



# CEHRes Roadmap For eHealth: Redesigning PCOS Menstrual-Tracking

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**Abstract:** The rapid rise of digital health technologies has revolutionized healthcare, but many eHealth interventions fail due to limited stakeholder involvement, poor contextual fit, and weak implementation. This study examines the CEHRes Roadmap from the University of Twente's Centre for eHealth Research—a holistic, user-centered framework with five phases: contextual inquiry (analyzing environments and needs), value specification (aligning with stakeholder priorities), iterative design (refining via feedback), operationalization (ensuring implementation and sustainability), and summative evaluation (measuring effectiveness, usability, engagement, and costs). By prioritizing stakeholder participation, value-driven development, and ongoing evaluation, the Roadmap boosts adoption, engagement, and sustainability. It ultimately enhances the quality, effectiveness, and long-term impact of eHealth solutions in diverse settings.

**Index Terms:** CEHRes Roadmap, PCOS, Menstrual Tracking, User-Centered Design, FemTech, eHealth, Personalization, Holistic Self-Tracking, Inclusivity, Ethical Data Practices

## 1. INTRODUCTION

Self-tracking applications now play a central role in monitoring daily health parameters, enabling users to record, reflect upon, and respond to bodily data in real time. Within this ecosystem, menstrual tracking applications such as Flo, Clue, and Glow have emerged as widely adopted tools, serving millions of women globally. These applications allow users to log menstrual cycles, moods, symptoms, and lifestyle factors, while providing algorithm-driven predictions related to ovulation, fertility, and cycle regularity. By offering accessible health insights, menstrual tracking apps claim to promote bodily awareness, empowerment, and reproductive autonomy.

Despite their growing popularity and potential benefits, menstrual tracking applications often rely on narrow design assumptions that fail to represent the diversity of women's reproductive experiences. Most existing apps are structured around a standardized 28–35-day menstrual cycle, implicitly positioning regularity as the norm. This design approach marginalizes users with irregular cycles and chronic reproductive health conditions, leading to inaccurate predictions and emotionally distressing interactions. As a result, women whose bodies deviate from these normative assumptions may experience frustration, alienation, and reduced trust in digital health technologies.

Polycystic Ovarian Syndrome (PCOS) is one such condition that exposes the limitations of current menstrual tracking systems. PCOS is a prevalent endocrine disorder affecting approximately 8–13% of reproductive-aged women worldwide. It is characterized by a wide range of symptoms including irregular menstruation, ovulatory dysfunction, infertility, insulin resistance, acne, weight fluctuations, and heightened susceptibility to anxiety and depression. The lived experience of PCOS is highly individualized and often requires long-term self-management involving lifestyle regulation, symptom monitoring, and emotional support. However, existing menstrual tracking apps frequently fail to accommodate these complexities, particularly due to their emphasis on fertility prediction and cycle regularity.

This seminar report addresses the central question: ‘*How can menstrual tracking applications be redesigned to better meet the needs of women with PCOS?*’ Drawing upon feminist Human–Computer Interaction (HCI) perspectives, research on self-tracking technologies, and documented challenges faced by women with PCOS, the report critically examines the shortcomings of current menstrual tracking applications. By reimagining menstrual tracking through a woman-centered and PCOS-sensitive design lens, this study aims to highlight the importance of developing digital health technologies that validate diverse reproductive experiences and genuinely support women’s health and well-being.

## 2. LITERATURE REVIEW

Bobel et al. (2020) presented a comprehensive analysis of menstrual health in *The Palgrave Handbook of Critical Menstruation Studies*. The authors emphasized that menstruation is not only a biological process but also a socio-cultural phenomenon shaped by stigma, silence, and gender norms. Their work explains how cultural taboos influence healthcare access and the design of menstrual technologies. The study highlights that many digital tools oversimplify menstrual health and fail to represent chronic conditions such as PCOS, thereby limiting their inclusiveness and clinical relevance.

Ranade (2021), in the design thesis *Bridging the Gap: Reimagining Menstrual Tracking Apps to Meet the Needs of Women with PCOS*, critically evaluated popular menstrual tracking applications from a feminist HCI perspective. The study reported that most apps assume regular cycles and prioritize fertility tracking, making them unsuitable for users with irregular patterns. Ranade proposed journaling-based interfaces, customizable symptom tracking, and long-term data visualization to better support PCOS users. This work provides direct design guidelines for developing inclusive and empathetic menstrual health technologies.

