mapping of previous and contemporary guidelines on health, information and obstetrics was carried out, based primarily on reports issued by the World

Health Organization (WHO) over the last 10 years, giving preference to the most up-to-date documents.

The integrative literature review was conducted using databases such as Latin American and Caribbean Health Sciences Literature (LILACS), Nursing Databases (BDENF), Scientific Electronic Library Online (SciELO), Science Direct, Cumulative Index to Nursing and Allied Health Literature (CINAHL) and the US National Library of Medicine National Institutes of Health (PubMed). The use of standardized descriptors - according to DeSC (Descriptors in Health Sciences) and MeSH (Medical Subject Headings) - such as "health", "obstetrics", "information", "technology", "mobile applications", was aimed at a retrieval that was both comprehensive and precise, capturing the multidimensional complexity of the object of study.

Additional consultations were carried out in national repositories, such as the portal of the Coordination for the Improvement of Higher Education Personnel (CAPES), as well as in normative documents, manuals, guidelines and legislation in force on prenatal care in Brazil issued by the Ministry of Health, integrating technical-legislative aspects with the practical and informational demands of pregnant women.

The development stage with the description of the proposal's elements was guided by the World Health Organization's Digital Adaptation Kit for Antenatal Care, based on a sequential approach to the digital construction stages. The specification of these components was supported by the descriptive tables in the Kit, as well as the use of the UML (Unified Modeling Language) notation. This notation provided the standard for modeling the system's internal dynamics, elaborated in the Figma tool, with segmentation into behavioral and structural diagrams that represented the static topology of the system's entities, their associations and cardinalities.

The development of the prototype involved the selection of interface elements, taking into account usability and accessibility criteria. With regard to configuring the environments and modeling the flows of use, an experimental approach was adopted, integrating examples of related systems such as *Meu Pré-Natal* (SOUZA, 2019) and *QualiParto* (SOUSA, 2020) to draw parallels and identify opportunities for improvement. Figma, the tool chosen to materialize the interfaces and interactive flows, made it possible to build prototypes with visualizations that integrated the system's functionalities with user behavior in real application scenarios.

The prototype was evaluated using a mixed questionnaire made up of objective and discursive questions, using a 5-point Likert scale to measure opinions. Data was collected via

Google Forms, with the link distributed via social networks and sent to participants with a profile aligned with the study's objective. The questionnaire was structured in stages of sociodemographic characterization, analysis of information demands, evaluation of the platform's relevance, practical interaction with the prototype in Figma, evaluation of usability, design and functionalities, with a final space for comments and additional suggestions. The responses were automatically organized in a Google Sheets spreadsheet, allowing for preliminary analysis and identification of the proposal's reception and suitability.

4. CONSTRUCTION OF THE PROPOSAL

As a premise, the value of information is understood based on the innovation, reorganization, restructuring and transformation it generates in favor of knowledge. Thus understood, it ceases to exist as an isolated element and is seen in its relationship with the user who, from being a recipient, becomes a constructor, a co-producer of information (ALMEIDA JÚNIOR, 2009). In health, information is seen in the act of informing the user about their health or all the aspects that make it up, but, seen as a process, the information cycle is made possible by various mediators - physical and digital. From health professionals to social networks, information circulates spontaneously through more than one channel with dynamic environments that connect different layers of individual and collective well-being (LEITE et. al., 2014).

Beyond the context, it is believed that timely, quality information can reduce conflicts sustained by myths and untruths about health, especially pregnancy (VETTORE, LAMARCA, 2012). Whether related to diagnoses, prognoses, exams, prescriptions, medications or interactions, the dissemination of this information needs to be considered as an object for promoting comprehensive care, since it enhances the patient's autonomy, empowering them with possibilities so that they can take advantage of them. effectively exercise their rights (LEITE et. al., 2014). Although far from the reality of many services, the vision of patient access to personalized quality information can bring advantages and represent, in the future, a change in current practices of direct access to knowledge by enabling participation and understanding of their conditions and needs.

In the search for a channel that brings information and users closer together, there is a need to exploit the potential of the digital environment, recognizing that although information already circulates widely in this space, it is imperative to generate new content, but essentially to refine, translate and validate existing information. The current panorama of information retrieval, marked by a fragility inherent in the demand for speed and practicality, emphasizes the urgency of a structure that democratizes obstetric science. This democratization must ensure adequate responses and establish protection mechanisms against the dissemination of incorrect information in various contexts, through robust systems that inform and educate users through an information experience that respects the particularities of maternal health.

In fact, digital resources are a ubiquitous reality, permeating both the daily micro routine of individuals and the global macro connections that shape contemporary society to provide facilities in different dimensions, either by creating solutions from scratch or by

improving existing systems. In the context of healthcare, it is remarkable to see the wide range of proposals that have emerged to support both the clinical agent and the manager, with the aim of optimizing the provision of services and decision-making. In this work, the pregnant woman is considered the target user, especially when addressing the information gaps that stand between her and autonomy in the childbirth process. These gaps, often fueled by structural and cultural barriers, limit access to essential information that enables mothers to make informed decisions about their care and experiences. The absence of a clear, accessible and centralized flow of information is considered the main demand in this research because of its link to the perpetuation of myths and misinformation, which compromise the clinical outcomes of childbirth as well as the overall physical and mental health of pregnant women.

Obstetric care models are influenced by their time, whether in terms of understanding and knowledge of women's physiology, or from a socio-cultural, regional, ethical and economic point of view (PATAH, MALIK, 2011). Thus, with the aim of catalyzing the quality of care and democratizing scientific knowledge, this work seeks to structure a multidirectional contribution to information science, technology and health as a step towards reinforcing the relevance of fulfilling the long-term vision of sustainable development with a digital ecosystem aligned with national and global health policies that focus on the patient's biopsychosocial well-being. In light of the complexity inherent in the multiple needs that permeate the obstetric scenario, an attempt has been made to develop a versatile resource, covering various components with an adaptable translation of information backed up by evidence and experience.

4.1 Definition of components

The structure proposed for this system is built on a multi-layered model derived from a systemic understanding where elements do not operate in isolation, but interdependently, forming a system of distributed networks that together enable autonomous learning and informed decision-making. Reflecting the intersection between instances usually treated in a compartmentalized way, this work simultaneously articulates the three layers essential to its operation: the health layer, anchored in clinical and biomedical guidelines; the informational layer, which structures the flow of data and its conversion into applicable knowledge; and the technological layer, which operationalizes these processes through digital algorithmic personalization solutions.

From this point of view, the multilayer system concept also allows the local needs of pregnant women (specific, contextual and individual) to be combined with the global requirements of best obstetric practices, based on scientific sources. The plurality applied here takes advantage of the ability to combine layers of micro and macro knowledge, optimizing the operationalization of personalized and evident solutions within the same digital environment. In addition, the concept of layers in health science also alludes to the stratified structures of care needs - ranging from basic to highly specialized - and the dissemination of knowledge itself, where raw data is transformed into information, and information, once processed and applied, becomes usable knowledge.

Another theoretical layer that guides this system is the fusion between science and experience, which is based on the concept of practical epistemology (SCHNEIDER; SBISSA, 2011) and evidence-based practice, amplified by the inclusion of users individual voices and narratives, which is vital for overcoming the conventional barriers of health systems that often suffer from a disconnection with contextual realities. By integrating these two levels, the proposed system offers a balance between generalizable clinical recommendations and adaptation to each pregnant woman. This intersection is critical because it recognizes that scientific knowledge, although robust, must always be contextualized by experience, which articulates subjective experiences with the universality of scientific evidence, creating a dialogue between science and practice. The science layer ensures that the 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 the recommendations.

This model is based on the complexity of contemporary obstetric care, seeking to go beyond the provision of information to create a dynamic ecosystem of decision support, where scientific information is curated with the aim of customizing guidelines and interventions. The decision is anchored in the attempt to operationalize the concept of patient centered care in the context of obstetric digital health, with an emphasis on empowering pregnant women and improving the quality of care. To this end, a structure was defined consisting of two main navigation layers: the dynamic layer and the static layer, each performing critical and complementary functions to promote an informed, safe and collaborative pregnancy journey.

The dynamic layer is designed to function as a responsive platform, capable of adapting in real time to changes in the user's conditions and preferences, while the static part provides a structured environment for planning long-term decisions, notably recording the

birth plan. Together, these cores form a modular architecture that is both adaptive and predictable, allowing pregnant women to move between levels of complexity and autonomy according to their stage of pregnancy and their information needs. Below is a descriptive table of the layers and their segmentations, which will be detailed below.

Table 3 - System layers

Layer	Sublayer	Macrolayer
Dynamic	Profile segmentation	Health / Information / Technology / Local
	Evidence consultation and translation	Health / Informational / Technological / Global
	Experience curation	Information / Technology / Local
	Personalization of recommendations	Health / Informational / Technological / Local
Static	Birth plan	Health / Informational / Local
	Scenario simulation	Health / Informational / Technological / Local

Source: Author

4.1.1 Dynamic layer: monitoring by science-experience

This layer forms the central part of the system, functioning as a continuous learning interface, updated from multiple sources of scientific evidence and real-life reports to personalize, filter and categorize recommendations, evidence, rights and experiences. Its dynamism is seen in the adaptive structure that uses data curation and processing technologies to personalize the user experience. This core operates through the articulation of layers that filter and contextualize information, resulting in algorithmic personalization capable of adjusting recommendations for each pregnant woman's profile through proactive information retrieval based on a progression within the platform and previously registered needs. Its workflows are divided into four processes:

(1) Profile segmentation: responsible for categorizing and grouping users based on clinical, demographic and contextual variables. The resulting segmentation generates groupings that allow recommendations to be adapted, minimizing unnecessary variability and maximizing the relevance of the suggested interventions;

(2) Evidence mining and translation: automated collection of scientific data from clinical databases, medical literature and evidence-based health guidelines to identify, extract

and translate into accessible language the most relevant information while maintaining scientific integrity;

(3) Curation of experiences: operates through an interactive module that allows users to share experiences based on similarities, promoting a space of support and exchange for empirical learning between peers;

(4) Personalization of recommendations: display of guidelines adapted to the profile that crosses the data obtained in the segmentation, mining and curation phases to display dynamic guidelines adapted with updates according to the progress of the pregnancy.

4.1.2 Static layer: planning for decision-making

This layer offers a more structured approach to long-term planning that enables the construction of personalized birth plans and the modeling of possible outcomes implied by possible choices. Despite the existence of non-digital platforms and media for this record, its association with validated information resources allows for the formulation of well-informed planning that results in safer decisions and autonomy. Its segmentation follows two compositions:

(5) Birth plan: an interactive interface module that allows pregnant women to compose, in a personalized and detailed way, their preferences for the moment of delivery. The tool would offer configurable options on the type of delivery (vaginal or cesarean), medical interventions (anesthesia, induction of labor, among others), place of delivery (hospital or home environment) and emotional support (presence of companions or professionals such as doulas). Based on the preferences entered by the pregnant woman, the system generates automated recommendations, validated by previously mined and adapted scientific guidelines;

(6) Scenario simulation: allows you to visualize different possible scenarios based on the choices made in the birth plan. Each simulated scenario is accompanied by a risk-benefit analysis, which details the clinical, psychological and logistical implications of each decision, such as the impact on complications, length of labor and postpartum recovery. The aim is to provide pregnant women with an in-depth understanding of the pros and cons of their choices, enabling informed, evidence-based and patient-centered decision-making.

4.2 System details

One one hand, evidence-based recommendations, such as those formulated in the World Health Organization guidelines, are regulatory frameworks that outline standards of care and serve as parameters for the architecture of digital systems implemented by different countries. On the other hand, conveying these guidelines in an essentially textual format imposes a series of challenges on their transposition into the social and digital environment, as they require translation processes which often give rise to subjective interpretations on the part of implementers and users. This subjectivity compromises the uniformity of the systems, with concrete risks of compromising the integrity of the content, resulting in possible functional inconsistencies and limitations in the ability to audit technical and clinical compliance.

This situation increases the potential for unwanted clinical outcomes and other adverse effects. In this context, the transition from paper models to digital systems requires data standardization and the adoption of instruments to ensure technical interoperability, as well as the integrity and reliability of the content integrated into the systems, mitigating the risks associated with variability in the interpretation of guidelines and safeguarding the safety and effectiveness of healthcare.

Therefore, to facilitate the reflection of clinical guidelines in public health and the use of data in the digital systems that countries adopt, the World Health Organization has developed digital adaptation kits as an operational mechanism that is not linked to specific software aimed at creating systems that can, indirectly or directly, translate guidelines into a standardized format, favoring more effective incorporation based on validated structures. In the design process, the WHO mobilized leaders from the digital and health spheres who reviewed existing approaches to gathering requirements, as well as mapping normative standards from global research.

As a result, a standardized, operational and independent documentation has materialized that holistically synthesizes the guidelines (TAMRAT et al. 2022). For each relevant conceptual core at the intersection of health and technology, specification guidelines are established, segmented into eight interrelated components (WHO, 2021, p. 7), namely:

- (1) Medical interventions and related recommendations, which provide a framework for clinical action;
- (2) Generic user profiles, which offer a comprehensive view of population needs;
- (3) Hypothetical user scenarios that make it easier to simulate a variety of contexts;

- (4) Operational processes and generic workflows that ensure the efficiency and effectiveness of the proposed interventions;
- (5) Fundamental data elements, the collection and analysis of which are crucial to making informed decisions;
- (6) Decision support systems, designed to help users choose appropriate interventions;
- (7) Indicators and information requirements, which act as metrics for evaluating the performance of interventions; and
- (8) Functional and non-functional requirements, which outline the performance expectations of the systems involved.

In the following sections, a detailed description of each component of the kit will be presented, adapting it to the context of the proposed obstetric information base. This study will delve into the function of each element, highlighting its contribution to the creation of a structure that will include the conceptual and physical composition of the base, establishing attributes that will guide subsequent prototyping.

4.2.1 Health interventions and recommendations

Understanding the interventions and recommendations that form the scientific basis of the system is a fundamental step in paving the way to support decision-making, ensuring alignment with established scientific precepts (WHO, 2021, p. 7). In this sense, this project aims to meet the specific demands of obstetrics in the information field, promoting the autonomy of pregnant women by providing accessible and robust scientific knowledge, capable of mitigating the uncertainties that permeate the experience of maternal care.

The bibliographic research process began by mapping relevant sources, with an emphasis on documents from renowned institutions such as the World Health Organization (WHO), given its authority as a global reference in prescriptive and preventive guidelines. WHO recommendations, based on analyses conducted by internationally renowned experts and enriched by a continuous process of exchanging experiences and interdisciplinary modeling, play a central role in improving public health. These guidelines represent a global consensus, based on rigorous scientific evidence, aimed not only at treating pathologies, but also at promoting preventive care.

Evaluating these guidelines in correlation with the information gaps that often place pregnant women in situations of vulnerability, both physical and psychological, reinforces the need for interventions that can go beyond the simple pathological approach and prioritize

women's integral well-being. In this process, priority was given to sources that focused on clinical practices and validated guidelines, with a focus on preventative and informative actions that could help pregnant women at all stages of their journey, reducing discomfort and uncertainty.

In the previous chapters, these recommendations provided conceptual support for understanding the context, particularities and specific needs of obstetric care. The description guide for the system proposed here is based on a global WHO recommendation, and this detailing is a metalanguage articulated with scientific referencing. Specifically, with regard to structuring the project's information base, three fundamental guidelines were selected, chosen for their methodology, validation and relevance: *WHO recommendations - Intrapartum care for a positive childbirth experience*, *WHO recommendations on antenatal care for a positive pregnancy experience* and *NICE guideline for Antenatal care*. These guidelines serve as a foundation for building maternal knowledge, guiding proposed interventions based on consolidated evidence and validated global practices.

The guideline entitled *WHO Recommendations - Intrapartum Care for a Positive Childbirth Experience* is an updated and consolidated synthesis of guidelines aimed at guaranteeing quality care in the management of labor and delivery, based on tested scientific evidence. The relevance of this guideline lies in its ability to integrate innovative and previously established recommendations, formulated by the World Health Organization, in order to standardize essential clinical practices for promoting a positive birth experience, regardless of the level of development of health systems and regional or institutional specificities. In this way, the document acts as a global normative framework, capable of supporting clinical decisions based on the best available evidence (WHO, 2018, p.1).

