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GBS Screening Standards of Care and the Impacts on Early-Onset GBS Disease

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Abstract: In spite of extensive research and various screening and management standards, group B streptococcus (GBS) continues to be the leading infectious cause of neonatal morbidity and mortality worldwide. Since 2002, the Centers for Disease Control and Prevention (CDC) in the US has recommended universal prenatal screening for GBS at 35 to 37 weeks gestation, as well as intrapartum antibiotic prophylaxis (IAP) during labor for those who screen positive for GBS. Although this protocol has resulted in a significant reduction in cases of early-onset GBS disease (EOGBSD), there are many complexities to consider when choosing to adopt such standards. Currently, there is no international consensus regarding the screening and management of GBS in the effort to reduce the risk of EOGBSD. This literature review provides background information on GBS, EOGBSD, and the history of screening and management in the US. Alternative approaches to GBS are outlined and considerations for each approach are discussed. Literature from various countries regarding screening and management approaches and the impacts on incidence of EOGBSD are reviewed and analyzed. Reflections on how this information applies to Certified Professional Midwives (CPMs) in the US, along with key recommendations, are provided.

Introduction

Group B streptococcus (GBS) is internationally recognized as the leading cause of early-onset neonatal infection, leading to significant morbidities and in many cases mortality in the first week of life.[1-7] Since the 1980s, researchers have recognized a connection between a pregnant person being colonized with GBS and early-onset GBS disease (EOGBSD).[1,3,5] Following this connection, several screening and management protocols have been designed, each aimed at decreasing the rate of EOGBSD. Currently, there is no internationally agreed-upon approach to the screening and management of GBS in pregnancy. New research and technology continues to emerge, contributing to the ever-evolving understanding of GBS colonization in pregnancy as it relates to the risk of EOGBSD.[3, 5] In the midwifery community in the US, care providers and pregnant clients are demanding a more evidence-based and informed choice-centered approach for screening and management options, leading to further debate and lack of consistency about how to responsibly educate and offer risk/benefit treatments for this significant yet rare infection.[8]

With this evolution, various approaches to screening birthing people for GBS colonization have emerged which differ depending on facility, country, and accessibility of technology.[3, 5, 9] Some countries have clear standards for screening and management of GBS colonization, while in other countries the appropriate standard is entirely up to the facility or care provider.[5,7,8,9] Although approaches can vary significantly, there are 2 main approaches for identifying the need for prophylactic management of EOGBSD: screening-based and risk-based.[3] Once a need for intervention has been identified, intrapartum antibiotic prophylaxis (IAP) has become the universal recommendation.[5, 10-12]

When comparing international standards and

approaches to GBS screening and management, it is clear that the global medical community has differing standards. The US has taken the lead in researching, screening, and managing GBS, with the Centers for Disease Control and Prevention (CDC) updating standards in 1996, 2002, and 2010.[3, 9] Recently, due to continued international debate among primary care providers and a lack of evidence-based guidelines on how to screen for and manage GBS, a clear question emerges in the US: Is universal screening for GBS at 35 to 37 weeks gestation the most effective screening approach to reduce the incidence of EOGBSD?

This literature review seeks to answer this question and clarify issues surrounding GBS colonization, screening approaches, management standards, and rates of EOGBSD in the newborn by synthesizing data from across the globe, presenting a clearer picture of how screening approaches directly impact EOGBSD incidence, and highlighting the challenges that exist when establishing screening and management standards.

Research Method

This review was conducted by searching PubMed for articles containing "GBS Screening Standards" and "Neonatal GBS Disease," primarily from the past 5 years, in English, from any country. Approximately 50 articles were identified, and after evaluation for relevancy and quality of research, the resource list was narrowed down to 38 articles. Many differing perspectives and country-wide position papers were cited, as well as government-issued statements on GBS management. Additional sources consulted were UpToDate, the CDC, and World Health Organization (WHO) websites and the Copley Hospital Medical Library in Morrisville, Vermont. When conflicting data and statistics were encountered, the most up to date information was utilized. All research searches occurred between January and May 2017.

Background Information

GBS is an encapsulated gram-positive coccus bacteria that colonizes in the genital and gastrointestinal tracts of up to 50% of healthy adults worldwide[13]. In healthy adults, GBS is not harmful, and in females GBS is considered part of the normal vaginal microbiome.[14] GBS will on occasion cause serious infections in people of varying ages.[15] The issues most commonly associated with GBS in newborns include sepsis, pneumonia, and sometimes meningitis.[15] In non-pregnant adults, GBS infections usually present as bloodstream infections, pneumonia, or skin, soft-tissue, bone, and joint infections.[15]

GBS in Pregnant People

GBS colonization of the colon and/or vagina is found in about 25% to 40% of pregnant people in the US,[14] and these rates have remained unchanged since the 1970s.[12] Data on global GBS colonization rates are lacking in certain countries; however, the international range for colonization in pregnant people is 10% to 35%.[5] Colonization does not require treatment; in fact, no treatment is available or necessary for non-pathological GBS colonization in pregnant people.[14] GBS can cause asymptomatic bacteriuria, urinary tract infection, chorioamnionitis, and endometritis in pregnant and postpartum people.[16] Vertical transmission of GBS is the most common cause of bacterial infection in fetuses and infants; vertical transmission can occur during the prenatal, intrapartum, or postpartum periods but is most common after rupture of membranes (ROM).[16]

Overview of Neonatal GBS Disease

There are 2 main types of neonatal disease associated with GBS: early- and late-onset GBS diseases. EOGBSD is defined as a neonatal infection occurring in the first 7 days of life with rapidly progressing and overwhelming sepsis, which can occur with or without meningitis.[10] Infants with EOGBSD usually show signs of respiratory distress, apnea, sepsis, and pneumonia within the first 24 to 48 hours of life.[12] The main risk factor for the development of EOGBSD is parental GBS colonization. About 50% of infants born to parents with GBS are colonized themselves, but only 1% to 2% of those infants develop EOGBSD.[17] EOGBSD will be the focus of the research for the remainder of the paper, as that is the disease currently targeted by screening and management protocols.

