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Original Research

Implementing a Neonatal Transport System With Simulation in Kosovo

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A B S T R A C T

Objective: Post-war Kosovar health care systems have reduced gaps in maternal and newborn health care. Coordinated neonatal transport programs may further improve survival and morbidities.
Methods: Transport care paradigms were tested using in situ (Kosovo) and ex situ (the United States) mobile immersive simulation. Patient demographics and outcomes were measured at the tertiary referral center.
Results: Four paired physician and nurse transport teams performed 7 simulated interfacility transports across Kosovo. In situ simulations revealed safety threats in facilities, ambulances, and team process. Ex situ observations reinforced roles and professionalism. For the first year after simulations, tertiary neonatal intensive care unit admissions were more premature (−2.4 weeks), smaller (−725 g), and out born (+12%). Mortality was higher (14.7% vs. 7.8%), hypothermia was lower (0.2% vs. 4.6%), and culture-positive sepsis was lower (15.7% vs. 42.9%).
Conclusion: In situ augmented by ex situ simulation provided perspective and depth of understanding to implement a new care delivery paradigm. Simulations involving Kosovar health care providers across a network of facilities generated practical experience in nationwide neonatal transport, with temporal association to altered referral patterns at the tertiary care facility.

In the decade after United Nations intervention in Kosovo, the United States Agency for International Development actively contributed to the revitalization of finance, economy, and health. As of 2011, this southeast European 10,908 km^2 country had 1,739,825 citizens. The American International Health Alliance extended United States Agency for International Development support to the Kosovo Ministry of Health for the purpose of implementing a systematized, cohesive, and comprehensive approach to the delivery of maternal and child health services as well as other key and supportive health services for women and children.[1] Great improvements in neonatal mortality were realized between 2004 and 2006 by the Kosovo-Dartmouth Alliance for Healthy Newborns' introduction of key evidence-based interventions such as prenatal steroids, the Neonatal Resuscitation Program (NRP), continuous positive airway pressure, and exogenous surfactant.[2] The reported infant mortality rate in Kosovo decreased from 2000 (23.9/1,000) to 2010 (20.5/1,000) yet was still 10-fold greater than other European countries.[3] American International Health Alliance partnered from 2009 to 2012 with Assist International, American Medical Resources Foundation, Rotary, and a multidisciplinary health care provider team from Women & Infants Hospital of Rhode Island in the United States toward the specific goal of extending the decline in neonatal mortality.[1] During the initial needs assessment, opportunities emerged for improving neonatal mortality and morbidity by systematizing interfacility neonatal transport. At the primary referral center in Pristina, University Clinical Center of Kosovo (UCCK) neonatal intensive care unit (NICU) records indicated a high incidence of transported neonates arriving with hypothermia, respiratory distress syndrome, infection, and hypoglycemia. Hypothermia has been associated with increased mortality in similar preterm populations in Malaysia,[4] India,[5] and Brazil[6] as well as pulmonary hypertension, pulmonary hemorrhage, chronic lung disease, acidosis, intracranial hemorrhage, and hypoglycemia. Moderate hypoglycemia, which occurs in up to 50% of high-risk neonates, has been associated with impaired neurodevelopment.[7] Organizing a neonatal transport program has the

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Table 1
Learning Objectives for In Situ Transport Simulations

Day: Simulation Team	Learning Objectives	Immersive Scenarios Overview
Day 1 RN1/MD1 RN2/MD2	1) Recognize retrotransport of stable neonates serves families and the regional network 2) Promote multispecialty/discipline teamwork 3) Practice interhospital handoffs 4) Manage mild physiologic instability en route	2,3. Called for bed availability, gathered paperwork and equipment, moved mannequins into the transport isolettes then into the ambulances. On the 20-minute drive to Gjilan, monitors alarmed desaturation, staff managed apnea and documented vital signs. Signed out to staff at the community hospital
Day 2 RN3/MD3	1) Practice NRP, stabilization at community hospital 2) Standardize documentation for data collection 3) Test referral protocol and team mobilization 4) Practice informed consent with the family, nonjudgmental	4. Term asphyxia requiring significant resuscitation, apnea and seizures, 2 hours. UCCK team took referral, mobilized to Pejë. Updates with referral team and parents, baby moved to transport isolette, ambulance. Copious secretions, call to medical control at UCCK
RN4/MD4	handoffs between care teams 5) Manage moderate physiologic instability, contingency (oxygen tanks, road delays), field decisions (departure delay, procedures moving)	5. Preterm 27 weeks gestation girl born in Gjakovë, manage issues of Respiratory Distress Syndrome, hypoglycemia, and hypothermia. Reports to team and parents as above. Extubation en route
Day 3 RN1/MD1	1) Practice NRP, stabilization at community hospital 2) Standardize documentation for data collection 3) Practice referral and transport mobilization 4) Practice informed consent with the family, nonjudgmental	6. Sick baby with meconium aspiration syndrome, pulmonary hypertension. UCCK team drives to Prizrin, gets report, moves ventilated baby to isolette to ambulance. Volatile hypoxia on return trip, status, admission note in Pristina, handoff, restocked bags
RN2/MD2	handoffs between care teams 5) Manage moderate physiologic instability en route, contingency (ventilator malfunction, lose IV access), field decisions (assess adequate stabilization, erratic driving, failure to call in)	7. Stable baby with gastroschisis collected from Gjilan for surgical management. Took referral, travelled, provided report, placed IVs, talked with parents. Infant transport record completed, communicated status, provided signouts, restocked transport bags

