Informatics

Beyond the Clinic

Exploring the Potential of User-Centered Design in mHealth for an Improved Wellbeing in Fertility Management.

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Wien, 26. März 2026

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DIPLOMA THESIS

submitted in partial fulfillment of the requirements for the degree of

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in

Media and Human-Centered Computing

by

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Registration Number 01451760

to the Faculty of Informatics

at the TU Wien

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Vienna, March 26, 2026

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Erklärung zur Verfassung der Arbeit

Caroline Sophie Altrichter, BA

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Wien, 26. März 2026

Caroline Sophie Altrichter

Danksagung

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Kurzfassung

Die weltweite Zunahme von Unfruchtbarkeit hat zu einer verstärkten Inansruchnahme medizinisch unterstützter Fortpflanzungsmethoden sowie mobiler Gesundheits-Apps (mHealth) für das eigenständige Fruchtbarkeitsmonitoring geführt. Viele digitale Hilfsmittel berücksichtigen jedoch nur in unzureichendem Ausmaß die Komplexität der Fruchtbarkeitsbehandlungen, die oft unvorhersehbar, emotional belastend und nicht-geradlinig verlaufen.

Diese Masterarbeit untersucht mithilfe nutzerzentrierter Designmethoden (UCD) die Anforderungen sowie die individuellen Erfahrungen von Frauen mit Verfahren der assistierten Reproduktion mit dem Ziel, die Entwicklung frauenspezifischer mHealth-Apps zu unterstützen, die konstruktiv, verantwortungsbewusst und frauenorientiert aufgebaut sind.

Diese Arbeit wendet einen qualitativen Ansatz in drei Phasen an. Die ersten Zwei kombinieren eine Literaturrecherche inklusive Untersuchung bestehender digitaler Anwendungen, „Cultural Probes” sowie semistrukturierte Interviews, um die erheblichen kognitiven Belastungen aufzudecken, die aktuellen Tracking-Apps mit sich bringen. Obwohl Fruchtbarkeits-Tracking zahlreiche Vorteile für reproduktive Gesundheit von Frauen bietet, wie etwa eine bessere Entscheidungsfindung und ein Gefühl der Selbstkontrolle, löst das Tracking häufig Angstzustände, zwanghafte Beschäftigung und Gefühle der Unzulänglichkeit aus, insbesondere wenn die Daten unverständlich, mehrdeutig oder erdrückend wahrgenommen werden. Darüber hinaus sind derzeit verfügbare Anwendungen im Bereich des Fruchtbarkeitsmanagements häufig dahingehend einseitig ausgerichtet, dass Rückschläge wie erfolglose Behandlungsversuche oder Fehlgeburten vernachlässigt werden und dadurch die psychische Belastung der Nutzerinnen zusätzlich verstärkt wird.

Mit diesen empirischen Erkenntnissen formuliert diese Masterarbeit in der dritten Phase sechs nutzervalidierte Designprinzipien, mit denen mHealth-Apps im Bereich der Reproduktionsmedizin auf einem stärker unterstützenden und einfühlsameren Ansatz hin ausgerichtet werden, der authentisch die Realitäten von Fruchtbarkeitsbehandlungen wiedergibt, indem er die Unsicherheiten und emotionalen Belastungenden damit befassten Menschen berücksichtigt und thematisiert.

Abstract

The global prevalence of infertility has led to an increasing reliance on medically assisted reproduction for conception and mobile health (mHealth) applications for fertility self-tracking. However, many digital tools do not adequately account for the complexity of the infertility treatment process, which is often unpredictable, emotionally demanding, and non-linear.

This thesis applies user-centered design methods to investigate the challenges and unique fertility journeys of women, with the aim of informing the design of more constructive, inclusive, and responsible female-oriented mHealth support tools.

The research adopts a three phase, qualitative approach, that combines a review of literature and existing digital interventions, cultural probes, and semi-structured interviews in the first two stages, to uncover the profound cognitive burdens imposed by current tracking practices. Despite offering many benefits for reproductive healthcare, such as enhanced decision-making and sense of control, fertility tracking frequently triggers anxiety, obsessive engagement, and feelings of inadequacy, particularly when the data becomes incomprehensible, ambiguous, laborious, and overwhelming. Moreover, available fertility management applications exhibit a prevalent design bias that marginalizes medical setbacks, such as failed treatment attempts or pregnancy loss, thereby further intensifying psychological distress of its users.

In the last research phase, drawing from these empirical insights, this thesis proposes six user-validated design principles that are established to redirect fertility mHealth toward a more supportive, sensitive approach that authentically aligns with the realities of individuals undergoing assisted reproduction by addressing the uncertainties and emotional labor.

Contents

CHAPTER 1

Introduction

1.1 Motivation and Problem Statement

Birth rates are declining world wide due to multiple factors, such as economic stress, shifting social values, better educational opportunities, as well as the availability of contraceptives. Moreover, in many countries, both advanced economies and developing nations, numerous couples are encountering obstacles in conceiving *naturally* [1, 2]. This incidence of infertility continuously grows as a result of medical, environmental, lifestyle, and personal circumstances combined, making it a rising concern [3].

In response, individuals pursue medically assisted reproduction (MAR) with the help of assisted reproductive technology (ART) treatments. Even though ART offers options, hope and prospects to a path to parenthood, the treatment process also introduces considerable obstacles regardless. Not only must patients deal with the underlying medical conditions that cause infertility, but they also have to face the immense social and psychological pressures associated with them [4, 5].

Navigating the process of ART is a complex and challenging issue that requires tremendous effort [6, 7] and the journey is rarely linear. A single treatment cycle involves strict scheduling, repeated clinical visits to extensively monitor and assess various health indicators, and numerous hormonal interventions. Infertile couples must face countless decisions regarding treatments, medications, and timing. In many instances, this is amid conditions of prolonged periods of uncertainty, low predictability (e.g., success of stimulation, fertilization, and embryo implantation), and high stress. These demands can be overwhelming, particularly for individuals that lack medical knowledge, a reliable support system, or those already struggling with the emotional burden of infertility, financial strain, and disruptions to everyday life.

To manage this process, patients increasingly use digital health technologies. Particularly mobile health (mHealth) applications are increasingly utilized to generate personal health data in unprecedented detail. These apps help individuals to proactively engage in their health by prevention and management of medical conditions, monitor progress towards a set goal, and in the facilitation of behavioral changes [8, 9]. Quantifying all aspects of life has emerged as a movement, thus tracking and understanding body metrics has become feasible, comprehensible, and normalized. As a result, self-monitoring now depicts an integral component of daily life, health, and wellness [10, 9, 11]. For women[1], continuous tracking of body signals throughout the menstrual cycle can aid in health management. It provides access to a more detailed summary of meaningful reproductive data and users can interpret their health information quickly. Thus, women-centered apps focusing on fertility tracking are being used more frequently to monitor key reproductive signs [12, 13, 14, 15]. Consequently, with this user-generated data people are able to formulate informed decisions and actions. It builds greater self-knowledge and contributes to the improvement of overall health outcomes [16, 17, 18].

However, fertility self-tracking does not occur in isolation. For women undergoing ART, self-tracking is embedded within already complex treatment trajectories. Rather than simply providing support, existing tools can introduce additional cognitive and emotional burdens by emphasizing biomedical optimization, prediction accuracy, and normative reproductive timelines. Many apps are predominantly engineered assuming a straight path toward a successful pregnancy. Thereby, these designs insufficiently account for the harsh reality of ART. Patients are confronted with uncertainty, treatment failures, relationship stress, and emotional vulnerability. As a result, current fertility technologies risk amplifying stress instead of alleviating it.

This thesis starts from the premise that couples in ART treatments are already dealing with a highly intricate situation. Designing fertility self-tracking tools without understanding these experiences may unintentionally exacerbate prevalent challenges. Accordingly, there is a need for design approaches that takes into consideration the users' actual experiences and translate them into meaningful digital support.

User-centered design (UCD), as a methodological approach, provides a promising framework for addressing the current gap. Through actively involving users and by attending to their situated experiences, user-centered methods contribute to uncovering needs, values, and concerns that remain invisible in purely technology-driven approaches. In sensitive health contexts such as infertility, these methodologies are particularly important for capturing emotional, relational, and experiential dimensions that cannot be derived from medical data alone.

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[1] In this thesis, the gendered term "woman" and "women" refers to anyone who either has currently, or has previously experienced a menstrual cycle. This aligns with the common framing of "women's health" within the HCI community, when exploring health issues related to menstruation, pregnancy, and menopause. I acknowledge that there are individuals who menstruate but may not identify as a woman and not everyone who identifies as a woman is menstruating.

1.2 Aim of the Work

The aim of this thesis is to explore the specific difficulties women and couples encounter when tracking fertility data during ART treatments and to investigate how these experiences can inform the design of more supportive tracking mHealth technologies. The main goal is to facilitate the advancement of more effective and user-centric fertility self-tracking applications that consider the unique challenges and factors associated with (in)fertility tracking and ART.

To achieve this, the thesis is guided by the following research questions:

RQ1. *How do women engage in fertility self-tracking, and what challenges do they encounter?*

RQ2. *How does the design of existing fertility technologies align or conflict with women's lived realities during ART treatment?*

RQ3. *How is the communication of uncertainty in fertility tracking experienced, and what does this imply for the design of fertility self-tracking technologies?*

In addressing these questions, the following hypotheses are investigated:

H1. *The way uncertainty is communicated in fertility self-tracking technologies influences users' trust, engagement, and decision-making. Appropriate visualization and explanatory design strategies may help to mitigate these effects.*

H2. *Engagement with fertility self-tracking technologies affects users' emotional wellbeing and self-perception, with design features potentially contributing to both positive and negative experiences.*

H3. *Users' experiences of fertility data and self-tracking technologies are shaped by socio-cultural context, personal values, and relational dynamics (including partner involvement), and these factors should be explicitly considered in the design of fertility tracking systems.*

Based on the research questions and hypotheses, the specific objectives of this work are:

1. Understanding Self-Tracking Practices and Challenges: Explore how women track fertility during treatment and identify the practical, emotional, and cognitive challenges they encounter in managing fertility-related information (addresses RQ1 and H2).

2. Examining Design, Data Experience, and Uncertainty Communication: Examine how existing fertility tracking apps communicate health data and uncertainty, and investigate how these design choices influence users' trust, engagement, interpretation, and decision-making (addresses RQ2, RQ3, and H1).

3. Investigating Psychological, Embodied, and Socio-Technical Impacts: Study how fertility tracking apps influence users' emotional wellbeing, self-perception, and relationships, taking into account socio-cultural context and partner involvement (addresses RQ2 and H3).

By exploring these objectives, the study contributes to the fields of mHealth in assisted reproduction and Human-Computer Interaction (HCI). The core contributions of this work are as follows:

- It provides empirical facts about the actual experiences and mental load of ART patients who track their fertility.
- It demonstrates the value of cultural probes in a highly sensitive fertility context to reveal the emotional dimensions of self-tracking.
- It translates qualitative insights into concrete, user-validated design principles that shift fertility tracking from a purely quantitative, data-driven practice into a supportive, human-centered approach.

1.3 Methodological Approach

To gain a realistic and holistic understanding of the unique experiences of women and couples undergoing ART, this study utilizes a qualitative, multi-method UCD approach. The process is divided into three distinct phases: (1) Discover, (2) Define, and (3) Develop and Evaluate. This framework ensures that the perspectives of those directly affected by infertility remain at the core of the design process. The employed methods are elaborated in detail in Chapter 3.

1.4 Structure of the Thesis

This thesis is organized into 8 chapters, structured as follows:

1. Introduction: Outlines the motivation, problem statement, research questions, and the methodological approach of the thesis.

2. Related Work: Reviews relevant literature on assisted reproduction, the burdens of fertility self-tracking, and the gaps in current mHealth technologies, establishing the conceptual foundation for the study.

3. Methodology: Details the qualitative, user-centered research design, including the procedures for the state-of-the-art review, cultural probes, semi-structured interviews, and a participatory co-evaluation workshop.

4. Findings from Reviewing mHealth Interventions: Presents the review of existing scientific and commercial ART support applications. It highlights the critical design flaws like the “happy path” bias.

5. Findings from User Research: Details the empirical insights gathered from patient diaries (cultural probes) and semi-structured interviews with both fertility specialists and patients.

6. Results: Synthesizes the research findings into an initial set of design principles, presents the feedback gathered during the co-evaluation workshop, and establishes the finalized design guidelines.

7. Discussion: Interprets the findings, answers the research questions and validates the hypotheses. It also discusses the broader ethical and design implications and presents the limitations of the study.

8. Conclusion: Summarizes the core contributions of the thesis and suggests future work.

CHAPTER 2

Related Work

This chapter provides the theoretical foundation for the thesis, by examining how assisted reproductive technology (ART), fertility self-tracking, and user-centered design in digital health intersect. It first examines the complexity of ART characterized by the medical uncertainty, emotional strain, and extensive self-management. It then reviews literature on mHealth and fertility self-tracking, highlighting tensions between empowerment and burden as well as limitations of current reproductive health technologies.

Together, these perspectives form the basis for this study and motivate the adoption of user-centered methods to design better fertility self-tracking tools that represent the realities of individuals undergoing ART.

2.1 Infertility and Assisted Reproduction

Infertility is a serious global health problem. It occurs in both men and women and may have a profound physical, psychological, and social impact. According to the World Health Organization (WHO), infertility, although not life-threatening, is classified as a disease and is clinically defined as the inability to achieve a successful pregnancy following twelve months of regular, unprotected sexual intercourse. Present figures indicate that infertility affects around 17.5% of the world's adult (childbearing) population, i.e., around one in six individuals [19, 7, 20, 21]. This corresponds to approximately 282 million people suffering from infertility [22].

Accordingly, there has been an escalating demand for medical assistance to have children. ART is a collection of advanced and sophisticated medical interventions that address several causes of infertility. Central to understanding the extent, possibilities, and limitations of medically assisted reproduction (MAR) are the wide-ranging causal factors of involuntary childlessness and the need for individualized treatment [3].

2.1.1 Reasons for Infertility and Childlessness

Infertility is defined as either primary (no prior pregnancies) or secondary (difficulty conceiving after a previous pregnancy, even if that pregnancy resulted in a live birth or not) [23], and is influenced by multiple conditions [5]. It results from various biological, environmental, lifestyle, age-related, and socio-cultural factors, that affect both women and men. Historically, the responsibility for fertility issues was primarily placed on the female reproductive health. However, up to half of the infertility cases can be attributed to male infertility factors [24, 25, 26, 27, 28, 29, 30]. Therefore, men and women share an equal role in a couple's ability to conceive.

In most cases, infertility emerges from the combined influence of several factors, and in other instances, remains unexplained despite thorough medical evaluation. The contributing factors for infertility are presented in Table 2.1. It provides a comprehensive overview of the potential challenges a couple may face.

Category	Specific Factors	Description
Female Biological	Ovulatory dysfunction (PCOS, thyroid issues, premature menopause, etc.)	Disrupts hormonal regulation and egg release, prevents or irregularizes ovulation [23]
	Fallopian tubal factors (scarring or blockages from infection, scarring, endometriosis)	Blocks egg–sperm transport, prevents fertilization [30, 31]
	Endometriosis (Growth of uterine lining outside the uterus)	Causes inflammation, cyst formation, scarring, impair fertilization and implantation [30, 31, 23]
	Uterine factors (noncancerous growths like polyps and fibroids, scarring)	Alters uterine structure, reduces implantation success [32]
	Cervical factors (pinhole cervical os, abnormally thick cervical mucus, "absolute untreatable uterine factor", cervical polyps, scarring)	Obstructs sperm passage, limits access to egg [30, 31, 23]
Male Biological	Abnormal sperm (low count, complete absence, poor motility, abnormal morphology, general decrease in sperm quality)	Reduces fertilization capacity [30, 31, 33]
	Genetic abnormalities (DNA fragmentation, chromosomal alterations)	Impairs embryo viability, increases miscarriage risk [30, 31, 34, 33]

Table 2.1: Multifactorial influences on infertility

Continued on next page

Category	**Specific Factors**	**Description**
Male Biological	Anatomic anomalies (congenital absence of seminal ducts, physical disabilities, etc.)	Blocks sperm transport, prevents sperm delivery [30, 31, 23]
	Endocrine & metabolic (diabetes, thyroid disease)	Disrupts hormone balance and spermatogenesis, reduces sperm quality [23]
Environmental	Pesticides, industrial pollutants, endocrine disruptors (BPA, plasticizers “phthalates”)	Hormonal interference and oxidative stress, impairs egg and sperm quality [5, 28, 34]
Lifestyle & Metabolic	Obesity or being overweight, insulin resistance, chronic inflammation	Hormonal imbalance, impaired ovulation and sperm production, increases infertility risk in both sexes: for women risk of infertility increases by 3% per additional centimeter of waist circumference, obesity in men has been linked to diminished sperm quality and total reproductive potential [5, 26, 28, 34, 29, 35, 36, 37]
Age	Female age >30	Increased aneuploid pregnancy (abnormal amount of chromosomes in an embryo elevates risk of genetic diseases or pregnancy failure), declining ovarian reserve, reduced conception rates (74% <31 vs. $54\% \geq 31 annually$)[29, 32, 38].
	Male age >40	Gradual sperm quality decline, increased DNA damage, higher risk of specific health conditions in offspring (i.e., autism/ASD, schizophrenia) [29, 37, 39, 40, 41]
Socio-Cultural	Gendered perceptions of infertility	Disproportionate emphasis on women’s reproductive roles (affects men and women at comparable rates), majority of fertility treatments centered on the female body, irrespective of whether the underlying cause of infertility is attributed to the female or male partner, may delay male evaluation and comprehensive care [25, 33, 42, 43, 44]

Table 2.1.: Multifactorial influences on infertility (continued)

Overall, infertility should be understood as a shared, systemic health condition influenced by biological vulnerability, environmental exposure, lifestyle decisions, and social context. It is never a single-cause or gender-specific issue.

2.1.2 Treatment Protocols (Procedures, Tests and Medications)

Fertility treatment is a complex process that runs in cycles. Its success relies on a series of coordinated procedures and tests arranged to optimize the reproductive outcome. Each medical intervention must be precisely scheduled with the menstrual cycle of the female patient. The degree of invasiveness is constantly changing and may be altered throughout the duration of the treatment. It is common for patients to move from less invasive approaches to more intensive procedures. In general, clinical guidelines suggest beginning with the least invasive of the available methods, taking the patient's specific medical profile and needs into consideration. This explains why intrauterine insemination (IUI) is usually performed before proceeding to more advanced methods like in vitro fertilization (IVF) or IVF with intracytoplasmic sperm injection (ICSI) [45]. Moreover, the selected treatment form is supposed to specifically address the identified cause of infertility and apply the techniques that are most likely to provide the best possible opportunity of assisting conception [32].

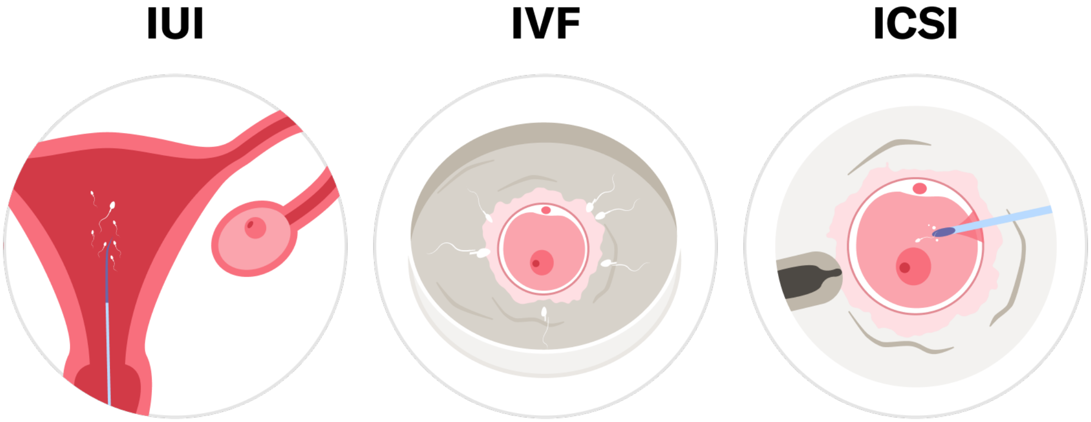
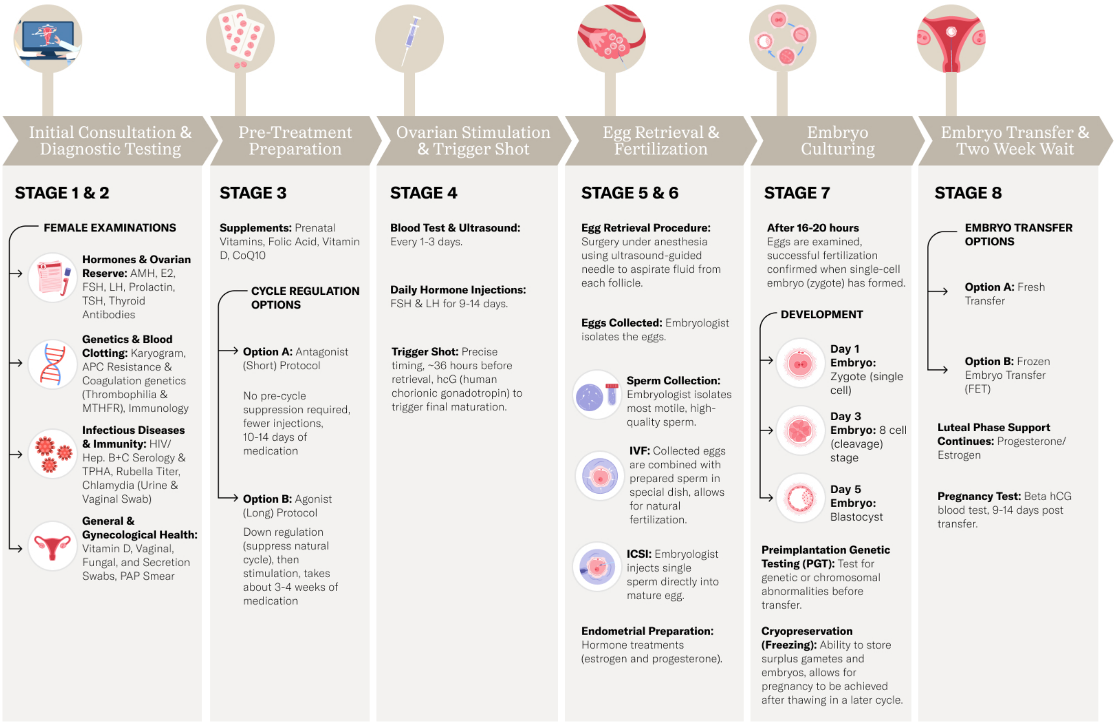


Figure 2.1: Comparison of ART treatments: IUI involves the direct insertion into the uterus during a natural cycle, conventional IVF with "natural" fertilization in a culture dish compared with ICSI, where a single sperm is injected into a mature oocyte (egg).

IVF and ICSI Fertilization Process

In conventional IVF, which is considered closer to the "natural" fertilization process, fertilization happens outside the body in a controlled laboratory culture dish, sperm penetrates the eggs, and the resulting embryos are transferred into the uterus [30]. ICSI is a specialized fertilization technique of IVF, in which the embryologist selects a single sperm, immobilizes it, and in a laboratory culture dish directly injects the sperm into the cytoplasm of a mature egg using a microscopic needle. This reduces the risk of fertilization failure and is typically advised for severe male factor infertility (e.g., surgical retrieval PESA/TESE, high anti-sperm antibodies, or previous IVF failure) [30, 46].

IVF/ICSI are meticulously coordinated clinical procedures, that are not singular medical events but multi-cycle, demanding processes. A single cycle consists of numerous distinct stages, which are typically carried out over the course of 4–6 weeks (excluding first consultation and diagnostic evaluation) and require the patient to navigate a rigorous protocol of hormonal injections, transvaginal ultrasounds, and blood tests. Each phase is critical to the overall success of the treatment and necessitates close observation (e.g., ultrasound scans and blood work every 2-3 days) and precise execution (e.g., adjusting medication dosages) by the medical team and the patient (e.g., daily hormone injections, “trigger shot” administration 36 hours before the scheduled egg retrieval), often requiring daily appointments for monitoring that disrupts work and social routines [47, 48], as seen in Figure 2.2.


Initial Consultation & Diagnostic Testing

STAGE 1 & 2

FEMALE EXAMINATIONS

- **Hormones & Ovarian Reserve:** AMH, E2, FSH, LH, Prolactin, TSH, Thyroid Antibodies
- **Genetics & Blood Clotting:** Karyogram, APC Resistance & Coagulation genetics (Thrombophilia & MTHFR), Immunology
- **Infectious Diseases & Immunity:** HIV/ Hep. B+C Serology & TPHA, Rubella Titer, Chlamydia (Urine & Vaginal Swab)
- **General & Gynecological Health:** Vitamin D, Vaginal, Fungal, and Secretion Swabs, PAP Smear

Pre-Treatment Preparation

STAGE 3

Supplements: Prenatal Vitamins, Folic Acid, Vitamin D, CoQ10

CYCLE REGULATION OPTIONS

- **Option A:** Antagonist (Short) Protocol

  No pre-cycle suppression required, fewer injections, 10-14 days of medication
- **Option B:** Agonist (Long) Protocol

  Down regulation (suppress natural cycle), then stimulation, takes about 3-4 weeks of medication

Ovarian Stimulation & Trigger Shot

STAGE 4

Blood Test & Ultrasound: Every 1-3 days.

Daily Hormone Injections: FSH & LH for 9-14 days.

Trigger Shot: Precise timing, ~36 hours before retrieval, hcG (human chorionic gonadotropin) to trigger final maturation.

Egg Retrieval & Fertilization

STAGE 5 & 6

Egg Retrieval Procedure: Surgery under anesthesia using ultrasound-guided needle to aspirate fluid from each follicle.

Eggs Collected: Embryologist isolates the eggs.

Sperm Collection: Embryologist isolates most motile, high-quality sperm.

IVF: Collected eggs are combined with prepared sperm in special dish, allows for natural fertilization.

ICSI: Embryologist injects single sperm directly into mature egg.

Endometrial Preparation: Hormone treatments (estrogen and progesterone).

Embryo Culturing

STAGE 7

After 16-20 hours Eggs are examined, successful fertilization confirmed when single-cell embryo (zygote) has formed.

DEVELOPMENT

- **Day 1 Embryo:** Zygote (single cell)
- **Day 3 Embryo:** 8 cell (cleavage) stage
- **Day 5 Embryo:** Blastocyst

Preimplantation Genetic Testing (PGT): Test for genetic or chromosomal abnormalities before transfer.

Cryopreservation (Freezing): Ability to store surplus gametes and embryos, allows for pregnancy to be achieved after thawing in a later cycle.

Embryo Transfer & Two Week Wait

STAGE 8

EMBRYO TRANSFER OPTIONS

- **Option A:** Fresh Transfer
- **Option B:** Frozen Embryo Transfer (FET)

Luteal Phase Support Continues: Progesterone/ Estrogen

Pregnancy Test: Beta hCG blood test, 9-14 days post transfer.

Figure 2.2: Overview of the key steps involved in IVF/ICSI, from ovarian stimulation and egg retrieval to fertilization, embryo culture, and embryo transfer.

Summary

Infertility is a complex health condition and rarely results solely from an isolated dysfunction. It develops from many interacting variables such as biological vulnerabilities, environmental exposures, lifestyle choices, and inevitable age-related declines affecting both partners [5, 29].

Historically and culturally, the burden of infertility and the subsequent medical interventions, have been placed disproportionately on the female body. However, current clinical evidence indicates that male factors contribute to approximately 50% of all infertility cases [24]. It is essential to acknowledge this shared biological reality in order to destigmatize the condition, and to ensure both partners receive timely and comprehensive medical evaluations. Due to the diversity of the underlying causes of infertility, ranging from genetic anomalies and endocrine disruption to structural blockages, the medical response cannot be a “one-size-fits-all” approach. Instead, addressing these diverse biological and environmental obstacles requires highly individualized, meticulously timed, and often invasive medical interventions.

2.1.3 The Burdens of Assisted Reproduction

ART provides a path to conception for individuals suffering from infertility, offering hope where biology has presented a barrier. Yet, the treatment comes at a profound economic cost, in addition to the considerable physical and emotional hardship. Moreover, the efficacy of ART is inherently overestimated, and the medical interventions do not guarantee a rewarding outcome: a clinical pregnancy followed by a live birth. The procedure of human implantation is intricate and the probability of achieving a favorable result per treatment cycle depends on numerous variables. Nonetheless, the success rate is never 100% [49]. The likelihood of a live birth ranges from below 20% to above 50% [32, 49, 50], with an astonishing 75% failure rate for every attempt [32]. To, therefore, compensate for the limitations of one treatment cycle, the conventional clinical approach involves a multicycle strategy. Following three ART cycles, the live birth rate reaches 42.3% [32, 49]. This demonstrates that the treatment process is frequently long and demanding. For this reason, the psychological distress associated with an unsuccessful procedure is reportedly immense, comparable in magnitude to the stress of the initial infertility diagnosis [32].

Economic Demands

The substantial medical expenditures of ART may vary by country, nevertheless across Europe and the Asia-Pacific region, the total amount spent on a single cycle ranges from €4,108 to €12,314 [51]. There is a great disparity in insurance or public coverage of fertility treatments in high-income countries. While Switzerland does not offer funding [52], partial coverage or reimbursement is provided in some nations, including Australia, Austria, Chile, Germany, Denmark, Ireland, and Italy [53]. Even when public funding exists, it is often accompanied by eligibility criteria and strict regulations. In Austria, qualification for financial support by the IVF Fund is contingent on fulfilling several non-medical and medical criteria. These include the presence of a legally recognized partnership, the adherence to the age thresholds (female under 40, and male under 50 years), a valid Austrian health insurance and the possession of a residence permit or citizenship (Austria, EEA, or Swiss). Moreover, a main residence registered in Austria for at least one partner is mandatory. In addition to these requirements, a medical indication for treatment must be present in at least one partner, such as endometriosis, PCOS, fallopian tube obstruction, or male infertility factors. Once prospective couples satisfy the defined set of requirements, the IVF Fund will cover 70% of the costs associated with IVF, ICSI, and cryopreservation of embryos, as well as MESA, and TESE, if applicable. The maximum number of public coverage is set at four cycle attempts [54]. This four-cycle limit also applies in Bulgaria, Croatia, France, and Iceland. Whereas Hungary, Belgium, and Slovenia offer partial compensation for up to six cycles, the most common limitation in European countries is three [55]. Additionally, government funding is frequently restricted by a range of non-clinical factors, including maternal age, body mass index (BMI), personal income, and whether the patient already has children [52, 53].

Even with public funding mechanism, individuals having to secure the requisite funds to finance the procedures and needing to liquidate assets, such as property, emphasizes how ART interventions impose a remarkable financial burden [47]. The high out-of-pocket payments may, therefore, be a barrier for many couples to accessing ART services and a justifiable reason for discontinuing treatment [51, 52, 53]. Furthermore, the economic pressure and societal expectation of the male being the provider is identified as a source of considerable psychological distress during the treatment process. Consequently, men with prior experience of unsuccessful cycles express concerns over the anticipated negative psychological effects on both themselves and their partners following a failed attempt [56, 57].

Procedural and Logistical Demands

The physical demands associated with multiple invasive procedures within the ART process clearly serve as a compelling demonstration of their influence on the emotional burden experienced by patients. A central feature of the embodied experience is that women become the primary recipient of medical interventions, regardless whether infertility is due to male factors or remains unexplained. Irrespective of the infertility's etiology, typically the woman's body is subject to the intensive treatment protocol, which includes diagnostic-curative operations, transvaginal ultrasounds, blood testing, daily hormonal injections, oocyte retrievals, and transfers, some of which frequently require anesthesia or hospitalization. Managing the physical pain and discomfort resulting from surgical interventions is often reported as an emotionally challenging aspect of ART [58, 59, 60, 61, 62]. Hormonal drugs[1] during infertility treatment include both orally administered and injectable medications. Research indicates that women undergoing ART treatment encounter significant psychological alterations throughout their journey. The changes in emotional and cognitive functioning are often attributed to both the pharmacological components as well as the inherent stress of the medical procedures itself [63]. These treatment-related side effects, commonly linked to the hormonal stimulation, encompass depressive and anxiety symptoms, mood fluctuations, irritability, sleep disturbances, difficulties in concentration, bloating, and fatigue. The inherent uncertainty of treatment outcome further contributes to the psychological distress in individuals [59, 60, 61, 62].

The overwhelming time commitment associated with scheduling difficulties, clinical appointments, and travel can additionally interfere with an individual's work responsibilities and daily routines [59, 62, 64, 65]. The combination of these factors with the inherent complexities of diagnosis, the required therapeutic procedures and longer waiting periods during critical phases of the treatment cycle, provoke elevated levels of disappointment and exacerbate persistent anxiety [43, 58, 66].

The psychological distress of the economic burden, medical demands, and the stringent infertility treatment regimens is substantiated by research, wherein 15% of men and 49%

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[1] Medication that (1) trigger the ovaries to release an egg, (2) trigger the growth of eggs, (3) help produce a high number of quality eggs, and (4) help prevent premature ovulation.

of women regarded their infertility as the most difficult period in their life [67, 68, 69]. Moreover, infertility was perceived as more stressful than the COVID-19 pandemic, according to a more recent study [67].

The decision for discontinuing ART treatment prematurely is driven by these various factors. While financial concerns are identified as a major contributor, even among insured patients, treatment failure with the accompanied discerned poor prognosis by the patients are also critical drivers for termination [43, 58, 70, 71, 72]. Additionally, the patient experience with the actual standard of clinical care impacts treatment adherence and discontinuation. This includes the deficiencies in clinic-related organization and coordination as well as insufficient information provided by staff. The disappointing quality of communication between patient and providers, as well as the perceived lack of empathy and unsatisfactory listening skills are all rudimental aspects [66].

Nevertheless, the most decisive cause for patients declining further treatment procedures is the emotional distress and psychological burden of the trauma of failure and physical pain during infertility treatments, superseding the aforementioned consequences [50, 58, 65, 71, 72].

Psychological Impact and Coping Strategies

Consistent with the patterns observed in other chronic health diseases, the diagnostic confirmation and management of infertility may cause or exacerbate emotional distress [64, 65, 73]. This psychological burden of infertility is not just the outcome of being diagnosed with a medical condition, but rather an inherent if not defining feature of the patient experience itself. Negative emotional states and stress often fluctuate throughout the infertility journey. The distress begins before ART treatments start but are highest for individuals currently undergoing assisted conception and often worsen during the course of the procedures, especially following a treatment failure [64, 67, 68]. Even though the majority of men and women seeking infertility treatments seem emotionally stable, the journey is often characterized by a cascade of feelings including depression, anxiety, social isolation, guilt, denial, and debilitating loss of control [73, 74]. Each individual's experience is unique, however, research consistently confirms that these emotional effects can be long-lasting, indefinite and devastating for both female and male patients receiving fertility treatments [57, 67].

It is worth mentioning, however, that individuals undergoing ART treatments for infertility and those donating eggs report markedly different physical and emotional experiences. Women suffering from infertility will frequently express that the process is overwhelming, physically uncomfortable, and isolating, as a result of the intense personal significance attached to achieving pregnancy. By contrast, egg donors, despite following an identical medical protocol, tend to portray the experience as brief, manageable, and only mildly uncomfortable. This divergence is due to the vastly different motivations and expectations of these two groups: donors receive financial compensation for their participation and are not pursuing a deeply desired pregnancy outcome. Both egg donors and infertility patients undergo the same medical regimen that involves several weeks of daily self-administered fertility hormone injections to stimulate the ovaries to produce multiple mature eggs. Following the injection period, both undergo an outpatient egg retrieval procedure in which needles are inserted through the vaginal wall to access the ovaries to aspirate and collect developed eggs. Objectively, as mentioned above, their medical journey appears identical. However, a crucial nuance exists. Egg donors are typically given slightly lower doses of medication than IVF patients as they are generally young and fertile. Moreover, at this stage, the treatment concludes for donors, whereas IVF patients must then wait to determine whether embryos successfully develop before proceeding with an additional embryo transfer procedure into the uterus. For repeat donors, the process becomes a known, manageable job. For IVF patients, however, subsequent cycles likely imply that previous attempts to conceive failed, maintaining the high emotional investment regardless of how many times they undergo the procedure [75].

Since IVF using a woman's own eggs occurred long before the practice of egg donation, much of the early research examining bodily experiences with these treatments focused primarily on *infertile* women seeking pregnancy. Consistently, these studies describe the hormone injection regimens and surgical interventions negatively. Even though both egg donors and IVF patients report comparable levels of physical pain and side effects, their emotional and cognitive responses to the process differ substantially. 76% of IVF patients report experiencing greater emotional distress (*"feeling blue"*) at least some of the time, compared to 60% of egg donors reporting no such feelings. The cognitive impact of the treatments is similarly more pronounced among IVF patients, who are far more likely to report persistent thoughts about the treatment cycle for extended periods of time (76% compared to 32% of egg donors), and to describe being unable to perform work or daily activities (62% versus 37%). These findings support existing literature, which characterizes infertility treatment through IVF as a challenging life event that generates negative emotions and places considerable demands on cognitive resources [75].

Medically assisted conception provokes different gender-specific responses, with men and women exhibiting diverse coping mechanisms and psychiatric symptoms. Women experience the infertility process as a direct physical and emotional burden, with a higher reported incidence of mental health issues. Documented in clinical samples, almost 40% of women experiencing infertility meet diagnostic criteria for a psychiatric condition [73]. The severity and scope of the distress felt by women suffering from involuntary childlessness is similar in intensity to that felt by patients with serious illness such as cancer [50, 76, 77]. Infertility and the strong desire to have a child appears to be a more pivotal element of womanhood [22, 61, 78]. For many women, pregnancy and motherhood is frequently considered a pathway to self-actualization, thus infertility may represent a great barrier to attaining a prominent life goal. Certain women, who are unable to conceive, report that infertility becomes the central focus of their existence, obstructing their sense of progression through life [79]. Therefore, not being able to overcome childlessness can expose women to social pressures, stigma, feelings of shame, powerlessness, and inadequacy as a woman [64, 70, 78, 79, 80]. Negative emotions such as jealousy and resentment are also associated with the experience of infertility treatment [50]. Additionally, the profound sadness linked to the sense of loss or failure to reproduce can erode self-esteem and challenge one's identity [58, 79]. Moreover, women exhibiting infertility may face devastating consequences in contexts where the continuation of lineage is instrumental in ensuring marital status and inheritance rights. In such cases, women are particularly vulnerable to intimate partner violence, which materializes as psychological abuse, physical harm, sexual violence, and money-related oppression [22].

As time progresses and in response to the psychological stressors, many women increasingly adopt and rely on emotion-focused coping strategies to manage the pervasive stress and uncertainty associated with their journey. To address the ongoing challenges, individuals seek social support from their network of friends, family members, and online peer groups for positive reappraisal [81, 82, 83]. Such social support commonly includes love and reassurance to those that undermine their self-worth, validation that particular thoughts and feelings are understandable, and guidance that helps individuals appraise their situations [84].

Across studies, evidence indicates that women engage more actively than men in online health information research, motivated in part by the social connection and the enjoyment derived from these activities [85, 86]. Individuals report that digital peer networks offer valuable information that complement expert guidance. The ability to search for advice from others facing similar diagnoses and to exchange precise strategies for symptom interpretation or management are regarded as a primary benefit [86]. Engaging with people over the internet gives women hope. Moreover, the formation of new social ties affirms that their experiences are shared [76]. Online information makes women feel more educated and capable of decision-making. Additionally, it also facilitates discussion with partners and physicians [76]. Compared with men, women rate both the usefulness of the information found and the usability of digital health channels more highly and participate more frequently across platforms, even while reporting lower self-assessed digital competence. Women also report to have a stronger desire to be well-informed as patients and more reluctant to seek formal medical care [85].

Gender differences in motivational attitudes toward parenthood also appear to exist. Whereas women more regularly express a stronger yearning for motherhood, men are more preoccupied with fulfilling the social expectations and responsibilities of fatherhood. These distinctions between motivations shape how infertility is experienced within the couple. In contrast, men live through their infertility journey as an indirect matter, mostly perceiving its impact as a stressor on their partner and the relationship. [57, 73, 74, 82]. Given that the medical attention is predominantly directed toward women, men commonly frame their role in the reproductive process as providing support to their partner. However, often feeling excluded and that they are solely occupying the position of a bystander [57, 87]. Rooted in gender norms that demand stoicism, men often attempt to appear strong for their partners, leading them to set aside or deny their own affective needs, thus suffering silently [44, 57, 87]. As with women, infertility often challenges a man's self-image and sense of identity. Furthermore, it is frequently experienced as a threat to a man's masculinity, as infertility is perceived as a sexual disability [43, 57, 87]. By internalizing or suppressing emotional responses, infertile men, therefore, suffer from lower self-confidence and anxiety [58]. An increase of men's depressive symptoms is observed only when men made the decision to refrain from discussing their ART status with others. When infertility is linked to male factors, men's psychological distress roughly resembles the severity of women's retaliation [73, 74]. Nevertheless, it has been shown that men involved in ART are less inclined than their female partners to disclose their emotions and to discuss their infertility with others [44, 57]. Literature suggests that primary male responses to infertility are often consistent with their reactions for managing other life events [73]. This typically involves a preference for problem-centric and task-oriented coping strategies, emphasizing taking action and seeking information regarding the medical facts rather than engaging in emotional interactions with others [57, 81, 82]. This is partly attributable to the finding that men demonstrate reduced sensitivity and influence to the feedback of others [81].

Such multidimensional suffering, whether or not it reaches the level of clinical depression, anxiety, social isolation and paralyzing loss of control can be a major determinant in prospective patient compliance, eventual outcome, and overall wellbeing. These burdens detailed above are often exacerbated by critical gaps in both informal social networks and professional support systems. Many couples are left to navigate on of the most stressful experiences of their lives without the structured support they need. Therefore, the challenges accompanying ART treatment underscore the need for critical interventions that can fundamentally impact the patient experience. Establishing support mechanisms that address the psychological burden and simultaneously help patients navigate this difficult terrain can take multiple forms.

Partner/Spousal Support

Persistent stress from ongoing infertility issues and medically assisted treatments impacts patients' quality of life heavily, with the relational dimension frequently becoming the most profoundly affected. Martial bonds may either strengthen or severely weaken under the emotional pressure that puts a strain on partnerships, leading to challenges with communication and intimacy. Disparities in coping mechanisms may result in partners finding it difficult to understand each other's needs, which can cause feelings of loneliness even within the relationship. In addition, in situations when a male partner is less emotionally expressive, the woman may feel she is shouldering the burden alone [68]. Frustration can also manifest as conflict, leading to arguments with couples looking for someone to blame for their infertility [88]. The demanding treatment processes and focus on the biological aspects of conception further cause deterioration of a couple's sexual life [68]. Research demonstrates that supportive elements from partners reduces these burdens, highlighting the need for continuous male partner participation across all stages of infertility treatments [56]. Partners in a mutually supportive relationship and with an equally shared sense of responsibility for the problem will generally handle the stressful challenges together and will implement better coping strategies as a couple

[88]. Partnership, which is defined by open communication and tangible supportive interventions (e.g., accompanying the women to the clinic, providing post-procedure care at home), contributes to the psychological wellbeing of each individual. Unconditional support from a partner can give the other the strength to endure the difficulties of treatment and reduce the fear of failure [62]. Men suffering from male factor infertility also acknowledge that emotional and encouraging reassurance from their partners enable them to continue persevering [56]. The mutual commitment by the couple is linked to lower levels of perceived stress, thus is indispensable for the emotional support during assisted reproduction [56, 64, 88].

Social Support (Friends, Family, Online Peer Support)

Beyond the support of their partner, an individual's broader social network (i.e., friends, family, and online peer communities), also impacts their experience with infertility and treatment outcomes [76, 89]. While offline networks may help create emotional stability, the stigma and discomfort that frequently accompany the condition, often discourage individuals from openly communicating about it to those they are closest to. As such, many individuals seek alternative sources of understanding online. Digital communities offer anonymous and timely access to shared experiences. This allows digital community members to receive feelings of validation and normalization while promoting hope and new social connections. Users frequently describe online peers as offering continuous emotional support, often described as "hand-holding", by providing them with an outlet to discuss the many facets of daily treatment that their offline friends or family may not fully be able to relate to or would prefer not to discuss. While there is a number of benefits associated with relying on online peer support, it also has a number of drawbacks. For example, exposure to other's sad or distressing stories may amplify the user's levels of sadness or anxiety. Additionally, the circulation of misinformation can lead to confusion. Moreover, some users of these digital communities report becoming so overly absorbed in online spaces that they become obsessive in their efforts to gather information and/or withdraw from their real-world relationships [76].

Emotional Support through Counseling and the Reproductive Team

The entire reproductive care team, comprising fertility specialists, nurses, midwives, and counselors, share equal responsibility for lessening the psychological burden caused by ART treatments. The primary objectives of professional counseling in this setting include providing patients with coping strategies, ensuring emotional readiness, assisting with complex decision-making regarding treatment options, and ultimately reducing ART-related stress and depression, while promoting healthy behaviors in patients [43, 89].

Nursing staff on the clinical team play a pivotal role due to their prolonged and intimate relationship with most patients. Therefore, fertility nurses and midwives are are best suited to assess patient comfort levels, identify and explore patient fears and anxieties, and provide comprehensive care to the patient throughout the infertility treatment process [59, 23]. In addition to their clinical duties such as administering medications and monitoring hormone levels, the nursing staff supplies education and emotional support to the patient, and helps individuals navigate the uncertainty of ART [59].

When increased anxiety is identified, these frontline providers serve as critical liaisons, referring patients to specialized psychological or genetic counselors to prevent unreasonable assumptions and misunderstandings [43]. Furthermore, research indicates that male patients appear more receptive to virtual patient–physician relationships, suggesting opportunities for general practitioners to expand online services, such as scheduling, referrals, prescriptions, and routine results communication, targeted to this group [85].

Patients actively seek information to cope with the stress of ART and to feel a sense of control over their treatment. Studies show a clear preference for clinic-provided information first, as the credibility of provider-vetted information is highly valued. However, patients often turn to outside sources to fill knowledge gaps. The failure to provide comprehensive, accessible information can exacerbate the very psychological distress documented in patients. Key information gaps frequently reported by patients include costs and insurance coverage, understanding complex academic or research-based information, as well as availability of mental health resources [90].

Educational Resources

It is the responsibility of healthcare providers to provide patients with clear and understandable information about cost, treatment options and mental health resources. This in turn is directly related to how well patients cope with their infertility diagnosis [89]. Research indicates that when patients gather and organize their medical knowledge they begin to view fertility treatments as useful and accessible options, rather than overwhelming obstacles. Through the process of active knowledge acquisition, women are able to separate their emotional distress from their bodily experiences. This “rational” approach to treatment creates less reliance on the medical staff, allowing for a more balanced dialogue with providers, and restoring a critical sense of control over the process [78].

Coping Interventions for Patients

A range of empirical evidence exists to support the effectiveness of a number of psychological interventions for reducing the psychological burden of infertility. Many of these interventions provide participants with the tools necessary to manage their distress and reframe their experience. Mindfulness, defined as the quality of consciousness or awareness that arises through deliberately paying attention to present moment experience without judgment, is a core component of of many successful interventions [91]. Wellbeing therapy, a problem-oriented method focused that is centered around reflection and constructive communication with others, has also demonstrated its efficacy in this context. The study involving infertile women demonstrates that the intervention is effective in decreasing both infertility-related anxiety and mental rumination. The success of these interventions can be attributed to their capacity to address and modify the specific psychological processes that contribute to distress in individuals who are undergoing ART and experiencing infertility. When women use interventions that promote self-compassion and mindfulness they are able to engage with their infertility treatments in less negative and more neutral ways than previously possible. This shift is a powerful tool for promoting adaptive emotion regulation.

One common theme across these interventions is facilitating the transition from maladaptive coping strategies (e.g., avoidance, self-blame) to adaptive ones, such as meaning-based coping and acceptance. Since loss of control is a major contributor to distress during ART treatments, interventions that increase patients' self-efficacy are essential. Patients are taking an active role in maintaining their own wellbeing when they are engaged in information-seeking behavior and self-care behaviors. By actively managing their health and mastering self-care skills (e.g., self-administering injections), patients restore a sense of personal agency and control over their medical journey [92, 89].

Summary

The journey through ART is marked by profound economic, procedural, and psychological demands. This includes navigating high financial costs associated with the treatment, undergoing invasive and physically painful medical procedures, and managing the intense emotional volatility caused by the unpredictability of success in their efforts to conceive [49, 51, 59]. While clinical interventions in reproductive technology focus on the biological aspects of conception, the psychological wellbeing of patients during the ART process is increasingly recognized as being dependent on the availability of supportive resources, such as emotionally involved partners, social validation from peers and friends, psychological counseling services, and coping mechanisms like education and mindfulness [76, 43, 92].

