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ORIGINAL ARTICLE

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The role of regional prenatal cardiac screening for congenital heart disease: A single center experience

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Abstract

Background: Accurate prenatal diagnosis of congenital heart disease (CHD) allows for appropriate delivery and postnatal management. Geographic constraints limit access to fetal cardiology subspecialists. In our approach, general pediatric cardiologists are first line in regional prenatal cardiac screening. We aim to demonstrate the utility of this approach in diagnosing CHD requiring cardiac interventions within 30 days of life.

Methods: This is a retrospective review of fetal echocardiograms performed at Seattle Children's Hospital regional cardiology sites (SCH-RC) from December 2008 to December 2015. Referrals to Seattle Children's Hospital Prenatal Program (SCH-PNP) were evaluated for referral timing, indication, diagnostic accuracy, and postnatal care. Diagnostic accuracy was determined using the initial postnatal echocardiogram as the gold standard. Major discrepancy was defined as one resulting in change in surgical management.

Results: Of 699 fetuses evaluated at regional sites throughout Washington and Alaska, a small subset (n = 48; 6.9%) required referral to SCH-PNP. Need for relocation was confirmed in 31 subjects, of which 27 required cardiac intervention within 30 days of life. Of those not referred to SCH-PNP (n = 643, 91.9%), none required neonatal cardiac intervention. There were 22 regional diagnostic discrepancies (31% major, 7% minor). Referral to SCH-PNP improved diagnostic accuracy (2% major, 0% minor).

Conclusions: Regional prenatal cardiac screening demonstrated 100% sensitivity and 98.9% specificity for identifying critical CHD. Utilizing regional pediatric cardiologists as first line in prenatal screening in geographically remote regions may improve access to care and outcomes in neonates with critical CHD while improving resource utilization.

KEYWORDS
access to care, fetal echocardiography, prenatal cardiac screening, regional pediatric cardiology

1 | INTRODUCTION

Fetal echocardiography is a valuable tool for identifying critical congenital heart disease (CHD; requiring neonatal intervention within 30 days of age)[1] in utero which in turn allows for preparation of both the expectant family and the medical team who will care for the neonate. Many studies highlight the importance of fetal diagnosis of CHD, but few have demonstrated an improvement in survival.[2–7] Morris et al. proposed that these studies may not account for infants who died before transfer to a tertiary care center or before surgical intervention. They demonstrated that longer drive time to a cardiac surgical center was associated with higher pretransport and presurgical mortality in hypoplastic left heart syndrome patients compared with those delivering near these centers.[8] The birth of a neonate with critical CHD may be rare in geographically remote hospitals and prostaglandin E1 may not be available. In a study by Moffett et al. the time to appropriate care for infants with CHD was directly related to morbidity.[1] Geographic constraints limit access to specialized fetal cardiologists for

many pregnant women.[9,10] Thus, there is a subset of neonates with undiagnosed critical CHD born in regions that are geographically distant from a tertiary care center, that are at risk for delayed recognition of their disease, inadequate hospital equipment for critical CHD management, and delayed transfer for appropriate medical management.

Seattle Children's Hospital (SCH) is the referral center for a geographically large region, which includes remote areas where access to prenatal care and screening is variable. In an effort to increase the prenatal diagnosis of CHD, the Seattle Children's Heart Center has developed a unique strategy for regional fetal echocardiography outreach to these regions. Screening fetal echocardiograms and consultations are performed by general pediatric cardiologists (with minimal or no formal subspecialty training in fetal cardiac imaging) at Seattle Children's Hospital Regional Cardiology sites (SCH-RC) in Southern and Eastern Washington and Anchorage, Alaska with referral to the Seattle Children's Prenatal Diagnosis and Treatment Program (SCH-PNP) reserved for those in whom a more detailed evaluation is needed or critical CHD is identified. We aim to demonstrate the utility of our regional prenatal cardiac screening strategy for improving identification of critical CHD in remote areas, thereby facilitating transfer of care to a tertiary care center for timely neonatal cardiac intervention.

