OVIS: A Clinical Decision Support System for PCOS Diagnosis and Management

COMP 4080

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Group Members:

Emilja Beneja, 101539668

Friskida Shkembi, 101559469

George Erasto Maleko,101602044

Marine, 101630073

Sotir Xhixho, 101557069

Introduction

Polycystic Ovary Syndrome (PCOS) is a complex and highly prevalent endocrine disorder affecting women of reproductive age, presenting with a wide range of reproductive, metabolic, and hormonal disturbances including irregular ovulation, hyperandrogenism, and increased risk of long-term complications such as insulin resistance and infertility (American Academy of Family Physicians [AAFP], 2024). Despite well-established diagnostic frameworks, such as the Rotterdam criteria, PCOS remains frequently underdiagnosed or diagnosed late because patient information is dispersed across laboratory systems, imaging services, and electronic health records. Clinicians must manually gather and interpret fragmented data, a process that increases the likelihood of inconsistent clinical judgments and delays in diagnosis (Sreejith et al., 2022). These systemic inefficiencies highlight an urgent need for tools that can unify data streams and support consistent diagnostic decision-making.

The proposed Clinical Decision Support System (CDSS) seeks to address these challenges by integrating relevant patient information from multiple sources and applying evidence-based diagnostic criteria in a standardized manner, thereby reducing variability and strengthening care coordination across providers (Beneja et al., 2025a). By automating data interpretation and supporting guideline-aligned decision-making, the CDSS has the potential to streamline the diagnostic pathway, enhance clinical accuracy, and reduce delays that currently burden both clinicians and patients. This report builds upon insights from the A2 analysis and the accompanying presentation materials to demonstrate the system's value, rationale, and required organizational considerations for successful implementation (Beneja et al., 2025b).

Business Case

PCOS diagnosis is slowed down by delayed test results, disorganized workflows, and inconsistent use of the Rotterdam criteria (Foscolou et al., 2023; Sreejith et al., 2022). The A2 report also points out several issues that make the process unreliable, such as manual interpretation of lab and imaging results, inefficient coordination between different departments, incomplete referral documents, and poor systems for tracking follow-up appointments (Beneja et al., 2025a). The presentation adds to this by identifying eight major problems that repeat across the current workflow: delayed results, mismatched criteria, unclear ultrasound requirements, heavy administrative workload, and gaps in follow-up communication (Beneja et al., 2025b).

These challenges lead to slow, inconsistent, and often incomplete diagnoses, which affect both patients and clinicians.

A CDSS can address these issues by bringing all patient information into one place, checking for completeness, applying diagnostic criteria the same way every time, and creating clear summaries for clinicians to use. Research in other areas of chronic disease care shows that CDSS tools can improve accuracy, reduce delays, and improve overall patient outcomes by supporting more efficient workflows (Fulop and Ramsay, 2019; Derksen et al., 2025). Although there are risks such as possible clinician resistance, temporary workflow changes during implementation, and questions about privacy, these risks can be reduced through early communication with stakeholders, good training, and strong system governance (Boaz et al., 2018; Petkovic et al., 2020). Overall, the CDSS offers a practical and evidence-based way to solve the main problems in the current PCOS diagnostic process.

Current State Workflows and Analysis

Field of Analysis

PCOS care involves a broad network of clinical and administrative actors whose tasks intersect across multiple stages of the diagnostic pathway. Primary care clinicians typically serve as the first point of contact, initiating investigations and coordinating referrals, while endocrinologists and gynecologists provide specialized assessment and long-term management. Laboratory medicine and imaging departments contribute essential diagnostic data, and administrative staff manage scheduling, documentation, and communication between departments. Because these roles operate across separate systems with limited interoperability, the organization faces ongoing challenges in achieving diagnostic consistency, minimizing delays, and maintaining coordinated workflows (Beneja et al., 2025a). These challenges mirror broader issues observed in chronic disease management, where fragmented processes and inconsistent guideline application have prompted many organizations to adopt CDSS tools to enhance standardization, improve workflow efficiency, and support evidence-based decision-making (Fulop & Ramsay, 2019). In this context, PCOS represents a clear candidate for digital workflow enhancement because it relies on integrating multiple data inputs and applying a rule-based diagnostic framework.