However, when these supportive structures are either fragmented or entirely absent, the cumulative stressors can result in patients discontinuing treatment and abandoning all viable options for medical assistance to achieve conception [71].

Recognizing this multifaceted burden experienced by patients is essential to developing an environment in which mHealth technologies can be effectively implemented to provide meaningful support to patients throughout the ART process.

2.2 (In)Fertility Self-Tracking and mHealth

Whereas ART addresses biological impediments to conception, many patients also resort to personal informatics as a means of navigating the uncertainties regarding timing, treatment impact, and the outcomes of procedures.

This section of the thesis examines how self-tracking mHealth technologies are often framed as empowering tools that enhance self-knowledge and autonomy, however, the practice of self-monitoring can also produce anxiety, obsessive behaviors, and feelings of failure when expected outcomes are not achieved. Cycles vary, treatments fail, and predictions remain probabilistic. When apps emphasize optimization and precision without acknowledging ambiguity, users internalize perceived shortcomings of their bodies. Rather than supporting wellbeing, tracking can amplify vulnerability. Particularly in (in)fertility context when conditions of uncertainty are unavoidable, the constant availability of data encourages ongoing interpretation and comparison, making it difficult for users to disengage.

2.2.1 mHealth for Personal Analytics (Quantified Self)

Mobile health, frequently abbreviated as mHealth, is a term created to describe the revolutionary approach to practicing medicine and the shifting focus toward empowering individuals through mobile technologies [93, 94, 95, 96, 97, 98]. Through smartphones and wearable devices (e.g., smartwatches, fitness bands), and in combination with mHealth applications, individuals are able to compile patient-generated health data (PGHD), diverse health indicators and metrics (i.e., heart rate, sleep patterns, physical activity, and dietary habits) [99], transforming bodies and experiences into quantifiable metrics. This practice of digitized self-tracking is commonly referred to by terms such as self-monitoring, personal informatics (PI), lifelogging, and the Quantified Self (QS) [9, 100, 16, 101]. The underlying idea of this systematic collection of data and the subsequent self-reflection is that numerical indicators and optimization recommendations can drive behavioral change, improve outcomes, and allow the individual to derive meaningful insights from their self-generated data [9, 101, 102, 11, 100].

At an individual end-user level, tracking supports the development of personal awareness and enables goal-setting across various lifestyle domains. From a patient perspective, mHealth apps further aid symptom management, self-care, and communication with clinicians [16]. These apps allow patients to access online information pertaining to their medical conditions, set personalized alerts for medication adherence, and receive timely reminders for scheduled doctor's appointments. Furthermore, numerous applications even simplify active engagement in virtual support groups or offer patients a certain level of care through virtual consultations, giving patients the convenience to engage with their doctors from a setting of comfort and eliminating the physical access barrier. [103, 104, 105, 106, 107, 108].

The on-demand retrieval of health data marks a fundamental development in patient empowerment in terms of self-monitoring of their health [109, 110]. Patients now have the ability to share extensive, comprehensive PGHD datasets with their healthcare providers [99]. For healthcare professionals, this user-aggregated data provides granular context between visits and enables new forms of collaboration. Consequently, patients using self-tracking methods become coproducers of health information, while physicians, including care givers, learn to interpret and incorporate this self-collected data into their clinical practice [16].

Crucially, the use of mHealth is not designed to replace medical professionals' expertise, but rather to support individuals to maintain and review their personal health records outside of conventional clinical environments [109, 110]. In doing so, the patient's role shifts from being primarily a passive recipient of care toward an active participant. This partially mitigates the inherent imbalance that typically exists in the traditional relationship between clinicians and patients. Empowering patients to become capable agents of their own health care is critical to enhance the communication between the two parties. Through shared decision making, discussions focus on patient autonomy and providing the necessary information to make informed choices regarding medical treatment. When patients have a clear understanding of treatment objectives they can participate more actively in the therapeutic process and as such they will be able to make higher quality treatment related decisions [110].

mHealth is ultimately ideally positioned to support long-term management of chronic diseases and conditions, beyond just promoting mental wellbeing. This continuous monitoring of patients and personalized interventions emphasizes the importance of giving patients the necessary resources and assistance needed to take a more active part in their own healthcare [110, 111].

The digital health technologies that exclusively cater to various aspects of women's health, encompassing sexual awareness and wellbeing, fertility management, mobile apps for period-tracking, menopause and broader self-care, are collectively being referred to as **"Femtech"**, or **female technology**. This term was introduced in 2016 by Ida Tin, the co-founder and CEO of an evidence-based, data-driven mHealth app for reproductive health and menstruation. The emergence of Femtech emphasizes the persistent stigmatization of female anatomy and the ongoing absence of female representation and gender bias within medical research and the health industry. The aim was to normalize discussions around often considered "uncomfortable" topics, particularly among men, as well as to highlight the presence of previously unaddressed needs within the technology and healthcare sector [112, 12, 113].

Central to many Femtech products and services are fertility and menstruation tracking (FMT) apps. Cycle tracking apps commonly incorporate the core functionality of recording the duration and intensity of the menstrual flow. In addition, users have the ability to log a wide range of physiological, emotional, and behavioral indicators. Users can input data manually on physical symptoms such as bloating, cramping, food cravings, and headaches, emotional states like mood fluctuations and energy levels, along with behavioral factors that include changes in sleep patterns. Regularly, modern menstrual apps extend basic period tracking and offer fertility awareness methods (FAM), which are designed to support users' self-reporting and monitoring. These methods include the daily logging of BBT, cervical mucus quality, contraceptive pill intake, and sexual activity, among other health-related data points [114, 115]. Educational material on menstrual health and hygiene, and interactive communication tools are often integrated into (FMT)s as well [116]. These apps allow users to input and save their reproductive health data and gather feedback for their past and future cycles [117].

While menstruation apps and fertility apps commonly have overlapping components and are often closely related or even combined, the distinction between them lies in their primary focus. Menstruation apps cater to a wider user base and are intended to track and predict menstrual cycles. This is seemingly to support management of symptoms, in addition to broadening general health awareness and understanding in order to promote menstrual literacy [15]. In contrast to menstruation apps, fertility-related tracking for conception is often a secondary feature [118, 114, 119]. Fertility apps are specifically designed to target aspects related to potential fertility. The intention being to conceive and the subsequent management and monitoring of the pregnancy development. Therefore, these apps are generally optimized for conception with more advanced features for pinpointing ovulation and fertile windows [120, 121].

These app functionalities demonstrate how mHealth technology can address the fundamental yet previously under-supported health needs. Despite the growing interest in these fields, self-tracking and fertility-specific health practices proceed to receive limited scholarly attention within (HCI) and studies on fertility self-tracking are notably absent. The meager scope is partly attributed to the mentioned historical stigmatization of women's bodies and intimate health. As a result, there is insufficient understanding as to how women engage with fertility-related technologies and how they encounter informational challenges in managing these deeply complex and personal health concerns [122, 118, 120, 10]. Although technology provides the means for quantification and much of the market is built on promises of quantifiable data, the reasons behind *fertility* self-tracking are fundamentally qualitative.

Summary

mHealth technologies increasingly shift health management from clinical settings to everyday life. Individuals continuously collect personal health data, transforming their bodies and experiences into quantifiable metrics. In reproductive health, this includes tracking menstrual cycles, symptoms, and medication schedules. However, mHealth technologies frequently neglect other dimensions essential to fertility self-tracking.

2.2.2 Practices and Perceptions of Fertility Tracking (Qualified Self)

In the field of human-computer interaction (HCI), menstrual and fertility tracking has evolved beyond plain behavioral change towards a concept known as "lived informatics". This approach entails women's tracking experiences (e.g., cycle phase, symptoms) as much as behaviors and recognizes the shifting aims across life stages (e.g., observation, contraception, conception, treatment), adapting routines, and renegotiating meanings as circumstances change, particularly salient in infertility and ART [10]. The actual intrinsic needs of the users are about embracing the *Qualified Self.* It emphasizes the personal significance, context, and control over their subjective experiences: understanding what symptoms mean for each individual at a particular moment, how uncertainty is understood and tolerated, and how identity, relationships, and different life stages influence data interpretation [123].

Sense-Making and Self-Knowledge

Many users frequently draw upon this information for family-planning and for interpretation of current symptoms [117]. A multitude of women regard self-tracking as a method to gain unmatched insights into their reproductive health. By identifying recurrent patterns of symptoms, many who seek reassurance about what counts as "normal" are able to distinguish expected variability from potential pathology. This information is especially sought-after by individuals whose natural cycles have been disrupted by prolonged hormonal contraception or by insufficiency in thorough fertility-related education. Thereby, tracking functions aid as a means to relearn and re-establish the felt connection with their physiological processes [124, 125, 122].

Empirical studies demonstrate that the motivations for self-tracking are multifaceted. These additional drivers include gaining self-knowledge, preparing for life events, supporting conception or contraception, and communication with clinicians [114, 10, 126]. Notably, a mixed-method study by Gambier-Ross et al. [117] found that only few participants are focused on using fertility self-monitoring as contraception (4%), and the majority of users are driven by the desire to understand and observe their reproductive health and to conceive.

This is also reflected in the findings of Figueiredo et. al [114], which indicate that fertility applications largely facilitate goal-directed practices, particularly those associated with attempting to conceive and period tracking. However, even the process of conception is rarely linear. Rather, it includes a complex sequence of changes, specifically the transitions from trying to conceive to pregnancy, or to possible miscarriage.

Women's Engagement in Fertility Self-Tracking for Conception

(In)fertility, natural conception, and MAR are very emotionally charged, data-intensive, and complex health contexts with a high degree of uncertainty. When difficulties with conception arise, individuals attempt to monitor various parameters to increase their likelihood of successfully conceiving. This rigorous self-tracking is driven not only by clinical requirements, but also by a woman's strong desire for bodily literacy, a need to manage the unpredictability of trying to conceive, and the "unknown" of her fertility. Moreover, many fertility-related interventions heavily rely on the systematic collection of health data. In order for this to be done, it requires observing a range of physiological markers, frequently obtained through patient-generated data. These data points may fall under broader categories like general health and lifestyle data, such as mood, emotions, diet, sleep patterns, supplements, physical symptoms. They may also be specifically related to fertility like basal body bemperature (BBT), ovulation predictor kit (OPK)results, cervical mucus consistency, and period flow and dates [127].

Self-tracked parameters remain essential to estimate ovulation and to optimize timing for conception during the fertile window. ART treatments also involve coordinated timing to ensure that all interventions are administered at the appropriate time. Fertility treatments require a tremendous amount of organizational effort and stress to coordinate the necessary components (e.g., medical appointments, insurance, pharmacy, etc.) with their specific fertility cycle date. The importance of using data to determine the best time for fertility treatments is even more apparent when working within a fractured health system, or when receiving fertility treatment from various countries. For this reason, patient-generated data support diagnostic assessments and therapeutic planning as well [128].

The studies suggest that the value of FMT apps extends beyond utility. The authors argue that women's digitally self-tracked data helps them gain a more nuanced comprehension of their own bodies. This signifies that women's motivations exceed simple, quantifiable goals and involve deeper, more complex psychological needs, social influences, and a yearning for bodily knowledge and autonomy [117].

Gaining a Sense of Control and Coping with Uncertainty

Significant tensions arise when women's self-tracking practices intersect with the formal healthcare system, creating a disconnect between patient experience and clinical practice. Healthcare providers tend to value controlled, objective data like OPK results and period dates, often dismissing patient-tracked subjective data as "unreliable" or "nonspecific" [127]. This devaluing of PGHD can leave women feeling unheard, discouraged, disengaged, and their efforts unrecognized [127, 128]. A communication gap often exists where patients feel confused and distrustful when providers recommend treatments without explaining the data-driven rationale behind them. However, this gap can be bridged when providers make their clinical protocols transparent and explain how patient data informs their decisions [127].

In many cases, women turn to self-tracking apps precisely because they feel their concerns are being dismissed. The app becomes a tool to gather evidence and seek answers when formal medical support feels inadequate or inaccessible [125].

The desire for a sense of agency and control over one's body is a compelling driver for fertility self-tracking. When there exists clinical uncertainty or no clear answers, gathering and analyzing data gives users a tangible approach to deal with their condition. Information seeking through tracking is described as a key strategy for managing the emotional strain of attempting to conceive. This behavior often escalated in the aftermath of traumatic reproductive events (e.g., experience of a miscarriage). What often feels like an unpredictable, overwhelming, and unmanageable situation, becomes a promise of empowerment and provides a certain degree of self-management and structure [86, 127].

In stark contrast to these positive motivations, the long-term practice of self-tracking can impose a significant emotional toll. The experience of living with data can become intensely challenging, stressful, and fraught with negative feelings [122, 127]. The interaction with personal data is often characterized by an internal conflict between a rational, long-term "planner" self and an impulsive, short-term "doer" self [9]. In the high-stakes context of fertility tracking, this conflict is amplified by what Figueiredo [127] characterizes as an "emotional rollercoaster" of the journey. A metaphor that captures the recurring pattern of heightened expectation followed by disappointment. The “doer” self, driven by the intense hope and anxiety of trying to conceive, often overrides the rational “planner”, leading to data interpretations colored by desire, particularly during the anxious two-week wait (TWW) between ovulation and before a pregnancy can be confirmed [127]. When confronted with undesirable data, users are not passive recipients, rather they develop active coping tactics, including disregarding the data, procrastinating on logging it, and applying selective attention to more favorable indicators. The data itself turns into a persistent marker of failure to reach the unmet goal of conception. When the sought-after objectives are not attained, engagement with tracking technologies can perpetuate or strengthen feelings of stress, anxiety, guilt and self-blame in the individual who feels entrapped by its use. A vicious cycle emerges in which the device enabled empowerment becomes a source of distress for the individual [9].

Types of Emotional Engagement with Fertility Data

Figueiredo et al. [124] analyzed online fertility forums and highlight the progression of engagement through which individuals relate to their reproductive data: positive, burdened, obsessive, trapped, and abandoning. These forms represent evolving configurations of emotional response and tracking behavior that may shift over the course of attempting to conceive. Together, they illustrate how data practices can both support and strain individuals as they interpret physiological information and navigate the uncertainties of fertility.

1. **Positive Engagement (Excited with Data):** In the initial stage, individuals often approach self-tracking with optimism, hope, and excitement. This early phase is marked by a sense of agency as engaging with the measured data reinforces the belief that recording and interpreting the indicators will help the users reach their reproductive goals [124].

2. **Burdened Engagement (Concerned with Data):** As time passes without achieving the desired goal, engagement can become more emotionally demanding. Although the overall attitude toward self-monitoring remains constructive, heightened stress and concern emerge, particularly when users feel pressure to generate “good” results. In response, the focus on tracking intensifies. Users may increase the number, frequency, or precision of the measures they monitor, in an attempt to get a more accurate understanding [124].

3. **Obsessive Engagement (Consumed with Data):** Some women experience a progression toward obsessive engagement, in which self-tracking becomes all-consuming. Tracking activities dominate their thoughts and routines, and they may track multiple measures simultaneously, searching for any small sign of hope. This stage is marked by growing frustration and a feeling of near hopelessness as their efforts continue to yield no success. The volume and granularity of data collection often reach their peak in this phase, with some users reinterpreting ordinary bodily

sensations as additional metrics or attempting to manipulate testing practices in search of reassurance [124].

This data interaction impacts users' perception of their bodies. In the lower-stakes context of general activity tracking, Boldi et al. [129] found that wearables, which connect to apps for data analysis and visualization, increase users' awareness of bodily sensations without altering their overall body image or leading to body surveillance behaviors. However, the high-stakes, goal-oriented nature of fertility tracking fundamentally alters this dynamic. While the authors found no change in overall body image, their qualitative findings reveal that data interaction do encourage a biomedical view of the body as either "healthy" or "unhealthy" [129]. In the fertility context, this phenomenon appears to be amplified, transforming the body from a site of general awareness into a biomedical system subject to performance evaluation and potential failure. This can foster a feeling of being under constant surveillance, a sentiment articulated by the user who felt obsessed with the fluctuations and accuracy of the data [117].

Moreover, fertility-focused self-tracking technologies define the type of health information individuals monitor and how data collection should occur. When data from apps or wearables cannot be seamlessly transferred across platforms, users are forced to manually copy information into separate spreadsheets for further analysis or cross-examination. Introducing additional workload and burden for the individual. These technologies also create data models or "pregnancy indicators" that reinforce certain standards. Since the calculations are often opaque, this can increase stress, anxiety, and disappointment when conception does not occur, thus fostering "an obsession" with tracking [128].

Similar patterns have been observed in other health contexts, where intensive monitoring can magnify distress, undermine confidence, and lead clinicians to describe detailed log-keeping as "obsessive and compulsive". Individuals in such states may also prefer to interpret results through personal histories or symptom patterns rather than strictly clinical frameworks, especially when numerical changes seem inconsistent or inexplicable [130].

4. Trapped Engagement (Ensnared within Data): This represents the most emotionally demanding stage of the journey. Users feel ensnared by their data and dependent on the act of tracking, yet the process brings them immense distress, feelings of guilt, and despair. Individuals may believe that their bodies are malfunctioning or that they are failing in ways that compromise their sense of normalcy. Although many express a strong desire to disengage from tracking, they often feel unable to stop, remaining caught in cycles of monitoring despite recurrent discouragement. Eventually, for some, the emotional burden becomes unsustainable, leading to abandoning engagement [124].

5. Abandoning Engagement (Rejection of Data): This is the final stopping point, where the emotional cost of tracking becomes unsustainable. Individuals

> articulate the inability to continue managing the intensity associated with self-tracking. The constant cycle of hope and disappointment becomes too much to bear, leading users to reject their data and abandon the practice, either temporarily or indefinitely. In certain cases, this abandonment also involves stepping back from their efforts to conceive permanently [124].

Obsessive, trapped, and abandoning engagement are particularly fragile configurations in which emotional distress begins to outweigh any perceived benefits of data collection. This research provides a nuanced understanding of the dynamic relationship between a user and their data, revealing how emotional states and tracking behaviors shape one another over time. These patterns also demonstrate the complexity of how fertility-related data practices can determine the experience of trying to conceive.

Emphasis on Women as Data Producers

The process of trying to conceive is generally a shared journey that is discussed and agreed upon by the couple. Nevertheless, the female partner frequently assumes primary responsibility for collecting the fertility-related data, and subsequently bringing decisions to the couple about reproductive choices. This is due to the prevailing societal norms that influence perceptions regarding the responsibilities associated with reproductive health, where conception (as well as household and healthcare decisions) is commonly seen as a woman's obligation. As a consequence, women are frequently placed under greater pressure than men, contributing to an internalization of negative feelings of being "defective" or "incomplete". The male partner's involvement in direct fertility assessment tends to be limited, aligning with observations reported in prior research (see Section 2.1.3). Data tracking for male fertility factors is minimal, as there are few indicators that can be reliably self-tracked at home and outside of a laboratory setting. The main aspects that partners can track to improve conception chances are lifestyle-related factors, including physical activity, nutrition, and the use of medications or supplements. This aforementioned societal pressure ensures that women are often the ones responsible for all self-tracking activities. Even for these male-relevant measures, it is often the female partner who tracks and manages the data, such as tracking dietary restrictions on behalf of her male partner. Lifestyle factors tracked through data influence individuals' daily activities, sometimes leading them to adopt a very strict way of life to maximize health and save money, often avoiding social events [128].

Reinforcing the same gendered norms repeatedly enables the normalization of an unequal allocation of fertility-related responsibilities, which provides men with the flexibility to engage in or withdraw from reproductive decision-making at their discretion, further corroborating the expectation that women will manage this sphere [131]. Hamper [131] explores how women view the feature in fertility apps that allows them to share fertility data with their male partners while attempting to conceive. The research investigates why this component, often promoted as a way to redistribute conception responsibilities and foster a shared commitment to parenthood, does not actually relieve the gendered burden of fertility work for women. Fertility apps actively promote partner-sharing features as a solution to the unequal burden of conceptive work. The marketing language is infused with ideals of teamwork, intimacy, and shared commitment. This approach shifts emphasis away from the individual woman toward fertility as a shared concern within the couple, thereby repositioning men as "half of the reproductive equation". Syncing apps is thus framed not merely as a practical method of data sharing, but as a symbolic act of adopting a "synchronized" commitment to the shared project of future parenting. For couples undergoing fertility treatments, both women and men are anticipated to demonstrate and internalize (embody) a profound dedication to parenthood even before conception occurs. However, despite the collaborative promise of the technology, many women do not involve their partners in fertility tracking in the ways envisioned by app developers. A pattern that contrasts sharply with women's openness to sharing data from fertility apps. Therefore, the author suggests that this is an indication that specific obstacles exist in sharing tasks related to conception, which are often overlooked in the marketing of these tools designed for joint use. A common theme is the female perception that male partners are simply not interested in the "logistics" of conception as it could dampen their sexual desire. This is often expressed with a mix of acceptance and humor, reinforcing the idea that fertility management is women's work. A major barrier to male participation is the connection between masculinity and procreative capacity. Infertility or "failed" months are perceived as threats to a man's virility. Consequently, women may avoid sharing tracking data (i.e., graphs showing missed fertile windows) to protect their partners from the visual evidence of failure or the suggestion that they are not fertile. To navigate these gendered tensions, couples often uphold the ideal of natural conception, which prioritizes romance over medicalized planning. Women engage in "conceptive fertility work" but often hide it to maintain an illusion of spontaneity for their partners. They may secretly track ovulation and initiate intercourse at fertile times without disclosing the underlying schedule, effectively staging the encounter to look natural. By hiding the charts, the temperature readings, and the timed schedules, women curate their partners' participation. They shield them from the pressures of performance and the potential ego-bruising "failures" of a missed fertile window. The curated performance of "naturalness" as a relational strategy allows men to remain comfortably disengaged from the logistical and emotional work of tracking. Women often reinforce this by joking that men only need to be physically present, assigning them a strictly "ejaculatory role". Typically, the partner's lack of engagement are tolerated, nevertheless, with couples undergoing fertility treatment, this tolerance can later evolve into frustration over men's perceive reluctance to fully engage with the challenges of infertility [131].

While this performance may preserve relational harmony, its primary consequence is the obfuscation of an intensified burden of preconception labor for women. This digital context reconfigures and intensifies, rather than resolves, the unequal distribution of reproductive labor. The barriers to open communication about fertility tracking are rooted in pervasive cultural norms. Female bodily processes are erased from public discourse and shame is often attached to female bodily fluids. For this reason, women often find it easier to share disembodied data graphs than to discuss the physical realities of their cycles, highlighting how deeply these taboos operate [131].

Collaborative Sense-Making

Fertility self-tracking apps are designed to reduce the cognitive effort by converting information entered by the user into data visualizations. The aim is to provide a clearer understanding of an individual's reproductive health or fertility status, thereby supporting the planning toward the desired reproductive outcomes. Despite this intention, the difficulties that arise in interpreting the presented data can increase both uncertainty and emotional strain, as the availability of the data alone does not guarantee meaningful understanding by users. Although these technologies have the capacity to organize large volumes of personal health information into structured formats, users may still find it challenging to interpret the outputs [127]. Fertility data is inherently inconsistent and sometimes will even contradict itself. When individuals obtain and analyze their personal metrics independently and in isolation, the data may be ambiguous or misleading [86, 122]. As a result, they may seek additional support from others to make sense of the information, which can ultimately influence their reproductive health decisions [127]. Many women use peer-based interpretations to supplement their self-reflection. They mostly use collaborative sensemaking through online health communities, patient support groups, and social media to discuss and compare experiences, and to assist them in understanding how to interpret the data they obtain, and to develop their own unique, personalized solutions to conceiving [127]. These spaces enable validation of lived events, bridge knowledge gaps, and generate personalized solutions to common challenges, which was discussed earlier in Section 2.1.3 [86, 122, 127]. Crucially, peer communities provide necessary alternatives when women perceive their self-tracked data and embodied accounts to be undervalued or dismissed in formal healthcare settings [122].

In addition, these emotional patterns of engagement also indicate the need for a better understanding of how data is both presented and understood, leading to broader concerns about the challenges involved in communicating uncertainty within data-driven fertility technologies.

Summary

The transition from analog to digital fertility tracking has profoundly affected how women engage with their reproductive health. Framed through the lens of the "Qualified Self", self-tracking was initially adopted as an empowering mechanism to gain bodily literacy, manage the unpredictability of conception, and assert control within a fragmented healthcare system [10, 123]. However, as the path toward conception prolongs, particularly as this journey extends into the high-stakes world of ART, this dynamic typically reverses itself.

The research demonstrates that continuous engagement with fertility data can quickly devolve from a positive, goal-oriented practice into a source of profound psychological distress. In particular, for those that find themselves trapped in an *obsessive* or *burdened* engagement, the app becomes a persistent, daily reminder of biological failure [124]. This distress is further exacerbated by the socio-cultural norms that have assigned the administrative and emotional labor of tracking (the “conceptive work”) to women, commonly isolating them from their partners [131].

Furthermore, when clinical providers dismiss the extensive, detailed, and carefully collected patient-generated data as unreliable, patients are driven toward online peer communities to collaboratively try to interpret their ambiguous metrics [127]. In conclusion, the **current paradigm of fertility tracking reveals a critical design flaw.** These technologies are highly efficient at collecting data, but lack the contextual sensitivity required to help users navigate the emotional weight of that data. This disparity underscores an immediate need to reconsider how information is presented to users of digital health tools, ultimately addressing a much more complex challenge of how to ethically and effectively convey medical uncertainty to vulnerable users.

2.2.3 Communicating Data Uncertainty

Uncertainty represents a state of imperfect knowledge where the exact accuracy of a fact or figure is not known to the use [132]. It refers to the range of potential outcomes, ambiguity, imprecision, and variability within a dataset, or possible error present in information or predictions [133]. Many datasets naturally contain some degree of uncertainty, yet they are frequently displayed as though they were completely accurate. Uncertainty can be caused by the noise in sensor readings, measuring devices being wrongly calibrated, or algorithms using thresholds to determine values [132]. Missing data is also a significant contributor to inaccuracy and uncertainty in predictive models [134]

A substantial body of psychological research demonstrates that presenting information about uncertainty can lead to improvements in the quality of making a decision [132]. For this reason, it is increasingly recognized as an *ethical necessity* that the communication of this uncertainty is important for enabling well-informed and transparent decision-making.

An ongoing challenge with expressing data uncertainty concerns how audiences interpret probabilistic or statistical indicators. While domain experts can typically understand concepts such as confidence intervals, non-expert readers often misinterpret these cues. Individuals may draw inaccurate conclusions or misplace their confidence in the underlying information [133]. For example, people often assign different meanings to the same verbally qualified statements (e.g., “low uncertainty” or “almost certainly”) and interpret them with different probable values [132]. Despite the ethical imperative to inform audiences about uncertainty, the act of communication itself can introduce unintended negative consequences that affect comprehension, perception, and trust, prompting audiences to judge information as unreliable [133].

Spoken Communication of Uncertain Information

Aspects of spoken communication introduces complexities in terms of the pitch variation and slower rate of speech that can serve as signals of the speaker's level of confidence and/or degree of hesitation or uncertainty. Moreover, the momentary character of speech hinders the listener's ability to revisit and clarify the provided information to better understand the message being communicated. Therefore, spoken communication has lower effectiveness than other modalities in providing support for making accurate judgments. Nevertheless, communication of uncertainty through speech garners the highest user trust and in conjunction with complementary methods of presentation, it can be used without reducing decision quality [133].

Communicating Uncertainty Through Text-Based Approaches

When communicating uncertainty textually, uncertainty is frequently expressed through linguistic "hedges" (e.g., "sort of", "perhaps", "might", or "could be"), which signal degrees of probability or opinion rather than fact and tend to be understood differently across individuals. As such, individuals rate arguments more persuasively when they are presented *without* hedge words. Medical research descriptions, on the other hand, that incorporate hedges are considered *more credible* [132]. Furthermore, numerical statements may be misinterpreted in that many individuals struggle accurately understanding simple probability questions (e.g., misreading weather forecast probability data). Studies further demonstrate that people use bias and heuristics when evaluating uncertain information in textual formats [132]. Nonetheless, textual communication can play a significant role in supporting decision-making. It is likely to be most suitable when combined with other forms of communication [132].

Visual Representations of Uncertain Data

Given that individuals exhibit lower confidence with text-based predictions compared to visual representations, data visualization provides an effective alternative for communicating uncertainty [132, 133]. When individuals are uncertain or experience reduced confidence in their judgments, they are more inclined to seek out additional information to support them in their decision-making process. Particular methods of visualizing uncertainty, such as dot plots and probability density functions, can help users understand conflicting information and more successfully combine and interpret multiple, differing estimates [132, 133]. Research in fertility-tracking contexts highlights that it is necessary to communicate multiple aspects of data quality, including accuracy, completeness, and consistency, to assist users in the interpretation of their self-collected data. In this domain, bar and pie charts are found to be beneficial at conveying proportions, whereas line charts better illustrate cyclical patterns or trends. Other visual variables such as fuzziness, location, color, size, arrangement, and transparency also demonstrate utility for depicting uncertainty. Fading color and transparency are especially suitable for representing temporal uncertainty [135, 136].

Comprehension difficulties arise when viewers lack the graphical literacy required to interpret complex visual encodings. When data visualizations place strong emphasis on arithmetic values, users tend to disregard the accompanying uncertainty cues and may incorrectly interpret larger visual separation as an indication of greater importance. Lengthy verbal explanations can mitigate these barriers but may also fatigue readers, ultimately constraining understanding. Providing explanations that are precise and easy to access alongside visual representations is essential to support accurate interpretation and effective use of uncertain data. This indicates a clear need for approaches that help users learn how to correctly read and understand uncertainty visualizations [133].

The challenge in communicating uncertainty is not merely a technical problem of selecting the "right" visualization, it is deeply cognitive and emotional. When uncertainty is poorly communicated, users tend to react in one of two ways: they either over-trust the data, leading to risky decisions, or they misinterpret the information, resulting in unnecessary worry or incorrect conclusions.

In fertility tracking, conception probability (typically ranging from 0-30%) reflects uncertainties that arise from biological variations, such as sperm and egg cell longevity and ovulation timing. Although interfaces may display prediction accuracy, fertile-window estimates, or conception likelihood, several sources of uncertainties remain difficult to quantify given current technological limits. Additionally, many uncertainties stem from unknown health issues and the subjective judgment required to interpret fertility indicators. A crucial finding from Schneider et al. [135] is that a metric like "prediction accuracy" is often misinterpreted by users as a direct measure of their cycle health or as a "safety indicator" for contraception. This misinterpretation leads to significant emotional responses, with changes in the accuracy metric triggering feelings of hope, stress, or fear. For example, one user trying to conceive saw an increase in prediction accuracy as a sign that her body was becoming "healthier" and that her chances of conception were improving. Pairing traffic light color codes to accuracy values intensifies these emotional reactions. It is advisable to avoid presenting metrics that could be perceived as judgmental or interpreted as an index for health. Thus, researchers recommend visualizing deviations between predicted and detected ovulation in past data. This direct comparison makes the potential for error tangible without provoking the strong negative emotions associated with a fluctuating accuracy score. Moreover, individuals, still value the additional uncertainty information and express preference for systems that incorporate these indicators, suggesting that making uncertainty more intelligible and concrete remains an important design goal [135].

Incorporating uncertainty information provides users with numerous benefits, including increased trust in the prediction and an overall positive user experience [135]. However, the relationship between communicating uncertainty and user trust is not straightforward. Some studies suggest that providing transparency can diminish credibility. However, applied research reveals a more complex dynamic. Communicating uncertainty can decrease a user's trust in a specific prognosis, while simultaneously increasing their trust in the provider or company for being transparent. This is a desirable outcome in risk-aware applications, as it encourages healthy skepticism about a single prediction without undermining faith in the overall system or expert. It suggests that users can appreciate honesty about limitations, and that such transparency can be a net positive for building long-term credibility [135].

The research clearly indicates that there is no one-size-fits-all solution. The success of any communication strategy is critically dependent on the context of the application, the modality used for presentation, and the user's own goals and cognitive state.

Summary

Communicating data uncertainty is a delicate balance between ethical transparency and the cognitive burden placed on the user. While spoken, textual, and visual modalities each offer distinct advantages, visual representations are generally the most effective for conveying complex probabilities, provided they are designed with the user's graphical literacy in mind. In the context of fertility tracking, uncertainty extends beyond simple data visualization, it acts as an emotionally impactful intervention. As the literature demonstrates, when providing abstract metrics (i.e., prediction accuracy) or judgmental traffic-light color codes, the impact often results in vulnerable users misinterpreting statistically expected variability (normal variance) with biological failure or decline in health [135]. Therefore, to create a sense of ambiguity while avoiding panic within the design of digital health tools, designers must employ nuanced and contextually aware design techniques, i.e., providing users with tangible examples of their past cycle deviations. By openly acknowledging system limitations, designers can foster a long term relationship of trust with users, and provide them with the information necessary to make informed decisions regarding their future choices.

2.3 Key Implications and Consequences of Use

This section analyzes the limitations and risks associated with fertility mHealth apps, including psychological harm, scientific inadequacy, regulatory ambiguities, and data exploitation. By examining these dimensions, this part of the thesis highlights how current design practices do not provide adequate support to its users, thus emphasizing the necessity for more responsible, evidence-based, and user-centered, indeed *women-centered design*, strategies in female-oriented digital health support tools.

2.3.1 Limitations of Fertility Tracking for Individualized Needs

Pregnancies do not always end in full term. Estimates suggest that approximately one in five (20%) clinically recognized pregnancies will miscarry, however, this figure is believed to underestimate the true occurrence. Many pregnancy losses happen before they were medically confirmed, hinting that the overall rate is likely significantly higher than reported [114, 137, 138, 139, 140, 141]. Despite its prevalence, the care systems available to those who experience early pregnancy loss are profoundly fragmented, leaving individuals to navigate a period of intense distress without adequate informational, emotional, or peer-supported resources [140]. This failure is not isolated to clinical settings, it is amplified by a digital health environment that is unprepared for the reality of pregnancy loss by systematically ignoring, excluding, or trivializing miscarriages. This erasure of non-normative outcomes not only fails to support users but actively exacerbates their psychosocial distress whose experiences deviate from this normative script and reveals a critical need for a new design paradigm rooted in compassion, inclusivity, and established user needs. These apps perpetuate a harmful, linear narrative of pregnancy that culminates only in a live birth. For users who experience a loss, this design is profoundly painful [137, 138, 142].

Andalibi [138] conducted a systematic feature analysis of 166 pregnancy-related mobile applications and reveals a stark pattern of exclusion. An overwhelming 72% of the examined apps do not account for pregnancy loss in any way. Their design architecture simply does not acknowledge or accommodate this outcome. Although only 18% of apps explicitly account for loss in their design, even in these cases, the implementation is frequently insensitive and unhelpful. Recording a pregnancy loss frequently requires users to navigate into application settings that are often difficult to locate, after which the loss has to be manually entered within the pregnancy-related data sections. Andalibi provides the example that several apps would permanently delete all pregnancy-related data upon a loss being logged, essentially erasing the woman's experience as if it never happened. A further 10% of apps provide the topic of pregnancy loss passively, typically through user-generated content posted to community forums. Nevertheless, the app's core design does not provide any direct affordances for managing or acknowledging a loss [138]. Figueiredo et al. [114] also came to a similar conclusion in their research: Out of the 31 fertility self-tracking apps reviewed, only five provide any form of post-miscarriage support. These features may include the ability to record a miscarriage, access informational or supportive content, receive guidance on tracking health data following a loss, or disable and reset automated predictions and email notifications. User feedback indicates that many applications, including those designed to support individuals trying to conceive, lack functionality for recording a pregnancy loss.

Pregnancy+, an industry-leading app for pregnancy, provides a strong illustration of how the design principles discussed above manifest in practice. When a user endures a miscarriage, the app, which has no mechanism to register the loss, continues to send the user notifications, and will continue to simulate fetal growth and development long after the pregnancy has ended [137]. The disconnect between the polished, linear narratives of these apps and the complex realities of individuals' lives creates both significant emotional and informational voids for many women. Research consistently documents the intense emotional and psychological experienced by many as a result of miscarriage. Far from being a minor medical event, it is a significant and often traumatic life experience characterized by a range of distressing outcomes [139, 140].

The sense of commitment to mHealth interventions is directly influenced by both patient autonomy and engagement. When users perceive limited control or involvement in managing their own care, this includes the ability to set personalized goals, make adjustments to treatment preferences, or modify app features to meet their needs, as a result, the sensed usefulness of these tools declines remarkably. The diminished understanding of their relevance and the loss of a sense of personal agency often translates into poor adherence to the tools. The patient's reduced motivation to engage with an application consistently is due to the inability of the app to adequately reflect the individual's unique needs and circumstances. As a consequence, insufficient opportunities for customization and shared decision-making may undermine the efficacy of mHealth interventions and patients' overall satisfaction with digital health solutions [143, 144].

2.3.2 Inaccuracy and Lack of Scientific Stringency

Considering the wide variety of available solutions, consumers, patients, and healthcare providers may face difficulties in identifying the most appropriate mHealth app. The proliferation of these applications has created a need for certification and rating mechanisms to help users and professionals distinguish between reliable apps and those that are inaccurate or even fraudulent. Safety concerns surrounding both clinical and lifestyle-oriented apps contribute to a lack of trust and discourages adoption. Evidently some applications fail to perform as intended, lack sufficient validation, or, in certain instances, may even endanger user safety. Moreover, health-related information provided by mHealth tools may have little to no clinical evidence to support their claims and recommendations, making them unreliable, and leading to potential misdiagnoses, ineffective health management, or misguided health decisions based on inaccurate content [97, 109, 145]. The scarcity of high-quality scientifically accurate information to confirm the effectiveness and clinical benefits of mHealth applications demonstrates a critical barrier to overall acceptance.

Female health-related apps collect sensitive data to generate fertility predictions. Users often rely on these forecasts to make deeply personal decisions related to their reproductive health and family planning, whether it be contraception or conception. Should the application incorrectly identify and individual's fertile window as infertile or vice versa, users relying on the information may incur unexpected repercussions. Conception-focused apps are not equipped to identify underlying infertility. When pregnancy does not occur, individuals may misattribute the outcome to errors in their tracking rather than to possible medical factors. End-users typically lack the means to evaluate an app's predictive validity, and some may only discover the tool's unsuitability once adverse results have already materialized [125, 146, 147, 148].

Numerous research studies have eliminated commercially available applications as possible options for menstrual tracking tools because most failed to achieve essential accuracy standards or did not satisfy minimal requirements [149]. Zwingerman et al. [150] conducted a systematic review of 140 apps designed for tracking menstrual cycles, estimating ovulation, and broader issues concerning fertility and infertility management. Their findings revealed that 31 of the apps (22.1%) had serious inaccuracies within their content, tools, or both. A third study examined 73 menstrual cycle tracking apps and determined that none could predict ovulation with any degree of accuracy [151].

Moreover, further studies suggest that the greater part of these mHealth apps lack transparency regarding their calculations methods and fail to reference supporting scientific literature [151, 152, 153]. Surprisingly, very few available self-tracking apps utilize evidence-based methods of fertility awareness [146].

More sophisticated data-driven algorithms using both manually entered and wearable-generated physiological markers have shown to identify complex patterns in cycle data, thereby increasing their predictive accuracy [154, 155, 119, 156, 157, 158, 159]. Nevertheless, even the most advanced algorithms can yield inaccurate results when supplied with incomplete or flawed data [160]. As such, there are serious concerns about the dependability of the apps being discussed, as their claims of success may not align with actual performance [161]. Thus, it is essential to inform users early, that the money, effort, and time invested in FMT apps could be worthless, because the applications may not actually utilize this data to enhance their predictive accuracy.

2.3.3 Misconceptions and the Illusion of Regulation

Due to the fast-paced technological innovation in mHealth, uncertainty around the legal frameworks increased, as it may be difficult to interpret and apply the complex regulations for medical devices and software. The heterogeneity of national and international data protection laws differs across jurisdictions and poses substantial compliance challenges, often leaving the applicable legal framework unclear. As mHealth apps may fall within a grey zone of being a simple tool for wellbeing or a governed medical device, the absence of clearly defined and consistent legal and regulatory guidelines may compromise patient safety [109]. Users may worry about the confidentiality of their personal and clinical data and therefore be reluctant to rely on these apps.

Data about a person's health comprises all forms of medical information that define an individual's complete health profile (diagnoses, applied treatments, appointment records, etc.) and even payment methods associated with healthcare services. Because of the immense value placed on personal health, it is essential to protect this type of data [162]. Applications for women's reproductive health are noteworthy examples of how consumer technology intersects with healthcare. Menstrual cycle and fertility tracking apps operate similarly to healthcare tools, however, they are notably not fully categorized as such. Consequently, concerns regarding both their accuracy and privacy remain unaddressed by the legal frameworks intended to govern them, leaving users vulnerable to the risk of potential threats [115, 163].

In conventional healthcare settings, patients generally depend on regulatory measures established by authorities such as the European Medicines Agency (EMA) or the United States Food and Drug Administration (FDA). These frameworks include laws, rules, and guidelines like the General Data Protection Regulation (GDPR) and the Health Insurance Portability and Accountability Act (HIPAA), which are designed to ensure the safety and effectiveness of medical interventions, as well as protect the privacy and security of personal health information to guarantee proper handling of this data [162, 164]. However, regulatory environment for mobile health technologies remains inconsistent and fragmented. Only those applications that effectively convert a mobile phone or other device into a medical device fall within the scope of regulatory review of the FDA. For example, software that performs individualized analysis and issues diagnostic, treatment, or preventive recommendations are classified as medical devices and thus are subject to regulatory oversight. In contrast, software intended solely for self-management of diseases or conditions, which is deemed to carry minimal risk for the patient, lies outside the scope of the FDA enforcement [145, 164].

Within the European Union, there currently exist no mandatory regulations clearly distinguishing lifestyle and wellbeing apps from medical devices. The responsibility of determining whether mHealth products are subject to the Medical Devices Directive guidelines remains with software developers and manufacturers. Therefore, applications may qualify as medical devices depending on their intended purpose and use, thus must adhere to the applicable requirements defined in the corresponding directives [109]. Their compliance involves ensuring that third-party vendors adhere to data protection standards. However, achieving this can be challenging.

Nowadays, with the increasing complexity of mHealth applications, many closely resemble traditional healthcare in appearance and functionality. Occasionally, certain mHealth applications even fall under these protective guidelines and statutes. Nevertheless, the overwhelming majority remain beyond those laws and regulations. Positioned between commercial products and medical services, these applications thereby introduce fundamental healthcare concerns such as effectiveness, safety, and data privacy/security and furthermore highlight the need for critical ethical evaluation, even when their use aligns with existing legal and contractual frameworks [115, 165]. Users of mHealth apps share an extensive amount of sensitive personal health data, and any privacy breaches can cause severe consequences.

One major issue is the fact that most menstrual tracking apps, irrespective of their development quality or regulatory clearance, emulate FDA-approved products like Natural Cycles. As a consequence, users may falsely assume that all apps have to adhere to the same stringent standards for safety and performance [146]. However, with the absence of governance standards, the potential of misinformation to users will increase remarkably. Furthermore, since the FDA guidelines only apply to applications that are available for purchase and download in the United States, comparable apps in other jurisdictions are left subject to less supervision. This regulatory deficiency shifts the accountability onto developers to ensure that the content included in their apps is accurate and grounded in credible and reliable evidence [166].

Furthermore, during the app store registration process, developers select a category that they deem most suitable for their application. Nonetheless, the inherent ambiguity of these category definitions creates opportunities for developers to misclassify or strategically manipulate category selection. Classifying a mobile health application that stores sensitive medical information as “Health & Fitness” instead of “Medical” allows developers to obscure its actual functionally and potentially evade regulatory oversight altogether [167, 115]. Prior research indicates that companies specializing in women’s health in Femtech are generally more attuned to the sensitivity of the information they collect and reflect this awareness in their governance measures and operational practices. By contrast, some developers appear to treat menstrual information as ordinary data points, rather than recognizing them as particularly sensitive health data [168]. This suggests that a substantial amount of Femtech apps are incorrectly labeled within various app stores [115, 168].

2.3.4 Commercial Exploitation and Targeted Advertising

In order for Femtech mHealth apps to enhance the precision of their analytics, they prompt users to provide in-depth personal health data and medical histories, frequently requesting entry of similar information to that found in formal clinical records. These apps are very effective at collecting and processing the health statuses of their users to a degree comparable with that of a physician or gynecologist [163]. Consequently, Femtech solutions produce extensive datasets containing highly private and sensitive information regarding an individual’s reproductive decisions and other intimate aspects of their lives. In numerous instances, Femtech apps leverage large volumes of user-generated data not only on the primary end-users but also on related individuals (e.g., their infants, partners, or additional family members). Almeida and Mehrnezhad have evaluated the tracking of the 30 leading fertility apps as well as their privacy policies and concluded that most of these applications have trackers which immediately begin monitoring users the moment the app is launched. Furthermore, they noted that there was a higher prevalence of embedded trackers in these fertility technologies compared to general-purpose websites [115]. Hence, it would appear that the amount of data collected exceeds what is strictly necessary.

This accumulated information is rarely gathered by any other digital technology and as a result possess extraordinary value for a variety of stakeholders. The intimate data is routinely shared with third-party data aggregators, predominantly for monetization to support targeted advertising. Such advertisers consider it highly profitable, given that pregnancy and childbirth represent pivotal periods for establishing consumer brand loyalties [146, 147, 148]. Although personalized advertisements may appear harmless, they can inadvertently inflict psychological and emotional distress when such ads continue to appear following a miscarriage or abortion [146].

The GDPR generally provides protection against the unauthorized collection of personal data, and the processing of it by private actors, mandating explicit user consent for any such use. Notably, the European Union defines personal data concerning health as:

> *“[...] information derived from the testing or examination of a body part or bodily substance, including from genetic data and biological samples; and any information on, for example, a disease, disability, disease risk, medical*

> *history, clinical treatment or the physiological or biomedical state of the data subject independent of its source, for example from a physician or other health professional, a hospital, a medical device or an in vitro diagnostic test"* [169, p.6].

Almeida and Mehrnezhad [115] argue that existing regulations do not explicitly address "fertility data" once it is gathered and handled outside of clinical settings (e.g., in mobile apps). Such legal uncertainty can, therefore, introduce significant risks for users of these technologies, as discussed above and further explored below.

2.3.5 Inverse and Collective Privacy Concerns

Moreover, a major privacy concern emerges when user information is intentionally sold or otherwise disclosed to independent partners, such as Google, Facebook, and Amazon, without the users' explicit knowledge. An individual's sensitive details are therefore transmitted to these external platforms regardless of whether the user holds an account. As a consequence, these third parties are able to associate data to specific devices and applications in order to deliver customized messages to an individual. Despite user information supposedly being anonymized, they can be re-identified by cross-referencing with supplementary sources like location history and social contacts. Dedicated firms then consolidate this information into detailed individual profiles. Subsequently, these accounts are sold to entities such as advertisers and insurance companies, which aim for precise marketing to highly targeted consumers [147, 170, 171]. The sharing of user information with data aggregators is neither novel nor straightforward, however, it is particularly acute in the context of Femtech given the heightened sensitivity of the data involved [170]. The primarily revenue-driven framework of most of these applications intensifies the inherent conflict between protecting user privacy and the pervasive practice of data sharing [146].

Various organizations collect information for legitimate purposes, for instance, commercial enterprises gather customer data to improve service delivery, medical institutions obtain patient records to inform accurate diagnosis and effective treatments, and governments compile citizen data to address broader societal challenges and public policy. Through interaction with these institutions, private data is stored, analyzed, and compiled [172]. Therefore, a substantial part of the deeply personal health data amassed by Femtech apps qualify as "inverse privacy", in that it is available to external parties but inaccessible to the individuals concerned [170, 172]. In other words, users themselves may not have full visibility or control over the ways in which their data are utilized. This raises a multitude of ethical challenges related to data ownership and informed consent. Such insufficient transparency undermines user trust and may discourage individuals from engaging with mHealth technologies.

Given the highly sensitive nature of personal health data, legitimate concerns lie in the risks associated with the collection, transmission, and storage of the large volumes of such information on mobile devices and cloud servers. Many mHealth apps employ inadequate security measures and fail to implement proper encryption protocols. In many cases, medical data are transmitted over the internet in unencrypted form, for example in plain text, increasing the probability of interception during the transfer. Furthermore, storing patient information on third-party servers with insufficient confidentiality policies can lead to increased data breaches, unauthorized access, and misuse of sensitive information [173, 109, 174, 165].

Beyond the susceptibility to phishing attacks and cybercriminals, mobile devices are also vulnerable to physical theft or loss. Health data stored on the stolen or lost device could potentially be exposed. Accordingly, preserving the integrity and confidentiality of health information is essential and protecting mHealth application data requires adherence to regulatory standards and implementation of robust access controls to mitigate privacy-breach threats [109, 174, 175].

