



CORRESPONDENCE

Targeted neonatal echocardiography in the United States of America: the contemporary perspective and challenges to implementation

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LETTER TO THE EDITOR

We read with interest the recent series of articles by the European Special Interest Group on the topic of Neonatologist Performed Echocardiography (NPE) in which the authors set out a guide to operations,¹ training,² and clinical practice points^{3–6} for the performance of bedside echocardiography by neonatologists within the European context. This series of articles joins an ever-growing body of literature describing the various ways that cardiovascular imaging using bedside ultrasound is being integrated into contemporary neonatal practice to provide diagnostic insights and enhance the medical decision-making process. Guidelines to govern the scope of clinical practice and training requirements in Targeted Neonatal Echocardiography (TnECHO), the name more commonly used in the North American context, were released in the form of a consensus statement by the American Society of Echocardiography and European groups in 2011.⁷ As mentioned by the authors, the growth of TnECHO internationally has been substantial. In Canada, a consultative model has been established whereby most tertiary neonatal intensive care units (NICUs) have at least 1, and typically several, formally trained practitioners who routinely conduct comprehensive hemodynamic assessments for the variety of clinical problems mentioned by the authors and provide clinical advice to colleagues. Currently, over 50 trained neonatologists from Canada, Mexico, and the United States of America (USA) are members of the PanAmerican Hemodynamic Collaborative, an academic consortium which promotes education through conferences, online webinars and simulation based learning and collaborative research initiatives [Fig. 1]. In addition, a formal one-year fellowship training program has been established in accordance with the 2011 guidelines at several sites in Canada and will begin in the USA in 2019. This program is on track to be one of few programs in pediatrics and the first neonatal sub-specialty with recognition as an Area of Focused Competency by the Royal College of Physicians and Surgeons of Canada. Most graduates of this program progress to tertiary neonatal faculty positions and contribute academically to the growing field of neonatal hemodynamics research.

One of the driving forces behind the rapid evolution of these programs is the increasing recognition that traditional metrics of cardiovascular wellbeing are limited.⁸ With scientific discovery and a dramatic increase in the use of sophisticated technology to maintain ventilation, fluid, and nutritional status more immature, complex, and increasingly tenuous patients have a chance at survival. Among patients where contributors to impaired circulation are diverse and may include pulmonary vascular disease, mechanical ventilation, cardiac dysfunction, intra- and extra-cardiac shunts, and abnormal systemic vascular tone among

other things, the limitations of clinical assessment in isolation become palpable. The use of TnECHO to characterize cardiovascular health in neonates has now become the standard of care in many neonatal intensive care units around the world with the realization that it can provide hemodynamic information that either complements what is clinically suspected or delivers novel physiologic insight.⁹ The benefits of TnECHO and hemodynamic appraisal are multiple. First, as the primary care team with the most first-hand knowledge of neonatal pathophysiology, neonatal intensivists are uniquely positioned to integrate the clinical evaluation with echocardiography-derived measurements of heart function and blood flow. Second, the acquisition of real-time bedside diagnostic information facilitates longitudinal assessment of physiological change with disease evolution or treatment which modern Pediatric Cardiology programs are typically not resourced to provide given their broader mandate. Finally, the delivery of this technology into the hands of neonatal clinical investigators enables the generation of thoughtful, physiology driven research in a neonatal context. TnECHO based research has led to enhanced diagnostic insight into cardiovascular decompensation following ligation of a hemodynamically significant ductus arteriosus¹⁰ and the hemodynamic antecedents of intraventricular hemorrhage.¹¹ It has also led to interventions to reduce pulmonary hemorrhage,¹² a score to predict bronchopulmonary dysplasia,¹³ and identification of risk factors for morbidity among infants with congenital diaphragmatic hernia.¹⁴ Internationally, investment in high-quality academic pursuit in the area of neonatal hemodynamics utilizing TnECHO (or NPE) has, and will continue to, improve the science that is the bedrock of our field.

Despite these many potential advantages, the growth of TnECHO in the USA remains in its infancy. Historically, the perceived barriers to implementation in the USA have been challenges in defining the scope and boundaries with pediatric cardiology and concern for medicolegal liability. With the changing international landscape, however, appraisal of the views of contemporary USA leaders in Neonatology on their access to and perspective on TnECHO was prudent. Members of the US hemodynamic collaborative recently conducted a 15-question survey designed to evaluate the following domains: (i) Utilization of TnECHO in their NICU and operating procedures, if applicable; (ii) Access to equipment to perform echocardiography; (iii) Barriers to the implementation of TnECHO in their unit. We utilized an online survey platform to generate a link which was circulated via email to the USA Neonatal Division Chiefs listserv. After 2 weeks, a reminder email was sent. Responses were collected anonymously and descriptive statistics were used to evaluate the data.

