BOSTON CHILDREN'S HOSPITAL

FY 2022 ANNUAL REPORT

Immersive Design Systems

Transformative experiences for healthcare

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DR. PETER H. WEINSTOCK, MD, PHD

EXECUTIVE PROGRAM DIRECTOR
ANESTHESIA CHAIR IN PEDIATRIC SIMULATION
SENIOR ASSOCIATE, CRITICAL CARE MEDICINE
ASSOCIATE PROFESSOR, HARVARD MEDICAL SCHOOL

Dear Colleagues-

It is with great pleasure that we present to you our Annual Report for 2022 highlighting the remarkable accomplishments, breakthrough innovations, and transformative initiatives that have propelled us forward.

For over 20 years, IDS has embraced innovation as the driving force behind our success. Our commitment to pushing boundaries, challenging conventions, and fostering a culture of creativity has enabled us to remain at the forefront of the rapidly evolving landscape of immersive technology and innovation @ healthcare.

IIn the past year, we have witnessed tremendous growth and transformation across various fronts. Our dedicated team of talented individuals has tirelessly pursued ambitious projects, resulting in groundbreaking developments that have supported safe, quality care, and saved lives.Through collaboration and perseverance, we have continued to redefine possibilities, empowering the BCH community, at home and abroad, to stay ahead of the curve.

One of our key achievements this year has been the successful launch of our new name Immersive Design Systems to describe most fully all we do among three major pillars of cutting-edge products and services across - training, human-centered systems design, and in-house device engineering. Additionally, by harnessing the power of emerging technologies such as 3D printing and Virtual Reality, we have delivered innovative solutions that have propelled 1000's of staff, programs and departments towards optimal efficiency, productivity, safety and outcomes.

As we reflect upon the achievements of the past year, we recognize that none of this would have been possible without the unwavering support and trust of you all, our partners, and stakeholders. I personally express my heartfelt gratitude for your continued faith in our abilities to deliver the highest quality experiences, devices and services, and in our commitment to continuous and deep collaboration.

I invite you to explore the enclosed Annual Report and am confident that you will be inspired by the remarkable progress, that together, we have made and the promising trajectory that lies ahead.

Once again, my deepest gratitude for your support and partnership. We are excited to continue our journey together, harnessing the power of immersive technologies to create a healthier future.

With Warmest Wishes,
Peter

JENNIFER ARNOLD, MD, MSC

PROGRAM DIRECTOR, IDS

Dear Colleagues,

I want to echo Peter's warm wishes. Earlier this year, I joined the IDS program here at Boston Children's Hospital. In the brief time I have been here, I have been incredibly proud of the work that our program does for both our patients and families and to our colleagues throughout Boston Children's Hospital.

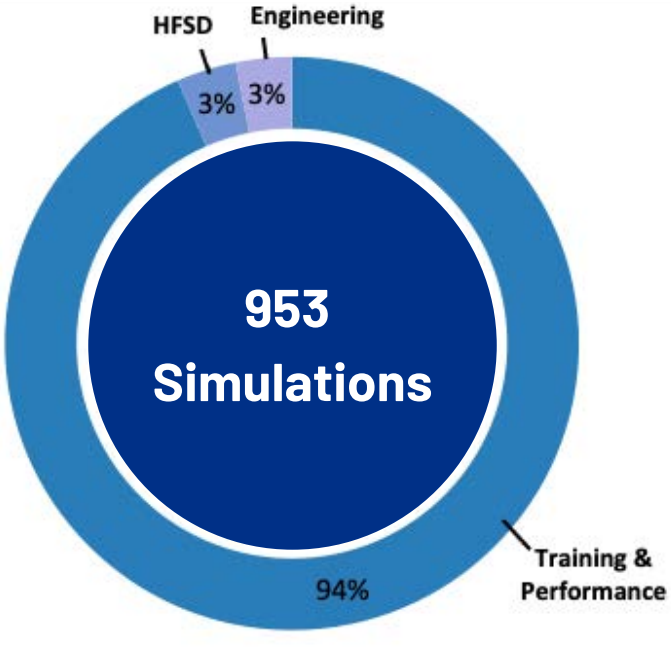
Our new rebranding shines light on the power of the work that we do: training BCH staff for optimal performance, designing better systems, and engineering impactful devices and solutions to help us provide the best care possible. I am so excited to be part of both the IDS team and Boston Children's Hospital and to continue our work together. The future is bright with IDS in sight.

Warm wishes,
Jen

BY THE NUMBERS

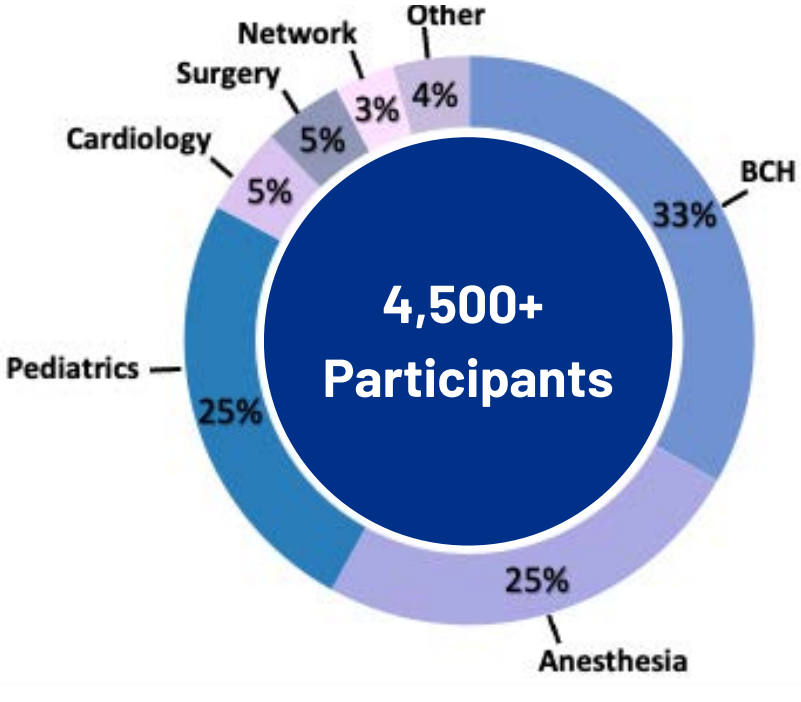
Simulations by Pillar

In FY 22, IDS delivered 953 simulations, which spanned across all of our pillars: Training and Performance, Human Factors and Systems Design, and Device Design and VR Solutions.



Simulations by Department

IDS partnered with myriad departments across Boston Children's to address critical training and testing needs.



TRAINING & PERFORMANCE

EQUIPPING CLINICIANS WITH ESSENTIAL SKILLS & KNOWLEDGE TO OPTIMIZE CARE

The Training and Performance team works closely with clinical partners and patient families to design customized instructional programs to address gaps in knowledge and skills to improve provider performance and maximize patient safety. IDS simulations range from low fidelity skills trainings and contextual medical simulations to advanced team training utilizing high-fidelity environments and technology to closely replicate the clinical environment.

