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Feasibility study assessing equitable delivery of newborn pulse oximetry screening in New Zealand's midwifery-led maternity setting

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ABSTRACT

Objectives The aim of this study was to conduct New Zealand-specific research to inform the design of a pulse oximetry screening strategy that ensures equity of access for the New Zealand maternity population. Equity is an important consideration as the test has the potential to benefit some populations and socioeconomic groups more than others.

Setting New Zealand has an ethnically diverse population and a midwifery-led maternity service. One quaternary hospital and urban primary birthing unit (Region A), two regional hospitals (Region B) and three regional primary birthing units (Region C) from three Health Boards in New Zealand's North Island participated in a feasibility study of pulse oximetry screening. Home births in these regions were also included.

Participants There were 27 172 infants that satisfied the inclusion criteria; 16 644 (61%) were screened. The following data were collected for all well newborn infants with a gestation age ≥35 weeks: date of birth, ethnicity, type of maternity care provider, deprivation index and screening status (yes/no). The study was conducted over a 2-year period from May 2016 to April 2018.

Results Screening rates improved over time. Infants born in Region B (adjusted OR=0.75; 95% CI 0.67 to 0.83) and C (adjusted OR=0.29; 95% CI 0.27 to 0.32) were less likely to receive screening compared with those born in Region A. There were significant associations between screening rates and deprivation, ethnicity and maternity care provider. Lack of human and material resources prohibited universal access to screening.

Conclusion A pulse oximetry screening programme that is sector-led is likely to perpetuate inequity. Screening programmes need to be designed so that resources are distributed in the way most likely to optimise health outcomes for infants born with cardiac anomalies.

Ethics approval This study was approved by the Health and Disability Ethics Committees of New Zealand (15/NTA/168).

Strengths and limitations of this study

- This study was conducted in a socioeconomic and culturally diverse setting.
- Demographic information was obtained from national data sets.
- This study highlights the potential to create greater inequity if screening programmes are not universal.
- Institutional constraints can prevent hospitals from introducing screening.
- Low engagement with self-employed maternity care providers in this midwifery-led maternity setting was a significant factor affecting screening rates.

INTRODUCTION

Pulse oximetry has been used to detect critical congenital heart disease (CHD) in newborns for more than a decade. The test is non-invasive, safe and easy to perform, and has been well-received by consumers.[1–3] Pulse oximetry screening has been introduced successfully into many healthcare settings around the world using approaches ranging from ad hoc implementation to mandatory policies.[4–8] New Zealand is an ethnically diverse country with a midwifery-led model of maternity care and policies that strive to deliver health services in a way that recognises the connexions between health and other aspects of people's lives, including culturally appropriate approaches to healthcare.

Inequities in health have been defined as differences in health that are unnecessary, avoidable, unfair and unjust.[9] Screening programmes have the potential to benefit some population groups more than others. Equity has, therefore, been an important consideration in the design and delivery of screening programmes. The aim of this study was to conduct New Zealand-specific research to inform the design of a pulse oximetry screening strategy that ensures equity of access for the New Zealand maternity population. The design and implementation of screening programmes that are people-centred and that