2 | METHODS

This is a retrospective review of all fetal echocardiograms performed at SCH-RC sites between December 2008 and December 2015. The study was approved by the Seattle Children's Hospital Institutional Review Board. In the majority of cases, obstetricians or maternal fetal medicine providers initiated referrals to our regional pediatric cardiologists for prenatal cardiac screening. Referrals to our tertiary care center, SCH-PNP, were driven by our regional pediatric cardiologists for the majority of cases; a small number of cases were seen at SCH-PNP first and then referred to SCH-RC for future visits. Fetal echocardiograms performed at all sites followed the SCH-PNP fetal echocardiogram protocol, which were based on the2004 American Society of Echocardiography Guidelines and Standards for the Performance of Fetal Echocardiogram.

Maternal records were reviewed to extract clinical data including initial referral indication for prenatal cardiac screening at SCH-RC and fetal cardiac diagnosis. Subjects referred to SCH-PNP were then evaluated for referral indication, fetal cardiac diagnosis at SCH-PNP and delivery plan (including need for transfer of care to SCH-PNP). Neonatal records were evaluated for postnatal diagnosis, type and timing of cardiac intervention, and clinical outcome. A separate evaluation was performed on subjects prenatally and/or postnatally diagnosed with ventricular septal defect (VSD). Although the identification of ventricular septal defects (VSD) is an accepted limitation of fetal echocardiography, we felt it important to account for this group in our population. For fetuses seen at SCH-RC and not referred to SCH-PNP, we attempted to identify prenatally missed CHD by querying the Seattle Children's Hospital (SCH) electronic medical record using the mother's name in the "Patient/Family contact" field. This method would capture any postnatal inpatient or outpatient Cardiology visits at SCH and the SCH-RC clinics. Subjects who required cardiac intervention were divided into neonatal (<30 days of age) and non-neonatal cardiac intervention. Within the neonatal intervention group, we assessed for delays in transfer/intervention as well as overall morbidity and mortality.

Finally, diagnostic accuracy of SCH-RC and SCH-PNP fetal cardiac diagnoses was determined using the findings of the initial postnatal echocardiogram as the gold standard. Major discrepancy was defined as one that resulted in a modification of the postnatal management plan, namely timing of transfer to a tertiary care center or type of cardiac intervention. Minor discrepancy was defined as one that did not result in a change to clinical management.

3 | RESULTS

The SCH-RC clinic locations and cardiologist experience level is described in Figure 1. There were 8 SCH-RC cardiologists over the study period, all of whom had a 3-year pediatric cardiology fellowship. All but one of the SCH-RC cardiologists had completed informal training in fetal cardiology (fetal courses and shadowing experiences), but none had any formal fetal cardiology training. The fetal echocardiograms were primarily performed by pediatric cardiac sonographers with no formal training in fetal echocardiography. They each performed fetal echocardiograms at SCH-PNP under the guidance of fetal cardiac sonographers who had successfully completed the Fetal Examination under Registered Diagnostic Cardiac Sonographers. There were three SCH-RC cardiologists who acquired additional images if needed.

There were 699 fetal subjects seen for prenatal cardiology consultation at one of the SCH-RC sites (mean gestational age at initial consultation 26.5 ± 4.0 weeks); 9% in Alaska (n = 60), 49% in Southern Washington (n = 342), and 42% in Eastern Washington (n = 297). The prenatal and postnatal course for the population is depicted in Figure 2, the referral indication to SCH-RC for screening echocardiogram in Figure 3, and the referral indication to SCH-PNP in Figure 4.

