# Testing With Simulation Before a Big Move at Women & Infants Hospital

*Jesse Bender, MD, Robin Shields, RNC, Karen Kennally, RN BSN*

**Women & Infants Hospital, Rhode** Island's regional high risk maternal and neonatal referral center, opened the nation's largest single family room **neonatal intensive care unit** (**NICU**) in September 2009. Housed in the adjacent newly constructed South Pavilion, this 50,000 square foot 80-bed NICU features family-centered care. Parents, now able to stay at their baby's bedside 24 hours per day, can expect less stress than in the traditional chaotic NICU,[1, 2] fewer catheter-related infections,[3] and improved neurodevelopmental outcomes with normalization of noise and light stimulation.[4]

## The Challenge

The prospect of transitioning from a 10,000 square foot open bay model (with prams, isolettes, and warmers clustered in six bays) to a unit 5 times larger with a single family room '*model of care*' was daunting. Our system had evolved over decades with refinements from generations of caregivers. That system was built on processes that were efficient, with redundancies for patient safety. Now, over the course of months, new processes would need to promote that same level of patient care. For example, physicians in the older model could readily identify the pulse of the bay with a quick scan, and neighboring nurses easily shared responsibility for each other's patients. In the new unit, staff would function in single, twin and triplet rooms spread over two floors, the combined size of a football field. How would staff be alerted and respond to acute situations?

Multidisciplinary workflow committees formed to wrestle with many the changes and unknowns. Preemptive changes, both strategic and procedural, were implemented as far in advance as possible, such as enhanced nurse practitioner coverage and delivery phone usage. But many best practices were elusive without a full understanding of how systems would come together. Despite all efforts, collective anxiety escalated as the move neared. We needed a "test flight."

**TESTPILOT—Transportable Enhanced Simulation Technologies for Pre-Implementation Limited Operations Testing**—was organized to see how individual systems could integrate into a new equivalently safe and effective NICU environment.

## Prior Use of Simulation

The utilization of simulation training to test new medical facilities had already been successfully implemented. In fact, the TESTPILOT concept originated with the opening of the Rhode Island Hospital adult emergency room in 2005. *In situ* simulations of cardiac arrest, multiple trauma, septic shock and pediatric toxicology were run four days prior to opening, letting staff identify, and address, multiple operations issues.[5] A new hospital facility in Texas used similar simulation-based protocols to orient code blue teams in the months after opening. Twelve mock codes in various non-ICU locations were run, comparing perceived and actual response times for resuscitation interventions.[6]

Nevertheless, the scope and complexity of TESTPILOT-NICU were unprecedented. A functional intensive care unit was simulated prior to its opening. The aims were to assess translation of existing processes to the new NICU, to minimize patient exposure, to allow personnel from all shifts to explore the new NICU, and to integrate solutions into the orientation workshop for all NICU staff. We hypothesized that 1) despite years of meticulous planning, numerous process gaps would be discovered, and 2) participants would feel better prepared to work in the new environment as a result of these sessions. TESTPILOT-NICU was designed as an observational study with consent obtained prior to participation and videotaping.

## The Scenarios

Nurses, respiratory therapists and physicians scripted scenarios, setting the stage with common situations such as management of prematurity, **meconium aspiration syndrome** (**MAS**) with **pulmonary hypertension** (**PPHN**), seizures in the **large-for-gestational age** (**LGA**) neonate, and hydrops with arrhythmias. (Table 1) Balanced assignments were

Figure 1: Vested TESTPILOT Participants (note SimNewB™ Mannequin[7])

**TABLE 1: Description of Scenarios**

| PATIENT | 1st Scenario | 2nd Scenario |
|---|---|---|
| Angel | Premature 28 weeks, incoming transport Secure endotracheal tube, set up ventilator, chest film, surfactant | Place central lines, hang IV Fluids, write orders |
| Bobby | Resolved cardiac hydrops, no IV, hyperkalemia, stable arrhythmia, EKG | If meds arrive, hung, labs sent, PAC's resolve; otherwise progress |
| Cassius | Pulmonary hypertension, meconium aspiration; elective intubation, volatile SaO2, acidosis; stressed parent | Improves on oscillator, bolus hypotension, vasopressors, inhaled nitric oxide |
| Delila | Late preterm LGA; mom scared, seizure, persists despite dextrose, Phenobarbital | Serial desaturation, apnea, intubate, prepare for CT scan |
| Wildcard: Code Stork | Precipitous delivery of 26 week twins: twin A on high risk antepartum floor, then mom to OR for breech twin B | Twin room admission; two ventilators, X-rays, meds, lines, carts |

built for each group of health care providers, orchestrated for baseline chaotic realism and infused with task-oriented urgency. (Figure 1)