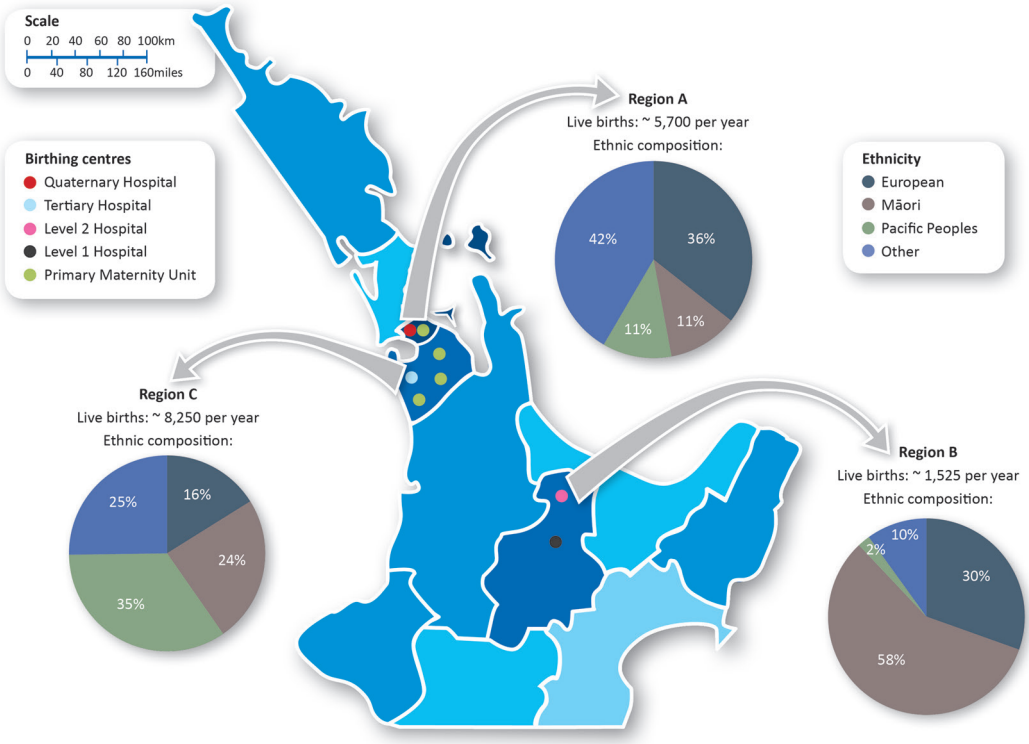

Figure 1 Participating regions.

result in equitable outcomes for all population groups is at the centre of the New Zealand Ministry of Health's National Screening Unit quality framework.[10]

METHODS

This intervention study of pulse oximetry screening in the newborn was conducted over a 2-year period. One quaternary hospital, one tertiary hospital, two regional hospitals and five primary maternity units from three Health Boards (Region A, B and C) in New Zealand's upper North Island and the maternity carers affiliated with these centres were invited to participate in the study (figure 1). The implementation was staged with the first centres initiating screening in May 2016 and the final centre joining 6 months later. Although invited, Region C's tertiary hospital did not participate in the study due to resource constraints. Nevertheless, several infants born at this hospital had the opportunity to be screened if they transferred to a participating primary maternity unit for postnatal care. Equipment, consumables and ongoing support were provided by the research team for the duration of the study. Study guidelines and information resources were developed prior to the introduction of screening and were available online.[11] The screening tests were primarily performed by community midwives or self-employed midwives. In some cases, nurses working on postnatal wards undertook the screening test. Well newborn infants with a gestational age of ≥35 weeks were eligible for inclusion. An electronic database was designed to store participating infants' test results.

Hospitals and birthing units keep a record of all births and were requested to provide the National Health Index (NHI) number of all infants born alive at their facility during the study period with a gestational age of ≥35 weeks. Infants with a prenatal diagnosis of a congenital cardiac anomaly and other unwell infants admitted to a newborn unit shortly after birth were ineligible for the study and were excluded from the lists. Home birth data were retrieved from the Ministry of Health's National Maternity (MAT) collection. All births (including home births) are reported to this body. Birth data were merged and the following demographic information was extracted from the MAT collection for each infant: (a) prioritised ethnicity, (b) maternity care provider, (c) deprivation index and (d) date of birth.

a. Prioritised ethnicity
   New Zealand has an established practice for the collection and reporting of ethnicity data in the healthcare sector. For the purposes of data analysis, a single ethnicity is assigned when an individual identifies with more than one ethnicity. Priority is given to Māori followed by Pacific Peoples, Indian and then Asian. All other ethnic groups receive priority over European.
b. Maternity care provider
   Maternity care is coordinated by the lead maternity carer (LMC) chosen by a pregnant woman. The LMC can be a self-employed midwife, obstetrician or general practitioner and is contracted through the Ministry of Health, and thus not employed by the Health Board, to provide a complete maternity service from enrolment until 6 weeks postpartum. In some regions, there

are insufficient LMCs to provide care, and community midwifery teams are employed directly by the Health Boards.

c. Deprivation index (NZ Dep)
The deprivation index is a measure of socioeconomic deprivation in New Zealand. It estimates the relative deprivation of an area and does not directly relate to individuals. The index groups deprivation scores into deciles, where 1 represents the least deprived scores and 10 the most deprived scores. A value of 10, therefore, represents the most deprived 10% of areas in New Zealand. The postal code of a healthcare consumer's home address is used to assign a score.[12] The 10 deprivation scores were grouped into 5 quintiles.

d. Date of birth
Participants' birth dates were used to divide the study period into three epochs to evaluate whether the screening rate changed over time. Region A and B participated for 24 months—for these regions, each epoch represents an 8-month period. Region C joined the study 6 months later and was, therefore, divided into three 6-month epochs.

