Clinician Preferences for IVF Data Visualisation, Analysis and Decision-Making: A Mixed Methods Approach

1. Study Title

Clinician Preferences for IVF Data Visualisation, Analysis and Decision-Making: A Mixed Methods Approach

Short Title: The CRYSTAL Study (Clinician Review of Yield-focused Scan Templates incorporating AI Logic)

2. Background and Rationale

The protocol, type and dose of medications in controlled ovarian stimulation significantly influence outcomes of in vitro fertilisation (IVF). Clinicians rely on ultrasound and endocrine data to monitor patients, including the determination of response and optimal timing of the trigger [1]. IVF clinics have evolved proprietary monitoring and documentation methodologies based on unit preferences and operational requirements, but there is little published information on how clinicians prefer this data to be displayed, whether this alters interpretation and decision making, or, ultimately, live birth rates.

In general, IVF cycles are personalised based on the patient's age, ovarian reserve (e.g., AMH, antral follicle count), and reproductive history. Subsequent cycles are informed by the historical response to stimulation, the trigger and laboratory outcomes. Clinicians formulate treatment plans primarily based on empirical evidence, such as the patient characteristics and unit guidelines. Thus, for a given patient, clinicians vary the protocol, FSH dose and preparation, as well as trigger dose and preparation to affect oocyte, embryo and patient outcomes. Higher medication doses may increase the total number of eggs retrieved, potentially resulting in more embryos, though high doses may affect egg quality and increase the risk of ovarian hyperstimulation syndrome (OHSS) [2, 3].

Similarly, excessive or inadequate stimulation may also negatively impact the endometrium, altering endometrial receptivity as well as pregnancy outcomes, necessitating a "freeze-all" approach in such cycles [4].

Finally, controlled ovarian stimulation has a direct physical, mental and financial impact on patients. To maximise success, clinicians need to accurately interpret and respond to each patient's cycle, including the follicle size, growth rate, endometrial thickness and morphology, as well as daily oestradiol, progesterone and gonadotropin levels.

Evidence from other areas of health care, particularly critical care medicine, has demonstrated that graphically displayed observations and colour-based scoring systems improve the detection of patient deterioration [5]. While such charts have become standard in Australian hospitals since developed by the team led by Chatterjee [6], it has been difficult to translate these insights to assisted reproduction, even though cycle data presentation is critical for clinical decision-making. Finally, there is a research gap in how this data is optimally structured and presented for the clinician, data analysis and interpretation.

Recent advances in medical imaging, data visualisation and artificial intelligence have significantly enhanced the ability to analyse complex information in real-time. The complexity of these variables renders the process highly suitable for artificial intelligence analysis. CHARLI is a validated new-generation AI deployed in a clinical setting with the capacity to provide real-time analytics and visualisations [7].

This study seeks to identify and evaluate preferences for cycle data presentation with a view to improving decision-making and clinical outcomes.

3. Objectives of CRYSTAL

- To identify and describe the current processes and infrastructure for cycle monitoring and decision-making (who)
- To identify clinician preferences for key variables in IVF monitoring (what)
- To identify the preferred formats and visualisations for IVF key variables (how)
- To develop real-time visualisation prototypes
- To assess the impact of different visualisations on decision-making efficiency and accuracy in both clinical and artificial intelligence environments

4. Methodology

4.1 Study Design

This study will employ a mixed-methods approach, combining qualitative interviews, quantitative surveys and discrete decision experiments.

4.2 Study Population

- Participants: clinicians involved in IVF procedures, including reproductive endocrinologists, specialists and nurses.
- Inclusion Criteria:
    - Clinicians actively engaged in IVF-related clinical practice.
- Exclusion Criteria:
    - Clinicians not directly involved in interpreting IVF scan data.

4.3 Sample Size Calculation

The sample size was calculated in line with the review of De-Bekker Grob [8], using the Johnson and Orme methodology based on the number of choice tasks, alternatives, and the number of analysis cells [9]. The estimated sample size is 46 respondents. Allowing for a 75% participation rate, 65 participants will be recruited.

4.4 Sampling Strategy

A purposive sampling method will be used to ensure the representation of a diverse range of clinicians in terms of experience levels, geographical locations, and clinical settings.

Reproductive endocrinologists	15
Specialists	15
Early Career	15
Nurses	20

4.5 Recruitment Strategy

Participants will be invited to participate through a general announcement at national fertility conferences. Participants will follow a QR code to complete a screening questionnaire and then offered an interview time.

4.6 Data Collection

1. **Qualitative Component**
    - **e-Delphi**
        - A panel of participants will contribute in a series of structured online rounds to iteratively refine and achieve consensus on preferred data presentation formats.
        - **Round 1:** Open-ended questions to gather initial insights on presentation preferences.

        - **Round 2:** Structured feedback on synthesized themes and prototype formats derived from Round 1.
        - **Round 3:** Final prioritization **and consensus-building on optimal formats.**
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2. **Quantitative Component**
    - **Survey**: Distributed to all participants to quantitatively assess and rank preferences using Likert ranking exercises.
    - **Discrete choice experiments (DCE)**: Clinicians will be presented with hypothetical scenarios comparing different IVF scan data presentations and asked to select their preferred presentation.
3. **Data Visualisation Prototypes**
    - Prototypes of cycle monitoring data visualisation will be developed based on clinician responses, existing literature, clinic guidelines and case scenarios.
    - clinicians will evaluate these prototypes during interviews and surveys.

4.7 Data Analysis

- **Qualitative Data**: Thematic analysis will be conducted to identify recurring themes and insights from interviews.
- **Quantitative Data**: Survey results will be analysed using descriptive statistics and conjoint analysis to determine preferences and trade-offs.
- **DCE Data**: Choice modelling techniques will be used to quantify the relative importance of different data presentation attributes.

5. Ethical Considerations

- Informed consent will be obtained from all participants.
- Participants' identities will be anonymized, and data will be stored securely.
- No identifying personal data is collected as part of the study
- This study is subject to Minimal and Low Risk Ethics Application through the University of Queensland
- All data will be collected electronically and encrypted at rest and in transit where pertinent. Data will be stored on the UQ Research Data Manager (UQRDM) platform.

6. Outcomes of CRYSTAL

- An overview of current processes and infrastructure for cycle monitoring and decision making
- Development real time visualisation prototypes based on identified key variables
- An analysis of the impact of different visualisation on decision-making efficiency and accuracy in both clinical and artificial intelligence environments

7. Timeline

- **Month 1-2**: Recruitment and development of data presentation prototypes.
- **Month 3-5**: Data collection (surveys).
- **Month 6-7**: Data analysis.
- **Month 8**: Dissemination of findings (reports, presentations, and potential publications).

8. Limitations

- Potential for selection bias due to purposive sampling.
- Generalizability may be limited to clinicians within the sampled settings.

9. Dissemination of Results

Findings will be shared through:

- Peer-reviewed journal articles.
- Presentations at relevant conferences, including FSANZ.
- Direct feedback to participating specialists and clinics.

11. Contact Information

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