Brouwer, Klinker, and Kwee (2022) examined the growth of FemTech and digital women’s health platforms. Their report noted that while menstrual tracking apps are widely adopted, most systems lack clinical integration and long-term analytics. The authors highlighted the need for evidence-based design and secure data handling, particularly for chronic reproductive disorders. The study emphasizes that future menstrual tracking systems should support personalized analytics and clinician-friendly reporting features.

Sharma and Mehra (2024) conducted a systematic review on digital self-management tools for PCOS. Their findings indicate that mobile applications can improve symptom awareness and lifestyle management when they provide personalized feedback and educational content. However, the review revealed that most existing apps lack adaptive algorithms and fail to capture long-term symptom variability. The authors concluded that flexible data models and integrated analytics are essential for effective PCOS-oriented digital health solutions.

Kaur, Singh, and Patel (2025) proposed a personalized menstrual health tracking framework using adaptive analytics. Their study demonstrated that machine learning-based prediction models can better handle irregular cycles compared to traditional fixed-length algorithms. The authors highlighted the importance of scalable architectures, modular system design, and ethical data governance in next-

generation menstrual tracking platforms. This work supports the feasibility of intelligent, PCOS-centric tracking systems within modern mobile health ecosystems.

### **3. RESEARCH METHODOLOGY**

This study adopts a structured and systematic research methodology to explore user needs in menstrual tracking and reproductive health. The approach ensures that findings are grounded in real-world experiences, guided by ethical research practices, and aligned with user-centered design principles.

#### **3.1 Research Approach (Qualitative Method)**

The study follows a qualitative research approach, focusing on understanding personal experiences, perceptions, and challenges related to menstrual tracking applications. This method allows for deeper exploration of emotional, behavioral, and experiential insights that cannot be fully captured through numerical or quantitative data.

#### **3.2 Data Collection Methods**

Data is collected using semi-structured interviews and guided discussions with participants who have experience using menstrual tracking apps or managing irregular menstrual cycles. This flexible method enables participants to share detailed personal narratives while ensuring that key research themes remain consistently addressed.

#### **3.3 Participant Selection**

Participants are selected based on their experience with menstrual tracking technologies or irregular menstrual health conditions. This ensures that the collected data reflects relevant, real-world user perspectives and challenges.

#### **3.4 Data Analysis Method (Thematic Analysis)**

The collected data is analyzed using thematic analysis, a systematic process that identifies recurring patterns, themes, and meaningful insights within participant responses. This involves coding transcripts, categorizing responses, and interpreting emerging trends to reflect core user needs and concerns.

#### **3.5 Ethical Considerations**

Ethical research practices are prioritized throughout the study, including participant consent, confidentiality, data privacy, and transparency. This ensures that sensitive health information is handled responsibly and respectfully.

#### **3.6 Research Outcomes and Design Implications**

The findings from the qualitative analysis inform evidence-based design recommendations aimed at improving menstrual tracking applications. These outcomes contribute to developing more inclusive, personalized, and effective digital health solutions.

### **4. BACKGROUND AND THEORITICAL FRAMEWORK**

This section establishes the academic foundation for menstrual tracking technologies in women's reproductive health, drawing on digital health, feminist technology studies, HCI, and reproductive health research. It explains how these tools influence health awareness, self-monitoring, and decision-making by framing menstrual apps as socio-technical systems that shape bodily understanding, attitudes, and behaviors within social, cultural, and ethical contexts.

Key ethical issues like data privacy, informed consent, algorithmic transparency, user trust, and autonomy are emphasized, especially for sensitive reproductive data. This theoretical lens grounds the analysis of user experiences and design practices, enabling user-centered reproductive health engagement.

#### **4.1 Self-Tracking Technologies and FemTech**

Self-tracking technologies—such as apps, wearables, and dashboards—enable recording and reflection on health data like activity, sleep, mood, and reproductive patterns, fostering awareness and informed choices. FemTech focuses on women's health, offering tools for menstrual tracking, fertility, contraception, pregnancy, and hormones to boost literacy, education, and active management.