During these immersive courses, psychological safety is imperative to ensure that everyone can voice their ideas in a judgement free zone. Such an environment allows for an effective and meaningful post-simulation debrief to identify best practices and areas for improvement.

First 5 Minutes of an Emergency Response

Emergency situations unfortunately do occur in every unit, including outpatient Cardiology. This makes it imperative that clinical staff respond in an organized and efficient manner. Patricia Burke, RN, and Theresa Quinn, RN, created a simulation tailored to the outpatient Cardiology Clinic, focused on the role of the nurse Event Manager and developing skills to effectively manage an acute medical situation. Nurses in the clinic are frequently the first clinical staff responding to emergencies in the first five minutes prior to additional support arriving.

Through this course, nurses have been able to enhance their emergency response skills while streamlining care and coordinating a multi-disciplinary team in preparation for the ICU and code teams to arrive. Skills learned through this course include emergent formation of a team at the point of crisis, closed loop communication and role clarity. At this time, clinical staff have participated in two training sessions and the goal is to continue these session until all staff have been trained – followed by ongoing refresher courses. Feedback thus far has shown that participants are more confident in their ability to respond to emergencies in the clinic.

Efficient ED Triage

IDS partnered with the Emergency Department (ED) staff, the Program for Patient Safety and Quality (PPSQ), and the Enterprise Project Management Office (EPMO) to address the patient triage process, including technology, workflows, staffing models and the environment. The project was initiated in response to the surge in patient numbers and high acuity, exacerbated by an increase in behavioral health admissions that coincided with the COVID-19 pandemic. Phase one, the integration of technology to screen patients, has been initiated – additional recommendations that stemmed from observations, staff interviews, and tabletop exercises are being considered as potential solutions by hospital leadership.

Improving Sepsis Management

In an effort to improve BCH sepsis indicator scores against national benchmarks, IDS partnered with PPSQ, nurse and resident education, and the sepsis committee to assess current practice and address gaps in the initiation of the sepsis bundle. Failure points and additional areas of improvement were identified and the project team is currently developing a multi-pronged approach to educating staff in order to decrease the time between the identification of sepsis and administration of antibiotics. This project started as an inpatient medicine nursing initiative and has the potential to impact patient care across the institution.

Simulation Training to Maximize Human Performance

Due to the emphasis of early mobility for critically ill patients, the Department of Physical Therapy and Occupational Therapy (PT/OT) noticed a lack of comfort and/or confidence mobilizing patients who are being supported via mechanical ventilation while intubated.

They also noticed a gap in knowledge around positioning of the tubing to ensure the patient's airway is maintained safely while still achieving the highest level of mobility a patient is capable.

Working with IDS, PT/OT created two high-fidelity training courses that provide their team a space to practice direct patient handling skills while being able to debrief and conceptualize their skills to enhance safety awareness, comfort, and confidence.

PT/OT ICU Orientation

All new PT/OT practitioners are oriented to BCH with simulation to become more confident in an ICU setting where patients are critically ill. Participants become accustomed to basic handling of patients with ICU equipment and repositioning of the patient. This course is then repeated a few months after hire to allow for real-life practice and self-reflection.

Mobilization of Mechanically Ventilated Patients

PT/OT practitioners are able to rehearse mobilizing patients on mechanical ventilation alongside respiratory therapists.

> ***IT'S GREAT WE CAN COLLABORATE WITH OUR RESPIRATORY THERAPISTS IN SIMULATION, JUST LIKE WE WOULD IN REAL TIME. FROM THIS COURSE, WE HAVE BEEN ABLE TO LEARN FROM EACH OTHER'S STRENGTHS AND HOW WE CAN COLLABORATE MORE EFFECTIVELY.***
>
> -CHLOE BAILEY, OT

During each of three simulation scenarios including one with a live actor as an intubated patient, the respiratory therapist and practitioners build trust and foster relationships that improve their teamwork to ensure both mobilization and maintaining critical airways.

One participant recently shared that the simulation completely changed her practice and that "therapists are now stronger advocates of their skills and what they are able to do."

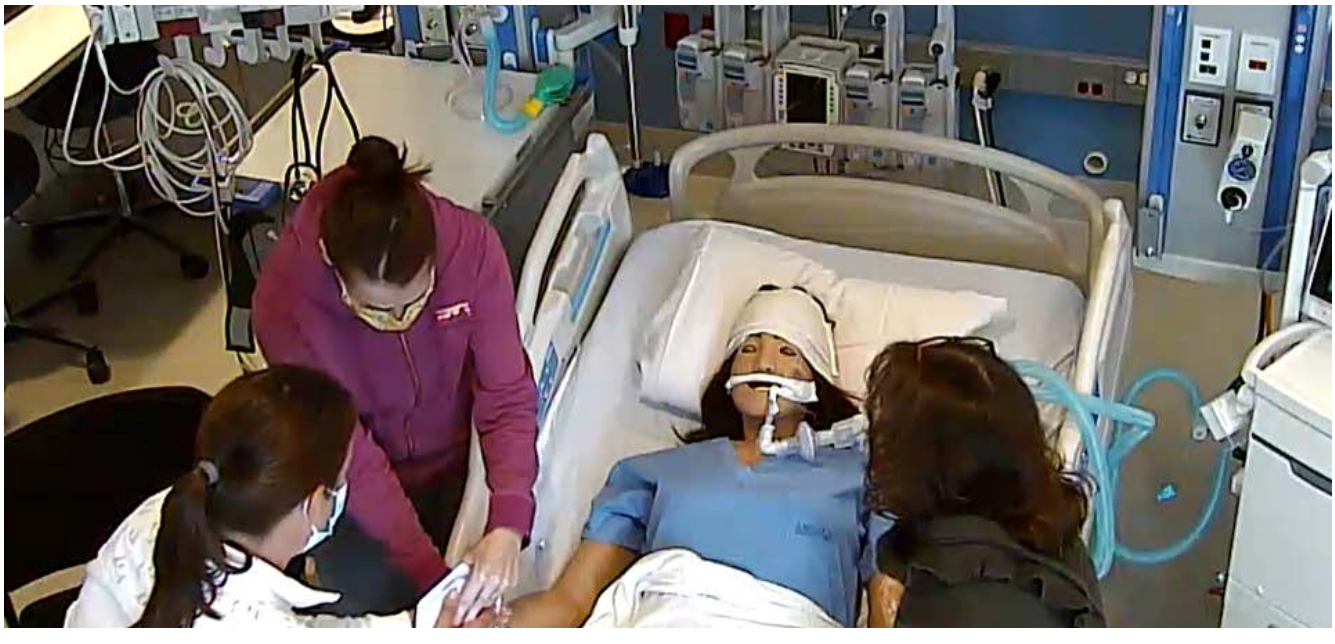
Psychosocial Simulation to Enhance Clinical Best Practices

IDS provides psychosocial simulation aligned with the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) and the National Institute of Mental Health (NIMH) best practices on suicide risk assessment.

