Novel Machine Learning Model Developed to Optimize Embryo Selection for Frozen Embryo Transfer (FET) and to Calculate Appropriate Number of Embryos Recommended for Embryo Banking

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Embryo selection for Frozen Embryo Transfer (FET) is routinely based on subjective parameters. In most modern In-Vitro Fertilization (IVF) labs a quantitative approach for embryo selection is not available. In order to determine which factors affect FET pregnancy rates, a de-identified data set was acquired, including 1254 patients and 8595 total embryos. 1233 embryos were transferred, 802 (65%) resulted in pregnancy, 665 (54%) in clinical pregnancy, and 641 (52%) had positive FHTs. The data set was analyzed to identify correlations between variables and pregnancy success rates, ANOVA confirming their significance. Embryo grade, day of blastocyst development, biopsy technique, and PGTa were identified as factors affecting pregnancy ($P<0.05$). The data set was modeled using machine learning. Resulting models demonstrated AUCs of 0.626, 0.630, and 0.584 for logistic regression, Least Absolute Shrinkage and Selection Operator (LASSO), and random forest, respectively, which is consistent with existing IVF literature. The relatively low values of AUC are because most transferred embryos in the data set have been used after PGTa, which greatly increases chances of FET success. These models were then used to create a graphical app where inputting various information (age, embryo grade, day of development, PGTa) can calculate pregnancy potential, along with a confidence interval for each embryo. Another graphical app was created to calculate cumulative pregnancy chances for any set of embryos, which can be used to optimize embryo banking for families pursuing fertility preservation. These new models can be used clinically to select embryos with the highest implantation potential, which can significantly improve the chances and time to pregnancy.

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