2.3.6 Ethical Concerns and Data Protection

As menstrual cycle and fertility tracking apps are “not quite” healthcare, individual companies retain discretion over the implementation of privacy and data security measures and users of these apps are often left to rely on the law of consumer contracts. Upon launch of an application, users are generally required to accept the app’s terms of service and privacy policy in order to access its features. These terms are non-negotiable and function primarily as informational disclosures [146, 171]. In the analysis which evaluated the tracking practices and privacy notices of the 30 leading fertility apps, 18 applications were identified that employed a “take it or leave it” consent model, whereas the remaining apps failed to provide any privacy notice. This inflexible approach was deemed highly inappropriate as it effectively compelled the user to accept the terms [115].

Furthermore, these agreements are typically provided via a simple click contract. Empirical research consistently demonstrates that users often agree to the data collection provisions presented without actually reviewing them [146, 171]. Partially, this is attributable to the consumer contracts’ complexity and length, often making them unreadable for most users who are struggling to understand. Such documents commonly include liability disclaimers, jurisdictional provisions, arbitration clauses, and warranty limitations, and most permit the service provider to unilaterally amend the terms, with continued use of the app considered acceptance to any changes [146].

2.3.7 Socioeconomic Barriers and Hidden Costs

In addition to the initial purchase costs of mHealth solutions, many apps introduce hidden expenses through feature gating and “freemium” business models to generate income. Clinically relevant functionalities such as trend reports, data export, or options to share information with clinicians are restricted to either paid subscriptions or in-app purchases. Research has documented frustration among users of wellbeing and mental health applications due to the constant upselling of services, paywalled essential features, and unclear distinctions between free and premium versions. Such practices do not build users' trust, nor does it encourage continued use of an app, thus limiting the clinical impact of the interventions. A health equity perspective suggests that relying on monetization strategies that prioritize revenue over accessibility risks excluding individuals unable or unwilling to pay. Therefore, further disparities in access to digital health support may potentially be reinforced [176, 177].

2.3.8 Digital Literacy and Usability Constraints

mHealth offers considerable promise to democratize healthcare, with the capacity to empower patients to assume responsibility for their own health. Simultaneously, however, there is an associated risk of exacerbating prevailing disparities in health outcomes. The benefits of digital health are not distributed equally, and as further digitization occurs in healthcare systems, those with limited health literacy or insufficient technological skills may encounter greater difficulties in navigating and accessing appropriate care. Effective use of mHealth assumes a fundamental level of digital and health literacy. It requires the ability to locate, evaluate, and utilize online health information, as well as to operate apps safely. Yet, when access to technology is available, skill gaps persist and can widen existing divides, potentially marginalizing those who have less technological proficiency or have complex health needs. These disparities undermine users' ability to evaluate app claims, configure privacy settings, and act on the guidance such tools provide [109, 175, 175]. Recent research demonstrates that usability and an individuals' general digital literacy directly influences the perceived usefulness of mHealth applications. When basic tasks such as account creation, data entry, or consent management create difficulties and feel confusing and overwhelming for the user, the individual is less likely to remain engaged and the likelihood of unintentional errors increases. This underscores the importance of designing for users with lower levels of literacy. Strategies such as using plain language, visual supports, and step-by-step guidance should, therefore, be regarded as a fundamental requirements for safety and equity, rather than merely an enhancement of usability [178].

The International Organization for Standardization (ISO) specifies in ISO 9241-20:2021 that the term usability is defined by:

> *"The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use."*[179, p.1]

This standard emphasizes that achieving specific goals with effectiveness, efficiency, and satisfaction depends on the product meeting these three criteria. It also outlines the necessary information to consider when evaluating usability in terms of user performance and efficiency. This highlights the integral role of usability in user experience and underscores its necessity in the successful development of effective and satisfying products for consumers. Furthermore, this definition underscores that both usability and its perception vary by product, intended user group, and usage context [179]. These variations are particularly pronounced in mHealth, where multiple domain-specific factors distinguish usability from that in other fields. Notably, assessing user satisfaction with mHealth systems is especially challenging. In healthcare settings, users must be informed about both the positive and negative outcomes. Consequently, they may receive information they would prefer to avoid, which can dampen satisfaction with the system. In contrast, in other domains, it is common for customers to receive enticing messages that are perfectly tailored to their needs. Within health communication, messages should be adapted to each user's health literacy level, to enhance patients' health knowledge, and their ability for self-management [180]. These issues are compounded by the fact that living with infertility often elevates stress and anxiety.

Other studies illustrate more technical aspects that hinder the effective use of mHealth tools. A frequent concern that has been identified is the absence of clear and concise instruction manuals. Without comprehensively written guides, patients are left feeling uncertain about how to navigate key features or integrate the application into their daily routines. On the contrary, when instructions and content are provided to mHealth users, they are often overly complex or excessively detailed, resulting in overabundance of information and subsequent reduced usability. Many applications have also been criticized for the aesthetic and functional design. The unappealing or non-intuitive interfaces can discourage continued engagement and contribute to user abandonment of the application. Additionally, technical inefficiencies such as high battery consumption and excessive drain of smartphone memory further reduce the feasibility of sustained use, particularly for individuals with older or lower-capacity devices [144].

2.3.9 Summary

The literature reveals that current Femtech apps often fall short of their promise to empower users, instead exposing them to psychological harm, inaccurate guidance, and privacy risks. From neglecting pregnancy loss and limited personalization, to commercial data exploitation, and usability barriers, these tools regularly prioritize monetization over clinical validity and inclusivity. This leads to an effect in which deeply personal reproductive experiences are insufficiently supported and, at times, actively compromised. These challenges point to the **urgent need for a paradigm shift in mHealth design**, one that centers compassion, transparency, and scientific accuracy, while embedding meaningful user control and privacy protections. Without such changes, female-oriented apps risk reinforcing existing vulnerabilities rather than alleviating them.

CHAPTER 3

Methodology

In this thesis, my aim was to formulate design principles that guide the development of fertility mHealth interventions. To pursue this objective, I utilized a multi-method research strategy that is divided into three stages (1) *discover (explore)*, (2) *define*, and (3) *develop and evaluate*. I began the research process with an extensive review of the literature and assessment of existing technologies, followed by user research methods that combined cultural probes and semi-structured interviews. These qualitative approaches enabled me to investigate how users experience self-tracking within assisted reproductive contexts, and how fertility experts perceive their ART patients and clinical workflows. The resulting insights were then translated into preliminary principles, which were discussed and examined collaboratively in a co-evaluation workshop. This participatory method led to the refinement and finalization of the design principles.

The related work presented in Section 2.2.2 demonstrates that fertility self-tracking technologies frequently add further burden to an already complex and difficult-to-navigate medical journey. Consequently, such tracking tools must be grounded in users' lived experiences to avoid exacerbating these existing challenges.

In response, I adopted a UCD approach that responds to the identified limitations present in fertility mHealth. The decision to apply a UCD process was driven by the need to obtain a deep understanding of the user expectations and needs, thereby ensuring that the user remains a priority at every stage of the UCD lifecycle [181]. By continuously incorporating the individual's input, issues are identified, concerns are addressed, and necessary adaptations are implemented [182, 183]. The user's involvement ultimately influences how a design takes shape [184], underscoring that all design decisions center on the user's perspective [182, 183]. Through this approach, UCD methods reveal otherwise invisible needs and guide fertility tracking technologies in a more supportive direction.

3.1 Research Overview and Structure

The recurring challenges related to women's self-tracked fertility data and usability issues discussed previously can be understood as discrepancies between system design and users' needs, expectations, and lived contexts. These problems emerge within a broader transformation of healthcare practices, in which traditional forms of patient consultations and documentation are increasingly supplemented by digital technologies [184]. As these interactive applications expand across various professional and personal contexts, usability remains a determinant of whether people accept and choose to use them. The usability issues of mHealth, mentioned previously in Section 2.3.8, further emphasize that usability is not limited to whether a system works efficiently or correctly. Rather, when framed around the users' personal goals, usability includes perceptual and emotional factors that contribute to the overall user experience [181].

For this reason, HCI is a central component in this shift, as it connects technology to what individuals need and value in their everyday practices, specifically concerning their personal relevance, context, and subjective experiences, as already mentioned in Section 2.2.2. Through its interdisciplinary nature, which draws from various fields including computer science, human factors, and psychology, HCI offers conceptual frameworks and methodological tools to examine how communication between people and machines can be effectively enhanced [185, 186]. The objective is to improve the user acceptance of such computer systems. This is achieved by developing technologies that facilitate more intuitive, usable and functional human-computer interactions [187]. In healthcare settings in particular, where technologies increasingly mediate clinical practices and patient agency, HCI enables the integration of empirical knowledge into design processes, ensuring that digital interventions are not only usable but also meaningful, ethical, and supportive. As such, HCI is important for translating lived experiences into actionable design insights, thereby addressing the aforementioned mismatches. This aligns with its definition as being *"concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them."* [185, p. 5].

Accordingly, this research employed a multi-method approach grounded in the field of HCI for informing the design of ART-related mHealth apps. The UCD process is foundational in HCI and represents a widely embraced design philosophy. It emphasizes the thorough understanding of a technology's usability, usefulness, and its capacity to be seamlessly integrated into everyday life. These core concepts are important goals, as information technology has become an essential component in routine activities [184].

To structure this investigation, the methodology was divided into three distinct phases: *discover (explore)*, *define*, and *develop and evaluate*. Figure 3.1 provides an overview of how these phases correspond to the research questions and hypotheses. The central goal of this structured approach was to generate the empirical and theoretical insights necessary to address the objectives guiding this study.

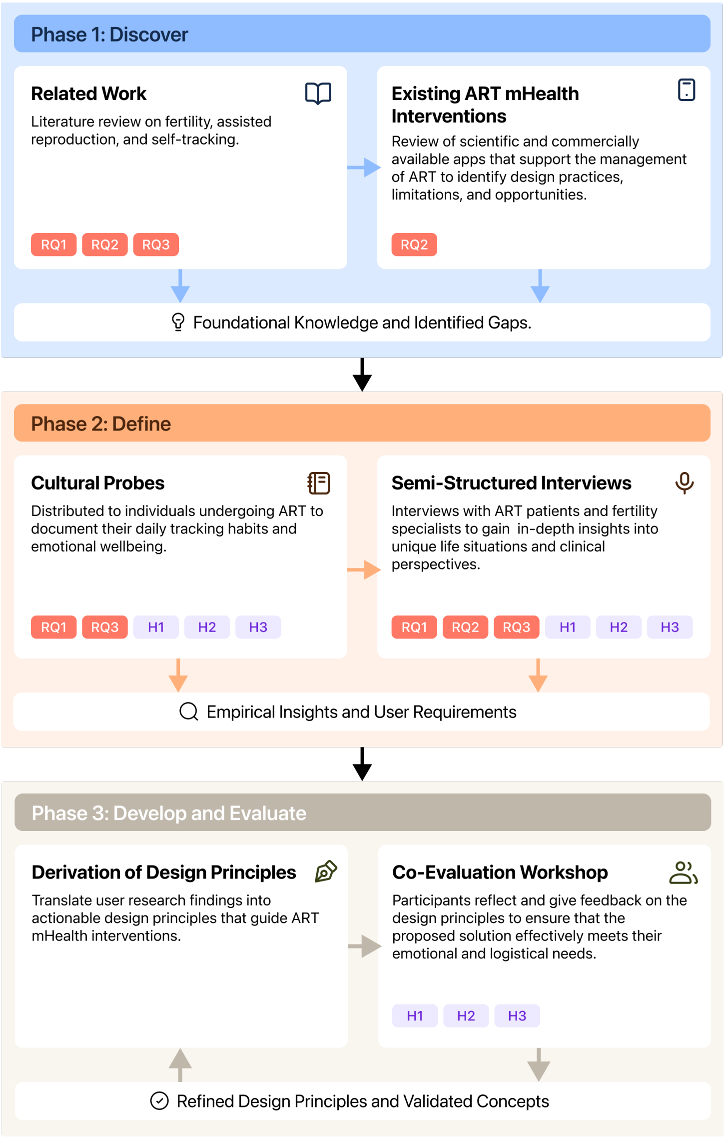

Figure 3.1: Methodological overview of the multi-phase research process. Phase 1 comprises a literature review and analysis of existing scientific and commercially available mHealth tools for ART. Phase 2 employs qualitative research methods to generate empirical insights, followed by Phase 3, which focuses on the development and co-evaluation of design principles. The process concludes with the refinement of these principles to ensure they effectively address the needs of ART patients.

3.1.1 Phase 1: Literature and Existing Technologies Review (Discover)

The first phase comprised a review of relevant related work on fertility and self-tracking, as well as an assessment of existing scientific and commercial ART mHealth applications to establish a foundational understanding of current design practices and biases, identify gaps and limitations, opportunities for intervention, and guide the subsequent stages of the research process.

3.1.2 Phase 2: User Research (Define)

Building on these findings, this phase involved two complementary methods that enable thorough investigation into empirical perspectives: (1) cultural probes with individuals undergoing assisted reproduction, and (2) semi-structured interviews with patients and fertility specialists. The cultural probes provided participants with creative tools (e.g., journal prompts) to help document their tracking habits and emotional fluctuations throughout the day. The interviews allowed for an in-depth exploration of the challenges they encounter, their relational dynamics, and their trust in existing technologies. These qualitative research methods helped gain a sense of the specific circumstances of each particular person within the context of their unique life situation. These strategies provided perspectives on how human behaviors, experiences, and perceptions are socially constructed. Therefore, the goal was to acquire a thorough analysis of the target audience, their needs, preferences, and constraints. Furthermore, these approaches helped extract user requirements, their context, and the specific use case.

3.1.3 Phase 3: Design and Co-Evaluation (Develop and Evaluate)

In the final phase, insights derived from the preceding stages were translated into actionable design principles that will guide ART mHealth interventions. To validate these guidelines, example user interface (UI) mockups were developed and examined through a participatory co-evaluation workshop with the target audience, in which participants gave feedback and reflected on these design principles. This ensured that the proposed solutions effectively meet their emotional and logistical needs.

3.2 Ethical Considerations

Effective research instruments are crucial for capturing the multifaceted perspectives of ART patients and fertility clinicians, ensuring that data is both rich and reliable. Given the sensitive nature of infertility and ART, the design of questions must prioritize participant comfort, safety, and the ethical handling of deeply personal information. To ensure compliance with ethical standards during data collection, I consulted with mentors from the Research Ethics Committee (TUW REC) of the Vienna University of Technology. I followed their guidance throughout the research process. In accordance with the guidelines provided by the TUW REC, all procedures involving participants were conducted with strict ethical consideration. Participation was entirely voluntary, and participants were appropriately prepared ahead of time regarding the types of subjects that would be discussed in the interviews. Each individual was provided with detailed written information about the purpose and procedures of the study prior to taking part, after which informed consent was obtained. Additionally, they were clearly informed about how their data will be collected, stored, and processed throughout the research. Participants were made aware that they could stop and/or remove themselves from the study at any time without consequence for terminating and/or withdrawing consent. The consent forms distributed to participants are included in Appendix A.

All participants were notified that the final thesis would be published on the university's publication site "reposiTUm"[1] and therefore publicly available. Participants were also given the opportunity to review the study results prior to publication and request to have any references or data removed if they were uncomfortable with the information. Additionally, to address the potential impact of sharing sensitive topics, debriefing materials were provided to the participants (ART patients) which listed available support services. Participants were given contact information for any additional follow-up questions or concerns. Each participant was offered a small compensation in recognition of their contribution, however, the majority declined.

To rigorously protect participant privacy, the names and locations of all participating fertility clinics remain confidential and anonymous. Furthermore, to prevent identification in the published findings, all healthcare providers and patient participants were assigned unique alphanumeric codes (e.g., E1, P1), and gender-neutral pronouns were used for the clinicians where applicable.

3.3 Recruitment of Participants

Participant recruitment was tailored to the specific requirements of each methodological phase, utilizing a combination of purposive and snowball sampling strategies. Since the research methodologies occurred at different stages of the thesis, participants were recruited using multiple strategies.

- **Cultural Probes Participants:** Recruitment of participants was achieved through personal connections with individuals undergoing fertility treatments. The primary inclusion criterion for the cultural probes was the active undergoing of ART treatment. Furthermore, there were no exclusionary criteria based on age, gender, or specific type of infertility diagnosis. In contrast to the alphanumeric coding used for interview participants, the two individuals involved in the cultural probes were not assigned numerical identifiers. Given the small cohort size, preserving their gender was deemed essential to properly contextualize the findings.

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[1] https://repositum.tuwien.at

- **Interview Participants:** *Healthcare providers* with the relevant expertise were recruited by distributing email invitations to fertility institutes in Vienna. Two of the physicians were specialists in obstetrics and gynecology particularly in reproductive medicine, while the third was a general practitioner and expert in personalized fertility treatment. All three healthcare providers were from different fertility clinics.
  ART patient recruitment was facilitated through personal contacts and postings on designated online platforms. The study participants were contacted and followed up with the interviews. Although more individuals showed interest in participating, only half completed the study. The 12 recruited patients were either currently undergoing or had previously completed MAR treatments. Except for P12, all participants were female. A summary of the patients who participated in the study can be viewed in Section 3.5.2. The overview includes the age and gender of the participants, their diagnoses and significant fertility-related events, the actions and treatments they pursued, and whether they successfully conceived.

- **Co-Evaluation Participants:** Participants were recruited from the previous user research cohort (cultural probes) and consisted of individuals with lived experience of infertility and ART. This continuity supported informed reflection on the design principles, grounding discussion in prior engagement with the study and ensuring relevance to the target user group. Additionally, to assemble a diverse group of individuals and capture a broad range of perspectives, I also invited participants without specific personal or professional expertise relevant to ART. Recruitment followed the same approach as in the cultural probes methodology, with me reaching out to participants through personal networks. Five participants took part in the workshop and I moderated the session in the role of the researcher.

3.4 Review of Scientific and Commercial ART mHealth

To map the current landscape of digital fertility tools and to identify their approaches, gaps, and opportunities for design, this section examines available research-supported digital tools developed specifically for infertility contexts and commercially available mHealth apps that support women managing ART. Table 3.1 presents an overview of the selected digital support tools. This research aimed to partially address RQ2 and RQ3, by revealing how the selected ART technologies currently handle the conflicts (see Section 2.2.2) associated with fertility self-tracking tools.

Category	Tool	Description	Source
Scientific	Infotility (Infotilité)	A mHealth intervention designed to address the psychoeducational and psychosocial needs of men and women undergoing infertility treatment by providing clinician-approved information and peer support	[188, 42]
	MediEmo	A treatment management tool designed to support patients through the medical and emotional aspects of MAR while generating time efficiencies for fertility clinics	[189]
	MyFertiCare	A web-based patient portal integrated into the clinical care process that empowers infertile couples through personalized information, access to health data, and interactive communication functionalities	[190, 191]
Commercial	BabyJa	A support app designed to help users understand their menstrual cycles and organize fertility treatments (i.e., IVF, IUI) by tracking logistics (medications, appointments) and documenting the journey visualizations (milestone cards).	[192]
	Bonzun IVF	A treatment-focused tool designed to reduce stress and increase success rates by guiding users through each step of their IVF journey.	[193]
	Hope Fertility	A management tool for digitally organizing infertility treatment plans, capable of operating as either a standalone tracker or a clinically integrated system (document exchange).	[194]
	Leeaf	A reproductive health app intended to assist individuals undergoing infertility treatments by monitoring their health data and organizing treatment-related information.	[195]
	OEVEO	An app designed to mitigate the administrative burden of fertility interventions by providing detailed logging for medical procedures and financial expense tracking.	[196]
	Olly	An app designed to support individuals and partners undergoing various infertility procedures by centralizing treatment information and tracking for multiple ART pathways.	[197]
	Tilly	A psychology-focused app that combines fertility tracking with evidence-based mental health tools and community support.	[198]

Table 3.1: Overview of research-based and commercially available ART support tools

3.4.1 Research-Supported Technology (Scientific)

To ensure relevance, academic papers published between 2021–2025 that focused on developing mHealth solutions for ART patients were included. The literature was identified through targeted keyword searches in multiple databases and search engines (e.g., Google Scholar, ScienceDirect (Elsevier), Elicit, and ChatGPT), using terms related to emotional support, mHealth, and assisted reproduction. Additional references were obtained through citation tracing from relevant HCI publications. *Infotility* [188, 42], *MediEmo* [189], and *MyFertiCare* [191, 190] were selected as representative research-supported applications addressing infertility and ART contexts, as they place great emphasis on user-centered design approaches and usability issues by following frameworks specifically developed for digital health technologies.

3.4.2 App-Based Infertility Interventions (Commercial Applications)

Multiple mHealth apps are currently commercially available to support women navigating ART, offering health insights, educational resources, and practical tools for fertility management, as seen in Table 3.1. As previously established in Section 2.3, many apps, whether focused on fertility and menstrual cycle tracking or pregnancy, tend to overlook the complex and non-linear nature of conception. Consequently, this section will review apps designed specifically for ART journeys, by using the walkthrough method [199] to determine whether and how they address pregnancy loss.

Step 1: Defining a Search Strategy

To broadly understand the range of available tools and to determine relevant technologies in ART in the marketplace, I performed a structured search on the Apple App Store, set to the Austrian storefront between April 2023 and September 2025. The goal is to cast a wide net to capture as many potentially relevant apps as possible. An effective search strategy relies on a combination of well-defined keywords that cover the relevant domain. Therefore, a predefined list of ART-related terms was applied one at a time: IVF (n=142), IVF management (n=5), IVF journey (n=6), ICSI (n=16), IUI (n=17), in-vitro fertilization (n=3), fertility treatment (n=15), assisted reproduction (n=4), infertility planner (n=2), and “Kinderwunsch”(n=45). This initial search identified 255 apps from the app store, which then had to be systematically narrowed down.

Step 2: Establishing Eligibility Criteria

For each keyword, I reviewed the entire list of results and opened individual apps to inspect the descriptions and feature sets. After the initial broad search returned numerous non-relevant apps, it was necessary to limit the results by introducing some criteria. I iteratively refined the approach by narrowing down the inclusion criteria and re-screening results for each keyword. Apps were eligible for inclusion if they met the following criteria:

1. **Language:** The app had to be available in English or German. Apps were excluded if they were available only in another language.
2. **Pricing:** The apps were either free to download or offered a freemium version.
3. **Access Requirements:** The apps had to be publicly accessible without clinic- or provider-specific login credentials. Apps that required institutional credentials to access any core functionality were excluded, as an analysis would have been impossible.
4. **Relevance:** Apps with a focus that was irrelevant to the research question were excluded. This included apps dedicated solely to pregnancy content or cycle

wellness without ART-specific topics, general lifestyle trackers lacking a specific fertility element, or those aimed at preventing conception. Apps were also excluded if they were limited to marketing or clinic locator functions without ART-related management tools.

5. Functionality: Apps that were non-functional or no longer available for download were removed from the dataset. The apps were required to offer at least some of the predefined functional features relevant to ART (e.g., health data entry or tracking, treatment or medication scheduling tools, educational content specific to infertility and ART procedures, or patient support/communication aids etc.), as listed in detail below 3.4.2.

Screening proceeded in two stages. First, titles, icons, and short descriptions were screened within search results to remove clearly irrelevant apps. Second, potentially eligible apps underwent full listing review, including long descriptions, feature lists, screenshots, and developer notes, to confirm language availability, access model (free/freemium vs. paywalled), and alignment with the feature criteria. When eligibility remained unclear, I installed the app to verify access and language settings. Duplicates across keywords were consolidated.

Step 3: Relevant App Feature Categorization

The essential features were defined through the review of prior research on digital support tools for fertility patients (see Table 3.2).

Category	Feature
Infertility & ART Features	Medication Tracking
	Treatment/Appointment Tracking
	Reminders (Medication or Appointments)
	Treatment Cycle History
	Notes (Journal, Symptoms, Mood)
	Logging Negative Outcomes
Communication & Data Sharing	Peer Support Forums or Messaging
	Messaging with Clinic Staff
	Health Records/Test Results (Upload, Store, Access, Download, or Share with Clinic)
	Partner Integration
Educational Resources & Psychological Support	Information Regarding Fertility/Infertility and Available ART Treatments and Procedures
	Medical Information (FAQs, Medical Glossar)
	Instructional Videos
	Psychological Coping Interventions for Self-Management (i.e., Guided Relaxation, Positive Affirmations, or Emotional (Mood) Tracking)

Table 3.2: Predefined set of established functional features

Step 4: Data Extraction

A data extraction strategy was used to simplify the retrieval and analysis of the information. For each retrieved app, app name, app category, version number, developer, language(s), pricing model (including in-app purchases), and presence or absence of each prespecified feature was recorded in a standardized spreadsheet. In total 7 apps were identified for further assessment and included for the analysis: *BabyJa* [192], *Bonzun IVF* [193], *Hope Fertility* [194], *Leeaf* [195], *OEVEO* [196], *Olly* [197], and *Tilly* [198]. A summary of the apps and their features can be found detailed in the following chapter, see Table 4.5.

3.5 User Research

This section presents the user research component of the thesis, which primarily aimed to develop an in-depth understanding of women's experiences with self-tracking during medically assisted fertility treatment, as well as to capture clinical perspectives on current practices and technological support. The findings from this research informs the development of design principles and interface concepts presented later in this thesis.

Furthermore, the goal of this phase was to directly address all three research questions.

RQ1. *How do women engage in fertility self-tracking, and what challenges do they encounter?*

RQ2. *How does the design of existing fertility technologies align or conflict with women's lived realities during ART treatment?*

RQ3. *How is the communication of uncertainty in fertility tracking experienced, and what does this imply for the design of fertility self-tracking technologies?*

In addition, this phase sought to examine the effects of communication on decision-making H1, the emotional, embodied, and social dimensions of fertility self-tracking, including impacts on wellbeing and self-perception H2, as well as the influence of personal values, cultural context, and relational dynamics on users' experiences with fertility data and technology H3.

H1. *The way uncertainty is communicated in fertility self-tracking technologies influences users' trust, engagement, and decision-making. Appropriate visualization and explanatory design strategies may help to mitigate these effects.*

H2. *Engagement with fertility self-tracking technologies affects users' emotional wellbeing and self-perception, with design features potentially contributing to both positive and negative experiences.*

H3. *Users' experiences of fertility data and self-tracking technologies are shaped by socio-cultural context, personal values, and relational dynamics (including partner involvement), and these factors should be explicitly considered in the design of fertility tracking systems.*

To address these objectives, I adopted the following two qualitative methods:

1. Cultural Probes: Individuals who were currently undergoing infertility treatment receive probe kits containing reflective activities (e.g., diary, exercises, prompts). These probes are designed to elicit authentic insight into their daily routines, emotional experiences, perceptions, and interactions with partners and/or clinicians. This directly addresses RQ1 and RQ3, and provides empirical evidence for H2 and H3.

2. Semi-Structured Interviews: To garner narrative accounts from both current or former ART patients, which allows for a deeper exploration of their individual perspectives, and to understand expert perspectives on patient challenges and clinical workflows from fertility specialists. This research supports RQ1–RQ3 and offers a connection to H1–H3 by integrating lived experiences and professional viewpoints.

3.5.1 Cultural Probes

Investigating the behaviors, motivations, and expectations of individuals undergoing treatment with ART is crucial in order to gain a genuine emotional understanding of their real-world experiences [200]. Based on this objective, I incorporated cultural probes as part of the qualitative research methods.

Cultural probes are a useful methodological tool for understanding the daily needs, goals, and obstacles of users during the early stages of the design process. They consist of a series of carefully designed tasks intended to evoke thought-provoking responses. Over a set period of time, participants are asked to document and deliberately reflect on certain aspects of their life. These probes are intended to stimulate personal engagement, foster empathetic analysis, and promote the acceptance of uncertainty as a beneficial principle in design. This process of self-observation enables the compilation of predominantly impartial, unbiased, and individualized insights. Consequently, making this research technique a valuable instrument for gathering plentiful, user-centered data in the initial phases of a project [200, 201, 202].

Preparations

Cultural probes kits were prepared and included a notebook for daily journaling in the size of A5, pens, sticky notes, and mindful affirmation cards. The participants were asked to take photographs using their own smartphones whenever they attended a doctor's appointment or administered medication at home. Taking pictures serves multiple purposes: it helps individuals in recalling their experiences more easily and captures elements and situations that might otherwise go unnoticed or unconsidered. In addition, these images provide partial yet valuable insights into participants' personal experiences and possibly their thoughts. Figure 3.2 presents the items that were included in the cultural probes kit and distributed to participants.

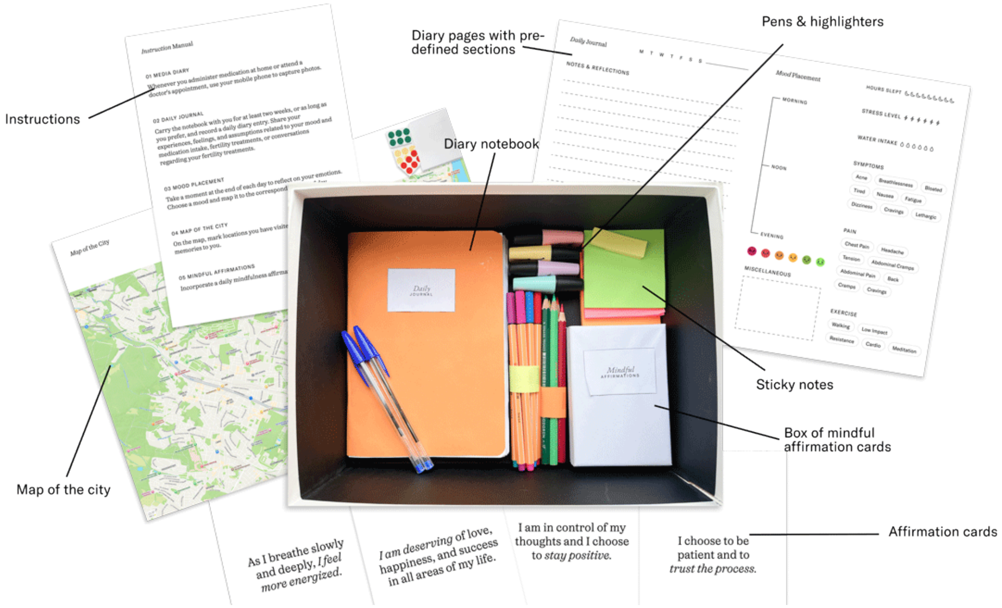

Figure 3.2: Contents of the cultural probes box

All items of the cultural probes kit were placed in a lidded box to ensure safe transport and prevent content from going missing. The diary notebook included an instruction manual to allow participants to revisit and clarify the task requirements, as well as pre-defined templates to guide and structure their input. For each day of the week, the journal pages consisted of a date entry, sections for notes and reflections, a map of the city to mark visited locations, and a page for logging data points such as mood throughout the day and various other metrics similar to those featured in mHealth apps (e.g., hours slept, stress level). The intention was to encourage participants to reflect on daily events and consider how these experiences affected them both positively and negatively. By keeping a mood diary, individuals are able to recognize emotional patterns and identify potential triggers that may influence their mental state. Pens, highlighters, and sticky notes were provided to support creative engagement and to ensure participants had access to sufficient materials.

As previously established in Section 2.1.3, individuals inherently link fertility data to their sense of purpose or personal fulfillment. Struggling to achieve parenthood often undermines the infertile couple's confidence in coping with both the demands of medical treatment and the intense emotional turmoil that accompanies it. Feelings of inadequacy as a woman or diminished masculinity underscore the emotional weight attached to the fertility data. For some, their bodies are primarily viewed through the lens of their reproductive capabilities, leading to intensified negative self-perceptions if their body is not responding as desired. For this reason, mindful affirmation cards included in the cultural probe kits were an attempt to remind participants of their intrinsic worth beyond their reproductive capacity and to lead them to a renewed appreciation for their body's resilience. Mindfulness is conceptualized as a deliberate state of awareness, in which the individual acknowledges and reflects the present moment, thereby continuously focusing on ongoing internal experiences [203]. The mindful affirmation cards added in the probes kit not only included phrases to cultivate self-compassion but also breathing exercises to promote calmness. This intervention was intended to promote acceptance and meaning-based coping techniques and help the participant transition away from from maladaptive coping strategies (e.g., self-blame).

Data Collection

The cultural probes were introduced in an informal meeting and held in a familiar setting, as participants had a personal relationship with me. During the session, participants were given a brief overview of the thesis topic to provide general context. The contents of the probe kit, along with the suggested tasks and activities were presented, however, my instructions were intentionally kept to a minimum to allow participants the freedom to engage with the materials in their own way. Participants were explicitly informed that they were free to decide which activities to complete and how many they wished to undertake.

In total, two cultural probes kits were distributed to participants, comprising one woman and a man undergoing ART treatment for infertility and stayed with them for the duration of the fertility procedures. The participants retained the cultural probes for the duration of several IVF cycles. In all cases, however, the daily diary entries ceased either after a successful pregnancy or the termination of the pregnancy. When a new treatment cycle began, participants continued with their journaling.

3.5.2 Semi-Structured Interviews

Complementing the insights gained from the cultural probes, semi-structured interviews were employed to capture retrospective narratives and expert perspectives.

Interviews are a common research instrument for collecting in-depth, empirical data and may therefore be effectively employed to identify valuable insights on user perceptions, experiences, opinions, and non-verbal reactions [204, 205]. In this method, interviewees are able to express their viewpoints freely and share unique highlights of the aspects they consider most significant. This qualitative method is especially useful in situations where it is necessary to gain a better understanding of particular details and examine an individual's personal perspective on a phenomenon, rather than to make broad generalizations for a larger population [204].

Whilst semi-structured interviews are conducted utilizing a predetermined framework of overarching themes, the mostly open-ended questions allow for a flexible and adaptable conversation between the researcher and the participant. In contrast to rigidly structured interviews, they are less restrictive than the fixed question-and-answer format. This is due to the fact that during the semi-structured interview process, questions can be continuously adjusted and fine-tuned according to the current situation [206, 207, 208, 209, 210].

As a result, this method of inquiry ensures that key points are investigated comprehensively while simultaneously specific topics are explored in more depth. The gathered narratives are subsequently analyzed to identify relevant and emerging trends.

Preparations

In advance, a general set of topics, open-ended questions, and follow-up questions were developed to obtain an overview of several points of view regarding assisted reproductive technology fertility treatment. Open-ended questions are fundamental to qualitative research, allowing participants to respond in their own words and provide detailed insights that go beyond simple “yes” or “no” answers [211]. Based on the existing research on infertility and ART experiences, critical themes were included in the development of the interview questionnaires in order to ensure comprehensive coverage of the expert perspectives surrounding these fertility treatments and the multifaceted patient journey.

In total, 15 semi-structured interviews (3 fertility specialists and 12 ART patients) were conducted during the research phase of the thesis.

The interviews with healthcare providers focused on clinical context and patient observations, communication practices, and attitudes toward digital health, as can be seen in Table 3.5.2. The interviews with patients placed emphasis on clinical context and general information, self-tracking modalities, impact on wellbeing and self-perception, as well as interactions with both clinical services and digital health technologies. Table 3.5.2 provides an overview of the established themes.

Topics	**Purpose**
T1. Clinical Context & Patient Journey	To understand the medical landscape of ART from the provider's perspective, identifying the most frequent diagnoses and challenging factors of infertility. **Relevance:** Establishes the boundaries of what technology can realistically solve versus what strictly requires medical intervention.
T2. Patient Communication & Emotional Support	To understand current communication methods, perceived patient needs, and the feasibility of new communication channels (i.e., contact between appointments, information gaps, current methods for providing support). **Relevance:** Directly addresses the emotional and educational gaps identified in the review of existing technologies. It highlights the need for digital tools to step in when clinical staff lack the time or resources to provide continuous emotional support.
T3. Test Results & Patient Comprehension	To explore clinical practices for delivering sensitive, complex, or disappointing health data, and how doctors ensure patients actually comprehend the probabilities of ART. **Relevance:** Directly answers RQ3 and tests H1 (communicating uncertainty). If physicians struggle to explain statistical realities and manage expectations in person, it proves that digital tools must be designed with extreme care to avoid misrepresenting data or causing panic.
T4. Digital Tools for Data Sharing & Support	To assess opinions on digital tools for data sharing, perceived benefits, and potential concerns and to explore willingness to engage in digital support. **Relevance:** Connects to RQ2. It helps define whether design principles for an ART support tool should focus purely on the patient as a standalone user, or if they should include clinical integration features (i.e., document sharing, communication).

Table 3.3: Topics established for the physician interview questionnaire

Topics	**Purpose**
T1. Clinical Context & General Information	To discover the unique paths that led to seeking fertility treatment and the impact on daily life. **Relevance:** Addresses the "happy path" design bias by understanding how complex and traumatic the clinical reality is (e.g., miscarriages, endometriosis, same-sex journeys).
T2. Fertility Self-Tracking & Personal Health Data	To understand the exact tools and methods they use to track health parameters, their motivations, the friction they encounter, and how app design influences their wellbeing. **Relevance:** Directly answers RQ1 (challenges) and RQ2 (design conflicts), and tests H2 (impact on emotional wellbeing).
T3. Communication of Uncertainty	To explore their reactions to the inherent unpredictability of ART and their preferences for how physicians and digital tools communicate uncertain data. **Relevance:** Directly answers RQ3 (communication of uncertainty) and tests H1 (trust and decision-making).
T4. Couple Dynamics & Support	To investigate how sharing tracking data with a partner impacts relationship health, and to validate the functional/emotional need for "partner synchronization" features in apps. **Relevance:** Directly tests H3 (relational dynamics and socio-cultural context).

Table 3.4: Topics established for the ART patients interview questionnaire

Data Collection and Analysis

Physicians were interviewed prior to other participant groups to provide insight into a professional context that was relevant to the study. The interviews lasted between 45 minutes to 2 hours, took place between April and June 2023, and were conducted in-person, via Zoom, or Microsoft Teams. All interviews were recorded by hand, with responses and observational notes written directly beneath the corresponding questionnaire items. Pen and paper were used for the data collection process, as audio and video recordings were not a viable option due to integrity issues and the sensitive nature of the matter. Key themes were then derived by repeatedly reviewing participants' answers to identify recurring patterns, attending closely to context, clinical observations, communication practices, and attitudes toward digital health. Further information on the findings can be found in Section 5.2.1.

Interviews with ART patients were conducted either online via Zoom or in-person, with strict data protection measures in place. All interviews took place in December 2025, two were carried out in-person, while the remaining took place online. In-person interviews were not audio-recorded, instead, data were captured exclusively through handwritten notes. Similarly, Zoom interviews were not recorded, neither manually or automatically, ensuring that all information remained local and secure. The duration of the interviews ranged from 20 minutes to 2 hours. Collectively, the interviews provided detailed accounts regarding the participants' experiences related to their infertility, as well as their data-related activities during their respective fertility journeys, as described fully in Section 5.2.3. Table 3.5 summarizes the interview participants' characteristics.

It is evident from the interviews that there is no single pathway to ART, instead there are multiple, which represent a complex interplay of circumstantial, biological, and historical factors. The cohort includes same-sex couples navigating family-building with donor gametes (sperm), as well as individuals responding to specific medical diagnoses and histories of traumatic loss:

- Same-sex couples or singles pursuing treatment with donor sperm, navigating IVF protocols to build their families (P3, P5, P10).
- Medical diagnoses that directly impact fertility, ranging from chronic inflammatory conditions like endometriosis (P2, P4) to autoimmune disorders such as Antiphospholipid syndrome (P6) and structural blockages resulting from conditions like hydrosalpinx (P7, P8), as well as male factor OAT syndrome (P12).
- Histories of pregnancy loss, with several participants having experienced the cumulative trauma of recurrent miscarriages, chemical pregnancies, and life-threatening ectopic pregnancies prior to or during their treatment (P1, P2, P6, P7, P9).
- Secondary infertility, where individuals face the inability to conceive a second child after a previous successful pregnancy (P11).

P#	Age & Gender	Background	Diagnoses & Events	ART Treatment	Tracking	Partner Involvement / Conceived
P1	30, F	Master's degree, Middle class, PT employment	Inability to conceive and recurrent miscarriages. Temporary immunological sterility; partner diagnosed with male factor infertility.	5 ICSI treatments over 2 years.	Commercial tracking app; pen & paper; digital fertility monitor.	Not involved in tracking; financially supportive, emotionally unsupported / Yes
P2	33, F	Bachelor's degree, Middle class, FT employment	Miscarriages; stage 5 endometriosis, Asherman's syndrome, adenomyosis, PCOS, MTHFR mutation; OHSS.	Trigger injections; laparoscopic surgery; 2 egg retrievals; multiple failed transfers; treatment pause; transfer planned Jan 2026.	Commercial tracking app; pen and paper.	Very involved and supportive / No
P3	33, F	Master's degree, Middle class, FT employment	Same-sex couple, no infertility diagnosis.	IVF treatment.	Clinic-provided app; pen and paper.	N/A
P4	32, F	Bachelor's degree, Middle class, FT employment	Stage 4 endometriosis after 1 year unsuccessful conception.	Surgery followed by IVF since July 2024.	Commercial tracking app; phone notes.	Very involved emotionally, minimal tracking / No
P5	41, F	PhD, Self-employed	Single lesbian participant; history of recurrent miscarriages.	IVF using known donor and later donor sperm; previous IUI.	Clinic-provided app; no self-tracking.	N/A
P6	31, F	Bachelor's degree, Middle/lower class, FT employment	3 miscarriages and one ectopic pregnancy; APS diagnosis.	Previous IVF; current IVF with possible ICSI.	Clinic app; commercial app; shared calendars; alarms.	Not involved / No
P7	32, F	Secondary school (i.e., "Matura"), Middle class, FT employment	2 ectopic pregnancies; one rupture; single damaged tube.	Decision to pursue IVF.	Commercial tracking app.	Not involved / N/A
P8	34, F	NVQ Level 2 (equivalent to Austrian "Lehre"), Unemployed	Hydrosalpinx and bilateral tubal blockage.	Surgical clipping followed by IVF.	Commercial tracking app with reminders.	N/A / No
P9	39, F	Bachelor's degree, Upper middle class, PT employment	Pregnancy loss due to chromosomal abnormalities; uterine scarring.	Surgical resolution followed by ICSI.	Commercial app; phone calendar; pen and paper.	N/A / Yes
P10	32, F	Master's degree, Middle class, PT employment	Same-sex couple; recurrent implantation failure.	IVF with donor sperm; 7 transfers planned.	Clinic app; commercial tracking app.	N/A / No
P11	39, F	Bachelor's degree, Middle class, FT employment	Secondary infertility; low ovarian reserve.	7 ART cycles; donor egg IVF; ongoing pregnancy.	Clinic app; commercial app; calendar; pen and paper.	Not involved / Yes
P12	43, M	Master's degree, Middle class, FT employment	Diagnosed with OAT.	5 ICSI treatments over 2 years with partner.	Digital calendar for appointments.	Very involved / Yes

Table 3.5: Overview of interview participants, diagnoses, ART treatments, and tracking practices

3.6 Design and Co-Evaluation

Following the empirical data collection and analysis, the research transitioned into the design and evaluation phase. This section outlines the approach of translating the complex experiences and unmet needs of fertility patients into actionable design guidelines. It details how the qualitative data was merged to formulate six design principles, and how these principles were subsequently visualized and iteratively refined through a participatory co-evaluation feedback round with the target audience.

3.6.1 Derivation of Design Principles

To translate the data gathered during the preceding research phases (*discover* and *define*) into actionable design principles, I employed an affinity mapping process. Affinity diagramming is a technique that is used to organize information by grouping related items together to reveal connections [212].

Data Processing

To manage my data, I utilized FigJam[2] as a digital whiteboard, as seen in Figure 3.3. I extracted the data points (e.g., user quotes, literature findings, etc.) that captured both practical challenges and experienced aspects of fertility tracking, and wrote each individual insight or statement on a separate digital sticky note that I then clustered based on thematic similarity, allowing patterns to emerge. This affinity diagramming process resulted in several clusters representing recurring subjects across participants and methodologies.

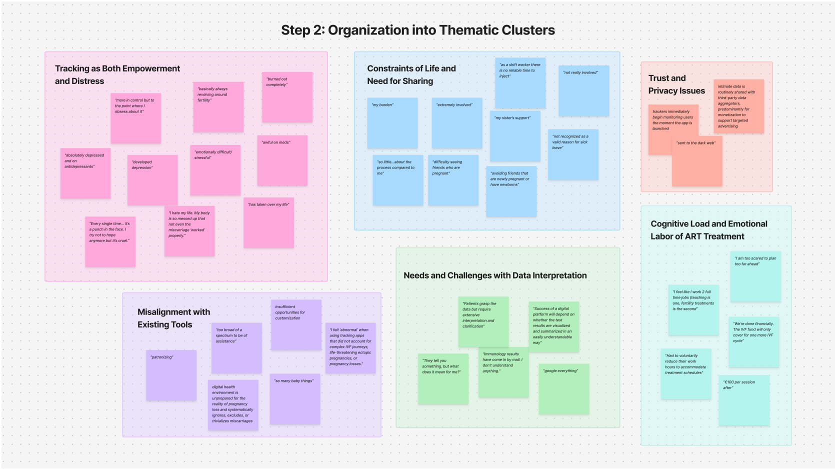

Figure 3.3: Clustered data points with participant quotes and literature findings that informed the emerging topic.

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[2] https://www.figma.com/figjam/

After clustering these items, I articulated higher-level thematic categories by interpreting each cluster in relation to the broader ART context and prior literature. For example, clusters revolving around miscarriage, failed transfers, and feeling “abnormal” were combined to form a category for non-linear journeys, while statements related to medication schedules, documentation, and financial stress were grouped into a theme for cognitive and administrative overload. Throughout this entire process, I took notes to help me develop emerging interpretations and to directly link the user needs with concrete opportunities for design. Directly building on this information, I formulated six design principles to guide the creation of fertility self-tracking apps in ART contexts.

Creating Interface Mockups

While the six design principles provided a strong theoretical framework, abstract guidelines can often be difficult for non-designers to evaluate conceptually. To facilitate a productive discussion for the upcoming co-evaluation phase, it was necessary to operationalize these principles into tangible artifacts.

Therefore, to support the evaluation and validation of these preliminary principles, I created a series of (UI) mockups (in black and white for simplicity) using *Figma*[3]. Each mockup was designed to exemplify the corresponding principle and to illustrate how each of the six principles might manifest in a real-world mHealth fertility app. The mockups served as concrete artifacts for participants to grasp more easily the practical implications of the concepts and to provide feedback on during the co-evaluation workshop. These conceptual interfaces were intended to illustrate design intentions rather than represent final solutions, allowing participants to interact with tangible representations of the proposed principles. The combination of design principles and illustrative mockups supported a traceable design process. This approach ensured a clear connection between empirical findings, design reasoning, and user-centered evaluation.

3.6.2 Co-Evaluation

Following the development of the initial set of design principles and accompanying interface mockups, a co-evaluation workshop with 5 participants was conducted as a feedback-based participatory method. In line with UCD practices in HCI, the workshop aimed to collaboratively reflect and assess whether the preliminary principles for mHealth support during ART treatment resonated with individuals and aligned with user needs.

Preparation

The session was facilitated in an informal environment to encourage open dialogue, support reflection and collaborative discussion. After an introduction to the study goals and workshop format, participants were presented with the six design principles alongside their corresponding UI mockups. Guided by structured prompts, participants were

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[3] https://www.figma.com/design/

invited to discuss each principle in relation to their experiences or assumptions, reflect on perceived usefulness, identify strengths and limitations, and suggest potential improvements. Particular attention was given to participants' interpretations of uncertainty visualizations, data presentation, and features related to emotional support and data sharing.

Data Collection and Analysis

The discussion was documented through my notes and collected artifacts (participants' index cards). The collected data provided qualitative feedback on the preliminary principles and generated insights into participants' expectations, concerns, and preferences regarding fertility self-tracking technologies. Subsequently, I analyzed the feedback to examine areas of alignment and mismatch between the proposed principles and the unanticipated design considerations. These insights were used to refine both the principles and their visual representations, ensuring that the final design guidelines were not only theoretically informed but would also resonate with users.

CHAPTER 4

Findings from Reviewing mHealth Interventions

4.1 Research-Supported Technology (Scientific)

This section reviews three scientific, research-supported mHealth interventions designed for ART patients: Infotility, MediEmo, and myFertiCare. The review focuses on their core functionalities and empirically measured outcomes.

4.1.1 Infotility: mHealth App for Fertility Care

Infotility (Infotilité) is a bilingual (English/French) mHealth intervention with the goal to provide reliable and easy to understand information regarding all aspects of infertility as well as peer support through a user forum. The final app itself is used for research purposes only and currently not publicly available for testing. Nevertheless, the creation process offers interesting takeaways. This study details how the application was systematically designed, developed, and evaluated to deliver clinician-approved information and peer support to men and women undergoing treatment for infertility and to address the psychoeducational and psychosocial needs of people navigating fertility challenges. Although some similar apps already exist, the authors, all based in the medical and academic fields in Montreal, Canada, assert that theirs is the first to document the development and evaluation process [188, 42]. The research team adhered to the Medical Research Council (MRC) framework for complex interventions for the development, feasibility/piloting, evaluation, and implementation by combining quantitative surveys and qualitative feedback throughout. This structured approach is repeatedly emphasized across publications and shapes the program logic: define the problem, co-design the solution, pilot, then iterate toward scale. The MRC's guidelines ensure a structured, patient-centered approach and provide rare transparency on usability and early implementation planning [188].