> ***IN RESPONSE TO THE MENTAL HEALTH CRISIS AND EVER-CHANGING LANDSCAPE OF WHAT GOOD TRAINING IS, WE WANTED TO ADVANCE OUR CLINICIAN'S EXPERTISE IN HOW TO LEARN WHY CHILDREN ARE SUICIDAL.***
>
> -MATT TVEDTE MSW, LICSW, CLINICAL SOCIAL WORKER

Tvedte added that "psychosocial simulation brought something new around interpersonal communication and crisis de-escalation." Participants found the course to be realistic, appropriate, and helpful to their practice.

Using Simulation for Difficult Conversations



IDS provides a safe environment for those who will have exposure to death and dying as a challenging part of their practice. Without simulation, clinicians' first end of life conversation happens in real-life, where emotions and fears are at an all-time high. In this course, child life specialists practice offering support and resources while learning tips on posture, positioning, key phrases, and additional support. In the end-of-life simulation training, clinicians focus on sibling support and memory making with the family, followed by a debrief of how things went and how they felt during the simulation. Although a difficult and emotional course, participants appreciate that they can practice their skills.

Improving Discharge Education through Caregiver Simulation Training

Social Workers for the Aerodigestive Center and the IDS team designed a monthly simulation for new parents to learn about the Nasogastric Tube (NG) tube, how to change the taping, and how to replace the tube in a controlled, experimental, and educational way.

> *WE WANTED TO BE ABLE TO SUPPORT FAMILIES IN A CREATIVE WAY WHILE REDUCING CAREGIVER ANXIETY. BY PRACTICING THESE SKILLS ON OUR SIMULATION [MANIKINS], THEY CAN LEARN AND PREPARE WITHOUT WORRYING THEY ARE GOING TO INJURE THEIR CHILD. IT GIVES THEM THE CONFIDENCE THEY NEED TO KNOW THAT THEY COULD CHANGE THE TUBE IF IT EVER FELL OUT.*
>
> -ALI HENRY MSW, LICSW

Not only is their department seeing reduced caregiver anxiety and greater confidence, but they are also hoping that this course will reduce emergency room visits, clinic calls, and overall reduce the burden of accessing healthcare when a tube falls out. Henry added, "Having a group of families take the course together reduces the feeling of isolation that parents of children with NG tubes often feel."

Human Factors and Systems Design

OPTIMIZING HEALTHCARE PROCESSES, ENVIRONMENTS, AND CARE

The Human Factors and Systems Design team transformed the unknown into second nature for BCH staff with the move into the new 12-floor Hale building. By using immersive, simulation-based testing methods, IDS worked with units to define patient care in new environments. Simulation redesigned workflows and built predicable, repeatable processes to ensure a safe health care environment for patients and staff.

Hale Engagement Summary

50
ACTIVITIES

20
IN-SITU SIMULATIONS

16
DEPARTMENTS

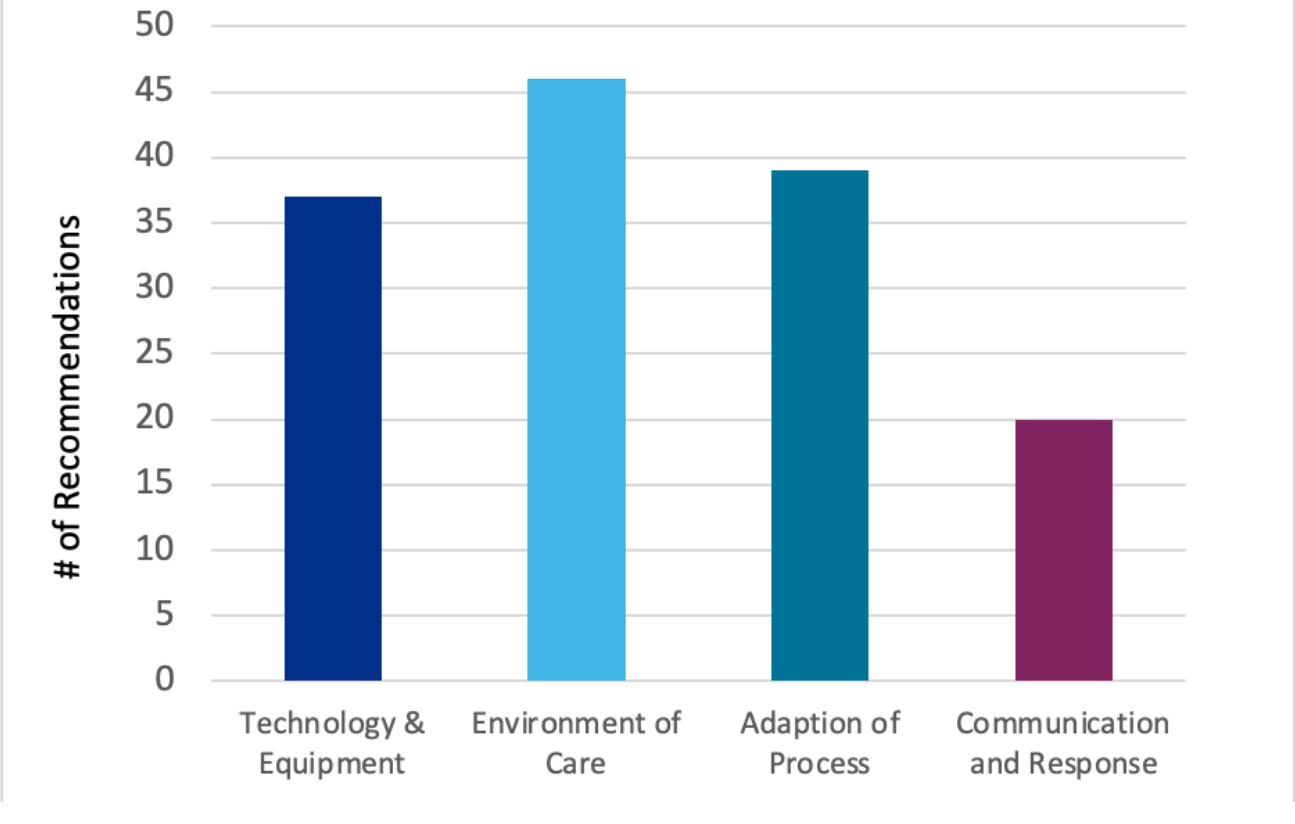
300+
STAKEHOLDERS ENGAGED

31
SAFETY THREATS AVERTED

142
RECOMMENDED CHANGES

Recommendations by Category

In collaboration with the "Transforming Tomorrow Operations" (TTOPS) team and clinical partners, 142 recommendations were identified and mitigated. Recommendations are grouped into 4 areas of focus: Technology & Equipment; Environment of Care; Adaptation of Process to New Context; Communication & Response Protocols.