The mentioned guideline sees childbirth as a physiological process which, for most women and their newborns, can take place without the need for invasive medical interventions. However, it is based on the premise that care should be based on a woman-centered approach, respecting her autonomy, integrity and human rights, with a view to optimizing not only the clinical outcome, but above all the experience of childbirth, understood here as a psychosocial and physiological event of great significance for maternal and neonatal health. The recommendations are therefore applicable to all low-risk pregnant women and were developed considering the complexities of the different care models around the world, allowing for flexible adaptation to the different realities of health systems, while ensuring quality and safety in care (WHO, 2018, p.1).

The development of this guideline was the result of technical consultations carried out by the WHO, which culminated in the formulation of 56 specific recommendations for intrapartum care, of which 26 are new and 30 were taken from pre-existing guidelines. These recommendations have been organized in a systematic way, covering the different phases of the childbirth process: from the dilation phase, through the expulsive period, to the moment of placental abruption, followed by immediate care for both the newborn and the puerperal woman (WHO, 2018, p.2).

This segmentation by stage allows for a more precise and contextualized application of the recommendations, aligned with the specific needs of each stage of the intrapartum process. And since its structure aims to establish a set of norms based on an expanded conception of care, which includes not only biomedical aspects but also psychosocial and cultural elements, the guideline can be highlighted as a reference for the obstetric information base, specifically in the dynamic core of evidence-based monitoring. This combination would reinforce the importance of promoting access to scientific knowledge as an instrument for mitigating risks, valuing women's autonomy and optimizing perinatal outcomes.

The WHO recommendations outlined in the document WHO recommendations on antenatal care for a positive pregnancy experience, present another relevant technical reference for the consolidation of practices that aim to transform the experience of pregnancy into a process greater than minimizing mortality and morbidity (WHO, 2016, p. 1). From the perspective of information accessibility, the recommendations emphasize the need to provide pregnant women with tools that allow them to continuously and autonomously monitor their health and the health of their babies. By covering nutritional interventions, maternal-fetal assessments, preventive measures and response to clinical signs, the document offers a practical and accessible guide, facilitating ongoing monitoring to promote an understanding clear about recommended practices and the support needed for pregnant women to be empowered and informed (WHO, 2016, p. 14).

This guideline, as well as being technically recommended for updating health professionals, is based on informational transparency to strengthen the bond between patient and health team and seeks to enhance women's autonomy in the decision-making process by allowing them to be fully informed about the course of their pregnancy and the planned interventions. For example, the recommendation that each woman keep a record of her appointments is part of a broader context of promoting equity in care, by reducing barriers to accessing qualified information and encouraging the active participation of users (WHO, 2016, p. 112).

With regard to adapting the recommendations to different contexts, the document stresses the importance of interventions to optimize communication and support for pregnant women, especially in regions where access to health services is limited. Community mobilization, advocated through participatory learning cycles, is a strategic element for increasing access and adherence to quality prenatal care, promoting more effective interaction between health services and the specific needs of the population (WHO, 2016, p. 151). In this way, we can see the validity of its use both in the evidence-gathering environment and in the definitions for curating the exchange of experiences in the follow-up hub.

Finally, the *NICE Guideline for Antenatal Care (NG201)* from the National Institute for Health and Care Excellence is another source that is widely recognized internationally and, although it is not a WHO publication, its prestige and scientific rigor give it significant applicability in global contexts, which justifies its inclusion as an essential source for the base proposal.

A notable point of the guideline is its technical approach to interventions for common problems during pregnancy, such as nausea and vomiting, gestational diabetes, pre-eclampsia and pelvic pain. The document offers specific recommendations on best practices for the treatment and management of these conditions, detailing protocols for tests and clinical interventions, as well as suggesting appropriate pharmacological and non-pharmacological treatments for each case. This precision makes the guideline a reliable source for generating direct knowledge for pregnant women, as it provides a clear understanding of the procedures that can be implemented throughout pregnancy, minimizing risks and optimizing care (NICE, p. 27).

In addition, the *NICE Guideline* highlights the role of clear and accessible communication between healthcare professionals and pregnant women. The guideline reinforces the need to adapt information to women's individual needs, promoting a patient-centered practice that respects their preferences and social contexts. By encouraging the provision of materials in different formats and languages (such as digital, printed and Braille), the guideline promotes a care environment where information is an empowerment tool for pregnant women, facilitating the internalization and practical application of medical knowledge in the daily monitoring of pregnancy (NICE, p. 19).

Finally, the document provides a detailed framework on care and emotional support for both pregnant women and their partners, recognizing the importance of family involvement in the gestational process. This inclusion is a differentiator that strengthens the

woman's support network, increasing her ability to make informed and conscious decisions about the different aspects of obstetric care (NICE, 2021, p. 40-42).

Below is an organized table with examples of specific recommendations and their categories for each of the three guidelines highlighted.

Table 4 - Specific recommendations

Guidelines	Category	Recommendations
WHO Recommendations - Intrapartum Care for a Positive Childbirth Experience	Care during labor	Continuous monitoring of maternal and fetal well-being during labor. Limiting unnecessary interventions in uncomplicated births.
	Support for women	Ensure that women have continuous support during labor, with a focus on a positive experience and respect for their rights and choices.
	Evidence-based practices	Promote the use of proven effective interventions, such as non-pharmacological pain relief techniques, when appropriate.
	Humanizing childbirth	Ensure that childbirth is treated as a physiological and natural process, minimizing unnecessary interventions.
	Prevention of complications	Actively monitor signs of risk to avoid serious complications and carry out interventions based on strict clinical criteria.
	Newborn care	Offer immediate care to the newborn, such as promoting skin-to-skin contact, breastfeeding support and neonatal assessment
WHO Recommendations on Antenatal Care for a Positive Pregnancy Experience	Routine clinical care	Carry out a regular schedule of prenatal consultations, including physical examinations, laboratory tests and ultrasounds to assess maternal and fetal well-being.
	Nutritional interventions	Reinforce the importance of proper nutrition, folic acid and iron supplementation, and weight gain control during pregnancy.
	Prevention of complications	Assessing the risks of conditions such as hypertension, gestational diabetes and infections, and proposing preventive interventions such as the use of aspirin for pre-eclampsia.
	Mental and emotional health	Identify and manage mental health problems such as depression and anxiety, offering emotional support to pregnant women.
	Promoting women's	Encourage pregnant women to actively

	autonomy	participate in their care by providing clear and accessible information about prenatal care and their options.
	Planning and preparation	Guidance on the different stages of pregnancy, fetal development and preparation for childbirth, including the creation of a birth plan.
NICE Guideline for Antenatal Care	Organization of antenatal care	Plan a schedule of antenatal appointments with an emphasis on continuity of care and the active involvement of the pregnant woman, with additional appointments when necessary.
	Clinical examinations and investigations	Carrying out laboratory tests, ultrasounds and maternal-fetal health assessments according to the stages of pregnancy, including tests for fetal anomalies and gestational diabetes.
	Monitoring clinical conditions	Monitor blood pressure, fetal growth, as well as the risk of pre-eclampsia, gestational diabetes and venous thromboembolism, with specific interventions for each condition.
	Informed decision support	Provide clear information on all procedures, tests and treatment options to enable an informed and shared decision between the woman and health professionals.
	Care for common problems	Interventions for common problems during pregnancy, such as nausea, vomiting, heartburn, pelvic pain and vaginal symptoms, with recommendations for pharmacological and non-pharmacological treatment.
	Emotional and social support	Offering psychological support, as well as involving partners in prenatal care and promoting preparation classes for childbirth and parenting.

Source: Adapted from WHO (2018), WHO (2016) e NICE (2021).

4.2.2 Personas type

Improving quality in healthcare networks depends primarily on building a technical language that is formal and uniformly disseminated at all the levels that make up these networks. This conceptual homogenization is achieved through the implementation of clinical guidelines drawn up collaboratively by key players, whose continuous interaction sustains the social fabric of these care networks (SBIBAE, 2019, p. 11). A thorough understanding of the dynamics and interests of the parties involved, whether they are direct or indirect agents in the

care process, is essential for the effectiveness of any digital health system that aims to be integrated and functional.

In the field of obstetric health, the precise articulation between multiple agents - obstetricians, pediatricians, nutritionists, doulas, pregnant women, partners, family nuclei, health managers and academics - is configured as a structuring axis for the systemic operation of care practices. By interacting within an interdependent ecosystem, these actors not only contribute, but also shape the scenario that defines obstetric health policies and practices. The effectiveness of this system depends, above all, on interdisciplinary cooperation and a confluence of technical skills aimed at promoting excellence in the care provided.

Specifically, in the scope of this work, guided by a patient-centered health perspective, the pregnant woman is positioned as the priority end user, and her specificities are the central axis of the intervention. Her multifactorial particularities can be stratified into several dimensions, comprising intrinsic and extrinsic characteristics, such as individual behaviors, lifestyles, social support network, living and working conditions, as well as access to health services. These elements are directly related to the social determinants of health, organized, according to Dahlgren and Whitehead's model, into proximal, intermediate and distal factors, which range from micro-environmental conditions to macro-social and economic structural factors (SBIBAE, 2019, p.14).

Despite the heterogeneity of the group of pregnant women, with varying demographic, psychological and social needs, there are common expectations of this public places on care programs. These include maintaining a healthy pregnancy, including the prevention and treatment of risks and diseases, promoting a safe and satisfactory birth, preserving physical and socio-cultural normality and achieving a motherhood that favors the development of maternal self-esteem, competence and autonomy. In this way, the adaptation of health systems must incorporate detailed descriptions of the persona(s), specifying their background, motivations and challenges, as central elements for the development of contextualized solutions suited to the needs of end users (WHO, 2021, p.7), which will be exemplified below.

- *Persona Type 1: Camila Bonfim, architect, 40 years old*

Camila is 38 years old, lives in São Paulo and is in her second pregnancy. In her first, she underwent a cesarean section due to complications and now wants to try a normal birth. With a university degree and a stable job in a multinational company, Camila has access to a high coverage health plan, which guarantees her frequent consultations with specialists and detailed examinations. Despite having access to a well-equipped private network, she faces

insecurities about the viability of a vaginal birth after cesarean (VBA2C), especially because of her age. Her obstetricians often recommend another cesarean section, justifying the increased risk of uterine rupture, but without providing clear, evidence-based information about the real chances of a successful vaginal birth. Camila wants to know for sure if it is possible to have this type of birth, considering her obstetric history. For her, her preferences should lead her to avoid an unnecessary cesarean section and make decisions based on personalized obstetric protocols backed up by clinical studies.

- *Persona Type 2: Lara Ribeiro, receptionist, 26 years old*

Lara is 26 years old and lives in a medium-sized town in the countryside of Minas Gerais. She is in her first pregnancy and relies exclusively on the SUS for prenatal care and childbirth. She works with her husband selling food and their income does not allow them to hire private health services. The local public hospital has limited obstetric resources, and care is often quick and without detailed explanations. Lara has significant fears due to recent reports of restrictions at the local hospital, such as the ban on doulas and companions during childbirth. In addition, her cousin underwent a traumatic episiotomy without consent at the same hospital, which intensified her concerns. She was also diagnosed with subclinical hypothyroidism in early pregnancy, which increases the risk of complications such as premature birth and gestational hypertension. Her biggest challenge is the lack of detailed information about local obstetric practices and the clinical management of hypothyroidism. Lara's wish is to have a safe birth, without unnecessary interventions, with clinical monitoring of her hypothyroidism and family support, something she considers essential to ensure her peace of mind during the process.

4.2.3 Hypothetical user situations

The creation of a direct channel between technical knowledge and the user is justified by the growing complexity and diversity of information available in obstetrics. The use of a system that filters, organizes and translates this data in a personalized way is essential to mitigate the information gap that commonly affects pregnant women in different socioeconomic and clinical contexts. In doing so, the system reduces uncertainty and promotes patient autonomy, ensuring that reproductive health decisions are based on up-to-date evidence and adjusted to their specific conditions.

To this end, the integration between components and personas in the proposed multi-layered system aims to establish a connection between the body of scientific knowledge and the individual needs of pregnant women, allowing clinical decisions to be informed and personalized. It is therefore essential to understand how each component of the system responds to specific contextual demands in order to offer an adaptable experience, ensuring that information is continually adjusted as the pregnant woman's clinical profile evolves.

We then present the detailed framework that associates the personas Camila and Lara with the components of the dynamic and static cores, generating specific hypothetical situations. Each situation includes a description of the persona, the component involved, the hypothetical situation that emerges from interaction with the system, the information used and the demand resolved through the process.

Table 5 - Breakdown of personas

Component	Persona	Situation	Information	Demand
Profile segmentation	Camila	Multiparous woman, 38 years old, previous cesarean section due to placenta previa.	Obstetric history, advanced maternal age, comorbidities. Study of Camila's cultural and emotional preferences.	High-risk segmentation for VBA2C, specific recommendations for safe delivery.
	Lara	26 years old first-time mother, subclinical hypothyroidism, concerns about invasive interventions and family support.	Diagnosis of hypothyroidism, SUS protocols, pregnant women's rights. Study of Lara's cultural preferences.	Personalized guidance for the management of hypothyroidism and guaranteed support for childbirth in the SUS.
Consultation and translation of evidence	Camila	Analysis of the benefits and risks of vaginal birth after cesarean section (VBA2C) in pregnant women over 35.	Review of longitudinal studies comparing vaginal delivery and cesarean section.	Evidence-based consultation for informed decisions on the method of delivery.
	Lara	Impact of subclinical hypothyroidism on childbirth, strategies for preventing complications such as premature birth.	Review of guidelines for endocrine disorders in pregnancy, case studies.	Safe management of hypothyroidism during childbirth.
Curating experiences	Camila	Reports from older pregnant women, feedback from VBA2C.	Topics related to successful VBA2C.	Curation of effective strategies for preparing for and carrying out safe childbirth.
	Lara	Parturients who avoided episiotomy	Review of hospital practices to reduce	Guidance for less invasive childbirth in the SUS.

		and invasive interventions, strategies for less interventional childbirth in the SUS.	invasive procedures.	
Personalization of recommendations	Camila	Personalized recommendations by gestational stage, adjustments to the birth plan to minimize risks and ensure safety.	Continuous updating based on clinical and nutritional data, specific protocols for advanced age. Study of Camila's emotional preferences.	Development of dynamic and personalized recommendations for risk management during pregnancy.
	Lara	Birth plan adapted to hypothyroidism and SUS policies, strategies for safety and support during childbirth.	Personalization of the plan based on the diagnosis and SUS guidelines. Study of Lara's emotional preferences.	Guidance for less invasive childbirth in the SUS, respecting preferences.
Birth plan	Camila	Strategies to minimize risks such as uterine rupture and management of myths about vaginal birth after cesarean section.	Details of protocols and indications of risk.	Visualizing your possibilities based on the progress of your pregnancy.
	Lara	Birth plan adapted to subclinical hypothyroidism and SUS policies.	Review of guidelines, rights and possible choices.	Having an adequate space to register your preferences.
Scenario Simulation	Camila	Analysis of complications and strategies for emotional and physical management.	Consideration of risks and the baby's condition with the preferences of the pregnant woman.	Strategic preparation for safe and uncomplicated childbirth.
	Lara	Simulation of childbirth scenarios, including emergencies and strategies to avoid episiotomy.	Physical and psychological conditions of the pregnant woman and structures of the place of delivery.	Anticipation of potential challenges and effective preparation for childbirth in the SUS.

Source: Author

4.2.4 Operational processes and workflows

The development of systems, regardless of their scale, has an associated level of complexity. Whether it's a specific mobile application or an enterprise-scale system, architectures can be made up of hundreds, if not thousands, of interdependent software and hardware components. In this scenario, the challenge arises of how to manage and control the

precise identification of the necessary components, their respective functions, their suitability for the established requirements and the way in which these components are shared or interact.

This set of elements, although individually understandable, becomes progressively complex when taken as a whole and the absence of a solid description structure can lead to essential aspects being misunderstood or omitted. This is where modeling comes in as an attempt to manage complexity. A model is an abstraction of the real thing and, when modeling a system, one seeks to abstract all the details that are irrelevant to allow the project and its feasibility to be understood, evaluated and criticized more quickly (HAMILTON, MILES, 2006, p. 23).

In order to model a system accurately, it is essential to adopt a robust formal notation, capable of accurately and rigorously representing the necessary abstractions. UML meets this demand by offering an extensive structure for modeling systems in multiple domains. However, its functional breadth requires selective use, since not all elements of its syntax are equally applicable to different project contexts. The modular nature of UML makes it possible to segment it into essential components, allowing the targeted use of its modeling capabilities according to the specifics of the system.

