The importance of KPIs in the management of laboratory outcomes in PMA

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ABSTRACT

Key Performance Indicators (KPIs) are fundamental tools for monitoring and improving quality in medically assisted reproduction (MAP) laboratories. By means of process, intermediate and outcome indicators, KPIs allow an objective assessment of clinical and laboratory performance, facilitating continuous improvement and comparability between centres. International consensus documents, such as ESHRE's Vienna Consensus and the Italian SIFES-MR/SIERR consensus, have contributed to the standardisation of indicators and their reference values. However, the interpretation of KPIs requires careful clinical contextualisation, as numerous factors, including patient characteristics and volume of activity of centres, may influence their results. Appropriate use of KPIs, embedded in a strong quality culture, can support evidence-based decisions and promote real improvement in clinical and laboratory processes.

Introduction

In the modern healthcare environment, quality of care is central to ensuring the safety and effectiveness of care. Key Performance Indicators (KPIs) are fundamental tools for measuring and monitoring clinical performance, enabling an objective assessment of processes and outcomes. In the field of medically-assisted reproduction (medically-assisted reproduction), the adoption of shared KPIs assumes a strategic role in maintaining quality standards and continuously improving clinical and laboratory performance. The growing interest in KPIs in PMA reflects the need for reliable, validated and reproducible parameters, capable of supporting clinical practice and favouring comparability between centres, while respecting the differences related to the population treated (ESHRE Special Interest Group of Embryology & Alpha Scientists in Reproductive Medicine, 2017; Scott & de Ziegler, 2020).

KPIs and relevance in healthcare

KPIs are quantitative indicators designed to concisely measure the performance of a system against pre-defined objectives. In reproductive medicine, they make it possible to monitor both

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technical processes and clinical outcomes, supporting decisions based on objective evidence. In order to be truly useful, KPIs must possess specific methodological characteristics: clinical relevance, validity, reliability, reproducibility and sensitivity to change. Moreover, their interpretation must always take place in an appropriate clinical context, avoiding a purely numerical reading of the results. In the PMA laboratory, these indicators make it possible to identify deviations from the expected standards, to analyse any operational criticalities related to both procedures and operators, and to assess the impact of corrective interventions with a view to continuous improvement.

The role of scientific societies

A turning point in the standardisation of KPIs in PMA è represented by the Vienna Consensus published by ESHRE in 2017, which defined for the first time a shared framework of performance indicators for Embryology laboratories (ESHRE Special Interest Group of Embryology & Alpha Scientists in Reproductive Medicine, 2017). In Italy, the joint SIFES-MR and SIERR document further integrated clinical and laboratory indicators into a shared model of quality assessment in IVF (Vaiarelli et al., 2022). In this consensus, standardised parameters are identified to monitor quality, safety and efficacy of treatments, including ovarian response rates, clinical pregnancy, live birth rate (LBR) and laboratory indicators such as fertilisation, blastocyst development and post-thaw survival. The document also proposes reference values and proficiency thresholds to facilitate internal quality control and comparison between centres.

Relevant KPIs in PMA and standardisation of practices

In the 2017 Vienna Consensus, KPIs in PMA are divided into process indicators (assessing how procedures are performed), intermediate indicators (measuring biological outcomes along the pathway) and outcome indicators (measuring the final clinical outcome). Among the most relevant laboratory KPIs, fertilisation rate, cleavage rate and blastulation rate represent central parameters for the assessment of technical quality and operational efficiency (ESHRE Special Interest Group of Embryology & Alpha Scientists in Reproductive Medicine, 2017; Fabozzi et al., 2020). A 2020 study critically analysed the effectiveness of different KPIs in evaluating a PMA laboratory as a whole, highlighting how not all indicators have the same informative value and underlining the need to select parameters that are truly representative of laboratory performance (Fabozzi et al., 2020). The standardisation of definitions and calculation criteria remains an essential element to ensure meaningful comparisons between centres.

Practical use of KPIs: benchmarking and operator evaluation

In addition to overall laboratory evaluation, KPIs can also be applied to the analysis of individual operator performance. However, the use of personal KPIs carries the risk of interpretation bias if

not properly corrected for confounding factors. The study by Mauchart et al. introduced an artificial intelligence-based benchmarking model that can analyse large datasets to be adjusted for clinical variables, reducing the risk of improperly attributing outcome variations to individual operators (Mauchart et al., 2025). This approach allows for a more equitable evaluation geared towards educational improvement rather than punitive purposes.

Limits and Criticisms; in the use of KPIs

In spite of the advantages, the use of KPIs in PMA has significant limitations. Many outcome indicators are strongly influenced by variables not directly controllable by the laboratory, such as maternal age, ovarian reserve or severe male factors (Scott & de Ziegler, 2020). The absence of adequate statistical corrections may lead to misleading interpretations. Furthermore, in centres with a low volume of activity, random variability may compromise the statistical reliability of KPIs. It is therefore necessary to consider minimum sample size thresholds and to adopt appropriate analysis models (Mauchart et al., 2025). Finally, an improper use of indicators may incentivise behaviours oriented towards the optimisation of numerical data rather than towards the real improvement of the clinical process, highlighting the importance of integrating KPIs into a shared quality culture (Scott & de Ziegler, 2020). Further recent studies have examined the influence of specific clinical variables on laboratory KPIs, as in the case of different ovarian stimulation programmes, showing how such factors may affect some intermediate indicators and thus require contextualised interpretation of the data. The standardisation of definitions and calculation criteria remains a must to ensure meaningful comparisons between centres.

Conclusions

KPIs are fundamental tools for quality management in PMA laboratories, allowing objective monitoring of performance and encouraging continuous improvement. Starting from the Vienna Consensus of the ESHRE to the recent Italian SIFES-MR/SIERR consensus, the definition of standardised indicators has helped to promote transparency, comparability and harmonisation of clinical-laboratory practices (ESHRE Special Interest Group of Embryology & Alpha Scientists in Reproductive Medicine, 2017; Vaiarelli et al., 2022). However, the value of KPIs depends on their correct selection, interpretation and clinical contextualisation. Only through an integrated approach, combining quantitative indicators, professional expertise and structured governance, can KPIs fully express their potential as tools for quality and improvement in the field of PMA.

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