The NHI numbers on the births list were matched with data entries made to the pulse oximetry screening study database to determine screening rates.

Patient and public involvement

This study was designed and overseen by a multidisciplinary steering committee with representation from consumer groups. Written informed consent was obtained from the parents of newborn infants prior to enrolment into the study. Consumer satisfaction with the screening procedure was assessed throughout the course of the study. Survey results are described elsewhere.[3]

Statistical analysis

Categorical variables are summarised as percentages and compared with the χ^2 test. To identify factors associated with pulse oximetry screening rates, ORs and 95% CIs were calculated using multivariable logistic regression. Unadjusted and adjusted ORs and CIs are presented. All variables were included in the analysis model to obtain adjusted ORs and CIs. Demographic features were compared with a multivariable logistic regression model to determine participants' probability of receiving a pulse oximetry screening test. A p value <0.05 was considered statistically significant. Data were analysed using statistical software (JMP, V.14.0; SAS Institute, Cary, North Carolina, USA).

RESULTS

During the course of the study, there were 27172 live-born infants in participating regions that satisfied the study's inclusion criteria. The largest number of births occurred in a hospital setting (24 826; 91.4%). A total of 413 (1.5%) births took place at home and 1812 (6.7%) at a primary birthing unit. A total of 16644 (61%) infants received pulse oximetry screening. The screening rate was significantly influenced by the place of birth, with the highest rate achieved among those born at a quaternary hospital and the lowest rate recorded for home births (81% and 6%, respectively; table 1). Infants born in Region B (adjusted OR=0.75; 95% CI 0.67 to 0.83) and C (adjusted OR=0.29; 95% CI 0.27 to 0.32) were significantly less likely to receive pulse oximetry screening compared with those born in Region A (table 2).

The number of births in the most deprived areas was three times higher than births in the least deprived areas (table 1). There was a significant association between screening rates and deprivation, with higher odds of screening recorded for babies born to families living in the least deprived areas

Table 1 Screening rates

	Births, n 27172	Screened, n (%) 16644 (61)	P value
Birth setting			<0.0001
Quaternary hospital	12908	10501 (81)	
Tertiary hospital	9313	3228 (35)	
Regional hospitals (×2)	2605	1741 (66)	
Primary Birthing Units (x4)	1812	1053 (58)	
Home	412	26 (6)	
Unknown	122	95 (78)	
Maternity care provider			<0.0001
LMC midwife	16738	9754 (58)	
Obstetrician	3841	3190 (83)	
Community midwife	2689	2232 (83)	
General practitioner	40	30 (75)	
No provider	2164	653 (30)	
Unknown	1700	785 (46)	
Ethnicity			<0.0001
Māori	5682	3031 (53)	
European	7386	5402 (73)	
Pacific Peoples	5310	2201 (41)	
Asian	4687	3449 (74)	
Indian	3140	1885 (60)	
MELAA	802	544 (68)	
Other/unknown	165	132 (80)	
Deprivation quintile*			<0.0001
One	3416	2603 (76)	
Two	4379	3123 (71)	
Three	4010	2902 (72)	
Four	4252	2716 (64)	
Five	10954	5169 (47)	
Unknown	161	131 (81)	

P values are comparing all known entities.
*One=least deprived; Five=most deprived.
LMC, lead maternity carer; MELAA, Middle Eastern, Latin American and African.