In this research, two layers of abstraction were chosen: the behavioral layer, which will describe the operational processes and flows, and the structural layer, which will map the data architecture, explored in the next chapter. The behavioral layer, in particular, is fundamental for the formal definition of the flows between objects (inter-objects) and within each entity (intra-objects), establishing the semantic bases for the analysis of the communication and exchange mechanisms between the structural units. This articulation is represented below by means of three diagrams that break down the system's behavior into specific sub-layers, allowing an analytical and granular visualization of systemic interactions (OMG, 2011).

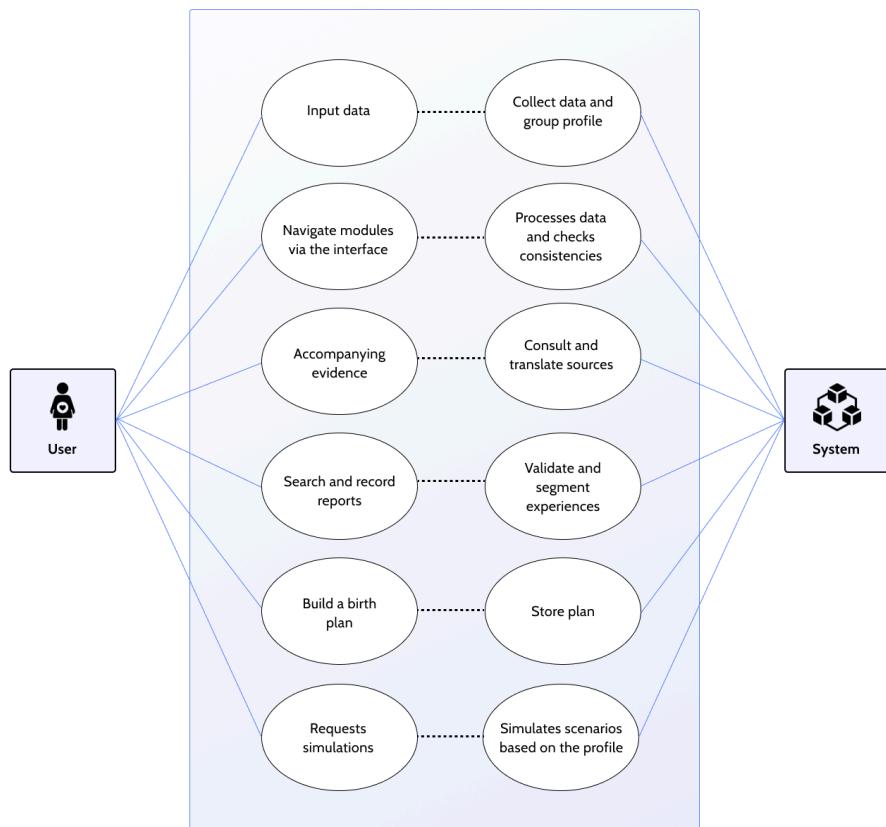
4.2.4.1 UML Use Case Diagram

The UML diagram of use cases shown below is organized in such a way as to highlight the clear division between the use cases assigned to the user and the operations processed by the system, highlighting bidirectional communication by means of dashed lines, which symbolize the flows of events or the exchange of data between the two parties. The justification for using this diagram lies in the need to represent the functional scope of the

system in a visual way, making it possible to identify the essential requirements and map the points of direct interaction between the actors and the system. It is fundamental for requirements analysis, as it describes the main functionalities that the system must offer in order to meet the user's needs.

In the flows described, the user initiates actions such as entering data, navigating through the modules and monitoring evidence, which trigger responses from the system, which in turn collects and groups profile data, processes and checks the consistency of the data and consults sources for translation and validation of information. The user can also record reports and build a birth plan, which requires the system to validate and segment the experiences, as well as storing the generated plan. The final flow involves the user's ability to simulate scenarios and carry out research, with the system reacting by simulating scenarios based on the pre-defined profile. Thus, the diagram represents the interactions in a modular way, indicating the main use cases and the system's functionalities in response to the user's actions¹.

Figure 4 - UML Use Case Diagram



Source: Author

¹ The full version of the Use Case Diagram is available via an external link. For a complete view, go to the following address:
<https://drive.google.com/file/d/1HDxEwI6lCnDjifw5ykQQGjDZWf66-7OF/view?usp=sharing>.

4.2.4.2 UML Activity Diagram

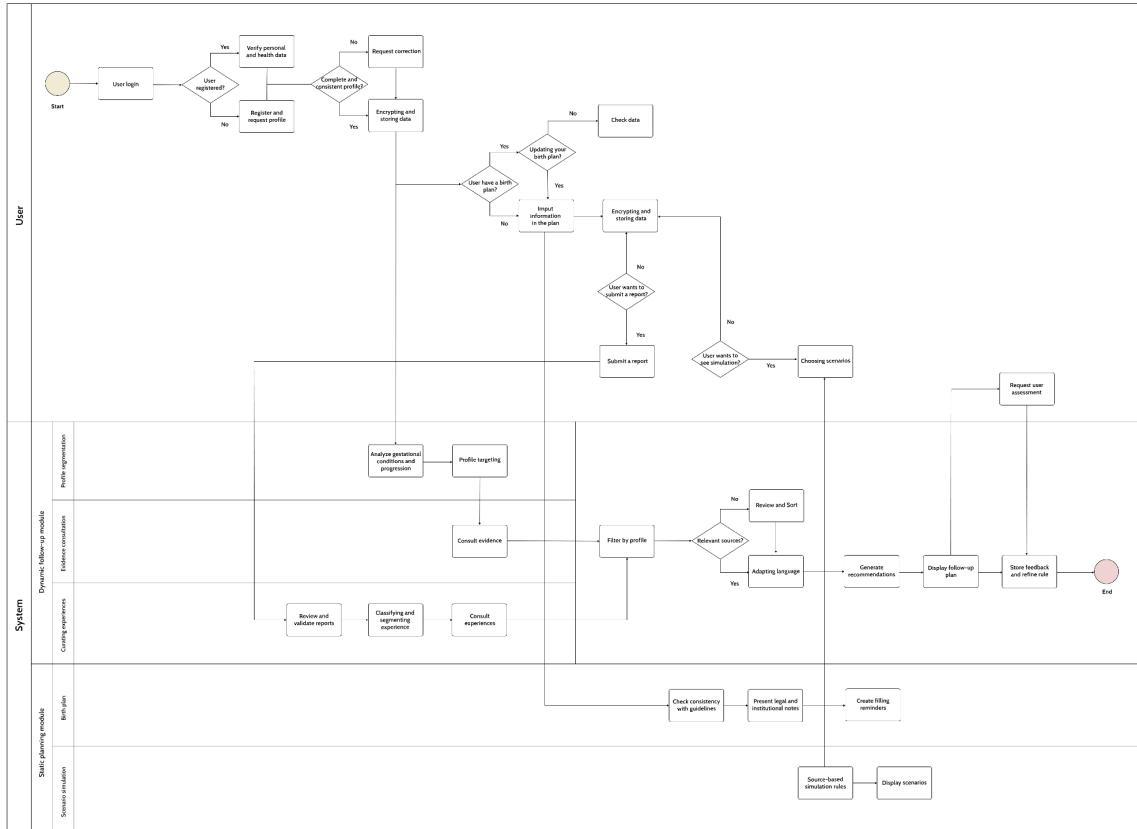
The proposed UML activity diagram was modeled to represent the sequential interaction between user and system distributed across different functional modules. The structure is organized horizontally, highlighting the pools of user and system activities, divided into multiple lanes that correspond to specific modules, such as health profile, birth plan, scenario analysis and evidence management. This approach segments the system's behavior into functional layers and details the interconnectivity of the modules through conditional decisions and control flows, ensuring clarity in interactions. Its validity lies in its ability to represent dynamic and collaborative processes between entities, as well as the flow of information within complex systems that require multiple interactions and coordination between various sub-processes.

The flows described in the diagram begin with user authentication, followed by data verification, which can lead to profile updates or the generation of a birth plan. The system, after encrypting and securely storing the data, interacts with specialized modules for gestational profile analysis and evidence classification, using defined rules to filter and adapt recommendations. The flows alternate according to the user's choices, including the possibility of simulating scenarios, with systematically adjusted interactions for validating guidelines and legal compliance. The diagram also covers the generation of reports and the customization of an action plan, where the system stores feedback, reinforcing the continuous cycle of evaluation and improvement of internal processes through rules based on simulation of clinical data².

² The full version of the Activity Diagram is available via an external link. For a complete view, go to the following address:

<https://drive.google.com/file/d/1-3uB4ezMGUxqTCa3icUbJgWUE-rawA9W/view?usp=sharing>.

Figure 5 - UML Activities Diagram



Source: Author

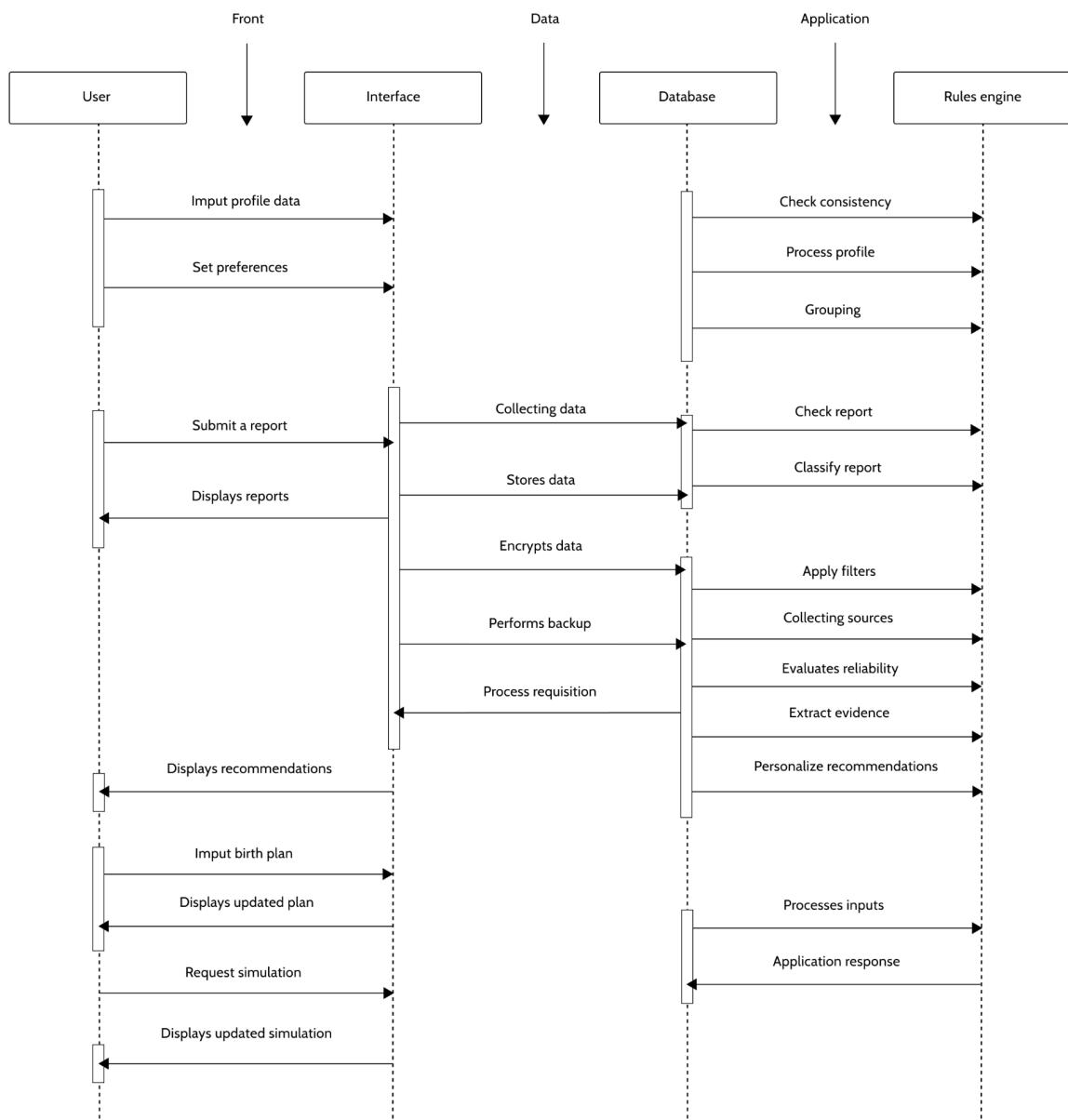
4.2.4.3 UML Sequence Diagram

The UML sequence diagram is a graphic notation designed to show the interaction between the various components of a distributed system in a given context. The structure of the diagram is organized vertically in different columns, called "lifelines", representing the actors and systems participating in the flow, while the messages exchanged between them are arranged along the horizontal axis. This type of diagram is particularly useful for describing the temporal order and dependency between interactions, and is widely used in system specification phases, making it possible to check the consistency between the business logic and the technical implementation, as well as providing a view of the sequencing of events.

The flow depicted shows the interaction between five main components: the user, the interface, the database, the application and the rules engine. The user initializes the process by entering profile and preference data, which is sent to the interface for subsequent storage in the database. The database performs functions such as collecting, storing, encrypting and backing up the information, while the application processes profiles, groups data and

personalized recommendations based on the rules defined. The rules engine performs analytical functions, such as checking consistency, classifying reports and evaluating data sources to generate precise recommendations. There is a constant exchange of messages between the components, evidenced by the need for parallel and synchronous processing of various requests. Each interaction is explicitly linked to an action that generates responses, whether in the form of reports, personalized recommendations or simulations, which are presented to the user in an iterative manner³.

Figure 6 - UML Sequence Diagram



Source: Author

³ The full version of the Sequence Diagram is available via an external link. For a complete view, go to the following address:
<https://drive.google.com/file/d/1WKZHDLH33TjqmaLdvfx2MzPiZFZFStwm/view?usp=sharing>.

4.2.5 Main data set

The specific description of the data components is a technical requirement that aims to capture the nature of the data entities and their interrelationships in the system. By materializing the information topology, these components act as central elements in defining the system's structure, determining the links that support the coherence of data flows and the operations derived from them. When each data object is modeled, it requires a characterization of its attributes and associated behaviors, since its position in the system's ecosystem directly influences the processes of manipulating and transferring information. The formalization of these components is therefore necessary to ensure that the operational abstractions are based on a solid and intelligible data architecture.

In this section, we map the primary set of data elements aligned with the different workflow points identified in the operational processes described in the previous chapter, following the structural formalisms of the UML. The structural layer is the core of this approach, based on the premise that behavior emerges exclusively from structural entities. Behavior, in this sense, is a direct consequence of the organization and interactions of the data components, eliminating any distinction between structure and functionality at the semantic level. Modeling is not limited to an instrumental representation, but acts as a device that exposes the complexity hidden in systemic interrelationships. By encapsulating these interactions in UML diagrams, it becomes possible to realize a technical view of the project with a degree of empirical observation (OMG, 2011). These artifacts are represented in three UML diagrams which will be detailed below as well as their descriptions.