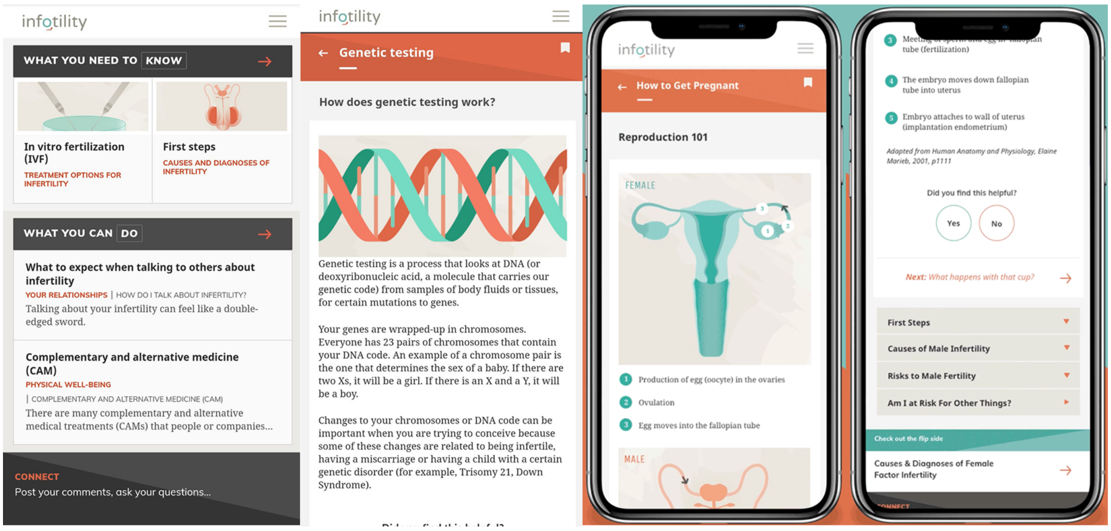
The application was designed following a needs assessment of 659 fertility patients and 127 healthcare providers. These surveys revealed a strong desire by patient in using a fertility app. Additionally, participants expressed their preferences for prioritizing features such as clear language, a glossary for medical terms, reproductive health content, stress reduction tools, information on healthcare coverage, and the availability of moderated online peer support. Crucially, the surveys identified that patients often lacked access to information on fertility laws and financial coverage. These data informed both feature set and content in the app [188]. It's key feature are listed in Table 4.1.1.

Patient Need	**Feature Solution**
Reliable, easy-to-understand information	Contains over 40 pages of clinician-approved content on medical, lifestyle, and financial topics, written at an accessible reading level (e.g., 8th grade for English content).
Support for both partners	Offers two distinct interfaces, one for female and one for male fertility, with a "flip side" function to access all content.
Connection with others	Includes a "Connect" feature, which allows for peer support through a moderated online community of other individuals, supported by trained peers who have experienced similar challenges, and who may communicate with each other anonymously to help alleviate feelings of isolation.
Actionable advice	Organizes its content into categories like "What you need to know" (informational) and "What you can do" (actionable), including a popular "Lifestyle" section.

Table 4.1: Infotility's key features [188]

The design phase focused on user-centered design principles to mitigate the risk of overwhelming patients with information. Based on their findings, the research team developed >40 pages across medical, lifestyle, psychosocial struggles of infertility, legal, and financial domains and the content was tailored for both men and women. Furthermore, the material was subjected to expert review by fertility specialists to ensure clinical relevance and accuracy [188].

Infotility provided two distinct interfaces, one highlighting female fertility information and one male-focused, while retaining access to all content through a "flip side" function [188, 42]. The content was organized into digestible segments under major categories such as "What you need to know" (informational) and "What you can do" (actionable aspects) [188], as seen in Figure 4.1.



Talking about your infertility can feel like a double-edged sword.

There are many complementary and alternative medical treatments (CAMs) that people or companies...

Genetic testing is a process that looks at DNA (or deoxyribonucleic acid, a molecule that carries our genetic code) from samples of body fluids or tissues, for certain mutations to genes.

Your genes are wrapped-up in chromosomes. Everyone has 23 pairs of chromosomes that contain your DNA code. An example of a chromosome pair is the one that determines the sex of a baby. If there are two Xs, it will be a girl. If there is an X and a Y, it will be a boy.

Changes to your chromosomes or DNA code can be important when you are trying to conceive because some of these changes are related to being infertile, having a miscarriage or having a child with a certain genetic disorder (for example, Trisomy 21, Down Syndrome).

1 Production of egg (oocyte) in the ovaries
2 Ovulation
3 Egg moves into the fallopian tube

3 Meeting [illegible] tube (fertilization)
4 The embryo moves down fallopian tube into uterus
5 Embryo attaches to wall of uterus (implantation endometrium)

Adapted from Human Anatomy and Physiology, Elaine Marieb, 2001, p1111

Figure 4.1: Infotility's informational and actionable content from [188, 213]

Infotility explicitly describes containing specific content addressing pregnancy loss and miscarriage. It includes dedicated articles and sections for both the medical and emotional aspects of loss:

- **Medical Information:** Under the category "Multiple pregnancy losses", the app provides information regarding the "Causes and treatments of multiple pregnancy losses".
- **Emotional Support:** Within the "Mental wellbeing" category, the app features a specific section titled "Dealing with pregnancy loss" to support users' psychological health.

In the feasibility study of Infotility, involving 250 participants over eight weeks, researchers investigated how different factors were related to a patient's use of the app. For both men and women, the "Lifestyle" section of the app was the most frequently visited category. In contrast, the "Medical" section was the least visited. The researchers hypothesized that this might be because patients were already receiving a lot of medical information directly from their clinics or other easily accessible sources. This suggests that patients are looking for actionable, as well as practical suggestions as to how they might maintain or improve their overall health and wellbeing through diet, exercise, and other behavioral changes, information they may not be receiving in detail during typical clinical consultations. Furthermore, usage data showed that women without children and with university education, a group known to experience higher levels of stress during fertility treatment, used the app more intensely. This demonstrates that the app may be a particularly valuable and timely resource for this group, potentially helping to ease anxiety during a difficult time [42].

The overall app received positive ratings across engagement, functionality, information, and aesthetics, with an overall app-quality mean of 3.75/5 and a star rating of 3.43/5. Qualitative feedback confirmed that the “Connect” peer support was a favorite component, contributing to the reduction of isolation and management of stress due to its confidential and safe nature. Notably, the study showed that user forums for the exchange of ideas and experiences were highly appreciated by patients, especially when they are available on mobile devices, offered links to external resources and were monitored by health professionals. This highlighted the need for psychosocial connection alongside informational content. However, it was reported that 50.2% of participants would not be willing to pay for such an app [188].

By creating and rigorously testing the Infotility app, the researchers demonstrated that evidence-based mobile tools can play a vital role in supporting patients with trusted, accessible information on their challenging journey with infertility.

It is worth mentioning that Infotility is solely an information and communication app and not designed to accompany or manage IVF treatment procedures.

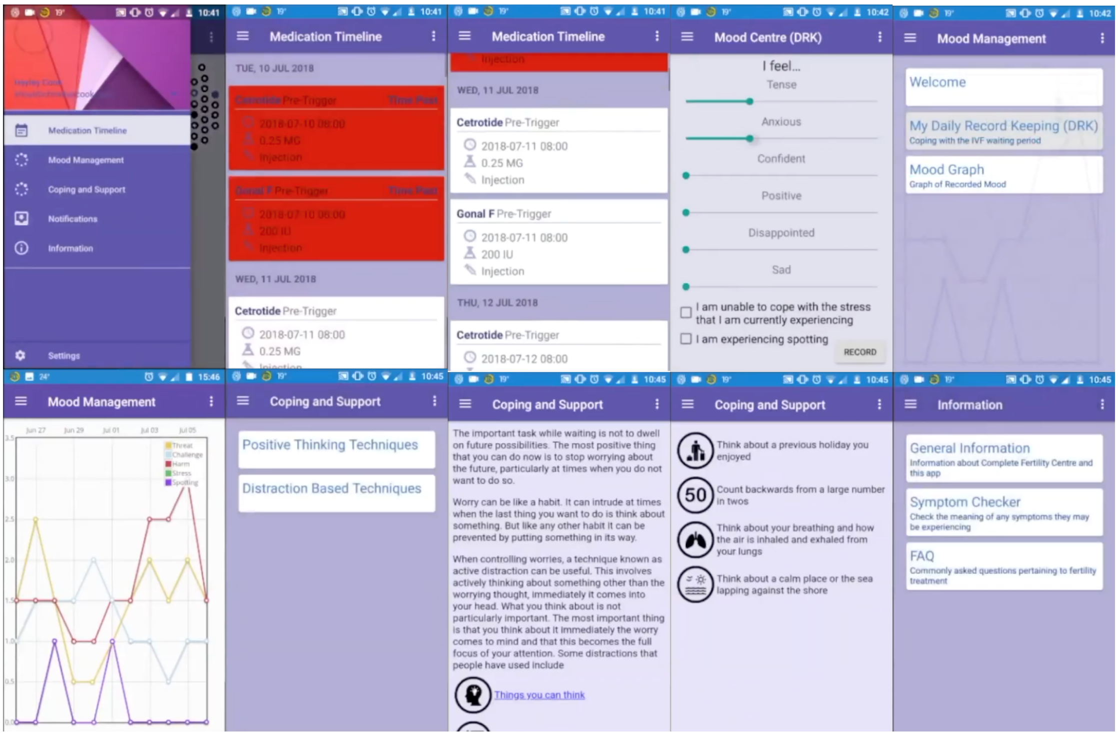
4.1.2 MediEmo: mHealth App for Support During ART

The MediEmo application offers a treatment management tool that focuses on the intense emotional and logistical challenges. Its value proposition is centered on reducing the dual burden of the ART process by integrating practical medication management with in-the-moment emotional support, directly addressing the core stressors of an active cycle. MediEmo was developed following the UK’s MRC framework for complex interventions, ensuring a systematic methodology that is grounded in an evidence-based and user-need informed approach. The overall development process consisted of a series of comprehensive literature reviews in addition to extensive consultations with both patients and fertility clinic staff to identify the most desirable and impactful features [189].

This user-centered design process resulted in the creation of an app consisting of three main components containing six key features to help address the primary challenges of the IVF journey. However, the sources do not indicate that MediEmo has specific content regarding miscarriage. Instead, its features are designed to manage the anxiety of the “two-week wait” leading up to a pregnancy test and to support patients through unsuccessful or failed cycles, The app aims to reduce the psychological burden so that patients are more likely to return for another cycle after a failure, but the text frames this as cycle outcome management rather than specific support for pregnancy loss. MediEmo’s key features are listed in Table 4.1.2.

Main Component	Feature Solution
Medication Management	Delivers a personalized medication timeline with push-notification reminders to improve compliance with complex regimens. A secure channel for the clinic to communicate to a patient's medication regimen.
Mood Management	Provides a daily emotional tracking log to monitor positive and negative emotions.
Coping and Support	Offers access to evidence-based psychological tools like Positive Reappraisal and Distraction Based Coping Interventions.
Information Support	Contains a FAQ repository of clinician-approved information organized by treatment phase and a symptom checker to provide guidance on common symptoms during treatment, reducing routine calls to the clinic.

Table 4.2: MediEmos's key features [189]



☐ I am unable to cope with the stress that I am currently experiencing

☐ I am experiencing spotting

The important task while waiting is not to dwell on future possibilities. The most positive thing that you can do now is to stop worrying about the future, particularly at times when you do not want to do so.

Worry can be like a habit. It can intrude at times when the last thing you want to do is think about something. But like any other habit it can be prevented by putting something in its way.

When controlling worries, a technique known as active distraction can be useful. This involves actively thinking about something other than the worrying thought, immediately it comes into your head. What you think about is not particularly important. The most important thing is that you think about it immediately the worry comes to mind and that this becomes the full focus of your attention. Some distractions that people have used include

Think about a previous holiday you enjoyed

Count backwards from a large number in twos

Think about your breathing and how the air is inhaled and exhaled from your lungs

Think about a calm place or the sea lapping against the shore

Figure 4.2: MediEmo's medication timeline, mood management, coping and support, and informational interface from [214]

The initial feasibility and implementation study found that the majority of users (of 1106 eligible patients) were accepting and engaged with the application. The medication timeline in MediEmo achieved a 79.8% adoption rate, highlighting the immense value of practical tools that reduce the cognitive load of treatment. Users notably engaged with the emotional support component. 61.9% of patients used both the medication timeline and emotional tracking features. No patients used the mood management in isolation. The heavy utilization of the medication timeline suggests that reminders may help improve compliance with complex medications regimens, possibly contributing to the higher live birth rates seen in fresh cycles. In turn, the coping tools and mood management features likely reduced the psychological burden, which is a known predictor of treatment discontinuation, thereby encouraging patients to return for further attempts. User provided overwhelmingly positive responses, with a total overall attitude score of 4.66 out of 5 [189].

Following the successful feasibility assessment, Robertson et al. [215] conducted a 3-year observational cohort study to examine the effects of MediEmo on ART outcome, including pregnancy rate.

The study indicated that patients who used the app were more likely to return for further treatment after experiencing an unsuccessful cycle. Additionally, the use of the app was associated with higher live birth rates in fresh treatment cycles. It should be noted that as an observational study, these findings show a strong association but do not demonstrate causation. For instance, those using the application may have had a greater motivation at the start. Nonetheless, the data suggests that the app's features may directly address two major barriers to achieving success: the medication timeline may help improve patient adherence to their medication regimen, while the emotional coping tools within the application may provide sufficient support to overcome the psychological burden that typically prompts patients to discontinue treatment.

There was a larger percent of "social infertility" (e.g., same-sex couples or single patients without biological infertility factors) in the "non-user" group (15.6% vs. 7.2%) compared to the "user" group. The authors suggest that these types of patients might not perceive themselves as infertile and therefore may not see a necessity to utilize a support app.

The successful development and positive feasibility data established MediEmo as an acceptable and well-utilized tool, paving the way for the subsequent investigation into its association with key clinical outcomes.

4.1.3 MyFertiCare: Web-Based App for ART

myFertiCare is a web-based patient portal developed in the Netherlands, designed to deliver both personalized medical information and interactive functionalities directly integrated into the clinic's care pathway (see Figure 4.3). Features that are meant to empower infertility patients, improve the patient-centeredness of care, and enhance transparency through providing user access to their own health data [190, 191]. Table 4.1.3 provides an overview of the available features that translated patient needs into a functional and refined digital health tool.

vrijdag 7 juli 2017
09:00 - 09:30

Verloskunde & Gynaecologie
Route 782
Bekijk de routebeschrijving

Mw. Dr. Bea Lintsen
Bekijk uw zorgverlener(s)

Vandaag staat de eicelpunctie gepland. Tijdens de punctie worden de rijpe eicellen uit uw lichaam gehaald. Hiervoor krijgt u pijnstilling via een infuus in uw arm. Uw partner mag tijdens de punctie bij u blijven. Het ontdooien van de ingevroren zaadcellen gebeurt ook op de dag van de punctie. De gehele afspraak neemt ongeveer twee uur in beslag, de daadwerkelijke eicelpunctie duurt meestal slechts 10-15 minuten.

Tip: als u dit wilt, kunt u op de polikliniek voorafgaand aan de eicelpunctie een rustgevende tablet krijgen.

- ☐ Actueel medicatieoverzicht. Deze kunt u opvragen bij uw apotheek.
- ☐ Identiteitsbewijs
- ☐ Verzekeringsbewijs

Figure 4.3: myFertiCare subway treatment timeline visualization [191]

Main Component	**Feature Solution**
Treatment Trajectory	Treatment trajectory is designed like a subway map, showing past and future appointments. Each stop on the map represents an appointment, also those that are necessary for the treatment path but have not yet been scheduled, helping couples anticipate the next steps. Clicking on a stop provides information specific to that treatment phase, advice on how to prepare, and a list of items to bring to the appointment. The system sends support messages to users before or after appointments to provide comfort or advice.
Notes	Users can write down information, such as questions they intend to ask during upcoming consultations. A key aspect of this feature is synchronization, as notes are shared between partners, allowing both individuals to view and edit the same list.
Care Providers	Allows users to submit non-urgent medical questions directly to their team, with responses typically within 24 hours.
Forum	Forum where patients can communicate with peers undergoing similar treatments. It is supervised by a clinician to ensure the accuracy and safety of the information exchanged.
Lifestyle Advice	Lifestyle advice checklists specifically for improving the chances of successful sperm retrieval and conception. Separate checklists for men and women, and like the notes feature, the completion of these checkboxes is synchronized between partners so they can track each other's progress.
General Information	Contact details and app settings.
Personal Health Records	Gives secure access to Personal Health Records, including test results and official correspondence, promoting transparency and patient involvement.

Table 4.3: Detailed overview of the personalized features of myFertiCare

A two-stage research methodology was conducted to document the entire lifecycle of myFertiCare. This approach ensured the final product was not merely a technological tool, but a clinically relevant resource grounded in the identified needs of patients and the practical expertise of medical professionals. The goal was to create an intervention with high user value that could be easily incorporated into the existing care pathway. The first phase of the methodology involved a qualitative study to assess the patient's perspective on the app's usability and user experience [191]. This was followed by a larger quantitative study to evaluate how the app would be implemented at the clinic and to measure the impact on patients and staff [190].

The platform was evaluated via a qualitative think-aloud study and a large-scale quantitative implementation study. The app achieved a System Usability Scale (SUS) score of 73/100 and a median qualitative satisfaction score of 8/10. Identified usability issues included a cumbersome security login and frustration with navigation (lack of a "home" button and inability to scroll the subway map timeline smoothly) [190].

Besides usability, the study also measured whether there were any direct effects on patient knowledge and experience. The findings demonstrate a clear positive impact on patient-centered aspects of care. A total of 50% of the couples participating in this study stated that myFertiCare helped them better manage their fertility treatment process. 50% of the couples in the study reported they experienced little to no change in their understanding of what causes their inability to conceive. However, 79% of couples stated that the app increased their knowledge of how the fertility treatments work [190].

4.1.4 Summary of Scientific Apps

Table 4.4 summarizes the core functionalities of the three research-supported applications.

Core Functionality	Infotility	MediEmo	myFertiCare
Primary Goal	Informational and peer support	Medical and emotional management during ART	An integrated patient-centered care portal to enhance transparency and empowerment
Informational Content	Broad medical, lifestyle, legal, and financial content (>40 pages)	Clinician-approved FAQs organized by treatment phase, symptom checker	Secure access to personal health records, test results, and official correspondence
Peer & Emotional Support	Monitored peer support forum (“Connect”)	Emotional tracking with validated questionnaire; evidence-based coping tools	Clinician-supervised peer forum with ability for users to delete their own messages
Treatment Management	Lifestyle change checklist, not designed for active treatment management	Automated, personalized medication timeline with push-notification reminders	Visualized treatment trajectory map (“subway map”) displaying past and future appointments
Clinician Interaction	None (research-only app)	One-way secure channel for the clinic to push medication regimen changes to the patient	Direct, non-urgent communication channel to the medical team, photos of care providers

Table 4.4: Comparison of Infotility, MediEmo, and myFertiCare

The development and study of apps like Infotility, MediEmo, and myFertiCare offer a detailed plan to create and evaluate effective digital health interventions. All three apps were developed after conducting extensive research to identify specific challenges faced by patients. They used tools like needs-assessment surveys, patient interviews, and consultations with clinical staff to ensure the final product addressed the problems of the real world. Even though each of the apps have different approaches to supporting patients, they share a common goal to provide patients with a supportive, reliable, and empowering resource.

The data reveals that feature utilization is highly skewed toward practical, actionable elements. Across the studies, features reducing cognitive load (MediEmo’s medication timeline) and offering actionable advice (Infotility’s lifestyle section) saw the highest engagement. Conversely, purely emotional tracking tools were rarely used in isolation. Furthermore, male engagement was consistently lower across platforms, though myFerti-

Care data suggests that once male partners are onboarded, their session length equals that of female users.

Because patients require more than just one type of help, the most effective apps combine a number of important elements, including reliable information, emotional coping tools, and practical organizational features. Addressing the medical, psychological, and logistical aspects of care is essential.

The effectiveness of an app is limited by its usability. Critical factors related to usability include clarity of organization (as demonstrated by Infotility), the ability to use the app to support daily practical tasks (i.e., using MediEmo's timeline), and the design of the app validated through direct user feedback (i.e., myFertiCare's "think-aloud" method). A powerful app is useless if it is difficult to navigate.

While MediEmo does not explicitly list "miscarriage" or "pregnancy loss" as a content category, it addresses negative outcomes under the terminology of an "unsuccessful cycle. The app focuses on cycle failure rather than grief, which frames the loss of a pregnancy or embryo primarily as a medical hurdle to be managed rather than solely a bereavement process. The text explicitly states that a major challenge for providers is patients stopping treatment due to psychological burden. myFertiCare emphasizes the logistics over psychosocial support and does not contain explicit sections on pregnancy loss. The app is designed for the active patient moving forward along a timeline. Without explicit content for loss, the app may lose relevance for patients when they fall off the "subway map" of scheduled appointments. The app is optimized for logistical "empowerment" and "involvement" in the active process, rather than emotional support for those exiting the process due to loss.

In contrast, Infotility does explicitly mention "multiple pregnancy losses". By explicitly naming and addressing loss, Infotility positions itself as a holistic resource for the "psychoeducational and psychosocial needs" of the patient, rather than just a tool for clinic management. This inclusion aligns with the app's goal to reduce isolation and provide "reliable information regarding all aspects of infertility", acknowledging that loss is a distinct part of that journey separate from the logistics of the next appointment.

Data consistently indicates lower usage of digital fertility tools among male partners. Furthermore, the Infotility study found no predictive factors for their engagement, signaling a need for male-focused design, content, and marketing strategies to better support all individuals in the fertility journey.

The awareness gap in the myFertiCare implementation illustrates that technical excellence is insufficient. To achieve future success with digital platforms, there will be a need for deeper integration into clinical practice and to develop comprehensive internal promotion strategies so that the patients are both aware of and encouraged to utilize the available resources.

The review of research-based tools has demonstrated that a combination of the three components (reliable information, compassionate psychosocial support, and practical treatment management) is crucial for the success of digital fertility solutions. By addressing the dual patients' needs for knowledge and emotional connection, these tools can provide a significant relief to the burden of their fertility journey. However, it is critical to create highly personalized and clinically relevant platforms.

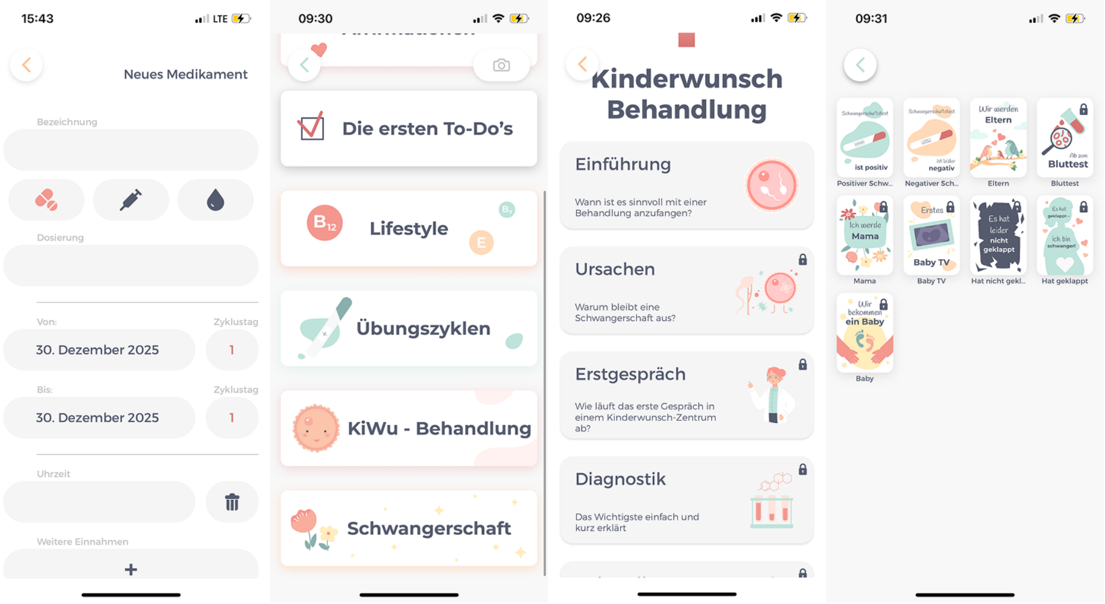
4.2 App-Based Infertility Interventions (Commercial Applications)

This section reviews seven commercially available fertility and ART-support applications to assess their functionality regarding treatment organization, informational support, psychological wellbeing, inclusivity, and the handling of negative outcomes.

4.2.1 BabyJa – Mein Kinderwunsch

BabyJa is a German fertility support app designed to help users understand their cycles and organize their treatments (IVF, ICSI, IUI). Main functionalities of the app include the tracking of menstrual cycles and ovulation, BBT logging, and a calendar-based overview to help determine fertile days. For those undergoing fertility treatments, the app allows users to easily upload their or their partner's treatment documents. BabyJa also enabled medication tracking, including type, dosage, timing as well as reminders to support adherence. In addition, the app incorporates a digital fertility journal with milestone cards for users to visualize their fertility journey. Although BabyJa allows users to log negative outcomes of a treatment (miscarriage) as a milestone card, the app's support for pregnancy loss is limited to documentation and it does not provide accompanying psychological interventions, coping strategies, or similar content to assist the user through this event. Educational content addressing the causes, diagnostics, therapies, and costs of fertility treatment is provided, accompanied by a concise glossary explaining key terms.

It is worth noting that the majority of ART treatment support-related critical features, such as treatment protocol and diagnostic findings, are restricted to paid subscriptions. However, basic functionalities, such as the cycle calendar, basal temperature input, and note-taking are free of charge. Moreover, the app fails to include several features related to peer support or community interaction, data-sharing, general communication tools, as well as self-care or wellbeing components.



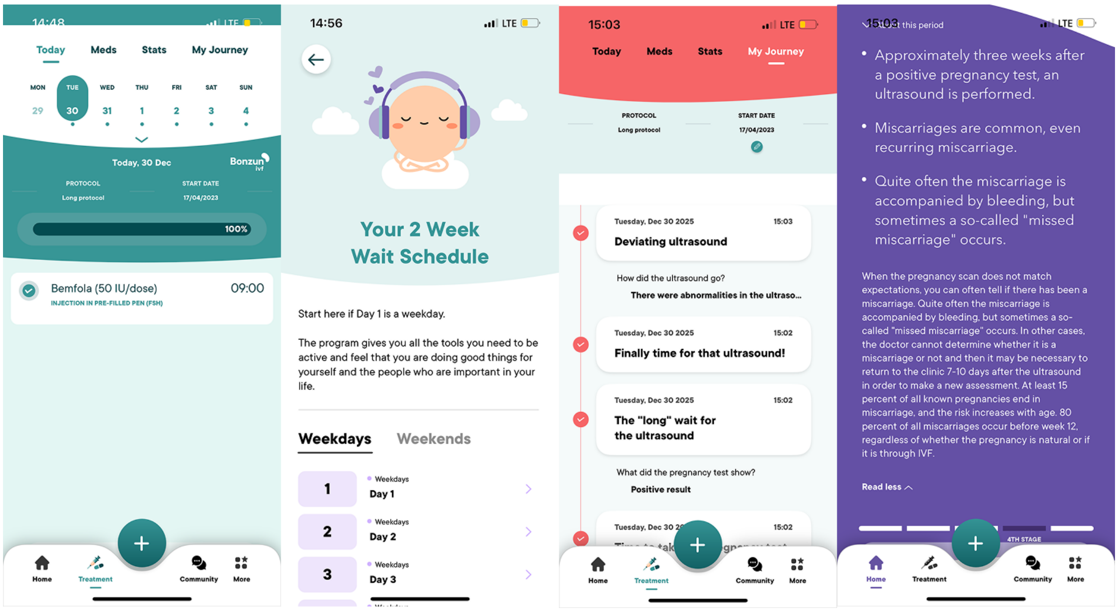
Von: 30. Dezember 2025 Zyklustag 1

Bis: 30. Dezember 2025 Zyklustag 1

Figure 4.4: Screenshots from BabyJa, featuring adding new medications, educational modules covering various phases of the fertility journey, and a gallery of selectable milestone cards.

4.2.2 Bonzun IVF

The Bonzun IVF app was created in Sweden as a treatment-focused tool that guides the user through each step of their unique IVF journey. The app is specifically designed to increase the chance of success and reduce stress for the individual. The app allows the user to track their medication intake, dosages, and frequency through the medication tracker and reminder feature. Bonzun IVF also offers a "cloning" feature where the user can share their journey with family and friends who are part of their support system and they will get updates on the treatment progress. Moreover, the app also includes a step-by-step guide that helps navigate through all the stages of the treatment as well as provides evidence-based information and facts on common discomforts and side effects to expect during an IVF treatment. Additionally, Bonzun IVF contains a limited number of fertility-related articles, self-care exercises, and a FAQ section. The user can also join the Bonzun IVF community to discuss, ask questions, and share experiences with others going through fertility treatments. However, participation is very sparse.



Today, 30 Dec

Bonzun ivf

PROTOCOL: Long protocol

START DATE: 17/04/2023

100%

Bemfola (50 IU/dose) 09:00

INJECTION IN PRE-FILLED PEN (FSH)

Your 2 Week Wait Schedule

Start here if Day 1 is a weekday.

The program gives you all the tools you need to be active and feel that you are doing good things for yourself and the people who are important in your life.

1 Weekdays Day 1

2 Weekdays Day 2

3 Weekdays Day 3

Tuesday, Dec 30 2025 15:03
Deviating ultrasound

How did the ultrasound go?
There were abnormalities in the ultraso...

Tuesday, Dec 30 2025 15:02
Finally time for that ultrasound!

Tuesday, Dec 30 2025 15:02
The "long" wait for the ultrasound

What did the pregnancy test show?
Positive result

Tuesday, Dec 30 2025 15:02

About this period

- Approximately three weeks after a positive pregnancy test, an ultrasound is performed.
- Miscarriages are common, even recurring miscarriage.
- Quite often the miscarriage is accompanied by bleeding, but sometimes a so-called "missed miscarriage" occurs.

When the pregnancy scan does not match expectations, you can often tell if there has been a miscarriage. Quite often the miscarriage is accompanied by bleeding, but sometimes a so-called "missed miscarriage" occurs. In other cases, the doctor cannot determine whether it is a miscarriage or not and then it may be necessary to return to the clinic 7-10 days after the ultrasound in order to make a new assessment. At least 15 percent of all known pregnancies end in miscarriage, and the risk increases with age. 80 percent of all miscarriages occur before week 12, regardless of whether the pregnancy is natural or if it is through IVF.

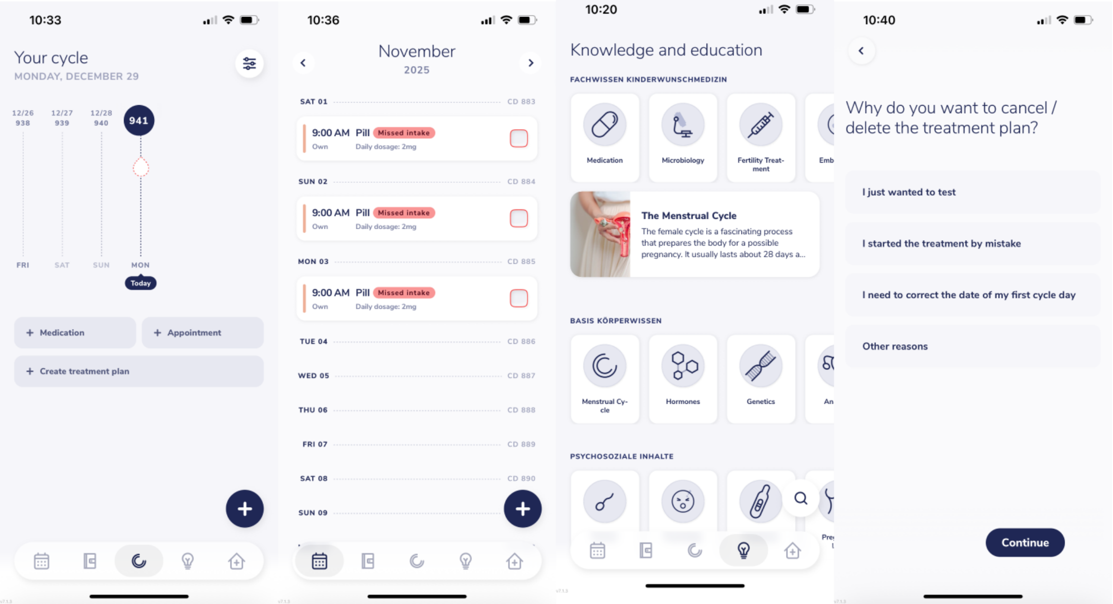
Read less

Figure 4.5: Screenshots from Bonzun IVF, displaying a home dashboard with protocol progress and medication reminders, a dedicated schedule for the "two-week wait" period, a timeline view of logged events and notes, and an informational section about miscarriage.

Despite the app offering a variety of features, there are several downsides that the developers did not consider. For instance, the user is not given the option to add results from the various treatments they undergo, and physicians cannot upload results either. While the app includes a "letter board" feature for visual milestones, there is no dedicated space within the app for taking freeform notes for personal reflection throughout the process. Furthermore, upon logging a positive pregnancy test, the app initiates an infinite loop regarding ultrasound status. When selecting "abnormalities in the ultrasound", the system resolves this loop and provides an explanation on miscarriages. The user will then be able to reset the app and begin a new treatment cycle. The input of a negative pregnancy test constitutes an irreversible action. Once submitted, the user is redirected to start a new treatment cycle, with no option to retract or modify the entry. Finally, all essential components of the free version of the app are behind a paywall and it solely provides possible examples of what a treatment journey could look like.

4.2.3 Hope Fertility

Hope Fertility is a fertility app intended to support patients throughout their infertility treatment. The platform functions as a comprehensive management tool and can operate as a standalone product for independent patient tracking or as a clinically integrated system. The Hope Fertility app incorporates a document management system that permits the uploading, downloading, and viewing of files. In the integrated configuration, the app interoperates directly with the patient's fertility clinic, allowing for the secure, exchange of clinical data, including test results, medical reports, medication regimens, and appointment schedules. The core functionality is the digital organization of treatment plans. The interface allows for entry of medications protocols and clinical appointments, including automated reminders and fields for patient-generated notes. To promote treatment adherence, the app offers reminders for pharmaceutical intake and scheduled procedures. Additionally, users can record clinical outcomes, for instance, oocyte retrieval outcome (e.g., fertilization rates) and pregnancy test results. To accommodate the variable nature of reproductive health, the application offers a personalization toggle, allowing the user interface to shift between a standard "menstrual cycle" and a "fertility treatment" mode.



9:00 AM Pill Missed intake ☐
Own Daily dosage: 2mg

9:00 AM Pill Missed intake ☐
Own Daily dosage: 2mg

9:00 AM Pill Missed intake ☐
Own Daily dosage: 2mg

The Menstrual Cycle
The female cycle is a fascinating process that prepares the body for a possible pregnancy. It usually lasts about 28 days a...

Why do you want to cancel / delete the treatment plan?

I just wanted to test

I started the treatment by mistake

I need to correct the date of my first cycle day

Other reasons

Figure 4.6: Screenshots from Hope Fertility, showing calendar-based cycle tracking, a medication log to check off, a "Knowledge and education" section covering biological and psychosocial topics, and a survey for canceling a treatment plan.

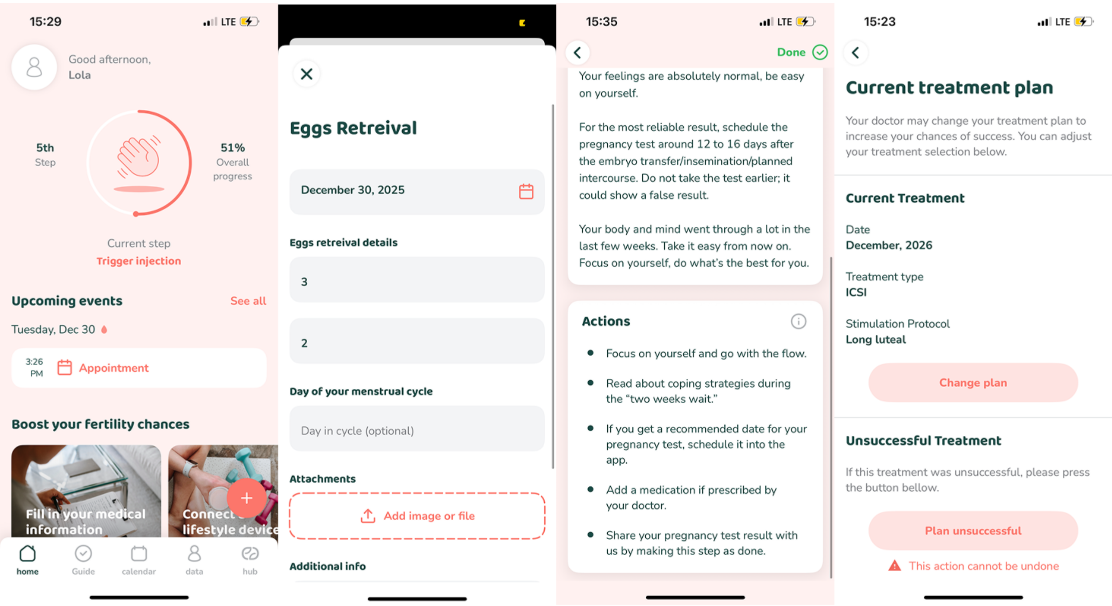
The app also includes a journaling feature which facilitates the highly detailed tracking of patient-reported data points, including menstruation intensity and color, mood, specific types of pain, physical symptoms like spotting or illness, and lifestyle factors like travel. This feature allows for the chronological logging of health metrics via free-text entries and photographic uploads. In addition to treatment organization, the app also serves as an educational tool prior to the formal consultation phase. By providing resources for cycle health tracking and pre-consultation education, the platform aims to empower patients in their decision-making process. From an organizational perspective, this early engagement is designed to streamline clinic admissions and improve patient readiness for treatment. Moreover, the provider of the app emphasizes secure data handling and continuity of care between patients and clinical providers.

Despite the platform's tracking capabilities, an analysis of the feature set reveals specific functional deficits and interface inconsistencies. The app operates as a closed system regarding direct interaction. It lacks communication capabilities with clinical staff and does not provide a peer-support forum. The educational component is restricted to static articles, omitting multimedia instructional aids, medical glossaries, FAQs, and prognostic calculators. Furthermore, the system falls short in dedicated psychological support modules, such as guided relaxation or cognitive behavioral tools. The cycle management logic exhibits limited flexibility. Specifically, the system does not support the recording of a miscarriage at any point within the timeline. The UI relies heavily on non-textual iconography, which may prevent intuitive navigation and necessitate a learning phase for icon memorization. Additionally, the software exhibits localization instability, presenting a linguistic mix of English and German text within the same interface.

4.2.4 Leeaf

Leeaf is a reproductive health and fertility treatment app intended to assisst individuals as they undergo infertility treatments. This includes the monitoring of reproductive health as well as organizing treatment-related information. There are a variety of features within the app that allow patients to manage their IVF treatments, these include the ability track medications and procedures in a calendar, as well as monitor key treatment milestones, which are in accordance with the prescribed protocol. Users can log menstrual cycle data and symptoms to gain a clearer understanding of cycle patterns, and track their wearable device information for additional insights into how lifestyle factors may influence treatment outcomes. To support preparation for infertility treatment, the app allows users to record medical history, test results, and pre-existing conditions, creating a complete patient profile. Additionally, partner involvement is also encouraged by allowing users to share their partner's health information and relevant test results, recognizing that fertility is a shared journey between a couple. However, the option to invite a partner to participate in the app is not available.

In addition to providing tools to manage treatment, Leeaf provides access to fertility-focused lifestyle support, including guidance in nutrition, physical activity, and coaching to help users prepare physically and mentally for treatment. Educational resources, such as a fertility glossary and knowledge hub, support learning and engagement. Nevertheless, the available content is limited to a small number of articles, with no instructional videos or structured psychological support offered. While journaling allows users to take note of their emotional wellbeing and mental health, the functionality is sparse, as users can select only five predefined mood options, and the app does not support any symptom tracking. Moreover, Leeaf does not provide peer support or direct communication with healthcare professionals.



December 30, 2025

Eggs retreival details: 3, 2

Your feelings are absolutely normal, be easy on yourself.

For the most reliable result, schedule the pregnancy test around 12 to 16 days after the embryo transfer/insemination/planned intercourse. Do not take the test earlier; it could show a false result.

Your body and mind went through a lot in the last few weeks. Take it easy from now on. Focus on yourself, do what's the best for you.

Actions

- Focus on yourself and go with the flow.
- Read about coping strategies during the "two weeks wait."
- If you get a recommended date for your pregnancy test, schedule it into the app.
- Add a medication if prescribed by your doctor.
- Share your pregnancy test result with us by making this step as done.

Your doctor may change your treatment plan to increase your chances of success. You can adjust your treatment selection below.

Current Treatment

Date
December, 2026

Treatment type
ICSI

Stimulation Protocol
Long luteal

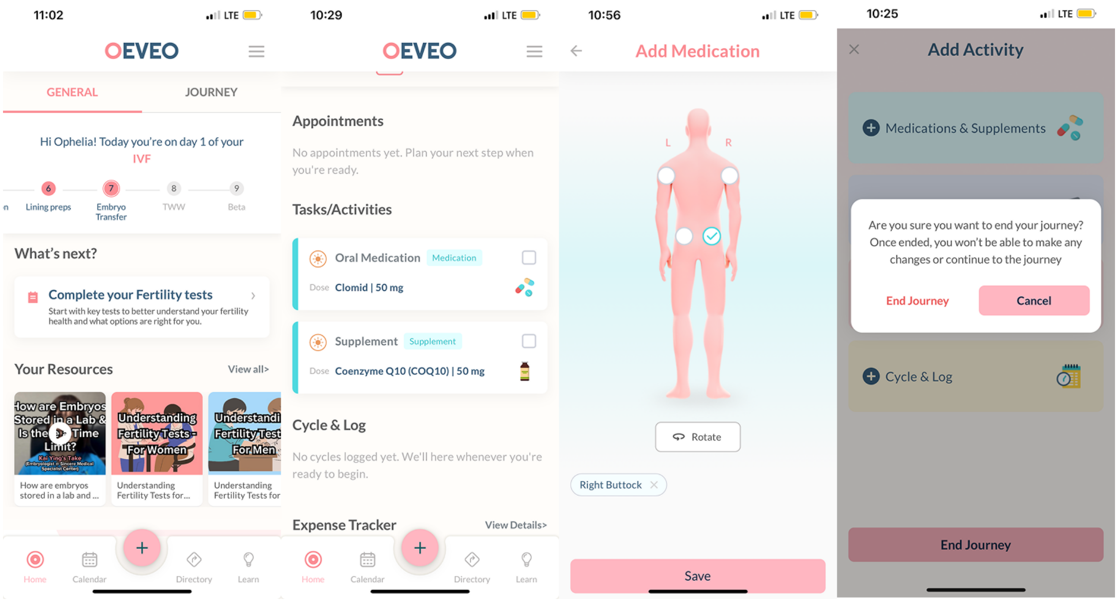
If this treatment was unsuccessful, please press the button bellow.

Figure 4.7: Screenshots from Leeaf, showcasing the overall treatment progress and current steps, allows users to log specific details of procedures like egg retrieval, provides post-procedure guidance, and offers options to manage or change the current treatment plan.

Finally, although the app provides general informative articles on pregnancy loss (including coagulation, immunology, and "what to do after"), there is no dedicated feature to input a loss into the app's tracking system itself. The interface does imply that completion of a step is an indicator success, and there is no specific entry possible for pregnancy loss.

4.2.5 OEVEO

OEVEO is a fertility treatment app that positions itself as a comprehensive "all-in-one" digital companion designed to mitigate the administrative burden of IVF, IUI, and other fertility interventions. The app enables detailed logging of medications, supplements, laboratory tests, as well as tracking for specific clinical procedures inherent to ART cycles, including egg retrieval, semen collection, embryo culturing, PGT testing, and embryo transfer. Users may upload photos of their documents, however the actual data has to be provided manually each time and there is a notable lack of input aids for the text fields. It provides calendar-based appointment tracking and customizable reminders for treatment-related tasks. This allows patients to document the entirety of a clinical protocol rather than just daily symptoms.



Hi Ophelia! Today you're on day 1 of your IVF

Complete your Fertility tests

Start with key tests to better understand your fertility health and what options are right for you.

No appointments yet. Plan your next step when you're ready.

Oral Medication Medication ☐

Dose Clomid | 50 mg

Supplement Supplement ☐

Dose Coenzyme Q10 (COQ10) | 50 mg

No cycles logged yet. We'll here whenever you're ready to begin.

Are you sure you want to end your journey? Once ended, you won't be able to make any changes or continue to the journey

Figure 4.8: Screenshot from OEVEO, featuring a personalized journey timeline with educational resources, a daily task list for medications and supplements, a 3D (male) body map for logging injection sites, and a confirmation screen for ending the treatment journey.

A distinguishing feature of OEVEO is its inclusion of an expense tracker, addressing the significant financial management required during fertility treatments. However, the only currency available is Singapore dollar. The app also includes a clinic directory and appointment scheduling capabilities, also exclusive to Singapore. The app facilitates data sharing, allowing users to forward treatment progress, test results, and medical documents to partners via email link. Users are also enabled to communicate with healthcare providers or support groups over WhatsApp[1]. Nevertheless, these support mechanisms are limited to Singapore as well. While the supplementary features include access to educational content and patient stories, users are not offered additional self-management or self-care resources. Despite OEVEO offering a generous treatment summary of various inputs, once enough data is provided by the user, a user can only end journey and it is not possible to enter a pregnancy loss anywhere within the app. Once you end the treatment cycle, the user has to start over.

4.2.6 Olly: ART & IVF Tracker

Olly is an app that provides support to individuals who are undergoing infertility procedures. The app offers multiple ART pathways, such as IVF, IUI, and other treatments. The app accommodates users to navigate their fertility treatment either

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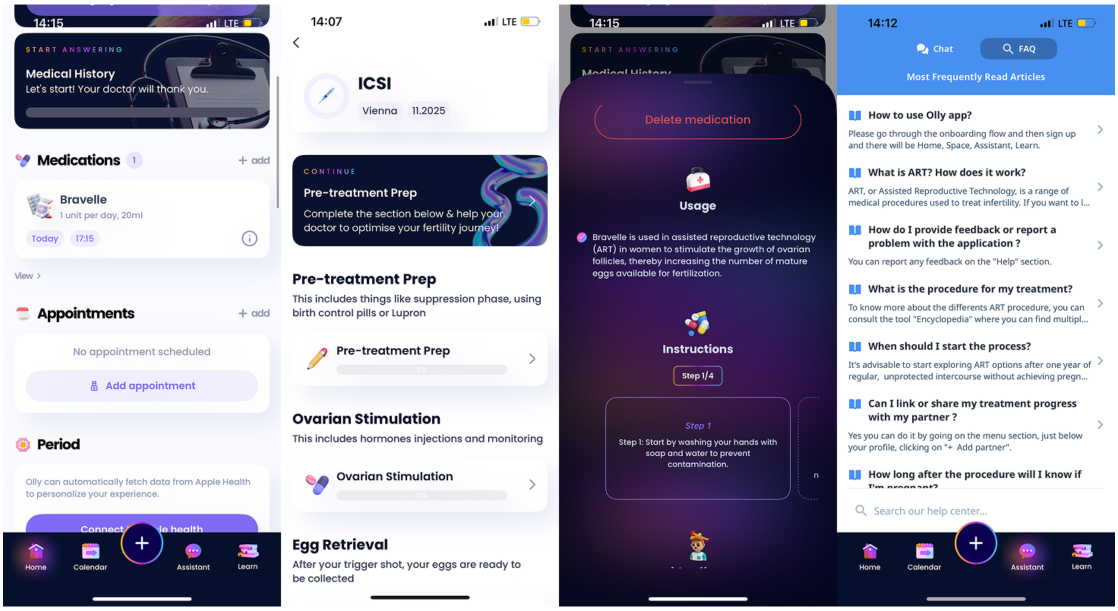
[1] https://www.whatsapp.com

individually or with a partner. Features are tailored for both women and men, enabling partner involvement and shared tracking throughout the treatment process.



Let's start! Your doctor will thank you.

1 unit per day, 20ml

No appointment scheduled

Olly can automatically fetch data from Apple Health to personalize your experience.