Global rates of EOGBSD range from 0.22 to 3 per 1,000 live births,[6, 7, 11, 18, 19] and the US rate is 0.22 per 1,000 live births as of 2014.[11] Although rates of GBS colonization in pregnant people are similar worldwide, rates of EOGBSD vary. There is a lack of re-

FIGURE 1. Instructions for the Collection of a Rectovaginal Culture to Screen for Group B Streptococcus[12]

1. After removing swab from package, insert swab 2cm into the vagina without touching the swab with fingers.
2. Remove the swab from the vagina and insert the same swab 1cm into the rectum (through the anal sphincter).
3. Insert swab into tube and cap securely.

- Cultures can be collected by care provider or by the client, with proper instruction.
- Cervical, perianal, perirectal, or perineal specimens are not acceptable.
- A speculum should not be used to collect a swab for GBS detection.

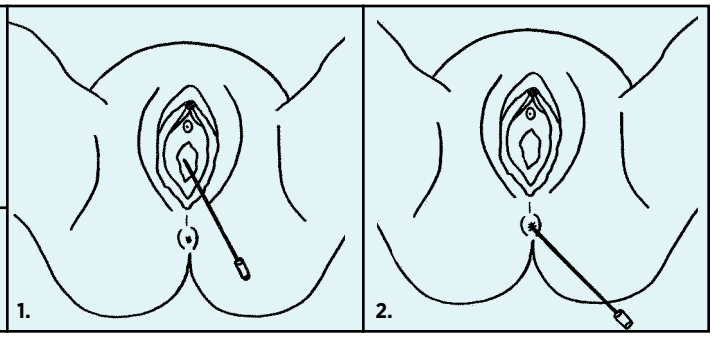


TABLE 1. GBS SCREENING PROCEDURE OPTIONS

Name of Screen	Description	Sensitivity (True Positive Rate)	Specificity (True Negative Rate)
Standard Culture: direct agar plating	Swab lower vagina and rectum (through the anal sphincter) prenatally	56%[38]	84%[38]
Culture: selective enrichment broth/ enriched culture medium	Swab lower vagina and rectum (through the anal sphincter) prenatally	51%-87%[5]	93.7%-97.1% [5]
NAAT (nucleic acid amplification tests) without enrichment	Swab lower vagina and rectum (through the anal sphincter) during labor	62.5%–98.5%[12]	64.5%–99.6% [2]
NAAT (nucleic acid amplification tests) with enrichment	Swab lower vagina and rectum (through the anal sphincter) prenatally	92.5%–100.0%[12]	92.5%-99.3%[12]
Real-Time PCR (polymerase chain reaction)	Swab lower vagina and rectum (through the anal sphincter) during labor	72.7%[25]	96.1%[25]
GBS Antigen Test	Swab lower vagina and rectum (through the anal sphincter) prenatally	100%[26]	99.5%[26]
GBS Antibody	Blood serum Detection	High levels of IgG GBS antibodies linked to healthy babies in GBS positive parents[10]	

search available to explain this phenomenon. In 2008, the CDC reported 1,200 cases of EOGBSD per year in the US, 70% of which occurred in infants born at term.[12] While the majority of babies who develop EOGBSD are born at term, preterm infants are 4 times more likely to present with EOGBSD than term infants, regardless of the prevention approach used.[20]

Screening and Management Options

There are several different types of collection and processing techniques used to identify GBS colonization. Differing usage choices among countries often depend upon available technology, cost, healthcare systems, and government regulations. Table 1. outlines some of the most common screening procedures available to identify GBS.

There are 2 main screening approaches for GBS used worldwide: the risk-based approach and routine prenatal screening. The risk-based approach assesses the presence of clinical risk factors that may indicate an increased risk of EOGBSD in the newborn.[11] Routine prenatal screening is offered between 35 and 37 weeks gestation and includes a rectovaginal swab to culture for GBS colonization in the pregnant person. Management is the same for the screening and risk-based approaches: once one or more risk factors have been identified, IAP is recommended.[11]

International Standards of Care

The US, Canada, France, and Italy are the only countries that have universal standards of care to routinely screen for GBS prenatally. In other countries standards vary from hospital to hospital and provider to provider, although most other countries employ the risk-based approach. In the US and Canada, the standard of care includes a rectovaginal culture between 35 to 37 weeks gestation for all pregnant people and reflexive antimicrobial susceptibility testing for positive people with penicillin allergies.[11, 12, 17] When GBS bacteriuria is identified prenatally, or if the pregnant person has previously given birth to an infant impacted by EOGBSD, IAP is automatically indicated with no further screening later in pregnancy recommended. Those with positive GBS bacteriuria are also advised to be treated according to standard recommendations for a urinary tract infection, immediately following the test results.[12] Antibiotic treatment of GBS during pregnancy is not indicated without the presence of GBS bacteriuria.