Table 2 Factors influencing screening rates

	All regions			
	Unadjusted OR (95% CI)	P value	Adjusted OR (95% CI)	P value
Region				
Region A	1		1	
Region B	0.50 (0.46 to 0.55)	<0.0001	0.75 (0.67 to 0.83)	<0.0001
Region C	0.16 (0.15 to 0.17)	<0.0001	0.29 (0.27 to 0.32)	<0.0001
Ethnicity				
Māori	1		1	
European	2.38 (2.21 to 2.56)	<0.0001	1.44 (1.32 to 1.57)	<0.0001
Pacific Peoples	0.62 (0.57 to 0.67)	<0.0001	0.77 (0.70 to 0.84)	<0.0001
Asian	2.43 (2.24 to 2.65)	<0.0001	1.46 (1.32 to 1.61)	<0.0001
Indian	1.31 (1.20 to 1.43)	<0.0001	1.21 (1.10 to 1.34)	0.0002
MELAA	1.84 (1.58 to 2.16)	<0.0001	1.17 (0.98 to 1.40)	NS
Maternity care provider				
LMC midwife	1		1	
Obstetrician	3.50 (3.20 to 3.84)	<0.0001	1.42 (1.28 to 1.58)	<0.0001
Community midwife	3.50 (3.15 to 3.89)	<0.0001	2.02 (1.79 to 2.27)	<0.0001
General practitioner	2.15 (1.05 to 4.40)	0.04	1.01 (0.49 to 2.09)	NS
No provider	0.31 (0.28 to 0.34)	<0.0001	0.61 (0.55 to 0.68)	<0.0001
Deprivation quintile				
Five	1		1	
Four	1.98 (1.84 to 2.13)	<0.0001	1.13 (1.04 to 1.23)	0.004
Three	2.93 (2.71 to 3.17)	<0.0001	1.30 (1.18 to 1.42)	<0.0001
Two	2.78 (2.58 to 3.00)	<0.0001	1.34 (1.22 to 1.46)	<0.0001
One	3.58 (3.28 to 3.91)	<0.0001	1.39 (1.25 to 1.54)	<0.0001
Study time epoch				
First	1		1	
Second	1.24 (1.17 to 1.32)	<0.0001	1.38 (1.29 to 1.48)	<0.0001
Third	1.28 (1.21 to 1.36)	<0.0001	1.44 (1.35 to 1.55)	<0.0001

For adjusted OR, all variables are included in the model.
LMC, lead maternity carer; MELAA, Middle Eastern, Latin American and African; NS, not significant.

(NZ Dep quintile 1) compared with those living in the most deprived areas (NZ Dep quintile 5); adjusted OR=1.39; 95% CI 1.25 to 1.54 (table 2). Regional analyses demonstrated that this variable had independent significance in Region C alone (table 3).

The majority of women had a midwife LMC (16 738; 62%). Obstetricians were the appointed LMC for 3841 (14%) of the births and general practitioners for 40 (0.1%). A further 2689 (10%) were provided with pregnancy and postnatal care from a team of community midwives. Community midwives provided services in Region A, but not Region B or C. There were 2164 (8%) babies born to mothers who were not registered with a maternity care provider. Failure to register with a maternity care provider was associated with lower odds of infant screening (table 2). Screening rates of ≥75% were achieved for babies under the care of the community midwifery team, obstetricians and general practitioners (table 1).

Only approximately half of Māori and Pacific Peoples babies were screened compared with three-quarters of Asian and European babies (p<0.0001, table 1). Ethnic variation in screening rates was most pronounced in Region C (table 3). In Region A, there was a little variation in screening rates with the lowest screening rate recorded for European infants (78%) and the highest for Asian infants (81%).

Screening rates improved over time. Birth in the first time epoch was associated with lower odds of screening compared with birth in the second (adjusted OR=1.38; 95% CI 1.29 to 1.48) and third epoch (adjusted OR=1.44; 95% CI 1.35 to 1.55) (table 2). The improvement was related to results achieved in Region A and C alone (table 3). In the third epoch, the probability of receiving a pulse oximetry test based on demographic characteristics ranged from 0.27 to 0.90. The highest probability was associated with the following combination of