What Has Been Done in Other Organizations

Existing research demonstrates promising outcomes for CDSS use in PCOS care. Studies applying machine learning and decision-support algorithms have shown that automated systems improve diagnostic accuracy by identifying risk patterns and synthesizing clinical data more consistently than manual review alone (Foscolou et al., 2023; Sreejith et al., 2022). Beyond PCOS-specific implementations, organizations developing digital health tools have increasingly adopted AI-driven analytics and interoperable data platforms to support chronic disease diagnosis and management. These efforts align with national and provincial digital health strategies that encourage innovation while requiring compliance with privacy and security legislation such as PHIPA, ensuring that patient information remains protected throughout the diagnostic process (Boaz et al., 2018). Collectively, these initiatives demonstrate both the feasibility and value of CDSS integration in environments characterized by complex workflows and multi-source data requirements.

Current State Analysis

The current workflow shows several important weaknesses that slow down the diagnostic process and reduce consistency in patient care. Data is spread across different systems, which makes it difficult for clinicians to access complete information in one place. This creates delays and increases the risk of missing key details. The workflow also depends heavily on the clinician's own interpretation of lab results, imaging findings, and patient history. This leads to differences in how diagnoses are made and can result in both underdiagnosis and overdiagnosis. Ultrasound ordering is not guided by clear or standardized rules, which causes unnecessary variation in decisions and sometimes leads to repeated or inappropriate tests. Another major issue is the slow and uneven return of laboratory and imaging results. These results often arrive at different times, and without automated alerts, clinicians may overlook them or fail to act quickly (Beneja et al., 2025a).

Additional operational problems include delays caused by manual review of results, mismatched diagnostic criteria, incomplete referral materials, workflow steps that require extra effort, missing documentation in patient records, inconsistent follow up planning, and a heavy administrative burden placed on staff (Beneja et al., 2025b). These issues show that the overall

process lacks standardization and requires continuous manual coordination, which makes the pathway inefficient and unreliable.

The BPMN diagram shows how these problems appear during real clinical work. The pathway is linear and relies on manual actions at each stage. There are no system checks to identify missing information such as incomplete intake forms, missing labs, or pending imaging. This often causes delays and increases the chance of errors. Ultrasound ordering does not follow a unified standard, so ordering decisions vary widely between clinicians. Lab and imaging results return at different times, and the absence of alert systems forces clinicians to check different platforms repeatedly. The Rotterdam criteria must also be applied manually, which increases variability in diagnostic decisions. In addition, the workflow depends heavily on administrative staff to coordinate follow up appointments and ensure that the necessary documents are complete. This dependence creates bottlenecks, adds workload, and increases the risk of communication failures.

Overall, the current workflow has systemic inefficiencies, high variability, and too much reliance on manual work. These issues show a clear need for a Clinical Decision Support System that can improve coordination, reduce errors, and introduce more consistent and automated processes across the diagnostic pathway.

Future State Workflows and analysis

The future state workflow creates a more organized and dependable diagnostic process by using the CDSS to support each step shown in the BPMN diagram. The new workflow begins as soon as the patient books an appointment and fills out the intake form. Instead of waiting for staff to manually review this information, the CDSS automatically collects the intake responses and any related data already stored in the EHR. This is very different from the current workflow, where clinicians often spend time searching for missing or unclear information. The CDSS then checks if the patient information is complete. If labs or imaging are missing, the system sends alerts so these issues can be fixed before the appointment takes place (Beneja et al., 2025b). This early step helps prevent delays and reduces the number of follow up visits that occur only because test results were incomplete.

After the appointment is approved, the clinician conducts a focused history and physical exam. When they order exclusion labs, the BPMN shows that the lab system receives the order, processes the tests, and returns the results. In the future state, these results flow directly into the CDSS, which removes the need for the clinician to manually check multiple systems. As results come in, the CDSS validates them and prepares them for review. When ultrasound is required, the workflow allows for ordering and completing the imaging while the CDSS waits to receive all results. Once both lab and imaging findings are available, the system begins its assessment.