The CDC recommends initiating IAP at the onset of labor or with ROM for those who screened positive for GBS. The exception to this standard is the person who has a cesarean birth prior to the onset of labor; IV antibiotics are not routinely indicated for planned cesarean births without a trial of labor.[12] If GBS status results are not available at the onset of labor or when ROM occurs, then IAP is recommended for anyone who presents with one or more of the following risk factors: <37 weeks gestation, ROM >18 hours, temperature >100.4°F (38.0°C), or a positive intrapartum nucleic acid amplification test (NAAT) screen for GBS.[12] NAAT screening is only recommended if GBS status is unknown, no other risk factors are present, and the facility has access to this test. If the NAAT screening is negative, but subsequent risk factors develop, IAP is indicated.[12]

The recommended antibiotic for treatment is penicillin G, administered intravenously, with an initial dose of 5 million units, then 2.5 to 3.0 million units every 4 hours until birth. Alternatively, IV ampicillin may be given, with an initial dose of 2 g, then 1 g every 4 hours until birth. Other antibiotics are recommended for those who are allergic to penicillin (see CDC guidelines: https://www.cdc.gov/groupbstrep/guidelines/downloads/recommended-regimens.pdf).[12] IAP is most effective when given at least 4 hours before birth, so prompt administration is recommended.

Screening Options Currently Available in the US

In the US, the most common testing method is a rectovaginal culture with selective enrichment broth, which is subsequently incubated for 18 to 24 hours.[12] A rapid NAAT without enrichment is available for use during labor, but has variable sensitiv-

ity and specificity. Therefore, the CDC recommends against its routine use.[12] The most accurate test is the NAAT with enrichment (see Table 1.). However, this test can take up to 2 hours to complete, and thus has not replaced the standard culture in the US.[12]

Culture Collection Procedure

The CDC specifies that the rectovaginal culture should be collected from the lower vagina and then the rectum, through the anal sphincter (see Figure 1.).[12] This can be done with 1 or 2 swabs, and evidence has shown that with proper explanation, clients are able to self-swab with comparable effectiveness to practitioner swabbing.[12]

Not all care providers use the CDC recommended collection procedure. A 2015 survey of 206 members of the American College of Obstetricians and Gynecologists, along with members of the Collaborative Ambulatory Research Network and non-Collaborative Ambulatory Research Network members, showed that although 97% of care providers collected screening samples between 35 and 37 weeks gestation, there were significant variations in the anatomical sites used to collect the samples.[21] Sixty-two percent of care providers reported collecting samples from the lower vagina and rectum, as recommended by the CDC, 26% from the lower vagina and perianal skin but not rectum, and 5% from the vagina but neither perianal skin nor rectum.[14]

One Australian study looked at the differences between collecting a lower vaginal, perianal or combined swab, and found that using a combined method identifies more pregnant people who are colonized with GBS, resulting in lower false negative rates.[22] Another Australian study of screening practices found that 44% of GBS culture samples had errors, including issues with incorrect specimen collection, incorrect anatomical site, collection at the wrong gestational age, and inconsistent lab

TABLE 2. INTER-COUNTRY GBS SCREENING STANDARDS AND NEONATAL OUTCOMES

Country	Screening Standard of Care	Incidence of Neonatal GBS Infection in live births	Neonatal GBS Mortality Rates (case-fatality ratios)
North America			
Canada	Vaginal and Rectal Culture Swab during 35-37 weeks gestation[9]	0.64/1,000[9]	5-9%[9]
US	Vaginal and Rectal Culture Swab (one or two swabs acceptable) during 35-37 weeks gestation[12]	0.22/1,000[11]	4-6%[12]
Central and South America			
Panama	Risk-based screening[6]	0.77/1,000[6]	16.7%[6]
Dominican Republic	Risk-based screening[6]	2.35/1,000[6]	21.4-33.3%[6]
Europe			
France	Vaginal and Rectal Culture Swab during 35-37 weeks gestation[27]	1/1,000[30]	10%[32]
Italy	Vaginal and Rectal Culture Swab during 35-37 weeks gestation[27]	0.26/1,000[31]	insufficient data
Sweden	No screening standards[5]	0.4/1,000[6]	13%[35]
United Kingdom	Risk-based screening[19]	0.5/1,000[19]	10%[21]
Asia			
Bangladesh	Risk-based screening[6]	0.9/1,000[6]	insufficient data
Hong Kong	Risk-based screening[6]	0.76/1,000[6]	10%[6]
Africa			
South Africa	No screening standards[28]	0.05-1.5/1,000[28]	10-60%[36]
Oceania			
Australia	No screening standards. Some hospitals Vaginal and Rectal Culture Swab during 35-37 weeks gestation[8]	2-3/1,000[18]	2.2%[18]
New Zealand	Risk-based screening[7]	0.26/1,000[7]	5-10%[37]

processing.[8] Additionally, 18% of pregnant people's GBS status changed from prenatal to intrapartum screening results, highlighting the transient nature of GBS colonization.[8] One prominent Australian hospital used this research as a basis for offering intrapartum real-time PCR screening for GBS before administering IV antibiotics.[8] These results indicate a clear need for more consistency with collection procedures amongst care providers to ensure accuracy in GBS screening.

How Do The Different Approaches Impact Neonatal Outcomes?