Twenty minutes into each session, an additional scenario was introduced, to which existing staff would have to adjust. Some of these "wildcard" scenarios drew from previous experiences in the NICU, such as coordinating multiple transports, managing a power outage, or simultaneous Code Blues (now on separate floors). Other wildcards tested geographic concerns from the original building (Infant Rapid Response Team called to the Newborn Nursery; an emergent delivery in Triage, or "slow to start" in the Labor & Delivery Room).

## The Timing

Several scheduling trade-offs were made for the sessions. *In situ* simulation best tests integration, but if tested too soon individual systems may have been incompletely functioning. Adaptations were made for the evolving functionality of the bedside monitors, electronic medical record, and wireless communication devices. For example, until wireless communication devices were programmed to send laboratory values directly to the provider, results were hand-delivered on pieces of paper. But scheduling the sessions too close to the actual move would also have been problematic. Ample lead time for identification of issues was required to fix problems and formulate a staff orientation plan. By using mannequins before the transition, we avoided putting actual neonates at risk. Thus, six sessions were offered 6 to 9 weeks prior to the transition.

## The Setting

Participants were recruited from all shifts and specialties, enticed by the opportunity to explore the new NICU. One eighth of the new NICU was chosen for simulation (Figure 2), the rooms staged with familiar monitors, hybrid paper charts for orders, and an active electronic medical record for documentation. Simulation realism ranged from low to high fidelity using appropriate mannequins and equipment.

## The Sessions and Debriefing

Each session started with a 90-minute orientation to the facility, code alarms, the location of equipment, and the use of communication devices. Multidisciplinary groups of participants, appropriate to the demands of the scenario, settled into each room. The study facilitator "confederates" introduced assignments, and allowed participants to explore the vignette over a 30- minute