Complete the section below & help your doctor to optimise your fertility journey!

This includes things like suppression phase, using birth control pills or Lupron

This includes hormones injections and monitoring

After your trigger shot, your eggs are ready to be collected

Bravelle is used in assisted reproductive technology (ART) in women to stimulate the growth of ovarian follicles, thereby increasing the number of mature eggs available for fertilization.

Step 1: Start by washing your hands with soap and water to prevent contamination.

How to use Olly app?
Please go through the onboarding flow and then sign up and there will be Home, Space, Assistant, Learn.

What is ART? How does it work?
ART, or Assisted Reproductive Technology, is a range of medical procedures used to treat infertility. If you want to l...

How do I provide feedback or report a problem with the application ?
You can report any feedback on the "Help" section.

What is the procedure for my treatment?
To know more about the differents ART procedure, you can consult the tool "Encyclopedia" where you can find multipl...

When should I start the process?
It's advisable to start exploring ART options after one year of regular, unprotected intercourse without achieving pregn...

Can I link or share my treatment progress with my partner ?
Yes you can do it by going on the menu section, just below your profile, clicking on "+ Add partner".

How long after the procedure will I know if I'm pregnant?

Search our help center...

Figure 4.9: Screenshots from Olly, displaying a main dashboard with medication and appointment overviews, a section tracking ICSI treatment milestones, step-by-step instructions for medication administration, and an FAQ page defining ART and its procedures.

All of the user's fertility treatment-related information are centralized within the app. These include but are not limited to medication schedules and appointment reminders, additional functionalities, such as document storage for medical records and test results, allowing users to organize and retain all treatment-related paperwork in one place and support continuity of care. Olly integrates with Apple Health[2] to incorporate menstrual cycle and fertility-related data. Period tracking and fertility window monitoring are, however, only available through this integration, which may limit usability for users who do not use Apple Health.

Users can mark the completion of a treatment cycle, but the app does not provide a specific option to log pregnancy loss, instead only allowing cycles to be labeled as "ended". Furthermore, while Olly emphasizes organization and empowerment throughout the fertility journey, it does not include psychological or emotional support features such as self-help tools, self-care exercises, or mental health resources, which may be a limitation for users seeking more holistic psychosocial support during ART treatment. Direct communication with healthcare providers or counselors is not supported within the app. The only available communication feature is a chat function, in which messages are addressed exclusively during designated working hours. Moreover, the responses appear

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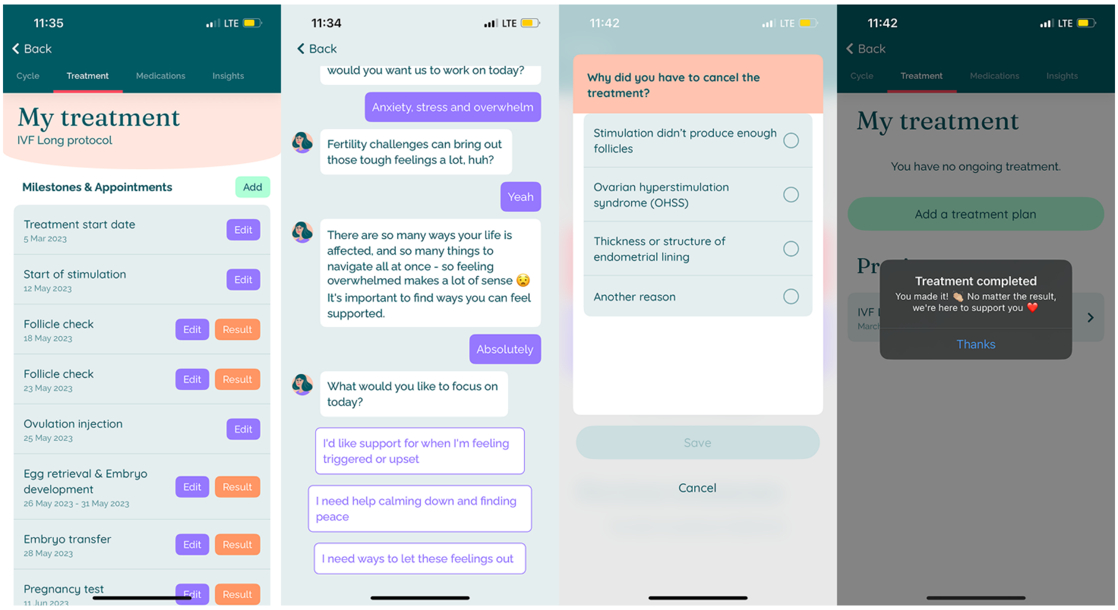
[2] https://www.apple.com/health/

to be automated and lack personalization, which may limit their perceived usefulness and user engagement.

4.2.7 Tilly: Fertility & IVF support

Tilly is a Swedish reproductive health and fertility app developed by psychologists to help women track their menstrual cycle and fertility, while providing them with a strong focus on supporting their mental health. Users can personalize the app based on their current journey stage, such as trying to conceive, undergoing treatment, or seeking fertility-related knowledge, allowing for a more tailored experience.



My treatment
IVF Long protocol

Milestones & Appointments

Treatment start date	5 Mar 2023
Start of stimulation	12 May 2023
Follicle check	18 May 2023
Follicle check	23 May 2023
Ovulation injection	25 May 2023
Egg retrieval & Embryo development	26 May 2023 - 31 May 2023
Embryo transfer	28 May 2023
Pregnancy test	11 Jun 2023

would you want us to work on today?

Anxiety, stress and overwhelm

Fertility challenges can bring out those tough feelings a lot, huh?

Yeah

There are so many ways your life is affected, and so many things to navigate all at once - so feeling overwhelmed makes a lot of sense 😟
It's important to find ways you can feel supported.

Absolutely

What would you like to focus on today?

I'd like support for when I'm feeling triggered or upset

I need help calming down and finding peace

I need ways to let these feelings out

Why did you have to cancel the treatment?

- Stimulation didn't produce enough follicles ○
- Ovarian hyperstimulation syndrome (OHSS) ○
- Thickness or structure of endometrial lining ○
- Another reason ○

My treatment

You have no ongoing treatment.

Treatment completed
You made it! 👏 No matter the result, we're here to support you ❤️

Figure 4.10: Screenshots from a Tilly, showing a detailed timeline for an IVF Long protocol, a chat interface for managing emotional stress, a survey to record reasons for treatment cancellation, and a pop-up notification confirming treatment completion.

Utilizing inputs from BBT and ovulation test results, the app enables users to determine when they are most likely to conceive during their fertile window. Like many known menstrual tracking apps, Tilly offers personalized insights related to menstrual and reproductive health. Tilly has introduced several features to help users monitor their fertility journey. These range from features such as medication tracking, which enables users to easily monitor medication intake, dosages, and frequency. Although users can input their treatment protocol and test results manually, there is currently no option to upload documents, which may limit convenience for users undergoing complex treatments. Furthermore, users can choose to invite their partners to their account, so they too can participate and follow the journey. One of Tilly's core feature is its community platform, where women can connect with others undergoing similar fertility procedures, share experiences, and provide advice and support. In addition, the app offers a range of interactive, evidence-based self-care tools, including fertility-focused meditations, journaling, cognitive behavioral therapy, acceptance and commitment therapy, interpersonal therapy, mindfulness exercises, and relaxation tools such as breathwork and fertility yoga. Many educational articles and self-care features are restricted behind a paywall.

Tilly also includes a counseling option that enabled the user to find a mental health professional in the UK or Sweden. Although the app places ample attention to mental health and emotional coping strategies, the fertility journey itself appears to be a less prominent feature in terms of clinical depth. Moreover, the app does not allow users to explicitly log pregnancy loos. Instead, treatments can only be marked as “completed”, accompanied by a supportive message regardless the outcome. Finally, the app’s user interface may be confusing and challenging to navigate, which may impact overall usability.

4.2.8 Summary of Commercial Apps

This analysis reviewed seven fertility and ART-support applications (BabyJa, Bonzun IVF, Hope Fertility, Leeaf, OEVEO, Olly, and Tilly) to assess their functionality across treatment organization, informational support, psychological wellbeing, inclusivity, and usability. Table 4.5 provides an overview, whether the commercially available apps included the pre-defined set of features or not.

All analyzed commercially available applications provide a dedicated feature for users to log medications and supplements. This functionality is almost universally paired with a reminder system to support treatment adherence, highlighting treatment organization as a core design priority across the apps.

While Hope Fertility demonstrates the potential of clinic-to-patient interoperability (uploading results, viewing medical reports directly), it is the exception. Most apps (BabyJa, OEVEO, Tilly) rely on manual user input and lack OCR (Optical Character Recognition) or direct data bridges.

Across all applications, there is a recurring limitation. None of the applications feature built-in pathways for non-linear ART events. A critical finding across nearly all analyzed apps (BabyJa, Bonzun, Hope, Leeaf, OEVEO, Olly) is the systemic failure to adequately handle negative outcomes (i.e., miscarriages, ectopic pregnancies, or failed cycles). Apps like Bonzun IVF enter “infinite loops” or require hard resets upon negative tests. OEVEO and Olly force users to simply “end” a journey without logging the specific nature of the loss. BabyJa allows for the documentation of miscarriage but offers no accompanying psychological intervention. Leeaf implies completion equals success, offering no entry for loss. This is consistent with prior research on pregnancy-related apps (see Section 2.3), where the possibility to enter pregnancy losses are largely absent.

Most applications also provide an integrated library of informational resources, typically consisting of articles, FAQs, medical glossaries, or treatment overviews covering topics such as infertility causes, ART procedures (e.g., IVF, ICSI, IUI), and general fertility-related topics. However, the scope of this educational content vary, with some platforms offering only basic articles and others incorporating interactive guidance through treatment stages.

Feature	**BabyJa**	**BonzunIVF**	**Hope Fertility**	**Leeaf**	**OEVEO**	**Olly**	**Tilly**
Medication & Treatment Tracking	x	x	x	x	x	x	x
Reminders	x	x	x	–	–	x	–
Health Records/Test Results	x	x	x	x	~	x	~
Notes (Journal, Symptoms, Mood)	~	~	x	~	~	x	x
Logging Negative Outcomes	–	–	–	–	–	–	–
History	x	–	x	x	~	–	x
Educational Resources	x	~	~	~	x	~	~
Medical Information (FAQ/Glossary)	~	~	-	x	x	~	~
Psychological (Coping) Interventions	x	x	–	–	~	–	x
Peer Support /Community	~	x	–	–	x	~	x
Partner Integration	–	x	–	–	x	x	x
Clinic Integration	–	–	x	–	~	-	~

Legend: x = yes; – = no; ~= partially

Table 4.5: Availability of pre-defined features in commercial ART support tools

The availability and quality of mental and emotional wellness support differ substantially. Apps such as Tilly and, to a limited extent, Bonzun IVF incorporate psychological self-care tools, whereas most others provide minimal or no structured emotional support, treating mental health as an afterthought and neglecting self-help or coping interventions. BabyJa, Leeaf, and Olly offer minimal to no psychological tools. Hope Fertility provides no guided relaxation, and Bonzun offers only limited exercises. Community or peer-support features are inconsistently implemented and often underutilized.

The utility of several apps is heavily restricted by localization. OEVEO is limited to Singapore Dollars (expense tracking) and local support groups. Hope Fertility suffers from “localization instability”, mixing English and German. Tilly’s counseling features are restricted to the UK and Sweden. Critical features such as treatment protocols (BabyJa) or self-care content (Tilly) are frequently paywalled, creating economic barriers to complete care.

The findings suggest that current fertility and ART-support applications prioritize administrative efficiency over holistic patient-centered care. While effective at organizing treatment logistics, most apps fall short in addressing the psychological, emotional, and experiential dimensions of infertility. This represents a critical design and clinical gap, given the well-documented mental health burden associated with fertility treatment.

Overall, although numerous infertility treatment-supporting apps exist, there is a notable deficiency of well-designed apps that provide comprehensive, integrated support addressing both the clinical complexity and the psychological burden of infertility.

Future app development should move beyond fragmented feature sets toward integrated, trauma-informed, and emotionally responsive designs. Incorporating flexible outcome tracking (including pregnancy loss), evidence-based psychological support, meaningful communication channels, and inclusive user journeys could substantially improve user experience and clinical relevance. Without these advances, digital fertility tools risk reinforcing the procedural aspects of ART while neglecting the complex human experience that accompanies it.

4.3 Summary of All Findings

- Infotility: Does not track active treatment, but includes broad educational content (>40 pages) and psychological support through peer connection. It is the only app with dedicated pregnancy loss support.
- MediEmo: Features medication management and mood tracking (psychological support). It integrates with clinics through one-directional communication for the patient’s medication schedule.
- MyFertiCare: Includes a “subway map” treatment timeline and partner syncronization features. It offers clinic communication but lacks specific psychological coping tools comparable to MediEmo or Tilly.
- Commercial Apps (General): All commercial apps analyzed (BabyJa, Bonzun, Hope, Leeaf, OEVEO, Olly, Tilly) include medication/treatment tracking.
- Psychological Support Gaps: BabyJa, Hope Fertility, Leeaf, OEVEO, and Olly lack structured psychological or emotional support tools. Tilly and Bonzun IVF are exceptions, though the later is limited.

- Pregnancy Loss Gap: None of the commercial apps analyzed allow for the effective handling or logging of pregnancy loss (or other negative outcomes).

CHAPTER 5

Findings from User Research

This chapter presents the empirical findings obtained in the user research phase, which included cultural probes with individuals undergoing ART treatment and semi-structured interviews with both fertility specialists and ART patients. The information gathered describes the practical, emotional, and logistical realities of undergoing fertility treatment and engaging with self-tracking technologies.

5.1 Key Findings from Cultural Probes

The collected data emphasizes that for patients, ART is not merely a medical procedure but a omnipresent life event marked by the emotional burden of the treatment, information-heavy and often disempowering journey.

The findings are organized into four primary themes. First, I examine the emotional toll of the treatment, which includes the recurring cycles of hope and disappointment, as well as the financial strain and the fragmented medical information that patients receive. Second, I analyze the interpersonal relationships of infertility. Third, I address the prevalent sense of loss of control and uncertainty caused by the information overload and the lack of communication between physician and patient. Finally, I discuss how patients regain autonomy and become empowered through documentation and knowledge.

Theme 1. Emotional "Rollercoaster" During Fertility Treatments
The emotional toll of fertility treatments is profound and pervasive. The daily journals demonstrated that participants consistently documented intense fluctuations of feelings, often shifting dramatically within a single day. The summaries presented below are quotations drawn from different cycles and are not arranged in chronological order.

- **Hope and Despair:** The initial excitement and hopefulness of starting a new cycle was repeatedly replaced by anxiety, for instance, during egg retrieval, transfer,

waiting for results, etc. After an extended period of stimulation and subsequent egg retrieval, the woman recorded in her journal:
"It was quick and painless. All 3 eggs developed well, one was PERFECT and was transferred immediately. The remaining two will continue to be monitored and then frozen if things go well. I now have to administer progesterone and hCG injections at home. hCG needs to be refrigerated."

However, a few days later, she expressed discouragement, noting,

> *"Of the 2 additional eggs, only one was frozen and the other failed to develop."*

The male partner expressed his inner conflict. He reflected,

> *"I am not overly excited about the positive pregnancy test... I won't be happy about it until we've reached the 2nd trimester. The first miscarriage just traumatized me."*

The anticipation for a positive outcome was frequently contrasted with the debilitating fear of potential failure. The female participant noted,

> *"Egg retrieval day!! Went fine, we got 18 eggs! I'm in a lot of pain though and my doctor said my progesterone is too high (3rd time!) to transfer, again. I'm gutted. What is wrong with me??"*

- **Anxiety and Stress:** Moreover, anxiety was fueled by the strict timelines of procedures, the uncertainty of success, and the financial burden. Although the Austrian IVF Fund subsidizes up to 70% of the costs for treatment and medication for (married) couples undergoing ART (see Section 2.1.3), the remainder of the expenses linked to additional required testing nevertheless total to several thousand euros. Fertility patients were acutely aware of the cost linked to each procedure, medication, and test and this burden was a constant factor which influenced decision-making. The female participant commented on the monetary strain involved,

  > *"[Partner] doesn't want to endure this entire process again for a second child. Maybe we'll even stick with just one child, as it's such an ordeal already. It's hard, I'm exhausted."*

  At another time, the participant mentioned,

  > *"[Partner] and I filed his tax return and stated that his spouse earned less than €6000 last year and that we had extraordinary costs (IVF). We declared total costs (approx. 7500€). The state gives back €75. Will file an objection...this is a joke!! It's being advertised that IVF and adoption is tax deductible... ".*

  Following yet another unsuccessful ART treatment, the participant remarked,

> *"We're done financially. The IVF fund will only cover for one more IVF cycle"*,

referring to the fund's policy of supporting a maximum of four treatment cycles (see Section 2.1.3).

Scheduling appointments to coincide with specific phases of the female menstrual cycle, administering medication on time, and navigating work obligations and other commitments throughout treatment generated ongoing stress.

> *"I hate this timing. I should get a transfer on the weekend, but obviously that is not possible. So transferring one of the embryos will be next week on Wednesday or so... I'll hear from the doctor on Monday whether my progesterone is fine. We'll see what happens."*

- **Impatience and Frustration:** The need for patience and the slow pace of treatment also led to frustration. Prior to initiating any assisted reproduction treatment, each individual undergoes a series of diagnostic procedures, including blood tests, ultrasounds, and gynecological or urological examinations, to determine the underlying causes of infertility (see Section 2.1.2. The female participant was frustrated and wrote,

  > *"I'm so annoyed by this waiting... We won't get an appointment at the fertility clinic until February. [Partner] won't have his final spermiogram until the end of December/January. His urologist appointment is not until 18th January, I think. That's another 3,5 months!! One quarter of the year wasted. Actually, losing a third of a year! I'm having a crisis. I am losing it."*

  Moreover, the participant noted,

  > *"Follow-up spermiogram for [Partner] and blood work for me in 8 weeks. And then perhaps clinic? Have to call and see whether they even have appointments available. I really thought this would be more straightforward".*

  In order to physically recover following oocyte retrieval, clinicians generally recommend postponing embryo transfer until the completion of at least one full menstrual cycle, approximately 6–8 weeks after egg retrieval.

  > *"Plan is to watch my progesterone levels before transferring, as that might be another issue", "I always feel like we're just waiting", "I now have to wait 2 full weeks until I can take a pregnancy test. Honestly, I'm not going to wait that long."*

  This was amplified by the feeling of losing control over her own body and future.

  > *"I have gained 3kg since starting stimulation a month ago. I feel really bad about it. My belly is still swollen too, so nothing fits me and that's incredibly frustrating. I barely got out of bed today."*

- **Grief and Loss:** Participants often expressed a sense of grief. Miscarriages, failed transfers, and even the ongoing struggle of infertility intensified these negative emotions. The female participant confided,

  > *"[...] the way everyone else seems to do it without thinking. I recently got triggered by a birth announcement from someone who never wanted children. It just threw me off. It's so unfair. [Partner] got mad at me. He just doesn't understand, probably because he doesn't care if he has kids or not."*

  The experience of a miscarriage, particularly after the intensive effort and discomfort of ART procedures, was described as shattering.

  > *"I'm so depressed. I guess I felt that something was wrong.", "I hate my life. My body is so messed up that not even the miscarriage 'worked' properly. The doctor told me that my uterus still had tissue remnants and said if it's not out by Monday I have to have scraping on Tuesday.", "At week 8, the doctor telling me the baby is quite small and insinuating that the pregnancy is not viable. I was so hopeful."*

  Similarly, those who did not achieve a successful pregnancy after embryo transfer experienced profound disappointment following the agonizing (TWW). The male participant disclosed,

  > *"Every single time... it's a punch in the face. I try not to hope anymore but it's cruel. All the energy, planning, and effort we put into this. I don't think our doctors are putting in the work. It's just a goldmine for them."*

  The recurring alternation between hope, dread, and loss became a considerable torment, which repeatedly required immense emotional resilience.

Theme 2. Feelings of Isolation vs. Shared Resilience
Participants reported experiences of both social isolation and mutual partner support.

- **Loneliness and Isolation:** Despite being in relationships, participants can feel lonely and isolated. Infertility is a deeply personal and emotional experience as well as stigmatized journey, which often results in individuals refraining from widely sharing their struggles. Oftentimes, the male partner mentioned feeling disconnected and alone as he felt the need to be a dependable and strong support for his partner without fully processing his own emotions. The female participant confessed,

  > *"I know I'm doing this for myself."*,

  highlighting the challenges, pain, and stress associated with every procedure and test that women must endure, in contrast to the relatively straightforward examinations that men undergo.

- **Mutual Support and Shared Decision-Making:** However, contrarily to the aforementioned, the couple also experienced a deeper mutual support and understanding through their joint engagement in the fertility processes. Reviewing medical data together, having access to the same information, and actively participating in appointments or tracking facilitated a more collaborative decision-making. The couple expressed reduced feelings of isolation for either partner. Moreover, the male partner expressed a greater empathy for their female partner's experienced physical and emotional distress. One diary entry mentioned,

  > *"[Partner] and I were discussing, if we should transfer one or two embryos. We don't want potential twins, it's too much of a risk for my body."*

  Another note reflected,

  > *"Today was transfer day! I don't know why, but compared to the last few times, I'm super relaxed. I'm not really anxious or overly excited, just calm. [Partner] actually had tears in his eyes!"*

Theme 3. Uncertainty and the Loss of Control
Assisted reproduction involves a demanding schedule of medical appointments and procedures, each with its own set of challenges.

- **Frequent Doctor Consultations:** Particularly during the initial stages of ART treatment, frequent visits (multiple times per week) for examinations aimed at determining the cause of infertility were common, thereby disrupting everyday routines and requiring logistical planning. Participants documented various appointments at different locations, typically before work or in between, and the mental preparation necessary for each visit. Furthermore, the female participant mentioned,

  > *"[...] and IVF is not recognized as a valid reason for sick leave, so they advised me to ask the general practitioner to state something else"*,

  highlighting that sick leave was not granted for routine consultations or even invasive procedures.

- **Uncertainty and Information Overload:** Individuals undergoing treatment frequently felt overwhelmed by the volume of medical information and technical jargon. The female participant expressed discouragement in her journal, writing,

  > *"Immunology results have come in by mail. I don't understand anything".*

  While the male participant recorded,

  > *"I went to the urologist today, they looked at everything. Bladder, kidneys, ureters, spermatic duct, testicles, everything. Looks great, even above average. No explanation for the bad spermiograms?!"*

While fertility data provided objective insights, participants expressed the need for empathetic encouragement and reassurance. Setbacks or unclear developments amplified distress as considerate wording and explanations were missing. Interpretation of ambiguous or contradictory data points and the lack of definitive answers caused challenges for the people undergoing ART treatment. Numerical data, whilst highly valued, failed to offer the contextual support or visualizations of progress that individuals needed. They appreciated interactions with medical professionals, however, felt that not all data was translated into understandable language or the presented information did not deliver the enlightenment that was needed in the given situation.

Moreover, they felt uncertain whether specific procedures were effective and genuinely necessary or if they were being recommended by clinicians primarily for financial gain within each treatment cycle. Contrarily, the female participant felt that her fertility doctors was not conducting a sufficient number of examinations. She expressed a desire for comprehensive testing within a single treatment cycle to maximize the chances of achieving pregnancy on the first ART attempt, thereby avoid the financial burden of undergoing multiple additional cycles and restricting the pain to one treatment cycle rather than going through it again and again.

Since the various procedures and tests were carried out across different institutions, laboratories, clinics, and hospitals, the format in which the results were delivered varied depending on the service provider; ranging from printed reports delivered by mail, paperwork sent via email to phone calls or in-person consultations. Despite the fact that the participants mentioned that they conducted extensive research on ART and arrived well-prepared with questions at consultations, they often appeared to be in a state of shock upon receiving their results. In this regard, participants' experiences with fertility data actively impacted the perceptions of themselves.

Theme 4. Patient Empowerment through Documentation and Knowledge
Participants struggled with inconclusive, unclear results in addition to the perceived intransparency behind the purpose of each test.

- **Empowerment through Knowledge:** Direct communication with the fertility specialist often meant that data and information were solely conveyed verbally, without any accompanying written documentation or record provided to the patient. The female participant questioned,

  > *"They tell you something, but what does it mean for me?"*

  This uncertainty often led to participants relying more heavily on additional educational resources and their own fertility self-monitoring and research as the generic data presentation often failed to resonate with them. Understanding, analyzing and seeing measurable changes offered a tangible connection with their treatment. The individuals undergoing ART procedures decided to consult with a different obstetrician-gynecologist for a second opinion to gain further clarity and reassurance regarding their treatment protocols. When the participants felt well-informed about their fertility journey and biological processes, they reported a greater sense of self-efficacy.

- **Tracking and Documentation:** The diary included in the cultural probes kit reinforced the existing behavior of meticulous tracking. The female participant diligently recorded her medication times, such as daily injections, dosages, and symptoms. Following consultations at the fertility clinic, she also documented the events that took place including the information they received and reflected on their emotional responses as well. The provided journal quickly filled with detailed and valuable logs on the thought processes and moods which participants experienced. Additionally, the participant utilized the notebook to create a mind map of their complex treatment protocols, using the visualization as a tool for observation and reflection.

  The journal also served as a practical instrument for participants to write down to-dos and reminders, as well as to track symptoms to share directly with other fertility specialists when individuals sought second opinions. Following her embryo transfer, the female participant shared,

  > *"[. . .] usually I don't feel a thing during the embryo transfer, but this time I was either more sensitive or the doctor really poked that thing in."*

  During the follow-up appointment she expanded further,

  > *"I told her that I felt everything more intensely this time, she said that she hopes this is a good sign".*

5.1.1 Summary

The findings from the cultural probes highlight the intense emotional fluctuations, uncertainty, and loss of control experienced by couples undergoing ART throughout their fertility treatments. While patients often feel isolated and overwhelmed by the medical information, self-tracking and shared knowledge between partners can serve as powerful tools for empowerment and resilience. The following three key findings can be derived:

1. Emotional Burden: Fertility treatments involve extreme mood fluctuations (e.g., hope, anxiety, grief, and frustration), which are intensified by miscarriages, failed cycles, financial pressure, and prolonged waiting periods.

2. Uncertainty and Fragmented Information Reduce Patient Control: Inconsistent data delivery, medical jargon, and unclear explanations leave patients overwhelmed and questioning both outcomes and clinical decisions. There is deep frustration when *good* numerical data contradicts clinical outcomes.

3. **Knowledge-Sharing and Self-Tracking Empower Patients:** Joint engagement between partners, along with personal documentation (journaling of medication, symptoms, and emotions) and accessible explanations, increases self-efficacy and agency, reduces isolation, and supports resilience during treatment. Patients used their own documentation to challenge doctors, seek second opinions, and manage expectations.

5.2 Themes and Insights From Interviews

The following interviews consist of conversations with fertility specialists and individuals undergoing fertility treatments, with that offering an extensive perspective on the subject matter.

5.2.1 Analysis of Fertility Specialist Interviews

The fertility specialists operate in distinct clinical contexts. E2 and E3 each manage a high patient load of approximately 20-30 patients per day. E2 works within a shared care model where *"every patient belongs to every physician"*, whereas E3's clinic model emphasizes a consistent physician-patient relationship. E1's clinic also assigns each patient to a dedicated physician.

The three physicians represent distinctly different perspectives on digital health tools, one as a clear opponent (E1), another as a cautious adopter (E2), and the third as a strong advocate (E3).

Theme 1. Uncertainty and Age-Related Limits in Fertility Treatment
This theme encompasses the clinical complexity inherent in fertility treatment, often stemming from multifactorial causes (i.e., PCOS, endometriosis, blocked fallopian tubes, and poor sperm). Infertility factors are split 50:50 between men and women. The most critical, limiting, and difficult-to-manage factor is the patient's age. Specialists frequently encounter difficult scenarios, such as the complete lack of viable eggs, where clear solutions are scarce, increasing uncertainty for both patient and provider. Women aged 40-43 get treated, but egg reserves from 43 onwards are minimal. From 44+ onwards, it is not recommended to use donated eggs, and it is suggested that no treatment is possible.

Theme 2. High Patient Need for Communication Between Scheduled Appointments
There is a clear pattern of high demand for patient communication coupled with significant staff and logistical constraints. While all specialists recognize the need for communication, their methods of handling it diverge, reflecting a struggle to balance patient needs against clinical workload.

- E1 (opposed) enforces a strict policy of *"no communication outside of office hours"* due to significant time constraints and rejects the idea of a secure messaging tool, even suggesting that only a fully automated, AI tool could manage asynchronous queries.

- E2 (skeptical) reports a high volume of emails and calls regarding medical content, side effects, emergencies, and requests for callbacks. They characterize the excessive call volume as *"Telefonitis"*[1]. E2 also expresses concern regarding messaging tools that patients would *"communicate any nonsense"* and that the informal nature of chats is inappropriate for medical discussions.
- E3 (ambivalent) experiences a *"great need for communication"*, and manages this through an emergency line (e.g., for forgotten injections) and nurse-led responses. Notes that frequent patient calls block the clinic's front desk phone line.

Theme 3. Perceived Patient Comprehension
The communication of test results is a critical and often emotionally charged event in the fertility journey. Examining how physicians currently manage this process and how they perceive patient understanding is crucial for designing digital solutions that can effectively support rather than complicate this interaction. The specialists' methods and perceptions reveal profoundly different philosophies of patient engagement. While some patients are perceived to understand their results (E1's view), E3 and E2 note a crucial gap. Patients grasp the data but require extensive interpretation and clarification.

Currently, each physician employs a distinct process for delivering results. E1 and E3 rely exclusively on phone calls to share results, with patients not being given their results. E2 also uses phone calls but follows them with a mandatory in-person appointment for discussion, where patients also receive their test results. Their views on patient comprehension are starkly opposed.

- E1 asserts that their *"patients consistently understand their test results"* and consequently do not have many follow-up questions beyond discussing the treatment plan. This perspective contrasts sharply with those of their peers.
- E2 states that while patients understand the information, they *"ask a lot of questions"* because what they truly seek is the physician's *"interpretation of the report"* and the rationale for the subsequent treatment plan.
- E3 echoes this sentiment and agrees that patients generally understand the results but emphasizes that they *"still have many questions"* that necessitate clarification.

These differing views on patient comprehension extend to their perspectives on patient self-research. Both E3 and E2 acknowledge that patients actively use the internet to research their conditions.

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[1] A person's tendency to make excessive phone calls.

- E1 believes their patients *"rely on the expertise of the medical professionals"* and typically refrain from self-diagnosis.

- Conversely, E2 states that *"most patients Google everything either way"*.

- E3 concurs and notes that patients often *"google their results"* and that those who have been unsuccessful with treatment may write *"self-diagnoses"*.

The findings consistently show that patients engage heavily with their health data outside the clinic by *"googling"* results and attempting self-diagnosis, particularly if they have experienced unsuccessful treatments. This topic highlights the physician's role as a necessary gatekeeper for contextualization, often delivering complex results (like genetic findings) directly to manage emotional reactions and ensure proper understanding.

Theme 4. Digital Tools for Test Results and Emotional Support
The physicians' perspectives on platforms for data sharing, communication, and digital emotional support demonstrate a large spectrum of acceptance, ranging from endorsement to rejection. This is dependent upon a number of factors, including their individual concerns and perceptions of value in what they are being asked to do or accept. The concept of a secure digital platform for patients to access their test results also elicited various reactions. The responses highlight the fundamental differences between how each physician views patient empowerment and their own need for workflow efficiency.

E2 and E3 agree that a secure digital platform would simplify processes and improve service quality and efficiency.

- E1 (opponent) considers a patient portal to be *"not necessary"* and an *"extra work"* burden for which they have no time. They believe existing systems, such as the national electronic health record (ELGA), are sufficient.

- E2 (cautious adopter) articulates a complex, conditional point of view. Their initial position is that digital tools are not used *"because patients are not interested, they would rather receive the information from their physician"*. However, they would use a platform for the *"direct storage of the documents and access"*, but only under the crucial condition that it *"should not facilitate as an additional communication channel"*. They underscore that patients primarily want interpretation, a feature a simple document portal lacks.

- E3 (advocate) sees such a platform as *"beneficial"*, believing it would *"simplify a lot of processes"*. They envision it as a tool that could support the *"emotional aspect of treatment"*, particularly if results were visualized for easier comprehension. They further suggest that direct access would aid patients in *"self-management and self-awareness"*.

Although the specialists acknowledge the potential for digital tools to bring about increased efficiency in this domain, they also stress that technology must complement, not replace, human interaction. Crucially, both E2 and E3 conclude that the success of a digital platform will depend on whether the test results are visualized and summarized in an easily understandable way to help with the emotionally charged nature of treatment.

The physicians also shared diverse views regarding the role of digital tools in providing emotional support, reflecting on differing approaches to the delivery of healthcare.

- E1 observes that patients typically seek support from independent therapists. They note that their clinic's treatment package already includes two therapist consultations, implying that further digital support provided by the clinic is unnecessary.
- E2 gives conditional approval (*"Yes, if the conditions are met"*) and points out that their clinic already holds a monthly webinar. They have *"no concerns"* about digital support, provided it is well-managed with *"specific guidelines"*.
- E3 believes online support is *"convenient"* and expresses a clear willingness to participate personally, *"even outside of office hours"*. Their main concern is handling *"serious psychological problems"*, suggesting a preliminary questionnaire to screen participants.

5.2.2 Summary

The findings from the semi-structured interviews with fertility specialists reveal a significant tension between patients' needs for constant reassurance and the logistical constraints of clinics. While one physician opposes digital integration, the others suggest that effective tools must go beyond simple document access to provide data visualization and interpretation that aids patient comprehension. The following three key findings can be derived:

1. **Contrasting Attitudes Toward Technology:** The fertility specialists demonstrated different attitudes toward digital health technologies, ranging from complete resistance to advocacy for them to enhance patient self-management.

2. **Gap Between Access and Understanding:** Although patients increasingly access and research their health data, they still depend on physicians for interpretation, as they frequently lack the ability to interpret it. The internet research results in a high-volume of follow-up questions for the clinic. This emphasizes that information availability alone does not ensure meaningful understanding or reduce clinical workload.

3. **Visualization Is Vital For Patient Empowerment:** For ART support platforms to provide real value, test results must be presented through clear visualizations, plain-language summaries, glossaries, and educational support must

be offered. This enables patients to better comprehend complex information while easing the emotional and interpretive burden on clinicians.

5.2.3 Analysis of ART Patient Interviews

Fertility treatment is not a passive experience. Rather than being a simple journey, it is an active, demanding process that fundamentally alters the structure of daily life. For many, it becomes an all-consuming endeavor that reorganizes priorities, schedules, and relationships, touching every aspect of their existence.

Participants have undergone a variety of treatment protocols, including IVF, ICSI, and the use of donor eggs. These intricate clinical pathways invariably extend beyond the clinic, imposing profound and multifaceted impacts on patients' daily lives.

Theme 1. Toll on Mental Health
The emotional and psychological burden of ART was a dominant theme. For many, the process was all-consuming. The journey is synonymous with a struggle against depression and anxiety, impacting their fundamental sense of wellbeing. One participant reported it led to *"developed depression"* (P10), while another conveyed the immense pressure by stating, *"I feel like I work 2 full time jobs (teaching is one, fertility treatments is the second)"* and *"absolutely depressed and on antidepressants"* (P2). This sentiment that the process *"has taken over my life"* (P4) was a common thread, reflecting the mental space that treatment occupies. With daily life becoming completely reoriented around treatment, one participant described how their thoughts are *"basically always revolving around fertility"* (P1).

In contrast, it is also important to note the variability of this impact. P3, who was part of a same-sex couple and did not have an underlying infertility diagnosis, when asked about the effect on their daily life, stated it was *"Not much"* (P3), illustrating that the intensity of the experience is not universal.

Theme 2. Impact and Disruptions on Professional Life
Beyond the emotional strain, participants detailed significant logistical, professional, and financial hardships. The sheer volume of appointments for scans, blood tests, and procedures requires a level of flexibility that many jobs do not afford. Several participants had to voluntarily reduce their work hours to accommodate treatment schedules (P9, P11), and the challenges were particularly acute for shift workers, who struggled with medication timing and unpredictable appointments (P6, P7). In one severe case, a respondent reported having *"lost my job because of it,"* explaining that the extensive time commitment required for operations and appointments would make it impossible to pass a probation period, which led them to being out of work for over a year (P8). The physical requirements of treatment interfere with specific job functions and environments. One individual on blood thinners noted this was *"too risky"* for their job involving tools and remote lone working. Another, a restaurant supervisor, explained the rigidity of

treatment protocols clashed with their unpredictable schedule, stating *"as a shift worker there is no reliable time to inject"* (P7), forcing them to disclose their private medical situation just to manage their care. They had to undergo a risk assessment to bring needles to work and inform managers so they could leave the floor to inject medication at precise times.

The logistical and time-consuming nature of fertility treatment often places an immense strain on work and careers. The constant cycle of appointments, medication schedules, and procedures requires a level of commitment that many describe as a second job, one that is unpaid, relentless, and emotionally taxing. The sheer volume of administrative and medical tasks leads some to feel they are working *"two full-time jobs"* (P2), one being their actual profession (e.g., teaching) and the second being fertility treatments.

This sense of a shrinking world is also reflected in the inability to plan for the future. The uncertainty of the treatment timeline paralyzes long-term planning. Participants described an inability to book holidays or social events due to appointment uncertainty and the need to be available for procedures like egg collection, which can shift unexpectedly. As one person noted, *"I am too scared to plan too far ahead"* (P1). Financial constraints caused by the high cost of treatment further restrict the ability to plan leisure activities or travel (P6, P11).

Theme 3. Between Isolation and Support

The demands of treatment extend far beyond the workplace, often leading to social withdrawal and isolation. Participants reported social gatherings as source of pain, particularly the *"difficulty seeing friends who are pregnant"* (P10). Navigating these situations requires immense emotional energy, and many choose to withdraw to protect themselves, *"avoiding friends that are newly pregnant or have newborns"* (P6). One respondent explained they *"lost friends"* (P2) and have less of a social life because it revolves entirely around appointments. Physical side effects, such as feeling *"awful on meds,"* (P11) also cause individuals to skip social occasions. The combination of physically feeling unwell from medication, the emotional exhaustion of the process, and a schedule dictated by appointments leaves little room for a social life.

While ART is often undertaken by a couple, the degree of partner involvement in the logistics and emotional labor of the journey varies dramatically. The interview responses reveal a wide spectrum of partner engagement, which in turn has a significant effect on relational dynamics.

On one end of the spectrum were partners who were *"very involved"* (P2) and *"extremely supportive"* (P6), attending all appointments, offering to administer daily injections, and even preparing an *"ice patch"* for the injection site. This level of shared responsibility was often reported to foster a stronger sense of togetherness and improved communication, helping the couple navigate the immense pressures of treatment as a unified team.

Other respondents described a significant disparity in involvement that created an emotional chasm. One participant stated her partner was *"not really involved"* (P11) in the process. Another felt the emotional weight fell squarely on her shoulders, describing how the journey was not a shared experience but *"my burden,"* expressing frustration that after years of treatment, her partner had learned *"so little...about the process compared to me"* (P7). When the immense pressure of ART exposed fractures in the couple, other close relationships became a critical source of comfort and strength, with one participant simply stating that a key positive aspect of their journey was *"my sister's support"* (P1).

Formal support services offered by clinics, such as counseling, were met with mixed reviews. The accessibility and perceived usefulness of these resources varied considerably. For instance, the cost of counseling could be a barrier, with one clinic offering an initial free session but charging *"€100 per session after"* (P6). Furthermore, the quality of the support was sometimes questioned, with one respondent finding the counseling she accessed *"too broad spectrum to be of assistance"* for her specific needs (P2). The quality of clinical support is complemented by the patient's personal support system, particularly the role played by their partner.

Theme 4. Sense of Control and Emotional Burnout

The relentless nature of treatment, with its cycles of high hope and deep loss, can take a significant toll on mental health, creating a complex inner world of anxiety, grief, and a shifting sense of self.

Gaining a sense of control was cited by numerous participants (P4, P6, P9, P10, P11), with P1 succinctly describing it as a way to *"have a sense of control in a situation in which you have none."* The experiences of two individuals highlight an internal conflict. While one felt a moderate sense of control from their data, both reported maximum levels of anxiety caused by that same information (P2, P11). The practice itself became a source of stress, with participants (P2, P9) noting that they found it *"emotionally difficult/stressful"* and ultimately stopped tracking when it became *"too overwhelming"* as a form of self-preservation (P2). The sheer time required to maintain detailed records was a problem for a subset of participants, adding another layer of effort to an already demanding regimen (P9, P11). Participants reported stopping for clear reasons. One stopped because she was *"fed up with it"* (P11) after a four-year journey, while another took extended breaks after feeling *"burned out completely"* (P1). The data suggests that access to information does not necessarily translate to peace of mind. One participant described feeling *"more in control but to the point where I obsess about it"* (P1), highlighting how empowerment can tip into a state of preoccupation.

Theme 5. Feeling "Abnormal" and a Mismatch of ART Journey Complexities

Participants reported negative self-perception and altered body image. One user expressed disliking their body *"more than ever before"* (P2) because it fails to follow a routine or function as expected. One individual felt *"abnormal"* (P7) when using tracking apps that did not account for complex IVF journeys, life-threatening ectopic pregnancies, or pregnancy losses.

Participants also offered specific critiques of the design and functionality of popular commercial FMT applications. These included:

- **Inadequate for Complex Journeys:** Participants expressed concerns about data accuracy (P4, P9, P11). More pointedly, they reported that consumer-grade tracking tools were fundamentally ill-suited for their complex medical journeys. Apps were criticized for being *"badly designed for TTC long term"* (P7) and for *"missing important features for ART"* (P2, P4, P7). By lacking features necessary to log the specific protocols of assisted reproduction and crucial ART-specific information such as an IVF cycle, down-regulation protocols, or non-standard pregnancy outcomes like an ectopic pregnancy, which is distinct from a miscarriage, *"I got lots of miscarriage stuff pushed to me. I didn't have a miscarriage. Ectopic is rare but not unheard of"* (P7), these tools become inappropriate for anything beyond a simple, natural conception journey (P1, P7). Therefore, these apps feel useless for a complex medical process, which is typical of ART procedures.

- **Insensitive and Patronizing Content:** Participants found the automated messaging and content within apps to be tone-deaf or *"patronizing"* (P7). The constant exposure to *"so many baby things"* was cited as a source of negative emotional impact (P2).

- **Data Privacy Concerns:** A crucial theme was the concern over data privacy. While some participants reported having *"no concerns"* (P1, P5, P6, P11), others expressed fears that their highly sensitive information could be shared (P4) or used for targeted advertising, which was particularly hurtful for one user who received pregnancy-related ads after a loss (P7). Significant worries also included that data could be *"released or my information sent to the dark web"* (P2). For one participant, these concerns were strong enough to lead to a refusal to use any non-clinic-provided applications (P3).

Participants reported that tracking data fostered a sense of control while simultaneously inducing significant emotional distress.

Theme 6. Erosion of Trust and the Demand for "Hard Facts"
When presented with uncertain clinical information, such as ambiguous test results or success probabilities, patients commonly respond by undertaking extensive personal research to gain clarity and context (P2, P4, P5). However, this drive for information is often born from dissatisfaction with clinic communication. Participants voiced several critiques, describing instances of feeling *"unheard"* or that information was *"deliberately misleading"* (P2), clinics providing *"not enough information to support my decision making"* (P4), and losing trust due to *"inconsistent"* communication about test results across different IVF cycles (P5). In a process where information can feel guarded or insufficient, P1 started seeking second opinions and joining online communities to learn from the collective *"wisdom"* of others.

5.2.4 Summary

The path of assisted reproduction is deeply personal, profoundly complex, and different for every single person who walks it. As these stories show, it is a journey that involves far more than medical appointments. The findings from the semi-structured interviews with ART patients reveal that fertility treatments are not only disruptions to every facet of daily life, but also become an all-consuming process. Behind the schedules, medication protocols, and data points of fertility treatment are challenges with mental health, strained finances, reshaped careers, and tests in relationships.

While every story is unique, they are connected by a common thread of incredible strength and resilience. These reflections reveal a journey marked by great personal and professional sacrifice, deep emotional struggle, and an ongoing search for clarity and control. The determination to endure countless injections, appointments, and emotional setbacks in pursuit of a family is a testament to the human spirit. The following three key findings can be derived:

1. **Fertility Treatments' Severe Psychological Impact:** Many participants reported anxiety, emotional exhaustion, depression, and a sense of losing control. This highlights that patients experience a severe mental health burden due to the intense demands of their ART journeys.

2. **Disruptions to Daily Life and Careers:** The time-intensive nature and logistical requirements of appointments, procedures, and medication schedules frequently leads to a "second full-time job". One that constantly consumes mental focus, disrupts work responsibilities and restricts finances, and results in social isolation, making it impossible to plan ahead or maintain normalcy.

3. **Existing Tools and Clinical Support Fail Patients:** Existing tracking apps are inadequate for the complexity of assisted reproduction journeys, and clinic communication is frequently criticized as insufficient, inconsistent, or outright misleading, eroding trust and pushing patients to seek information through self-research and peer communities.

CHAPTER 6

Results

This chapter presents the results of the iterative process of the *design and co-evaluation* phase of my thesis. First, the initial design principles are introduced. Second, findings from the co-evaluation workshop are reported. Finally, the refined design principles are presented as the primary outcome of this thesis.

6.1 Derivation of Design Principles (Iteration 1)

Based on the related work, review of existing technologies, and user research presented in the thesis, five recurring thematic clusters related to the challenges of self-tracking during ART were identified.

T1. Misalignment with Existing Tools

The women's experiences revealed discrepancies in what is assumed by existing fertility tracking apps and the realities of their ART treatments, which did not follow a continuous or predictable trajectory. The treatment journeys were characterized by several interruptions, cycles that failed, medical pauses, and repeated resets, none of which were adequately represented and supported in the apps available today.

Participants described how the apps' interfaces assumed positive outcomes and followed linear paths with forward motion, providing celebratory messaging and/or pregnancy-oriented milestones. Often, situations felt misaligned with their emotional state during treatment setbacks. Several participants expressed how emotionally isolated they felt when faced with unsuccessful cycles, pregnancy loss, or other health issues related to their infertility. As such, the apps continued to promote hopeful narratives without acknowledging their losses or the complexities of their experiences.

Additionally, women stated that the existing tools provided limited or no support for reflection or recovery after negative outcomes, instead immediately encouraged them to re-engage and begin preparing for their next treatment cycle. These apps further contributed to feelings of isolation and invalidation, as individuals struggled to reconcile their emotional experiences with interfaces that framed fertility as a continuous, goal-oriented journey.

T2. Cognitive Load and Emotional Labor of ART Treatment
Participants discussed how ART was as a form of continuous mental labor extending far beyond clinical appointments. The process of receiving treatment involves coordinating fragmented tools, tracking medications and symptoms manually, managing appointments at multiple locations, and navigating the cost of care through insurance and financing. In spite of partial public financing for some aspects of ART treatment, many participants experienced several thousand euros of out-of-pocket expenses, which directly affected their decisions on whether continuing treatment or limiting family size.

The rigid timelines for treatments combined with prolonged waiting periods (i.e., two-week waits, delayed medical procedures) intensified stress and uncertainty. The physical side effects from ART treatment, such as pain, significant weight gain, and hormonal changes, added to the loss of bodily autonomy. Participants emphasized that their physical experiences exacerbated their emotional strain.

Repeated cycle failures and miscarriage(s) were described by participants as severely debilitating. Each unsuccessful outcome created grief, trauma, and decreased of self-worth. Fertility-related data became tightly interwoven into every aspect of their lives, amplifying emotional vulnerability. Instead of being episodic, participants described ART as an ongoing psychological and emotional burden on their everyday life, requiring sustained vigilance, decision-making, and resilience during extended periods of uncertainty.

T3. Needs and Challenges with Data Interpretation
Participants consistently reported difficulties making sense of fertility-related data. Metrics were often presented without relation to each other, requiring users to perform manual sensemaking across laboratory results, clinical updates, and personal observations. Frequently, fertility-related information was delivered through fragmented communication channels, such as email, phone calls, printed documents, and in-person consultations, which contributed to confusion and cognitive overload.

Many participants were left feeling overwhelmed due to the medical jargon, ambiguity or contradiction in test results, and inadequate contextual explanations. Although participants perceived fertility data as valuable, they did not believe that this data alone would provide them with reassurance or clarity regarding their care. Many participants questioned whether recommended treatments were medically indicated or financially motivated, and/or if sufficient testing was being done during individual cycles to optimize the potential for success.

The few participants that considered themselves well-informed described feelings of shock upon receipt of unanticipated results, and these reactions reinforced feelings of helplessness and loss of control over their fertility care. The absence of clearly articulated explanations that linked specific measurements to recommendations for treatment, provided little insight into how data points related to the participant's personal situation, and therefore, highlighting a gap between the raw clinical information and the patient's ability to understand it.