These tools use visuals, reminders, and algorithms to interpret bodily trends, while the ecosystem stresses ethical data practices, transparency, user control, and respectful communication for sensitive information. Overall, they expand health management opportunities through engagement and personalization.

## 4.2 Polycystic Ovarian Syndrome and mHealth

Polycystic Ovarian Syndrome (PCOS) is a chronic endocrine disorder causing irregular cycles, acne, weight changes, insulin resistance, hair growth, fatigue, and emotional issues, requiring personalized monitoring and lifestyle strategies due to symptom variability.

mHealth apps support self-management by logging cycles, symptoms, diet, exercise, meds, and mood, helping users track trends and prepare for consultations. They promote self-awareness, proactive care, and long-term data engagement, complementing clinical support with accessible, user-friendly insights for empowered health management.

## 5. LIMITATIONS OF EXISTING MENSTRUAL TRACKERS

Menstrual tracking apps help monitor cycles, predict periods, and build reproductive awareness, but they often fall short for users with irregular cycles or conditions like PCOS. Most rely on simplified models optimized for regular patterns, leading to inaccurate predictions, inconsistent reminders, and limited insights that erode user confidence.

Apps also prioritize period and ovulation tracking over broader symptom monitoring (e.g., pain, mood, fatigue, lifestyle), with weak data privacy and transparency raising trust issues. This narrow scope hinders holistic, long-term support, calling for designs that address diverse needs and experiences.

### 5.1 Normative Assumptions and Exclusion

Apps embed assumptions of regular cycles, conventional timelines, and fertility goals, shaping predictions and feedback that mismatch users with variations, fostering feelings of abnormality or frustration and discouraging use.

Narrow language, visuals, and designs emphasize idealized womanhood, excluding diverse health conditions, cultures, genders, and intentions. Inclusive designs must acknowledge variability, support multiple paths, and use neutral, supportive communication to represent all users.

### 5.2 Reductionist Design Approach

Many apps reduce menstruation to isolated period/ovulation predictions, ignoring interconnected factors like hormones, emotions, lifestyle, nutrition, sleep, stress, and activity that influence cycles and well-being.

This limits depth for PCOS users tracking complex symptoms (mood, fatigue, acne), missing patterns and insights. Prioritizing numbers over reflection disconnects users; holistic designs integrating multidimensional data enable better self-understanding and management.

### 5.3 Algorithmic Bias and Inaccuracy

Algorithms in trackers often train on datasets from regular-cycle users, amplifying biases that disadvantage those with PCOS or irregular patterns, leading to flawed predictions like mistimed fertility windows.

This perpetuates inequities, as underrepresented groups (e.g., by age, ethnicity, or health status) receive unreliable insights. Transparent, diverse training data and bias audits are essential for equitable, accurate tools.

### 5.4 Accessibility and Usability Barriers

Many apps lack features for low-literacy users, non-smartphone owners, or those in low-connectivity areas, with complex interfaces, small text, or high data demands excluding marginalized populations.

Poor customization for disabilities (e.g., no voice input, color-blind modes) further limits reach. Universal design principles—simple navigation, offline modes, and inclusive testing—can broaden access and effectiveness.

## 6. DESIGN FRAMEWORK

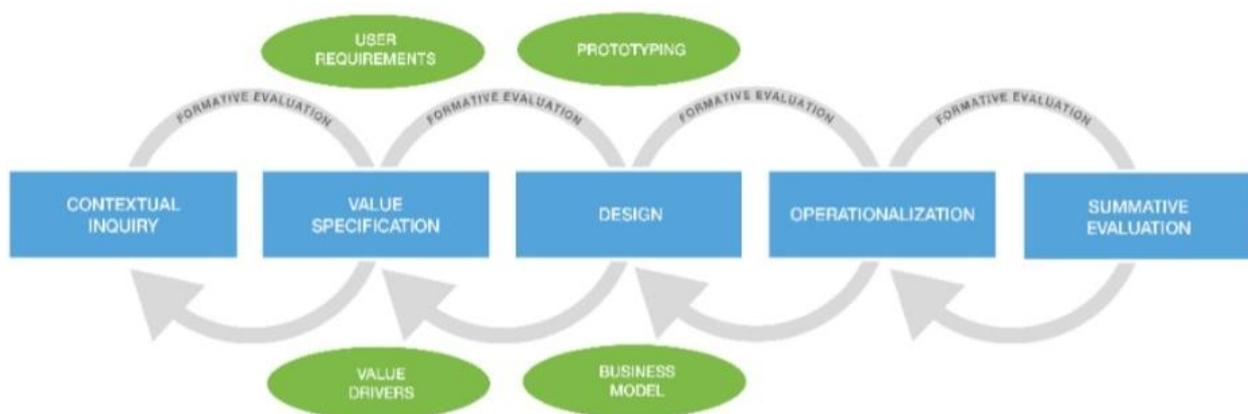
The design framework adopted in this study is informed by the Center for eHealth Research (CeHRes) Roadmap (fig 1), which emphasizes iterative development, stakeholder involvement, and evidence-based design. This framework supports a structured process that integrates user insights at multiple stages of design and evaluation. It encourages ongoing refinement of concepts based on feedback, ensuring that design recommendations remain relevant and responsive to user experiences.

