

Towards Universal Newborn Screening in Developing Countries: Obstacles and the Way Forward

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Abstract

Newborn Screening is a well recognised public health programme aimed at the early identification of infants who are affected by certain genetic/metabolic/infectious conditions. Early identification of these conditions is particularly crucial, since timely intervention can lead to a significant reduced morbidity, mortality, and associated disabilities in affected infants. Establishing sustainable newborn screening programmes in developing countries poses major challenges as it competes with other health priorities – infectious disease control, immunisation, malnutrition, etc. Despite this, it is imperative that developing countries recognise the importance of newborn screening based on experiences on both developed and developing countries in saving thousands of babies from mental retardation, death and other complications. Some of the critical factors necessary for a successful national newborn screening programme are inclusion of newborn screening among government priorities, funding (including the possibility of newborn screening fees), public acceptance, health practitioners cooperation, and government participation in institutionalising the newborn screening system. This paper presents a historical review of 4 eras of newborn screening in the Asia Pacific, discusses enabling factors leading to successful newborn screening programme implementation, and identifies obstacles that threaten the programme implementation in developing countries.

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Introduction

In most economically developed countries, newborn bloodspot screening (NBS) using biochemical markers to detect certain congenital conditions is a public health measure aimed at the early identification and management of affected newborns.¹ Since the Asia Pacific region is vast and diverse, the development of newborn screening in the region has been likewise varied. The Asia Pacific Region includes countries varying widely in size from very small countries (Singapore, New Zealand) to extremely large countries (China, Mongolia). It includes both economically developed (Japan, Taiwan, Korea, Singapore, Australia, New Zealand) and economically developing countries (the rest of the Asia Pacific Region). Asia Pacific countries have faced and continue to face many challenges in implementing newborn screening including differences in language and culture, extremes in geography (large numbers of islands and many mountainous regions), poor economies, and unstable governments. In countries with depressed or

developing economies, particularly in Asia, newborn screening and other forms of infant screening compete with other health priorities, i.e. control of infectious diseases, immunisation and malnutrition, etc. In some of the more progressive developing countries, NBS is now emerging as a priority.

Eras of Newborn Screening

Pre Guthrie Era. Prior to bloodspot newborn screening, newborn screening was performed using urine testing in New Zealand, Australia and Japan.²⁻⁴ In 1964, urine testing for PKU attained 80% coverage in New South Wales, Australia.³ However, due to the reported increase in false-negative results and the difficulties in collecting a satisfactory specimen, urine screening was subsequently replaced with dried bloodspot screening method introduced by Dr Robert Guthrie in the 1960s.⁵

First Asia Pacific Screening Era. One of the first national NBS programmes in the world was developed in New

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Zealand. It began as a pilot study for phenylketonuria (PKU) in 1966 and became a national screening programme in 1970. Nearby country, Australia started its pilot study of PKU screening in 1967 and it also progressed to national in coverage in 1970. Japan also began a pilot study in 1967, but it did not develop into a national programme until 1977. A pilot screening programme for glucose-6-phosphate dehydrogenase (G6PD) deficiency using cord blood began in Singapore in 1965 and developed into a national programme in 1970. Subsequently, this cord blood screening programme expanded to include screening for congenital hypothyroidism (CH).¹ It has remained cord blood based until recent expansions to metabolic conditions required a transition to dried blood on filter paper.

Second Asia Pacific Screening Era. Twenty years later after the development of the Guthrie process, newborn screening began in Malaysia in 1980, with cord blood screening for G6PD deficiency. In India, a pilot study occurred in Bangalore, screening for various amino-acidopathies, homocystinuria (HCY), hyperglycinemia, maple syrup urine disease (MSUD), PKU. Taiwan began limited screening for CH, PKU, and G6PD deficiency in 1981, which became a national programme in 1985. China also began screening for CH, PKU, and galactosemia (GAL) in 1981, but legislation of national expansion did not exist until 1995. Hong Kong started a national programme of cord blood screening for G6PD deficiency and CH in 1984.¹

