

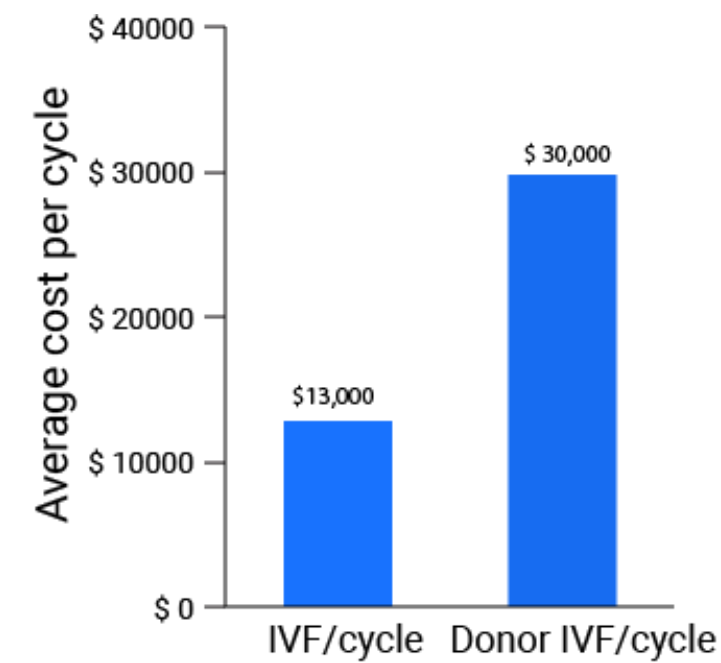
Deep-learning enables prediction of fertilization based on oocyte morphological quality

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Introduction

- Failure to fertilize oocytes can be associated with both the male and female factors. However, for certain women especially with premature ovarian failure, diminished ovarian reserves or genetically transmittable diseases, donor egg may be the only available option in giving birth to a healthy child.
- Addition of donor eggs to a cycle significantly increases the patient's out-of-pocket costs [1].
- Obtaining premium quality eggs that have a high chance of success may help reduce the uncertainty in patients, while potentially improve rates of pregnancy.
- Deep learning methods have shown potential in embryo evaluations and predictions [2] [3].

However, there is **no objective system** that can evaluate oocyte quality and predict its developmental potential.



Deep learning method

In this work, we have developed a deep learning-based approach that evaluates oocytes based on their morphology and predicts their fertilization potential.