4.2.5.1 UML Class Diagram

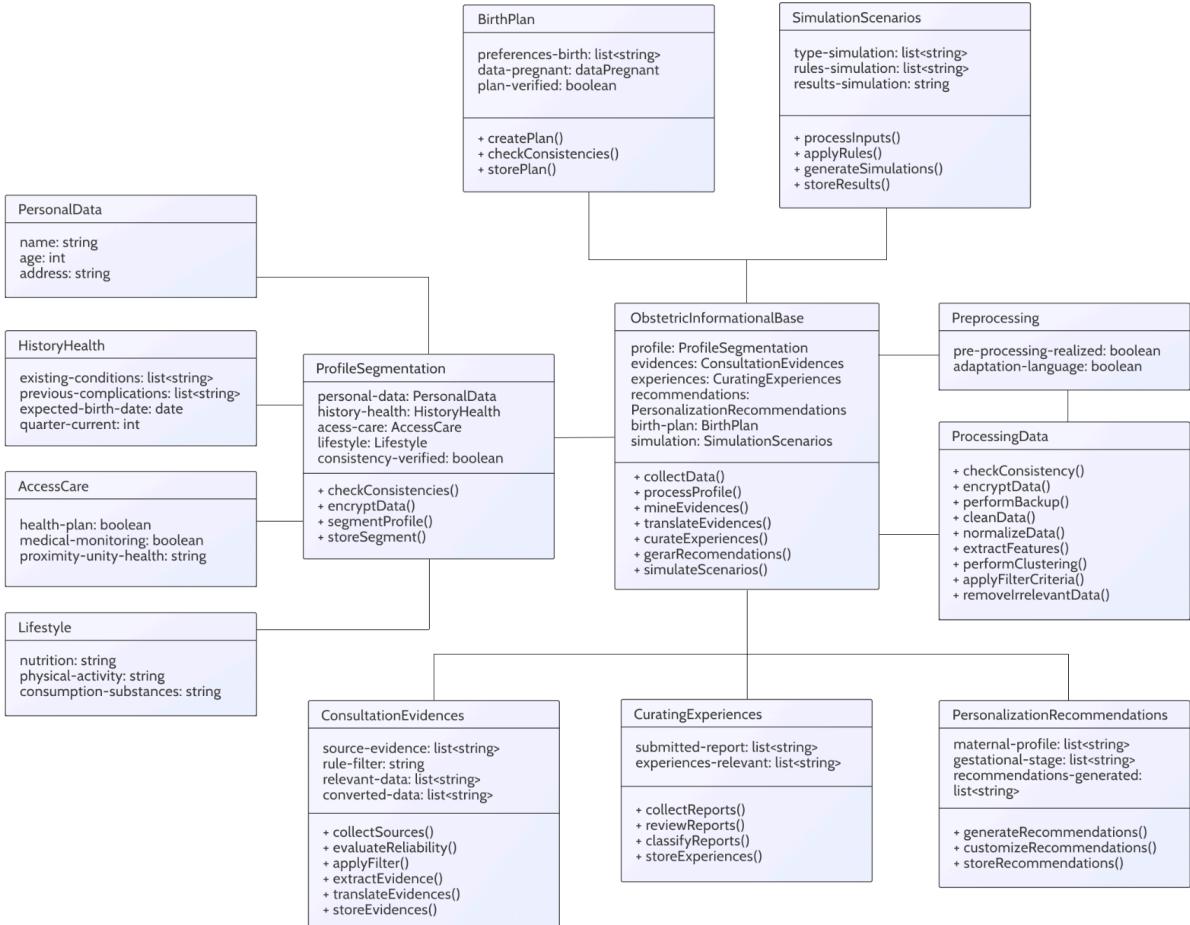
The class diagram is a representation of the structural model of an object-oriented system, focusing on the description of classes, their attributes, methods and the relationships they maintain with each other. This type of diagram aims to capture the static structure of the system, detailing the dependencies and associations between the objects that make it up. By organizing the system into classes and subcomponents, the diagram makes it possible to visualize the responsibilities of each entity and how they interact in terms of composition and aggregation. It is widely used in design phases to ensure that the essential aspects of the system's logic are correctly encapsulated and that interclass relationships are properly defined.

You can see the centrality of the ProfileSegmentation class, which encapsulates information related to personal data (PersonalData), health history (HistoryHealth), access care (AccessCare) and lifestyle (Lifestyle). This data is checked for consistency, encrypted and stored. The BirthPlan class defines the birth plan, integrating preferences and pregnancy data, as well as providing methods for creating and verifying this plan. In addition, the ObstetricInformationalBase class aggregates the profile segmentations and birth plans, as well as evidence collected in consultations and personalized recommendations, managing these information for subsequent simulation processing. SimulationScenarios, in turn, deals with the simulation of scenarios based on defined rules and simulation types.

Other classes, such as CuratingExperiences and PersonalizationRecommendations, deal with collecting reports and customizing recommendations, respectively, providing mechanisms for processing clinical data and suggesting personalized maternal care. Data processing is carried out by the ProcessingData class, which is responsible for carrying out critical tasks such as encrypting, backing up and normalizing data. The Preprocessing class prepares the data for processing, checking preconditions and adapting the language. The cohesion between the classes is reinforced by methods that guarantee the integrity and personalization of the results, as well as promoting efficiency in the management and simulation of the various obstetric and care scenarios⁴.

⁴ The full version of the Class Diagram is available via an external link. For a complete view, go to the following address: https://drive.google.com/file/d/1_A9iZICKrkTLzdmAGvzKkisQ1dWIbAP7/view?usp=sharing.

Figure 7 - UML Class Diagram



Source: Author

4.2.5.2 UML Object Diagram

The UML object diagram offers a concrete representation of the class instances in the system, emphasizing runtime data and the way objects interact with each other in a given system state. While the class diagram defines the structure and attributes that classes should contain, the object diagram reflects the instantiated data, demonstrating the actual associations and dependencies between objects in a specific scenario. This representation focuses on the materialization of components in their objective forms, filled with processed values, allowing a visualization of the system's actual behavior under a given configuration of inputs and outputs.

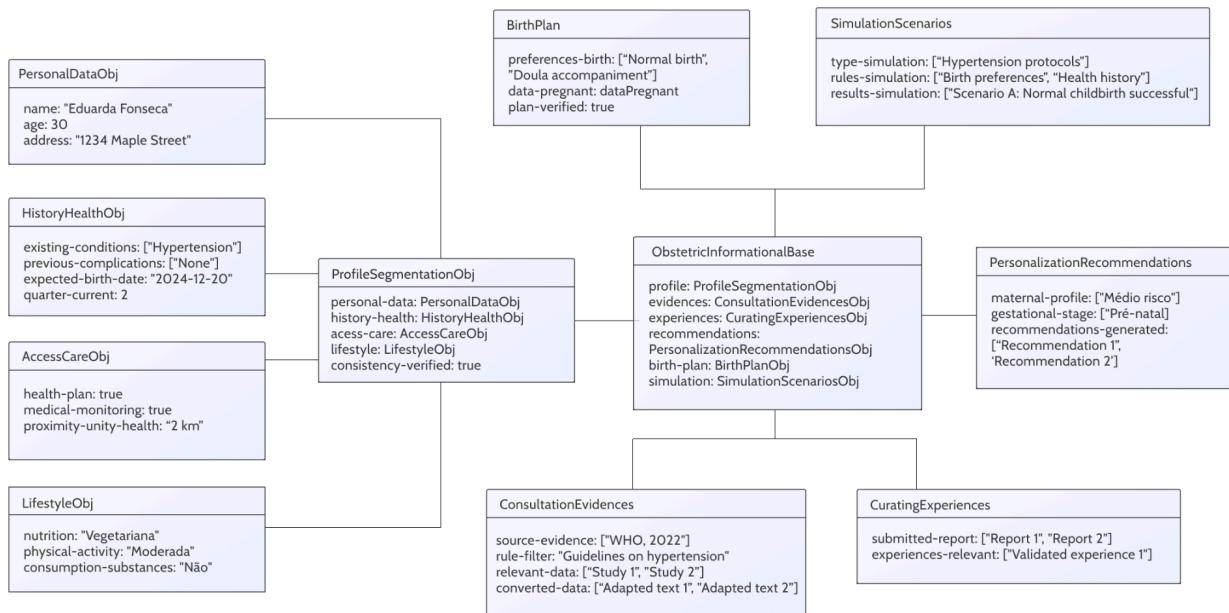
From the component diagram, the transition to an object diagram would consist of instantiating each component with the computed data, giving rise to concrete entities that reflect the state of the system. For example, the abstract Patient Profile component is materialized in a specific object, containing information about a real user, such as her name,

age, health history and other variables. Similarly, the Birth Plan component would be converted into an object that reflects the preferences and personalized birth plan, already verified and validated for that particular profile.

In the Data Transformation module, the Data Processing and Personalization of Recommendations objects would be instantiated with the normalized and transformed data, respectively, already containing the values obtained from segmenting the patient's profile and the evidence collected from external sources. The personalization of recommendations for each specific case is also made tangible through objects that contain concrete information about maternal care suggestions and possible simulated scenarios.

At the Sources layer level, instantiated objects, such as Evidence Consultation and Curating Experiences, would fill in the gaps with clinical evidence and classified reports, offering a concrete overview of the data sources that feed the system. These objects would operate with real data, such as medical reports and simulation results, allowing the flow of information to be analyzed in a practical and verifiable context⁵.

Figure 8 - UML Object Diagram



Source: Author

⁵ The full version of the Object Diagram is available via an external link. For a complete view, go to the following address: <https://drive.google.com/file/d/1sAbvmjpfi7GXFFxFVWjlMuGtPES50Gt/view?usp=sharing>.

4.2.5.3 UML Component Diagram

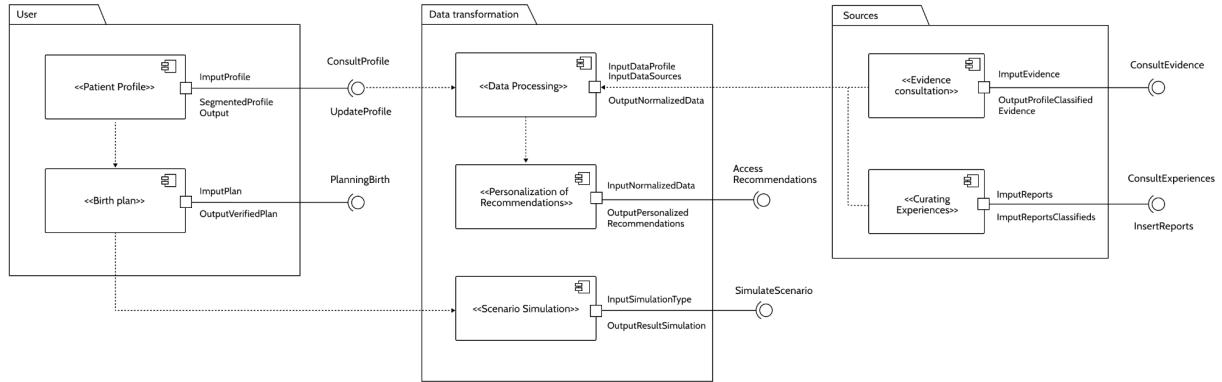
The component diagram is characterized by a modular and distributed structure of a system, emphasizing the fundamental blocks that make up the application's architecture. Each component is represented as an encapsulated module, with well-defined interfaces, facilitating communication and the exchange of information between elements, promoting code reuse and efficient system maintenance. This diagram shows a clear separation of responsibilities between the different layers and components.

The User layer contains interface components for capturing patient profile and birth plan data, which is then transferred to the Data Transformation layer. This is where the data is processed through components such as Data Processing, which is responsible for normalizing the profile data and data from external sources, which then feeds the Personalization of Recommendations module, where personalized recommendations are generated based on the processed data. The Scenario Simulation component uses the normalized data and personalized recommendations to simulate different scenarios related to birth planning.

In the Sources layer, there is interaction with modules that provide external data, such as the Evidence Consultation component, which accesses relevant evidence from clinical sources, and Curating Experiences, which classifies inserted reports and collected experiences. This data is essentially integrated and processed by the system, returning enriched information to the user, such as personalized recommendations and scenario simulations. The flow of data between components is strictly controlled through explicit interfaces, such as InputProfile, OutputVerifiedPlan, and AccessRecommendations, ensuring the cohesion and robustness of interactions. In short, the diagram shows a distributed architecture that clearly separates the functions of data input, information transformation and consultation of external sources, reinforcing the modularity and efficiency of the system as a whole⁶.

⁶ The full version of the Component Diagram is available via an external link. For a complete view, go to the following address:
<https://drive.google.com/file/d/1mtrCbmndR9UWTf6PEWMZdRVZxoLLXrM/view?usp=sharing>.

Figure 9 - UML Component Diagram



Source: Author

4.2.6 Decision support system

As part of the digital adaptation kit's decision support system, a systematic conceptual decision support infrastructure is designed with algorithms, as well as the programming of services, in accordance with WHO guidelines. The description resources seek to interpret in a format that clearly indicates the inputs and results, along with all the required measures, which has been operationalized in a digital decision support system (WHO, 2022).

The logic of the official proposal directly translates WHO guidelines and guidance documents and was reviewed by the expert panel that created these guidance documents. However, it is worth noting that a level of adaptation was necessary due to the dependence on changes to the workflow and data dictionary aimed at interaction with users rather than clinical staff. As a result, this section first provides an overview with tables segmented by system modules to specify the inputs and conditions that would result in a decision and action within the system.

Table 6 establishes a set of technical criteria for segmenting the pregnant woman's profile, based on personal data, health history and lifestyle habits. Each entry in this table acts as a determining variable, allowing the pregnant woman to be categorized into specific groups that require different interventions. Based on structured business rules, the table outlines the conditions under which the system should classify and segment the information, with a view to personalizing care and adapting care practices. The resulting measures, together with the technical notes, provide precise guidelines for ongoing monitoring and medical intervention, ensuring care centered on the patient's individuality.

Table 6 - Profile segmentation

Identifying the decision	Parametric user profile segmentation		
Business rule	IF inconsistencies in demographic patterns, lifestyle indicators or longitudinal clinical history THEN classify as non-validated profile; ELSE generate validation token and associate with algorithmic segment.		
Trigger	Asynchronous trigger after data integration		
Inputs	Output	Action	Annotations
Metadata (age, gender, location)	Profile classified according to predefined categories	Profile stored in SQL database structure with geospatial redundancy	Compliance percentage \geq 95% for acceptance
Inconsistency in any primary identification attributes	Profile marked for manual review	Error forwarded to data rectification pipeline	Generate flag for review
Behavioral variables (e.g. smoking, sedentary lifestyle) validated and cross-checked with clinical history	Profile segmented for predictive analysis	Segmentation prepared for prediction of clinical events via probabilistic models	Agreement of standards with cluster \geq 80%

Source: Adapted from WHO (2022)

Table 7 shows a model for mining clinical evidence, enabling the collection and analysis of relevant information to support obstetric decision-making. The inputs refer to data sources and filtering criteria, which are essential to ensure the reliability and relevance of the information extracted. The expected results include the generation of evidence to support medical interventions, while the measures indicate the actions required, such as carrying out tests and generating reports. Technical notes detail the analysis procedures and methodologies, ensuring that the evidence collected is interpreted within an appropriate clinical context, thus enriching the knowledge available to healthcare professionals.

Table 7 - Evidence Mining

Identifying the decision	Clinical evidence extraction and curation framework		
Business rule	IF data sources comply with GCP and ICH standards E6 THEN proceed with extraction for feasibility analysis; ELSE reject dataset for re-evaluation		
Trigger	Request for evidence review for clinical decision support via the data governance module		
Inputs	Output	Action	Annotations
Structured database (relational DB according to ANSI SQL standard) with clinically validated evidence	Evidence mined and categorized based on Level of Confidence (LoE)	Evidence stored in a data lake with AES-256 encryption	Level of evidence \geq 2A (according to Oxford classification)
External sources (scientific literature, databases such as PubMed, ClinicalTrials.gov) with compliant metadata	Validation of external evidence for use in personalized recommendations	Natural language processing algorithms applied for automated inference and summarization	Application of NLP for automated categorization
Compliance with regulatory guidelines (e.g. FDA, EMA) for multicenter studies	Ensuring usability of evidence for implementation in recommendations	Conclusions integrated into the Bayesian model for clinical probability assessment	Conclusions integrated into the Bayesian model for clinical probability assessment

Source: Adapted from WHO (2022)

Table 8 is designed to structure the curation of experiences shared by pregnant women, allowing for the systematization and analysis of personal accounts that can influence the clinical decision-making process. Each entry captures reports and experiences that are relevant to obstetric practice, making it possible to identify patterns and trends in maternal experiences. The expected results of this table are the consolidation of information that reflects the reality of pregnant women, while the measures suggest actions for integrating these experiences into medical care. The technical notes provide a basis for validating and classifying the experiences, ensuring that they are adequately contextualized and used to improve the psychological and emotional support offered to patients.

