
## CHALLENGE STATEMENT #02

### 1. Challenge Owner Index and Pseudonym

**#02 – MunCHKins**

### 2. Challenge Statement

We are looking for a Solution Partner to develop a learning solution to train the embryologist to perform Intracytoplasmic Sperm Injection (ICSI) clinically.

The use of simulation technology can potentially aid in the embryologist's training process, allowing self and independent learning, and at the same time, reduce wastage of biological materials and time spent for senior trainers to coach the trainee.

### 3. About the Challenge Owner Organisation

We are an IVF Centre located within a hospital setting to provide a wide range of assisted reproductive (AR) services such as egg retrieval cum fertilization and embryo transfer, to infertile couples who face difficulty in conceiving successfully on their own. Through assisted reproductive technology, the odds of these couples who receive treatment in the fertility clinic, having a biological child of their own is raised or enhanced.

We are a team of IVF (in-vitro fertilization) laboratory scientists, also known as embryologists, involved in the daily operations of laboratory procedures and services within the IVF Centre to assist infertile couples in their treatment through the culture of their gametes and embryos. In the field of Assisted Reproductive Technology (ART), Intracytoplasmic Sperm Injection (ICSI), is one of the several IVF procedures, performed by the Embryologist.

### 4. Define the Challenge

**Current Situation**

An embryologist is a highly specialized scientist who is responsible for the in-vitro fertilization (IVF) of eggs that are extracted from the follicular fluid during the process of ART. It is an extremely steep learning curve and requires on average about 2 to 4 years to train to full competency.

Intracytoplasmic Sperm Injection (ICSI), is one of the final training modules in the field of ART, performed by the embryologist whereby a single sperm is injected into the cytoplasm of the egg to aid in fertilization. Due to the delicate and critical procedures of IVF, an embryologist is required to undergo specialized training and extensive practice before being able to perform clinically.

The process to train an embryologist for ICSI is very steep, prolong and labour-intensive which entails an estimate of 3-12 months of clinical training in this procedure to perform independently. Due to the intricate setup and operational requirements of the equipment and the hand-eye coordination to

operate this equipment effectively is not a natural process, hence requires lots of time and practice. The embryologist is first required to visualize the concept of three-dimensional space and depth to sharpen their visual motor skills using their eyes and hands. After which they will be required to learn how to use a set of micromanipulators, under the view of the inverted microscope at high magnification, to manoeuvre the micromanipulators, involving joysticks (https://uk.narishige-group.com/), which then translates into movement of the micro tools to manipulate the human egg and sperm for injection. Aside to the lengthy practice time which often compels both the trainer and trainee to stay back beyond clinical work hours, the training also requires the use of limited biological material (donated sperm and egg). Only until they have mastered the skill of visual-motor coordination using their eyes and hands, will they then be ready to move on to the next phase of training for the actual clinical procedure.

Embryologists are not the only ones who need to learn how to use these micromanipulators, people in the field of research also need to use this exact setup to perform microinjection of molecules (eg genetic material, stem cells, etc) and hence will require the same kind of intensive training prior to operating on the actual equipment.

Due to the stringent and labour-intensive requirements of ICSI training, groups in the scientific community have tried other methods to replace/automate the training. Previously, a group in Italy (Abate et al, 2010) attempted to use virtual reality (VR) to assist in ICSI training using visual-haptic interface. However, due to the weight of the exoskeletons used, it was not ergonomic for long term use, resulting in fatigue. Other groups (Faroque et al.,2015; Ammi and Ferreira A, 2012) used VR with similar interfaces to inject biological cells. However, limitations included the need to optimize the haptic technology and to provide more immersive representation and guidance to the operator.

**Past & Current Solutioning Efforts**

This is an area which has been left relatively untapped due to much focus on daily operational activities within the laboratory, rather than training and education. Simulation technology was still novel and in its infancy a decade ago. This will be the first in innovation to reduce this training crunch faced by embryologists. Hence, there is currently no data (e.g. how many turns on the knob to inject, joysticks on the micromanipulator, degree of freedom of force used) available yet in creating this innovation.

**Challenge / Gap / Unrealised Potential**

If this training gap is not bridged, the current conventional method of training shall persist, consuming much time and manpower on training an individual. The trainee embryologist is allowed hands-on practice on the ICSI technique, in the presence or guidance from the mentor embryologist (1-on-1 and face-to-face) during the initial phase of their training on the equipment. Thus, the trainee embryologist has to coordinate his/ her training time with that of the mentor embryologist's availability to familiarise with the equipment and technique swiftly before he or she can adequately practise at their own time. Aside to coaching the trainee intensively, the mentor has to focus on the heavy clinical demands at other times.