3.1 | Regional cardiology referral patterns

Subject demographics by region are detailed in Table 1. Of the 699 subjects seen at a SCH-RC, only 48 (6.9%) were referred to SCH-PNP for evaluation by a fetal cardiology subspecialist (mean gestational age at initial consultation 30.7 ± 4.3 weeks) for critical CHD requiring relocation for specialized care (n = 31), suspected CHD requiring further diagnostic clarity (n = 11), or difficulty visualizing the fetal heart (n = 6). Critical CHD and need for relocation prior to delivery was confirmed by SCH-PNP evaluation in a total of 31 (4.4%) of the 48 fetuses. Of these 31 subjects, 25 underwent neonatal intervention. The remaining 6 included one subject who remained on prostaglandin E1 and had delayed aortopulmonary shunt placement (day of life 33) due to prematurity, a second with pulmonary atresia, ventricular septal defect, and confluent pulmonary arteries supplied by aortopulmonary collaterals who was discharged with stable circulation, and a third with complex single ventricle anatomy and obstructed total anomalous pulmonary venous return whose care was redirected following delivery. Postnatal

Distance to SCH-PNP (miles)	Years in Practice
Anchorage, Alaska (2 providers)	
2,264	Provider A: 27 Provider B: 16
Tacoma, Washington (4 providers)	
41	Provider A: 25 Provider B: 20 Provider C: 6 Provider D: 2
Eastern Washington (2 providers)	
Yakima = 148	Provider A: 41 Provider B: 29
Tricities = 218	

FIGURE 1 Seattle Children's Hospital Regional Clinic demographics and map

data was not available for the remaining three due to the intrauterine demise of two (both with severe Ebstein's anomaly) and a single pregnancy termination (total anomalous pulmonary venous return).

An additional eight subjects (1.2%) were initially referred to SCH-PNP by the obstetrician either due to family request or concern for significant anomalies. These subjects were then referred by the SCH-PNP regionally for future follow-up. Two subjects had single ventricle physiology and required transfer of care to SCH at 36 weeks' gestation and ultimately underwent neonatal cardiac intervention, but were referred to their local SCH-RC for more convenient interim prenatal follow-up. There were 5 subjects that had CHD requiring prenatal and postnatal cardiology follow-up without neonatal cardiac intervention, and one had a normal evaluation prenatally, but was seen postnatally for family history of left-sided CHD.

Of the 643 cases not referred to SCH-PNP, none required neonatal intervention. Regional prenatal screening demonstrated 100% sensitivity and 98.9% specificity of identifying CHD requiring neonatal cardiac intervention.

3.2 | Diagnostic accuracy of regional fetal cardiac screening

We evaluated the 48 subjects referred to SCH-PNP for regional diagnostic accuracy, using the postnatal echocardiogram as the gold