Table 3 Regional factors influencing screening rates

	Region A				Region B				Region C			
	Unadjusted OR (95% CI)	P value	Adjusted OR (95% CI)	P value	Unadjusted OR (95% CI)	P value	Adjusted OR (95% CI)	P value	Unadjusted OR (95% CI)	P value	Adjusted OR (95% CI)	P value
Ethnicity												
Māori	1		1		1		1		1		1	
European	0.98 (0.86 to 1.13)	NS	0.94 (0.82 to 1.09)	NS	1.96 (1.62 to 2.37)	<0.0001	1.96 (1.60 to 2.39)	<0.0001	2.90 (2.56 to 3.29)	<0.0001	2.15 (1.87 to 2.47)	<0.0001
Pacific Peoples	1.14 (0.96 to 1.36)	NS	1.10 (0.92 to 1.31)	NS	0.99 (0.57 to 1.71)	NS	0.98 (0.56 to 1.70)	NS	0.63 (0.56 to 0.70)	<0.0001	0.65 (0.58 to 0.73)	<0.0001
Asian	1.23 (1.06 to 1.42)	0.005	1.27 (1.10 to 1.48)	0.002	1.32 (0.89 to 1.95)	NS	1.30 (0.88 to 1.93)	NS	1.76 (1.52 to 2.04)	<0.0001	1.42 (1.21 to 1.68)	<0.0001
Indian	1.18 (0.99 to 1.40)	NS	1.22 (1.02 to 1.46)	0.03	1.27 (0.87 to 1.87)	NS	1.31 (0.88 to 1.94)	NS	1.19 (1.04 to 1.35)	0.01	1.10 (0.95 to 1.27)	NS
MELAA	1.12 (0.89 to 1.42)	NS	1.13 (0.89 to 1.44)	NS	1.06 (0.34 to 3.24)	NS	0.98 (0.32 to 3.04)	NS	1.08 (0.81 to 1.44)	NS	0.90 (0.66 to 1.24)	NS
Maternity care provider												
LMC midwife	1		1		1		1		1		1	
Obstetrician	1.71 (1.54 to 1.89)	<0.0001	1.72 (1.55 to 1.92)	<0.0001	–		–		0.75 (0.30 to 1.90)	NS	0.41 (0.16 to 1.07)	NS
Community midwife	1.68 (1.50 to 1.88)	<0.0001	1.69 (1.50 to 1.91)	<0.0001	–		–		–		–	
General practitioner	1.45 (0.49 to 4.33)	NS	1.28 (0.42 to 3.84)	NS	1.15 (0.44 to 3.04)	NS	0.93 (0.34 to 2.51)	NS	–		–	
No provider	1.43 (0.97 to 2.12)	NS	1.33 (0.89 to 1.96)	NS	1.06 (0.47 to 2.37)	NS	1.08 (0.48 to 2.45)	NS	0.48 (0.43 to 0.53)	<0.0001	0.58 (0.51 to 0.65)	<0.0001
Deprivation quintile												
Five	1		1		1		1		1		1	
Four	0.93 (0.81 to 1.07)	NS	0.96 (0.83 to 1.10)	NS	1.12 (0.90 to 1.37)	NS	0.99 (0.80 to 1.23)	NS	1.36 (1.21 to 1.54)	<0.0001	1.11 (0.97 to 1.27)	NS
Three	0.89 (0.78 to 1.01)	NS	0.93 (0.81 to 1.07)	NS	1.31 (1.00 to 1.72)	NS	1.10 (0.83 to 1.45)	NS	2.71 (2.34 to 3.14)	<0.0001	1.71 (1.45 to 2.02)	<0.0001
Two	0.92 (0.81 to 1.04)	NS	0.94 (0.82 to 1.08)	NS	1.25 (0.97 to 1.63)	NS	1.01 (0.77 to 1.32)	NS	2.73 (2.40 to 3.09)	<0.0001	1.80 (1.56 to 2.08)	<0.0001
One	1.05 (0.92 to 1.20)	NS	1.07 (0.92 to 1.24)	NS	1.33 (0.86 to 2.06)	NS	0.96 (0.61 to 1.52)	NS	3.16 (2.67 to 3.74)	<0.0001	1.79 (1.48 to 2.16)	<0.0001
Study time epoch												
First	1		1		1		1		1		1	
Second	1.72 (1.56 to 1.90)	<0.0001	1.72 (1.56 to 1.90)	<0.0001	1.08 (0.88 to 1.31)	NS	1.09 (0.90 to 1.34)	NS	1.16 (1.05 to 1.28)	0.002	1.16 (1.05 to 1.29)	0.003
Third	1.86 (1.68 to 1.06)	<0.0001	1.86 (1.67 to 2.07)	<0.0001	0.80 (0.66 to 0.98)	0.03	0.83 (0.68 to 1.01)	NS	1.30 (1.18 to 1.43)	0.0001	1.24 (1.11 to 1.39)	0.0001