The CDSS then applies the Rotterdam criteria automatically. This is a major improvement from the current state, where clinicians must manually review hormone levels, ultrasound findings, and patient history to decide if the criteria are met. The CDSS uses all the collected data to generate a diagnostic summary that explains which criteria are met and whether a diagnosis of PCOS can be confirmed (Beneja et al., 2025a). If the information is not enough for a diagnosis, the CDSS recommends specific next steps. These may include repeating certain labs, order an ultrasound, or confirm patient history details. This type of guidance helps reduce confusion and makes the process more reliable.

Once the diagnosis is confirmed, the BPMN shows that the clinician reviews the lab results together with the CDSS summary. The system then recommends an appropriate care pathway, such as fertility care or metabolic management, based on the patient's needs. This helps ensure that treatment decisions are consistent and follow established clinical guidelines. The CDSS also pushes a structured diagnostic note directly into the EHR so the clinician does not need to retype information. This reduces errors and saves time. After the care plan is chosen, the clinician communicates the plan to the patient and requests follow up scheduling.

The future workflow also includes strong support for follow up. The CDSS helps track future appointments and sends reminders to reduce missed visits. This addresses one of the major problems in the current workflow, where follow up scheduling often breaks down because it depends on manual communication. By sending alerts to clinicians, administrative staff, and patients, the CDSS improves communication and reduces the chance of someone being lost to follow up (Beneja et al., 2025b).

Overall, the future state workflow shown in the BPMN demonstrates a shift from a manual, inconsistent process to a more efficient and coordinated diagnostic pathway. The CDSS

reduces the need for manual data checks, organizes information in one place, applies diagnostic criteria consistently, improves communication between departments, and supports follow up care. These improvements help create a smoother, faster, and more reliable experience for both clinicians and patients.

Knowledge Conversion

From a Knowledge Management perspective, the future-state workflow incorporates both tacit and explicit knowledge. Clinicians continue to rely on tacit knowledge such as clinical judgment, empathy, and experience in interacting with patients, but these insights are now supported by explicit knowledge embedded in the CDSS, clinical guidelines, diagnostic thresholds, and decision algorithms. This combination helps reduce uncertainty during the diagnostic process and gives clinicians more confidence when making decisions. The CDSS also strengthens organizational learning by embedding Nonaka's SECI Model. Socialization occurs when clinicians share experiential knowledge during collaborative case discussions and system feedback sessions. Externalization happens when clinicians express their tacit insights about diagnostic challenges and workflow problems, which are then translated into system rules or interface adjustments that improve the CDSS over time. Combination is reflected in the CDSS's ability to merge multiple explicit knowledge sources, such as lab results, ultrasound criteria, and clinical guidelines, into structured decision outputs that are easy for clinicians to review. Internalization occurs as clinicians repeatedly use the CDSS and begin to adopt its standardized processes and recommendations in their own daily reasoning. Over time, this helps create more consistent clinical practices and reduces variability in how PCOS is diagnosed across the organization.

Key improvements

The future workflow introduces several important improvements that directly fix the problems seen in the current state. First, the CDSS automatically checks for missing or incomplete information before the clinician begins the assessment. This removes the need for manual verification and prevents delays caused by overlooked tests. Second, ultrasound decisions follow clear and standardized criteria, which reduces confusion and makes imaging requests more consistent across different clinicians. Third, the Rotterdam criteria are applied automatically by the CDSS, which lowers the chances of mistakes and helps ensure that every

patient is assessed using the same evidence-based approach. In addition, the system sends real-time alerts when lab or imaging results are available, which removes delays caused by results arriving at different times without notice. Referral and follow-up steps are also automated, which reduces the administrative workload and limits the communication problems that previously caused missed or delayed appointments (Beneja et al., 2025b). Together, these improvements create a more efficient, predictable, and coordinated diagnostic process. They support the organization's goals of improving the accuracy of PCOS diagnosis, reducing unnecessary delays, and strengthening communication between all departments involved in patient care.

