Bridging the Gap in Congenital Heart Disease Detection: Rural Implementation of Newborn CCHD Screening in Karnataka, India

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Background: Critical congenital heart disease (CCHD) is a major cause of preventable neonatal mortality [1][2][3][4], however screening coverage in low-resource settings remains limited[5]. Rural and tribal communities in India face persistent barriers to early detection including shortages of trained personnel, limited access to echocardiography, and fragmented referral pathways.[6][7][8] Pulse oximetry–based screening is a low-cost, evidence-based tool endorsed by the American Academy of Pediatrics (AAP) [9][10], but implementation across low- and middle-income countries remains sparse[11][12][13]. This study evaluates the feasibility, adoption, and early performance of a universal CCHD screening program in a rural Indian hospital.

Methods: As part of the SISHU (Standardizing Infant Screening and Health for the Underserved) initiative, CCHD screening was implemented at Vivekananda Memorial Hospital, a rural secondary-level facility in Karnataka, India. The intervention included delivery of neonatal pulse oximeters, structured virtual and in-person staff training, workflow redesign, and integration of the AAP-endorsed screening algorithm into a digital application supporting real-time data entry and automated classification. Iterative Plan-Do-Study-Act cycles addressed early challenges such as measurement errors, missed repeat screens, and distinguishing cardiac from pulmonary hypoxemia. Screening was performed at 24 hours of life or prior to discharge, with continuous monitoring of coverage, adherence, and follow-up.

Results: Of 407 live births during the implementation period, 406 newborns (99.8%) were screened. 376 infants passed the initial screen, and 2 failed the initial screen, including one later diagnosed with truncus arteriosus. Repeat screening was indicated for 28 infants; 13 passed, 1 failed and required transfer for higher-level care, and 14 missed the repeat screen, though per staff documentation may have been missed.. Screening coverage increased from 0% to 99%, and adherence to the AAP algorithm reached 99% following workflow refinements and targeted retraining. The digital tool improved documentation accuracy and supported consistent decision-making across staff. After one year, the model was scaled to four additional hospitals serving approximately 4,000 annual births.

Conclusions: Universal CCHD screening can be effectively implemented in rural Indian

hospitals through targeted training, workflow integration, and digital clinical decision support. Empowering nurses and community health workers to conduct screening and standardizing referral pathways improved feasibility and fidelity in a low-resource setting. This model offers a scalable approach for expanding equitable newborn heart screening across underserved regions and strengthening early detection systems to reduce preventable infant mortality.

Table 1. Characteristics of Newborns and Screening Outcomes at VMH

Variable	Value
Total live births	407
Total newborns screened	406
Not screened	1
Passed initial screen	376
Failed initial screen	2
Repeat screen indicated	28
— Passed repeat screen	13
— Failed repeat screen	1
— Missed repeat screen	14
Screening coverage	99%
Algorithm adherence	99%

Table 2. Details of Infants With Failed or Incomplete Screens

Category	Clinical Details
Failed initial screen (n=2)	on supplemental O_2 for meconium aspiration/TTN
Failed repeat screen (n=1)	Critically ill infant with subgaleal bleed and seizures; transferred for higher-level care
Missed repeat screen (n=14)	
One diagnosed with truncus arteriosus; one	Repeat screening not documented

Missed screening (n=1) after birth
Emergent transfer immediately

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