Since approaches to GBS screening and management vary worldwide, it is important to analyze the impacts of the different approaches on neonatal outcomes. To gain further insight, several factors must be considered for each country, including existing health care systems, rates of parental GBS colonization, rates of intrapartum antibiotic use, and rates of EOGBSD and neonatal mortality from GBS. The following section will examine this information and highlight key considerations when evaluating the data. Table 2. summarizes the key information from 13 countries across 6 continents, including screening standards of care, incidence of neonatal GBS infection, and neonatal GBS mortality rates.

2013 European Consensus Conference

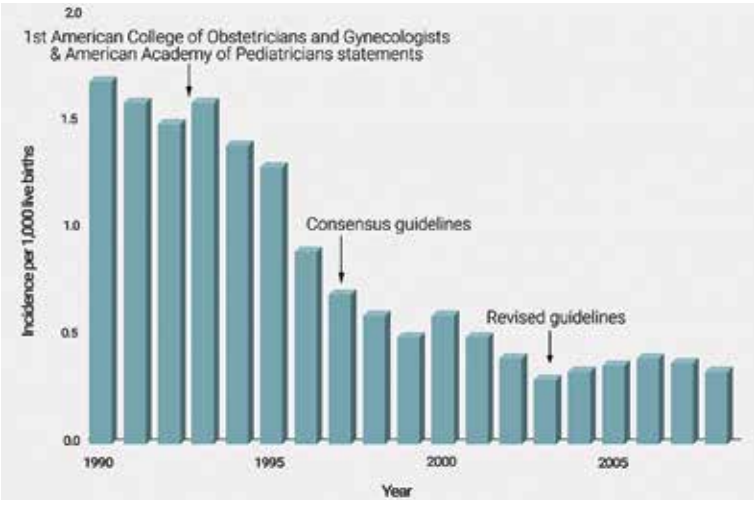
In 2013, representatives from several European countries got together to analyze all of the data relating to GBS and its impact on EOGBSD in order to create a unified recommendation for how European countries should manage GBS. In Europe, many different approaches to GBS were being used, which led to inconsistencies in clients' access to care options. Participants of the consensus conference included experts in neonatology, gynecology, obstetrics, and clinical microbiology from Italy, Belgium, Sweden, Spain, Israel, Russia, France, Norway, and Poland. While examining the data, the group took into consideration the accuracy of screenings, cost effectiveness, and limits on unnecessary antibiotics (especially for those in preterm labor).[5]

Many questions about the accuracy, and thus the effectiveness, of routine prenatal GBS screening were addressed. The conference reviewed several studies, including a large 2009 multi-state evaluation of the US standard of care for GBS screening, which reported that 61.4% of infants born at term with EOGBSD were born from parents who screened negative for GBS prenatally, while only 13.4% of those babies had a birthing parent who was not screened prenatally.[5] Additionally, 30% to 50% of people who screened positive for GBS at birth did not screen positive for GBS prenatally, and 25% to 40% of people who screened positive for GBS prenatally screened negative at the time of birth.[5] Furthermore, predictive values are not reliable, as sensitivities range from 51% to 87% and specificities range from 93.7% to 97.1%.[5] Positive predictive values range from 60.6% to 87% and negative predictive values range from 88% to 96%.[5] Another shortcoming of the available research is that no randomized control trials (RCTs) exist in order to assess the risk-based approach versus the universal screening approach.[5] This is a key factor, as RCTs are the gold standard for research. RCTs randomly choose which participants in a study receive the treatment and which receive the placebo, minimizing bias by keeping other variables constant. Without this randomization, the efficacy of the study is compromised.

The European consensus conference concluded that universal intrapartum rapid real-time PCR screening and IAP management are the most reliable options that lead to a reduction of the rates of EOGBSD.[5] The consensus conference recommended taking 2 swabs so that the practitioner can run a culture with selective enrichment broth in case something happens to the rapid real-time PCR screening. This ensures that a person's GBS status is known when assessing an infant for signs of EOGBSD.[5] Several studies, evaluating over 14 different real-time PCR screenings, have reported that these screenings are equal to or potentially more accurate than the prenatal culture (see Table 1.).[5]

One type of screening, the Xpert™ GBS assay, is processed in 30 to 50 minutes on a platform with automated technology, requiring very little training to operate. A one-year study that took place in France in 2012 with midwives using the Xpert™ GBS assay proved successful, as it empowered the midwives to collect and process the samples as needed and eliminated the step of waiting for a lab to process the results.[5] There are some disadvantages to this screening method as well. The real-time PCR screening is not suitable for people with a penicillin allergy, as a susceptibility test would need to be run to identify which alternative antibiotic to use.[5] Other concerns include the potential for increased costs, limited access to screening equipment, and the ability to screen clients early enough to provide IAP if necessary.

FIGURE 2. INCIDENCE OF EARLY-ONSET GROUP B STREPTOCOCCAL DISEASE 1990-2008[12]



Although routine GBS screening and IAP has reduced the incidence of EOGBSD, antibiotic use does not come without concerns, including the development of antibiotic resistance, increased rates of other bacterial infections, and drug-related side effects. Furthermore, IAP has not proven effective at reducing neonatal mortality due to EOGBSD[5, 26]

The conference highlighted that there are very few cases of EOGBSD, and the risks of EOGBSD do not outweigh the risks of high levels of antibiotic use. They also identified the benefit of the risk-based screening approach in leading to fewer interventions.[5] Further, despite the high levels of effort in the form of research and financial resources to prevent EOGBSD, it still occurs and remains the leading infections cause of infant morbidity and mortality worldwide.

