Newborn screening is the largest genetic screening program in the United States, with approximately 4 million infants screened annually (1). It is a mandatory state-based public health program that provides all newborns in the United States with presymptomatic testing and necessary follow-up health care for a variety of medical conditions. The goal of this essential public health program is to decrease morbidity and mortality by screening for disorders in which early intervention will improve neonatal and long-term health outcomes. Newborn screening programs test for a variety of genetic, metabolic, and congenital endocrine disorders as well as some infectious diseases, hearing loss, and congenital heart disease. Noninvasive tests are used to screen for some infectious diseases, hearing loss, and congenital heart disease. Noninvasive tests are used to screen for hearing loss and to measure blood oxygen levels, which can indicate some forms of critical congenital heart disease (CHD [commonly known as CCHD]). Genetic, metabolic, and congenital endocrine disorders, as well as some infectious diseases, are tested for by obtaining a small blood sample from the newborn. Most of the disorders screened for have no clinical findings at birth. In 2012, the Centers for Disease Control and Prevention estimated that 12,500 newborns were diagnosed by newborn screening (Table 1) (2). The five most commonly diagnosed conditions in the United States are 1) hearing loss, 2) primary congenital hypothyroidism, 3) cystic fibrosis, 4) sickle cell disease, and 5) medium-chain acyl-CoA dehydrogenase (MCAD) deficiency (2). Although these disorders are rare individually, it was estimated that 1:500–1:1,000 births will be affected with a disorder identified by newborn screening (2). This document revises Committee Opinion No. 481, Newborn Screening, to include screening for critical CHD, which comprises a group of potentially life-threatening structural abnormalities of the heart that often require surgery in infancy to correct. For early identification of disease, pulse oximetry screening via skin sensors is used to detect the lower oxygen saturation levels in the blood that are associated with critical congenital heart defects (3, 4).

Newborn screening programs are developed and managed on the state level and operate through collaborations between public health programs, laboratories, hospitals, pediatricians, subspecialists, and specialty diagnostic centers. Their functions include the initial screening of all newborns, identifying screen-positive newborns, diagnosing conditions, communicating with families, ensuring that affected children are referred to treatment centers, following up with long-term outcomes, and educating physicians and the public according to individual state or jurisdictional guidelines.

Screening programs test newborns primarily through blood samples obtained by a tiny heel prick shortly after birth, placed on a special filter paper, and sent to a designated state newborn screening laboratory within
In patients in whom a blood sample is unable to be obtained shortly after birth—such as newborns who require a transfusion or total parenteral nutrition, are sick, born preterm, or born out of the hospital setting—screening takes place in a variable time frame, with adjustments made according to the clinical circumstances. In addition, hearing screening and pulse oximetry screening for critical CHD are also part of the recent recommended newborn screening process, although screening for critical CHD has not been adopted by all newborn screening programs at this time.

### Table 1. Recommended Uniform Newborn Screening Panel of Core Conditions*

<table>
<thead>
<tr>
<th>Disease Categories</th>
<th>Diseases</th>
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| Inborn errors of organic acid metabolism | Isovaleric acidemia  
Glutaric acidemia type I  
3-Hydroxy-3-methylglutaric aciduria  
Holocarboxylase synthase deficiency  
Methylmalonic acidemia (methylmalonyl-CoA mutase)  
3-Methylcrotonyl-CoA carboxylase deficiency  
Methylmalonic acidemia (cobalamin disorders)  
Propionic acidemia  
β-ketothiolase deficiency |
| Inborn errors of fatty acid metabolism | Medium-chain acyl-CoA dehydrogenase deficiency  
Very long-chain acyl-CoA dehydrogenase deficiency  
Long-chain L-3 hydroxyacyl-CoA dehydrogenase deficiency  
Trifunctional protein deficiency  
Carnitine uptake defect/transport defect |
| Inborn errors of amino acid metabolism | Classic phenylketonuria  
Maple syrup urine disease  
Homocystinuria  
Citrullinemia, type I  
Argininosuccinic aciduria  
Tyrosinemia, type I |
| Hemoglobinopathies | S,S disease (Sickle cell anemia)  
S,β-thalassemia  
S,C disease |
| Miscellaneous multisystem diseases | Primary congenital hypothyroidism  
Biotinidase deficiency  
Congenital adrenal hyperplasia  
Classic galactosemia  
Cystic fibrosis  
Severe combined immunodeficiency |
| Newborn screening by methods other than by heel stick | Hearing loss  
Critical congenital heart disease |


Data from Newborn screening: toward a uniform screening panel and system. Genet Med 2006;8 Suppl 1:1S–252S.

### Recommended Uniform Screening Panel: Core Conditions

In 2006, the American College of Medical Genetics and Genomics published an Executive Summary, commissioned by the Maternal and Child Health Bureau of the Health Resources and Services Administration of the U.S. Department of Health and Human Services, to establish guidelines for U.S. newborn screening programs (5). This summary, based on recommendations from a multidisciplinary team of experts, included a uniform panel of 29 core conditions for which screening is currently...
recommended for all newborns (see Table 1). The uniform panel was subsequently endorsed by the U.S. Secretary of Health and Human Services as the national standard for newborn screening programs. Each condition on the panel has a screening test that can be performed within 24–48 hours after birth, can be treated, and has a known natural history. The uniform panel of core conditions was intended to be flexible, and criteria have been established to perform evidence-based reviews to expand the panel over time. This panel consists of five main categories of disorders: 1) hemoglobinopathies, 2) organic acid disorders, 3) amino acid disorders, 4) fatty acid oxidation disorders, and 5) miscellaneous disorders, such as cystic fibrosis, hypothyroidism, and hearing loss. For a current list, see the Health Resources and Services Administration’s Discretionary Advisory Committee on Heritable Disorders in Newborns and Children web site, available at www.hrsa.gov/advisorycommittees/mchbadvisory/heritabledisorders/recommendedpanel or state health department web sites.