Simulation Activities Delivered

The activity types below represent milestones in the systems engineering lifecycle. Between each milestone activity, the IDS team engaged in numerous hours of scoping and planning, data synthesis, testing objective and scenario development, client management, and findings reporting.

Methodology	Purpose	Number of Activities
Stakeholder Engagement	Meet with clinical team members to assess process redesign and environmental testing needs introduced by transition to Hale.	11
Tabletop	Contextually explore and clarify key processes in preparation for in situ simulation.	10
Sandbox	Conduct targeted assessment of clinical environment (e.g. travel paths), develop and document processes, or contextually evaluate options. Most Sandbox activities address multiple aims or produce multiple outputs.	12
In Situ Simulation Scenarios	Leverage high-fidelity simulation to identify latent safety threats in clinical systems, processes, and environments (e.g. during emergency response).	20

Hale Teams Served

IDS engaged nearly every clinical stakeholder group impacted by the Hale move, along with many non-clinical support staff. For each clinical team or support service, IDS sought participation across disciplines and roles to ensure fuller understanding of work processes.

Identifying and Mitigating Environmental Hazards

The 6th Floor of Hale requires teamwork across numerous interdisciplinary functions newly co-located: Cardiovascular Operating Room, Cath, and Electrophysiology (EP) Labs, Patient Preparation and Recovery Rooms, and Cardiac MRI and Procedure Rooms. Simulations allowed clinical staff to identify latent safety threats and design responsive improvement strategies and mitigation plans prior to patient moves.

Nurse participants said that the simulations brought to light many important considerations to adapt to the new building prior to the move.

> *THE HIGH-FIDELITY SIMULATIONS WERE ESSENTIAL IN ALLOWING US TO SEE [WHAT] WE COULDN'T HAVE ANTICIPATED... MULTI-DISCIPLINARY TEAMS [COLLABORATED] TOGETHER TO WORK THROUGH ISSUES.*
> -BRENDA BRAWN BSN, RN, CCRN

During the simulation in the Cath Lab, participants discovered wired radiology pedals, which led to additional tripping hazards and the inability to perform all aspects of patient care relative to the current state wireless pedals
This prompted a supply chain resolution.

Participants identified another concern during the simulation with remaining sterile after scrubbing due to the need to open the door using a handle. This resulted in workflow changes to ensure a sterile environment, because the door could not be replaced with a swinging, automatic door for regulatory reasons.

IDS also conducted sandbox activities to clarify the roles and responsibilities of a new nurse liaison role prior to relying on the position during live care. Sandbox activities provide a framework and resources to support clinical teams in leading low fidelity activities related to process and/or environment.

Designing and Documenting New Processes

With the NICU moving into a much larger and more partitioned footprint, simulations helped prepare the staff to communicate in a new clinical environment. Previously, the NICU staff used organic communication methods and structures due to the openness of their floor. The larger space and closed rooms shift visibility and access. Simulations highlighted recommendations to:

Socialize low threshold for use of staff assist buttons to recruit help	**Group rooms together as pods and plan for at least one senior nurse to be in each pod for every shift**	Leave windows open between rooms to allow visibility into the next room

Defining Optimal Response and Patient Transport Pathways

The IDS team worked with the CICU and CACU to ensure a safe transport of a critically ill patient from one floor to another. This simulation highlighted the importance of communication between various specialty teams and testing optimal pathways for transporting critically ill patients requiring ECMO. During the transport, the team identified risks, including inadequate airway management, inadequate CPR, limited airway equipment, no portable suction, and no emergency medications during the transport. In response to these safety threats, IDS worked with participants to create and implement a critical patient transport checklist to increase patient safety.

Device and VR Solutions

JUST-IN-TIME INNOVATION FOR HEALTH CARE

The Device Design and VR Solutions pillar includes collaborations with our clinical and non-clinical partners to develop innovative concepts, to design and prototype solutions that ultimately improve the care of the patient. IDS enables clinicians to practice fundamental skills and change the care they provide in a low-stakes environment through immersive technology such as virtual and augmented reality or by using precise anatomical organic modeling and 3D-printing to replicate patient's anatomy for complex pre-surgical planning.

Training through Virtual and Augmented Reality

In healthcare and at Boston Children's Hospital (BCH) specifically, virtual reality (VR) and augmented reality (AR) usage for education has increased rapidly. Within BCH, VR and AR have been leveraged for onboarding new nurses; IDS created and developed two courses to orient all new nurses to code cart and sepsis practices in the Medical-Surgical Intensive Care Unit (MSICU) and Cardiac ICU (CICU).

VR for Code Cart Training

Code carts house life-saving medications used during medical crises. Low frequency and high criticality of the task makes this VR training essential for nurses and builds confidence when an emergency arises. Student can access the scenario on their own.

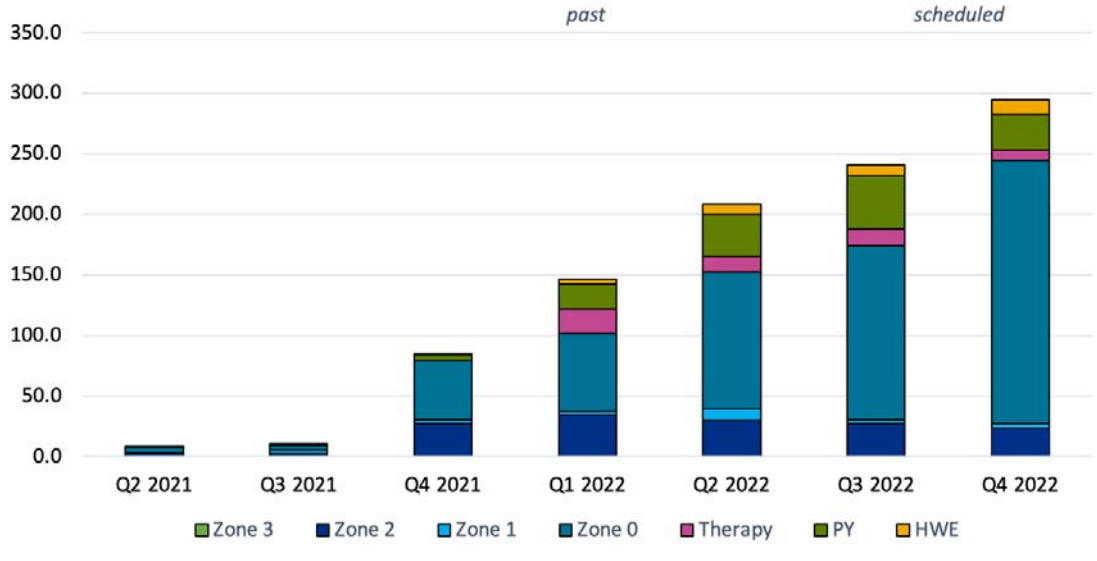
VR for Sepsis Training

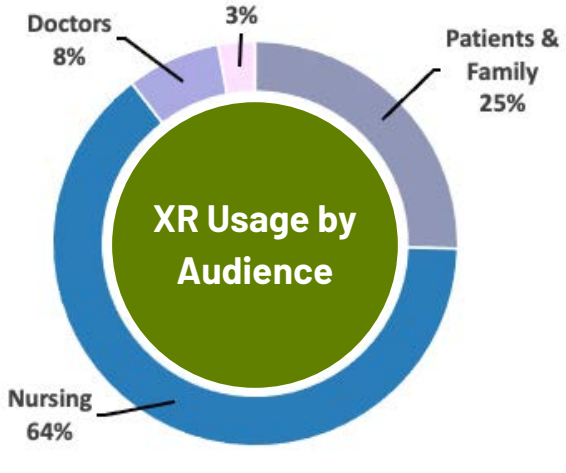
Early recognition of sepsis is critical, as any delay in antibiotic treatment has been found to increase the patient's mortality. Our VR scenario promotes early identification of sepsis signs and symptoms, and swift interventions such as fluid administrations, cultures, and rapid administration of antibiotics.