Additional Considerations

According to the CDC, since the early 1990s and the implementation of IAP for those who present in labor with elevated risk factors, rates of EOGBSD have declined from 1.7/1,000 to 0.34-0.37/1,000 live births (see Figure 2.).[12] An Australian prospective study found an 84% reduction in EOGBSD after adopting a routine screening and management protocol.[18] During the Australian study, the management protocol was to offer people in labor IAP every 4 hours if they screened positive for GBS in the current pregnancy. This data was collected from 1994 to 2006 and included 42,471 pregnant people at 3 different hospitals in Australia.[18] An Australian diagnostic cohort study looked at screening timing and found strong evidence that waiting until 35 to 38 weeks increases accuracy of GBS colonization status.[22] With regard to management, an extensive systematic review comparing routine prenatal screening and IAP to the risk-based approach found that people who had the routine culture were 69% more likely to receive IAP than those in the risk-based approach,[20] even though rates of GBS colonization in pregnancy are comparable between the 2 groups. IAP is associated with its own set of risks, as discussed in the following section.

One of the main concerns about the risk-based approach is that it misses a significant number of newborns who go on to develop EOGBSD. A 2002 study published in the New England Journal of Medicine became a major factor in the CDC's universal recommendation to screen all pregnant people and subsequently treat with IAP. It showed that 50% of people who had newborns with EOGBSD did not present with any of the above risk factors.[5, 11, 12] Subsequent studies in 2012 in Sweden and 2014 in the United Kingdom found similar results.[5] Following the publication of this 2002 study, Canada switched from an approach where management included IAP only if the client screened positive for GBS and presented with a risk factor to the US standard of routine screening for all pregnant people and IAP for those who are positive.[4, 9]

Concerns With IAP Management

Although routine GBS screening and IAP has reduced the incidence of EOGBSD, antibiotic use does not come without concerns, including the development of antibiotic resistance, increased rates of other bacterial infections, and drug-related side effects. Furthermore, IAP has not proven effective at reducing neonatal mortality due to EOGBSD.[5, 26]

Penicillin and ampicillin have been the antibiotics of choice for IAP to reduce the risk of EOGBSD.[12] In spite of popular belief that GBS has not shown any resistance to these antibiotics, there has been some evidence to the contrary. Two studies, one from Japan from 1995 to 2005 on 14 noninvasive isolates and one from the US from 1999 to 2005 on 11 invasive isolates,[12, 24] revealed that all 14 isolates from Japan and 4 isolates from the US showed signs of modifications in penicillin-binding proteins.[25] The CDC states that the significance of these findings is still unclear but nonetheless acknowledges that they may represent early signs of GBS resistance to penicillin and ampicillin.[12]

GBS resistance to clindamycin and erythromycin, 2 alternative antibiotics for those with a penicillin allergy, has increased significantly over the last 20 years. In reports published from 2006 to 2009, resistance for erythromycin was 25% to 32%, and resistance for clindamycin was 13% to 20%.[12] A study conducted in Iran and published in the Global Journal of Health Science in 2015 showed that in 22 GBS isolates, there was 100% resistance to erythromycin and clindamycin and 4% resistance to penicillin.[25] We do not know enough to conclude that GBS resistance to penicillin is not a possibility, and it is likely that resistance will increase in the future if IAP continues at its current rate.

While neonatal GBS infection rates have declined since the routine use of IAP, the rates of other bacterial infections including Escherichia coli have been increasing.[24] Many of these are known to be antibiotic resistant infections.[24] Many argue that although GBS infection rates are declining, overall neonatal infection rates are remaining unchanged due to an increase in other bacterial infections.[24] This is an important reminder to look at the whole picture of neonatal infection rates when managing the problem and to take all causes into consideration.

Although rates of EOGBSD have been decreasing since the implementation of routine prenatal screening and use of IAP, neonatal mortality rates due to EOGBSD have not decreased.[5, 26] A 2014 Cochrane Review showed that in 4 trials with a total of 852 women, which evaluated the use of IAP ver-

sus no treatment, IAP did not reduce instances of mortality from GBS or other bacterial infections.[27] The conclusion of the review stated that administering IV antibiotics is not supported by conclusive evidence and although it does reduce the rates of infection, the decision to routinely administer IAP needs further research.[27] This review further demonstrates why restricting use of IAP is warranted, especially given its lack of efficacy.

Several studies have shown that IAP can have negative impacts on the microbiome of the neonate, which can lead to future health issues. Connections have been established between gut flora health and attention deficit disorder, attention deficit hyperactive disorder, autism, dyslexia and dyspraxia, and digestive disorders.[20] Antibiotic use is also a risk factor for urinary tract infections, vaginal yeast, and newborn thrush, leading to the need for further pharmaceutical intervention for parents and babies. Newborn thrush can lead to difficulties breastfeeding, including potential disruption or weaning.[20] Finally, anaphylaxis is a serious side effect of antibiotic use, occurring in 1 in 10,000 people exposed to penicillin.[20]

Emerging Research

New technological advances have brought emerging screening alternatives, though their use is not yet widespread. Many of the new screenings have promising outcomes and advantages over the routine screening and risk-based approaches and have been gaining popularity with some care providers. A study in Turkey had outcomes of 100% sensitivity with a GBS antigen test.[26] Other researchers have been able to identify a type-specific circulating antibody to the antigens for GBS that seems to have an association with infants developing GBS disease.[10] This progressive research offers an opportunity for more accurate screening tools for GBS susceptibility to help limit the use of IAP, further reducing the risk for EOGBSD.

