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Current status of newborn screening worldwide: 2015

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ABSTRACT

Newborn screening describes various tests that can occur during the first few hours or days of a newborn's life and have the potential for preventing severe health problems, including death. Newborn screening has evolved from a simple blood or urine screening test to a more comprehensive and complex screening system capable of detecting over 50 different conditions. While a number of papers have described various newborn screening activities around the world, including a series of papers in 2007, a comprehensive review of ongoing activities since that time has not been published. In this report, we divide the world into 5 regions (North America, Europe, Middle East and North Africa, Latin America, and Asia Pacific), assessing the current NBS situation in each region and reviewing activities that have taken place in recent years. We have also provided an extensive reference listing and summary of NBS and health data in tabular form.

Introduction

The general term "newborn screening" is used to describe various tests that can occur during the first few hours or days of a newborn's life and which, when properly timed and performed, have the potential for preventing severe health problems, including death. Newborn screening has evolved from a relatively simple blood or urine screening test,

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originally used for detecting a single congenital condition, to a more comprehensive and complex screening system that can detect over 50 different conditions.[1] While typically using blood taken from a heelstick, more recent newborn screening expansion has included bedside testing to detect conditions such as hearing loss and cardiac disease. The latter 2 conditions are now included in the U.S. federally recommended uniform screening panel (RUSP)[2] and are included in some programs in other parts of the world. This report focuses on newborn bloodspot screening (NBS) commonly used to identify inborn errors of metabolism or other inherited disorders and updates screening reports that were published in 2007, outlining NBS activities in various parts of the world.[3–9] More detailed information on hearing screening can be found in an earlier issue of this Journal,[10] and information on CCHD can be found elsewhere in the current issue.[11]

NBS typically uses blood taken from a heelstick, absorbed onto special collection paper (similar consistency to filter paper), and transported to a special screening laboratory.[12] While hospital laboratories may be qualified to perform NBS testing in some settings, the screening laboratory is usually a specialized laboratory because of the micro-techniques used, the cost savings from centralizing the laboratory services, and improvements in quality realized when testing large quantities of specimens for relatively rare conditions. In the U.S., it is most often a special public health laboratory. In some settings, it may be part of a larger clinical genetics laboratory, and in others, particularly in developing countries, it may be in a research setting.

In order to assess NBS activities globally, we have divided the world into 5 regions: North America, Europe, Asia Pacific, Middle East and North Africa (MENA), and Latin America. Obviously missing is Sub-Saharan Africa for which little information is currently available, and limited congenital hypothyroidism (CH) and sickle cell NBS activities are ongoing.[13–15] A review of the literature and personal contacts working in Africa revealed documentation of various beginning newborn screening activities in Ghana,[16,17] Nigeria,[18] Tanzania,[19] Angola,[20] Ethiopia,[21] Democratic Republic of Congo,[22] and South Africa.[23,24] For the remainder of the world, we have drawn on our extensive NBS experience and contacts with NBS program managers within our respective regions to solicit recent updates in order to comprehensively describe ongoing regional NBS activities.

North America

For purposes of this report, North America is comprised of the 51 U.S. programs (50 states and the District of Columbia) and 15 Canadian programs (10 provinces and 3 territories with 1 territory, Nunavut, divided into 3 regions). Because of similar language and culture, Mexico, while a part of North America, is included in the discussion of Latin American programs. Although screening exists in some U.S. territories, little effort has been made to collect systematic data on these programs, and they are not included in the discussion here. It suffices to say that the programs in Puerto Rico, Virgin Islands, and Guam are the most advanced U.S. territorial programs. A recent report summarizes the challenges faced by NBS expansion in the territories, with particular emphasis on the Virgin Islands and Puerto Rico.[25] While nationally managed NBS programs do not exist in either the U.S. or Canada, the state, provincial, and territorial NBS programs have long histories and well established infrastructures similar to national programs in other countries.

Building on federally supported efforts to develop a national newborn screening plan (blueprint) by the American Academy of Pediatrics,[26] the U.S. Congress passed legislation supporting national screening efforts, which was signed into law in 2008[27] and recently reauthorized.[28] In addition to funding for various newborn screening activities, the Secretary of Health and Human Services' Advisory Committee on Heritable Disorders in Newborns and Children (SACHDNC) was created. This committee has provided national NBS leadership through its carefully considered recommendations to the Secretary.[29] In addition to approving recommendations for a nationally Recommended Uniform Screening Panel (RUSP) from the American College of Medical Genetics,[30] the SACHDNC has implemented, and periodically refined and updated, an evidence-based protocol for reviewing and recommending other conditions for inclusion on the RUSP.[31] Since adoption of the initial 29 core conditions and 25 recommended secondary targets, 4 additional core conditions have been recommended [severe combined immunodeficiency disease (SCID), critical congenital heart disease (CCHD), Pompe disease, and Mucopolysaccharidosis type I (MPS I)] along with 1 secondary target, T-cell lymphocyte deficiencies. As of March 2, 2015, all except MPS-I have now been accepted for recommendation by the Secretary increasing the RUSP to 32 conditions. Several other conditions have been nominated for inclusion on the RUSP but have not yet met the criteria for inclusion, including early infantile Krabbe disease and Hemoglobin H disease, among others.[32]

Table 1 presents a tabular overview of screening activities in the U.S. Compared to the previous version of this table published in 2007,[3] there are several noteworthy observations. In general, the number of required screening conditions has increased as state funding has permitted, following the recommendations of the SACHDNC. Most notable has been the addition of tandem mass spectrometry (MS/MS) to expand screening for metabolic conditions, screening for SCID, and CCHD screening. Expanded metabolic screening with MS/MS is now included in every state screening program and SCID, added to the RUSP in 2010, is now implemented in over 30 states.[33] The results of SCID screening in Wisconsin (the first state to require NBS for SCID), California, New York and an 11-state consortium have been published.[34–37]

All but 4 state programs are at least partially fee based, and the average initial NBS screening fee has increased from about $45 in 2007 to about $76 in 2015. Despite a SACHDNC recommendation that states should consider linking birth certificates to NBS screening, the Secretary of Health and Human Services did not approve the recommendation and many state programs are still unable to accurately determine screening coverage (most "assume" at least 98% coverage).[38] While almost all states require point-of-care screening for hearing loss and CCHD, both included on the RUSP, many programs have elected to monitor hospital CCHD activities