For adjusted OR, all variables are included in the model.
LMC, lead maternity carer; MELAA, Middle Eastern, Latin American and African.

characteristics: European or Asian ethnicity, community midwifery care, Region A and residence in a deprivation quintile 1 area. Pacific infants from a deprivation quintile 5 area in Region C, whose mothers were not registered with a maternity carer, were least likely to receive pulse oximetry screening.

DISCUSSION

This study has addressed the feasibility of introducing an equitable pulse oximetry screening programme within a midwifery-led maternity sector. The findings demonstrate that screening rates varied significantly across regions and reveal ethnic and socioeconomic disparities in the delivery of healthcare services.

Screening programmes in New Zealand have been less successful in engaging with Māori and Pacific Peoples compared with Europeans. This disparity is most evident in the adult healthcare sector with lower breast and cervical cancer screening rates recorded among New Zealand's minority groups.[13] Screening rates >95% have been achieved for the National Newborn Metabolic Screening Programme since its introduction in 1969.[14] In 2017, a national coverage rate of 99% was recorded with only minor variance among ethnic groups; 98% for Māori and Pacific Peoples, and 99.6% for other ethnicities. Within regions, rates ranging from 94% to 100% have, however, been recorded. In August 2010, the national implementation of the Universal Newborn Hearing Screening and Early Intervention Programme was completed. The most recent monitoring report stated that 91.5% of newborns were screened in 2015.[15] The success of these screening programmes is likely due to a variety of factors, such as their national governance, length of time since the inception of the programme and consumer acceptance of the programme. It may also be in part related to the care and oversight provided by LMCs during pregnancy and the first 6 weeks postpartum. Indeed, this study showed that failure to register with an LMC is associated with lower pulse oximetry screening rates.

In New Zealand, >90% of pregnant women appoint a midwife as their LMC.[16] LMCs are expected to initiate discussions with parents about screening programmes during pregnancy.[17] This provides parents with an opportunity to ask questions and to consider participation in the programme. The advice that parents receive from their midwife and trust in the midwife can lead to acceptance of the test that is offered to them.[18 19] Midwives' involvement with intrapartum care and their ongoing involvement in the care of newborn babies on the first day postpartum also puts them in an optimal position to conduct the pulse oximetry screening test. Pulse oximeters are portable, and therefore can be used equally effectively in a hospital setting, maternity unit or at home. Performing a screening test at the place of birth eliminates potential barriers to screening, such as travel time and cost to consumers. Delivering equitable screening requires that all consumers are offered the test regardless of where they birth. In this study, the place of birth had a significant impact on screening rates with <10% of those born at home receiving the test. This highlights the importance of obtaining the support of LMC midwives and ensuring that they are supported with access to education and supplied with the resources to perform the screening test. The New Zealand Ministry of Health is committed to providing healthcare 'closer to home' and to invest in health and well-being early in life as defined in the Health Strategy.[20] Therefore, access to services is an important consideration when determining how a screening programme should be delivered.