Research Limitations

It is important to consider the limitations of this research and the multi-country comparisons being made. Many confounding variables impact the rates of EOGBSD in various countries including cultural norms, socioeconomic status, access to technology, rates of other diseases and infections, overall health of parents and babies, costs of tests, and medical politics. It should be noted that cesarean births are excluded from this research because GBS positive cases are managed differently for cesarean births without a trial of labor. Many of the studies analyzed exclude homebirth, as data is lacking in many countries. With regard to preterm births, not all studies separate out preterm from term births, which complicates the data as preterm infants are 4 times more likely to develop EOGBSD.[20] Furthermore, EOGBSD should be studied further, as the link between GBS colonization of a pregnant person and EOGBSD of the newborn varies, independent of screening and management approaches.[20]

Discussion

This research provides insight into the background of GBS research and recommendations in the US and worldwide. There is no international consesnsus on GBS screening and management protocol. This is true for a reason: EOGBSD is a complex issue with uncertain etiology. There is no clear link between any one screening approach and lower rates of EOGBSD. In fact, many countries that have adopted the universal prenatal screening approach have very similar rates of EOGBSD to those who use the risk-based approach or have no screening standards of care. Sufficient RCTs are lacking on GBS screening and management. Furthermore, EOGBSD continues to occur, in spite of ongoing universal screening and management practices. It is clear that there are many complexities to consider and that out-of-hospital midwives must continue to offer the highest level of informed choice to their clients about GBS screening and management. Although rates of EOGBSD have decreased since 2002, there are many other issues impacting the decision to support routine screening and IAP.

For out-of-hospital midwives, it can be challenging to know how to interpret this research. Homebirth data is often excluded from broad based studies, and some recommendations may be impossible to offer in the home setting. However, the standard of care is relevant to out-of-hospital midwives as issues regarding GBS colonization, EOGBSD, and IAP exist for out-of-hospital midwifery clientele all the same. When reviewing community standards, it is important to remember that the CDC makes recommendations based on larger public health concerns, many of which out-of-hospital midwives do not encounter due to their scope being limited to healthy, term pregnancies. Risks of infection are inherently higher in the hospital than at home; with fewer caregivers and patients comes reduced transmission of germs.

Going forward, Certified Professional Midwives (CPMs) should collect GBS cultures if desired by the client, should follow the CDC guidelines for how to collect a sample, and should do it the same way each time. It is acceptable for clients to collect their own samples,[12] but proper education and explanation must be given. Inconsistencies in collection methods add to the inaccuracies and potential ineffectiveness of GBS screening. It is the responsibility of CPMs to educate themselves on the laboratory requirements in their community regarding storage, processing, and reporting of samples taken from clients.

CPMs should keep up to date on technological advances in screening options, especially as rapid real-time PCR screening technology improves and becomes more available in the US. CPMs can also work in their communities to advocate for access to emerging technologies and be part of the conversation for their future integration. Based on the trial study conducted in France in which midwives ran the screening process, it is feasible to think out-of-hospital midwives may someday be able to do the same.

FIGURE 3. Client Reference Sheet: GBS Screening & Management

- Group B streptococcus (GBS) is internationally recognized as the leading cause of early-onset neonatal infection.[1-7]
- The US, Canada, France and Italy are the only countries that have standards of care to routinely screen for GBS prenatally. In other countries standards vary with most other countries using the risk-based approach.
- A large 2009 multistate evaluation of the US standard of care for GBS screening reported that 61.4% of infants born at term with EOGBSD were born from parents who screened negative for GBS prenatally.[5]
- According to a 2013 European Consensus Conference, up to 30% to 50% of people who screened positive for GBS at birth did not screen positive for GBS prenatally; and up to 25% to 40% of people who screened positive for GBS prenatally screened negative at the time of birth.[5]
- A 2013 European consensus conference analyzed all available data on GBS and highlighted that there are very few cases of EOGBSD, and the risks of EOGBSD do not outweigh the risks of high levels of antibiotic use.[5]
- According to the CDC, since the early 1990s and the introduction of the risk-based and universal screening approaches, rates of EOGBSD have declined from 1.7/1000 to 0.34-0.37/1000 live births.[12] Neonatal mortality rates due to EOGBSD have not decreased.[5, 26]
- GBS resistance to clindamycin and erythromycin, 2 alternative antibiotics for those with a penicillin allergy, has increased significantly over the last 20 years. We do not know enough to conclude that GBS resistance to pencillin is not a possibility and it is likely that resistance will increase in the future if IAP continues at its current rate.
- Several studies have shown that IAP can have negative impacts on the microbiome of the neonate, which can lead to future health issues. There have been connections between gut flora health and attention deficit disorder, attention deficit hyperactive disorder, autism, dyslexia and dyspraxia, and digestive disorders.[20]
- When looking at the recommendations, it is important to remember that the CDC makes recommendations based on larger public health concerns, many of which homebirth midwives do not encounter due to our scope being limited to healthy, term pregnancies.

CPMs are encouraged to discuss the findings of this article with their clients and support them in making an informed choice in terms of how to proceed with screening and management (See Figure 3.) Be sure that clients are presented with the most up to date evidence-based research and findings, not only what is provided by the CDC and in the US. Take time for these conversations to ensure there is space for a rich dialogue about the intricacies of GBS screening and management. Articulate these complexities to clients and be clear that there is no one right answer for every person. A clear understanding of the risk and benefit of IAP should be the guide to an informed choice. For clients who choose not to screen for GBS, carefully monitor them for risks of GBS infection in labor. CPMs should know the signs of GBS infection in labor and review them regularly. Early postpartum signs of EOGBSD should be discussed and reviewed with clients so they are able to identify an infection themselves.

