Implementing Point-of-Care Newborn Screening

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Abbreviations: dried-blood spots (DBS), Secretary's Advisory Committee on Heritable Disorders in Newborns and Children (SACHDNC), United States Preventive Services Task Force (USPSTF)

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Abstract

Newborn screening is performed under public health authority, with analysis primarily performed by public health or other centralized laboratories. Increasingly, opportunities to improve infant health will arise from including screening tests that are completed within birth hospitals rather than centralized laboratories. This is a paradigm shift for which the roles of those involved in screening have not been resolved. This report summarizes a framework developed by the Long-Term Follow-Up Subcommittee of the United States Secretary's Advisory Committee on Heritable Disorders in Newborns and Children for evaluating whether conditions identifiable through point-of-care screening should be added to the recommended universal screening panel and to identify key considerations for birth hospitals, public health agencies, and clinicians when point-of-care newborn screening is implemented.

Introduction

Newborn screening has led to dramatic improvements in the morbidity and mortality associated with a wide range of conditions. Newborn screening programs are authorized by public health departments and generally make use of centralized laboratories for analysis of infant samples. However, there are increasing opportunities to complete screening prior to discharge from the nursery. This raises several critical issues for newborn screening programs including: assuring that all newborns are tested, maintaining quality across a wide range of clinical sites (e.g., birth centers, community hospitals, academic medical centers), and, providing short- and long-term follow-up. This report summarizes a framework for the evaluation and implementation of hospital-based screening tests within the context of newborn screening programs to guide the development of plans to address these critical but complex questions.

Overview of Newborn Screening

Population-based newborn screening began in the 1960s[1] as a strategy to detect specific inherited metabolic disorders in neonates, with the goal of initiating pre-symptomatic therapy to prevent associated manifestations and decrease mortality. Since then, newborn screening has expanded to include other metabolic, genetic, hematologic, and endocrine disorders that require urgent identification and treatment. All states participate in newborn screening, which is firmly established as a component of public health.[2,3] As a state-based national program, newborn screening has led to early diagnosis, treatment, and improved health outcomes for thousands of children in the United States.[2]

Historically, newborn screening has been based on the analysis of dried-blood spots (DBS) within centralized public health laboratories. Incorporation of newborn screening within state public health systems has provided authority for universal population-based screening with

centralized laboratory analyses and quality assurance. This has also facilitated economies of scale for complex tests, reporting, and follow-up. State public health programs assure that newborns are screened in a timely fashion, that those with an abnormal test result receive appropriate and timely follow-up (e.g., parent and physician reporting, confirmatory diagnostic testing, specialty referral), and that standard treatment is initiated.[4] New efforts have now started to improve follow-up after treatment is initiated.[5]

Public health departments also often engage in activities to monitor the impact of screening in preventing death and disability. For example, some states have birth defects registries that can be used to evaluate the degree to which screening for some conditions effectively identifies cases and leads to improved health outcomes.[6,7]

In the 1990s, newborn hearing screening for the early identification of permanent hearing loss began through hospital-based initiatives. By 2002, early hearing detection and intervention programs were established as part of the public health system in all 50 states and the District of Columbia.[8] Unlike newborn screening based on the analysis of DBS within centralized laboratories, testing for congenital hearing loss is conducted in the newborn nursery and is based on assessment of physiologic parameters (e.g., auditory evoked brainstem response, otoacoustic emissions).[9] To implement the public health mandate for newborn hearing screening, birth hospitals acquired equipment; developed protocols to assure screening and communication of results to families, healthcare providers and state public health agencies; and trained their personnel in these protocols.[10] Although nearly all newborns in the United States are screened for hearing loss before hospital discharge,[11] assuring follow-up for those infants with abnormal results remains challenging.[12,13] Hearing screening programs have not had a standardized approach to structuring program operation or responsibilities. In some states, the newborn

hearing screening program assumes responsibility for monitoring hospital screening programs, follow-up of newborns who did not pass screening, and tracking and reporting progress. In other states, tracking of infants with abnormal newborn hearing screening results is primarily the responsibility of the institutions where testing is performed. In most states, the public health responsibility for newborn hearing screening is primarily related to surveillance rather than individual case management, probably contributing to incomplete follow-up or reporting.[12]

Recently, screening for critical congenital heart disease has been added to the recommended universal newborn screening panel. As with congenital hearing loss, screening requires a physiologic test (i.e., pulse oximetry). However, unlike screening for congenital hearing loss, those with a positive screen for critical congenital heart disease require diagnostic testing prior to hospital discharge.