Third Asia Pacific Screening Era. A third era of NBS in the Asia Pacific appears to have occurred during the 1990s following the initiation of CH screening in much of the economically developed world. Screening for CH began in South Korea and the iodine-deficient areas of Thailand as pilot studies were carried out in 1991 and 1992 respectively. The Thailand pilot project became a national screening programme in 1996. In South Korea, nationalisation of screening occurred in 1997. NBS began in the Philippines as a pilot project for 5 conditions [PKU, CH, congenital adrenal hyperplasia (CAH), galactosemia (GAL), and homocystinuria] in 1996 and became a national programme when a screening law was passed in 2004.¹

Fourth Asia Pacific Screening Era. The fourth NBS era began in the late 1990s with pilot NBS programmes for CH in Mongolia, Vietnam, Bangladesh and Indonesia in 1999, Myanmar in 2000, Sri Lanka in 2005, Pakistan in 2006 and Palau in 2008.⁷ Laos has expressed interest on a pilot CH screening project during a recent workshop entitled 'Consolidating Newborn Screening Efforts in the Asia Pacific' held in the Philippines.⁶ There is still no screening programmes in Nepal and Cambodia. Aside from Guam, Saipan (part of the Federated States of Micronesia) and Palau (personal communication—Ms Berry Watson), there

is little newborn screening activity in the rest of the Islands in the Pacific Basin.⁶

Burden of CH in Asia

NBS for CH began in developed programmes in the 1970s. As programmes began to develop in Asia during the 1990s, screening for CH became an important consideration, particularly since many areas in the developing world are iodine deficient. Globally, the incidence of CH approaches 1:3000, with substantially higher prevalence in iodine deficient areas, sometimes in excess of 1:900.⁷ With annual births of 66.9 million of babies in Asia, there are at least 22,200 potential new cases of CH every year and probably even more, given the limited documented areas of iodine deficiency in Asia. Of the 66.9 million annual births in Asia, only 10% are screened for CH; thus, only a small proportion of new CH cases even have the chances for identification.

Enabling Factors and Obstacles

In a survey conducted among newborn screening managers in the Asian countries, the following factors were identified as integral to the success of full population newborn screening: (i) government prioritisation; (ii) full or partial government financing; (iii) public education and acceptance; (iv) health practitioner cooperation/ involvement; and (v) government participation in institutionalising a newborn screening system. Among the countries that lack total coverage, the following obstacles are most often cited: (i) poor economies; (ii) insufficient health education; (iii) lack of government support; (iv) early hospital discharge; and (v) a large numbers of out-of-hospital births.¹

Geography. Geographical location is a hindrance for some countries, i.e. the Philippines (7107 islands) and Indonesia (13,667 islands) are huge archipelagoes, and Mongolia has 90% of its land as either pasture or desert.

Population and number of births. Of the 133 million births worldwide, 66.9 million occur in Asia. Eighty percent (80%) of these are born in 5 countries: India (25 million), China (17 million), Pakistan (4.7million), Indonesia (4.5 million), and Bangladesh (3.7 million).⁶ These 5 Asian birthing giants account for over two-thirds of all people living in rural areas without access to proper sanitation, children who suffered from malnutrition, people living on less than US\$1 a day and rampant tuberculosis cases.⁸ These 5 giants collectively have only reached <1% of screening coverage. Table 1 shows that the countries with lower annual births yet higher coverage for NBS. Singapore, Hong Kong, Taiwan, Australia, New Zealand have almost 100% coverage. Mongolia is the only country with low NBS coverage and with a low birth rate. This shows that

other than population and birth rates, there are other factors that contribute to a successful NBS programme.

General health priorities. All countries with an Infant Mortality Rate (IMR) of less than 10 per 1000 live births have achieved better than 90% screening coverage of their newborn population. Of the remaining countries with higher IMRs, Thailand (IMR 13 per 1000) is the only one that has achieved a high rate of newborn coverage (97%). There are other factors responsible for this success and most notably is the high level of government financial support.

Government support and integration in the health delivery

system. Integration into the national health delivery system was cited as the single most critical element among survey responders. All countries with coverage of at least 90% have fully integrated NBS into the health delivery system, including the payment scheme for a NBS fee. Payment is either covered by government, insurance or out-of-pocket expense of the family (Table 1).