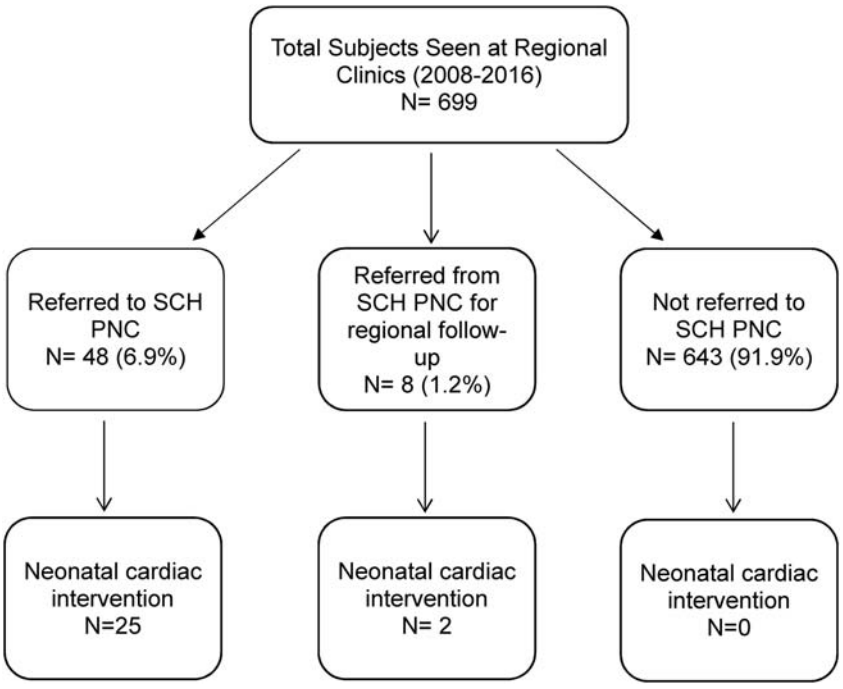

FIGURE 2 Subject prenatal and postnatal clinical course

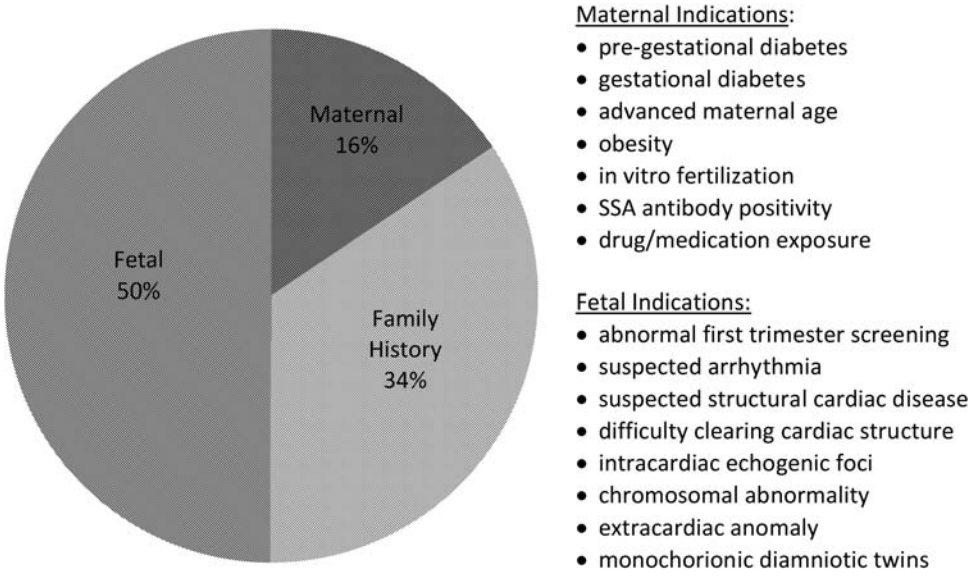

FIGURE 3 Reason for referral to Seattle Children's Hospital Regional Clinics for screening fetal echocardiogram (n = 699)

standard comparison. A total of 26 regional diagnostic discrepancies were identified and 15 (31%) met major discrepancy criteria when comparing the regional prenatal and postnatal diagnosis (Table 2). Referral to SCH-PNP improved diagnostic accuracy with only one major discrepancy (2%), a missed diagnosis of total anomalous pulmonary venous return (TAPVR) in a fetus with known hypoplastic left heart syndrome. There were 10 (7%) minor discrepancies found between regional prenatal diagnoses and postnatal (Table 3). These did not result in a change in surgical planning or counseling. Of those referred to SCH-PNP for diagnosis, there were no minor discrepancies.

There were 17 fetuses with prenatal diagnosis of VSD, 12 of which had postnatal confirmation. There were an additional 11 subjects who had a normal fetal echocardiogram in whom a VSD was diagnosed postnatally. None of these subjects required neonatal intervention under 30 days of age and one required surgical VSD closure at 4 months of age and is included in the major discrepancies evaluation.