The impact on workload is a vital factor that will determine the success of a pulse oximetry screening programme in a midwifery-led setting, such as New Zealand. Management at one large tertiary hospital deemed that it was not possible for that hospital to participate in the study due to midwifery staff shortages and other institutional barriers. This had an ongoing impact on equity of access to the screening test for infants born in that region, which is ethnically diverse and characterised by high levels of deprivation. Region C is home to the largest population of Pacific People and the second-largest Māori population. More than 50% of women giving birth in this region are from the most deprived (NZ Dep quintile 5) communities in New Zealand.[21] In addition, the New Zealand maternity setting is characterised by a short duration of hospital stay following birth. Mothers and babies are often discharged home or transferred to a primary maternity unit within 4–6 hours after birth. Some infants may not be offered screening as a direct result of short hospital stays. Māori culture regards childbirth as a time of spiritual significance when extended family is important; some hospital environments are not conducive to supporting cultural needs and Māori, therefore, often choose to return home as soon as able. This may put them at particular risk of not being offered the test. Māori and Pacific mothers often have extended family present at birth. Elders in these extended communities often take on leading roles in decision-making. Large numbers of people around the parents and lack of a clear decision-maker may impact on the ease of obtaining consent. Reassuringly both consumers and midwives reported that pulse oximetry is important. The simplicity and non-invasive nature of the test meant that it was well-received. Obtaining consent was not regarded as a barrier to screening.[3 22] The relatively low screening rates can be attributed primarily to institutional constraints and difficulty accessing equipment when attending a home birth, which prevented midwives from offering the test to consumers.[22]

Quality improvement initiatives have the potential to benefit some population groups more than others. In this study, equal support and resources were offered to all maternity care providers and birthing units that were

invited to partake in the study. Participation was, however, voluntary and dictated by individual perceptions as well as institutional constraints. This resulted in inequitable service delivery with lower screening rates achieved for Māori and Pacific Peoples, those living in the most deprived areas, and those born at home or primary maternity units. No ethnic or socioeconomic disparity was evident in Region A, where a screening rate of 80% was achieved. If equal participation in screening can be reached, pulse oximetry screening will likely result in greater health gains for Māori, Pacific Peoples and those living in the most deprived areas of New Zealand. This relates to the lower LMC registration rates reported among women living in the most deprived areas as well as Pacific women. Māori women are also less likely to register with a maternity care provider compared with European women.[16] Engagement with antenatal maternity care providers is directly related to the likelihood of detecting abnormalities during pregnancy. Crucially, failure to obtain a midtrimester fetal anatomy scan eliminates the possibility of making the diagnosis of a congenital anomaly before birth.

This study demonstrated that there is the potential to create greater inequity if newborn pulse oximetry screening is not universal. Standardising care can reduce this risk by enabling fair access to quality services. A study conducted in the USA showed a significant reduction in infant cardiac deaths following the implementation of state-wide policies mandating pulse oximetry screening. In contrast, there was no significant reduction in deaths in states with non-mandatory screening policies.[6] The decision on whether newborn pulse oximetry screening should be sector-led or nationally governed is, therefore, important and one that will impact on outcomes.

In addition to social justice and ethical rationale for health equity, the economic consequences of health inequities are important to consider. Māori children access primary healthcare at a lower rate than non-Māori and potentially avoidable hospitalisation rates are greater for Māori children and people living in the most deprived areas.[23–25] Mills *et al* investigated the cost of health inequalities in New Zealand and concluded that eliminating inequities could result in significant economic benefits.[23] A late diagnosis of CHD can result in significant healthcare costs with a higher demand on hospital resources compared with timely detected anomalies.[26 27] The human cost measured in avoidable mortality is, however, a greater cost to society.

Study limitations

The Health and Disability Ethics Committees of New Zealand required that written parental consent be obtained prior to enrolling an infant in the study to ensure that parents were aware that personal information will be collected and that they agree that the data can be stored and used. As a result, it was not possible to establish how many parents declined participation after they were offered screening, as failure to obtain consent prevented us from collecting and storing personal data.

CONCLUSION

Equity in health means equal opportunity to be healthy, for all population groups. A pulse oximetry screening programme that is sector-led is likely to perpetuate inequality as human and material resource constraints may prohibit access to the test. Programmes need to be designed so that resources are distributed in the way most likely to optimise health outcomes for infants born with critical cardiac anomalies.

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Contributors EC conceptualised and designed the study, drafted the initial manuscript, collected data, analysed data, and reviewed and revised the manuscript. FHB and TLG assisted with the study design, supervised data collection and analysis, and reviewed and revised the manuscript. SD assisted with the study design, supervised and assisted with regional data collection, and reviewed and revised the manuscript. DRW, JMA and LAD contributed to the study design and critically reviewed the manuscript. JDA and JR contributed to the study design and critically reviewed the manuscript from a Pacifica and Māori perspective. All the authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

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