If this learning challenge is not solved, training remains less sustainable with the use of more biological waste subjected to practice for the training. More time will be spent by the trainee on the actual equipment and allowing less efficient usage of the equipment for daily operations. The risk of trainees causing accidental damage to the expensive equipment due to inexperience while training remains. The use of actual equipment for training also gives undue stress to the trainee which can potentially impair their progress in training.

## 5. Targeted Learners / Users

Trainee embryologists who are usually young, entry-level working professionals in healthcare who have to juggle both clinical lab work and on-the-job training (OJT) for entrants in their initial years in the profession. A typical workday involves carrying out clinical procedures, performing administrative duties and setting aside spare time for their training on one or two procedures depending on their learning capabilities (adaptive learning).

Trained embryologists who are licensed and have already gained competency in their day-to-day clinical procedures who can utilize this solution tool to ensure that they remain highly competent in their ICSI skill set.

There are approximately 50 embryologists currently in Singapore. The primary targeted user population will be the embryologists in our Centre, i.e. approximately 2-3 trainee embryologists, as well as 10-12 trained embryologists (refresher training) per year, in addition to approximately 220 man-hour savings for the trained embryologist to supervise training.

The secondary targeted user population will be targeted at all embryologists (both trained and trainees) locally and internationally if the solution can be developed commercially and marketed across the IVF Centres in Singapore and overseas.

The estimated number of embryologists worldwide is about 68,000 (~15K in APAC; ~29K in USA/ Latin America; ~24K in Europe/ Middle East). Taking into consideration that at least 20% of the embryologist pool are trainees, there will be approximately 13,600 embryologists who will need to train for ICSI and can potentially use this tool to aid in their training.

Beyond the clinical field, we can reach out to the research community who may wish to deploy this solution for training on microinjection as a prerequisite prior to actual research deployment.

## 6. Deliverables

The ideal Solution Partner should present with expertise in collection and building of datasets with data analytics capabilities, they should also be equipped with experience in technology platforms involving motion or immersive experiences and gaming tools as well as troubleshooting. These outcomes should be quantifiable with feedback responses to both trainees and trainers for further improvements or test of competency to qualify for next level of training.

## 7. Expectations of Solution

The solution must take place in an indoor setting, within an enclosed room void of disturbances from surrounding, within the IVF Centre.

There is currently no dataset available yet. Hence the solution partner will need to have this ability to collect current dataset pre and post, and use data analytics to analyse and generate information to continuously improve the training outcomes or for test of competency.

The solution should preferably include both a hardware and software component to allow complete immersion of the learning experience; without ruling out the possibility of the software being accessible by both the trainer and learner from home.

The solution should involve equipment that are portable and lightweight to enable easy transportation between the workstations should the need arises.

The solution should allow a pilot testing phase to include testing the software and troubleshooting for program bugs, to also allow fine tuning of the software such as optimizing the responsiveness to the functional requirements in ICSI to suit our training application needs.

The training schedule for the embryologist is already very rigorous, highly stressful and time consuming. Hence the solution should make learning and training light hearted and more importantly enjoyable; and yet at the same time still able to guide the learner trainee through the various stages of learning how to manoeuvre the various micromanipulators in the motion environment to experience the 'feel' of catching sperm, rolling and holding the egg, up to the point of injecting the sperm into the egg successfully. Through this, we expect the trainee to become proficient in 3D visualization and be able to accomplish and achieve small wins as part of various stages of overall completion.

The solution must have a timer mode incorporated to avoid over-usage of the learning tool to prolong its shelf-life and reduce eye and arm strain on the user.

The solution should involve 2 phases of training – initial phase where it is trainer-led to allow sufficient contact or coaching time between the trainer and learner to ensure proper guidance and assimilation of knowledge of the equipment and hands-on skills; the second phase where learner undergoes self-learning through interaction with the tool.

The solution should have the potential to allow the choice option for the user or trainer to create a proficiency assessment for experienced or senior embryologists who are already competent in ICSI to undergo an internal audit of their competency or an assessment as a form of an entrustable professional activity (EPA) to ensure they remain clinically proficient in ICSI.

The solution must have the ability to provide feedback to the learner on their performance in both phases of their training.

The solution should have the potential for the software to enable more than 1 trainee to be trained in the procedure at the same time or period, to save time and improve the efficiency of training.

We are working in a busy clinical laboratory setting and are quite limited with available time slots for discussions and hence will require the Solution Partner to be flexible in timing to meet our needs.

## 8. Measures of Success

1. 50% reduction in turnaround time in learning ICSI

2. 50% improvement in learning outcomes
3. 100% pass rate for trainees attempting learning tool.