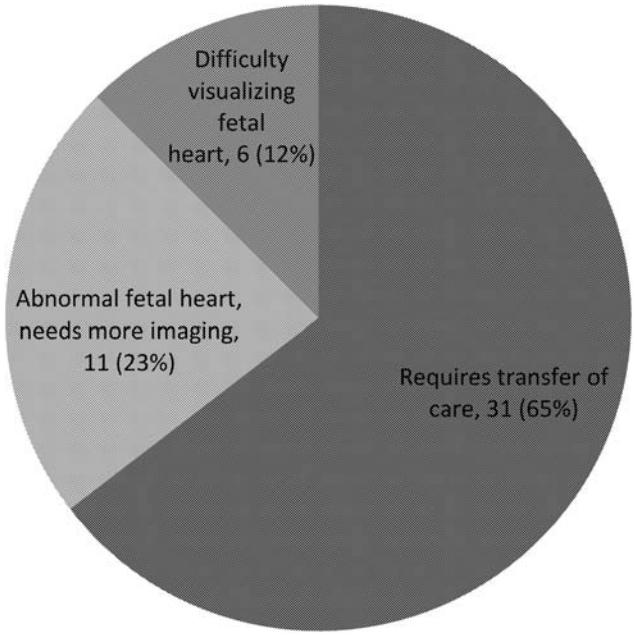

FIGURE 4 Reason for referral to Seattle Children's Hospital Prenatal Program (n = 48)

3.3 | Postnatal outcomes and follow-up

Of the 48 patients referred to the SCH-PNP, 29 (60%) were referred postnatally back to their primary regional pediatric cardiologist for further care and two patients required no further follow-up. There were 8 patients that remained in the care of SCH for complex medical care with other comorbidities or for care by our single ventricle clinic or heart failure/transplant team. There were 9 mortalities, 7 were secondary to complications of extracorporeal membrane oxygenation and two were managed with comfort care due to the complexity of their CHD. No deaths were related to delayed or missed diagnosis.

4 | DISCUSSION

Our regional prenatal cardiac screening strategy in geographically remote regions provided care to nearly 700 fetuses over a 7-year period, with 100% sensitivity and 98.9% specificity of identifying critical CHD. All fetuses requiring neonatal cardiac intervention were appropriately referred to the SCH-PNP and delivered near our tertiary care center. There were no delayed diagnoses or unanticipated transfers and ultimately, no mortality associated with our strategy.

This approach increases access to care in geographically distant regions and improves allocation of specialty prenatal cardiology resources to those patients truly requiring it; while saving families from unnecessary travel and associated expenditures. Numerous indications for referral for fetal cardiac evaluation exist though many of these indications are estimated to carry a less than 5%–10% risk of CHD compared to 0.3%–1.2% in the general population.[11] Still, the prevalence of CHD in fetuses referred for prenatal cardiology evaluation is high.[12] As

TABLE 1 Referrals to Seattle Children's Hospital Prenatal Program broken down by regions

Location	Mean gestational age (weeks) first visit - regional	Mean gestational age (weeks) first visit - SCHPNP	Total prenatal visits	Mean gestational age at birth (weeks)	Mean age (days) at neonatal surgery	Mean age (days) at non-neonatal surgery
Alaska n=10	26.3 ± 3.3	33.3 ± 5	3.2	38.9± 0.7	5.1 ± 2.93 (n=9)	144 (n=1)
Southern WA n=12	26.8 ± 5	29.2 ± 3.4	2.9	37.7 ±2.9	5.5 ± 3.93 (n=6)	113.6 ± 82.61 (n=5)
Eastern WA n=26	27.3 ± 3.9	29.7 ± 3.8	1	38.1 ± 1.1	4.5 ±1.93 (n=8)	93 ± 47.43 (n=4)
SCH-PNP n=8	31.8 ± 1.8	21.6 ± 1.2	2.5	39 ± 0.07	3.5 ± 3.54 (n=2)	129 (n=1)

the indications for fetal cardiology referral increase, so does the burden on the medical system to provide care to these patients and this strategy becomes even more pertinent to fetal cardiac care. In our experience, only 6.9% of the fetal cardiac screenings resulted in a referral to SCH-PNP and 3.9% required neonatal cardiac intervention. There were 643 pregnant women who received prenatal cardiac evaluation by our general pediatric cardiologists at regional sites, forgoing the time and financial burden of arranging travel to SCH for ultimately low risk fetuses.