User participation plays a central role in shaping design decisions throughout the research process. Participant feedback informs the identification of key functional requirements, interface expectations, and feature priorities. This participatory approach helps align design outcomes with real user needs and promotes greater relevance, accessibility, and usability in the proposed solutions.

Ethical considerations are also integral to the research methodology. Participants are informed about the purpose of the study, data usage, and confidentiality measures prior to involvement. Personal health information is handled with care to ensure privacy, anonymity, and secure data management. Ethical research practices strengthen participant trust and contribute to the credibility and integrity of the study.

The design process incorporates iterative evaluation, where initial concepts and prototypes are reviewed and refined based on participant input. This cyclical approach allows for continuous improvement, helping to identify usability challenges, enhance clarity, and improve the overall user experience. Feedback-driven iteration supports the development of design recommendations that are practical, meaningful, and aligned with user expectations.

The research methodology and design framework provide a structured foundation for exploring user experiences and translating empirical insights into actionable design outcomes. By combining qualitative inquiry, thematic analysis, participatory engagement, and ethical research principles, the study ensures that its findings contribute to the development of user-centered, informed, and context-aware health technology solutions.



**Fig 1:** (CeHRes) Roadmap Framework

- **Contextual Inquiry:** This phase focuses on understanding the real healthcare problem within its environment. Researchers study the target users, healthcare settings, workflow, and challenges. The aim is to identify existing gaps and clearly define the need for the digital health intervention.
- **Value Specification:** In this stage, the values and requirements of stakeholders (patients, healthcare providers, policymakers) are identified and prioritized. Instead of only defining technical requirements, this phase determines what is important for users, such as privacy, usability, accessibility, trust, and effectiveness.
- **Design:** Based on the identified values, prototypes of the eHealth solution are created. This phase follows an iterative approach, meaning the design is continuously tested, evaluated, and improved through user feedback to ensure it meets stakeholder expectations.
- **Operationalization:** This phase deals with the real-world implementation of the technology. It includes integration into healthcare systems, organizational readiness, training, infrastructure planning, and strategies to encourage adoption and long-term use.
- **Summative Evaluation:** The final phase evaluates the effectiveness and impact of the implemented solution. It measures outcomes such as usability, clinical effectiveness, user satisfaction, cost-effectiveness, and sustainability.

## 7. KEY FINDINGS AND DESIGN RECOMMENDATIONS

### 7.1 Personalization

Personalization adapts digital health tools to individual needs, preferences, and patterns, boosting engagement and insight relevance in menstrual tracking. Users customize cycle lengths, symptoms, reminders, and notifications, aligning apps with personal experiences, goals, and routines via flexible dashboards and visualizations.

Tailored feedback, predictive summaries, and context-aware recommendations build clarity and confidence, using supportive language, adjustable tones, and accessibility options. Dynamic processing ensures transparency and security, fostering trust and sustained self-awareness through user-controlled features.

### 7.2 Holistic Self-Tracking

Holistic self-tracking monitors interconnected physical, emotional, hormonal, and lifestyle factors influencing menstrual health, like mood, stress, sleep, diet, activity, energy, pain, and meds, revealing long-term trends and interactions.

Integrated platforms enable pattern identification, trigger recognition, and informed management with visual timelines. This promotes mindfulness, better decisions, and provider communication. User-friendly inputs, intuitive interfaces, and flexible categories ensure accessibility without overwhelm, enhancing overall well-being.

