Newborn Screening Saves Babies Using Public/Private Partnerships

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Insights in Public Health is a monthly solicited column from the public health community and is coordinated by HJMPH Contributing Editors Tetine L. Sentell PhD from the Office of Public Health Studies at the University of Hawai'i at Manoa and Donald Hayes MD, MPH from the Hawai'i Department of Health in collaboration with HJMPH Associate Editors Ranjani R. Starr MPH and Lance K. Ching PhD, MPH from the Hawai'i Department of Health.

Newborn screening (NBS) is heralded as one of the most successful public health programs using early detection and intervention to prevent disability, disease, and death in children. Nationally, 4 million newborns receive NBS annually and 12,500 of these newborns are identified as having a disorder.[1] This year marks 50 years of NBS in Hawai'i and we have come a long way since the first tests for phenylketonuria (PKU) were ordered by Hawai'i pediatricians in 1965. Newborn screening has matured into a statewide program coordinated by the Department of Health (DOH), and the screening panel now includes tests for 33 metabolic disorders, hearing loss, and critical congenital heart disease. In 2014, 99.8 percent of all newborns received NBS in Hawai'i. Approximately 1 in 55 newborns have a positive test result that needs follow-up to determine if the newborn has the disorder. All newborns detected and confirmed with a disorder (1 in 624) receive appropriate follow-up and intervention services in a timely manner.[2]

Background

Newborn screening began over 50 years ago when Guthrie and Susi developed a method to detect PKU on a filter paper dried blood spot.[3] Phenylalanine is an amino acid present in protein products. Individuals with PKU lack the enzyme to break down phenylalanine. The toxic buildup of phenylalanine causes several health issues including brain damage that results in moderate to severe intellectual and developmental disability. Using the Guthrie test, newborns with PKU can be detected early and receive dietary intervention to prevent the health problems and intellectual disability. Massachusetts was the first state to mandate PKU NBS in 1963. Eventually, all states followed including Hawai'i which mandated screening in 1965.[4]

Hawai'i Newborn Metabolic Screening Program

Many states that mandated NBS in the 1960s created programs within their health departments and/or state laboratories to provide coordination and oversight for NBS. Before 1986, NBS in Hawai'i was conducted by birthing facilities and private primary care physicians without statewide or public health coordination or oversight. Unfortunately, this system led to a missed case of PKU resulting in profound intellectual disability in the child. Following this case, the Hawai'i legislature mandated a Newborn Metabolic Screening Program (NBMSP) within the Department of Health to provide coordination, limited oversight, and education for newborn screening starting in 1986. The legislation also updated the mandate from only screening for PKU to also require screening for congenital hypothyroidism. Parents were given the right to opt out of screening on the basis of religious tenets or beliefs.

Over the following decade, the NBMSP developed a statewide program to educate birthing facility nursery staff and health care providers, to ensure timely follow-up of newborns with positive newborn screening results, to track newborns detected with confirmed diagnoses, and to provide technical assistance on NBS. Although the increased education and oversight greatly improved NBS in Hawai'i, the work was time-consuming and not well coordinated. One major challenge was that multiple private laboratories were engaged in doing the NBS laboratory testing for a low birth rate of about 21,000 newborns per year. The small number of newborns and multiple laboratories made quality assurance of the laboratory activities very difficult since laboratory issues (e.g. machine calibrations, differences in batches of reagents, lack of experience identifying true positive results) could take months or years to identify and resolve. In addition, the limited authority and funding of the NBMSP to develop a statewide coordinated and comprehensive NBS system hampered the ability to add new disorders to the NBS panel. By 1994, Hawai'i remained the lone state screening for only PKU and congenital hypothyroidism while most states were screening for at least seven disorders (PKU, congenital hypothyroid, hemoglobinopathies, congenital adrenal hyperplasia, galactosemia, biotinidase deficiency, and maple syrup urine disease).

Public/Private Partnership to Save Babies

Community Support for Newborn Screening

The state's economic crisis in the mid-1990s was the catalyst for positive and sustained change for the NBMSP. For many years in the mid-1990s, state government programs were scrutinized for cost savings and/or elimination as the state's income

continued to decline. During one of the state's worst economic years in 1995, the NBMSP was one of the programs considered for elimination. Elimination would have put all NBS activities back into the hands of the birthing facilities and primary care providers. The only hope for saving the program was to gather community support and approach the legislature to mandate a sustained program through user fees deposited to a special fund to be used for newborn screening.