Fetal echocardiographic diagnoses in the hands of specialized fetal cardiologists practicing at tertiary care centers results in between 8.1% to 10.6% major discrepancies and 18.7% minor discrepancies when compared to the postnatal diagnosis.[13–17] The SCH-RC demonstrated a higher rate of major discrepancies and similar minor discrepancies compared with the published data, 31% and 7%, respectively. Our regional pediatric cardiologists have significant time constraints for prenatal cardiology visits and both the physicians and cardiac sonographers have limited or no formal training in fetal cardiology. The

TABLE 2 Table of major discrepancies, regional diagnoses versus postnatal diagnosis

Regional diagnosis (discrepancy in bold)	Postnatal diagnosis (discrepancy in bold)	SCH-PNP discrepancy
Truncus arteriosus or TOF/**pulmonary atresia**	TOF, **severe PS**, **MAPCAs**	No
Large VSD	**IAA**, large VSD	No
Single ventricle with aortic valve atresia	**Heterotaxy**, single ventricle, **pulmonary atresia, MAPCAs, supracardiac TAPVR**	No
Single ventricle, **DORV**, d-TGA physiology	**Tricuspid atresia**, d-TGA, VSD	No
Hypoplastic left heart syndrome	Hypoplastic left heart syndrome and **TAPVR**	No
Suspected normal, could not clear aortic arch	**Truncus arteriosus**	No
Mildly hypoplastic left heart, possible coarctation	**Normal**	No
RV dominant CAVSD , **aortic atresia, aortic arch hypoplasia**	**Heterotaxy**, RV dominant CAVSD, **DORV, d-TGA physiology, pulmonary atresia, mixed TAPVR**	No
Truncus arteriosus	**TOF**, severe PS, confluent PAs, MAPCAs	No
DORV, d-TGA physiology, mild PS	**Heterotaxy, dextrocardia, cor triatriatum, CAVSD,** DORV, **L-TGA physiology**, PS	No
DORV versus TOF	Large anterior malalignment **VSD**	No
Heterotaxy, dextrocardia, LV dominant CAVSD, d-TGA, mild PS	Heterotaxy, dextrocardia, **RV dominant CAVSD, TAPVR**	Yes
Right and left ventricular size discrepancy, poorly visualized aortic arch and pulmonary veins	Bicuspid aortic valve, **mild mitral valve and aortic arch hypoplasia**	No
Tricuspid atresia, d-TGA and possible aortic arch hypoplasia	Tricuspid atresia, d-TGA, **type A IAA**	No
Normal	Moderate sized posterior malalignment **VSD**	No SCH visit

Abbreviations: TOF, tetralogy of Fallot; PV, pulmonary valve; PS, pulmonary valve stenosis; PAs, pulmonary arteries; MAPCAs, major aortopulmonary collateral arteries; VSD, ventricular septal defect; IAA, interrupted aortic arch; TAPVR, total anomalous pulmonary venous return; DORV, double outlet right ventricle; d-TGA, dextro-transposition of the great arteries; CAVSD, complete atrioventricular septal defect.

TABLE 3 Table of minor discrepancies, regional diagnoses versus postnatal diagnoses

Regional diagnosis (discrepancy in bold)	Postnatal diagnosis (discrepancy in bold)	SCH-PNP discrepancy
D-TGA	D-TGA, **vascular ring**	No
Hypoplastic left heart syndrome with VSD	**Double outlet right ventricle, mitral atresia**, hypoplastic arch	No
Hypoplastic ascending aorta	**Normal**	No
Normal	**Left superior vena cava to coronary sinus**	No
Tricuspid atresia, **VSD, PS**, confluent PAs, **tumor in RV**	Tricuspid atresia, **no VSD**, hypertrophied RV, **absent pulmonary valve**, confluent PAs	No
RV dominant CAVSD, single ventricle with aortic arch hypoplasia, **left superior vena cava**	RV dominant CAVSD, aortic arch hypoplasia, **no left superior vena cava**	No
TOF, PS, confluent PAs	TOF, **discontinuous left PA**	No
TOF/**pulmonary atresia** with confluent PAs	TOF, **PS**	No
Heterotaxy, DILV, L-TGA, pulmonary atresia, **confluent PAs**.	Heterotaxy, DILV, D-TGA, pulmonary atresia, **discontinuous PAs**	No
CAVSD	CAVSD with **left superior vena cava to coronary sinus**	No