Of those surveyed, 41 (44%) responded [Table 1]. Only 5 centers (12%) reported that they employed one or more neonatologists currently performing bedside echocardiography in their NICU. In these centers, more scans are performed for

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patients with hypotension, suggesting greater access to physiological information as compared to reliance on arterial pressure in isolation. Assessment of central line placement using echocardiography, a superior method of identifying tip position,^{15,16} was also more common in TnECHO centers as



Fig. 1 Sites across the United States of America, Canada, and Mexico with established or emerging Targeted Neonatal Echocardiography programs

compared to non-TnECHO responders [Table 1]. Most TnECHO practitioners both provide consultative advice to colleagues ($n=4$, 80%) and store all images centrally ($n=5$, 100%); however, most neither bill for these services ($n=2$, 40%) nor receive credit towards relative value unit (RVU, $n=1$, 20%) generation. This suggests that the value added by the information is sufficiently important to compensate for the volunteer-basis on which the service is currently being provided.

Among centers without TnECHO at present, the vast majority ($n=33$, 92%) of Division Chiefs expressed interest in developing this skill at their center. This suggests a high level of engagement in bridging the gap between neonatal hemodynamics in the USA and abroad. Interestingly, 26 (72%) of these centers already have access to echocardiography equipment in their NICU emphasizing the scarcity of trained personnel. Most notably, 74% of respondents identified the lack of a formalized training program as the major barrier to implementation, making the development of high-quality training programs the most urgent need in this area. The rigorouslyness with which this training is conducted may go a long way to ameliorate other top barriers reported by US leaders, which included concern for liability (42%), and lack of access to echocardiography expertise (42%). Building these programs in collaboration with Pediatric Cardiology, as emphasized by both the authors of the NPE series and 2011 guidelines and as practiced in other parts of the world, has an important role to play in overcoming historical opposition, an issue which was felt still to be important by a minority (45%) of respondents.

Our survey indicates that the establishment of TnECHO programs is a high priority of US leaders in Neonatology. There is widespread recognition that meticulous hemodynamic data is essential to optimal care for fragile, critically ill neonates. However, the next steps forward are critical. A unique opportunity exists to plan and develop training and programmatic infrastructure that is well suited to the US healthcare system. The substantial work, time, and value added that is provided by these sub-specialized TnECHO practitioners should be considered by both healthcare leadership and payers as these programs become established going forward. Of paramount

Table 1. Responses of representatives from each center divided into those with and without an active Targeted Neonatal Echocardiography (TnECHO) program

	Active TnECHO program ($n=5$)	No TnECHO program ($n=36$)	Non-responders ($n=53$)	p
Number of NICU beds	46 ± 9	59 ± 24	51 ± 24	ns
Quaternary center	4 (80)	24 (67)	31 (59)	ns
Number of echocardiograms per month to assess each indication:				
● Assessment of ductal significance	16 [3, 29]	8 [8, 15]		ns
● Acute pulmonary hypertension	11 [0.5, 23]	4 [4, 8]		ns
● Shock/hypotension	12 [3, 19]	1.4 [0, 4]		0.02
● Chronic pulmonary hypertension	6.5 [0.25, 18]	4 [2, 8]		ns
● Central line tip position	14 [9, 28]	0 [0, 0]		<0.001
Echocardiography equipment in NICU	4 (80)	26 (72)		ns
Perceived barriers to implementation:				
1. Lack of organized training programs	2 (40)	29 (76)		ns
2. Opposition from Cardiology	2 (20)	16 (46)		ns
3. Lack of echocardiography expertise	0	17 (42)		ns
4. Medicolegal liability concerns	1 (20)	11 (31)		ns
5. No interest from Neonatology	3 (60)	9 (25)		ns
6. Lack of equipment	1 (20)	8 (22)		ns
7. Insufficient evidence of benefit	2 (40)	6 (17)		ns
8. Inadequate support from Department	0	6 (17)		ns
9. Work not reflected in RVUs	2 (40)	4 (11)		ns
10. Inability to bill for the service	1 (20)	2 (6)		ns

NICU neonatal intensive care unit, RVU relative value unit, TnECHO Targeted neonatal echocardiography

importance, quality care depends on rigorous training and therefore, it is incumbent on these early programs to ensure that they nurture highly principled, dedicated, and collaborative pioneers who will represent the US well on the world stage of neonatal hemodynamics experts.

ADDITIONAL INFORMATION

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