Conclusion

In conclusion, certain interventions can reduce rates of EOGBSD but have yet to completely eliminate the disease. Additionally, other types of infection still exist, and available research does not address how current approaches to EOGBSD are impacting those rates. In summary, the approach held by the US of universal screening for GBS at 35 to 37 weeks gestation is an effective screening approach to reduce the incidence of EOGBSD, but it is not the only effective approach. It must also be recognized that universal screening with current tools does not eliminate the incidence of EOGBSD or alter the rate of neonatal mortality due to EOGBSD. Together with our clients, we must consider the whole picture of one's health history, pregnancy, birth, and postpartum period and discuss the risks and benefits of GBS screening and management for each individual. ◉

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REFERENCES

1. Wessels MR. Harrison's Principles of Internal Medicine. 19th ed. Streptococcal Infections. New York, NY: McGraw-Hill; c2017.
2. Nguyen N, Worstell T, Griffin E, Beigi R, Pereira L, Caughey, A. Repeat antepartum GBS screening: a cost-effectiveness analysis. Am J Obstet Gynecol. 2014 Jan 1;210(1):244-244.
3. Van Dyke MK, Phares CR, Lynfield R, Thomas AR, Arnold KE, Craig AS, Mohle-Boetani J, Gershman K, Schaffner W, Petit S, Zansky SM, Morin CA, Spina NL, Wymore K, Harrison LH, Shutt KA, Bareta J, Bulens SN, Zell ER, Schuchat A, Schrag SJ, Phil D. Evaluation of Universal Antenatal Screening for Group B Streptococcus. N Engl J Med. 2009 Jun 18;360:2626-2636.
4. Davies HD. Preventing group B streptococcal infections: New recommendations. Can J Infect Dis. 2002 Jul-Aug;13(4):232-235.
5. Di Renzo GC, Melin P, Berardi A, Blennow M, Carbonell-