To create the user fee based system and a more centralized and comprehensive newborn screening system, the NBMSP requested more authority from the legislature to collect fees for NBS activities. This was expected to allow the NBMSP to contract with one central newborn screening laboratory and fund the staff and services to coordinate the entire system of NBS for pre-screening education, testing, follow-up, and treatment. Having all NBS centralized and coordinated as a statewide system also enabled the provision of services at lower costs to birthing facilities, third party payers, and families with added quality assurance and improvement opportunities.

Fortunately, the mandate was passed during the 1996 legislative session.[5] The legislative success surprised many since it normally takes an average of three years to introduce a bill, provide information to the legislators about the bill, and have the bill passed by the legislature in Hawai'i. The quick passage of the bill was accomplished with the enormous collaborative efforts and hard work of the Department of Health staff, birthing facilities, primary care providers, families that benefited from newborn screening, professional organizations such as the American Academy of Pediatrics, and advocacy organizations such as the March of Dimes. Act 259, Newborn Metabolic Screening, came into effect on July 1, 1996.

Fiscal Sustainability

To seed the Newborn Metabolic Screening Special Fund, birthing facilities paid four dollars per newborn into the fund from July 1, 1996 to June 30, 1997. These funds were used to support three staff positions in the NBMSP as they developed the infrastructure needed for the statewide centralized and comprehensive NBS system to meet national standards. During this phase, total costs (staff salaries, laboratory testing, specimen delivery, supplies, educational materials and activities, follow-up testing, specialty clinical services, and testing for indigent families) for the program were calculated. The estimated fee per newborn for screening was calculated as the total funding needed to sustain the NBMSP and the NBS services divided by the average annual birth rate. All fiscal calculations and contracts were transparent to the public and followed state procurement laws. The information was presented to the State Newborn Metabolic Screening Advisory Committee and the initial fee of $27 per newborn for seven disorders was supported by the Committee. The $27 fee supported the cost savings expected as a result of centralizing NBS. A survey of the laboratory billing and reimbursement for only PKU and congenital hypothyroidism before the legislation was passed revealed a cost of $30-$165 per newborn so one of the benefits of the legislation represents a significant cost savings.

Over the almost 20 years since passage of this legislation, Hawai'i increased its NBS fee using the same process. The first major fee increase occurred when a new technology, tandem mass spectrometry (MS/MS), was added to the NBS laboratory methods. The new MS/MS methodology allowed the detection of over 30 disorders using the same amount of dried blood with one machine. In 2003, Hawai'i began screening for 31 primary disorders and the NBS fee was calculated at $47 per newborn. Cystic fibrosis was added to the NBS panel in 2007 with a minor increase in the fee. Currently, the fee is $55 per newborn and has not been increased in over six years.

Recently, another new technique was introduced to the NBS laboratory using deoxyribonucleic acid (DNA) technology. This technology is used to detect newborns with Severe Combined Immunodeficiency (SCID) wherein the newborn fails to develop an immune system to fight off infections. Adding DNA technology was expensive since NBS laboratories had to add new DNA facilities to do the testing. The State Newborn Metabolic Screening Advisory Committee recommended the addition of SCID to the Hawai'i NBS panel in the fall of 2014. Screening began in March 2015 and now Hawai'i screens for 33 primary disorders (See Table 1). The new testing and the increase in overall costs for NBS over the past six years will increase the fee to $99 per newborn. The fee increase was approved by the Newborn Metabolic Screening Advisory Committee in September 2015 and the NBMSP is currently working to have the fee approved in the administrative rules. This new fee still makes newborn screening one of the best values in healthcare.

The fiscal collaboration between public health and private partners has allowed the NBMSP to be self-sufficient, cost efficient, and accountable. All funds and how the funding is used is presented annually to the legislature in a report and available for public review. No general fund dollars have been used to sustain the program and its activities for almost twenty years. Only families that have babies are charged the newborn screening fee which is covered by all third party payers. Families with an inability to pay can also receive newborn screening services through the program at no cost. Annually, the NBMSP pays for less than five percent of NBS for indigent patients which is factored into the NBS fee.