Abbreviations: d-TGA, dextro-transposition of the great arteries; l-TGA, levo-transposition of the great arteries; VSD, ventricular septal defect; PS, pulmonary valve stenosis; PAs, pulmonary arteries; RV, right ventricle; CAVSD, complete atrioventricular septal defect; TOF, tetralogy of Fallot; DILV, double inlet left ventricle.

echocardiography machines utilized are predominantly utilized for imaging pediatric patients. Although there are specific settings for fetal imaging with appropriate probes, the optimal technology for challenging fetal imaging is not available. These factors likely impact the diagnostic accuracy. Future studies should focus on determining acceptable diagnostic discrepancies for regional pediatric cardiologists performing screening prenatal cardiac evaluation.

Because the institution's digital echocardiogram storage system is shared among the various SCH sites locally and regionally, it is common for our regional cardiologists to review complex CHD diagnoses and technically challenging studies with the SCH-PNP cardiologists. This facilitates referral and management planning. Thus, despite the increased discrepancy rate, in all cases of critical CHD, the regional diagnoses led to appropriate referral and transfer of care to SCH-PNP and there were no mortalities due to delayed diagnosis or transfer. Furthermore, the SCH-PNP diagnostic discrepancies are similar, if not slightly improved compared with the current literature, (2% major and 0% minor discrepancies), thereby improving the accuracy of the prenatal diagnoses.

The majority of subjects referred from SCH-RC to SCH-PNP were postnatally referred back to their primary regional pediatric cardiologists for outpatient follow-up. Regional prenatal cardiac screening established continuity of care between the prenatal and postnatal periods despite the need for tertiary neonatal care. Most patients who remained in the care of the SCH outpatient clinic were instructed to remain locally after hospital discharge due to medical complexity and high mortality risk related to living in distant/remote regions. Patients with single ventricle physiology alternated visits at the SCH single ventricle and regional cardiology clinic. Once they returned home and required less frequent follow-up or interventions, families chose to be seen by the regional cardiologists.

4.1 | Study limitations

The study was limited by the inherent nature of single-center retrospective studies. Evaluation of postnatal outcomes for fetuses not evaluated by the SCH-PNP was extensive within the SCH medical records, however, did not account for patients not seen within the SCH and SCH-RC system. Subjects who died at unaffiliated regional hospitals or birthing centers would not be captured by this analysis, nor would patients evaluated and treated at other pediatric cardiology practices or hospitals. We expect that the number of subjects lost in this analysis, though important, is quite low as SCH is the primary referral site for the regions described.

5 | CONCLUSION

Prenatal cardiac screening performed by regional pediatric cardiologists is effective for diagnosing critical CHD in geographically remote regions, with 100% sensitivity and 98.9% specificity of identifying CHD requiring neonatal cardiac intervention. Furthermore, regional screening reserves specialized prenatal care for the small subset of patients who require more detailed cardiac evaluation. Utilizing general pediatric cardiologists as a first line in prenatal cardiac screening in geographically remote regions may improve access to care, rate of diagnosis, and outcomes in neonates with critical CHD while improving resource utilization.

ETHICAL APPROVAL

This article does not contain any studies with human participants or animals performed by any of the authors.

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest with the contents of this article.

AUTHOR CONTRIBUTIONS

Data analysis/interpretation: Pasierb, Peñalver, Vernon, Arya
Drafting article: Pasierb, Arya
Critical Revision and approval of the article: Peñalver, Vernon, Arya
Concept/Design: Vernon, Arya

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REFERENCES

[1] Moffett BS, Garrison JM, Hang A, et al. Prostaglandin availability and association with outcomes for infants with congenital heart disease. *Pediatr Cardiol.* 2016;37(2):338–344.