Stakeholder Engagement Strategy

The stakeholder engagement strategy builds on the information gathered in the A2 report and the presentation, and focuses on making sure that the CDSS is accepted, understood, and effectively used by all groups involved in PCOS diagnosis. Strong engagement is important because it reduces resistance, supports smooth adoption, and ensures that the system reflects real clinical needs and workflow patterns (Boaz et al., 2018; Petkovic et al., 2020). The involvement of different stakeholders also helps identify practical challenges that the system must solve and encourages shared ownership of the final solution.

The key stakeholders in the PCOS CDSS project include primary care clinicians, gynecologists, endocrinologists, IT and EHR integration teams, administrative staff, patient advocates, clinic leadership, and quality improvement personnel. Each group contributes something important to the design and use of the system. Clinicians bring direct knowledge of diagnostic challenges and patient care needs. IT and integration teams ensure that the CDSS connects smoothly with existing systems. Administrative staff provide insight into scheduling, communication, and documentation issues. Patient advocates help represent patient needs, including clarity of information and ease of follow up. Leadership and quality improvement teams guide decision making and ensure that the CDSS aligns with organizational goals and standards (Beneja et al., 2025b).

Where and when the CDSS will Operate

The CDSS is designed to support many parts of the diagnostic workflow, starting from the moment a patient enters the system. It becomes active during the intake review, where it

gathers information from the patient form and the EHR to build a complete picture of the case. As clinicians order labs, the CDSS tracks these tests and waits for the results to return, making it easier to identify what is missing and what still needs to be completed. When an ultrasound is required, the system also monitors the imaging process and collects the findings so they can be included in the diagnostic review.

The CDSS plays an important role when the clinician is ready to interpret the results and make a diagnosis. It applies the Rotterdam criteria, organizes the information in a clear format, and provides a summary that helps guide the clinician through the final decision. The system then continues to support the process by recommending care pathways and helping with follow up planning. Because it is involved at every key point, the CDSS supports both primary care and specialty care and helps maintain consistency between departments. This constant presence throughout the workflow reduces confusion, prevents delays, and improves the overall flow of information in the PCOS diagnostic pathway (Beneja et al., 2025a).

Stakeholder Engagement Phases

The engagement process follows a structured set of phases to make sure all voices are included and the system is shaped by real clinical experience. The first phase is the needs assessment, where interviews and focus groups with clinicians and patient advocates help identify workflow problems, sources of delay, and information gaps. This phase helps define what the CDSS must improve or automate. The second phase is design and development. In this stage, co-design workshops allow clinicians, IT staff, and other stakeholders to work together on the CDSS logic, user interface, alerts, and integration points. Feedback is gathered often to make sure the system fits naturally into existing workflows and does not create new problems (Beneja et al., 2025a).

The third phase is pilot testing. During this phase, small groups of clinicians use the CDSS in real or simulated cases to evaluate its ease of use, clarity, and impact on workflow. This helps identify issues that were not visible during design and guides revisions before full implementation (Beneja et al., 2025b). The final phase is implementation and evaluation. This includes training sessions, support resources, and regular feedback opportunities to help users become comfortable with the system. Monitoring adoption, performance outcomes, and user

concerns ensures that the CDSS continues to improve and becomes a stable part of everyday clinical practice.

Next Steps and Conclusion

Future work should consider broadening the capabilities of the CDSS beyond PCOS to support related reproductive and metabolic conditions, such as infertility assessments, menstrual irregularity evaluation, and long-term monitoring of insulin resistance. Because PCOS frequently coexists with these conditions, expanding the system's analytic and decision-support functions would enhance continuity of care and increase the system's overall clinical utility. Integrating patient-facing tools, such as symptom trackers, lifestyle monitoring applications, and personalized education modules, could further improve patient engagement, promote adherence to care plans, and provide clinicians with richer, longitudinal data to support more precise clinical decision-making. Additional research is required to evaluate the CDSS across diverse clinical settings, ensuring it performs consistently in environments with differing resources, workflows, and patient populations. It is also essential to investigate potential algorithmic bias and validate long-term patient outcomes to confirm that the system supports equitable, evidence-based care (Foscolou et al., 2023).