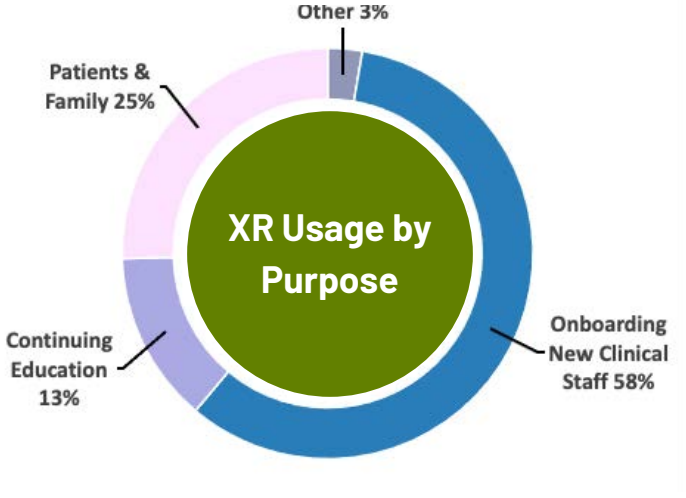
Clinical Training and Patient/Family Engagement with Extended Reality (XR)

The educational use of extended reality (XR) in healthcare has increased rapidly. (XR is a general term for virtual reality, augmented reality, and related media) BCH leverages XR for training, especially with new clinical staff. The image below shows the quarterly hours of training delivered with learning activities centered on XR. (Includes non-XR time, mostly debrief.)

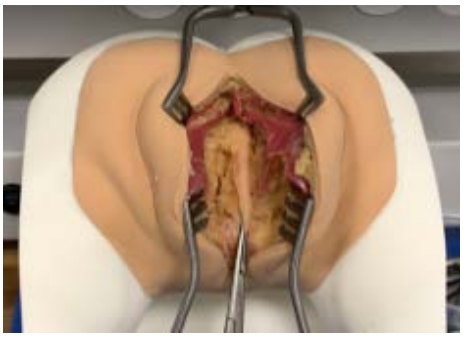
XR- based training hours delivered per quarter



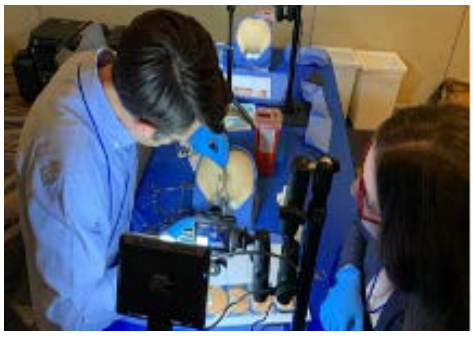
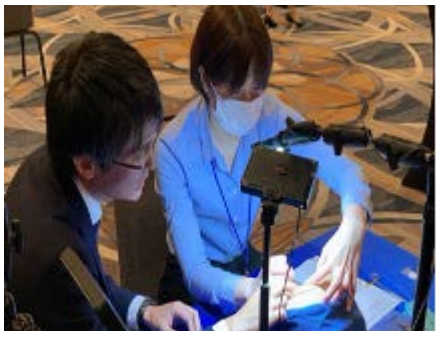




One-of-a-Kind Clinical Preparation Tools

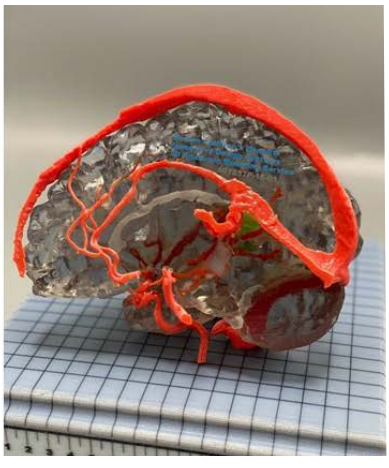




The IDS Engineering team supporting the Device Design and Systems pillar created a high-fidelity, custom tool for training fellows, residents, and surgeons to successfully execute surgical treatment of a rectovestibular fistula. IDS, in partnership with Dr. Belinda Dickie, MD, PhD and the Department of Surgery, iterated multiple functional prototypes and initiated a validation study of the trainer with a select group of trainees and colleagues.

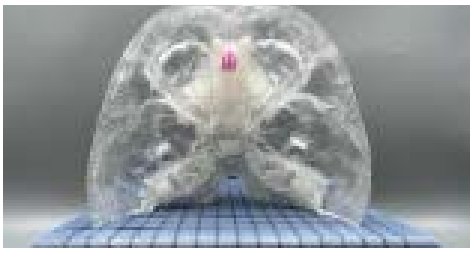




IDS then fabricated and assembled 30 trainers in less than 5 weeks for use in a validation study at the International Pediatric Endosurgery Group (IPEG) Conference in June of this year. This was the first time IDS has completed a production of this quantity of complex trainers and in such a short amount of time, highlighting the maturity of the production tooling and processes.

Advanced Surgical Preparation and Rehearsal



BCH procured a new 3D Printer earlier this year that better meets collaborators needs for increased textures and color options. The new printer produces 3D anatomic models in materials that more closely respond like bone, tumor, fat, and soft organs. In addition, the new printer can easily apply a full spectrum of color to identify vasculature, bone, soft tissue, and other anatomic features.


IDS leveraged the new printer to create a complex model of a 5-year-old male with an extensive nasal dermoid mass that extends from the nasal tip to the skull base. The model included the soft tissue of the face, the mass identified in a bright color, and the skull in clear hard bone material.