Table 8 - Curating clinical experiences

Identifying the decision	Hierarchical classification of clinical reports		
Business rule	IF clinically relevant reports AND validated by standard protocol THEN classify by level of clinical impact; ELSE reject and request new input		
Trigger	Inserting a new clinical report via the data submission interface		
Inputs	Output	Action	Annotations
Submission of reports via the system	Classificação automática das experiências por relevância clínica	Automatic classification of experiences by clinical relevance	Machine learning algorithm trained to classify reports with accuracy $\geq 90\%$
Clinical experiences reviewed according to protocol	Relatos curados e validados para futura recomendação	Reports curated and validated for future recommendation	Reports with inappropriate terms rejected
Reports classified according to severity and potential impact on treatment	Integração dos relatos no banco de dados clínico para futuras intervenções	Integration of reports into the clinical database for future interventions	Application of risk matrix based on impact and probability

Source: Adapted from WHO (2022)

The next table 9 outlines the framework for personalizing clinical recommendations, focusing on the individual preferences and needs of the pregnant woman. The inputs address personal choices and previous experiences, which are crucial for formulating recommendations in line with the patient's objectives and expectations. The expected results consist of generating practical guidelines that promote obstetric care that is closer to the reality experienced by each pregnant woman, while the measures to be taken can include drawing up personalized action plans. The technical notes highlight the importance of a patient-centered approach, ensuring that recommendations are evidence-based and adapted to each woman's specific circumstances.

Table 9 - Personalization of recommendations

Identifying the decision	Parametric modeling and birth plan validation		
Business rule	IF complete gestational data AND validated birth preferences THEN generate customized birth plan; ELSE review inconsistencies and request adjustments		
Trigger	Automatic submission and verification of preferences via data capture system		
Inputs	Output	Action	Annotations
Complete gestational data (e.g. gestational age, history of complications) and delivery preferences	Customized birth plan generated and validated with integration into the clinical base	Final validation of the plan by AI system with real-time risk verification	Accuracy $\geq 95\%$ in mapping documented preferences
Clinical history with flag of previous complications	Automatic adjustment to the plan based on predictive obstetric risk algorithms	Updates rotated in real time with continuous adjustments to the birth plan	Risk detection $\geq 90\%$ according to critical scenario simulations
Verification of consistency between preferences and clinical reality	Complete integration of the birth plan with the follow-up module	Plan validated and synchronized with fetal monitoring systems in real time	Consistency $\geq 95\%$ between preferences and clinical data

Source: Adapted from WHO (2022)

Table 10 provides a methodical structure for drawing up and reviewing the birth plan, addressing the pregnant woman's preferences and considerations in relation to the birth process. The inputs include the intervention options and relevant personal data, allowing decisions to be made in an informed and reflective manner. Expected outcomes include the creation of a clear and feasible birth plan, while measures suggest concrete actions to be taken during labor and the postpartum period. The technical notes emphasize the need for close monitoring and continuous review of the plan, ensuring that the decisions made are monitored and adjusted as necessary in order to optimize the pregnant woman's experience and the safety of the newborn.

Table 10 - Birth plan

Identifying the decision	Recommendation personalization algorithm		
Business rule	IF patient preferences AND validated clinical data THEN generate personalized recommendation; ELSE adjust recommendation based on predefined models		
Trigger	Updating patient preferences via customized interface		
Inputs	Output	Action	Annotations
Documented preferences (via preference capture interface)	Personalized recommendations generated based on clinical profile	Deep learning algorithm trained for continuous learning of patient preferences	Compliance $\geq 90\%$ with documented preferences
Clinical data structured and validated via integration system	Continuous adjustment of recommendations based on longitudinal clinical history	Use of convolutional neural networks for real-time adjustment of clinical recommendations	Model accuracy $\geq 95\%$ in personalized recommendations
Predictive recommendation models adjusted with high variability data	Integration of recommendations into the final treatment plan	Adaptive recommendations with clinical impact analysis and probabilistic simulations	Feedback loop with automatic integration of future data

Source: Adapted from WHO (2022)

Finally, table 11 is designed to simulate obstetric scenarios, allowing pregnant women to assess the consequences of their choices in the birth plan beforehand. The inputs consist of intervention preferences and personal considerations, which serve as key variables for the simulation. The expected results include a clear visualization of the physical and emotional implications of each decision, while the measures guide the interventions that can be carried out based on the simulations. The technical notes address the methodology used for scenario modeling, providing an in-depth understanding of the repercussions of the pregnant woman's choices, and highlighting the importance of an informed decision-making process that anticipates potential clinical outcomes.

Table 11 - Scenario simulation

Identifying the decision	Simulating the consequences of decisions in the birth plan		
Business rule	IF the pregnant woman provides birth plan options ELSE simulate outcomes based on the choices, considering risk variables and potential benefits		
Trigger	Finalization of the birth plan or change in intervention preferences during pregnancy		
Inputs	Output	Action	Annotations
Choice of intervention: type of delivery (cesarean section, vaginal delivery)	Simulation of the physical and emotional consequences for mother and baby, considering the risks associated with each choice	Simulation based on decision analysis and risk scenario modeling, using conditional logic	Percentage of perceived risks and benefits, with comparative graphs
Medication preferences (analgesia, anesthesia, use of medication for labor induction)	Evaluation of the impact of the choice of medication on the pain, recovery and health of the newborn	Simulation models integrating pharmacological variables and side effects, allowing visualization	Maternal and neonatal satisfaction indicators
Personal considerations (history of complications and current emotional state)	Generation of scenarios illustrating how choices can affect the childbirth experience and maternal and child health	Integration of psychosocial approaches, allowing the pregnant woman to visualize the repercussions	Qualitative analysis of simulated experiences

Source: Adapted from WHO (2022)

4.2.7 Performance indicators and metrics

In many contexts, data collection in health systems is costly, disjointed and disconnected from decision-making processes. The tools and indicators used remain dispersed between different pathologies and funding sources, characterized by a lack of efficient harmonization and the scarcity of national plans that promote the coordination and proper use of this information. Research has investigated how accurately this proliferation of tools assesses the quality of health systems, examining sets of indicators or surveys from multinational health systems and comparing national indicators from low- and middle-income countries (Kruk et al., 2018, p. 1223), as shown in the figure below.

Figure 10 - Representation of quality subdomains in global, cross national and national measurement sets

	Indicators	Quality-relevant indicators	Foundations	Processes of care		Quality impacts			Patient-reported
			All*	Competent care	User experience	Health outcomes	Confidence	Economic benefit	
Global measurement sets									
Countdown 2030 indicators	137	91	41	26	1	23	0	2	0
EURO health for all database	603	130	68	16	0	45	0	1	3
OECD health care indicators	183	160	87	11	9	42	0	6	13
SDG health indicators	89	28	11	7	1	8	0	1	1
WHO core 100 (2015)	100	49	15	14	0	18	0	2	0
WHO IPCHS global indicators	14	11	6	4	1	1	0	0	1
Cross-national measurement sets									
DHS	NA	72	4	51	2	14	0	1	63
SARA	NA	268	268	0	0	0	0	0	0
SDI	761	726	723	2	0	1	0	0	0
SPA	1413	1269	784	349	108	22	6	0	156
Example of national measurement sets for routine health system measurement									
Ethiopia HMIS	121	30	8	11	0	11	0	0	0
Kenya HIS	198	135	60	53	3	17	0	0	3
Mexico IMSS, ISSSTE, MOH	1055	471	205	97	36	103	17	13	21
Nepal HMIS	305	183	89	39	0	32	0	0	0
Senegal DHIS2	398	168	51	35	3	29	5	0	0

Source: KRUK et al. (2018)

Although useful for monitoring population health, the outcome indicators identified in this analysis reveal a shortage of metrics that are directly sensitive to the performance of health systems and a near absence of results reported by patients themselves. At national and global level, current approaches to measuring health systems demonstrate significant limitations in assessing overall system efficiency and do not offer robust accountability mechanisms, either with regard to user experience or the impacts, both health and extra-health, that are relevant to patients (KRUK et al., 2018, p. 1225).

Achieving the targets set by the Sustainable Development Goals (SDGs) and consequently raising the quality standards of health systems by 2030 will require the development and implementation of a more sophisticated and integrated technical measurement framework, which implies a substantial commitment to investing in the analytical and time infrastructure needed to make this transformation possible. In this sense, we advocate the integration of direct communication channels with pregnant women as a viable method for transforming qualitative data into information that can be measured and analyzed in obstetric health monitoring.

To begin with, the birth plan itself can generate measurable indicators, extracted directly from the classes defined in the proposal based on the preferences recorded by the pregnant woman, such as the type of birth desired, pain relief methods and preferences regarding the presence of a companion. This data, captured by the BirthPlan class, is stored in a segmented way by ProfileSegmentation, and can be aggregated and analyzed to generate metrics such as the percentage of planned natural births, the incidence of preferred cesarean sections, the use of non-pharmacological pain control methods and preferences for family accompaniment. Each metric becomes an indicator of the health system's adherence to patients' expectations, and is stored and ready for longitudinal analysis and comparison with clinical outcomes.

As far as experience reports are concerned, experience curation offers a structured mechanism for collecting and processing subjective data. Each report submitted can be classified and reviewed, generating specific indicators such as: satisfaction with care, perception of support during childbirth, and the frequency of reports of subjective complications such as fear or anxiety. These reports are normalized and clustered by the ProcessingData class, which applies predefined filters, allowing insights to be extracted such as the patients' overall satisfaction index, comparing positive and negative reports, as well as identifying correlations between the subjective experience and the obstetric outcomes. This standardization allows subjective data to be transformed into objective metrics, such as the percentage of patients who reported adequate support during childbirth, in order to consolidate this data into a unified and comparable base.

In addition, validated questionnaires such as the Childbirth Attitudes Questionnaire (CAQ), the Childbirth Self-Efficacy Inventory (CBSEI) and the Birth Companion Support Questionnaire (BCSQ) can be integrated into the system as additional records in the database, complementing the birth planning module. Integrating these questionnaires with the birth plan in the system enables the structured collection of indicators on fear, self-efficacy and support. For example, the data captured by the CAQ (TSCHUDIN; HUWENDIEK, 2003) makes it possible to monitor the level of fear in relation to childbirth and compare it with the preferred type of childbirth and actual outcomes. The CBSEI (TSAI, 2009), which measures the self-efficacy perceived by pregnant women, generates indicators related to confidence in their own ability to conduct labor, directly influencing decisions about interventions or assisted deliveries. The BCSQ (TULLY; BALL, 2013), which assesses the support provided by the companion, generates metrics of involvement and effectiveness of family or professional support.

While providing a detailed view of the pregnant woman's emotional and behavioral preparation, these instruments also offer data that can be correlated with concrete obstetric outcomes, such as interventions, complications or satisfaction with the experience. For this reason, the information could also be processed in the follow-up environment by the ConsultationEvidences class to extract and filter the relevant data and identify which specific scenarios are most associated with high levels of fear, low self-efficacy or inadequate support. This would make it possible to adjust the recommendations generated in the recommendation personalization module, directing guidance to pregnant women based on the results of the questionnaires, while at the same time storing the data in the system for future analysis and modeling predictions about childbirth by simulating scenarios.

4.2.8 Functional and non-functional requirements

The last component of the Digital Adaptation Kit for Prenatal Care proposes a preliminary description of the functional and non-functional requirements that make up the design and adaptation of the digital decision support system. The functional requirements are a detailed set of specifications that articulate the system's intrinsic capabilities, defining a spectrum of operations that must be carried out in order to respond satisfactorily to the demands of end users (WHO, 2022). This definition encompasses the integration of complex processes, allowing the system to perform operational tasks and to do so in accordance with the criteria of efficiency, effectiveness and precision required in critical and dynamic environments. Below is a detailed breakdown of these requirements, elucidating their categorization.

Table 12 - Functional requirements

Category	Requirement
Data Management - Client Identification	The system to display sufficient data to identify the client
Data Entry - Identification Information	To be able to enter identification information
User Interface - Form Validation	The system to indicate mandatory fields that must be filled out for registration to be valid
Data Management - Personal Information	Validate and store personal data (name, age, address) with input and integrity checks
Data Management - Medical History	Record pre-existing conditions, complications, date of delivery and trimester, according to medical record specifications
User Profiling - Profile Segmentation	Implement profile segmentation based on habits, health history and personal data, with consistency checks and mandatory encryption
User Engagement - Notifications	Allow pregnant women to receive notifications about the most important milestones in their pregnancy
Information Access - Educational Content	Provide access to reliable and educational information about pregnancy
Recommendation System - Personalized Recommendations	Generate recommendations based on preferences, analysis of habits, medical history and clinical recommendations
Content Management - Citation and Sources	Informing bibliographic sources for technical-scientific content
Clinical Tools - Pregnancy Tracking	Calculate the probable date of birth and display a calendar with the months of pregnancy using a gestogram
Simulation Tools - Medical Scenario Simulation	Simulate scenarios based on medical rules and generate consistent results for the pregnant woman
Data Processing - Cleaning and Normalization	Clean, normalize and cluster data, applying relevance criteria and removing irrelevant data
Data Management - Feedback Collection	Collect, classify and store relevant reports for future recommendations and continuous improvement of the system

Source: Adapted from WHO (2022), ZILMA et al. (2018)

With regard to non-functional requirements, a framework of qualitative characteristics is established that are necessary for the viability and robustness of the digital system. These requirements go beyond functionality, covering dimensions such as scalability, maintainability, security and performance under variable conditions. Analyzing these aspects ensures that the system is intuitive and user-friendly, but also that it remains resilient in the

face of technical challenges and infrastructure limitations. The following breakdown will look at their descriptions for each category.

Table 13 - Non-functional requirements

Category	Requirement
Security - Confidentiality and Privacy	Provide a means to ensure confidentiality and privacy of personal health information
Security - Encrypted Communication	Provide encrypted communication between components
Monitoring - Access Logging	Log access to views of individual client records
Monitoring - Data Summary Logging	Log access to data summaries, reports, analysis and visualization features
Analytics - Feature Usage Analysis	Generate analysis of the usage of different system features and reports
Monitoring - Error Logging	Log all data and system errors
User Management - Password Management	Allow user to change their own password
Data Management - Version Control	Enable earlier versions of a record to be recoverable
Flexibility - System Adaptability	Be designed to be flexible enough to accommodate necessary changes in the future
Functionality - Offline and Online Support	Allow for offline and online functionality
Data Management - Backup Capability	Have ability to easily backup information
Data Management - Storage of Unstructured Data	Must have the ability to store images and other unstructured data
Scalability - Demand Accommodation	Scalable to accommodate new demands
Usability - User-Friendliness	Be user-friendly for people with low computer literacy
Usability - Error Messaging	Provide informative error messages and tool-tips
Usability - Navigation Alerts	Alert the user when navigating away from a form without saving
Usability - Data Entry Validation	Support real-time data-entry validation and feedback to prevent data-entry errors from being recorded
Usability - Simplified Data Entry	Simplify data recording through predefined drop-down menu or searchable lists, radio buttons, check boxes
Localization - Multilingual Support	Support multiple languages
Usability - User Interface Consistency	Use industry standard user interface practices and apply them consistently throughout the system

Usability - Intuitive Navigation	Easy to learn and intuitive to enable user to navigate between pages
Usability - Clinical Guidance Support	Provide guidance to users to better support clinical guidelines and best clinical practices
Reliability - System Robustness	Be reliable and robust (minimize the number of system crashes)
Usability - Responsive Design	Adjust display to fit small screens (e.g. mobile phones)
Usability - Configurable Error Messages	Configure error messages
Interoperability - External Communication	Communicate with external systems through mediators
Interoperability - API Access	Provide access to data through application programming interfaces (APIs)
Interoperability - Data Exchange and Synchronization	Be interoperable with external systems through mediators
Interoperability - Efficient Data Synchronization	Allow for data exchange and efficient synchronization across multiple facilities and points of service when Internet is available, even when it is intermittent and slow
Compliance - Data Protection Regulations	Ensure compliance with GDPR, LGPD and other data protection regulations
Performance - Response Time	Response time of less than 2 seconds for queries and simulations, even with large volumes of data
Scalability - User Capacity	The system must support horizontal scalability, with performance maintained at up to 1,000,000 simultaneous users
Maintainability - Modular Architecture	Ensure maintainability with a modular and decoupled architecture, allowing updates and corrections without interrupting services or affecting the integrity of the system
Security - Authentication and Access Control	Multi-factor authentication and role-based permissions system, with restricted access control
Monitoring - Activity Logging and Anomaly Detection	Implement detailed logs of user activity and system events, with real-time auditing and anomaly detection
Usability - Mobile and Web Compatibility	The system must be compatible with mobile devices (iOS and Android) and web browsers, with responsive design and compliance with the WCAG 2.1 guidelines for accessibility
Performance - Resource Optimization	The system must be optimized for efficient use of resources, minimizing energy consumption and processing on mobile devices

Source: Adapted from WHO (2022), ZILMA et al. (2018)

5. PROTOTYPE

The development of an interdisciplinary multilayer system requires a methodological metalanguage that articulates its premises on different scales and dimensions. The structuring of a project transcends the justification for its existence and emerges from the demands that foster the genesis of technological ideas and is based on theoretical foundations that stabilize and legitimize its configurations. In this context, conceptual modeling is incomplete without the use of a robust visual layer, which acts as a means of transmuting the abstract idea into a cognitively tangible and perceptible object.