Conclusion

In conclusion, the current PCOS diagnostic pathway is limited by disconnected information systems, inconsistent use of diagnostic criteria, and a heavy dependence on manual work. These issues slow down the process and create differences in how patients are assessed and treated, which can lead to delayed or incomplete care (Beneja et al., 2025a). The introduction of a Clinical Decision Support System provides a practical and evidence-based way to solve these problems. By bringing patient data together in one place, checking for missing information, and applying the Rotterdam criteria the same way for every patient, the CDSS supports a more accurate and reliable diagnostic process. It also strengthens communication between primary care, specialty services, laboratories, imaging departments, and administrative teams, which helps remove many of the bottlenecks that exist today (Beneja et al., 2025b).

The CDSS also supports long term improvements by creating a more organized workflow and reducing the amount of manual work required from clinicians and staff. With regular

feedback, training, and engagement from all stakeholders, the system can continue to grow and adjust to real clinical needs. When combined with digital health strategies and strong governance, the CDSS can help the organization reach its goals of improved diagnostic accuracy, reduced delays, and better coordination across departments. Ultimately, the CDSS has the potential to create a smoother, faster, and more patient centered diagnostic experience, while supporting clinicians in making consistent and informed decisions.

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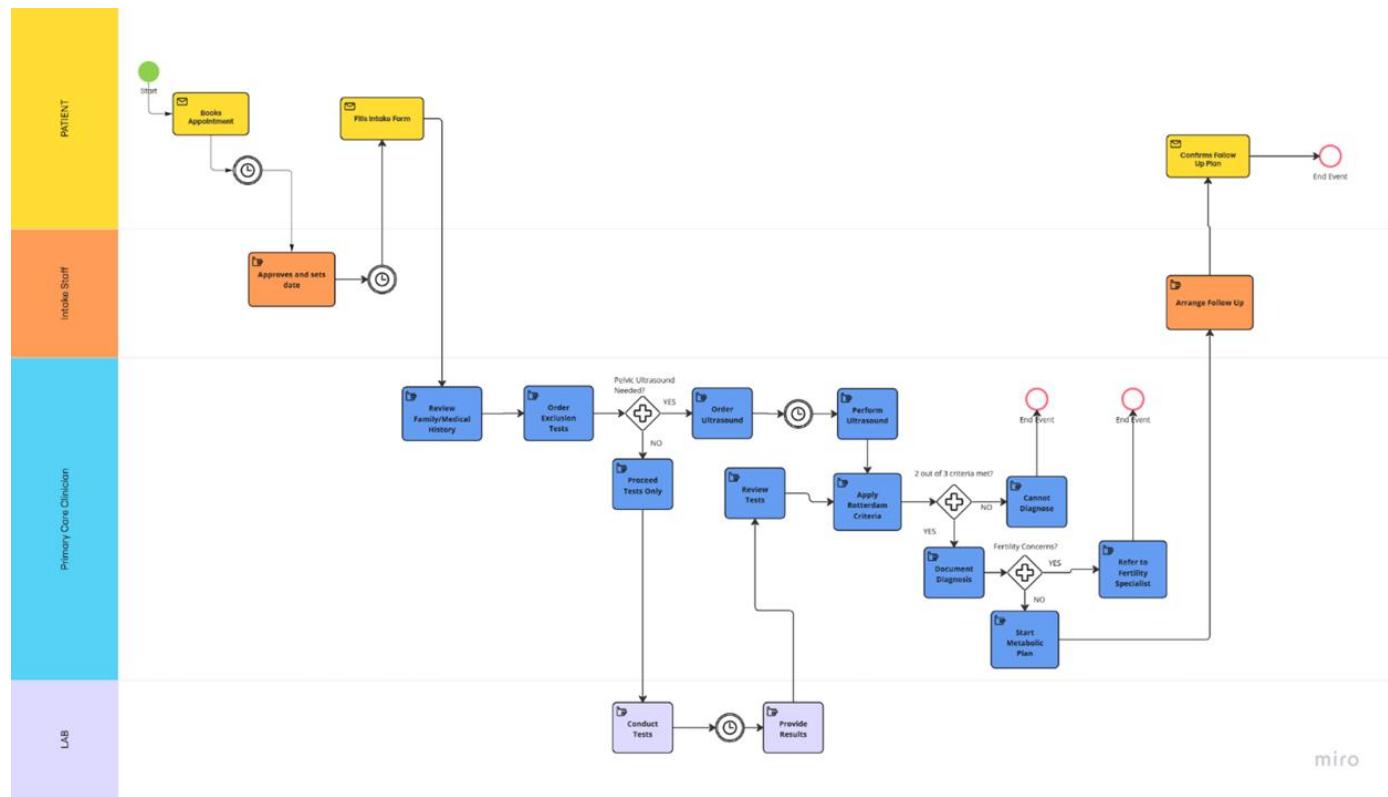
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**APPENDIX A**