> *NOT ONLY DID THIS ASSIST GREATLY IN SURGICAL APPROACH PLANNING AND TEAM COMMUNICATION, BUT IT ALSO HELPED SIGNIFICANTLY IN FAMILY COMMUNICATION.*
>
> *-DR. DANIEL BALKIN, DEPARTMENT OF PLASTIC AND ORAL SURGERY*

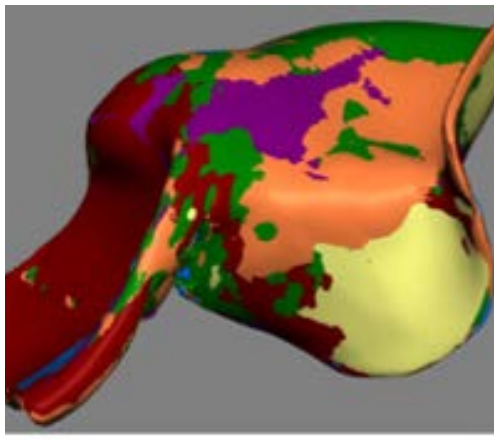
PATIENT DEVICE SOLUTIONS - IMPROVING MOBILITY

Leveraging IDS's cutting-edge technology, engineers' expertise, and state-of-the-art facilities, the IDS Engineering team designed an IV pole modification to allow for greater mobility and improved quality of life for patients awaiting heart transplantation.

Heart failure patients are tethered to both an electrically powered driving unit-system (IKUS) and an IV pole with increased risk for tension, dislodgment, or migration risks to their IV line, ambulation requires the assistance of multiple adults. Using 3D modeling, laser cutting, waterjet cutting and SLS 3D printing, multiple prototypes were created and tested to design a modified IV pole that can be safely adhered to the IKUS. The final product allowed patients to ambulate with only one caregiver and improved quality of the life for the patient.

PATIENT DEVICE SOLUTIONS - IMPROVING COMMUNICATION





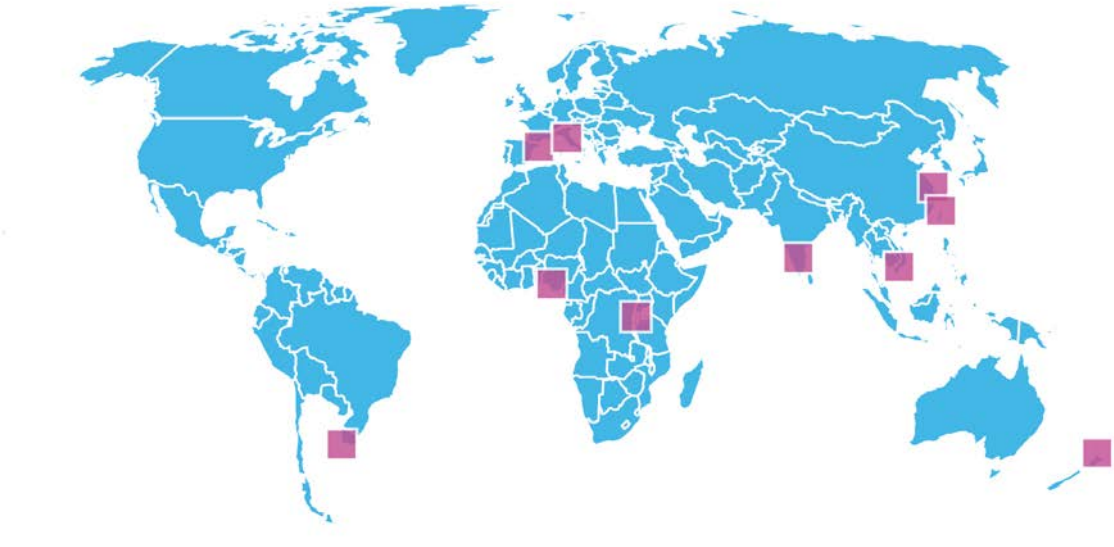
The IDS Engineering team rapidly designed and 3D-printed an assistive hand splint that allowed for continued communication capabilities for a patient with spinal muscular atrophy. This new splint was requested to replaced an original, worn, hand-formed splint that was shaped to allow the paraplegic patient to communicate with others via a switch connected with an iPAD.

The Engineering team worked with Margaret Maynard, Med, OTR, BCP, CHT in Occupational Therapy & Rachel Santiago, M.S., CCC-SLP, Clinical Coordinator of the Inpatient Augmentative Communication Program. While originally the project was estimated to take 4 weeks, the team was able to design, fabricate & deliver the device in 1½ weeks, in response to concerns raised after the original splint broke in use, during cleaning.


International Work

ADVANCING SIMULATION SCIENCE AROUND THE GLOBE

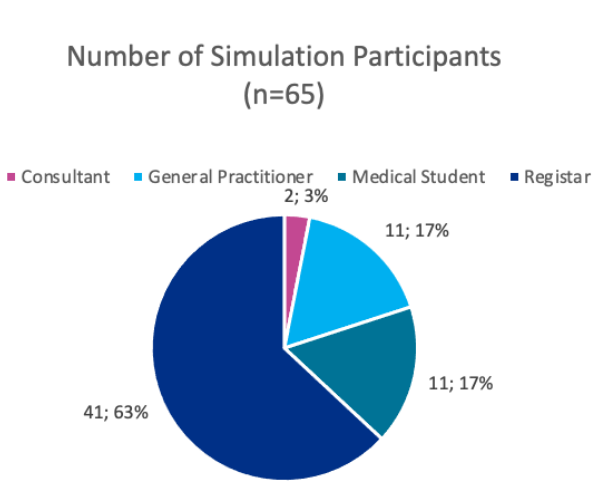
IDS continues to spread its methodology internationally to promote simulation being leveraged to improve the quality and safety of health care delivery. Having global adoption is validation of the program's approach to simulation. These collaborative partnerships not only provide opportunities to teach others about simulation, but also collaborate in building sustainable simulation centers around the globe.

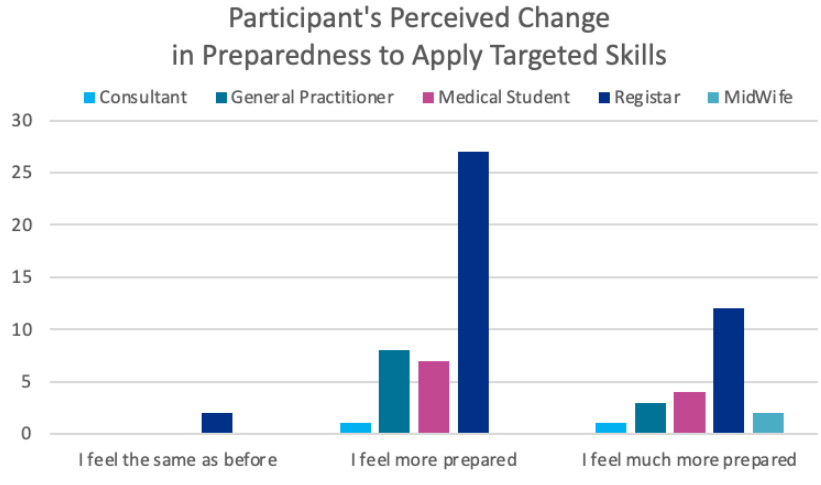


RWANDA

IDS is working with Rwanda's medical school, the University of Global Health Equity, in designing curriculum to seamlessly integrate simulation into their program. IDS has visited in both June and August of 2022 to teach a virtual faculty development course and to assist with their new simulation center. During the most recent trip in August, IDS worked to support their mission to develop a fully SIM-Integrated Medical school to solve clinical capacity issues for the country. For the two weeks of the visit, IDS met with local and national leadership to further advance and develop their skills as instructors of simulation and in developing their simulation center.

