HOW i3 SIMULATIONS IS MAKING CUTTING-EDGE VR SIMULATION TRAINING FOR HEALTHCARE ROBUST, SCALABLE, COST-EFFECTIVE.

i3 SIMULATIONS' RESUS VR MADE MANDATORY FOR TRAINEE DOCTORS AT CCU'S

Resus VR was aimed at the healthcare market and targeted towards solving problems that occur in training staff for high-stress, critical care environments. It is aimed to train junior doctors and other medical staff in CCU's across hospitals.

EXECUTIVE SUMMARY:

Resuscitation VR is an application built on i3 Simulations' proprietary platform GAIA, and has been designed for training medical professionals to practice and refine critical decision-making in a safe, repeatable, cost-effective and intuitive environment. Doctors around the world) have now started using i3 Simulations's **Resuscitation VR** as a compulsory module to training doctors to diagnose and resolve critical emergencies (like seizures, anaphylaxis) while in a high-pressure, simulated environment. For i3 Simulations, **Resuscitation VR** started as a pilot study (pilot project) in partnership with Children's

Hospital Los Angeles (CHLA), and Oculus and after this pilot study proved to be a success, the application became a mandatory part of staff training at the hospital and is now in the process of being deployed to hospitals around the world. i3 Simulations was the lead developer, responsible for developing all simulations, testing and integrating the modules on platforms, collecting and deploying builds based on feedback from doctors, all analysis and data collection.

Resuscitation VR modules are scalable, which means that additional procedures can be designed and developed using same master framework. We have already received requests to build modules for other emergency critical care procedures and the framework has been very useful for this.

CHALLENGES:

Resuscitations are stressful healthcare events

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that are frequently and traditionally explored through manikin-based simulations because of their high-stakes, low-frequency nature. These scenarios include critical situations ranging from neurological emergencies to cardiopulmonary arrest and are known to be a source of significant mental load and stress.

Much of the stress experienced by a resuscitation team leader comes from the need for rapid information processing, situational awareness, and decision-making, rather than in the physical tasks, which are left to other team members. Virtual reality has the capacity to provide a high level of audiovisual immersion because it allows the real environment to be completely recreated. Careful development of the audiovisual environment enables VR simulation to fully immerse the subject as a form of experiential learning.

The challenges that CCU's face are giving trainee/junior doctors a safe environment that replicates high stress scenarios and reduces the dependency on manikin- based training which are expensive and require the presence of a senior medical professional.

i3 Simulations' VR solved these problems and based on intensive testing was able to deliver training modules that are scalable and more cost-effective.

ABOUT RESUS VR

1. Resuscitation VR is split into modules (often referred to as scenarios) that focus on a particular type of patient/emergency.

2. Each module places the user as the lead physician in the room, who must make decisions and perform tests to diagnose and stabilise the patient.

3. Modules have a lot of similarities such as layout of the environment and characters, but the patient and symptoms always vary, there are differences in what medications and tools

are available, and most crucially, the steps to resolve the problem are always different.

4. Each module also varies the VR experience depending on the skill level of the user.

5. Beginner modes offer simpler problems and helpful suggestions from staff, whereas in Advanced modes the standard protocol may not be effective and the characters around the lead physician will be much more stressed and less patient with mistakes.

6. The first modules of Resuscitation VR were designed to reflect two common paediatric resuscitation scenarios (infant status epilepticus and paediatric anaphylactic shock) and situated the user at the foot of the bed as code leader.

7. Both scenarios had significant airway, breathing, or circulation problems that matched an emergency severity index (ESI) 1 or 2 resuscitation.

8. Hand-held controllers allowed the user to select appropriate physical examinations and treatment options.

9. Both scenarios used branched-chain algorithms to alter the virtual patient's physiology beneficially or adversely, depending on the user's actions.

RESULTS, RETURN ON INVESTMENT AND FUTURE PLANS

As well as offering a safe place to practice, Resuscitation VR also captures information about each session, ranging from what stimuli are presented to the user, events that occur and what decisions the user is making (as well as the consequences of those decisions). All of this data is uploaded to i3 Simulations' servers in real-time, and at feedback to help the user understand how they could improve. As well as receiving feedback at the end of the session, there is also an online portal

where users can log in and review their session history. Resuscitation VR modules have been tested for over 2 years by doctors and medical staff. After intensive testing and a published medical study (see attachment), Resuscitation VR was rolled out in April 2019 and has been adopted by over 11 hospitals as a standard training that all junior doctors and medical practitioners in CCU's undertake. This is an important differentiator as the modules have been vetted by doctors for doctors, and the module is now live in 11 hospitals across the globe.