Current State Workflow BPMN
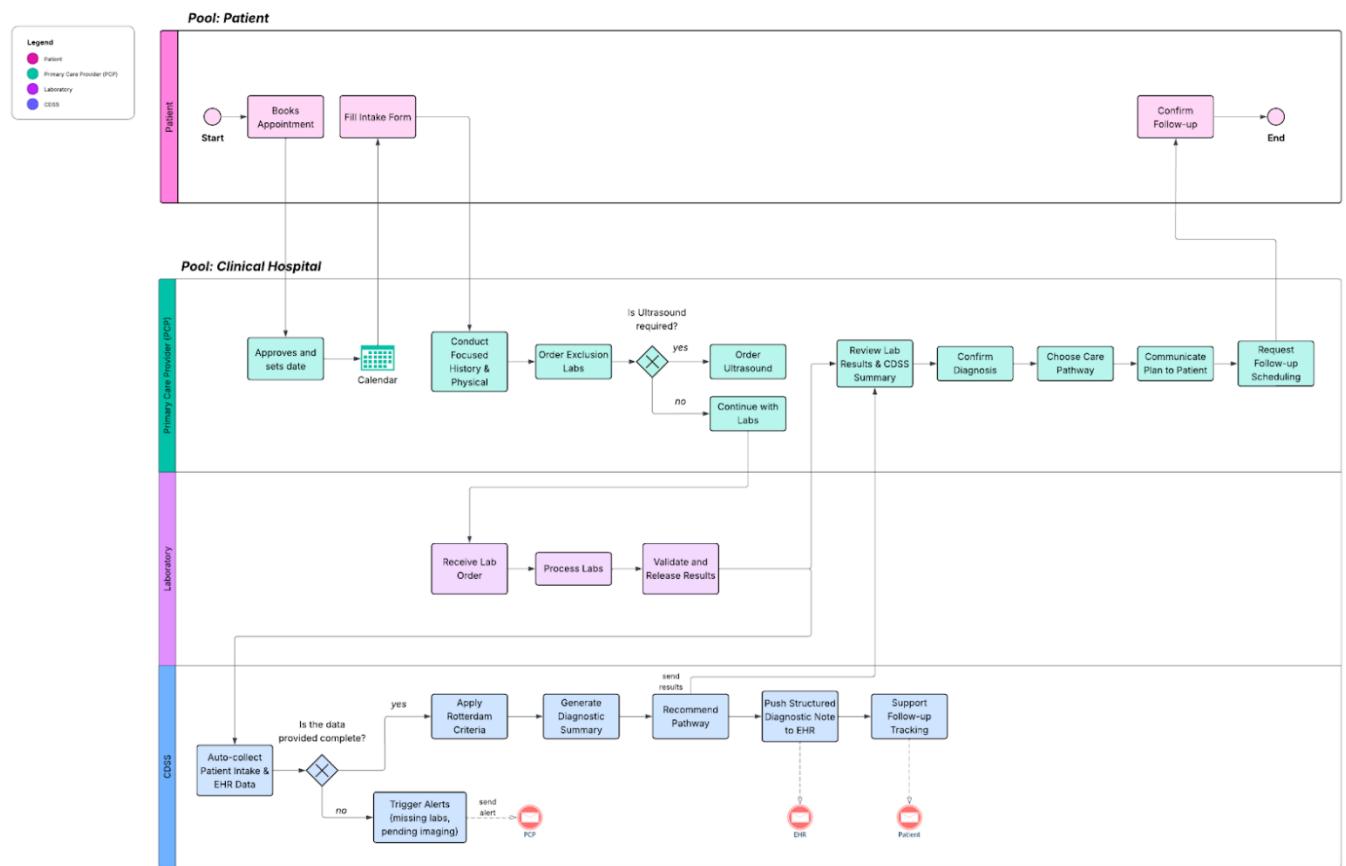
APPENDIX B

Infographics

APPENDIX C
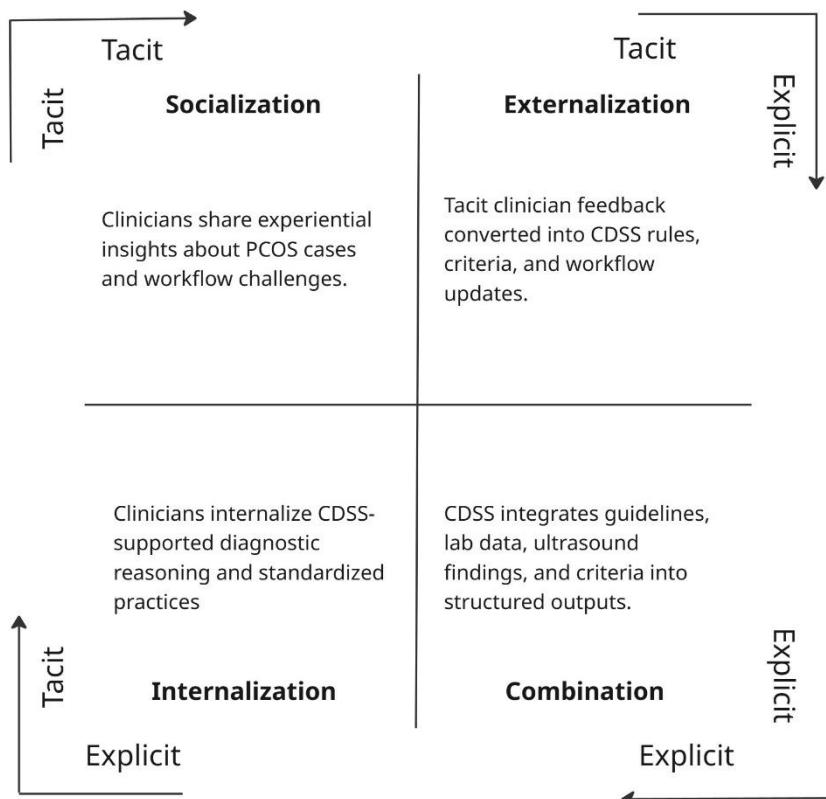
Future State Workflow BPMN

APPENDIX D

SECI Diagram

APPENDIX E

RACI MATRIX

Stakeholder	Roles / Responsibilities	R	A	C	I
Gynecologist	**Provides expertise in PCOS diagnosis and treatment; ensures CDSS supports evidence-based practice.**	✓		✓	
Endocrinologist	**Offers insights into hormonal and metabolic management; validates diagnostic and treatment algorithms.**			✓	
Patient Representative	**Shares lived experience and ensures patient-centred design and usability.**			✓	✓
IT Development Team	**Designs, develops, and integrates the CDSS with existing EHR systems.**	✓	✓		
Project Manager	**Coordinates collaboration, monitors timelines, and ensures project milestones are achieved.**		✓	✓	
Health Informatics / Administration	**Provides oversight on privacy, data governance, and compliance with institutional policies.**		✓		✓

Note. Reproduced from the A2 report