NIGERIA- CENTER FOR REPRODUCTIVE HEALTH INNOVATION (CERHI)





In connection with the University of Benin in Benin City, Nigeria, the Center for Reproductive Health Innovation created a first of it's kind masters nursing program to promote a highly skilled clinical work force in West Africa and advances reproductive public health by engaging public health professionals and clinicians in the region. To further advance their clinical training capabilities, CERHI is focused on developing a robust medical simulation program specializing in reproductive health, neonatal, and pediatric care. IDS became involved as a partner through the Boston Children's Global Health team, led by Michelle Niescierenko, who has an existing working relationship with CERHI leadership. To date, IDS has provided consulting support in identifying and procuring simulation equipment (e.g., manikins), related medical supplies, space utilization, and simulation faculty, along with an in-person Simulation Instructor Course to:

- train faculty to teach clinicians and students using simulation
- training on high-fidelity simulation equipment
- provide simulation-based practice built on essential clinical use cases for improving reproductive care in the region

BARCELONA, SPAIN (SAINT JOAN DE DEU)

Since 2012, IDS has partnered with Saint Joan de Deu in Barcelona, Spain, but as of last year, IDS became fully affiliated with this organization's simulation center. Most recent visits focused on a faculty development class, mastering subjects such as psychological safety, emotional intelligence, and leadership skills. One main area of focus will be expanding their engineering capabilities for custom trainers and patient-specific rehearsal.

NEW ZEALAND (STARSHIP)

IDS's relationship with Starship in New Zealand spans over ten years. The Douglas Starship Simulation Programme has a large-scale simulation program that services all of Starship Health. They have adopted most of IDS's service lines and continue to incorporate IDS's course content to their curriculum. IDS will be visiting them in the fall and spring of next year to continue to expand their program.

FLORENCE, ITALY (MEYER CHILDREN'S HOSPITAL)

IDS's longest standing hospital partnership in Florence, Italy, has been maintained via tele-simulation. Supported by the region of Tuscany, Meyer Children's Hospital is preparing to open their first full scale simulation center over the next year. IDS will continue to teach faculty instructor courses for their simulation facilitators.

BENGALURU, INDIA (PEDISTARS)

The executive director of IDS, Dr. Peter Weinstock, founded and was an original board member of the Pediatric Simulation Training and Research Society of India (pediSTARS). IDS has worked closely to build faculty development programs to optimize care for children in India.

Scholarly/Academic Productivity

Publications:

Arnold, J.L., Bosch, S.J., Valipoor, S. (2021). Exploring New Hospital Patient Care Spaces Using Simulation. In: Deutsch, E.S., Perry, S.J., Gurnaney, H.G. (eds) Comprehensive Healthcare Simulation: Improving Healthcare Systems. *Comprehensive Healthcare Simulation.* Springer, Cham. https://doi.org/10.1007/978-3-030-72973-8_15

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Posters & Presentations:

Birch C., Bae DS., Miller P., Luff D., Shore B. (May 12-15, 2021). Teaching Effective Management of Protective Equipment for Surgical Teams - Managing the COVID-19 Tempest. POSNA, Dallas, TX.

Crnjak E., Kerns M., **O'Connell B.**, Tvedte M., Henry A., Stevens M., Chamorro P., Ross A., **Taylor M.**, Smith-Millman M. (June 10-13, 2022). Developing Psychosocial Simulations: Lessons Learned From the Field. International Pediatric Simulation Society (IPSS) Symposia and Workshops. St. Petersburg, Florida.

Crnjack E., Kerns M., Stevens M., O'Connell B., Mednick L., Smith-Millman, M. (June 10-13, 2022). What the Research Reveals: Enhancing Psychosocial Care Through Bereavement Simulation Training. International Pediatric Simulation Society (IPSS) Symposia and Workshops. St. Petersburg, Florida.

Donovan K. (n.d.). Healthcare Innovation: The Importance of Interprofessional Collaboration [Hackathon session]. SONSIEL Virtual Nurse Hack.

Donovan K. (2021-2022). Designing Avatars for XR Medical Simulation [Lecture]. MassArt, Boston, MA.

Donovan K. (2021-2022). Healthcare Innovation: Digital Therapeutics [Lecture]. MCPHS, Boston, MA.

Donovan K. (2021-2022). Creating Engaging Healthcare Education Using XR [Lecture]. Harvard iLab, Cambridge, MA.

Donovan K., & Birckhead B. (2022). The Creative Science of Medical VR [Grand Rounds]. Johns Hopkins, Baltimore, MD.

Donovan K. (2022). Creating Engaging Healthcare Education Using XR [Grand Rounds]. Mayo Clinic, Rochester, MN.

Donovan K. (2022). Using Virtual and Augmented Reality in the Clinical Environment [Lecture]. MCPHS, Boston, MA.

Donovan K. (2022). Innovation in Pediatric Healthcare: How XR is Transforming Clinical Education [Conference session]. Alder Hey Children's Hospital, Liverpool, UK, Virtual.

Donovan K. (2022). Using XR in the Healthcare Environment [Lecture]. Massachusetts Institute of Technology.

Donovan K. (2022). Healthcare Innovation: Creating Solutions with the Patient Lens [Grand Rounds]. SJD Barcelona Children's Hospital, Virtual.

Donovan K. (2022). Creating XR solutions as a Companion to Traditional Clinical Education [Poster session]. IPSS Innovation Poster Session, Virtual.

Donovan K., Downey D., **Jacobson J.** (2022). Incorporating Virtual Reality in Graduate Nurse Orientation in the Pediatric Emergency Department. Nurses Week, Boston, MA.

Donovan K., Kulkarni S., Gold J., & Bogdanski T. (2022). More Than Just Games: Use of VR in Pediatric Population [Conference session]. vMed22 Virtual Medicine Conference, Cedars-Sinai.

Downey D., **Jacobson J.** (2021). Virtual Reality Trainer for Emergency Department Nurses. IPSSV.

Imprescia A.S., **Jacobson J.**, Simth-Millman M., **Lamberto A, Weinstock P.** (2021). VR Code Cart Trainer at Boston Children's Hospital. IPSSV.

Imprescia A.S., **Jacobson J.**, Jones E., McArdle R., Meehan P., Lunetta S., Downey D., **Donovan K., Wilson S., Weinstock P.** (2022). Extended Reality Simulation for Nurse Education: A Program Overview. Nurses Week, Boston, MA.

Imprescia A.S., **Jacobson J.**, Meehan P., Smith-Millman M., **Lamberto A., Weinstock P.** (2022). VR Code Cart Trainer. Nurses Week, Boston, MA.