- Doctors have found it to be more cost-effective than manikin- based training which makes it scalable and builds a business case for easy adoption across CCU's.

- After the success of the 'paediatric' modules we have had requests for 'adult modules' to be built and are in the process of rolling these out.

- We have had first-hand feedback from doctors (see case study below) and an intensive study was conducted independently by CHLA to measure the impact of the VR resuscitation modules and benchmark it against existing training modules.

- The initial results were so promising, CHLA now requires that the training is mandatory for all incoming residents and offers it as an optional supplement for med students.

- Unlike other VR simulations & training solutions that are often stuck in the pilot stage, we have working modules live in hospitals.

i3 Simulations was the platform programming partner for this project which started as a pilot study. Children's Hospital Los Angeles (CHLA) partnered with Facebook, Oculus and i3 Simulations to create and deploy medical VR simulations that replicate peadiatric emergencies difficult to train and prepare for in real life. The group developed VR simulations in a pilot study by CHLA doctors researching whether the immersive technology could be useful for training medical students and residents. The results were extremely positive. Data from the study was analyzed through 2018 and the results were shared by the principal researchers on the pilot, Dr. Todd Chang and Dr. Josh Sherman.

EFFECTIVENESS OF VR IN HIGH-STAKES CRITICAL CARE ASSESSMENT

"This study validates that VR is an effective tool for high-stakes assessment," Chang said in a statement. *"By piloting the initial VR modules on a variety of physician types, we have a better idea now on how and when to best implement VR. We are using that momentum to investigate best practices for training more novice providers."* Encouraged by the results,

the doctors are now making VR training required for incoming residents and optional for med students. Chang added, "We discovered that VR training modules should be targeted towards younger, less experienced trainees. That's why the CHLA residency program and hospital have greenlit VR as part of a required curriculum for our interns prior to setting foot in our emergency department."

COST-EFFECTIVENESS & SCALABILITY

The CHLA VR project has since attracted interest from peadiatric medical professionals wanting to find more efficient, cost-effective, and customizable training solutions for their students, staff and residents. It has now been rolled out to the following hospitals:

Resuscitation VR is currently live in the following locations:

- Children's Hospital Los Angeles
- Allgemeines Krankenhaus Wien, Medizinische Universität Wien (Vienna General Hospital & Medical University of Vienna)
- INSELSPITAL, Universitätsspital Bern
- (University Hospital of Bern)
- John Hopkins Hospital
- Yale University
- Columbia University
    - University of Alabama Birmingham
    - Stanford University
    - University of Washington / Seattle Children's
- NYU (New York University)
- Ojai Valley Community Hospital
- Kaiser Permanente Hospital (Southern California)

SOLVES A PROBLEM

Kathryn Schaivone, certified health care simulation educator at Kaiser Permanente Hospital said,

"Currently we are only able to run critical events

such as paediatric resuscitation training two to four times per year since we cannot take our teams away from patient care more frequently." "VR levels the playing field in a way that doesn't happen with in-person methods and provides the flexibility for more frequent participation in simulation."

"A limitation of many outpatient offices and care centers is lack of space for simulation rooms and simulation centers," explains principal researcher on the project Dr. Josh Sherman. "Using Oculus Go for our VR modules will allow for on-the-spot training without the need for the extra real estate."

Sighting the impact VR can have on the future of medical simulation training, Sherman said, "As more hospitals are staffed by non-pediatric specialists, it is of utmost importance now to have easily distributed and performed methods of training for pediatric emergencies and urgencies. VR provides a solution that addresses the portability, asynchrony, and strong psychological fidelity required for effective experiential learning and training."

RETENTION

Rachel Umoren, a doctor at University of Washington and Seattle Children's Hospital, "Immersive VR simulations help learners build new memories through realistic experiences that traditional methods cannot provide". "Doctors and other health care providers can repeat a task over and over in the simulation with standardized feedback, honing and perfecting their skills," While childhood seizure and shock were targeted as the first two resuscitation procedures to translate into VR simulation, the doctors look forward to expanding the variety of modules that will be created.
"Now that we have the proof-of-concept, we're thinking about other skills and medical scenarios that are considered low-frequency, high-stakes within our field and in larger fields such as emergency medicine, critical care, obstetrics," said Chang.

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