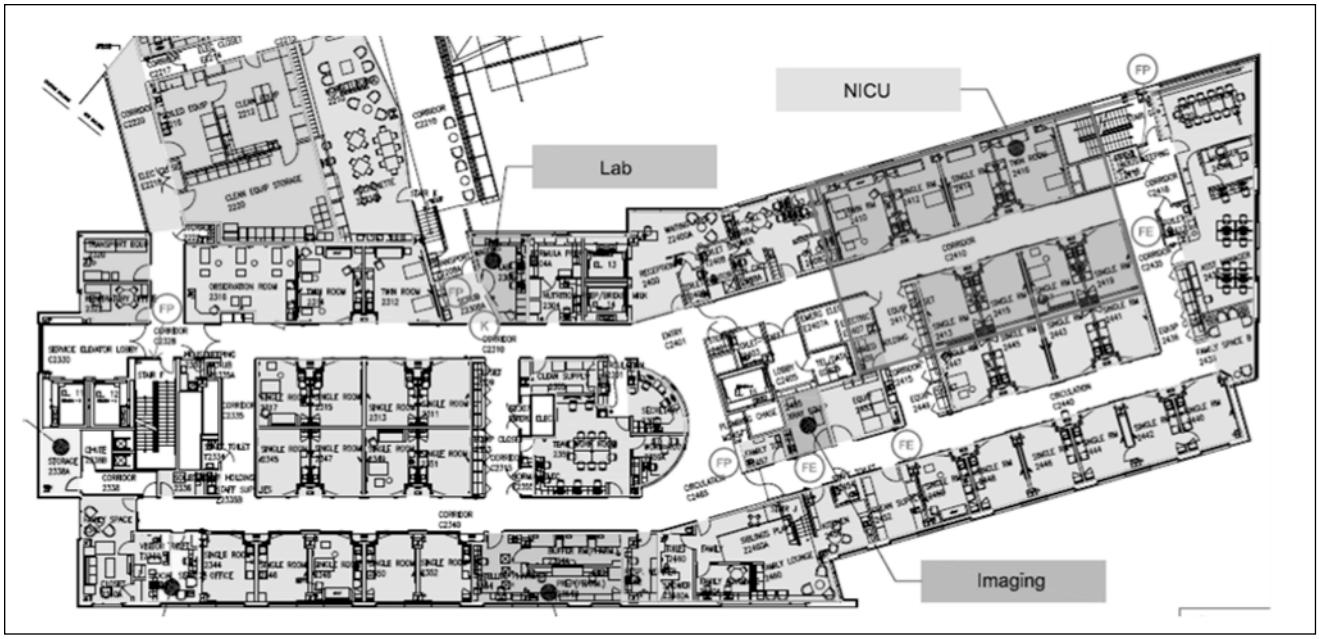


Figure 2. Schematic drawing of NICU, with focus of TESTPILOT shaded

simulation. This was followed by one hour of facilitated debriefing directed towards discovery of problem areas. Participants had a second 30-minute simulation, progressing with the same patient, followed by a second debriefing.

## The Issues Identified

The response to TESTPILOT was overwhelmingly positive. While half of the participants had never experienced simulation before, nearly everybody suspended disbelief and stated the high impact on their practice. Each session generated more volunteer confederates. Nurses (28), physicians (15), respiratory therapists (11), radiology and laboratory technicians (10), assistant nurse managers (9), neonatal nurse practitioners (7), secretaries (3), and other hospital staff participated. They were 97% female, ranged from 21 to 61 years of age and 1 to 35 years of NICU experience.

Participants were universally constructive in the debriefing process, identifying 172 discrete latent safety threats. Communication, organizational, facilities, ergonomic and technical safety threats were resolved by workflow modification or by practice change. Systems for recruiting bedside assistance were modeled; verbal and written communication processes were revised and tested. Workflow was modified for the admissions process, running codes, and mobilization of the delivery and rapid response teams. Significant facilities issues were identified, as were staffing and training concerns. Feedback from our "parents" highlighted instances of ineffective family-centered care, enabling scripting and process changes.

## The Participant Feedback

Staff preparedness was assessed with a series of questionnaires; 1) after TESTPILOT, 2) after the 4-hour employee orientation workshop, and 3) after the transition to the new unit. Awareness of supply and equipment locations, communication and workflow patterns improved in the weeks prior to transition. TESTPILOT accelerated and enriched the natural history of discovery and improvement, having a ripple effect on numerous workflow committees. Participants felt equally prepared by TESTPILOT or the orientation workshop, which was developed largely via TESTPILOT discoveries. Though only half of staff reported sufficient orientation to provide effective care in the new facility prior to the big move, the majority reported, in one-on-one interviews, they felt comfortable within three weeks.

## Summary

Simulation can identify process gaps prior to major institutional change. NICU staff found simulation very beneficial for facilities orientation; the majority of providers considered patient safety enhanced by scenario-based training. TESTPILOT identified problems that could not have been identified by committees. This information improved processes and was used to tailor staff training workshops, all of which led to better preparedness and patient safety. The impact has been recognized as so beneficial that we are now collaborating with the Rhode Island Hospital Medical Simulation Center to build a simulation facility at Women & Infants Hospital.

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*Jesse Bender, MD, is a Staff Neonatologist at Women & Infants Hospital, the Principle Investigator for the TESTPILOT Project, the Associate Director of Neonatal Simulation at Rhode Island Hospital Medical Simulation Center and an Assistant Professor of Pediatrics at the Warren Alpert School of Medicine of Brown University.*

*Robin Shields, RNC, is a Pediatric Research Nurse specializing in Simulation-Based Medical Education at Women & Infants Hospital.*

*Karen Kennally, RN, BSN, is the Perinatal Outreach Educator and the Newborn Resuscitation Program Regional Trainer for the Nursing Education Department at Women & Infants Hospital.*



### Disclosure of Financial Interests

The authors and their spouses/significant others have no financial interests to disclose.


## Correspondence


Jesse Bender, MD
Women & Infants Hospital
Department of Pediatrics
101 Dudley Street
Providence, RI 02905
Email: gbender@wihri.org