

Researchers develop formula to convert qualitative embryo grading to a quantitative ranking

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Roughly one in six couples in Canada experiences infertility, a figure that has doubled since the 1980s. Many of these couples are turning to assisted reproduction technology (ART) for help with conceiving.

Now, a new method developed by University of Saskatchewan (USask) researcher Dr. Roger Pierson (Ph.D.) and his team, including his daughter, first author and alumna Dr. Hannah Pierson (Ph.D.'13), to statistically assess the quality of human embryos for transplant success promises to revolutionize the field of ART.

In a paper published in the journal *Reproductive BioMedicine Online*, the researchers explain the formula they developed to convert the currently used qualitative method of grading embryo quality into a quantitative ranking.

"It's a revolutionary approach to understanding the contribution of the embryo in assisted reproduction therapies, and how to use the indicator embryo quality in statistical analyzes to improve therapy," he said. "Solving this problem has opened up a whole new world for us and everyone in embryology. It's a very exciting development."

The team developed the [algorithm](#) to tease out the relative contributions of the embryo, the endometrium and embryo transfer efficiency. They validated the NEQsi system with a detailed clinical analysis of more than 1,700 in vitro fertilization cycles at a single Canadian fertility center. The results showed that NEQsi score was a significant predictor of pregnancy.

The currently used Gardner grading system assigns qualitative scores to an embryo based on three visual factors: the expansion of the blastocyst (the space inside the fertilized egg); inner cell mass (cells that grow into a fetus); trophectoderm quality (cells become the placenta and membranes). Given the possible grade combinations, that works out to an unwieldy 54 possible embryo grades which combine quantitative and qualitative indicators. These broad categories obscure useful data.

Respecting the Gardner system's strength in yielding a high-quality

assessment of embryo quality in the lab, Pierson's group developed an equation, called the numeric embryo quality scoring index (NEQsi), that mathematically condenses the 54 Gardner grades to a linear scoring system ranging from 2-11 that better represents the embryo grade. This enables researchers to incorporate embryo quality into their statistical analyzes of other factors in ART.

Pierson's group is making the algorithm public and providing a NEQsi calculator so that clinics and embryologists everywhere can use it. Even patients will be able to access it to help understand where their embryos fit onto the scale and have informed conversations with their care providers about how best to proceed.

"It's a part of being a small piece of the university that the world needs—building collaborations with new university technologies and commercial entities to bring new technology to the marketplace—and we also hope to demonstrate how businesses and academia can work well together," Pierson said.

He connects the great potential of the NEQsi equation to another of his research successes at USask—a non-invasive, ultrasound-based endometrial receptivity (usER) system. His Synergyne Group of Companies reached an agreement with USask to secure the rights to the technology in 2012, and Synergyne's trademarked Matris system is used in ART clinics across Canada. Trials in clinics around the world will be initiated in the coming weeks.

Matris uses mathematical algorithms and specialized visualization technologies to assess and interpret ultrasonographic images and assigns a numeric score based on what the results predict will be the quality of the endometrial lining at the time of embryo transfer.

"It's a very important tool in helping patients increase the probability of

pregnancy at each transfer, decrease the time it takes to become pregnant, decrease the cost, and to support women through this process because they often feel personally responsible for the quality of the uterus," said Pierson.

The higher the Matris score, the higher the probability of pregnancy. Pierson said Matris has successfully raised the likelihood of pregnancy by 20 percent for fresh embryo transfer cycles and 10 percent for frozen embryos in some clinics.

"Matris is revolutionary in understanding the contribution of the endometrium. This new NEQsi system is allowing us to analyze the contribution of the embryo on a transfer-by-transfer basis. The next step is to put those two pieces together," said Pierson.

Matching all the patient parameters, embryo parameters and endometrial parameters to assess the success of the innovative approach is expected to take between 12,000 to 20,000 fertilization cycles at large ART clinics in Europe and North America, he said.

"The combination of these two technologies incorporated into leading assisted reproduction clinics will represent a highly significant improvement to the care of women globally."

More information: Hannah E. Pierson et al, A novel system for rapid conversion of Gardner embryo grades to linear scale numeric variables, *Reproductive BioMedicine Online* (2023). [DOI: 10.1016/j.rbmo.2023.01.008](https://doi.org/10.1016/j.rbmo.2023.01.008)

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