States determine which conditions to include in their public health newborn screening programs. This process is now informed by the recommended uniform screening panel endorsed by the Secretary of the United States Department of Health and Human Services, based on guidance from the Secretary's Advisory Committee on Heritable Disorders in Newborns and Children (SACHDNC). Since 2007, the SACHDNC has made recommendations based on a comprehensive evidence review.[14]

Defining Point-of-Care Newborn Screening

Point-of-care testing refers to those tests administered and interpreted outside of a laboratory but close to the site of direct delivery of medical care for a patient.[15] Unlike conventional newborn screening, in which samples are obtained at the bedside and sent to a central laboratory for testing for a state-specified list of conditions, point-of-care newborn screening describes those practices in which actionable results are obtained at the bedside with

oversight from public health agencies for the detection of a state-specified list of conditions. Regardless of approach, newborn screening should be universal, with testing of all newborns regardless of where they are born.

Point-of-care newborn screening is different than the expected usual care provided by the healthcare system, which reflects standards of care and clinical practice guidelines in the care of newborns. Usual care is supported by clinical guidelines produced by professional societies, and includes screening for a wide array of conditions (e.g., the physical exam of otherwise well-appearing newborns for conditions such as congenital hip dysplasia or visual impairment). Evidence-based recommendations for such clinical preventive activities for newborns are available from sources such as Bright Futures and the United States Preventive Services Task Force (USPSTF),[16,17]. However, these components of routine care are not provided under public health authority, nor do public agencies provide direct oversight for performing screening, ensuring uniform quality of procedures, follow-up care, and reporting.

Potential of Decentralized Newborn Screening

As screening for critical congenital heart disease illustrates, point-of-care newborn screening provides opportunities to expand universal screening via nursery-based physiologic assessment for additional treatable disorders. New conditions requiring local laboratory analysis could be added to the recommended uniform screening panel if even the short time required for a centralized laboratory to receive specimens, process and analyze them, and report findings may be too late to for newborns to receive the benefit of early detection. As such, point-of-care screening might augment or even eventually replace the centralized screening services currently used for certain conditions on the existing uniform panel. Such decentralization would require demonstrating that local analysis could reliably meet or even exceed current standards of

centralized analysis. Regardless of the specific circumstances in favor of local screening, public health authority would need to assure that any shifts away from centralized analysis would universally translate into timely diagnosis and quality medical care.

Criteria for Point-of-Care Newborn Screening

Regardless of how newborn screening is implemented, there are fundamental criteria for all conditions included in newborn screening: the condition is medically serious; the screening test has reasonable positive and negative predictive value; confirmatory diagnostic testing is accurate and available after a positive screen; early or pre-symptomatic treatment leads to better outcomes than when diagnosis follows the clinical manifestation of the condition; the process of screening must be feasible; and the costs acceptable. Point-of-care newborn screening is applicable when urgent treatment of the condition is required earlier than the feasible turnaround time for a public health laboratory or when the screening is based on physiologic testing that requires the presence of the newborn at the time the results are generated. For such conditions, consideration for inclusion in the recommended universal screening panel should include an assessment of the feasibility of decentralized implementation, including not only the screening test but also the follow-up services. Before point-of-care newborn screening is recommended, it must be demonstrated that screening technology is readily available and can be standardized, the screening protocol can feasibly be administered in the often chaotic newborn nursery setting without significant loss of clinical validity and that appropriate follow-up care can be begun for those with a positive screen. However, the major consideration for point-of-care newborn screening is whether there are better outcomes if testing is performed under a public health mandate compared to usual clinical care.

The Role of Public Health Agencies in Point-of-Care Newborn Screening

The degree to which public health agencies are directly involved in point-of-care newborn screening will depend on the legislation and regulations authorizing the particular screening test. Use of state authority for point-of-care newborn screening engenders a state responsibility for monitoring its effectiveness and impact. Factors that can help determine the degree of public health involvement include: the risk of a missed affected case (e.g. home births); the complexity of the screening procedure; the degree to which the screening test is not already a component of standard clinical care; the challenge of providing confirmatory diagnostic follow-up after an abnormal screen; and variability between sites on quality measures related to screening and diagnosis, as well as health outcomes. Regardless of the level of involvement, at a minimum, public health departments have roles in: informing the public about a new screened condition; facilitating standardized implementation of screening; participating in quality assurance; developing systems for diagnostic confirmation and follow-up; and evaluating the degree to which the newborn screening is effective.