National Standards

Newborn screening is a state mandated activity across the nation. Variations in NBS activities, especially the number and type of disorders on state NBS panels, were commonplace due to the lack of national standards and guidelines. In 2008, Congress passed the first Newborn Screening Saves Lives Act to create a federal advisory committee to advise the Secretary of Health and Human Services about NBS.[6] One of the initial acts of the Secretary's Advisory Committee on Heritable Disease in Newborns and Children (SACHDNC) was to recommend 29 disorders that all states should have on their newborn screening panel, thus, creating the Recommended Uniform Screening Panel (RUSP). The Secretary accepted this recommendation and the RUSP was born. Subsequently, the SACHDNC developed a process for nomination of disorders to the RUSP which

Table 1. List of Disorders on Hawai'i Newborn Screening Panel as of November 1, 2015
Amino Acid Disorders
Arginase Deficiency
Argininosuccinate Lyase Deficiency (ASA)
Citrullinemia
Homocystinuria
Phenylketonuria (PKU)
Tyrosinemia (Types I and II)
Organic Acid Disorders
Beta-Ketothiolase Deficiency
Glutaric Acidemia (Type I)
Isobutyryl CoA Dehydrogenase Deficiency
Isovaleric Acidemia
Malonic Aciduria
Maple Syrup Urine Disease (MSUD)
Methylmalonic Acidemias
Multiple Carboxylase Deficiency (MCD)
Propionic Acidemia
2-Methyl-3-Hydroxybutyryl CoA Dehydrogenase Deficiency
2-Methylbutyryl CoA Dehydrogenase Deficiency
3-Hydroxy-3-Methylglutaryl (HMG) CoA Lyase Deficiency
3-Methylcrotonyl CoA Carboxylase Deficiency (3MCC)
3-Methylglutaconyl CoA Hydratase Deficiency
Fatty Acid Oxidation Disorders
Carnitine Uptake/Transport Defects
Glutaric Acidemia (Type II)
Long Chain 3-hydroxyacyl-CoA Dehydrogenase Deficiency (LCHAD)
Medium Chain acyl-CoA Dehydrogenase Deficiency (MCAD)
Short Chain acyl-CoA Dehydrogenase Deficiency (SCAD)
Very Long Chain acyl-CoA Dehydrogenase Deficiency (VLCAD)
Other Disorders
Biotinidase Deficiency
Congenital Adrenal Hyperplasia (CAH)
Congenital Hypothyroidism
Cystic Fibrosis
Galactosemia
Hemoglobinopathies (including Sickle Cell)
Severe Combined Immunodeficiency (SCID)

included a formal evidence review and committee deliberation and vote to recommend to the Secretary.

The advisory committee was reauthorized by Congress in 2014 and the requirement for a public health impact assessment and cost considerations be added to the committee deliberations to recommend a disorder for the RUSP.[7] Besides development of the RUSP, the SACHDNC is also responsible for reviewing the NBS system and developing recommendations for the Secretary to improve NBS laboratory and follow-up activities.

The national standards and recommendations from the SACHDNC and the Secretary have helped guide the community decision making and quality assurance and improvement activities in Hawai'i.

Community Decision Making

An important foundation for the NBMSP is community engagement and decision making to guide the activities of the NBMSP and the disorders that are on the screening panel especially as more disorders, standards, and recommendations come from the SACHDNC and Secretary of Health and Human Services. The NBMSP convenes a state Newborn Metabolic Screening Program Advisory Committee at least once annually to provide recommendations to the DOH about NBS. The Committee consists of representatives from each birthing facility in the state, local laboratories, primary care providers, specialty care providers, parents of children with disorders detected by newborn screening, public health staff, advocacy organizations, and third party payers.

To aid the discussion and recommendations of the Advisory Committee, the DOH employs various methods to provide information to the Committee:

(1) Collecting and analyzing data from the NBMSP and other related state public and private programs;
(2) Collecting and disseminating information from national sources, other states, and literature searches;
(3) Conducting surveys, focus groups, and interviews to collect community input from families and health care providers; and
(4) Convening condition specific task forces to review evidence for adding a disorder to the panel and make recommendations to the Committee.