IV = intravenous; NRP = Neonatal Resuscitation Program; UCCK = University Clinical Center of Kosovo.

potential to improve these short-term morbidities, survival, and long-term outcomes. This potential is supported by reports from other regions where up to 31% of neonatal transports are performed under suboptimal conditions, 13% of which have serious complications.[8] Additionally, complication rates may be halved with the introduction of a formal transport program,[9] and enhanced monitoring may improve outcomes.[10] Reducing physiologic instability on transport may be associated with decreased 7-day mortality.[11] It was unclear whether standardizing neonatal transport nationwide was practical or sustainable in Kosovo's existing context. Simulating a transport system with local providers in ambulances could provide some clarity, revealing latent safety threats while enabling deliberate practice with transport care paradigms. Immersive simulation has been used for systems testing in obstetric units,[12] intensive care units,[13] new hospitals,[14] and for neonatal interfacility transport.[15] Over the past decade, established neonatal transport programs have mainstreamed simulation into the training for monitoring, interventions, and cutting-edge care in mobile intensive care units.[16] This field study describes the novel application of multidisciplinary, interfacility simulation to prepare an emerging nationwide transport program.

Methods

Our interventions were designed in a Plan-Do-Study-Act framework in the midst of ongoing improvement initiatives as follows:

1. Plan: perform needs assessment to identify modifiable barriers addressable within three years. Specific resource limitations, communication issues, and professional education opportunities will be described elsewhere (submission pending).
2. Do: develop a neonatal transport infrastructure. Enable deliberate practice and test transport systems using simulation and other educational interventions, both in situ (in Kosovo) and ex situ (in the United States).
3. Study: assess clinician perspective of educational interventions. Identify concurrent patient demographics before and after the interventions.
4. Act: offer recommendations regarding progressing toward a nationwide transport system. Explore wider application of this training/testing paradigm.

Development of a Neonatal Transport System Infrastructure

An implementation plan emerged from the needs assessment data collected to define transport scope, leadership team, role definition, transport process and procedures, and required equipment. The scope of the proposed regional program was restricted to neonatal transport, rather than maternal-fetal transport, to enhance practicality and sustainability. Although in utero transfer of the preterm neonate results in better outcomes,[17,18] expecting obstetric and neonatal providers at different facilities to coordinate effectively was impractical at the initial implementation. A centralized service structure with a dedicated team would augment timely dispatch and mobilization response times,[19] remove divergent priorities of shared ambulance services, and enhance team familiarity with specific equipment. Centralized services would also more likely generate sufficient transport frequency to sustain clinical proficiency. Transport team composition was defined (Table 1). Following a structured microsystems model[20] to enhance sustainment, responsibility for specific leadership roles (Table 2) was individually assigned. The neonatal transport service was to be piloted within an existing network of hospitals. Bidirectional transport would be promoted between level II and III facilities, with real-time medical control by qualified physicians on dispatch and communications. Endorsements were obtained from each community health care facility. In the absence of an ethical oversight body, approval was obtained from the Ministry of Health. During the first year of the partnership, the clinical leadership team emerged following the needs assessment process and the interactive newborn resuscitation and stabilization for transport refresher education programs. Obstetric and pediatric nurses and physicians observed to have exemplary communication, resourcefulness, and critical thinking skills became the clinical, administrative, and teaching champions who nurtured the developing transport program. Working arrangements were made for rotations of ambulance drivers as well as physician and nursing coverage.