For some screening procedures or conditions, public health may need to take a greater role in implementation and follow-up for point-of-care screening. For example, if screening for a condition requires special equipment or staff training, public health expertise may be needed for establishing standardized procedures and evaluation of the quality of the implementation. Another example is if availability of confirmatory diagnostic testing or treatment exists at only a limited number of sites, public health agencies could help facilitate transfer. For example, public health agencies might play a role in financing for these rare but potentially costly activities. For some conditions, public health roles may be limited to educating the public and providers and standardizing the implementation. Delineating the responsibility of public health agencies, birth

hospitals, healthcare providers, and payers can be complex and should be considered prior to the adoption of point-of-care newborn screening.

Implementing Point-of-Care Newborn Screening

The key distinguishing features between point-of-care newborn screening compared to usual nursery-based clinical care are that point-of-care newborn screening is conducted under state authority in order to ensure that it is universally applied to all newborns and that there are coordinated systems for providing follow-up care after diagnosis. For point-of-care newborn screening, birth hospitals must be able to obtain the necessary screening equipment, employ and train screeners, ensure that nursery procedures will accommodate accurate screening, provide appropriate educational materials to parents and families, and engage in continuous quality assurance activities. Clearly delineated procedures to record screening results and report individual-level data must be in place to assure timely communication with families, health care providers, and state public health agencies. Birth hospitals must also be prepared to coordinate timely follow-up and confirmatory diagnostic services after an abnormal screen.

Public health agencies must be able to monitor and evaluate the quality of the decentralized screening test results as part of evaluation of the screening program's effectiveness in improving health outcomes. In addition, public health agencies will play a central role in developing screening plans, including education and training for clinicians and families.

As with any screening program, the costs associated with point-of-care newborn screening include the costs of both testing and follow-up. Important costs beyond administration of the screening test include those associated with purchase of screening equipment, start-up and continuous hospital staff training; the development of information systems to track short- and long-term follow-up; entering of results into these information systems; quality assurance

monitoring; and program evaluation. The scientific evidence base for screening, diagnosis and treatment must provide a clear rationale for allocation of resources from clinical care and public health agencies to support point-of-care newborn screening programmatic activities.

In contrast to usual clinical care, screening with public health oversight helps to assure universal access and uptake of testing; high-quality standardized screening; coordinated follow-up with effective linkage to diagnosis, intervention, and family support; and, surveillance. Expanding use of electronic medical records and health information exchanges may help with documentation of screening and tracking of population health; such strategies will facilitate public health monitoring and evaluation of the delivery of point-of-care newborn screening services, from test administration through short- and long-term follow-up. Although there are some existing data systems for tracking healthcare delivery (e.g., the national health care surveys administered by the Centers for Disease Control and Prevention), none are repeated with sufficient frequency or currently have enough detail to evaluate service delivery for point-of-care newborn screening.

Concerns About Implementing Point-of-Care Newborn Screening

The challenge of adopting critical congenital heart disease into the recommended screening panel illustrates the major issues that need to be addressed when considering any point-of-care newborn screening test:

- The infrastructure needed for the screening, confirmatory diagnostic evaluation, and follow-up, education and training, and tracking and reporting;
- The development of practical screening approaches despite a wide variety of nursery settings;
- The cost of the screening and its implementation;

- The feasibility of condition-specific statewide assurance of timely medical treatment services;
- The feasibility of condition-specific statewide surveillance;
- The roles and responsibilities of public health agencies;
- The roles and responsibilities of healthcare providers within birth centers, including well-baby nurseries and neonatal intensive care units;
- The roles and responsibilities of those who deliver babies outside of birth centers;
- The roles and responsibilities of primary and specialty care providers;
- The integration of clinical services and tracking into the existing systems for traditional newborn screening; and
- The impact of point-of-care newborn screening on routine clinical care.

As with all newborn screening activities, there are many stakeholders, including families, primary care and specialty healthcare providers, hospitals, public health agencies, and payers. Collaboration and leadership across the participating clinical and public health entities will be needed to effectively implement point-of-care newborn screening and minimize the potential harms, including false positives, missed cases, poorly coordinated follow-up and disparities in program quality.

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