T4. Tracking as Both Empowerment and Distress

Participants described tracking as an experience with two opposing sides to it. Verbal-only communication from clinics left patients uncertain about what results meant for them personally, prompting many to seek out second opinions, conduct their own research and engage in detailed self-tracking practices.

Probe diaries emerged as a way to manage the complexity of treatment. Participants used them to log medications, symptoms, appointments, and emotional states. Diaries were also a tool for participants to develop visual maps of treatment protocol and to help prepare for consultations. These practices supported continuity among different healthcare providers, and helped provide participants with a feeling of being back in control.

Once participants felt they had the ability to understand their data, symptoms, and the rationale behind procedures, they reported higher levels of self-efficacy, improved wellbeing, and more confidence to navigate treatment. However, tracking could also become emotionally burdensome, particularly when it focused on outcomes during uncertain periods. This tension created a contrast for how actively engaging with data can both empower patients and amplify vulnerability, depending on how the information was presented and supported.

T5. Constraints of Life and Need for Sharing

ART treatment placed considerable strain on participants' professional, financial, and social lives. Participants experienced daily disruptions due to frequent appointments at several different institutions for treatment. Often having to hide the reason for their absences from work as IVF was not formally recognized for taking sick leave. Financial pressures further constrained choices and added stress.

The responsibility to coordinate and track all appointments fell mostly on the female patients who were also the ones receiving the majority of the medical interventions during the treatment process. Despite undergoing treatment as couples, many participants reported feeling alone, while male partners usually suppressed their own distress in order to appear supportive. These dynamics intensified emotional burden on both sides.

At the same time, shared access to information, joint appointments, and collaborative decision-making fostered empathy and mutual support. When participants engaged in treatment-related activities together, it had a positive impact as it reduced their feelings of isolation and strengthened relational resilience. Moreover, beyond partnerships, participants expressed a desire to connect with peers who were undergoing similar experiences. They sought opportunities for collaborative sensemaking with others to exchange practical knowledge as well as validate the emotions they were experiencing.

T6. Trust and Privacy Issues

Participants viewed their fertility data as exceptionally private and many expressed extreme concern regarding the safety of their personal health information. For fear that their data might be sold to third parties or leaked, many reported a fundamental lack of trust in digital platforms. This skepticism toward digital services was exacerbated by opaque consent models that typically forced users to give up their right to privacy in order to utilize the full functionality. Participants expressed deep anxiety toward this commercialization, leaving them with the feeling of being exploited rather than supported.

The consequences of these data practices did not just compromise the participants' right to privacy, but caused the participants psychological harm. Participants described painful moments where apps continued to serve targeted advertisements for baby items or maternity products immediately following a miscarriage or failed cycle. These examples emphasize how severely disconnected the user's medical reality and the system's commercial algorithms are.

Through this process, I synthesized an initial set of six design principles to guide the development of fertility self-tracking mHealth apps in the context of ART. Figure 3.3 illustrates an excerpt of the mapping process, showing merging of the themes into design principles.

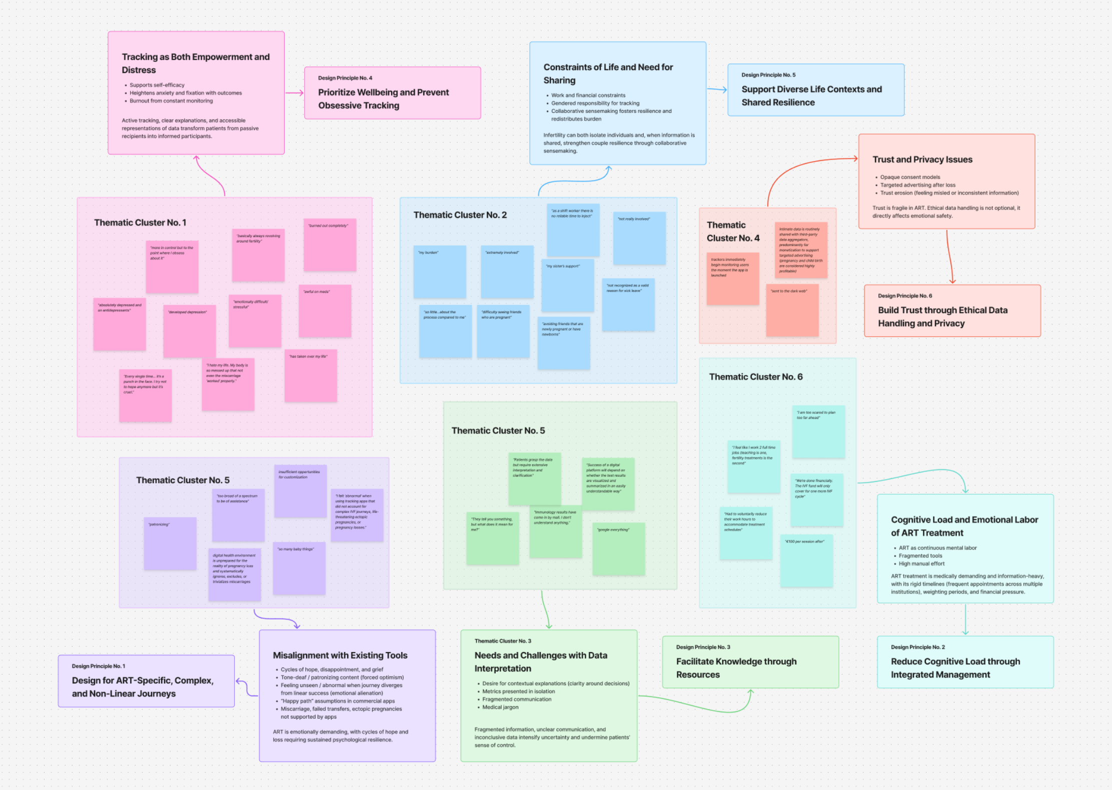


Figure 6.1: Process of merging themes into design principles

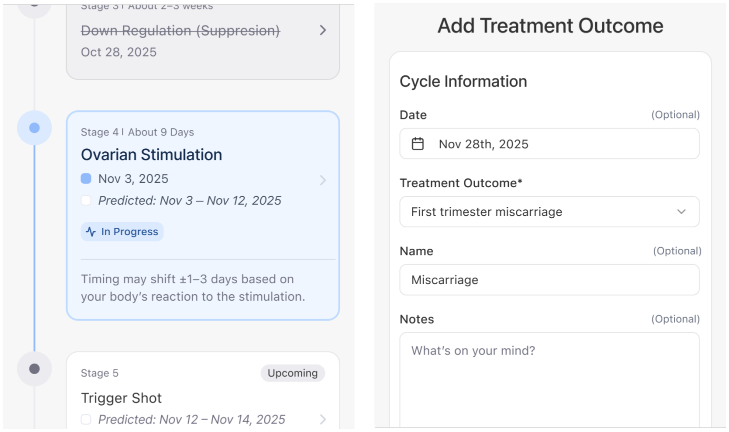
6.1.1 Preliminary Design Principles

These principles were treated as provisional and served as sensitizing concepts rather than finalized outcomes. Listed below are the preliminary design principles developed prior to the co-evaluation. These principles served as sensitizing concepts for the subsequent co-evaluation workshop and provided a baseline for collaborative reflection and refinement.

P1. Design for ART-Specific, Complex, and Non-Linear Journeys

The timeline reflects the unpredictable nature of physiological responses during ovarian stimulation and shows users how due dates and schedules may adjust as individuals' bodies do not react identically to all medical treatments.

The interface normalizes non-linear trajectories by allowing users to document negative events (i.e., miscarriage). The user will not have to endure celebratory, upbeat messages or features that assume the user's pregnancy is still progressing, see Figure 6.2.



Stage 3 I About 2–3 weeks

~~Down Regulation (Suppresion)~~

Oct 28, 2025

Stage 4 I About 9 Days

Ovarian Stimulation

Nov 3, 2025

Predicted: Nov 3 – Nov 12, 2025

In Progress

Timing may shift ±1–3 days based on your body's reaction to the stimulation.

Stage 5 Upcoming

Trigger Shot

Predicted: Nov 12 – Nov 14, 2025

Add Treatment Outcome

Cycle Information

Date (Optional)

Nov 28th, 2025

Treatment Outcome*

First trimester miscarriage

Name (Optional)

Miscarriage

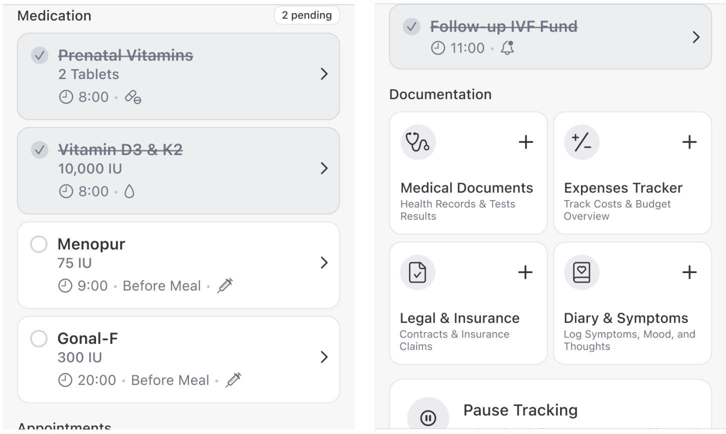
Notes (Optional)

What's on your mind?

Figure 6.2: UI screenshot translating design principle 1, presenting the treatment timeline alongside a form for adding a negative treatment outcome

P2. Reduce Cognitive Load through Integrated Management

The management dashboard reduces the burden of ART by aggregating medical records, financial tracking, legal documents, and symptom diaries into a single, cohesive ecosystem, see Figure 6.3.



Medication 2 pending

~~Prenatal Vitamins~~

2 Tablets

8:00

~~Vitamin D3 & K2~~

10,000 IU

8:00

Menopur

75 IU

9:00 · Before Meal

Gonal-F

300 IU

20:00 · Before Meal

Appointments

~~Follow-up IVF Fund~~

11:00

Documentation

Medical Documents
Health Records & Tests Results

Expenses Tracker
Track Costs & Budget Overview

Legal & Insurance
Contracts & Insurance Claims

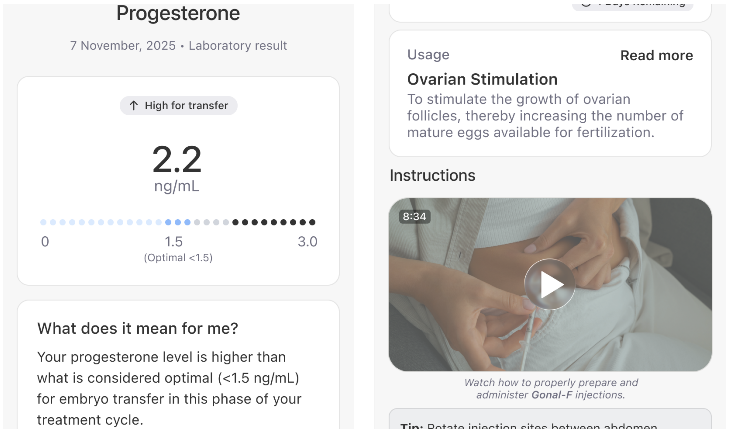
Diary & Symptoms
Log Symptoms, Mood, and Thoughts

Pause Tracking

Figure 6.3: UI screenshot illustrating design principle 2, showcasing the "Home" interface with daily tasks and document management features

P3. Facilitate Knowledge through Resources

In order to create a connection between raw clinical data (e.g., laboratory results for progesterone levels), and patient understanding, test results are combined with contextual explanations in plain-language that describe the metric, as it relates to the users' current treatment phase and risk factors as shown in the Figure 6.4.



What does it mean for me?

Your progesterone level is higher than what is considered optimal (<1.5 ng/mL) for embryo transfer in this phase of your treatment cycle.

Ovarian Stimulation

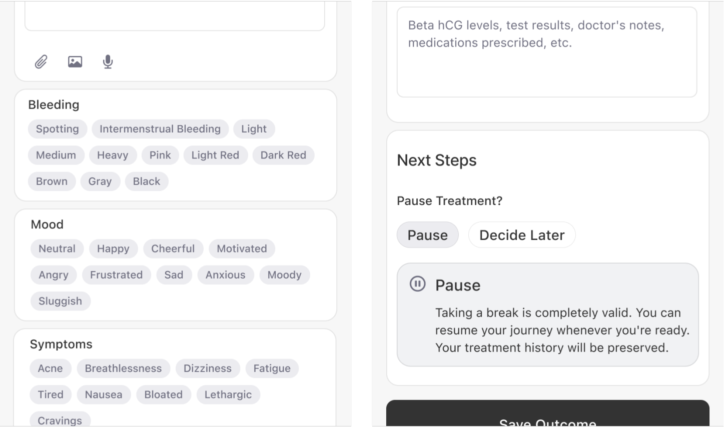
To stimulate the growth of ovarian follicles, thereby increasing the number of mature eggs available for fertilization.

*Watch how to properly prepare and administer **Gonal-F** injections.*

Figure 6.4: UI screenshot illustrating design principle 3, featuring a detailed analysis of a blood value along with an instructional section for the current medication

P4. Prioritize Wellbeing and Prevent Obsessive Tracking

The "Pause Tracking" feature explicitly supports emotional wellbeing by validating the user's need for breaks. This allows users to disengage (frictionless) from the app's notification and tracking systems during periods of grief, medical pauses, or overwhelm, see Figure 6.5.



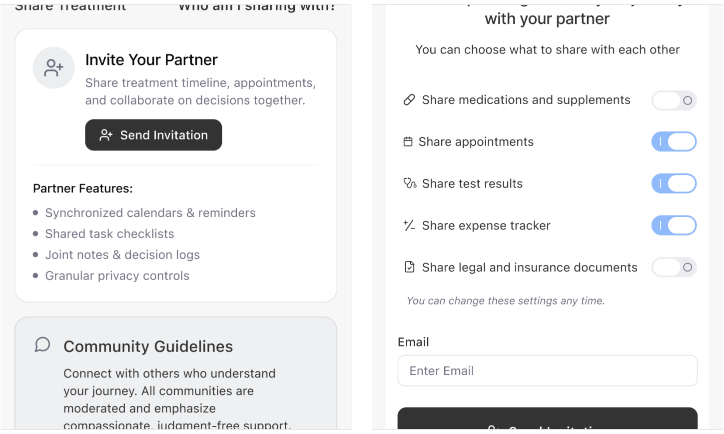
Beta hCG levels, test results, doctor's notes, medications prescribed, etc.

Taking a break is completely valid. You can resume your journey whenever you're ready. Your treatment history will be preserved.

Figure 6.5: UI screenshot illustrating design principle 4, showcasing the daily journal with mood and symptom tracking, and a post-entry "pause treatment" question following a negative outcome

P5. Support Diverse Life Contexts and Shared Resilience

Granular sharing options provide users with the ability to distribute the cognitive and emotional burdens of treatment with a partner, which may include synchronizing calendars and shared decision-making, while still allowing each individual control over what information is being shared, as shown in Figure 6.6.



Share Treatment
Who am I sharing with?

Invite Your Partner

Share treatment timeline, appointments, and collaborate on decisions together.

Partner Features:

- Synchronized calendars & reminders
- Shared task checklists
- Joint notes & decision logs
- Granular privacy controls

Community Guidelines

Connect with others who understand your journey. All communities are moderated and emphasize compassionate, judgment-free support.

with your partner

You can choose what to share with each other

Share medications and supplements ○
Share appointments ●
Share test results ●
Share expense tracker ●
Share legal and insurance documents ○

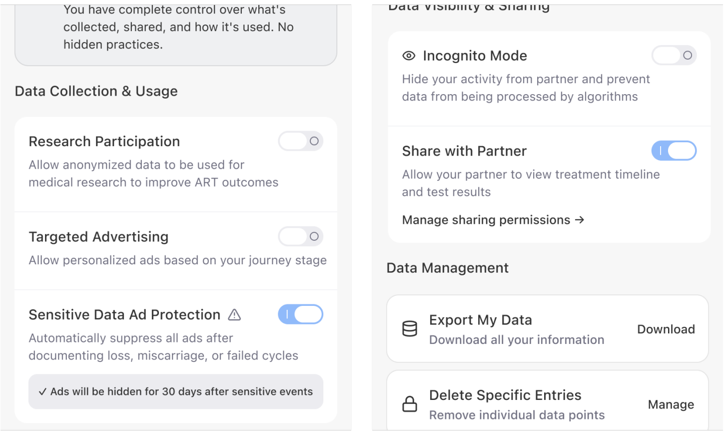
You can change these settings any time.

Email
Enter Email

Figure 6.6: UI screenshot illustrating design principle 5, enabling users to invite their partner and configure specific sharing options

P6. Build Trust through Ethical Data Handling and Privacy

The “Sensitive Data Ad Protection” feature protects users from commercial algorithms that can cause significant psychological damage, by automatically turning off all forms of targeted advertising upon the recording of a sensitive event (i.e. loss or failed cycle), as shown in 6.7.



You have complete control over what's collected, shared, and how it's used. No hidden practices.

Data Collection & Usage

Research Participation ○
Allow anonymized data to be used for medical research to improve ART outcomes

Targeted Advertising ○
Allow personalized ads based on your journey stage

Sensitive Data Ad Protection ⚠ ●
Automatically suppress all ads after documenting loss, miscarriage, or failed cycles

✓ Ads will be hidden for 30 days after sensitive events

Data Visibility & Sharing

Incognito Mode ○
Hide your activity from partner and prevent data from being processed by algorithms

Share with Partner ●
Allow your partner to view treatment timeline and test results

Manage sharing permissions →

Data Management

Export My Data
Download all your information

Delete Specific Entries
Remove individual data points

Figure 6.7: UI screenshot illustrating design principle 6, featuring user-controlled settings for data privacy and security

6.1.2 Summary

Together, these design principles shift fertility self-tracking from a primarily biomedical optimization task toward an experience-sensitive practice. They foreground uncertainty, emotional complexity, and everyday constraints as central design considerations. In doing so, they operationalize the user-centered insights of this study and provide a foundation for developing fertility technologies that better align with the lived realities of assisted reproduction.

Table 6.1 provides an overview of the six initial design principles and their focus.

Theme	Design Principle	Focus
T1.	P1. Design for ART-Specific, Complex, and Non-Linear Journeys	Interfaces should support diverse ART outcomes and acknowledge uncertainty, setbacks, and cyclical treatment paths rather than enforcing linear success narratives. Designs must enable sensitive documentation of negative events while avoiding patronizing language.
T2.	P2. Reduce Cognitive Load through Integrated Management	Systems should reduce administrative burden by centralizing medications, appointments, documents, and expenses, minimizing manual data entry, and prioritizing features that address immediate practical needs.
T3.	P3. Facilitate Knowledge through Resources	Designs should help users interpret fertility data through clear visualizations, plain-language explanations, and evidence-based educational resources. Interfaces should support understanding of relationships between symptoms, treatments, timelines, and outcomes.
T4.	P4. Prioritize Wellbeing and Prevent Obsessive Tracking	Interfaces should balance informational support with emotional care by integrating coping tools, enabling respectful disengagement, and supporting holistic health tracking. Emotional support should be embedded throughout the experience, helping users maintain wellbeing without reinforcing compulsive monitoring behaviors.
T5.	P5. Support Diverse Life Contexts and Shared Resilience	Designs should accommodate users' everyday environments through discretion and flexibility, while enabling collaborative engagement with partners and peers. Shared tools and moderated community spaces can redistribute cognitive and emotional labor and foster collective sensemaking.
T6.	P6. Build Trust through Ethical Data Handling and Privacy	Systems must prioritize transparency and user agency by providing granular privacy controls, clear communication about data use, and protections around sensitive entries. Ethical data practices should replace opaque consent models and prevent emotionally harmful secondary uses such as targeted advertising following negative outcomes.

Table 6.1: Overview of initial design principles prior to co-evaluation

6.2 Co-Evaluation Workshop Findings

To evaluate and refine the initial principles, a co-evaluation workshop with five participants was conducted. The workshop was designed for the participants to engage in structured discussions and collaborative reflection on the proposed principles' relevance, clarity, and completeness, using both their personal experiences and hypothetical scenarios as references for this evaluation. The group's feedback during this session was used to revise the proposed principles.

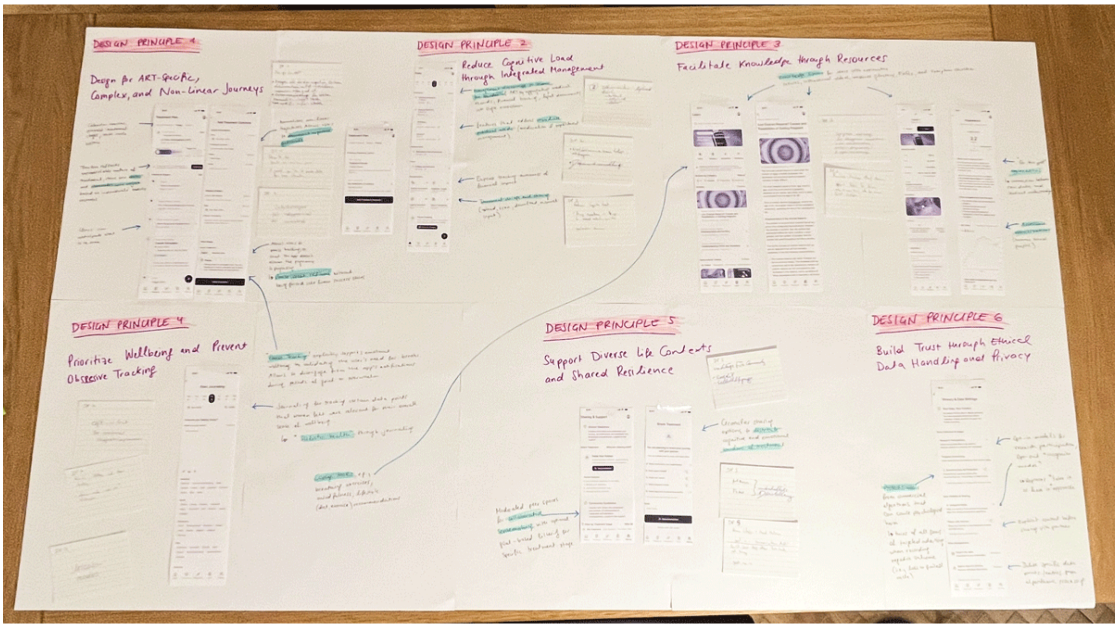


Figure 6.8: Feedback results from the co-evaluation workshop

The feedback was categorized by theme to determine which elements aligned with the initial design principles and where there existed opportunities for refinement. A total of four overarching themes emerged: the need for users to have control over the system, personalization, safety and clinical integration, anticipatory guidance for medical risks, and additional support that is accessible through shared and external resources.

T1. Emphasis on User Control and Personalization
Participants stated that their ability to determine when and how they will engage sensitive content is based on their own agency. In relation to negative outcomes, participants expressed a preference for being explicitly asked whether they wished to document such events, as opposed to being required to enter distressing information by default. Several suggested that the system should provide users with explanations of why documenting may be beneficial (e.g., to inform future cycles or promote reflective thought), and then give them the opportunity to opt out.

Similarly, participants also emphasized the need to regulate the intensity of system prompts/recommendation and emotional support. Participants offered several suggestions to adjust the level of advice (e.g., regarding exercise or supplements) and offer "opt-in" or "opt-out" options for emotional content. The participants agreed unanimously on the idea of an application-wide "vacation mode", which allows users to pause engagement with the app emotionally demanding periods. Overall, these discussions emphasize the importance of using flexible engagement models that can be modified based upon a user's emotional states and needs.

Participants also proposed to include treatment cycle summaries as part of their ART treatment tracking. This would provide participants with an opportunity to reflect upon prior cycles and give explanations for possible reasons behind unsuccessful outcomes.

T2. Safety-Oriented Features and Clinical Integration

Participants stressed that there is a need to improve the ways that fertility tracking apps can facilitate safety and continuity of care. Aspects of this include incorporating emergency contact information of clinics into the initial setup of the app, as well as permitting the use of geolocation to help identify locations when participants are experiencing medical emergencies.

Workshop participants also emphasized the importance of seamless information exchange between patients, clinics, and laboratories. A number of participants suggested the development of shared documents that could be uploaded/downloaded by different institutions. The need to enhance interoperability between tracking tools and clinical infrastructures was clearly reflected through this feedback.

T3. Anticipatory Guidance for Medical Risks

Participants viewed preemptive education about potential complications as very valuable. They suggested symptom-based warnings for serious conditions (e.g., OHSS, ectopic pregnancy, septic miscarriage), noting that clinical warnings often arrive too late to be useful by the time they are received by the patient.

In addition, participants expressed an interest in informational resources that would provide a description of what could potentially go wrong during procedures and how to react to it. This was reflective of a larger goal of obtaining anticipatory knowledge to support rapid decision-making and minimize uncertainty at critical points in time.

T4. Shared Experiences and External Support Networks

Participants acknowledged that their partners should be involved in the process, but expressed a need for user experience to be individualized based on gender, suggesting two separate, yet connected interfaces for female and male partners to switch back and forth.

They further emphasized the usefulness of peer support, recommending integration into existing online forums such as Reddit or self-help groups on Facebook rather than creating duplicate platforms. This feedback confirmed the function of online communities to offer both emotional validation and practical advice as a compliment to the in-app support mechanism.

6.3 Final Design Principles

The workshop feedback primarily resulted in refinements that included a greater emphasis on safety, collaboration and personalization. The existing principles were extended to incorporate explicit user control over emotional content and recommendations, better clinical integration with emergency and documentation features, and anticipatory guidance for medical risks, as well as more flexible models of support from partners and peers.

These refinements led to the final set of design principles presented below.

Principle No.1: Design for ART-Specific, Complex, and Non-Linear Journeys

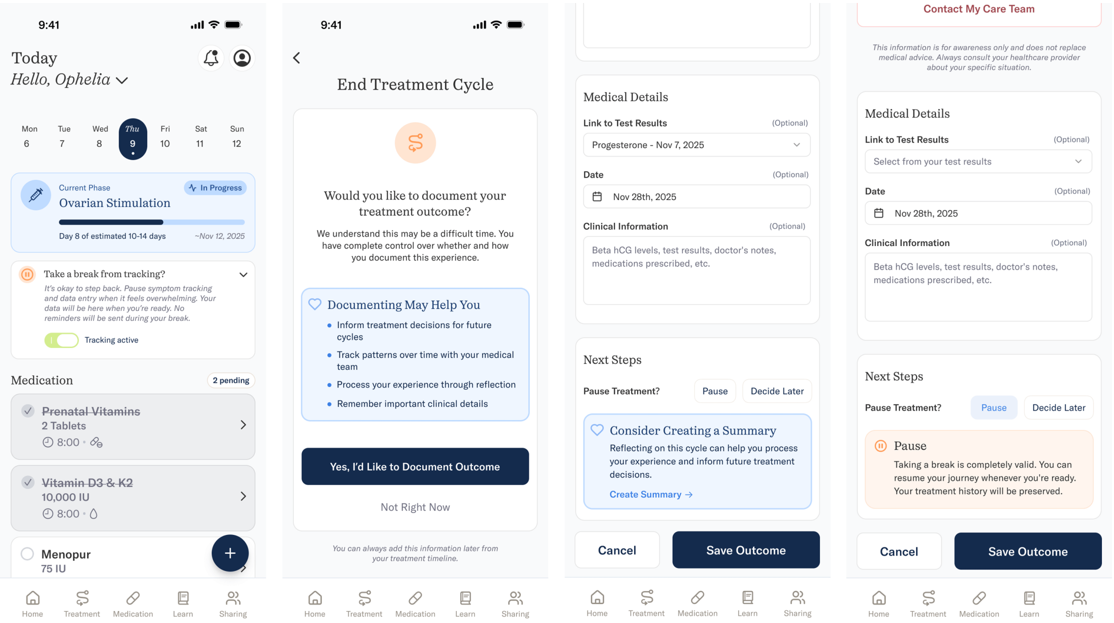
mHealth apps that support ART must shift away from linear, success-oriented narratives (the "happy path") toward flexible frameworks that accommodate medical setbacks, non-standard outcomes, and cyclical timelines.

Rationale:
Participants often viewed their ART journeys as a series of fragmented, cyclical, and emotionally complex experiences. When users encountered the common setbacks of ART, like miscarriage, ectopic pregnancy, or cycle cancellation, they hit "functional dead-ends" (e.g., infinite loops or hard resets) or pushed optimistic progress metaphors. This lack of flexibility does not only cause usability issues, but reinforces perceptions of being "abnormal" and unsupported during critical moments.

Design Implications:

- Prompt users before requesting **documentation of negative outcomes**, explain potential benefits while respecting the option to decline.
    - Include specific pathways for chemical pregnancies and first trimester miscarriages, ectopic pregnancies, canceled cycles, failed transfers (e.g., lack of viable embryos, genetic abnormalities), and planned or unplanned treatment breaks
- Allow users to adjust the intensity of recommendations (e.g., lifestyle suggestions or supplements).
- **Avoid patronizing language**, "toxic positivity", motivational clichés, and progress narratives that presume eventual success.

- Explicitly **acknowledge uncertainty and setbacks**, allow users to pause, reset, or reframe their journey without being forced into linear success models.
- Treatment trajectories must be **represented as cyclical** or dynamic rather than strictly sequential.
- Provide cycle-level summaries that contextualize past treatments and offer non-deterministic explanations of possible contributing factors.



Take a break from tracking?

It's okay to step back. Pause symptom tracking and data entry when it feels overwhelming. Your data will be here when you're ready. No reminders will be sent during your break.

Would you like to document your treatment outcome?

We understand this may be a difficult time. You have complete control over whether and how you document this experience.

Documenting May Help You

- Inform treatment decisions for future cycles
- Track patterns over time with your medical team
- Process your experience through reflection
- Remember important clinical details

You can always add this information later from your treatment timeline.

Medical Details

Link to Test Results (Optional): Progesterone - Nov 7, 2025

Date (Optional): Nov 28th, 2025

Clinical Information (Optional): Beta hCG levels, test results, doctor's notes, medications prescribed, etc.

Next Steps

Pause Treatment? Pause Decide Later

Consider Creating a Summary

Reflecting on this cycle can help you process your experience and inform future treatment decisions.

This information is for awareness only and does not replace medical advice. Always consult your healthcare provider about your specific situation.

Medical Details

Link to Test Results (Optional): Select from your test results

Date (Optional): Nov 28th, 2025

Clinical Information (Optional): Beta hCG levels, test results, doctor's notes, medications prescribed, etc.

Next Steps

Pause Treatment? Pause Decide Later

Pause

Taking a break is completely valid. You can resume your journey whenever you're ready. Your treatment history will be preserved.

Figure 6.9: Example UI of DP1: ability to pause tracking, user-controlled documentation of negative outcomes, communication of potential benefits, and support for logging diverse (including negative) outcomes

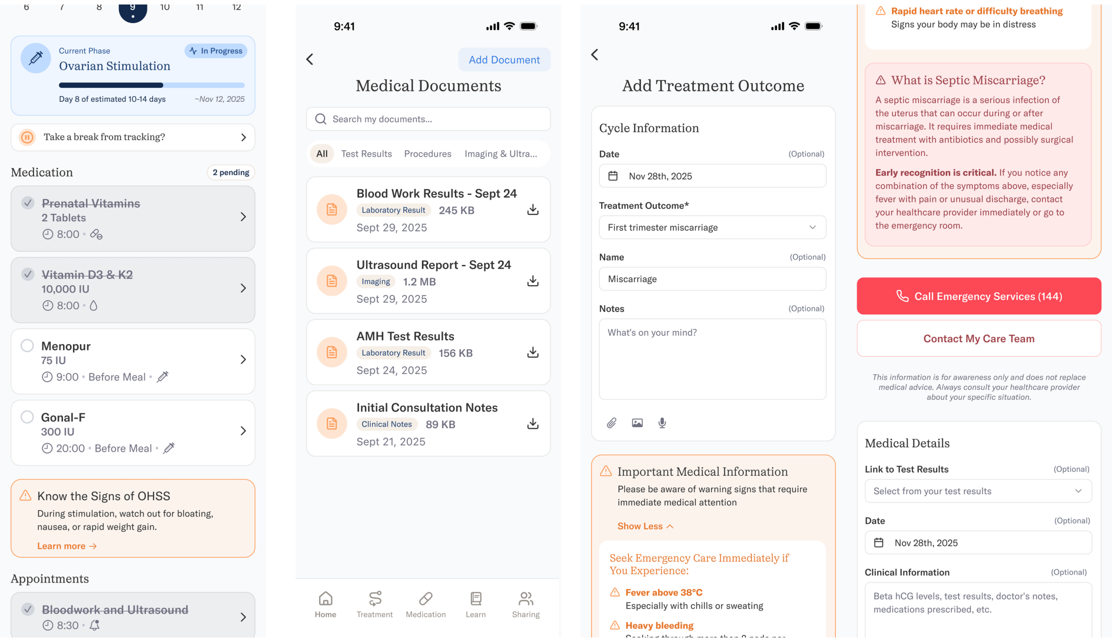
Principle No.2: Reduce Cognitive Load through Integrated Management

Design must consolidate fragmented administrative tasks into a single cohesive system to minimize manual effort and organizational fatigue.

Rationale: ART treatment imposes substantial logistical and administrative demands, often resembling a second full-time job. The mental fatigue arising from juggling multiple tools and communication channels, as well as the manually tracking of medications, appointments, documents, insurance claims, and financial tracking compounded emotional distress and contributed to disengagement. Integrating these functions can alleviate administrative overload, support continuity of care, and free cognitive resources for emotional coping and informed decision-making.

Design Implications:

- Provide centralized medication and appointment management with reminders and visual timelines.
- Support document storage and sharing (e.g., upload, scan, download) to reduce fragmentation between clinics and patients and enable bidirectional sharing between patients, clinics, and laboratories.
- Minimize manual data entry by enabling reuse of existing records where possible and/or improve usability of data entry.
- Include expense tracking to support awareness of financial impact across cycles.
- Prioritize features that address immediate practical needs (e.g., medication timelines), which have demonstrated high adoption due to their tangible utility.
- Include clinic emergency contact information during onboarding and provide quick-access emergency features.
- Support optional geolocation services for emergencies.



Know the Signs of OHSS

During stimulation, watch out for bloating, nausea, or rapid weight gain.

Blood Work Results - Sept 24
Laboratory Result 245 KB
Sept 29, 2025

Ultrasound Report - Sept 24
Imaging 1.2 MB
Sept 29, 2025

AMH Test Results
Laboratory Result 156 KB
Sept 24, 2025

Initial Consultation Notes
Clinical Notes 89 KB
Sept 21, 2025

Cycle Information

Date (Optional): Nov 28th, 2025
Treatment Outcome*: First trimester miscarriage
Name (Optional): Miscarriage
Notes (Optional): What's on your mind?

Important Medical Information

Please be aware of warning signs that require immediate medical attention

Seek Emergency Care Immediately if You Experience:

Fever above 38°C
Especially with chills or sweating

Heavy bleeding

Rapid heart rate or difficulty breathing
Signs your body may be in distress

What is Septic Miscarriage?

A septic miscarriage is a serious infection of the uterus that can occur during or after miscarriage. It requires immediate medical treatment with antibiotics and possibly surgical intervention.

Early recognition is critical. If you notice any combination of the symptoms above, especially fever with pain or unusual discharge, contact your healthcare provider immediately or go to the emergency room.

This information is for awareness only and does not replace medical advice. Always consult your healthcare provider about your specific situation.

Medical Details

Link to Test Results (Optional): Select from your test results
Date (Optional): Nov 28th, 2025
Clinical Information (Optional): Beta hCG levels, test results, doctor's notes, medications prescribed, etc.

Figure 6.10: Example UI of DP2: integrated medication and appointment schedules, document storage and sharing, enhanced data entry (attachments, photos, voice recordings), and quick access to clinic emergency contacts when specific treatment outcomes are entered

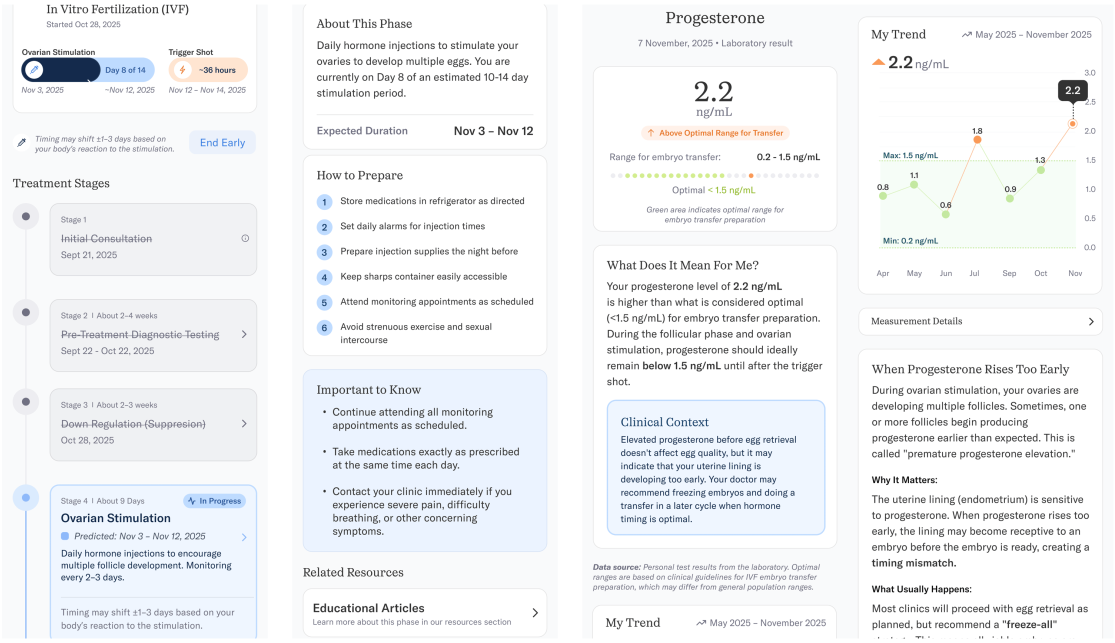
Principle No.3: Facilitate Knowledge through Resources

Systems must support contextualized interpretation of health data through accessible visualizations, plain-language explanations, and anticipatory guidance, rather than presenting isolated medical metrics.

Rationale:
Participants actively sought meaning in their fertility data but frequently felt overwhelmed by medical jargon, fragmented information delivery, and ambiguous test results. Raw metrics rarely provided reassurance on their own, prompting obsessive information seeking and distrust. Providing contextual explanations and just-in-time learning opportunities helps bridge the gap between clinical data and personal understanding, mitigating the distress caused by ambiguity.

Design Implications:

- Present treatment trajectories using clear visual metaphors (e.g., “subway maps” of ART pathways).
- Use accessible visualizations (e.g., dot plots for probabilities, hormone trend graphs over time).
- Provide “on the spot” explanations alongside test results, including glossaries and plain-language summaries.
- Offer evidence-based educational resources (FAQs, instructional videos, fertility/infertility related articles, symptom checkers) that are clinician-approved.
  - Provide anticipatory educational resources describing possible complications and appropriate actions.
  - Implement symptom-based alerts for potentially dangerous conditions (e.g., OHSS, ectopic pregnancy, septic miscarriage).
- Avoid presenting forecasts as deterministic, explicitly communicate uncertainty and variability.
- Support understanding of relationships between symptoms, treatments, timelines, and outcomes rather than displaying isolated metrics.



In Vitro Fertilization (IVF)
Started Oct 28, 2025

Timing may shift ±1–3 days based on your body's reaction to the stimulation.

Treatment Stages

Stage 1
~~Initial Consultation~~
Sept 21, 2025

Stage 2 | About 2–4 weeks
~~Pre-Treatment Diagnostic Testing~~
Sept 22 - Oct 22, 2025

Stage 3 | About 2–3 weeks
~~Down Regulation (Suppresion)~~
Oct 28, 2025

Stage 4 | About 9 Days
In Progress
Ovarian Stimulation
Predicted: Nov 3 – Nov 12, 2025
Daily hormone injections to encourage multiple follicle development. Monitoring every 2–3 days.

Timing may shift ±1–3 days based on your body's reaction to the stimulation.

About This Phase

Daily hormone injections to stimulate your ovaries to develop multiple eggs. You are currently on Day 8 of an estimated 10-14 day stimulation period.

Expected Duration: **Nov 3 – Nov 12**

How to Prepare

1. Store medications in refrigerator as directed
2. Set daily alarms for injection times
3. Prepare injection supplies the night before
4. Keep sharps container easily accessible
5. Attend monitoring appointments as scheduled
6. Avoid strenuous exercise and sexual intercourse

Important to Know

- Continue attending all monitoring appointments as scheduled.
- Take medications exactly as prescribed at the same time each day.
- Contact your clinic immediately if you experience severe pain, difficulty breathing, or other concerning symptoms.

Related Resources

Educational Articles
Learn more about this phase in our resources section

Progesterone
7 November, 2025 • Laboratory result

2.2
ng/mL
Above Optimal Range for Transfer
Range for embryo transfer: **0.2 - 1.5 ng/mL**
Optimal < 1.5 ng/mL
Green area indicates optimal range for embryo transfer preparation

What Does It Mean For Me?

Your progesterone level of **2.2 ng/mL** is higher than what is considered optimal (<1.5 ng/mL) for embryo transfer preparation. During the follicular phase and ovarian stimulation, progesterone should ideally remain **below 1.5 ng/mL** until after the trigger shot.

Clinical Context

Elevated progesterone before egg retrieval doesn't affect egg quality, but it may indicate that your uterine lining is developing too early. Your doctor may recommend freezing embryos and doing a transfer in a later cycle when hormone timing is optimal.

***Data source:** Personal test results from the laboratory. Optimal ranges are based on clinical guidelines for IVF embryo transfer preparation, which may differ from general population ranges.*

My Trend — May 2025 – November 2025

My Trend — May 2025 – November 2025
2.2 ng/mL

Measurement Details

When Progesterone Rises Too Early

During ovarian stimulation, your ovaries are developing multiple follicles. Sometimes, one or more follicles begin producing progesterone earlier than expected. This is called "premature progesterone elevation."

Why It Matters:

The uterine lining (endometrium) is sensitive to progesterone. When progesterone rises too early, the lining may become receptive to an embryo before the embryo is ready, creating a **timing mismatch.**

What Usually Happens:

Most clinics will proceed with egg retrieval as planned, but recommend a **"freeze-all"**

Figure 6.11: Example UI of DP3: clear representation of the treatment timeline, anticipatory guidance on what to expect at specific stages, and personalized interpretation of health data through visualizations

Principle No.4: Prioritize Wellbeing and Prevent Obsessive Tracking

Digital tools shall prioritize mental wellbeing by supporting healthy engagement patterns, emotional regulation, and respectful disengagement from data tracking.

Rationale:

Participants reported that tracking sometimes intensified anxiety and fixation on outcomes, even when it no longer felt beneficial. Without appropriate safeguards, continuous self-monitoring reinforced distress and vulnerability. Supporting wellbeing acknowledges the emotional risks of tracking and enables users to engage with data in ways that align with their changing emotional needs.

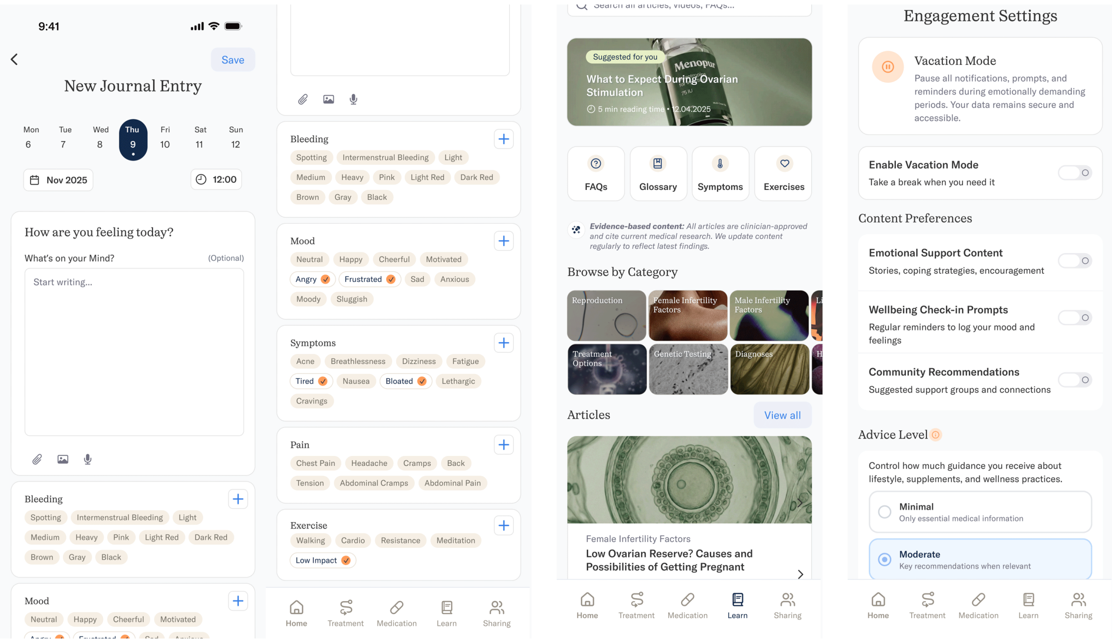
Design Implications:

- Integrate coping tools such as breathing exercises, mindfulness, or CBT-informed techniques tailored to specific moments (e.g., two-week waits).
- Support holistic health through journaling and mood, sleep, and symptom tracking.
- Offer lifestyle guidance focused on actionable, supportive behaviors rather than performance metrics.

  - Provide adjustable “advice modes” to regulate how proactively the system offers guidance.

- Ensure that emotional support features are embedded throughout the experience, not treated as optional add-ons.
  - Allow users to opt in or out of emotional support features and explanatory content.

- Enable respectful disengagement by allowing users to pause or stop tracking without penalty or aggressive re-engagement prompts.



Mood: Angry ✓, Frustrated ✓

Symptoms: Tired ✓, Bloated ✓

Exercise: Low Impact ✓

Evidence-based content: All articles are clinician-approved and cite current medical research. We update content regularly to reflect latest findings.

Vacation Mode
Pause all notifications, prompts, and reminders during emotionally demanding periods. Your data remains secure and accessible.

Enable Vacation Mode — Take a break when you need it ○

Emotional Support Content — Stories, coping strategies, encouragement ○

Wellbeing Check-in Prompts — Regular reminders to log your mood and feelings ○

Community Recommendations — Suggested support groups and connections ○

Control how much guidance you receive about lifestyle, supplements, and wellness practices.

○ Minimal — Only essential medical information

● Moderate — Key recommendations when relevant

Figure 6.12: Example UI of DP4: emotional support tools for tracking multiple metrics and journaling, access to educational resources for wellbeing exercises, and settings that allow disengagement and adjustment of advice preferences

Principle No.5: Support Diverse Life Contexts and Shared Resilience

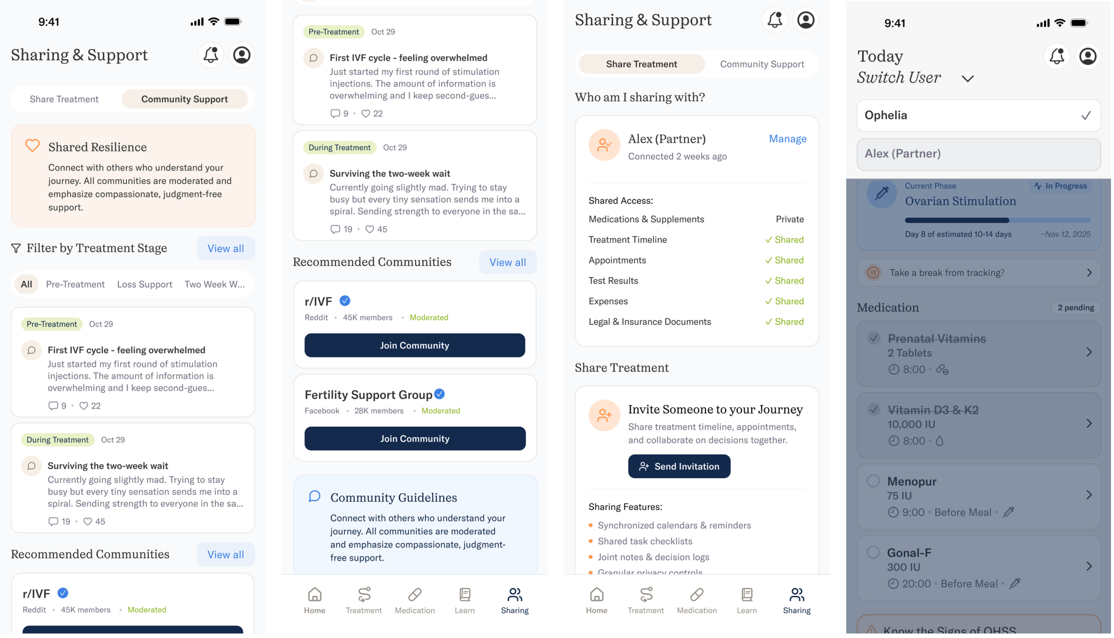
Design must account for external realities of treatment, such as work obligations, financial constraints, gendered labor, and social stigma, by supporting discretion, flexibility, and collaborative engagement. Systems should recognize fertility treatment as a shared journey and enable partners and peers to participate meaningfully in sensemaking and support.