[2] Feinstein JA, Benson DW, Dubin AM, et al. Hypoplastic left heart syndrome: current considerations and expectations. *J Am Coll Cardiol.* 2012;59(1):S1–S42.

[3] Levey A, Glickstein JS, Kleinman CS, et al. The impact of prenatal diagnosis of complex congenital heart disease on neonatal outcomes. *Pediatr Cardiol.* 2010;31(5):587–597.

[4] Copel JA, Tan AS, Kleinman CS. Does a prenatal diagnosis of congenital heart disease alter short-term outcome? *Ultrasound Obstet Gynecol.* 1997;10(4):237–241.

[5] Atz AM, Travison TG, Williams IA, et al. Prenatal diagnosis and risk factors for preoperative death in neonates with single right ventricle and systemic outflow obstruction: screening data from the Pediatric Heart Network Single Ventricle Reconstruction Trial (*). *J Thorac Cardiovasc Surg.* 2010;140(6):1245–1250.

[6] Kipps AK, Feuille C, Azakie A, et al. Prenatal diagnosis of hypoplastic left heart syndrome in current era. *Am J Cardiol.* 2011;108(3):421–427.

[7] Kumar RK, Newburger JW, Gauvreau K, Kamenir SA, Hornberger LK. Comparison of outcome when hypoplastic left heart syndrome and transposition of the great arteries are diagnosed prenatally versus when diagnosis of these two conditions is made only postnatally. *Am J Cardiol.* 1999;83(12):1649–1653.

[8] Morris SA, Ethen MK, Penny DJ, et al. Prenatal diagnosis, birth location, surgical center, and neonatal mortality in infants with hypoplastic left heart syndrome. *Circulation.* 2014;129(3):285–292.

[9] Pinto NM, Keenan HT, Minich LL, Puchalski MD, Heywood M, Botto LD. Barriers to prenatal detection of congenital heart disease: a population-based study. *Ultrasound Obstet Gynecol.* 2012;40(4):418–425.

[10] Quartermain MD, Pasquali SK, Hill KD, et al. Variation in prenatal diagnosis of congenital heart disease in infants. *Pediatrics.* 2015;136(2):e378–e385.

[11] American Institute of Ultrasound in Medicine. AIUM practice guideline for the performance of fetal echocardiography. *J Ultrasound Med.* 2013;32(6):1067–1082.

[12] Rychik J, Ayres N, Cuneo B, et al. American Society of Echocardiography guidelines and standards for performance of the fetal echocardiogram. *J Am Soc Echocardiogr.* 2004;17(7):803–810.

[13] Donofrio MT, Moon-Grady AJ, Hornberger LK, et al. Diagnosis and treatment of fetal cardiac disease: a scientific statement from the American Heart Association. *Circulation.* 2014;129(21):2183–2242.

[14] Wright L, Stauffer N, Samai C, Oster M. Who should be referred? An evaluation of referral indications for fetal echocardiography in the detection of structural congenital heart disease. *Pediatr Cardiol.* 2014;35(6):928–933.

[15] Bensemlali M, Stirnemann J, Le Bidois J, et al. Discordances between pre-natal and post-natal diagnoses of congenital heart diseases and impact on care strategies. *J Am Coll Cardiol.* 2016;68(9):921–930.

[16] van Velzen CL, Clur SA, Rijlaarsdam ME, et al. Prenatal diagnosis of congenital heart defects: accuracy and discrepancies in a multicenter cohort. *Ultrasound Obstet Gynecol.* 2016;47(5):616–622.

[17] Bakiler AR, Ozer EA, Kanik A, Kanit H, Aktas FN. Accuracy of prenatal diagnosis of congenital heart disease with fetal echocardiography. *Fetal Diagn Ther.* 2007;22(4):241–244.

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