### 7.3 Supportive and Community Features

Supportive features offer affirming messages, education, self-care reminders, and non-judgmental prompts, creating empathetic environments with mental health tools and journaling for emotional reassurance in sensitive reproductive topics.

Community elements like forums, peer groups, and moderated discussions enable sharing, encouragement, and strategies, combating isolation. Privacy via anonymity, moderation, and controls builds safety. These foster belonging, motivation, and engagement through challenges and collaborative goals.

### 7.4 Ethical Data Practices

Ethical data practices prioritize user privacy, consent, and transparency in handling sensitive reproductive information, with clear policies on collection, storage, sharing, and deletion. Features like granular permissions and data export tools empower users to control their information.

Regular audits, minimal data retention, and compliance with regulations (e.g., GDPR) build trust, while anonymized analytics prevent misuse. Transparent algorithms explain predictions, reducing black-box concerns and supporting accountability in health tech design.

### 7.5 Inclusivity and Accessibility

Inclusivity ensures apps serve diverse users regardless of cycle regularity, health conditions like PCOS, gender identities, cultures, or reproductive goals, avoiding normative biases through varied representations and neutral language.

Accessibility includes voice input, high-contrast modes, offline functionality, and low-data options for disabilities or low-resource settings. User testing with underrepresented groups refines interfaces, promoting equitable engagement and broader health benefits.

## 8. FUTURE SCOPE

- **Integration with AI & Smart Technologies:** The CEHRes Roadmap can evolve by integrating Artificial Intelligence and smart technologies into eHealth systems. AI can enable predictive analytics to identify health risks early and support decision-making. Machine learning algorithms can provide personalized health recommendations based on individual data patterns. Additionally, real-time health monitoring through smart devices can improve continuous care and timely interventions.
- **Expansion to New Health Domains:** The roadmap can be applied to various health sectors beyond its current use. It can support the development of mental health applications, chronic disease management systems, maternal and reproductive health platforms such as PCOS tracking apps, and telemedicine services. This expansion increases its relevance across diverse healthcare needs.
- **Global Implementation:** There is strong potential to implement the CEHRes framework globally. It can be adapted for low-resource and rural healthcare settings, ensuring accessibility and inclusivity.

By localizing content and design according to cultural contexts and healthcare systems, it can be effectively used in different countries and communities.

- **Stronger Policy & Institutional Adoption:** The roadmap can serve as a structured framework for government-led eHealth initiatives. It can guide national digital health programs and institutional digital transformation strategies. This strengthens policy-level support and promotes standardized, evidence-based eHealth development.
- **Long-Term Evaluation Studies:** Future research can focus on conducting longitudinal studies to measure the long-term sustainability of eHealth interventions developed using the roadmap. These studies can evaluate patient engagement, behavioral changes, health outcomes, and overall effectiveness over extended periods.
- **Integration with Wearables & IoT:** The CEHRes Roadmap can further benefit from integration with wearable technologies and Internet of Things (IoT) devices such as smartwatches and fitness trackers. These tools allow continuous health data collection, monitoring, and automated feedback systems, enhancing personalized and preventive healthcare.
- **Advanced Personalization:** Advanced personalization can be achieved by incorporating behavior change techniques tailored to individual users. Adaptive interfaces that adjust according to user data, preferences, and health patterns can improve engagement, usability, and long-term adherence to digital health solutions.

## 9. CONCLUSION

This research advances FemTech and digital health discourse by exploring user-centered menstrual-tracking apps for Polycystic Ovarian Syndrome (PCOS), integrating woman-centered HCI perspectives. It highlights designing for reproductive health's complexity, variability, and individuality, extending beyond basic cycle monitoring to holistic dimensions like symptoms, emotions, lifestyle, and self-management.

Findings from participants emphasize adaptive, personalized features for irregular cycles and diverse patterns, plus inclusive designs challenging normative assumptions on regularity, fertility, and gender. Supportive communities, empathetic communication, and education boost engagement, trust, and well-being.

Methodologically, the CEHRes roadmap and qualitative methods ensure ethical, sustainable development, contributing to feminist HCI via participatory practices. Ultimately, reimagining trackers as empowering ecosystems offers guidance for designers, professionals, and policymakers to foster equitable digital innovations for PCOS users.

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