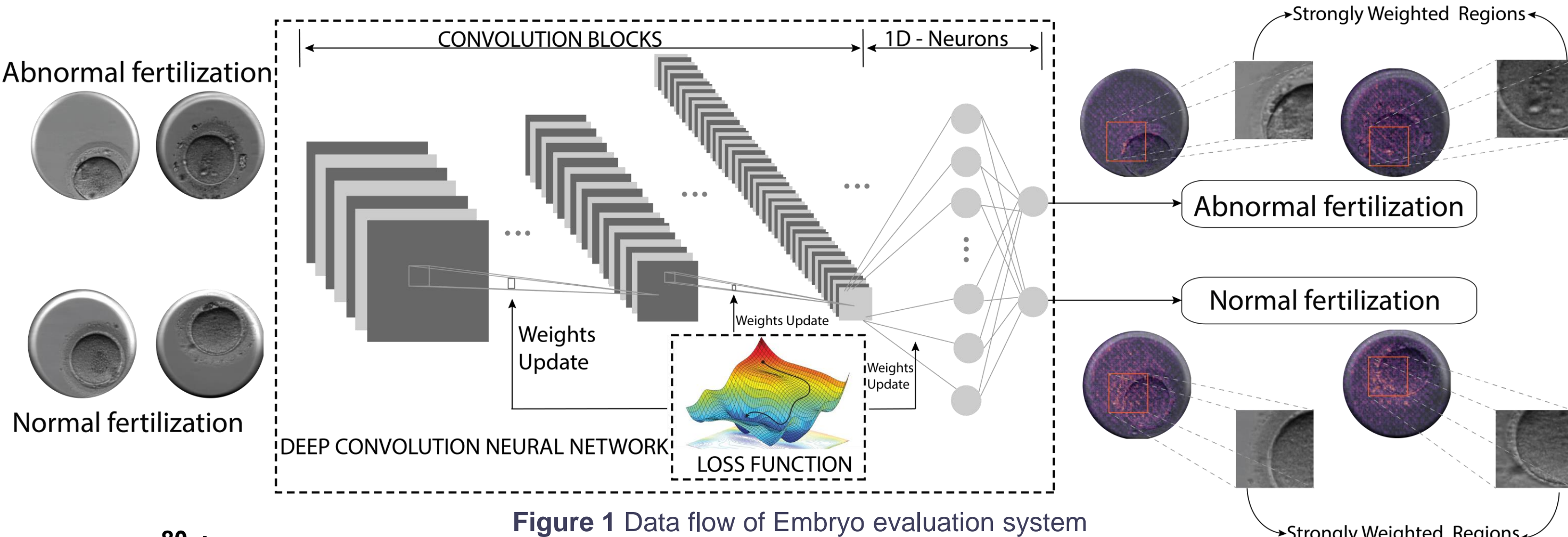


Figure 1 Data flow of Embryo evaluation system

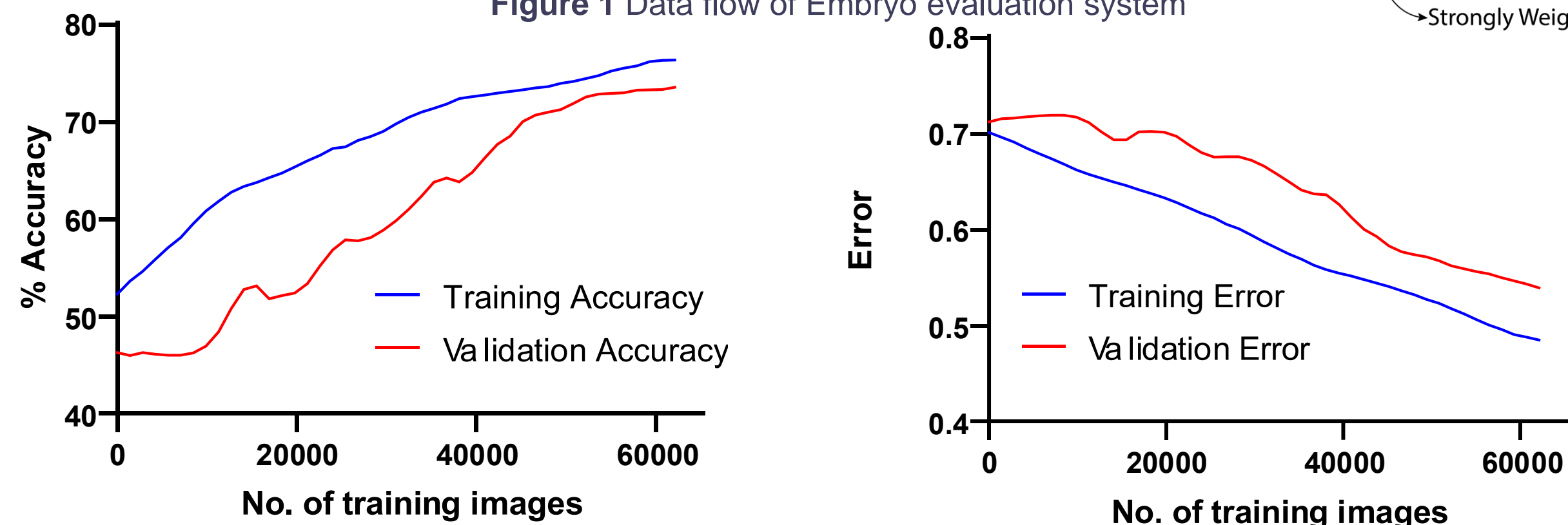


Figure 2 Training and validation curves for accuracy and cross-entropy loss

Results

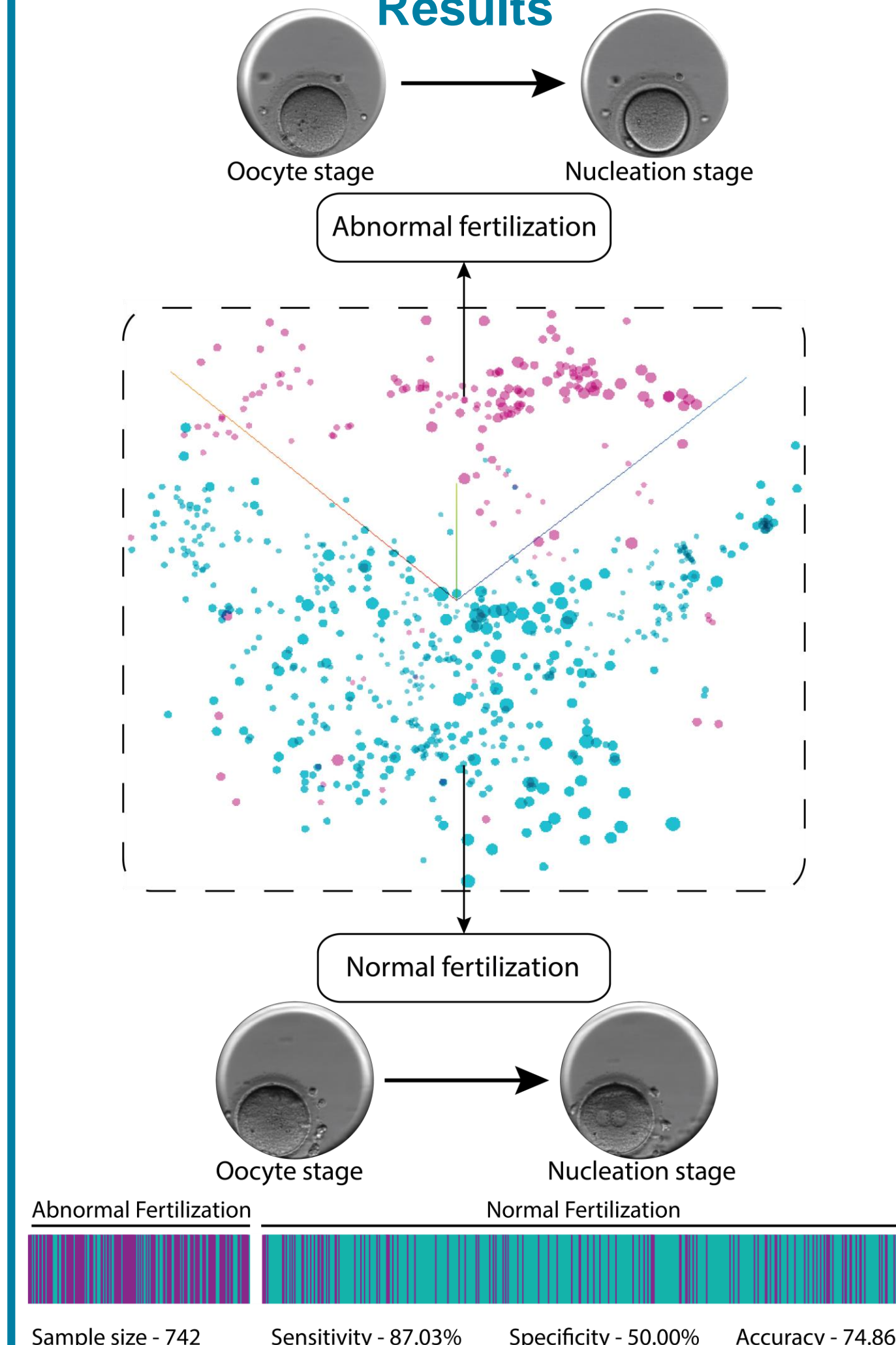


Figure 3: System performance along with TSNE and bar plot visualization (n = 742)

Receiver Operating Characteristic

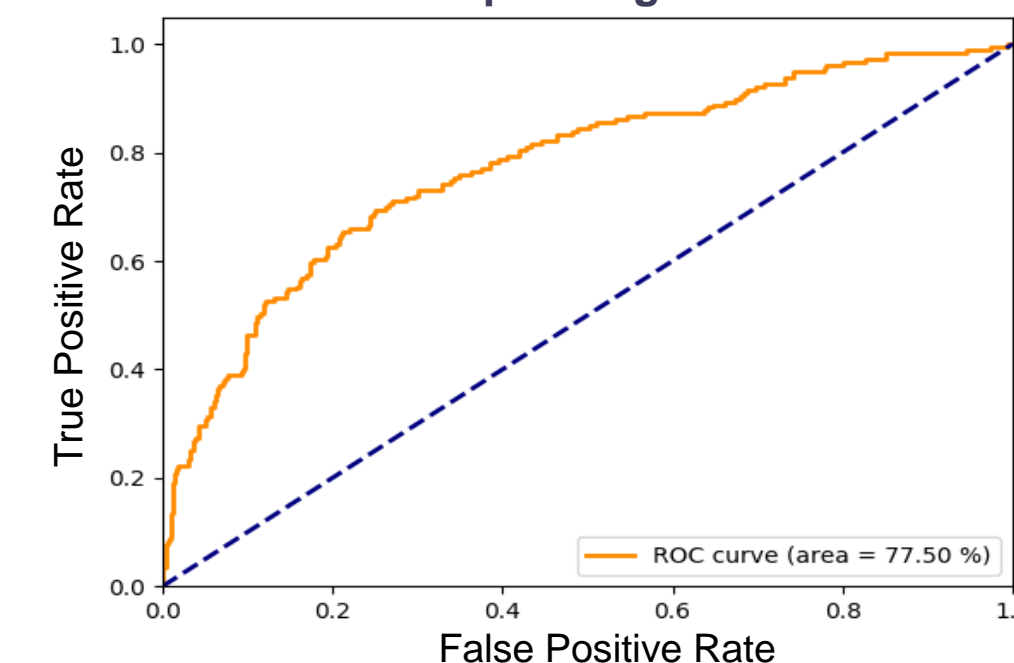


Figure 4: ROC analysis for Oocytes prediction

Conclusions

- Deep learning was used to predict the fertilization status using oocyte images.
- Our results suggest that a neural network can be used to help identify the highest quality oocytes objectively based on their fertilization potential.
- The high predictive power of the trained network can carefully select the oocytes with the promise of improving the patient prognosis.
- Studies involving other endpoints such as pregnancy and live birth are also warranted.

References

1. Chambers G.M. et al. Acceptable cost for the patient and society. *Fertility and Sterility* 2013;100(2):319–27.
2. Thirumalaraju P. et al. Deep learning-enabled blastocyst prediction system for cleavage stage embryo selection. *Fertil Steril* 2019;111:e29.
3. Dimitriadis I. et al. Artificial intelligence-enabled system for embryo classification and selection based on image analysis. *Fertil Steril* 2019;111:e21.

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