Legislation. While most of the developed programmes in the region have successfully accomplished health care integration without requiring legislation, at least 2 of the developing programmes (China and the Philippines) have found national legislation to be necessary. In China,

Table 1. Programme Demographics in Asia Pacific

Country	Thousand births ^a	Infant mortality rate (under 1) ^a	Reported programme coverage in 2006	Source of payment for newborn screening fee ¹
Australia	250	5	100%	Government
Bangladesh	3,747	54	<1%	Government
Cambodia	429	98	0	?
China	17,310	21	25%	Family
Hong Kong (China) ^b	65 ^b	1.8 ^b	99%	Government
India	25,926	43	<1%	Family
Indonesia	4,495	18	<1%	Family
Japan	1,162	2	>99%	Government
Korea (South)	457	3	94%	Government
Korea (North)	342	22	?	?
Laos	205	35	0	?
Malaysia	547	5	95%	Government/Private
Mongolia	58	26	<1%	Grant
Myanmar	976	40	<1%	Government
Nepal	787	40	?	?
New Zealand	54	4	100%	Government
Palau ^c	0.385 ^c	13.7 ^c	0	Government
Pakistan	4773	57	<1%	?
Philippines	2018	15	10%	Family /Ins
Singapore	39	1	>99%	Family 40%
Sri Lanka	329	11	<1%	Government
Taiwan ^d	287 ^d	6.3 ^d	>99%	Family
Thailand	1009	13	97%	Government
Vietnam	1648	15	<1%	Government
Totals	66,913			
World Statistics	133,801			

^a Source: UNICEF 2006 The State of the World's Children 2007. New York: UNICEF, 102-105. (Available at: <http://www.unicef.org/sowc/archive/ENGLISH/The%20State%20of%20the%20World%27s%20Children%202007.pdf>)

^b Source: Hongkong Statistics. [http://www.censtatd.gov.hk/FileManager/EN/Content_811/health.pdf\(2006\)](http://www.censtatd.gov.hk/FileManager/EN/Content_811/health.pdf(2006))

^c Source: Palau Statistics. <https://www.cia.gov/library/publications/the-world-factbook/print/ps.html>

^d Source: Taiwan Statistics. http://indexmundi.com/taiwan/birth_rate; <http://indexmundi.com/taiwan/population.html> (2006)

Presidential Order No 33 (1994) Article 24 states that “medical and health institutions shall gradually develop medical and health care services such as the screening of newborn babies”.⁹ In the Philippines, Republic Act 9288 or the Newborn Screening Act of 2004 Article 1 Section 3 states that “every newborn must be given access to newborn screening” and article 3 states that “any health practitioner who delivers, or assists in the delivery, of a newborn in the Philippines shall, prior to delivery, must inform the parents or legal guardian of the newborn of the availability, nature, and benefits of newborn screening”.¹⁰

Health providers. Some healthcare providers have insufficient knowledge, interest and commitment to newborn screening. In most developing programmes, there are very few specialists to whom referrals can be made once newborns have been confirmed to be positive for a particular disease.

Parents and family. In beginning programmes, parents and family members remain unaware of the benefits of NBS as well as consequences of late diagnosis for the disorders in the panel. Hence, they remain uncooperative to the screening process. The early discharge policy in the developing countries, contribute to missed opportunities for the newborns as parents decide not to screen their babies for any disorders after being discharged.

Partnership. All sectors must be empowered to participate in the implementation of the NBS programme, i.e. paediatricians, obstetricians, midwives, neonatologists, geneticists, endocrinologists, nurses, community health workers, hospital administrators and policy makers.

Operations and infrastructure. For countries with beginning pilot projects, operations at either hospital or community setting, may need guidance from neighbouring countries with more developed programmes. Off-site newborn screening laboratories may be a consideration for small populations and countries without ready infrastructure. A guidance book entitled *Screening of Newborns for Congenital Hypothyroidism Guidance for Developing Programmes*⁷ provides step-by-step instructions for the organisation of a screening programme.

The Way Forward

Experience from successful programmes showed that integration into the national health delivery system is the

single most critical element. All beginning programmes must work towards this end. Integration must include a payment scheme to ensure ready acceptance by the families. The pilot projects must work within the framework of a national programme with a national committee taking charge of the different phases of implementation. As of 2007, only 10% of the newborn population in the Asia Pacific Region is being screened. As newborn screening competes with other priorities of the developing countries, there is a need for an international body to convince national governments that NBS is important for their population. Though small in numbers, the countries in the Pacific Basin must give sufficient attention to NBS as their problems are similar to all of the developing programmes.

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