Since adoption of the uniform screening panel, two core conditions have been added. One of these conditions is severe combined immunodeficiency, which is a genetic disorder that causes profound immunodeficiency by impairing B-lymphocyte and T-lymphocyte function and is treated by bone marrow transplantation. It is screened for by performing DNA analysis on the newborn blood sample (6). The other additional core condition added, critical CHD, comprises a group of potentially life-threatening structural abnormalities of the heart that often require surgery in infancy to correct. Congenital heart disease affects approximately 8/1,000 newborns and accounts for 24% of all infant deaths resulting from congenital birth defects (7). Pulse oximetry screening via skin sensors is used to detect the lower oxygen saturation levels in the blood that are associated with critical congenital heart defects (3, 4) for early identification of disease.

**Recommended Uniform Screening Panel: Secondary Conditions**

With the development and introduction of tandem mass spectrometry, a sophisticated laboratory instrument, it is possible to detect many more disorders than those on the core panel. Additional disorders (called secondary conditions) may be included in the panels of some newborn screening programs, and the Discretionary Advisory Committee on Heritable Disorders in Newborns and Children has a recommended uniform screening panel of secondary conditions (available at www.hrsa.gov/advisorycommittees/mchbadvisory/heritabledisorders/recommendedpanel/). Although these secondary conditions are believed to be clinically significant, they may have an unclear natural history or lack an appropriate medical therapy that affects long-term outcome. These conditions are not recommended as core screening conditions; however, if testing is performed, the results of these conditions should be reported.

**State Guidelines**

All U.S. states and the District of Columbia have individual newborn screening programs with varying screening panels, policies, statutes, and regulations. Almost all programs have adopted the guidelines suggested by the Discretionary Advisory Committee on Heritable Disorders in Newborns and Children. The selection of disorders screened for is affected by the disease prevalence within the state or jurisdiction, detection rates, treatment availability, and cost considerations (8). A current list of conditions screened for in each state is maintained online by Baby’s First Test (9) and the National Newborn Screening and Global Resource Center (8). States also vary in their policies for parental or legal guardian consent for the use of residual blood samples for secondary purposes, such as research or program quality evaluation (10) (Box 1) or for refusal of newborn screening in rare circumstances.

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**Box 1. What Obstetric Care Providers Need to Know About Newborn Screening**

- Patients should be offered information regarding newborn screening at some time during the course of prenatal care through informational brochures, electronic sources, and review or discussion. This can be accomplished at different moments in prenatal care:
  - During the first-trimester new obstetric visit and include written or web site information along with other patient education materials
  - Later in pregnancy when other educational information is routinely distributed, such as at the time of glucose or group B streptococcal screening in the third trimester
  - During a discussion of past adverse pregnancy outcomes related to a positive newborn screening test result or birth defect, at the same time that options for prenatal or preimplantation genetic screening or diagnostic testing are considered
  - Newborn screening programs are state-based public health programs that provide all newborns in the United States with presymptomatic testing and necessary follow-up health care for a variety of medical conditions for which early intervention will improve neonatal and long-term health outcomes.
  - All U.S. states and the District of Columbia have individual newborn screening programs with varying policies, statutes, and regulations.
  - Newborn screening consists of blood-spot screening for metabolic and genetic conditions, hearing screening, and pulse oximetry screening for critical congenital heart defects.
  - State health department’s newborn screening programs vary as to the long-term disposition of samples for storage and research. For further information, please check with your state health department.
Parent Education and the Role of Obstetric Care Providers

The results of surveys and focus groups of expectant parents demonstrate that women and their families would like to receive information about newborn screening during their prenatal care visits (11, 12). The American College of Obstetricians and Gynecologists recommends that obstetric care providers review and make resources about newborn screening available to patients during pregnancy. Information can be disseminated through informational brochures, electronic sources, and through review or discussion at some time during the course of prenatal care.

Integrating education about newborn screening into prenatal care allows parents to be prepared for having their child undergo screening as well as for receiving newborn screening test results. Furthermore, parents often view their care from prenatal management through newborn screening available to patients during prenatal care visits (11, 12). The American College of Obstetricians and Gynecologists recommends that obstetric providers when counseling patients. There are also many available resources on newborn screening for patients (Box 2) and health care professionals (Box 3), including videos, printable brochures, and web sites.

Providing newborn screening information during prenatal care visits can be accomplished in a number of ways and should be adapted to individual practice style. For example, newborn screening information could be provided during the first-trimester new obstetric visit and include written or web site information along with other patient education materials. It could be given to patients

Box 2. Selected Online Patient Resources on Newborn Screening*

*The following resources are for information purposes only. Referral to these sources and web sites does not imply the endorsement of the American College of Obstetricians and Gynecologists. These resources are not meant to be comprehensive. The exclusion of a source or web site does not reflect the quality of that source or web site. Please note that web sites are subject to change without notice.


Box 3. Selected Online Obstetric Care Provider Resources on Newborn Screening*

*The following resources are for information purposes only. Referral to these sources and web sites does not imply the endorsement of the American College of Obstetricians and Gynecologists. These resources are not meant to be comprehensive. The exclusion of a source or web site does not reflect the quality of that source or web site. Please note that web sites are subject to change without notice.


later in pregnancy when other educational information is routinely distributed, such as at the time of glucola or group B streptococcal screening in the third trimester. Information on newborn screening also could be reviewed during a discussion of past adverse pregnancy outcomes related to a positive newborn screening test result or birth defect, at the same time that options for prenatal or preimplantation genetic screening or diagnostic testing are considered.

References