Quality Assurance and Continuous Quality Improvement

The authority and funding to have a coordinated and comprehensive NBS system allowed the NBMSP to develop, collect, and disseminate data for quality assurance and improvement activities. Using the data, a monthly performance report is generated for the entire state and each birthing facility. The report contains information about the timing of the collection of the blood after birth, quality of the specimens obtained from the newborns for testing, how long it took for the specimen to get to the laboratory, and any problems encountered. Recommendations for quality improvement for the birthing facility based on published or national standards are included with each performance report. The Hawai'i birthing facilities gener-

ally do very well at meeting the performance measures. When deficiencies are noted, corrective actions are executed quickly.

The collaborative relationship with clinical providers also allows the NBMSP to have information about follow-up, diagnostic testing, treatment, and management. This allows documentation of confirmation of diagnosis, initiation of treatment, and follow-up activities. Deficiencies in the process are monitored and changes are made to policies and procedures if corrective action is warranted.

Continuing Challenges

Growth of Disorders on Newborn Screening Panel

Since the original RUSP was recommended in 2010, three additional conditions, Severe Combined Immunodeficiency (2010), Critical Congenital Heart Defects (2011), and Pompe Disease (2015), have been recommended by the SACHDNC and put on the RUSP by the Secretary of Health and Human Services. In addition, the SACHDNC recommended two additional disorders to the Secretary, Mucopolysaccharidosis Type I and Adrenoleukodystrophy.

Hawai'i has responded to each new addition to the RUSP using the community decision making process with the NBMSP Advisory Committee when the NBS laboratory methodology has been validated. Currently, Hawai'i screens for 32 of the 33 disorders on the RUSP and has not started deliberation on Pompe Disease since the NBS laboratory has not identified or validated a method to do NBS efficiently for this one disorder.

The increasing number of disorders being added to the RUSP is a challenge for any state especially when most states are under budgetary constraints. The workload grows as states struggle with a reduced workforce due to retirement, attrition, and lack of funding or hiring freezes. As we add new disorders, we also have to be mindful to continue doing as well with the current disorders we detect which is difficult with a staff that is stretched thin.

Data systems need to be updated and become interoperable in both the public and private sector to provide accurate and timely tracking of the entire NBS process from the birth through resolution of screening results. Additional data systems need to be in place for long-term follow-up of infants diagnosed with disorders to improve future treatment and disease management.

Payment for treatment and management for disorders is also challenging. Coverage for treatment is variable depending on the family's health insurance plan. Some of the treatment is expensive and not always available in the state the family resides. This is especially problematic for Hawai'i since we have smaller numbers of pediatric specialists and the closest available treatment for some disorders is 2500 miles across the Pacific Ocean. Also, while we have a program that has successfully allowed children with these disorders to grow into productive adults, many adult providers and third party payers are not accustomed to caring for or covering services for adults with these disorders.

Ethical Issues

The principle of mandated newborn screening has been early detection in the newborn period to detect disorders that cannot be diagnosed easily so that the newborn can receive treatment to avoid disease, disability, and death. In recent years, late onset disorders have begun to be considered for inclusion into the NBS panel. Late onset disorders, such as Adrenoleukodystrophy, appear sometime after the newborn period with some not having any possible consequence until adulthood. Advocates argue this is the best and potentially the only method to detect those children and adults at risk for a disorder. Opponents respond that mandated newborn screening should only be used to detect disorders needing immediate treatment to preserve the principles that have been the foundation of newborn screening. All states will have to address this issue with their communities in the near future especially as the possibility of doing whole genome sequencing for the purpose of newborn screening becomes a reality.

Conclusions

Since the NBMSP started in 1986, over 1,100 children have been found with a disorder and treated to prevent disease, disability, and death. Hawai'i has become a model for creating a sustainable, community driven, cost effective, and comprehensive newborn screening system.

The continued success and sustainability of the program depends on the strong public/private partnership and community involvement that has been fostered over the last 20 years. We will need to expand and strengthen this collaborative effort as newborn screening moves into the future with the continuous addition of disorders to the screening panel and new technology for screening is developed.

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