Rationale:
Participants’ experiences were heavily shaped by their socio-economic contexts. Rigid app designs failed shift workers, while the cognitive labor of tracking fell disproportionately

on women, leading to isolation. Joint decision-making and shared access to information were shown to foster empathy and shared resilience, shifting the paradigm from solitary tracking to collaborative management.

Design Implications:

- Provide discreet modes (e.g., coded notifications instead of explicit medication alerts)
- Support synchronized partner accounts, shared calendars, task checklists, and joint notes.
  - Differentiated but interconnected partner experiences through role-sensitive interfaces that can be switched between users.
  - Enable sharing while respecting individual boundaries.
- Include structured, moderated peer spaces for collaborative sensemaking, with optional goal-based filtering by journey stage (e.g., IVF preparation, loss support).
  - Provide pathways to existing peer support networks rather than duplicating established platforms, enabling users to engage in external collaboration.



Shared Resilience
Connect with others who understand your journey. All communities are moderated and emphasize compassionate, judgment-free support.

First IVF cycle - feeling overwhelmed
Just started my first round of stimulation injections. The amount of information is overwhelming and I keep second-gues...

Surviving the two-week wait
Currently going slightly mad. Trying to stay busy but every tiny sensation sends me into a spiral. Sending strength to everyone in the sa...

r/IVF
Reddit • 45K members • Moderated

Fertility Support Group
Facebook • 28K members • Moderated

Community Guidelines
Connect with others who understand your journey. All communities are moderated and emphasize compassionate, judgment-free support.

Who am I sharing with?

Alex (Partner)
Connected 2 weeks ago

Shared Access:

Medications & Supplements	Private
Treatment Timeline	✓ Shared
Appointments	✓ Shared
Test Results	✓ Shared
Expenses	✓ Shared
Legal & Insurance Documents	✓ Shared

Share Treatment

Invite Someone to your Journey
Share treatment timeline, appointments, and collaborate on decisions together.

Sharing Features:
- Synchronized calendars & reminders
- Shared task checklists
- Joint notes & decision logs
- Granular privacy controls

Ophelia ✓
Alex (Partner)

Ovarian Stimulation
Day 8 of estimated 10-14 days ~Nov 12, 2025

Medication
- ~~Prenatal Vitamins~~ 2 Tablets 8:00
- ~~Vitamin D3 & K2~~ 10,000 IU 8:00
- Menopur 75 IU 9:00 • Before Meal
- Gonal-F 300 IU 20:00 • Before Meal

Know the Signs of OHSS

Figure 6.13: Example UI of DP5: support through integrated and externally linked peer groups or forums, along with sharing features that enable partners or other individuals to be invited for collaborative treatment management

Principle No.6: Build Trust through Ethical Data Handling and Privacy

Systems need to move away from intransparent consent models and exploitative monetization strategies toward ethical, user-centered data governance that protects users from emotional harm.

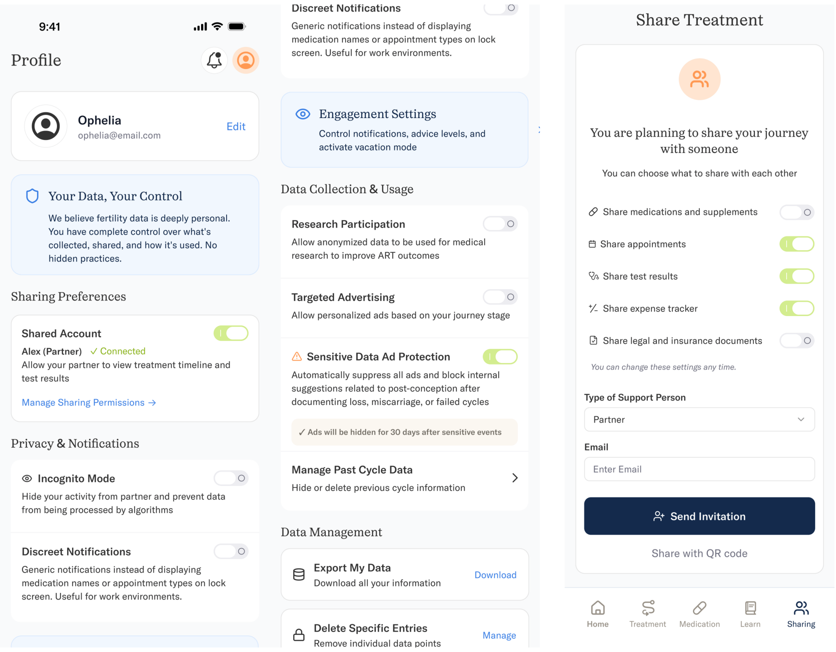
Rationale:

Fertility data is uniquely sensitive. Participants expressed acute fear of their information being leaked and reported active trauma from receiving targeted baby advertisements following a pregnancy loss. This "commercialization of trauma" entirely destroys user trust, making granular privacy controls an absolute ethical imperative for sustained engagement.

Design Implications:

- Allow users to delete specific data points or hide entries from algorithmic processing.
- Clearly communicate how data is used and who has access.
- Provide opt in models for research participation and opt out "incognito" modes.
- Ensure that sensitive entries (e.g., miscarriage or IVF failure) suppress targeted advertising where ads are present.

- Replace “take it or leave it” consent with granular, user-controlled privacy settings.
- Explicit consent before sharing sensitive outcomes with partners.



Profile

Ophelia
ophelia@email.com

Your Data, Your Control

We believe fertility data is deeply personal. You have complete control over what's collected, shared, and how it's used. No hidden practices.

Sharing Preferences

Shared Account ☑
Alex (Partner) ✓ Connected
Allow your partner to view treatment timeline and test results

Manage Sharing Permissions →

Privacy & Notifications

Incognito Mode ☐
Hide your activity from partner and prevent data from being processed by algorithms

Discreet Notifications ☐
Generic notifications instead of displaying medication names or appointment types on lock screen. Useful for work environments.

Engagement Settings

Control notifications, advice levels, and activate vacation mode

Data Collection & Usage

Research Participation ☐
Allow anonymized data to be used for medical research to improve ART outcomes

Targeted Advertising ☐
Allow personalized ads based on your journey stage

Sensitive Data Ad Protection ☑
Automatically suppress all ads and block internal suggestions related to post-conception after documenting loss, miscarriage, or failed cycles

✓ Ads will be hidden for 30 days after sensitive events

Manage Past Cycle Data
Hide or delete previous cycle information

Data Management

Export My Data
Download all your information

Delete Specific Entries
Remove individual data points

Share Treatment

You are planning to share your journey with someone

You can choose what to share with each other

Share medications and supplements ☐
Share appointments ☑
Share test results ☑
Share expense tracker ☑
Share legal and insurance documents ☐

You can change these settings any time.

Type of Support Person
Partner

Email
Enter Email

Send Invitation

Share with QR code

Figure 6.14: Example UI of DP6: Granular, user-controlled settings for data sharing and deletion, and options to suppress advertisements (if applicable)

6.4 Summary

To make the iterative refinement process explicit, Table 6.2 summarizes how feedback from the co-evaluation workshop informed changes to the initial design principles. The table highlights participant inputs and the resulting refinements incorporated into the final principles.

P#	Initial Focus	Co-Evaluation Feedback	Final Principles
P1.	Support setbacks and uncertainty, avoid “happy path” narratives	Users wanted explicit consent before documenting negative outcomes, desire for cycle summaries and adjustable recommendation intensity	Added user-controlled logging of negative outcomes, cycle summaries with contextual explanations, and adjustable recommendation intensity
P2.	Integrated management of medications, appointments, documents, and expenses	Need for emergency clinic access, geolocation support, and bidirectional document sharing with clinics and labs	Extended principle to include emergency contact setup, optional geolocation, and shared document infrastructure across patients and providers
P3.	Contextualized data interpretation and educational resources	Desire for symptom-based warnings and anticipatory guidance on medical risks	Added safety-oriented alerts for critical conditions and resources explaining potential complications and recommended actions
P4.	Prevent obsessive tracking, support emotional regulation and disengagement	Participants requested opt-in/opt-out emotional support and adjustable advice levels	Incorporated flexible engagement controls including emotional support preferences and advice modes
P5.	Partner collaboration and peer support	Suggested role-sensitive partner interfaces and integration with existing online communities	Refined to include differentiated but interconnected partner views and pathways to external peer-support networks
P6.	Privacy, transparency, and user control over sensitive data	Reinforced importance of consent around sharing sensitive outcomes	Strengthened emphasis on granular consent and user-controlled visibility of sensitive information

Table 6.2: Mapping of initial design principles to co-evaluation feedback and resulting refinements.

CHAPTER 7

Discussion

This thesis explored how women experience fertility self-tracking during assisted reproduction and derived design principles from those insights that support, rather than burden, the user. As established in the related work (see Chapter 2), self-tracking in the context of ART deviates considerably from standard cycle tracking, evolving into a demanding engagement due to its high-stakes.
A synthesis of the findings of Chapters 4, 5, and 6 further illustrates the critical disconnect between the design of current mHealth technologies and the unpredictable and emotionally complex nature of ART. Consequently, these applications frequently generate invisible labor and inflict unintended emotional harm to those patients whose fertility journeys do not align with normative expectations.

This chapter interprets the broader implications of these results for HCI and mHealth, by systematically addressing the research questions and evaluating the accompanying hypotheses. Finally, it examines ethical implications surrounding the collection, storage, and utilization of patient data and the commercialization of trauma, and concludes with a discussion of the study's methodological limitations.

7.1 Research Questions

This section directly answers the three research questions and their corresponding hypotheses, and goes into detail of the diverse nature of data tracking, the misalignment of current designs, and the socio-cultural contexts that shape patient experiences.

7.1.1 Data is Never Neutral (RQ1, H2)

A central premise of the *Quantified Self* movement is that data tracking empowers the user. However, this research reveals that in the context of ART, tracking is frequently experienced as a burdensome "second full-time job", challenging the fundamentally optimistic and optimization-driven narratives found in self-tracking literature [16, 11]. These findings reinforce previous work on fertility tracking [124, 17], emphasizing that mHealth technologies will need to move beyond merely digitizing clinical schedules and instead provide holistic support to patients through access to educational, relational, and psychological support mechanisms to help patients endure the trauma and uncertainty of treatment.

RQ1. How do women engage in fertility self-tracking, and what challenges do they encounter?

In answering RQ1, the data shows that tracking during ART treatment is distinct from standard fertility tracking. It is performed at a higher intensity of tracking, characterized by redundancy, and includes unique logistical challenges. Due to the clinical complexity and profound uncertainty, fertility self-tracking often emerges as a patient strategy. The interview data suggests that this practice is frequently an attempt to assist in regaining a sense of control and understanding over a process that can feel overwhelming and opaque.

Existing apps (Chapter 4) lack interoperability with clinical systems and patients are forced to act as “data entry clerks” for their own medical histories and test results. To ensure that all requirements of the treatment protocols are met, women create a redundant safety net of tools, utilizing a mix of mobile apps, digital calendars, and physical checklists, rather than depending upon a single method for data tracking. They track not only standard menstruation dates, but also medical and logistical aspects of their reproductive treatment, including injection schedules, appointments, laboratory test results, and subjectively reported states (mood, physical symptoms) to feel more in control of the situation. This high-stakes routine involving phone alarms, calendar entries, and physical pieces of paper for ticking off daily tasks, creates an immense cognitive load. This aligns with findings by Hamper [131] regarding women’s “conceptive fertility work”, highlighting a critical failure in the current digital health ecosystem, in which technology is adding to the work of treatment rather than alleviating it.

This finding directly necessitates **Principle No.2 “Reduce Cognitive Load through Integrated Management”** (see Section 6.3), which advocates for centralized administration and the bidirectional sharing of documents to eliminate this redundant, manual labor.

H2. Engagement with fertility self-tracking technologies affects users’ emotional wellbeing and self-perception, with design features potentially contributing to both positive and negative experiences.

This hypothesis postulates that engagement with tracking affects emotional wellbeing. The findings confirm that the desire for knowledge and control often becomes counterproductive, as the very data meant to empower are at times, the source of challenges and frustration.

On the one hand, tracking provides **positive agency**. In a medical process defined by chaos, data offers a mechanism for control. Users reported that tracking specific physical markers strengthened their self-concept and fostered a sense of competency regarding their bodies. Specifically in the cultural probes study, the participants' interactions with their own fertility data, gathered from tracking apps, laboratory results, and clinic reports, were often a complex and contradictory experience. The data provided the individuals with sense of control over their body while also inducing considerable emotional distress.

On the other hand, the data are a source of empowerment and at the same time a driver of acute anxiety. This engagement frequently shifts into a **negative impact**. The research found a phenomenon of high information, high anxiety. Many users feel highly informed by their data but in parallel experience maximum levels of anxiety. Anxiety is often rated at 10/10 despite feeling fully informed, noting that while the data are viewed as accurate, the process makes them feel unheard. Moreover, many users dislike their bodies after comparing their data to the standardized expectations of mainstream apps. These normative presumptions highlight that their bodies did not follow a routine or did what it should. For many, the negative impact was so acute that they deliberately abandoned tracking natural cycles once IVF began and for fear of further damaging their mental health. This corroborates existing HCI literature [124] which warns that rigid tracking architectures can transform empowering self-knowledge into detrimental obsessive behaviors.
This volatile emotional tension is the foundation for **Principle No.4 "Prioritize Well-being and Prevent Obsessive Tracking"**, which demands features like "respectful disengagement" (allowing users to pause tracking without penalty) and integrated coping tools to manage the anxiety induced by constant data exposure (see Section 6.3).

It is worth noting that not all users internalize the design, as some view the tools purely functionally. Occasionally, the design did not influence the users' self-perception as the tools were viewed as simply a means to store and collect data. This observation suggests that the emotional impact of ART may be substantially lower in cases where infertility is not present. This finding aligns with existing evidence (see Section 2.1.3) indicating that individuals such as egg donors, who undergo ART procedures without an infertility diagnosis, tend to experience fewer psychological challenges during treatment.

7.1.2 Misalignment with ART Realities (RQ2)

In addressing RQ2, the findings expose a severe misalignment. The most significant flaw in commercial fertility apps is the prevalence of the "happy path" design bias.

RQ2. How does the design of existing fertility technologies align or conflict with women's lived realities during ART treatment?

As detailed in Chapter 4, the majority of commercially available apps operate on the presumption of a linear journey concluding in a live birth. However, this design choice contrasts directly with the medical reality of ART, where success rates per cycle are often below 50%, and the user journey is frequently brought to a halt by cancellations, intentional pauses, and loss.

When technology fails to account for non-linear journeys, it does not merely fail functionally, it inflicts emotional harm. For women undergoing fertility treatments, the design of mainstream apps often create a dissonance between the user's reality (complex histories and specific treatment phases) and the app's natural conception model, leading to negative self-worth and a sense of alienation. The erasure of non-normative outcomes (i.e., miscarriage or ectopic pregnancy) validates the critique in related work (see Section 2.3) that such design choices exacerbate psychosocial distress. By designing exclusively for the "ideal" user who conceives naturally or quickly, current tools inadvertently stigmatize the ART patient, framing their medical reality as a system error rather than a valid user journey. This builds upon critiques by Andalibi [138] and Figueiredo et al. [114], who have documented how normative designs marginalize users experiencing adverse outcomes, making those on more complex journeys feel unseen and alienated.

In addition, many users reported they were subjected to "toxic positivity" through automated messages in these apps. While undergoing painful medical procedures or experiencing pregnancy loss, users expressed deep aggravation at receiving cheerful (*"cutesy"*), condescending notifications from their apps. A major source of trauma, was the inability of apps to sensitively handle failure, often continuing to push pregnancy-related content after a miscarriage, making users feel alienated by the very tools meant to support them. These specific harms are used to define the primary directives for **Principle No.1 "Design for ART-Specific, Complex, and Non-Linear Journeys"** (see Section 6.3), which instructs that systems should model trajectories in cycles, avoid patronizing language, and provide safe, user-controlled ways to document or record negative outcomes without triggering a functional "hard reset" of the app.

7.1.3 Rejection of False Reassurance: Trust and Anticipatory Guidance (RQ3, H1)

A major subject emerging from the research is the management of ambiguity in medical data. In answering RQ3, the data shows that users reject false reassurances. High success probabilities (e.g., 99% success) offer no solace when outcomes fail, especially when patients perceive themselves to be in the 1%. Instead, this exacerbates the pain of falling on the wrong side of statistics.

RQ3. How is the communication of uncertainty in fertility tracking experienced, and what does this imply for the design of fertility self-tracking technologies?

The majority of participants were in favor of **receiving hard facts**. These participants, many of whom possess higher levels of health literacy, overwhelmingly rejected design choices that attempted to soften the impact of uncertainty. They explicitly requested raw data along with proper scientific information, and the complete picture rather than an over-simplified and overly optimistic summary.

When clinics or apps present ambiguous or inconsistent data, it causes users to seek out **advanced interpretation and independent research**. Overwhelmed by medical terminology and under pressure to rapidly make life-changing medical decisions, users refuse to passively accept uncertainty. They turn toward additional tools, including artificial intelligence (e.g., ChatGPT) to assist them in interpreting complex fertility data and regaining a sense of understanding. This reflects broader discussions in critical digital health literature [86, 122] regarding how patients must actively merge fragmented data to manage medical ambiguity.
This directly supports the first hypothesis, which stated that the communication of uncertainty influences trust and decision-making.

H1. The way uncertainty is communicated in fertility self-tracking technologies influences users' trust, engagement, and decision-making. Appropriate visualization and explanatory design strategies may help to mitigate these effects.

The interviews with physicians revealed a critical gap that patients have access to data (via portals or apps) but lack interpretation. When apps present deterministic probabilities (e.g., 80% change of conception), they set false expectations. When the patients' expectations regarding success predictions fall through, trust in the overall fertility process diminishes. Similarly, when clinics provide inconsistent information across treatment cycles or when patients cannot determine how their clinics treat results from genetic testing, patients lose trust in their providers. The patients' accounts emphasize that a lack of clear, consistent, and comprehensive communication can directly erode patient trust with their fertility specialists.

The finding from the cultural probes emphasized that when patients felt confident understanding symptoms, the *why* of certain procedures, and interpreting basic data, their overall sense of wellbeing improved. Clear and intuitive visualizations, as well as comprehensive instructions, and accessible information and educational content, therefore, played a crucial role in how individuals perceived their fertility journey.

The Co-Evaluation Workshop (Chapter 6) demonstrated that users prefer "anticipatory guidance", knowing exactly what might go wrong (e.g., OHSS symptoms), over precise but unreliable probability scores. This confirms that transparency about the limitations of the available data is far more valuable to users than the illusion of precision, forming the basis of **Principle No.3 "Facilitate Knowledge through Resources"** (see Section 6.3). Design can help users in navigating uncertainty while maintaining their confidence in the process by providing symptom-based alerts or interpretive information that is relevant to the context of the user's journey instead of deterministic predictions.

7.1.4 Socio-Cultural Contexts and the Solitary Burden (H3)

H3 argued that socio-cultural contexts, personal values, and relationship dynamics affect the tracking of fertility data. The findings support this hypothesis, as these factors define how health data is experienced by the individual, in contrast to the common "one-size-fits-all" approach adopted by most Femtech apps.

H3. Users' experiences of fertility data and self-tracking technologies are shaped by socio-cultural context, personal values, and relational dynamics (including partner involvement), and these factors should be explicitly considered in the design of fertility tracking systems.

The Impact of Socio-Economic Status and Work
User research (Chapter 5) has shown that educational background and employment conditions have an enormous influence on the person's data perception. Participants with advanced academic backgrounds (e.g., PhDs) noted that their training in reading research papers affected how they interpreted the data from the clinics. In particular, they expressed frustration when details were withheld by the clinics and demanded appropriate science-based information to make assessments of reliability themselves as opposed to receiving simplified summaries. On the contrary, the data suggests that users without strong scientific backgrounds and orientation struggle to interpret clinic results at a glance, therefore, the design of current systems fails to accommodate diverse health literacy levels.

Furthermore, the logistical demands of tracking are heavily influenced by perceived socio-economic status (class) and profession. Middle and upper middle class participants were often able to utilize workplace fertility policies, reduce working hours, or completely stop working to manage the logistics of treatments. Conversely, participants in shift work or service industries endure extreme levels of stress, describing standard tracking metrics were impossible to maintain, and injecting medication logistically hazardous (e.g., restaurant floors). These realities directly inform **Principle No.5 "Support Diverse Life Contexts and Shared Resilience"**, specifically the requirement for "discreet modes" (e.g., coded notifications) that protect users in inflexible or public workplace environments (see Section 6.3).

Tracking as a Solitary, Gendered Burden
Despite marketing claims of "partner sync" features in commercial apps, the research found that the actual work of data tracking remains an asymmetrical, gendered burden.

Even in supportive relationships, the woman acts as the project manager. Despite certain women sharing information with their partners, the cognitive load of tracking, scheduling, and app engagement falls entirely on the female partner. This reflects work by Hamper [131], which demonstrates that digital tools often digitize, rather than disrupt, traditional gender roles in healthcare.

Furthermore, these accounts illustrate that when the burden is not shared, it can expose or create a divide in understanding and shared responsibility within the relationship. While partner support is described as beneficial for the relationship, it is unclear whether simply giving a partner *access* to an app improves emotional wellbeing. Instead, true shared resilience requires redesigning tools to *actively* distribute the logistical labor. Even though not directly measured in the small cultural probes study, the couple's shared understanding and experiences highlight a crucial dimension of self-tracking that could lead to a more resilient approach to the challenges of assisted reproduction.

This insight is operationalized in **Principle No.5** through the recommendation of "synchronized partner accounts" and "shared task checklists" designed to shift the interaction paradigm from self-tracking to co-tracking (see Section 6.3).

7.2 Ethical Implications: Privacy and the Commercialization of Trauma

Finally, the research highlighted severe ethical concerns regarding data privacy. While some users viewed their utilized apps as purely functionally, many expressed acute fear that their intimate health data was being shared without consent or monetized.

There is a growing concern with regard to the commercialization of trauma. Participants recounted experiences that apps profited from their data (e.g., sending targeted advertisements for baby products immediately following a miscarriage). This demonstrate a fundamental lack of duty of care within the commercial Femtech market. The "inverse privacy", where companies know more about the user's reproductive status than the user controls, destroys the consumer's confidence in the service provider entirely. These findings strongly support recent research on Femtech applications [147, 170, 171, 146, 115], which highlight the predatory data practices surrounding reproductive vulnerabilities. This discovery defines the final **Principle No.6 "Build Trust through Ethical Data Handling and Privacy"**(see Section 6.3) that granular privacy controls and the immediate suppression of targeted advertising during negative outcomes are not merely desirable optional features, but absolute necessary and obligatory elements for future digital health design.

7.3 Limitations

Despite this thesis presenting valuable knowledge regarding the lived experiences of women who use fertility tracking apps during ART treatment, several methodological limitations must be acknowledged when interpreting these results.

7.3.1 Sample Size and Demographics

Rather than prioritizing statistically representative data, qualitative research methods explore in-depth, unique situations and gain a deeper understanding of the underlying meanings and values, however, the sample size of the user research phases was very limited. The cultural probe study, while providing a wealth of information, involved only two participants (one couple). Therefore, the findings obtained through their personal experiences place limits on how widely the results can be generalized to the broader population of individuals undergoing ART treatments. The experiences documented may not reflect the full spectrum of fertility journeys, particularly those with different medical diagnoses or treatment outcomes not represented in this specific group.

Furthermore, the semi-structured interview ART patient cohort was predominantly female, out of 12 interviewees, only one was male. While the disproportionately high levels of physical and logistical labor that women experience during ART is accurately represented, the study's ability to collect the distinct experiences and unmet digital needs of male partners has been scarce. Although the thesis argues for partner involvement and shared resilience, the data driving these principles is derived primarily from the female experience.

Additionally, the participants were largely highly educated and employed. They likely possess higher health and digital literacy than the general population, as their ability to "google everything" and articulate complex needs may not reflect the challenges faced by individuals from different socio-economic backgrounds.

Moreover, all of the participants for the study resided within a unique geographic and socio-cultural area of Austria and Central Europe. The experiences of undergoing ART may vary greatly from one country to another based on their respective national healthcare systems, economic support for infertility treatment, and cultural stigmas surrounding infertility. For this reason, the study's findings may not be fully translatable to regions with vastly different healthcare infrastructures, wherein these frameworks are largely privatized, such as the United States.

7.3.2 Researcher Bias and Methodological Constraints

The sensitive and private nature of the subject of infertility required the use of strict privacy measures for the semi-structured interviews, therefore, no audio or video recordings were made. Consequently, the analyses relied on detailed handwritten notes taken during the interview sessions. Despite allowing the participants to feel comfortable sharing their very vulnerable, personal, and often painful experiences of infertility, it introduces the risk of recall bias. Without having access to verbatim transcripts of the interviews, some of the subtleties in participants' language that would have otherwise been captured in their words, may have been lost and the filtering of information as it happened, could have introduced my own subjective interpretation of determining what was the most relevant data to record.

Within this thesis, the cultural probes proved to be a valuable method for getting a sense of the participants' experiences and needs. The self-documentation provided insight into deeply personal aspects of their emotional, relational, and financial challenges, as well as their overall ART journey, as described in detail in Section 5.1. These honest and concrete accounts of their perceptions presented a depth of understanding that may not have been achievable through, for instance, observational methods alone. Moreover, the cultural probes enabled me to actively involve participants in the research process and provided them an opportunity to engage with an analogue representation of a feature that may be incorporated into an ART support mHealth app.

The cultural probes were designed to collect visual data on participants' behaviors, individuals did not take photographs during the study and although participants supplied a wealth of information through their written reflections on their circumstances, no photos were captured on their smartphones during the study. A disposable camera was deliberately excluded from the probes kit to avoid imposing additional burden on participants (e.g., remembering to bring the camera to appointments). However, this choice eliminated the possibility of collecting visual evidence of participants' daily habits. The information collected from this research phase was based on written responses (journal entries). Thus, non-verbal aspects of the treatment environment could have informed more specific design decisions regarding the physical context of app usage. In retrospect, including a camera in future studies may encourage visual documentation and support alternative forms of participant expression.

7.3.3 Participation Bias

The recruitment process to find participants for this study heavily relied on personal connections and online platforms. This utilized strategy may have introduced bias regarding who volunteered to share their stories.

Individuals who are willing to document their emotional journey related to their infertility through the use of cultural probes, are most likely highly engaged patients. These may also represent a subset of users who experienced difficult and stressful ART treatment cycles. Therefore, those who are willing to document their disappointment with existing clinical and digital support systems are actively seeking an outlet to voice their dissatisfaction.

Individuals who agree to discuss their sensitive issues such as their experiences with infertility in an interview setting may have developed different coping strategies or varying levels of willingness to openly communicate their feelings compared to those individuals who are more isolated. As such, the results of the study may provide an overemphasized representation of the desire of users to share and connect, possibly at the expense of the needs of those users who prefer complete privacy and total isolation from others.

As a consequence, the findings may provide an exaggerated picture of the potential psychological harm associated with using fertility tracking technology, while simultaneously providing an underrepresentation of those patients whose fertility treatments were rapid, successful, or those patients who view fertility tracking as simply a simple, functional task.

7.3.4 Scope of the Evaluations

The existing scientific and commercial mHealth apps that were reviewed as part of my methodology were digital tools that were available at the time of the research. Given the fast iterations of development of mobile apps, the specific features critiqued ("happy path") in this study are likely to evolve.

The final phase involved a co-evaluation workshop where participants discussed and reflected on the design principles. This was a session that provided feedback and validation based on UI mockups, not a study of a functional prototype. The co-evaluation workshop demonstrated that the participants understood and valued the concepts, but does not demonstrate whether the proposed designs will be effective over time in improving their fertility journey in a clinically stressful environment. The actual psychological effect of features such as "pause tracking" or "sensitive data advertising protection" has yet to be proven through testing in an operational environment with a working prototype.

CHAPTER 8

Conclusion

The primary objective of this thesis was to understand the experiences of women and couples who utilize fertility self-tracking to manage their ART treatments, and to apply UCD methods to create mHealth technologies that are more supportive of individuals using these tools.

The process of collecting and interpreting fertility data is inherently burdensome. Unlike the management of chronic conditions, which often involves long-term maintenance, this type of fertility tracking is characterized by a singular, discrete goal, achieving pregnancy, within a relatively narrow and highly time-sensitive window. Crucially, despite diligent tracking, the desired outcome is never guaranteed. This inherent unpredictability in fertility care creates a profound tension, a paradox of control in uncertainty. Self-tracking in this domain is frequently adopted by individuals seeking to gain a sense of agency and control over what is, at its core, an uncertain biological process. It promises empowerment, provides unprecedented convenience and better access to personalized data, enables informed decision-making, and is perceived as a means to increase one's sense of control.

Simultaneously, the research identifies many considerable challenges and persistent frictions. In fact, the very "solution" (self-tracking) can inadvertently become a central part of the "problem" (the emotional burden), particularly when the data generated by self-tracking cannot fully resolve or predict inherent biological uncertainties. Through a multi-method qualitative approach, this thesis revealed that fertility tracking often devolves into a "second full-time job", that causes a considerable amount of cognitive and emotional load. This is further compounded by the fact that the logistical labor of tracking is disproportionately carried by women, pointing to a critical gap in true partner integration.

Furthermore, the design of current Femtech applications often ignores the aforementioned emotional labor of fertility-related health journeys, creating a critical disconnect between patient experience and clinical understanding. Additionally, they frequently increase the psychological burden associated with infertility because they follow a “happy path” bias which assumes that all treatments and procedures will be successful, therefore not only failing to account for the substantial emotional and medical challenges inherent in medically assisted reproduction but also creating emotional harm (e.g., by targeting baby advertisements directly after a miscarriage). Moreover, the communication of deterministic probabilities by fertility specialists and within these fertility tracking apps creates a false sense of certainty that ultimately erodes patient trust in the event that treatments do not produce anticipated results. Instead of artificial reassurances, users strongly prefer anticipatory guidance and objective facts presented in a contextual manner.

To remedy these systemic failures, the main contribution of this thesis is the derivation of six user-validated design principles that substantially transform fertility tracking from a solely biological and medical, data-driven optimization task into an experience-sensitive practice. These practical guidelines provide an essential framework for:

- Designing non-linear treatment paths for ART patients.
- Decreasing cognitive load through integrated management.
- Facilitating contextualized knowledge.
- Addressing emotional wellbeing as a priority.
- Supporting couples to develop shared resilience in their struggle to conceive.
- Governing data ethically with strong privacy protections.

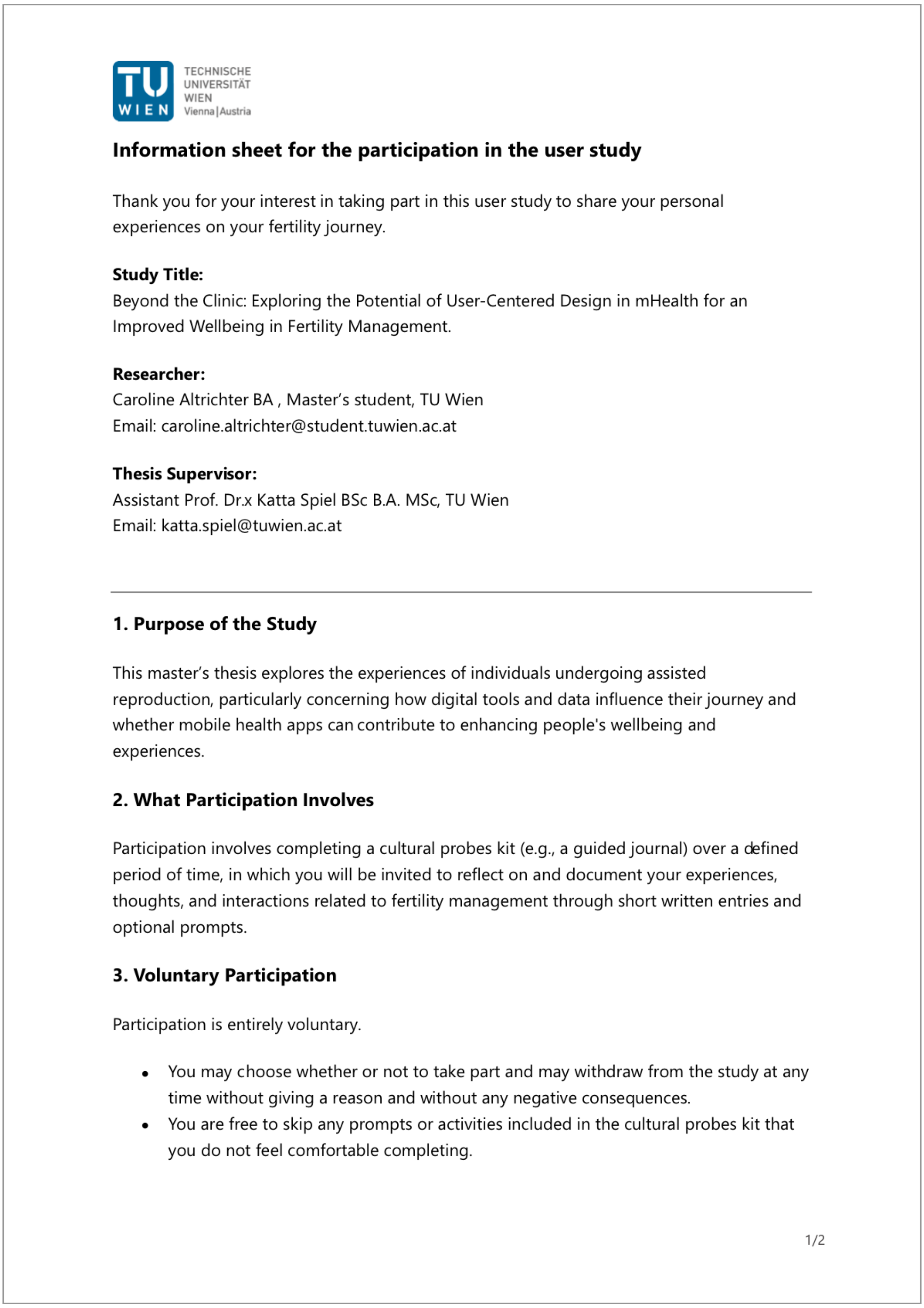
Building upon these principles, future research and application development must also be directed at male-inclusive design and interconnected couple interfaces to equitably distribute the logistical and emotional labor of conception among both partners. In addition, there also exists the urgent need to investigate the interoperability of these digital tools with existing clinical infrastructures.

In conclusion, navigating through the journey of assisted reproduction is as much a test for emotional endurance as it is a medical procedure. Consequently, this thesis emphasizes the importance of integrating UCD in reproductive mHealth applications to address the problems they generate. The technologies we build must accurately reflect the complexity of the people who use them and set an example for empathy-driven HCI. In this regard, a fertility tracking tool must serve the user at their most vulnerable. Therefore, its architecture must provide a supportive environment, regardless of the outcome, whether normative or otherwise. It is essential to design for the *Qualified Self*, ensuring technology serves the human, not simply the dataset. In addition, when designing future Femtech applications, prioritizing compassion, transparency, and inclusivity over procedural efficiency and profit maximization can enable the creation of digital tools that serve as genuine pillars of support and allow individuals to navigate the profound uncertainty of assisted reproduction with dignity and resilience.

APPENDIX A

User Study Consent Forms

A.1 Cultural Probes Consent Form



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Information sheet for the participation in the user study

Thank you for your interest in taking part in this user study to share your personal experiences on your fertility journey.

Study Title:
Beyond the Clinic: Exploring the Potential of User-Centered Design in mHealth for an Improved Wellbeing in Fertility Management.

Researcher:
Caroline Altrichter BA , Master's student, TU Wien
Email: caroline.altrichter@student.tuwien.ac.at

Thesis Supervisor:
Assistant Prof. Dr.x Katta Spiel BSc B.A. MSc, TU Wien
Email: katta.spiel@tuwien.ac.at

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1. Purpose of the Study

This master's thesis explores the experiences of individuals undergoing assisted reproduction, particularly concerning how digital tools and data influence their journey and whether mobile health apps can contribute to enhancing people's wellbeing and experiences.

2. What Participation Involves

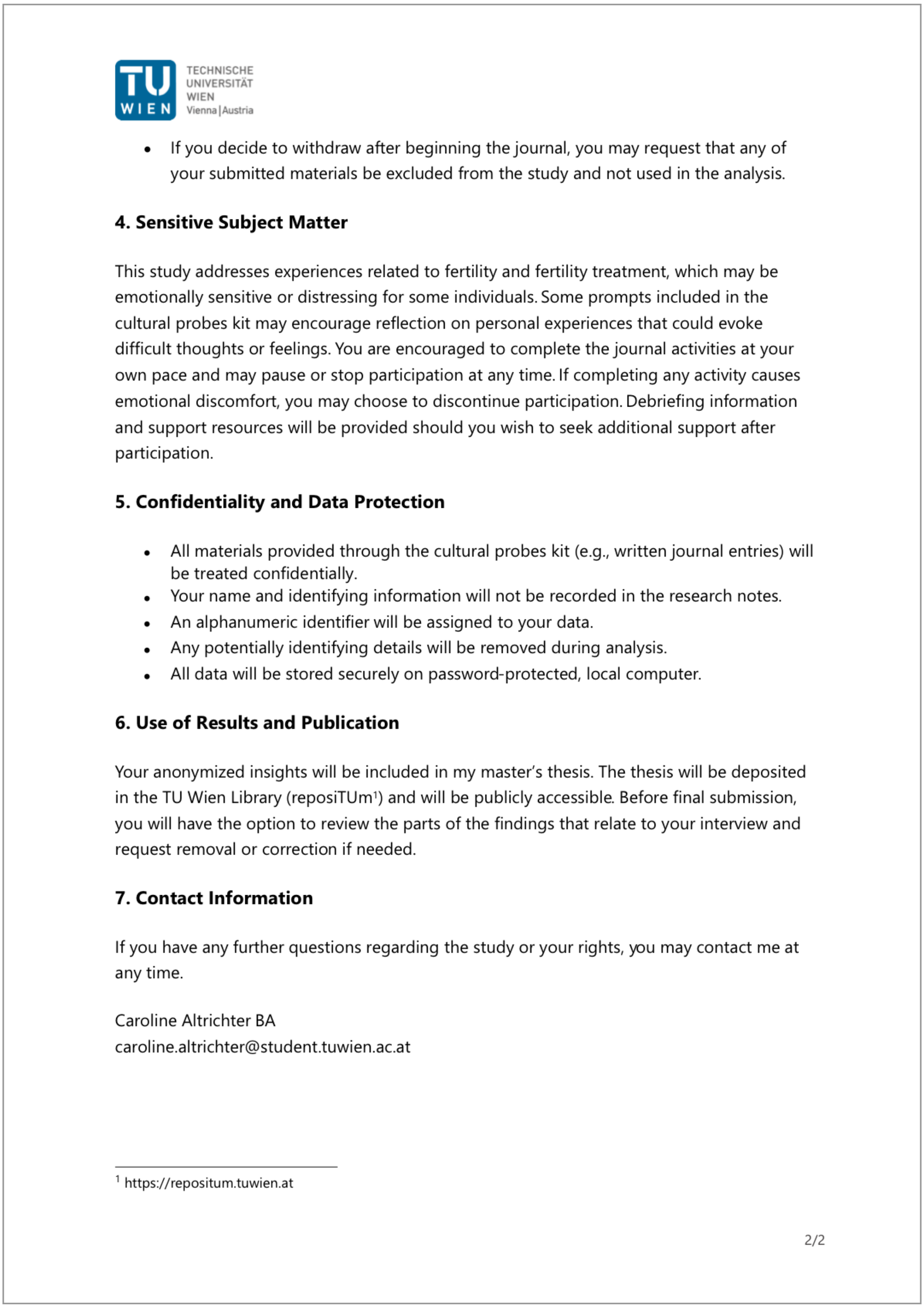
Participation involves completing a cultural probes kit (e.g., a guided journal) over a defined period of time, in which you will be invited to reflect on and document your experiences, thoughts, and interactions related to fertility management through short written entries and optional prompts.

3. Voluntary Participation

Participation is entirely voluntary.

- You may choose whether or not to take part and may withdraw from the study at any time without giving a reason and without any negative consequences.
- You are free to skip any prompts or activities included in the cultural probes kit that you do not feel comfortable completing.

1/2



- If you decide to withdraw after beginning the journal, you may request that any of your submitted materials be excluded from the study and not used in the analysis.

4. Sensitive Subject Matter

This study addresses experiences related to fertility and fertility treatment, which may be emotionally sensitive or distressing for some individuals. Some prompts included in the cultural probes kit may encourage reflection on personal experiences that could evoke difficult thoughts or feelings. You are encouraged to complete the journal activities at your own pace and may pause or stop participation at any time. If completing any activity causes emotional discomfort, you may choose to discontinue participation. Debriefing information and support resources will be provided should you wish to seek additional support after participation.

5. Confidentiality and Data Protection

- All materials provided through the cultural probes kit (e.g., written journal entries) will be treated confidentially.
- Your name and identifying information will not be recorded in the research notes.
- An alphanumeric identifier will be assigned to your data.
- Any potentially identifying details will be removed during analysis.
- All data will be stored securely on password-protected, local computer.

6. Use of Results and Publication

Your anonymized insights will be included in my master's thesis. The thesis will be deposited in the TU Wien Library (reposiTUm[1]) and will be publicly accessible. Before final submission, you will have the option to review the parts of the findings that relate to your interview and request removal or correction if needed.

7. Contact Information

If you have any further questions regarding the study or your rights, you may contact me at any time.

Caroline Altrichter BA
caroline.altrichter@student.tuwien.ac.at

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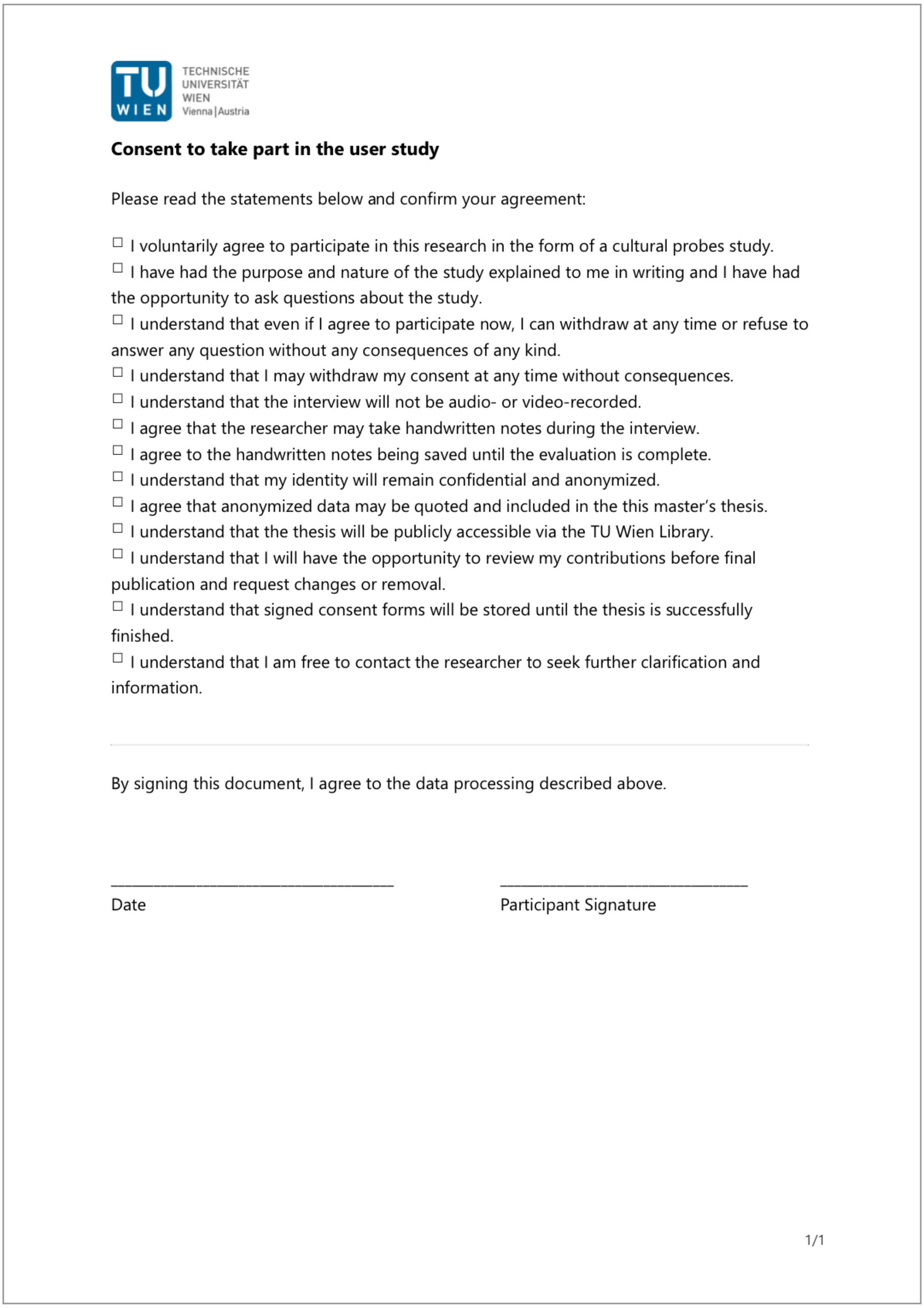
[1] https://repositum.tuwien.at



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Consent to take part in the user study

Please read the statements below and confirm your agreement:

☐ I voluntarily agree to participate in this research in the form of a cultural probes study.
☐ I have had the purpose and nature of the study explained to me in writing and I have had the opportunity to ask questions about the study.
☐ I understand that even if I agree to participate now, I can withdraw at any time or refuse to answer any question without any consequences of any kind.
☐ I understand that I may withdraw my consent at any time without consequences.
☐ I understand that the interview will not be audio- or video-recorded.
☐ I agree that the researcher may take handwritten notes during the interview.
☐ I agree to the handwritten notes being saved until the evaluation is complete.
☐ I understand that my identity will remain confidential and anonymized.
☐ I agree that anonymized data may be quoted and included in the this master's thesis.
☐ I understand that the thesis will be publicly accessible via the TU Wien Library.
☐ I understand that I will have the opportunity to review my contributions before final publication and request changes or removal.
☐ I understand that signed consent forms will be stored until the thesis is successfully finished.
☐ I understand that I am free to contact the researcher to seek further clarification and information.

By signing this document, I agree to the data processing described above.

______________________________	______________________________
Date	Participant Signature

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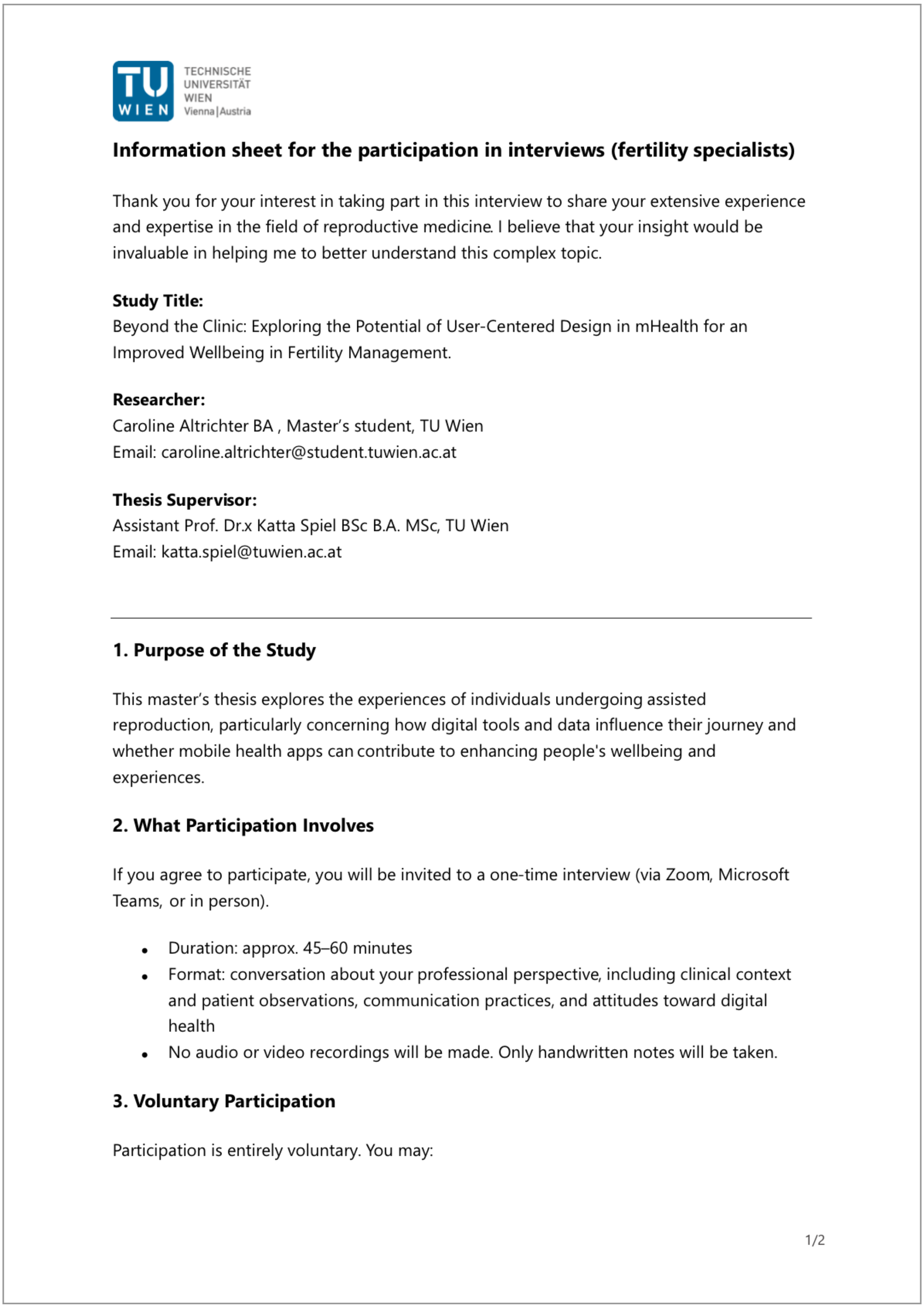
A.2 Semi-Structured Interviews Consent Form



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Information sheet for the participation in interviews (fertility specialists)

Thank you for your interest in taking part in this interview to share your extensive experience and expertise in the field of reproductive medicine. I believe that your insight would be invaluable in helping me to better understand this complex topic.