Jacobson J. (2022). XR Simulation-Based Training at Boston Children's Hospital. Shift Medical.

Jones E., **Donovan, K.** (2022). Evaluating the Use of Virtual Reality Meditation for Front-line Healthcare Staff in a Busy Pediatric Intermediate Care Program. Nurses Week, Boston, MA.

Khan A., Baird JD., Mauskar S., Haskell H., Mercer AM., Ngo T., Berry JG., Copp K., Hennessy K., Humphrey K., **Luff D.**, Mallick N., Matherson S., McGeachey A., Melvin P., Pinkham A., Quiñones-Pérez B., Rogers J., Singer S., Viswanath K., Williams D., Schuster M., Landrigan CP. (April 21-25, 2022). FACES: A Mobile Family Safety Reporting Intervention for Hospitalized Children with Medical Complexity. Annual Pediatric Academic Societies Conference, Denver, CO.

Kieren MQ., Kelly MM., Garcia MA., Chen T., Baird J., Haskell H., **Luff D.**, Mercer A., Ngo T., Quiñones-Pérez B., Williams D., Khan A.. (2022). The Process of Safety Reporting by Parents of Hospitalized Children with Medical Complexity: A Qualitative Analysis. PHM.

Latshaw M., Livingston K., Wilson S., Prabhu S., Weinstock P., Vuillermin C. (2022). In-hospital Virtual Surgical Planning as an Adjunct/Alternative to 3D-Printing for Surgical Correctino of Forearm Abnormalities. RSNA.

Latshaw M., Wilson S., Prabhu S., Weinstock P., Poe D. (2022). Using 3D Printed Models for the Planning of Challenging X-Linked Deafness Cochlear Implantation Insertion Procedures. RSNA.

Latshaw, M. (2022). Elements of a Sustainable Hospital-based 3D Anatomic Modeling Service. RSNA.

Luercio M., Quiñones-Pérez B., Ngo T., Blaine K., Haskell H., **Luff D.**, Mallick N., Mercer A., Williams D., Baird J., Khan A. (April – June 2021). Communicating with Hospitalized Families with Limited English Proficiency: Perspectives from Providers and Spanish-Speaking Parents. Pediatric Academic Societies Meeting PAS, Virtual.

Luercio M., Quiñones-Pérez B., Ngo T., Blaine K., Haskell H., **Luff D.,** Mallick N., Mercer A., Williams D., Baird J., Khan A. (August 4-6, 2021). Communicating with Hospitalized Families with Limited English Proficiency: Perspectives from Providers and Spanish-Speaking Parents. Pediatric Hospital Medicine Conference (PHM) Meeting, Virtual.

Lunetta S., McArdle R., **Jacobson J.,** Smith A.T. (2022). Virtual Reality Scrub Trainer for Pediatric General Surgery. Nurses Week, Boston, MA.

Marcus C., Michaelson C., **Luff D.,** Newman L. (April – June 2021). The Motivations and Impacts on Faculty Coaches in a Resident-as-Teacher Program. Pediatric Academic Societies Meeting PAS, Virtual.

McArdle R., **Jacobson J.,** Thornton J. (2021). VR Surgical Scrub Trainer at Boston Children's Hospital. IPSSV.

McArdle R., Burke C., **Jacobson J.,** Thornton J. (2022). Creating a Virtual Reality Scrub Trainer in the Pediatric CVOR, Nurses Week, Boston, MA.

Meehan P., Impresecia A.S., **Jacobson J., Gu A.** (2022). Integrating New Technology into Nursing Education on VR Sepsis SIM Case Study. Nurses Week, Boston, MA.

Moga MA., McBride M., **Allan C.,** Su Lillian., Lobos AT. (June 10-13, 2022). 3 Birds With 1 Stone Multi-Lens Simulation to Optimize Value. International Pediatric Simulation Society (IPSS) Symposia and Workshops. St. Petersburg, Florida.

Ostertag-Hill C.A., **Silver M.,** Loan G., **Wilson S.,** Dickie B.H. (2022). Development Of A High-Fidelity Anorectal Malformation Surgical Simulator. PCPLC Conference, Cincinnati, OH.

Smith-Millman M., Palmo L., Brown K., Williams R., Miller A., Eisenberg M., Downey D., Aiello L., McMahon M., Mooney D. Allan C. (June 10-13, 2022). Application of the Hazard Assessment and Remediation Tool for Safety Threat Identification and Mitigation. International Pediatric Simulation Society (IPSS) Symposia and Workshops. St. Petersburg, Florida.

Stallo K., & **Donovan K.** (2022). Virtual Reality: The Future of Anesthesia Education [Conference session]. MedVR Virtual Conference.

Stone S., Shannon T., **Donovan K.,** Vega J., Dedian K., McDonnell E., Nothacker E. (2022). Room Safety for the Behavioral Health Patient: Validating Competency Using Screen Based Simulation. Nurses Week, Boston, MA.

Sullivan A., Schnur M., Williams D., Arzuaga B., Luff D., Cummings C., Sullivan A., Schnur M., Williams D., Arzuaga B., Luff D., Cummings C. (October 11-16, 2021). A Qualitative Exploration of Parental Preferred Language and Approach to Prenatal Counseling at Extreme Prematurity. ASBH Annual Conference, Virtual.

Sullivan A., Schnur M., Williams D., Arzuaga B., Luff D., Cummings C. (October, 2021). Approach Speaks Louder Than Words: Parental Perspectives on Prenatal Counseling at Extreme Prematurity. AAP Conference, Virtual.

Tvedte M., Henry A., Meers A., Chamorro P., **O'Connell B.**, Smith-Millman M., Ross A. (June 10-13, 2022). Developing Pyschosocial Simulations: A Suicide Risk Assessment and Management Course for Social Workers. International Pediatric Simulation Society (IPSS) Symposia and Workshops. St. Petersburg, Florida.

Patents:

Dickie, B. (2022) . Surgical Repair Simulation Devices (U.S. Patent No. 63,347,403).

Rogers-Vizena, C. (2022). Surgical Repair Simulation Device (U.S. Patent No. 63,390,557).

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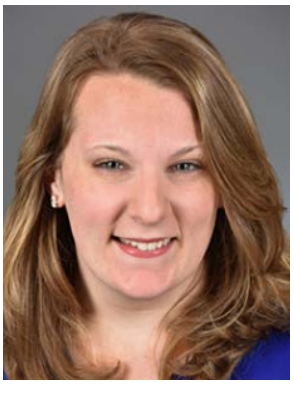

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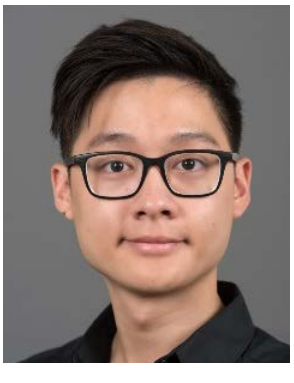

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