Innovation here manifests itself as a phenomenon that goes beyond the sphere of abstract and idealized creativity, progressing along the path of pragmatic invention until it culminates in added value - an essential aspect for innovation to materialize into something feasible and applicable. In essence, the construction of systems guided by prototype design enhances this innovation and seeks to consolidate its creative power in a structured and functional form. Thus, design is a manufacturing process centered on meeting human needs, in line with systematic methodologies that result in finished products with practical, aesthetic and, not least, symbolic functions. These three dimensions must converge in a single object that communicates value to its user (BÜRDEK, 2006).

This practice of ideation, seen as the act of drawing or sketching the idea, prevails as an immemorial strategy in projects, dating back to times before digital tools. From preliminary scribbles, through schematics and diagrams, to the modern application of augmented reality, prototyping presents itself as an effective cognitive and synesthetic resource in the transition from subjective concepts to concrete artifacts. This process amplifies human perception and the capacity for experimentation, reinforcing the role of prototypes as an artifact for materializing the intangible (BROWN, 2010).

In the context of this project, the aim is to design this artifact based on the interface screens of the obstetric information base. To do this, we went through a planning process based on a breakdown of the functional modules and components that allowed us to draw up the navigation structure and configuration of environments optimized for improved usability. Despite being designed with the premise of modular expandability, the initial prototyping was deliberately adjusted for mobile interfaces, given the prevalence and accessibility of these devices among the target audience. This approach is aimed at tangibly democratizing access to the resource, promoting its adoption in everyday life and favoring a digital interface that minimizes socio-economic and geographical barriers.

The interfaces were built using Figma, a tool renowned for its adaptability in developing highly configurable and detailed visual components. Each element was designed to meet functional specificities, as well as to coherently integrate the proposal's visual identity, guaranteeing a unified aesthetic and communicative experience. At the end of the process, 12 screens were configured, segmented according to the modules and their respective functional layers and sublayers, which represent an attempt to visually materialize the technique with a design approach that is sensitive to the specific requirements of the users⁷. The detailed descriptions of these screens are presented below, offering an insight into the structural logic and attributes that make up the scope of this project.

5.1 Aesthetic-symbolic composition

In designing the interfaces, a chromatic palette based on principles of color psychodynamics and visual neuroaesthetics was implemented, prioritizing bluish hues that evoke a semiotic association with the field of health, while inducing a perceptual state of tranquility and reliability. The choice of chromatic gradations favors a transition of tones through optimized gradients, which were applied to achieve a precise balance in inter-elemental contrast, with the aim of minimizing direct light interference and enabling a continuous and ergonomic viewing experience. This chromatic approach is in line with contemporary studies of digital chromotherapy (SONODA; SILVA FERREIRA; COELHO GRELLET, 2022), contributing to an environment that favors ocular well-being and reduces the user's cognitive load in contexts of prolonged interaction.

The selected typography is the result of a curation of fonts with high functional accuracy, whose optical traceability properties were analyzed in terms of readability in mobile interfaces. A typeface with a minimalist anatomical construction was chosen, favoring proportional spacing between characters and optimized reading at different resolutions, avoiding decorative variations that could compromise informational neutrality. As far as iconography is concerned, the neomorphism paradigm was applied with technical acuity, ensuring that each icon has a simulated depth of low intensity, produced by discreetly offset shadows and relief effects calculated in their opacity and angle. This

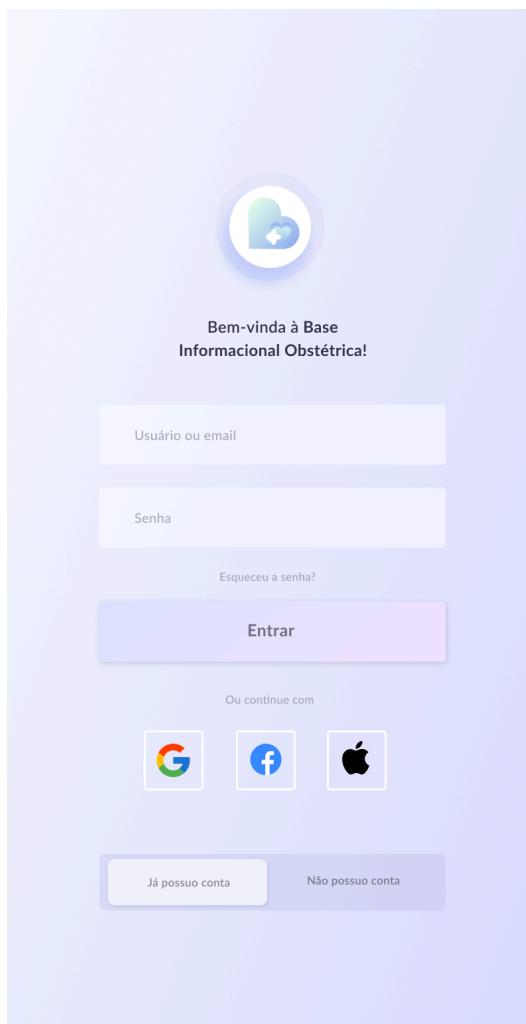
⁷ The complete prototype is available at the following link:
<https://www.figma.com/proto/1HAAmMFNLYY9AGysPvmHPO/Prot%C3%B3tipo-TCC---Base-Informacional-Obst%C3%A9trica?node-id=22046-2&node-type=canvas&t=DykdQOuFWuGRAApR-1&scaling=contain&content-scaling=fixed&page-id=0%3A1&starting-point-node-id=22046%3A2>.

pseudo-three-dimensionality technique offers the user visual feedback analogous to touch, consolidating a tangibility that facilitates tactile-synaptic recognition of the structures.

5.2 System interfaces

The initial login and registration screen is the main entry point to the system, with functions designed to authenticate the user or register new profiles, in order to allow secure and personalized access to the platform. This interface offers two functional paths: the first, for users who are already registered, allows them to enter their credentials directly into the system; the second, for new users, leads to the registration process, formalizing the creation of a new account with secure data validation. In addition, the screen offers the option of logging in via federated authentication, integrating with third-party accounts to increase access flexibility and optimize entry flow.

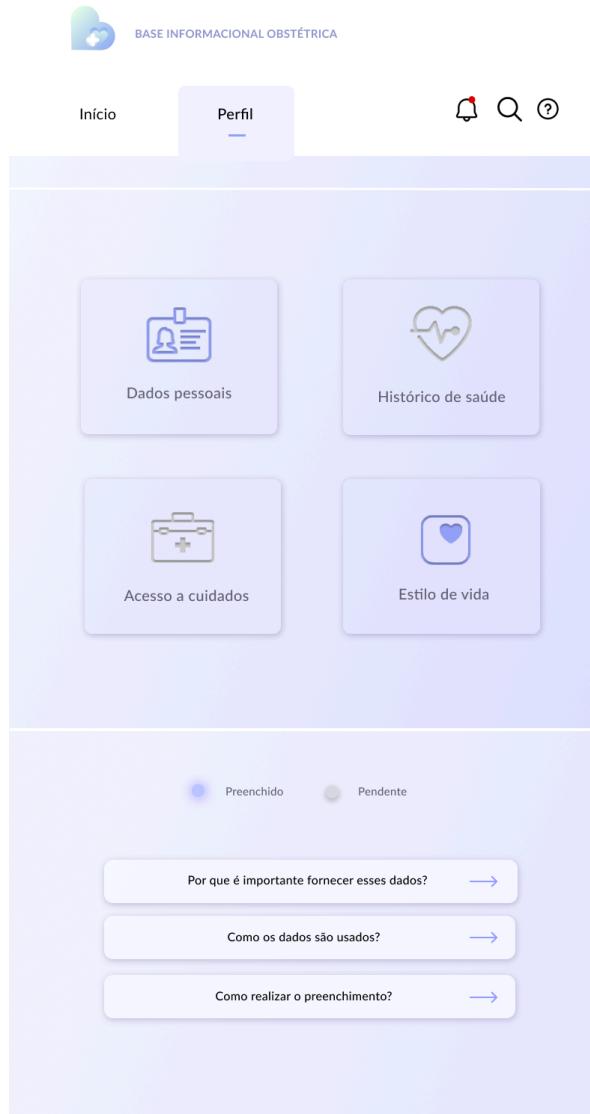
Figure 11 - Access screen



Source: Author

The profile screen is a central module for collecting essential data for personalized segmentation of users, including an organized structure for filling in personal information, health history, conditions of access to medical care and lifestyle profile. This interface is divided into specialized subpages, each geared towards a specific set of data, allowing for detailed and segmented collection that enables customized analyses and recommendations tailored to the particularities of each profile. In addition, the profile screen integrates informative sections dedicated to clarifying the motivation and criteria for using the data, ensuring transparency and ethical compliance, as well as a step-by-step tutorial to guide the correct completion of the information.

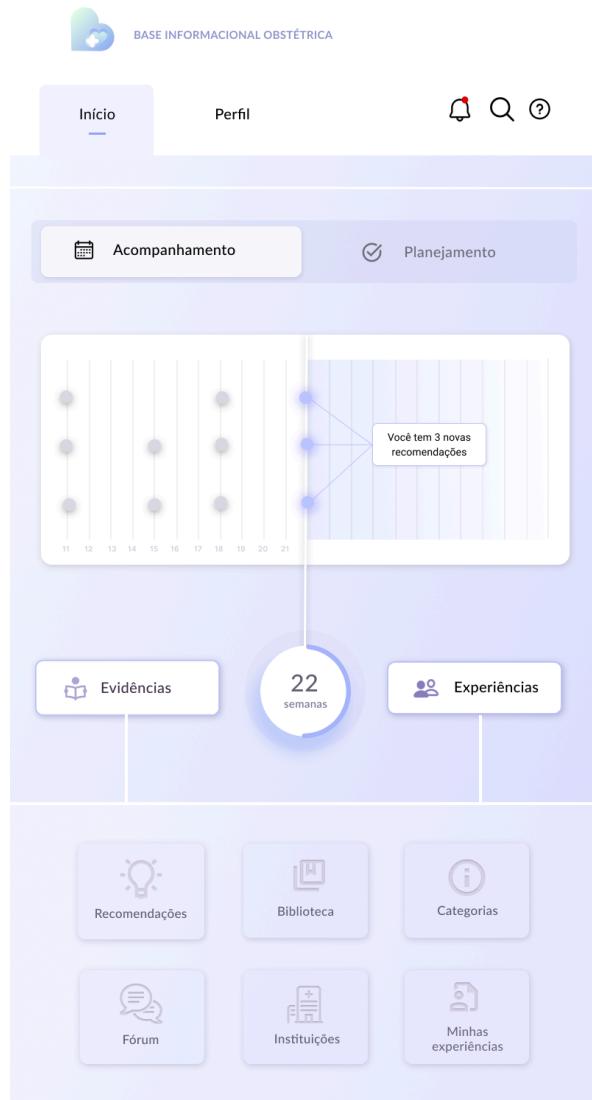
Figure 12 - Profile screen



Source: Author

The initial screen of the monitoring module organizes the recommendations specific to the user's gestational period, providing a centralized and structured view of the appropriate guidelines for each stage of pregnancy. This main interface allows immediate access to the essential sub-modules, segmented to facilitate navigation between guidelines based on scientific evidence and reports of practical experiences. There are also quick-view sections for other associated subpages that are accessible for more in-depth exploration of each type of content, ensuring that the user finds the relevant information in a fluid and intuitive way within the module.

Figure 13 - Initial tracking screen



Source: Author

The screen dedicated to the evidence module offers specialized recommendations tailored to the user's gestational period, presented in the form of information cards. Each card displays a succinct summary of the recommendations based on scientific evidence, making it easy to quickly consult the most relevant information. These summaries are organized for quick viewing, allowing the user to identify the main guidelines at each stage of pregnancy. In addition, the cards have an expansion feature, allowing each recommendation to be expanded with additional details, such as scientific justifications, bibliographical references and practical implications.

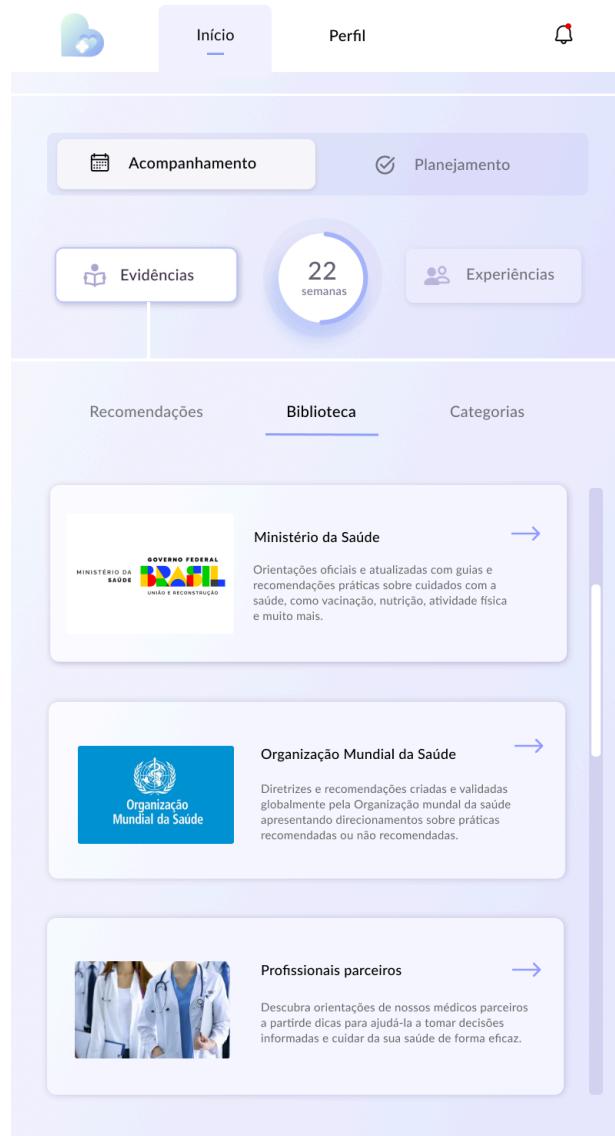
Figure 14 - Evidence screen with recommendations



Source: Author

The evidence library screen presents an organized collection of the main sources for consulting national and international guidelines, constituting a comprehensive repository of essential scientific references for gestational follow-up. This library has been structured to provide easy access to documents of normative relevance and up-to-date clinical guidelines, making available guides and protocols from recognized institutions. In addition, the interface would offer a specific section to include content produced in collaboration with partner professionals, broadening the scope of information available and ensuring that the user has access to a diverse network of knowledge and practices backed by leading experts.

Figure 15 - Evidence library screen



Source: Author

The categorized evidence screen organizes the content into specific areas of knowledge, such as nutrition, clinical examinations, mental health, vaccinations, sleep and other topics pertinent to pregnancy, allowing for segmented and targeted navigation. Each knowledge category acts as a filter to facilitate quick searches, enabling users to find guidance or clarify doubts according to their information needs.

Figure 16 - Evidence category screen



Source: Author

The centerpiece of the experience sublayer screen is an interactive forum in which users can access reports, doubts, tips and various questions shared by other pregnant women at similar stages of pregnancy. This interface facilitates the exchange of experiences through a space for the collective construction of knowledge, where users can support each other, increasing the social and emotional support provided by the system. The forum is structured to allow active and segmented participation, with topics organized according to the different needs and concerns of each gestational period, promoting an environment of empathy and solidarity. In this way, the space is configured as an instrument of digital humanization, which aims to strengthen the social support network by providing a shared experience and a representation of gestational experiences.

Figure 17 - Experience forum screen



Source: Author

The screen dedicated to the evaluation and organic monitoring of healthcare institutions offers a centralized space for the comparative analysis of institutional practices, contrasting the adoption rates of recommended practices with data relating to the actual performance of healthcare units. This module provides a clear visualization of the divergences between the ideal practices, according to the established guidelines, and the practices observed in the institutions, allowing the user to make a critical and informed assessment. Considering the already existing, albeit informal, choice of link with health units by pregnant women, the space aims to integrate, in an accessible and intuitive way, essential information for decision-making, not only geographically targeted, but also with a preventive focus.