Study Title:
Beyond the Clinic: Exploring the Potential of User-Centered Design in mHealth for an Improved Wellbeing in Fertility Management.

Researcher:
Caroline Altrichter BA , Master’s student, TU Wien
Email: caroline.altrichter@student.tuwien.ac.at

Thesis Supervisor:
Assistant Prof. Dr.x Katta Spiel BSc B.A. MSc, TU Wien
Email: katta.spiel@tuwien.ac.at

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1. Purpose of the Study

This master’s thesis explores the experiences of individuals undergoing assisted reproduction, particularly concerning how digital tools and data influence their journey and whether mobile health apps can contribute to enhancing people's wellbeing and experiences.

2. What Participation Involves

If you agree to participate, you will be invited to a one-time interview (via Zoom, Microsoft Teams, or in person).

- Duration: approx. 45–60 minutes
- Format: conversation about your professional perspective, including clinical context and patient observations, communication practices, and attitudes toward digital health
- No audio or video recordings will be made. Only handwritten notes will be taken.

3. Voluntary Participation

Participation is entirely voluntary. You may:

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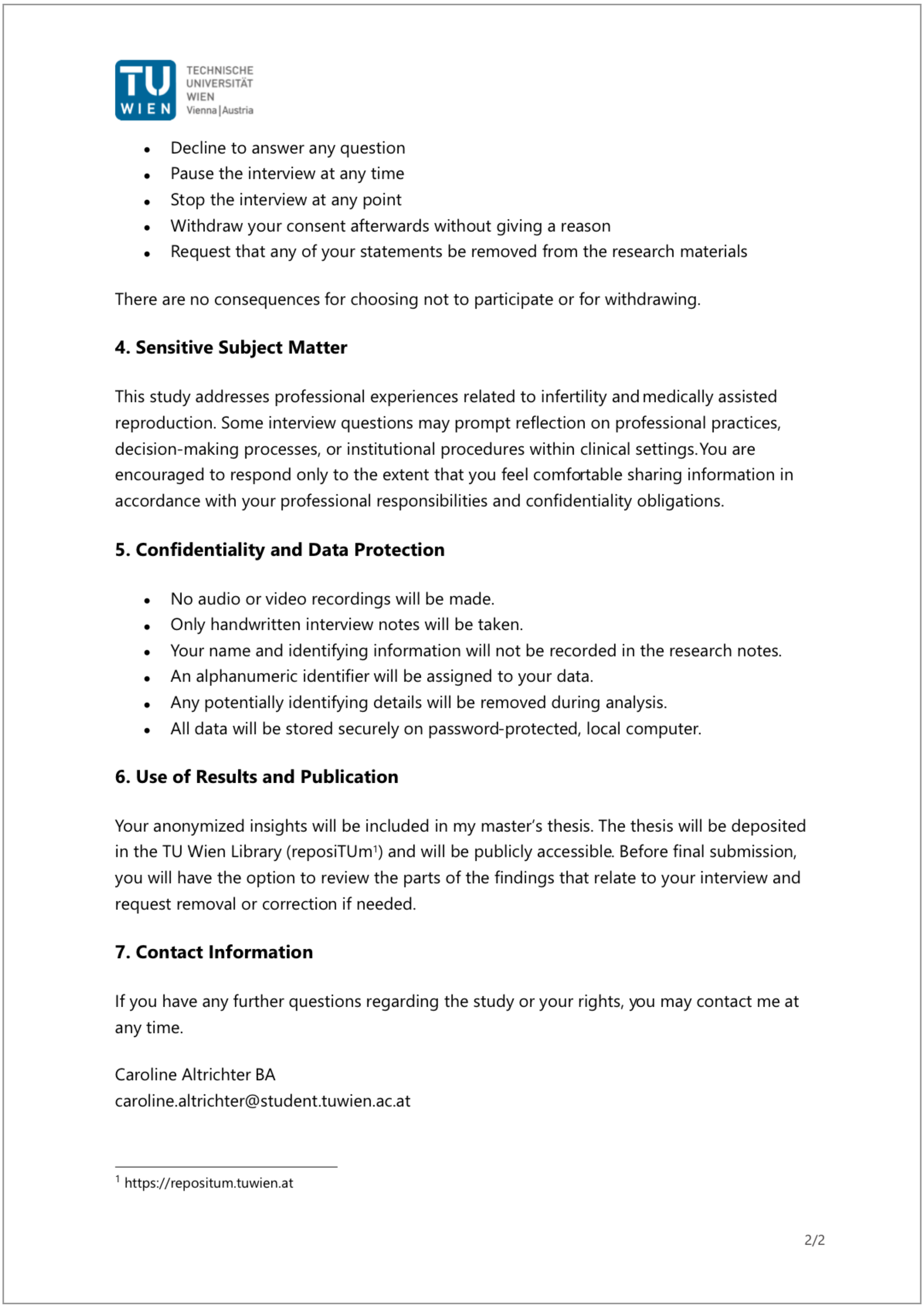

- Decline to answer any question
- Pause the interview at any time
- Stop the interview at any point
- Withdraw your consent afterwards without giving a reason
- Request that any of your statements be removed from the research materials

There are no consequences for choosing not to participate or for withdrawing.

4. Sensitive Subject Matter

This study addresses professional experiences related to infertility and medically assisted reproduction. Some interview questions may prompt reflection on professional practices, decision-making processes, or institutional procedures within clinical settings. You are encouraged to respond only to the extent that you feel comfortable sharing information in accordance with your professional responsibilities and confidentiality obligations.

5. Confidentiality and Data Protection

- No audio or video recordings will be made.
- Only handwritten interview notes will be taken.
- Your name and identifying information will not be recorded in the research notes.
- An alphanumeric identifier will be assigned to your data.
- Any potentially identifying details will be removed during analysis.
- All data will be stored securely on password-protected, local computer.

6. Use of Results and Publication

Your anonymized insights will be included in my master's thesis. The thesis will be deposited in the TU Wien Library (reposiTUm[1]) and will be publicly accessible. Before final submission, you will have the option to review the parts of the findings that relate to your interview and request removal or correction if needed.

7. Contact Information

If you have any further questions regarding the study or your rights, you may contact me at any time.

Caroline Altrichter BA
caroline.altrichter@student.tuwien.ac.at

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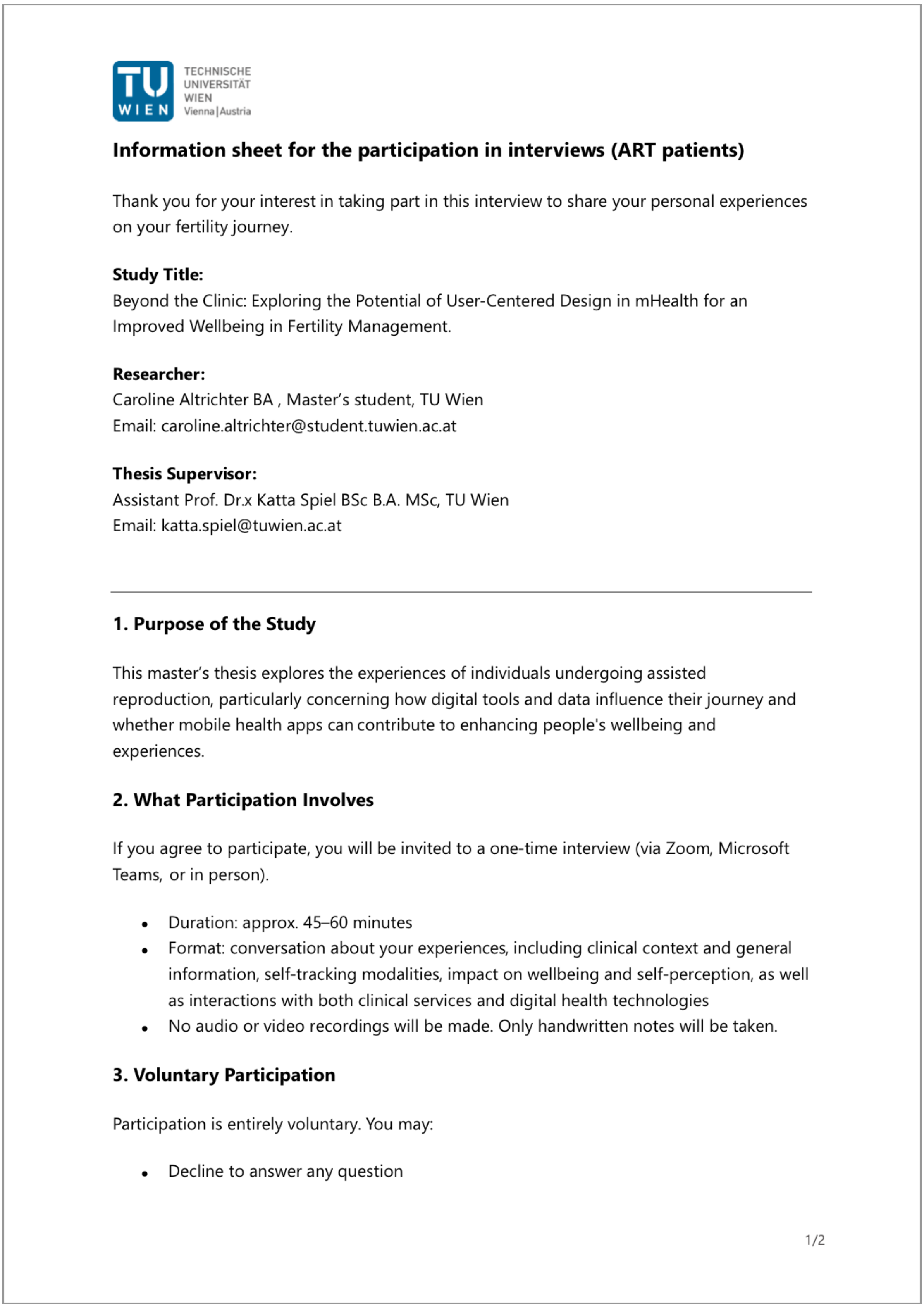
[1] https://repositum.tuwien.at



Information sheet for the participation in interviews (ART patients)

Thank you for your interest in taking part in this interview to share your personal experiences on your fertility journey.

Study Title:
Beyond the Clinic: Exploring the Potential of User-Centered Design in mHealth for an Improved Wellbeing in Fertility Management.

Researcher:
Caroline Altrichter BA , Master's student, TU Wien
Email: caroline.altrichter@student.tuwien.ac.at

Thesis Supervisor:
Assistant Prof. Dr.x Katta Spiel BSc B.A. MSc, TU Wien
Email: katta.spiel@tuwien.ac.at

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1. Purpose of the Study

This master's thesis explores the experiences of individuals undergoing assisted reproduction, particularly concerning how digital tools and data influence their journey and whether mobile health apps can contribute to enhancing people's wellbeing and experiences.

2. What Participation Involves

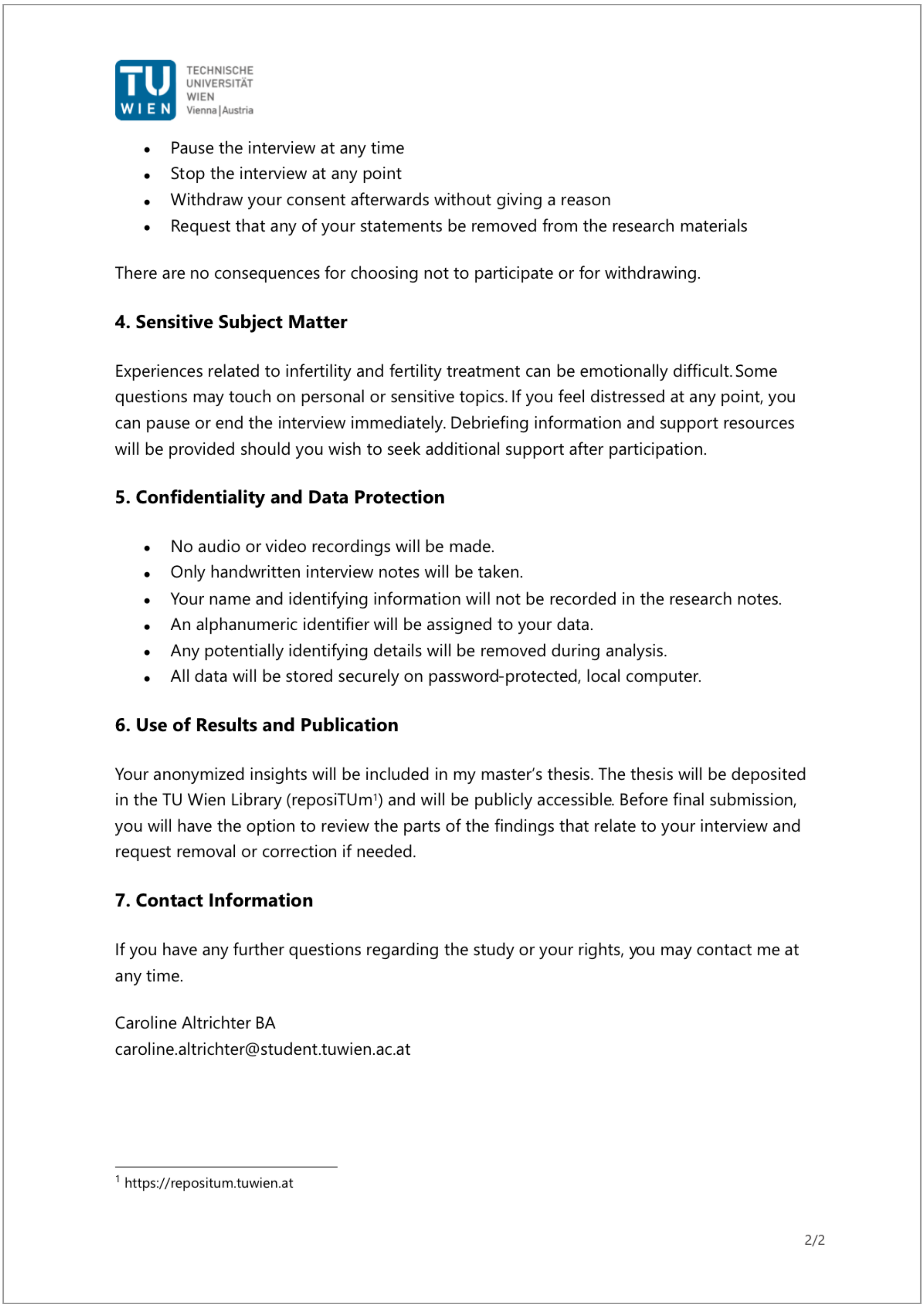
If you agree to participate, you will be invited to a one-time interview (via Zoom, Microsoft Teams, or in person).

- Duration: approx. 45–60 minutes
- Format: conversation about your experiences, including clinical context and general information, self-tracking modalities, impact on wellbeing and self-perception, as well as interactions with both clinical services and digital health technologies
- No audio or video recordings will be made. Only handwritten notes will be taken.

3. Voluntary Participation

Participation is entirely voluntary. You may:

- Decline to answer any question



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- Pause the interview at any time
- Stop the interview at any point
- Withdraw your consent afterwards without giving a reason
- Request that any of your statements be removed from the research materials

There are no consequences for choosing not to participate or for withdrawing.

4. Sensitive Subject Matter

Experiences related to infertility and fertility treatment can be emotionally difficult. Some questions may touch on personal or sensitive topics. If you feel distressed at any point, you can pause or end the interview immediately. Debriefing information and support resources will be provided should you wish to seek additional support after participation.

5. Confidentiality and Data Protection

- No audio or video recordings will be made.
- Only handwritten interview notes will be taken.
- Your name and identifying information will not be recorded in the research notes.
- An alphanumeric identifier will be assigned to your data.
- Any potentially identifying details will be removed during analysis.
- All data will be stored securely on password-protected, local computer.

6. Use of Results and Publication

Your anonymized insights will be included in my master's thesis. The thesis will be deposited in the TU Wien Library (reposiTUm[1]) and will be publicly accessible. Before final submission, you will have the option to review the parts of the findings that relate to your interview and request removal or correction if needed.

7. Contact Information

If you have any further questions regarding the study or your rights, you may contact me at any time.

Caroline Altrichter BA
caroline.altrichter@student.tuwien.ac.at

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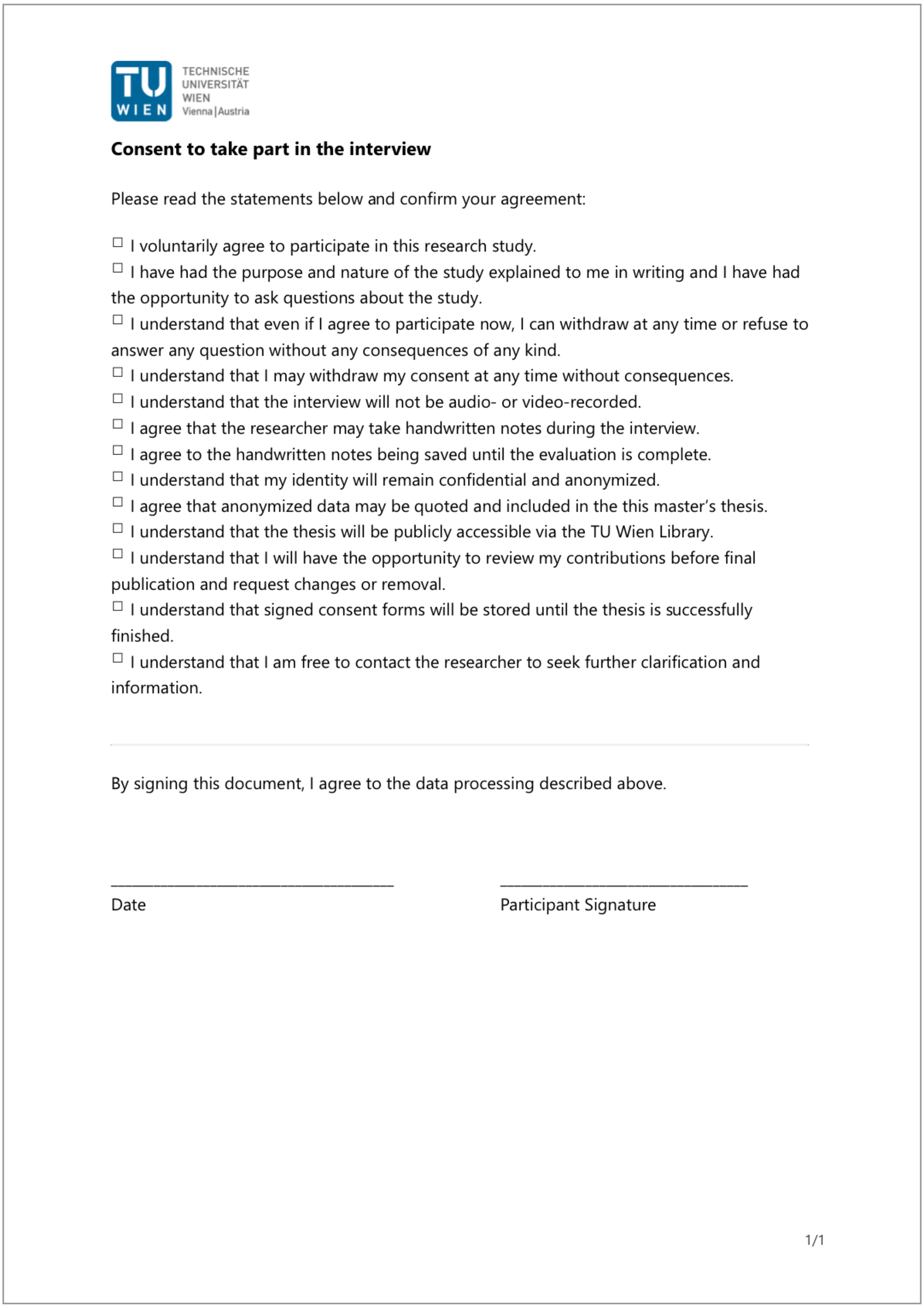

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Consent to take part in the interview

Please read the statements below and confirm your agreement:

☐ I voluntarily agree to participate in this research study.
☐ I have had the purpose and nature of the study explained to me in writing and I have had the opportunity to ask questions about the study.
☐ I understand that even if I agree to participate now, I can withdraw at any time or refuse to answer any question without any consequences of any kind.
☐ I understand that I may withdraw my consent at any time without consequences.
☐ I understand that the interview will not be audio- or video-recorded.
☐ I agree that the researcher may take handwritten notes during the interview.
☐ I agree to the handwritten notes being saved until the evaluation is complete.
☐ I understand that my identity will remain confidential and anonymized.
☐ I agree that anonymized data may be quoted and included in the this master's thesis.
☐ I understand that the thesis will be publicly accessible via the TU Wien Library.
☐ I understand that I will have the opportunity to review my contributions before final publication and request changes or removal.
☐ I understand that signed consent forms will be stored until the thesis is successfully finished.
☐ I understand that I am free to contact the researcher to seek further clarification and information.

By signing this document, I agree to the data processing described above.

________________________________	____________________________
Date	Participant Signature

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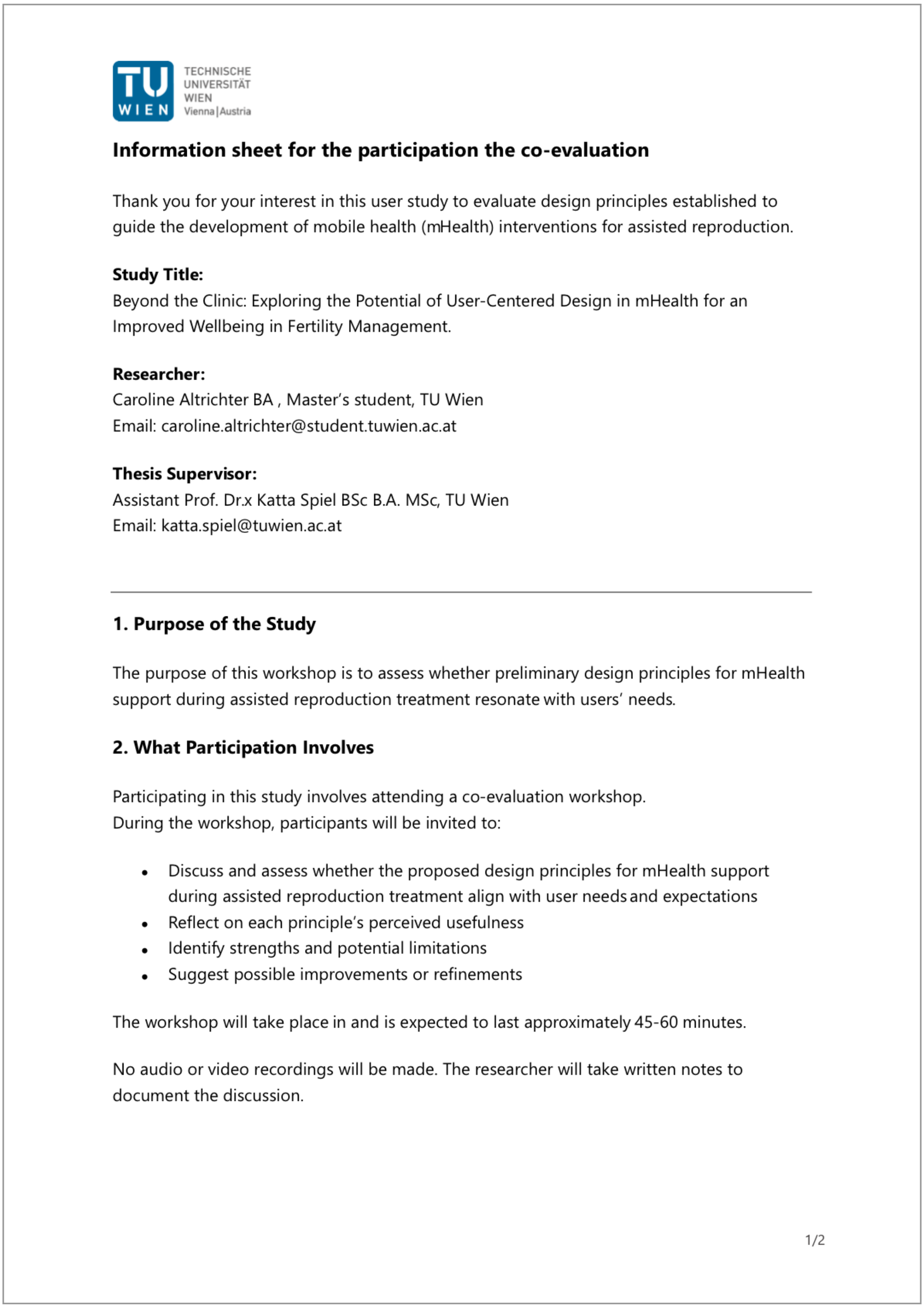
A.3 Co-Evaluation Consent Form



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Information sheet for the participation the co-evaluation

Thank you for your interest in this user study to evaluate design principles established to guide the development of mobile health (mHealth) interventions for assisted reproduction.

Study Title:
Beyond the Clinic: Exploring the Potential of User-Centered Design in mHealth for an Improved Wellbeing in Fertility Management.

Researcher:
Caroline Altrichter BA , Master's student, TU Wien
Email: caroline.altrichter@student.tuwien.ac.at

Thesis Supervisor:
Assistant Prof. Dr.x Katta Spiel BSc B.A. MSc, TU Wien
Email: katta.spiel@tuwien.ac.at

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1. Purpose of the Study

The purpose of this workshop is to assess whether preliminary design principles for mHealth support during assisted reproduction treatment resonate with users' needs.

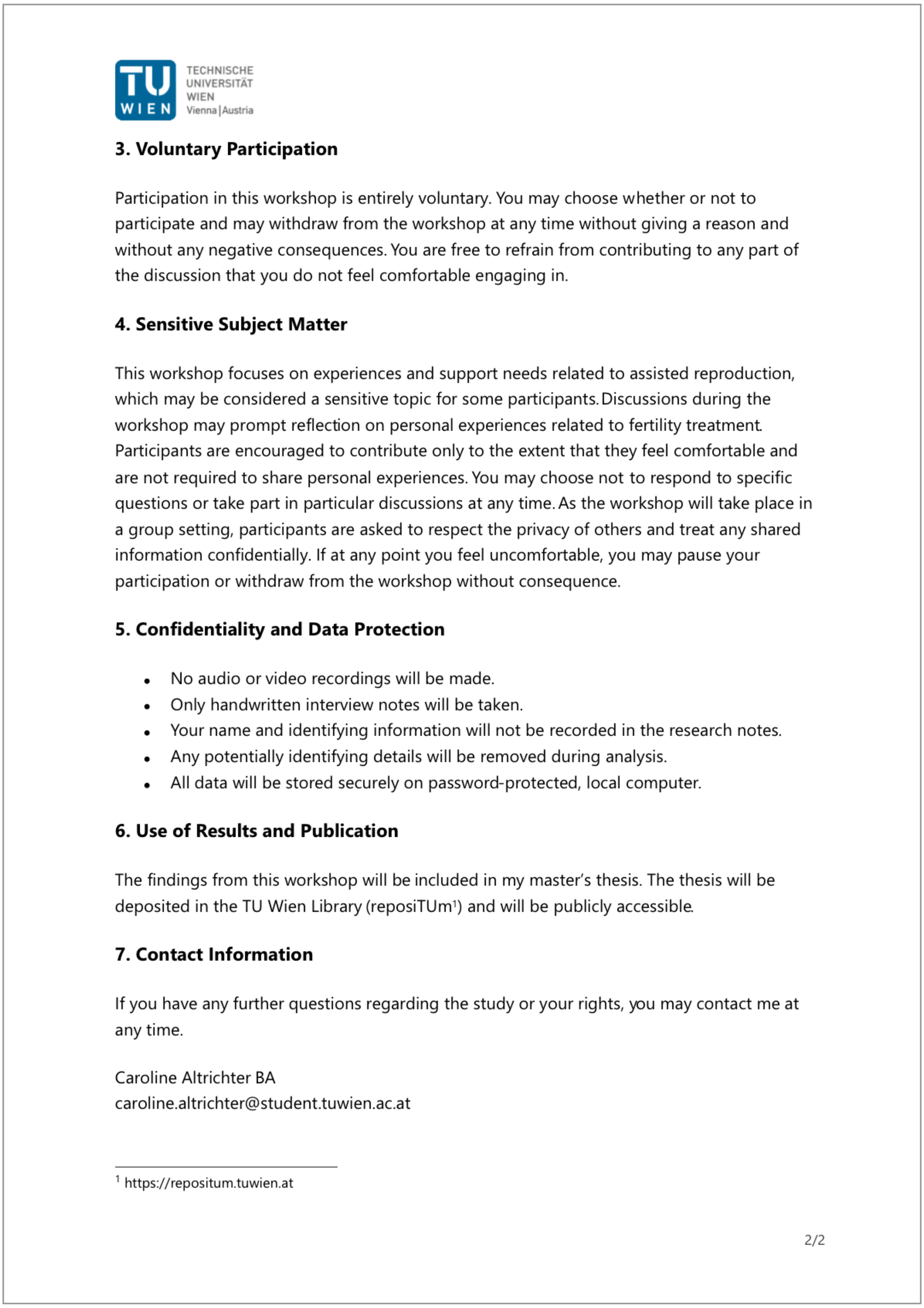
2. What Participation Involves

Participating in this study involves attending a co-evaluation workshop.
During the workshop, participants will be invited to:

- Discuss and assess whether the proposed design principles for mHealth support during assisted reproduction treatment align with user needs and expectations
- Reflect on each principle's perceived usefulness
- Identify strengths and potential limitations
- Suggest possible improvements or refinements

The workshop will take place in and is expected to last approximately 45-60 minutes.

No audio or video recordings will be made. The researcher will take written notes to document the discussion.



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3. Voluntary Participation

Participation in this workshop is entirely voluntary. You may choose whether or not to participate and may withdraw from the workshop at any time without giving a reason and without any negative consequences. You are free to refrain from contributing to any part of the discussion that you do not feel comfortable engaging in.

4. Sensitive Subject Matter

This workshop focuses on experiences and support needs related to assisted reproduction, which may be considered a sensitive topic for some participants. Discussions during the workshop may prompt reflection on personal experiences related to fertility treatment. Participants are encouraged to contribute only to the extent that they feel comfortable and are not required to share personal experiences. You may choose not to respond to specific questions or take part in particular discussions at any time. As the workshop will take place in a group setting, participants are asked to respect the privacy of others and treat any shared information confidentially. If at any point you feel uncomfortable, you may pause your participation or withdraw from the workshop without consequence.

5. Confidentiality and Data Protection

- No audio or video recordings will be made.
- Only handwritten interview notes will be taken.
- Your name and identifying information will not be recorded in the research notes.
- Any potentially identifying details will be removed during analysis.
- All data will be stored securely on password-protected, local computer.

6. Use of Results and Publication

The findings from this workshop will be included in my master's thesis. The thesis will be deposited in the TU Wien Library (reposiTUm[1]) and will be publicly accessible.

7. Contact Information

If you have any further questions regarding the study or your rights, you may contact me at any time.

Caroline Altrichter BA
caroline.altrichter@student.tuwien.ac.at

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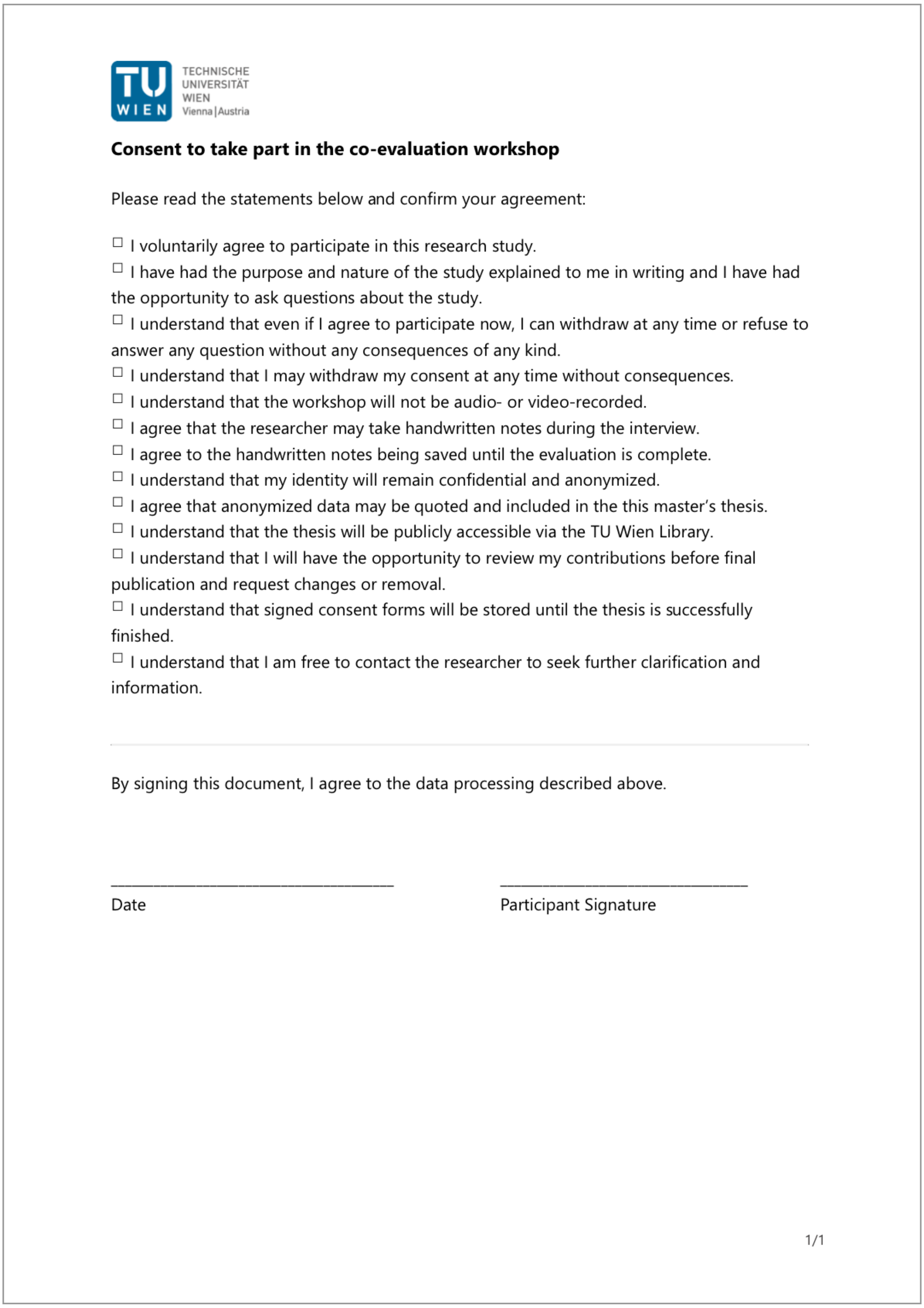
[1] https://repositum.tuwien.at



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Consent to take part in the co-evaluation workshop

Please read the statements below and confirm your agreement:

☐ I voluntarily agree to participate in this research study.
☐ I have had the purpose and nature of the study explained to me in writing and I have had the opportunity to ask questions about the study.
☐ I understand that even if I agree to participate now, I can withdraw at any time or refuse to answer any question without any consequences of any kind.
☐ I understand that I may withdraw my consent at any time without consequences.
☐ I understand that the workshop will not be audio- or video-recorded.
☐ I agree that the researcher may take handwritten notes during the interview.
☐ I agree to the handwritten notes being saved until the evaluation is complete.
☐ I understand that my identity will remain confidential and anonymized.
☐ I agree that anonymized data may be quoted and included in the this master's thesis.
☐ I understand that the thesis will be publicly accessible via the TU Wien Library.
☐ I understand that I will have the opportunity to review my contributions before final publication and request changes or removal.
☐ I understand that signed consent forms will be stored until the thesis is successfully finished.
☐ I understand that I am free to contact the researcher to seek further clarification and information.

By signing this document, I agree to the data processing described above.

______________________________	______________________________
Date	Participant Signature

APPENDIX B

Interview Questions

B.1 Fertility Specialists List of Questions

B.1.1 Clinical Context and Patient Journey

1. Approximately how many patients do you personally care for on an ongoing basis?
2. What are the most common factors causing infertility that you observe in your practice?
3. Are there specific conditions or factors for which it is particularly difficult to take effective action or provide clear solutions?
    - **Probe:** How do you navigate that uncertainty with the patient?

B.1.2 Patient Communication and Emotional Support

1. Walk me through the typical communication flow between you and your patients between scheduled appointments.
    - **Probe:** What are the most common reasons or situations that prompt patients to reach out outside of formal scheduling?
2. How do you currently handle the emotional support needs of your patients during treatment?
3. How do you think introducing a secure, asynchronous messaging tool would impact your workflow compared to your current methods?

B.1.3 Test Results and Patient Comprehension

1. Do you typically send the medical tests you order to an external laboratory for analysis, or are they processed in-house?
2. Do your patients currently receive their official test results directly from the lab, or do they only receive them through your clinic?
3. Are patients currently permitted to take their test results or copies of their medical records home for further review?
4. How do you currently inform your patients about their test results and the factors contributing to their infertility?
5. In your experience, how well do patients generally grasp their test results during consultations?
   - **Probe:** How can you usually tell if a patient has truly understood the results you have just explained?
6. What effect, if any, do you think a digitized delivery process for test results would have on patient understanding and engagement?

B.1.4 Digital Tools for Data Sharing and Digital Support

1. What is your general opinion on using digital tools to facilitate sharing test results directly with patients?
2. What concerns, if any, do you have about patients having direct, digitized access to their raw medical data?
   - **Probe:** What unintended consequences might arise?
3. If a secure digital platform allowed patients to view their test results directly (uploaded by your staff), what advantages and disadvantages do you foresee?
4. How do you think such a system would impact your existing need to explain results to patients? Would it support or undermine that crucial interaction?
5. In your view, could a more digitized process for sharing results also bring negative effects or consequences?
6. What impact do you think digital approaches (i.e., virtual support groups, online counseling, or dedicated patient forums) might have on emotional support for patients undergoing fertility treatment?

7. Under what conditions, if any, would you personally be willing to participate in digital communication channels to provide advice to your patients outside of regular office hours?
8. Finally, what guidelines do you think are essential for patient communication outside scheduled appointments, especially in a digital context?

B.2 ART Patients List of Questions

B.2.1 Clinical Context and General Information

1. Background Information
    - Age
    - Educational Background
    - Occupation / Employment Status
    - Where are you currently in your fertility journey?
    - If you are comfortable sharing, what is your current fertility diagnosis?
2. To start, could you describe the path that led you to pursue medically assisted reproduction?
3. Assisted reproduction involves a massive amount of information. How do you personally manage the logistics, like tracking appointments, medications, and test results?
4. How has undergoing ART impacted your daily life and routines?
    - **Probe:** What have been the most challenging aspects, and what have been the most supportive?

B.2.2 Fertility Self-Tracking and Personal Health Data

1. Before or during your treatment, have you used any form of self-tracking? (e.g., apps, wearables, physical calendars).
    - **If NO:** What made you decide not to track? *Skip to question 4.*
    - **If YES:** *Continue to next question.*
2. What specific information do you track, and what tools do you use to do it?
3. What originally motivated you to start tracking, and what are the biggest challenges or frustrations you've run into with it?

- **Probe:** Have you ever had to stop taking a break from tracking? What led to that?

4. When you get new fertility data, whether from your app or a clinic report, how do you typically interact with it?
    - **Probe:** Do you analyze it yourself, discuss it with your partner, or jump online to research it?
5. How has having access to all this fertility data impacted your emotional wellbeing and your sense of control over the journey?
    - **Probe:** Can you give an example of a time it made you feel empowered, or a time it made you feel anxious?
6. Do you have any concerns regarding the privacy and security of your personal fertility data when using digital tools?
7. Thinking about the tracking apps or tools you've used, how would you describe their overall design? (e.g., supportive, clinical, confusing, intuitive)
8. Beyond just logging data, how does using these tools influence how you perceive yourself or your body?
    - **Probe:** Does it make you feel more connected to your body, or disconnected
    - **Probe:** For example, some people say it makes them feel empowered, while others say it makes them feel like a "data point". How is it for you?
9. Do you feel that your personal background or the way you were raised influences how you look at this medical data or make decisions about it?
10. Based on your personal experience, what are your key recommendations for developers creating future fertility apps? What features or changes are absolutely crucial?

B.2.3 Communication of Uncertainty

1. In fertility treatment, information often is not 100% certain, like success probabilities or ambiguous test results. How do you typically react when presented with this kind of uncertain information?
2. How do you prefer uncertain information to be presented to you by an app or a clinic?
    - **Probe:** Do you prefer raw numbers, ranges, visual graphs, or qualitative descriptions?

3. Can you describe a time when the way uncertainty was communicated (or hidden) impacted your trust in the information or your medical decisions?

B.2.4 Couple Dynamics and Support

1. How involved is your partner with your tracking and the data side of your journey?
    - **Probe:** How has sharing (or not sharing) this information impacted your relationship and shared sense of burden?
2. What has been your experience with the educational resources and emotional support provided by your clinic (or outside support groups)?
3. Did having access to those resources make you feel more confident and equipped to handle the treatment process?

Overview of Generative AI Tools Used

The following AI tools were used in this thesis:

ChatGPT-4o to 5.2 (free version)

- Usage: Was used to (1) help me evaluate whether my narrative flow was consistent and logical and if transitions between paragraphs were smooth, (2) receive suggestions for improvement to make paragraphs more cohesive, (3) reformulate sentences when readability needed refinement, (4) grammar and spell-checking, (5) for translation purposes to express ideas from the study participants' native language (DE) into the thesis language (EN) e.g., interviews and co-evaluation workshop, (6) converting written text into data tables, and (7) as academic search engine.
- Place of use: Whole thesis (1-5), Chapter "Methodology" (6)

Gemini 3 (Pro Version)

- Usage: Was used (1) to create images within UI mockups (images in app articles), (2) for the refinement of interview questions, (3) and occasionally for explaining complex topics in research papers
- Place of use: Chapter 6 "Results" (1)

I reviewed the output critically and based on this feedback I modified areas that needed improvement (rewording suggestions, grammar refinements) and revised the writing using my own words and expressions. I only integrated AI-generated recommendations when they aligned with my thesis and overall approach. The output primarily served as inspiration and was never used for content creation.

Übersicht verwendeter Hilfsmittel

Die folgenden KI-Tools wurden in dieser Arbeit verwendet:

ChatGPT-4o bis 5.2 (gratis Version)

- Verwendungszweck: Wurde verwendet, um (1) zu bewerten, ob mein narrativer Fluss konsistent und logisch war und ob die Übergänge zwischen den Absätzen fließend waren, (2) Verbesserungsvorschläge zu erhalten, um die Absätze kohärenter zu gestalten, (3) Sätze umzuformulieren, wenn die Lesbarkeit verbessert werden musste, (4) Grammatik und Rechtschreibung zu überprüfen, (5) zu Übersetzungszwecken, um komplexe Ideen aus der Muttersprache der Studienteilnehmer (DE) in die Sprache der Masterarbeit (EN) zu übertragen, (6) zur Umwandlung von geschriebenem Text in Tabellen, (7) als akademische Suchmaschine.
- Ort der Verwendung: Gesamte Arbeit (1-5), Kapitel 3 “Methodik” (6)

Gemini 3 (Pro Version)

- Verwendungszweck: Wurde verwendet (1) für die Erstellung von Bildern innerhalb der UI Mockups (Bilder in App-Artikeln) und (2) für die Verfeinerung von Interviewfragen und (3) gelegentlich zur Erläuterung komplexer Themen in Forschungsarbeiten.
- Ort der Verwendung: Kapitel 6 “Results” (1)

Ich habe die Ergebnisse kritisch überprüft und änderte auf der Grundlage dieses Feedbacks verbesserungswürdige Bereiche (Umformulierungsvorschläge, Grammatikverbesserungen) und überarbeitete den Text mit meinen eigenen Worten und Ausdrücken. Ich habe die von der KI generierten Empfehlungen nur dann integriert, wenn sie mit meiner Masterarbeit und meinem Gesamtansatz übereinstimmten. Der Output diente in erster Linie als Inspiration und wurde nie für die Erstellung von Inhalten verwendet.

List of Figures

List of Tables

Acronyms

AI Artificial Intelligence. 97

APS Antiphospholipid Syndrome. 61

ART Assisted Reproductive Technology. 1–5, 7, 10, 12–14, 17–20, 23, 24, 30, 46–55, 57–61, 63, 65, 68, 70, 73, 75, 80–82, 84–86, 89, 90, 92–95, 99–108, 110, 113, 115–117, 119, 127–130, 135, 137, 138, 165, 166, 169

ASD Autism Spectrum Disorder. 9

BBT Basal Body Temperature. 22, 24, 75, 83

BMI Body Mass Index. 12

CBT Cognitive Behavioral Therapy. 120

CEO Chief Executive Officer. 22

DP Design Principle. 117, 118, 120, 121, 123, 124, 166, 167

EEA European Economic Area. 12

EMA European Medicines Agency. 37

FAM Fertility Awareness Methods. 22

FDA Food and Drug Administration. 37, 38

FMT Fertility and Menstruation Tracking. 22, 25, 37, 103

FT Full Time. 61

GDPR General Data Protection Regulation. 37, 39

HCI Human-Computer Iteraction. 2, 4, 23, 46, 51, 63, 127, 129, 138

HIPAA Health Insurance Portability and Accountability Act. 37

ICSI Intracytoplasmic Sperm Injection. 10–12, 52, 61, 75, 82, 84, 100, 165, 166

ISO International Organization for Standardization. 42

IUI Intrauterine Insemination. 10, 51, 52, 75, 80, 81, 84, 165

IVF In Vitro Fertilization. 10–12, 15, 51, 52, 60, 61, 68, 75, 76, 79–81, 83, 84, 90, 91, 100, 102, 103, 129, 165, 166

MAR Medically Assisted Reproduction. 1, 7, 24, 50, 51

MESA Microsurgical Epididymal Sperm Aspiration. 12

MRC Medical Research Council. 65, 68

MTHFR Methylenetetrahydrofolate Reductase. 61

NVQ National Vocational Qualifications. 61

OAT Oligoasthenoteratozoospermia. 60, 61

OHSS Ovarian Hyperstimulation Syndrome. 61

OPK Ovulation Predictor Kit. 24, 25

PCOS Polycystic Ovary Syndrome. 12, 61, 96

PESA Percutaneous Epididymal Sperm Aspiration. 10

PGHD Patient-Generated Health Data. 21, 25

PGT Preimplantation Genetic Testing. 80

PI Personal Informatics. 21

PT Part Time. 61

QS Quantified Self. 21

SUS System Usability Scale. 72

TESE Testicular Sperm Aspiration. 10, 12

TTC Trying To Conceive. 103

TUW REC Research Ethics Committee. 48

TWW Two-Week Wait. 26, 92

UCD User-Centered Design. xi, 2, 4, 45, 46, 63, 137, 138

UI User Interface. 48, 63, 79, 136

UK United Kingdom. 68

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