Estrany X, Donzelli GP, Hakansson S, Hod M, Hughes R, Kurtzer M, Poyart C, Shinwell E, Stray-Pedersen B, Wielgos M, El Helali N. Intrapartum GBS screening and antibiotic prophylaxis: a European consensus conference. Journal of Maternal-Fetal and Neonatal Medicine. 2014 Aug 27;28(7):766-782.
6. Rivera L, Sáez-Llorens X, Feris-Iglesias J, Ip M, Saha S, Adrian PV, Madhi SA, Boudville IC, Cunnington MC, Casellas JM, Slobod KS. Incidence and serotype distribution of invasive group B streptococcal disease in young infants: a multi-country observational study. BMC Pediatr. 2015 Oct 1;15:143.
7. Darlow B, Campbell N, Austin N, Chin A, Grigg C, Skidmore C, Voss L, Walls T, Wise M, Werno A. The prevention of early-onset neonatal group B streptococcus infection: New Zealand Consensus Guidelines 2014. NZ Med J. 2015 Nov 20;128(1425):69-76.
8. Clack D. Antenatal GBS screening: an Australian perspective. Pract Midwife. 2015 Oct;18(9):26-8.
9. Money D, Allen VM. The Prevention of Early-Onset Neonatal Group B Streptococcal Disease. J Obstet Gynaecol Can. 2013;35(10):1–10.
10. Hay WW, Myron JL, Deterding RR, Abzug MJ, editors. CURRENT Diagnosis and Treatment. 4th ed. Infections: Bacterial and Spirochetal. New York, NY: McGraw-Hill; c2014.
11. Baker CJ, Ramin SM, Sexton DJ, Barss VA. Neonatal group B streptococcal disease: Prevention. UpToDate. 2016 Dec 12;Topic 438(Version 53.0).
12. Centers for Disease Control and Prevention. Prevention of Perinatal Group B Streptococcal Disease: Revised Guidelines from CDC, 2010. MMWR. 2010 Nov 19;59(No. RR-10):1-34.
13. Johri AK, Paoletti LC, Glaser P, Meenakshi D, Sharma PK, Grandi G, Rappuoli, R. Group B Streptococcus: global incidence and vaccine development. Nat Rev Microbiol. 2006 Dec;4(12):932-942.
14. Puopolo KM, Baker CJ. Patient Education: Group B streptococcus and pregnancy (Beyond the Basics). UpToDate. 2017 Mar 28; 6718(14.0).
15. Centers for Disease Control and Prevention. About Group B Strep [Internet]. National Center for Immunization and Respiratory Diseases, Division of Bacterial Diseases, Atlanta, GA; 2016 May 23; cited 2017 Apr 6. Available from: https://www.cdc.gov/groupbstrep/about/index.html.
16. Puopolo KM, Madoff LC, Baker CJ. Group B streptococcal infection in pregnant women. UpToDate. 2017 Mar 17; 3170(18.0).
17. Puopolo KM, Baker CJ, Edwards MS, Weisman LE, Armsby C. Group B streptococcal infection in neonates and young infants. UpToDate. 2015 Aug 10;Topic 5961(Version 30.0).
18. Angstetra D, Ferguson J, Warwick BG. Institution of universal screening for Group B streptococcus (GBS) from a risk management protocol results in reduction of early-onset GBS disease in a tertiary obstetric unit. Australian and New Zealand Journal of Obstetrics and Gynaecology. 2007;(47):378–382.
19. Royal College of Obstetricians and Gynaecologists. The Prevention of Early-onset Neonatal Group B Streptococcal Disease. Green-top Guideline. 2012 Jul 1;36(2):1-13.
20. Kurz E, Davis D. Routine culture-based screening versus risk-based management for the prevention of early-onset group B streptococcus disease in the neonate: a systematic review. JBI Database System Rev Implement Rep. 2015 Apr 17;13(3):206-46.
21. Edwards RK, Tang Y, Raglan GB, Szychowski M, Schulkin J, Schrag SJ. Survey of American obstetricians regarding group B streptococcus: opinions and practice patterns. Am J Obstet Gynecol. 2015 Aug;213(2):229.
22. Hiller JE, McDonald HM, Darbyshire P, Crowther CA. Antenatal screening for Group B Streptococcus: A diagnostic cohort study. BMC Pregnancy and Childbirth. 2005 Jul 22;5(12):1471-2393.
23. Group B Strep Support. The facts about group B Strep in pregnancy [Internet]. UK; 2014 Sep. Available from: www.gbss.org.uk.
24. Bishara RM. GBS in a home birth setting. Midwifery Today Int Midwife. 2006 Autumn;(79):32-4, 67.
25. Goudarzi G, Ghafarzadeh M, Shakib P, Anbari K. Culture and Real-Time PCR Based Maternal Screening and Antibiotic Susceptibility for Group B Streptococcus: An Iranian Experience. Glob J Health Sci. 2015 Apr 19;7(6)233-9.
26. Alp F, Findik D, Dagi HT, Arslan U, Pekin AT, Yilmaz SA. Screening and genotyping of group B streptococcus in pregnant and non-pregnant women in Turkey. J Infect Dev Ctries. 2016 Mar 31;10(3)222-6.
27. Ohlsson AS, Shah VS. Intrapartum antibiotics for known maternal Group B streptococcal colonization (Review). Cochrane Database of Systematic Reviews. 2014;6(CD007467).
28. Quan V, Verani JR, Cohen C, von Gottberg A, Meiring S, Cutland CL, Schrag SJ, Madhi SA. Invasive Group B Streptococcal Disease in South Africa: Importance of Surveillance Methodology. PLoS One. 2016 Apr 7;11(4).
29. El Helali N, Giovangrandi Y, Guyot K, Chevet K, Gutmann L, Durand-Zaleski I. Cost and effectiveness of intrapartum group B streptococcus polymerase chain reaction screening for term deliveries. Obstet Gynecol. 2012 Apr;119(4):822-9.
30. Berardi A, Lugli L, Baronciani D, Creti R, Rossi K, Ciccia M, Gambini L, Mariani S, Papa I, Serra L, Tridapalli E, Ferrari F. Group B Streptococcal Infections in a Northern Region of Italy. Pediatrics in Review. 2007 Sep;120(3).
31. El Helali N, Giovangrandi Y, Guyot K, Chevet K, Gutmann L, Durand-Zaleski I. Cost and Effectiveness of Intrapartum Group B Streptococcus Polymerase Chain Reaction Screening for Term Deliveries. Obstetrics & Gynecology. 2012 Apr;119(4).
32. Joubrel C, Tazi A, Six A, Dmytruk N, Touak G, Bidet P, Raymound J, Trieu Cuot P, Fouet A, Kerneis S, Poyart C. Group B streptococcus neonatal invasive infections, France 2007-2012. Clinical Microbiology and Infection. 2015 Jun 5;21:910-916.
33. Puccio G, Cajozzo C, Canduscio LA, Cino L, Romano A, Schimmenti MG, Guiffre M, Corsello G. Epidemiology of Toxoplasma and CMV serology and of GBS colonization in pregnancy and neonatal outcome in a Sicilian population. Italian Journal of Pediatrics. 2014;40(23).
34. Hakansson S, Axemo P, Bremme K, Bryngelsson AL, Wallin MC, Ekstrom CM, Granlund M, Jacobsson B, Kallen K, Spetz E, Tessin I, Swedish Working Group For The Prevention of Perinatal Group B Streptococcal Infections. Group B streptococcal carriage in Sweden: a national study on risk factors for mother and infant colonisation. Acta Obstet Gynecol Scand. 2008;87(1):50-8.
35. Dahl MS, Tessinc I, Trollfors B. Invasive group B streptococcal infections in Sweden: incidence, predisposing factors and prognosis. International Journal of Infectious Diseases. 2003;7(2).
36. Dangor Z, Lala SG, Cutland CL, Koen A, Jose L. Burden of Invasive Group B Streptococcus Disease and Early Neurological Sequelae in South African Infants [Internet]. PLOS ONE. 2015;10(4). Available from: https://doi.org/10.1371/journal.pone.0123014.
37. Canterbury District Health Board. Group B Streptococcus - Management and Prophylactic Antibiotics in Labour. Women's Health Service: Christchurch Women's Hospital: Maternity Guideline. 2014 Jul.
38. Aila NA, Tency I, Claeys G, Saerens B, Cools P, Verstraelen H, Temmerman M, Verhelst R, Vaneechoutte M. Comparison of different sampling techniques and of different culture methods for detection of group B streptococcus carriage in pregnant women. BMC Infectious Diseases. 2010; 10:285.