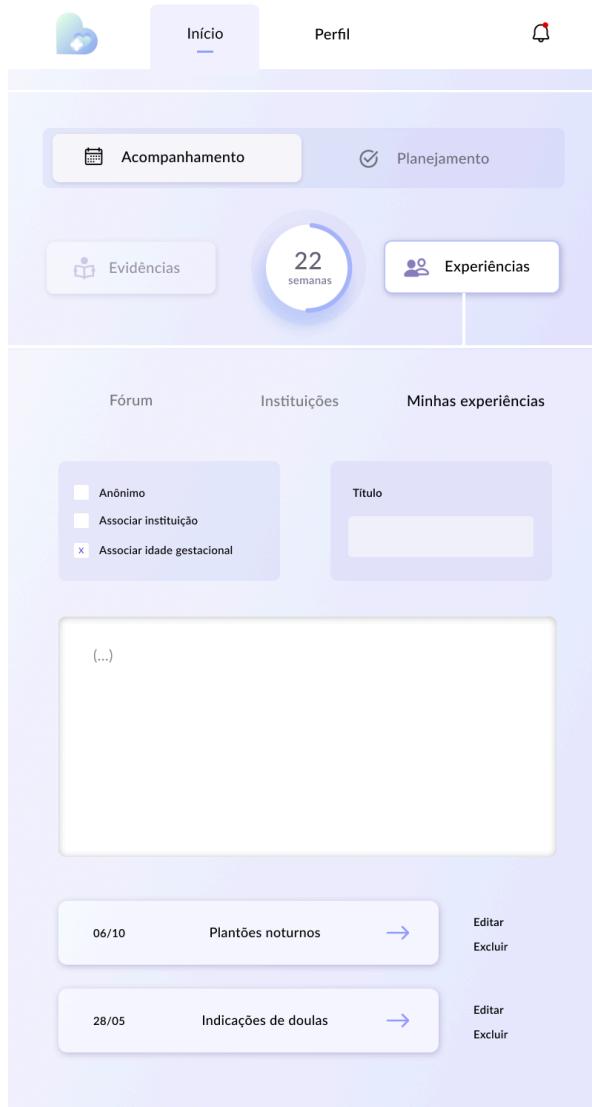
Figure 18 - Screen of experiences in institutions



Source: Author

The report inclusion screen offers a dedicated environment for users to share their experiences, even anonymously, to add to the exchange of knowledge in an open and secure way. This module makes it possible to associate each report with a specific institution and the respective gestational age at the time of the experience, allowing for precise and relevant contextualization of the information shared. The ability to edit and delete previous reports gives the user total control over their content, ensuring flexibility and updating information as necessary. This structure aims to create a detailed overview of practices and experiences related to different institutions and gestational periods, enriching the database with continuous reports adjusted to the reality of each user.

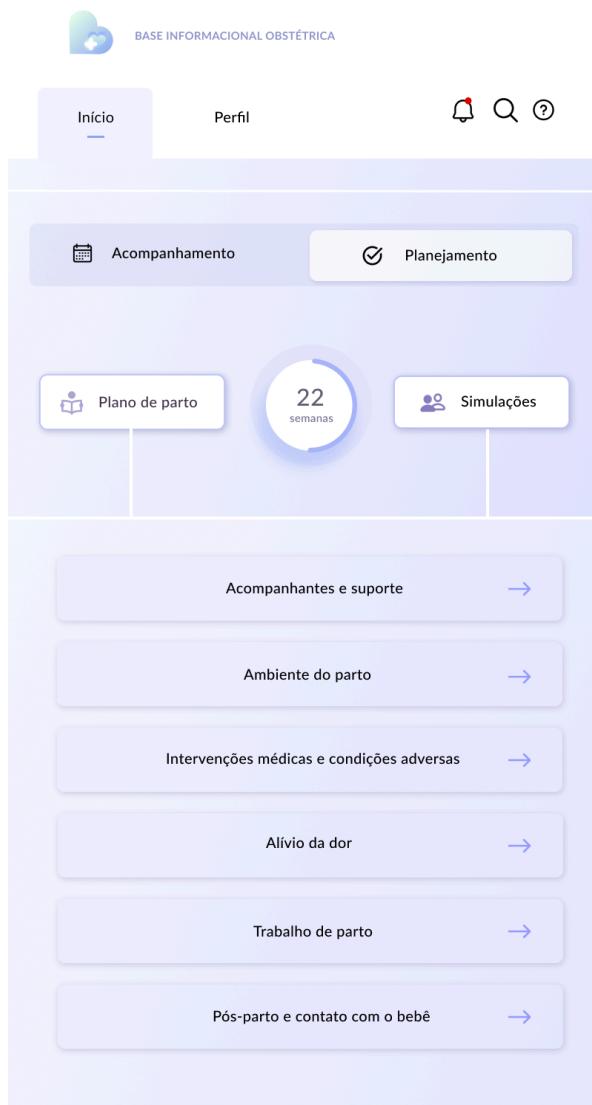
Figure 19 - Screen for adding and editing experiences



Source: Author

The macro planning layer offers a structured interface for recording the pregnant woman's critical decisions, allowing her to define her preferences and care needs in a clear and personalized way. The home screen organizes the different strata of knowledge related to childbirth, categorized to facilitate access to relevant information that can be detailed and explored according to the possibilities for completion, offering the user the flexibility to adjust her choices based on detailed and substantiated information, ensuring that her decisions are made in an informed manner and in line with her expectations.

Figure 20 - Planning screen



Source: Author

The page dedicated specifically to recording the birth plan offers a segmented and detailed structure, with specific fields for filling in the pregnant woman's preferences regarding different aspects of the birth. Each field has been designed to cover relevant topics, such as the type of birth, preferences regarding analgesia, desired or avoided interventions, the presence of companions and other aspects that may influence the birth environment and process. This form includes open-ended description sections, where the pregnant woman can freely and personally express her wishes and expectations about the service, providing the necessary flexibility for a complete and individualized expression.

Figure 21 - Birth plan registration screen

Início

Perfil

Acompanhamento

Planejamento

Plano de parto

22 semanas

Simulação

Acompanhante e suporte

Acompanhante: João Silva (marido)

Doula: Mariana Oliveira

Equipe médica: Equipe feminina, se possível

Ambiente do parto

Iluminação: Luz suave, para manter o ambiente mais calmo e confortável.

Sons: Música relaxante de preferência (playlist personalizada).

Privacidade: Mínimo de pessoas na sala.

Intervenções médicas

Indução: Prefiro evitar induções, a menos que sejam clínicamente necessárias.

Monitoramento fetal: Monitoramento não contínuo, se possível, para permitir movimentação.

Ruptura de bolsa: Solicito que a bolsa não seja rompida artificialmente sem necessidade.

Alívio da dor

Métodos naturais: Movimentação livre, banho morno, bola e técnicas de respiração

Anestesia: Prefiro aguardar o máximo possível antes de optar por analgesia.

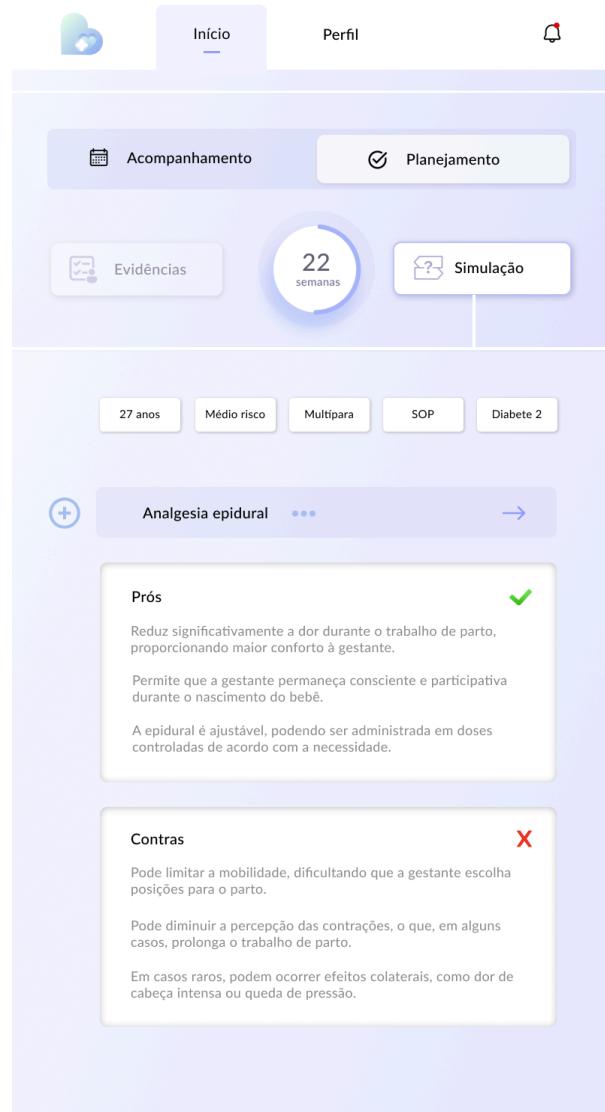
Salvar

Exportar

Source: Author

Finally, the scenario simulation screen was designed to provide the pregnant woman with an analysis of the possible impacts of her choices within the birth plan, presenting an evaluation of the pros and cons of each decision. Based on personalized segmentation of the specific data of each pregnant woman, the system offers a visualization of the potential effects of interventions, considering both positive and adverse occurrences. This feature allows for a non-linear understanding of the decision-making process, by integrating complex variables related to different childbirth practices, with an emphasis on the dynamic interactions between choices and their possible consequences, which allows for a more conscious and informed decision, reinforcing the user's autonomy in planning her childbirth.

Figure 22 - Simulation screen



Source: Author

6. PROPOSAL EVALUATION

As indicated in Chapter 3, the methodological procedure adopted to validate the proposal was conducted using a structured questionnaire in a qualitative format, made up of objective and discursive items. The instrument used a 5-point Likert scale to measure shades of opinion in continuous gradations. At the same time, open fields were incorporated in order to explore subjective dimensions and deepen understanding of the proposed prototype.

To enable dissemination and data collection, the evaluation instrument was developed on the Google Forms platform, whose access link was disseminated both via social networks and by sending it to specific contacts, previously indicated based on alignment with the profile required for the study, with a final total sample of 19 responses obtained between the 18th and 22nd of November 2024.

6.1 Evaluation tool

The structure of the questionnaire was organized in sequential stages to optimize the flow of responses. Initially, a brief introduction was presented setting out the purpose of the form, along with a consent form, in which respondents had to agree to their participation in order to proceed.

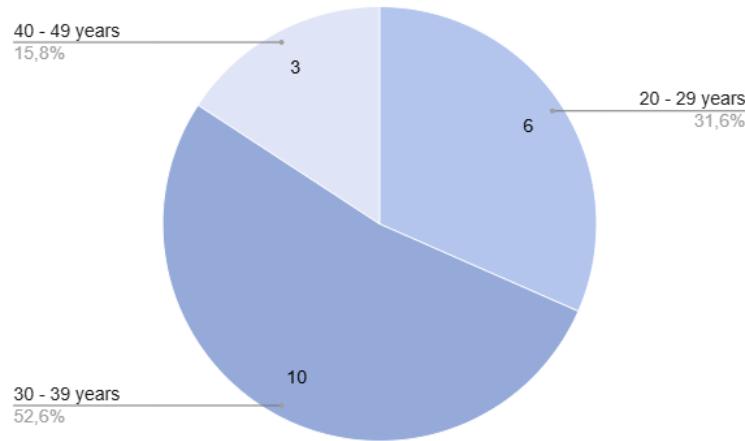
In the first stage, the aim was to characterize the profile of the participants through questions aimed at collecting sociodemographic and behavioral data, allowing contextual variables to be identified. Next, questions were asked with the aim of analyzing information demands, having in mind the understanding of specific needs from the target audience, followed by questions investigating the perceived relevance of the proposed platform. After this, participants were given a link to access the prototype on Figma for practical exploration. After interacting with the prototype, participants answered questions that assessed aspects of usability, design and functionality. Finally, a space was made available for comments and suggestions, providing an opening for free and complementary contributions to the structured evaluation.

Given the methodological choice of using Google Forms as the collection tool, the responses were automatically organized and centralized in a Google Sheets spreadsheet, which provided an immediate repository for processing the data. Based on this set of information, the results were analyzed and will be presented and discussed below according to the steps previously defined in the questionnaire.

6.2 Profile of the participants

Despite being a product that indirectly supports families in general, the survey was made up exclusively of female respondents, the main target audience for the idea. In terms of age, most of the participants were aged between 30 and 39 (50%), followed by 33.3% aged between 20 and 29 and 16.7% aged between 40 and 49, as shown in Graph 1.

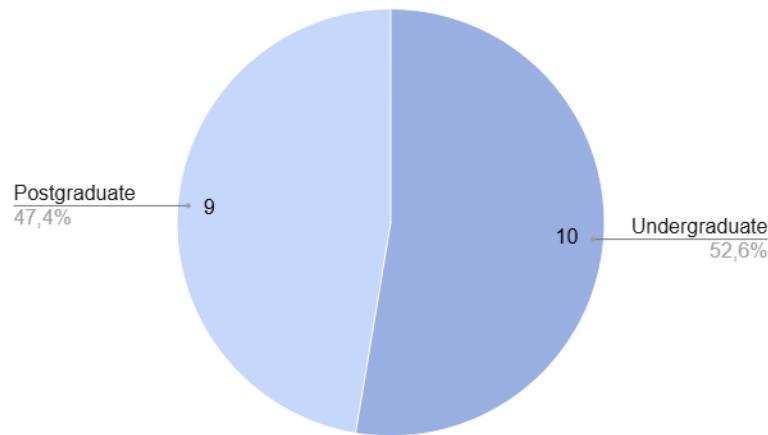
Graph 1 - Age of participants



Source: Author

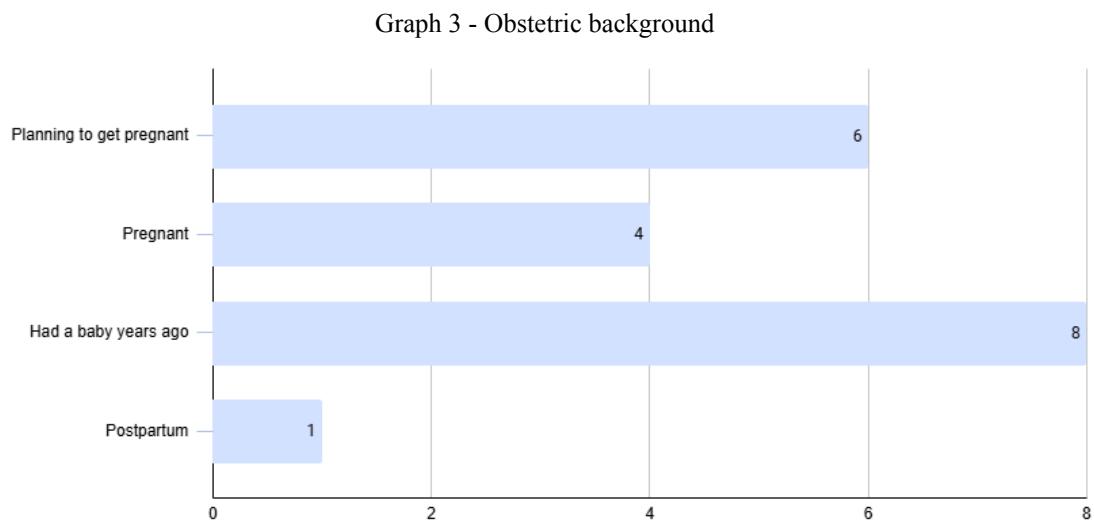
As for schooling, the survey was divided between participants with higher education (55.6%) and postgraduate degrees (44.4%).

Graph 2 - Participants' schooling



Source: Author

With regard to the participants' obstetric context, the group was divided into 6 participants who intend to become pregnant, 3 participants who are pregnant, 8 participants who gave birth years ago and 1 participant who is in the postpartum period, as shown in Graph 3.



Source: Author

With regard to the main sources of information used, each participant was asked to indicate the sources they used, allowing for multiple choices, and the majority cited clinical staff, social networks and websites or apps. The relative frequency, calculated as the percentage of each source in relation to the total responses, indicates the proportion of times each source was cited within the total set of responses. The frequency relative to the total number of participants expresses the proportion of participants who mentioned each source, which allows us to assess the popularity of each source among individuals, as shown in the table below.

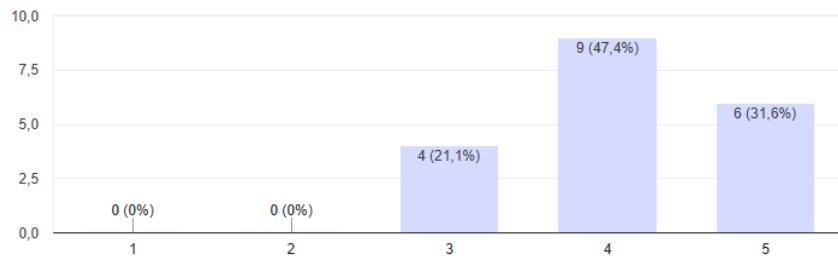
Table 14 - Sources of information

Source	Absolute frequency	Relative frequency - Total responses %	Relative frequency - Total participants %
Doctors and nurses	13	68,4%	26,5%
Social media	11	57,9%	22,4%
Websites and apps	11	57,9%	22,4%
Family and friends	10	52,6%	20,4%
Scientific research	2	10,5%	4,1%
Courses for pregnant	1	5,3%	2,0%
Midwives and doulas	1	5,3%	2,0%
Total	49	257,9%	100,0%

Source: Author

With regard to confidence in finding information on pregnancy care, the group indicated a level of confidence ranging from 1 (not very confident) to 5 (very confident), demonstrating previous confidence, within a scale between 3 and 5, as shown in Graph 4.

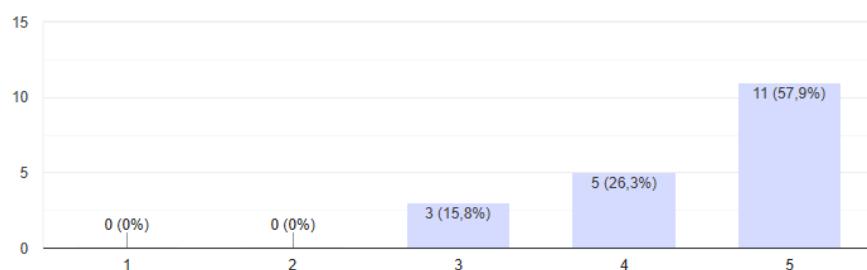
Graph 4 - Level of confidence in the information



Source: Author

In order to understand the relevance of the platform, the question was asked how useful a platform would be for centralizing information, with responses also within the range of 3 to 5.

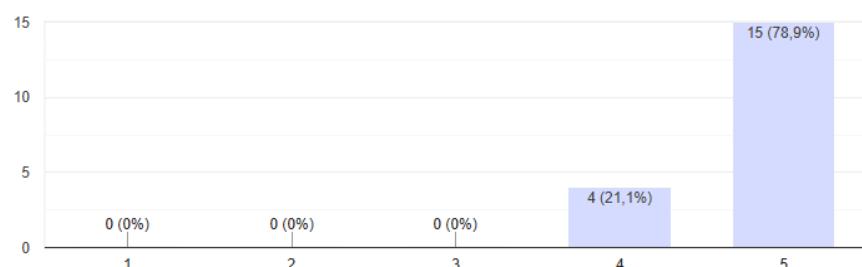
Graph 5 - Level of usefulness of a platform in decision-making



Source: Author

Regarding how reliable the platform would be considering that its main source would be evidence-based health guidelines, there were responses with a confidence level between 4 and 5.

Graph 6 - Trust level of a platform based on guidelines

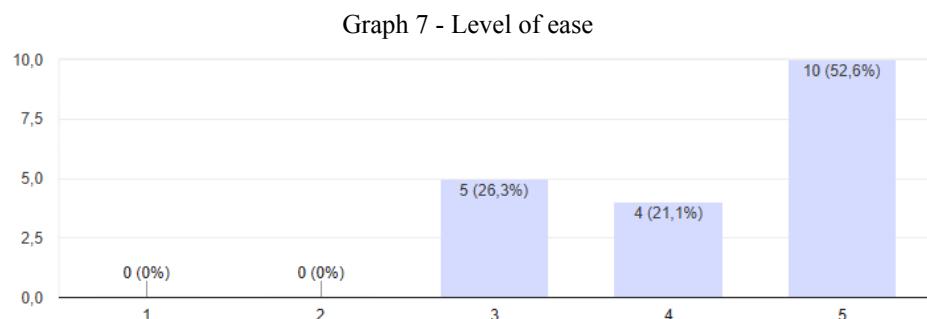


Source: Author

6.3 Perceptions of the prototype

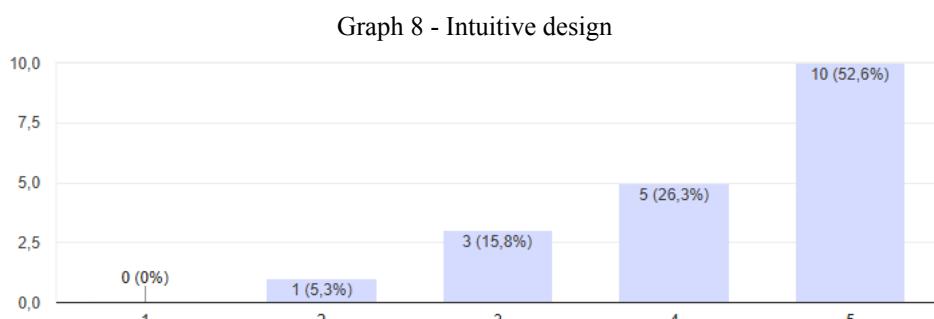
At this stage, the system was prototyped within the Figma tool, where screens were displayed with the possibility of navigating between interfaces. After observing the prototype, questions were asked about the visualization of the system in order to understand points of usability and visual organization. Each question followed the pattern of options on a scale of 1 to 5.

On the question “how easy do you think it would be to use the platform to monitor and plan your pregnancy?”, with options ranging from 1 (not at all easy) to 5 (very easy), 5 participants indicated level 3 ease, 4 indicated level 4 and 10 participants indicated level 5.



Source: Author

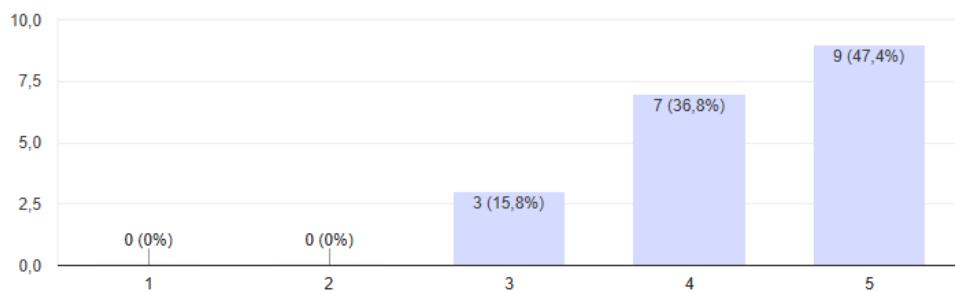
When asked “How intuitive does the design seem, i.e. easy to understand and use without needing instructions?”, the answers ranged from 1 (not at all intuitive) to 5 (very intuitive) with the majority indicating intuitive design, but 1 participant indicating level 2, as shown in the graph below.



Source: Author

The next question, asking “How do you rate the visual organization of the information on the screens?”, with options ranging from 1 (Very disorganized) to 5 (Very well organized), showed the following answers:

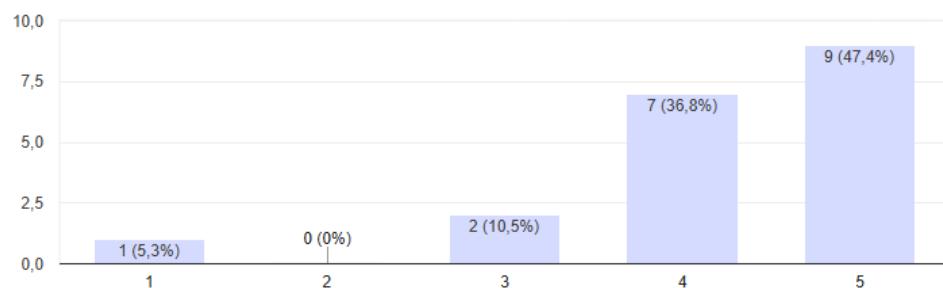
Graph 9 - Screen organization



Source: Author

With regard to “How visually pleasing and suitable does the layout of the screens seem for a health platform, considering reading comfort?”, which ranged from 1 (Not at all pleasing) to 5 (Very pleasing), the responses were more varied, with the majority indicating the layout was pleasing, but with 1 participant indicating level 1, as shown in the graph below:

Graph 10 - Layout pleasantness



Source: Author

6.4 Comments and suggestions

Considering the need to understand the diversity of perceptions for a more in-depth analysis of the proposal's strengths, limitations and opportunities for improvement, it was also decided to use open-ended discursive questions as a qualitative evaluation tool. Three main questions were designed to explore different dimensions of the participants' experience: “What did you like most about the idea of the platform?”, “What did you dislike most?” and “Is there any other functionality that you think is important to have in the system?”.

With regard to the first question, three main categories emerged: accessibility and centralization of information, reliability and specific functionalities. Centralization was widely recognized, as demonstrated by “*The practicality of finding information in one place*”

and “*Gathering information on maternity in a single/centralized location*”, showing that a recurring problem has been overcome: the dispersion of information that makes it difficult to find coherent and relevant data.

The credibility of the content received strong emphasis. Comments such as “*Having information from reliable sources*” and “*Gathering practical as well as theoretical information from reliable sources*” reinforce the importance of scientific and reliable sources, especially in a context where misinformation can impact pregnancy-related decisions. The democratization of access to this data was also highlighted: “*Reliable information for mothers who may not have easy access... because many mothers with access to information are mothers with money*”.

With regard to specific functionalities, comments such as “*I really liked the part that has data on maternity hospitals and the form that generates a birth plan*” and “*In addition to evidence-based information, having a forum for sharing real experiences*” indicate the value attributed to practical and socially connected resources. The balanced approach between technical objectivity and human sensitivity was another highlight: “*A platform that treats birth as something natural and outside of the medical aspect*”.

Analysis of the answers to the question “What did you dislike most?” revealed critical aspects and perceived gaps in the obstetric platform prototype. A recurring point in the responses was the difficulty of using and navigating the platform, attributed to the prototype presented. Comments such as “*I found it difficult to navigate. The letters are very small, I found it difficult to read*” and “*Lack of a content search tool, links make it difficult to find what you're actually looking for*” highlight weaknesses in the interface that impact the user experience.

The presence of many informative elements on a single screen was mentioned as potentially confusing, especially for individuals less familiar with digital applications: “*There is a lot of information immediately when you access the platform. For people who may not be familiar with app navigation, it's easier to sort through the information*.”

The perception of an excessive focus on design, to the detriment of informational content, was a relevant concern. The comment “*In the Figma displayed it is only possible to analyze the design of the platform, which I don't think is pertinent, since I understand that the focus is information and not UI/UX*” reinforces the need to prioritize the presentation of consistent data.

The space for sharing experiences raised concerns about moderation: “*If anyone can give their opinion without a mediator, then the purpose of the platform will probably be lost*”.

This criticism highlights the risk of misinformation, suggesting evidence-based mediation, involving professionals or experienced users.

Comparisons with established apps, as in “*I pay for the FLO app and it has more complete information on the menstrual cycle and pregnancy monitoring*”, highlighted the need for innovation and functional differentiation.

Analysis of the answers to the question “Is there any other functionality that you think should be present in the system?” pointed to technical and structural demands for improving the prototype. Extending the theme to the postpartum period was one of the main proposals: “*Include postpartum information, because many mothers focus on caring for the baby and forget to look at themselves. This attention to the puerperal woman can advance the assessment and diagnosis of postpartum depression.*”

The organization of the content was another point emphasized, with suggestions such as “*The separation by categories of themes and subcategories*” and “*A list of ‘warning signs’, priority exams by month and minimum items for layette*”, which aim to facilitate access to essential information. Resources such as checklists for the maternity bag were also mentioned in “*Counting the weeks and a checklist for preparing the maternity bag*”.

Proposals aimed at inclusion and interactivity highlighted the importance of engaging the pregnant woman's support network. Comments such as “*A page dedicated to the pregnant woman's partners, with articles aimed at their support role during pregnancy and in the postpartum period*” suggest the need to extend the system's reach to include third parties.

Technical integrations were mentioned as potential differentiators: “*Insert a link or functionality that connects with e-Lactancia, to search for medicines by active ingredients and assess their compatibility with breastfeeding*”.

Finally, functionalities that combine technical and emotional aspects were proposed to increase engagement. Comments such as “*Information to monitor the baby's growth during pregnancy with playful comparisons, such as size in relation to fruit*” and “*A space that brings real empowerment to this pregnant woman, more than just technical information*” highlight the importance of combining scientific objectivity with emotional connection.

These comments highlight the need for functionalities that broaden the scope of the system, improve the organization of content and promote greater interactivity and inclusion. These proposals, if implemented, could strengthen the utilitarian nature of the platform, guaranteeing its technical and emotional edge in supporting pregnant women and their support networks.

7. FINAL CONSIDERATIONS

The analysis carried out shows that there is a marked disjunction between the care that is ideally designed and the care that is actually offered to the population, manifesting itself across the board and on a permanent basis, whether in the context of preventive, acute or chronic care. This dissociation persists when considering practices of overuse, underuse and inadequate use of resources, transcends age and socio-economic categories, and encompasses various care modalities and health coverage configurations. It is therefore a structurally rooted and wide-ranging problem, found both in urban and metropolitan areas and in more peripheral regions, revealing a scenario of inequality and insufficiency in the provision of health services, as indicated by the Institute of Medicine (US) Committee on Quality of Health Care in America (2001).

In order to mitigate these gaps, there is an emerging need for tools that balance the demands between scarcity and overabundance of resources, without incurring in technological reductionism or the determinism of digital advances. Information technologies, although increasing, suffer from unequal access and development that is often decontextualized, without taking into account the specificities of each social and health reality. This dichotomy requires know-how that transcends the purely technical and enters a realm of epistemological integration that harmonizes competing values and offers innovative and adaptive responses to perennial issues. This approach requires, in addition to technical adaptation, the incorporation of a cultural intelligence capable of absorbing and learning from user experiences, keeping them at the heart of the innovative process and validating the importance of a continuous feedback loop.

In this sense, this research is committed to translating scientific rhetoric into applied practice, creating a favorable environment for the emergence of knowledge and innovations that are sensitive to the needs of the community. Structured according to the WHO's international guidelines and based on the principles of digital health, the proposal of a system capable of providing accessible, contextualized and scientifically based information, aims to promote informational empowerment, enhance discernment and expand the decision-making capacity of women at one of the most critical moments in their health trajectory.

The preliminary evaluation of the system, carried out through the construction and presentation of a prototype to potential users, indicated a predominantly positive reception, albeit limited by gaps that require further study. To ensure the validity of the proposal, it would be necessary to expand the sample and conduct more robust analyses, considering

qualitative saturation methods for content and themes, as well as quantitative approaches for statistical support. Despite these limitations, the preliminary results highlight positive aspects that validate the relevance of the platform and its ability to promote greater access to reliable and centralized information.

This final undergraduate work has therefore fulfilled its fundamental objective by designing an information environment that meets the needs of a specific audience, inserted in a complex and demanding ecosystem, while at the same time contributing to filling a biopsychosocial gap that limits humanized approaches and excludes women from fully exercising their citizenship in the health sphere.

It is pertinent to recognize that although this platform represents an important tool for information access, it is not self-sufficient in improving obstetric health. Its maximum impact depends on strategic coordination with other technologies and quality improvement initiatives, thus forming a multimodal intervention that covers the various dimensions of care. In addition, the open and free availability of this digital solution for health services nationwide could enable the implementation of a quality management program, benefiting not only the clinical care of pregnant women and newborns, but also the organization of care processes.

In conclusion, this study offers relevant contributions to health management and public health by proposing an innovative way to restructure obstetric care, with the aim of building a care model that prioritizes safety and humanization in childbirth. This proposal outlines a horizon of opportunities for strengthening the quality of care, broadening the spectrum of safe, effective and equitable interventions, in line with the global sustainable development goals and the health promotion strategy for women, children and adolescents.

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