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Group B Streptococcus: A New Perspective

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Group B Streptococcus: A New Perspective

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by

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Contents

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Executive Summary

Group B streptococcus (GBS) is a major cause of illness and death in young infants across the nation. Current guidelines suggest pregnant women should be screened from thirty-five-to- thirty-seven-weeks gestation. Although screening may be negative at that time, the expectant mother could become colonized with GBS before delivery. GBS is a pathogen that lives in the gastrointestinal and genitourinary tract of fifteen to twenty percent of women of childbearing age (Moorhead et al., 2019). GBS does not become a problem until it is passed from colonized mothers to the neonate during delivery (Virranniemi et al., 2019). When GBS is passed to the neonate during birth serious complications such as meningitis, pneumonia, and neonatal sepsis can occur (Johansen et al., 2019). Guidelines set forth in 1996 and updated in 2002 continue to be recommended today by the Centers for Disease Control and Prevention (CDC) and the American College of Obstetricians and Gynecologists (ACOG) (Kunze et al., 2015). This guideline includes a culture-based screening approach and is recommended for all pregnant women between thirty-five to thirty-seven-weeks of gestation (Kunze et al., 2015). Treatment for colonized pregnant women includes intrapartum antibiotic prophylaxis (IAP). However, screening and providing antibiotic prophylaxis during this period may not completely eradicate the risk to the neonate. The pregnant woman continues to have the potential to become colonized with GBS before true labor begins. Therefore, it is important to screen with polymerase chain reaction (PCR) or similar rapid tests when labor begins to ensure GBS colonization has not occurred (Virranniemi et al., 2019). By screening the laboring woman with PCR testing upon arrival to the labor/delivery unit, antibiotic prophylaxis may be administered before delivery. Continuing consequences of neonatal illness and death may occur if GBS testing is not performed routinely while the expectant mother is in labor.

Group B Streptococcus: A New Perspective

The occurrence of Group B streptococcus in the laboring woman can result in dangerous circumstances for the newborn. Through screening and preventive measures during labor, early treatment of GBS can decrease risks for the newborn. With the PICOT question, "In delivery (P), how does screening every patient during labor for Group B streptococcus regardless of previous results (I) compared to the recommended screening (C) decrease sepsis in the neonate (O) within a three-month period (T)?" The knowledge of GBS, its prevention, diagnosis, and treatment is essential to nursing (Edwards, 2019). With evidence-based practice, clinicians can determine and establish guidelines for testing and treatment to prevent disability and infection in newborns. The purpose of this project is to inform, instruct, and initiate testing and treatment in laboring women to prevent the devastating effects GBS can have on the newborn.

Rationale for the Project

While GBS naturally colonize the lower gastrointestinal and genitourinary tract in humans, it does not become a problem until it spreads to the vaginal area of a pregnant female. Once a pregnant female is colonized with GBS it can be passed on to the neonate during labor and delivery. By vertical transmission, it can infect the healthy neonate during delivery, resulting in sepsis, pneumonia, and meningitis. GBS infection is termed as early-onset disease when it occurs from birth to six days old, with late-onset disease occurring within seven days to three months of birth (Ding et al., 2020). Fortunately, screening is available for the pregnant female, and is usually performed at the thirty-five-to-thirty-seven-weeks gestation within the health providers office setting. In the event of a positive screen, the pregnant female is then treated with oral antibiotics pre-labor and is routinely treated with intravenous antibiotics during labor. Due to several reasons, a pregnant woman may not be tested during pregnancy and will

come into the labor and delivery unit with rupture of membranes and progressive labor in which there is no time to receive GBS screening results nor have opportunity to administer antibiotics to prevent vertical transmission to the newborn. Therefore, the newborn may be admitted to the neonatal intensive care unit for screening and prophylactic antibiotic therapy.

When the pregnant woman is screened during pregnancy and receives a positive result, she is responsible for completing the medication therapy before delivery. Due to the previously positive result, she is prescribed intravenous antibiotics upon true labor. By utilizing a PCR rapid screening test, the woman may be screened again during labor, before delivery of the neonate. Rapid results will then be available to prevent the administration of unnecessary antibiotics to the woman and the fetus.

Literature Synthesis.

Studies have found that screening and treating GBS in laboring women produce better outcomes for the newborn. With the prevalence of GBS colonization in pregnant women and concerns with compliance in a variety of global settings, including private obstetric practices, hospital clinical environments and maternity homes, screening is essential to decrease negative effects on the newborn (Kolkman et al., 2017; Kwatra et al., 2016; Pangrel et al., 2021). In the search for evidence, systematic searching of electronic databases such as PubMed, CINAHL (Cumulative Index for Nursing and Allied Health), and The Cochrane Library were utilized. Key words used for this search included: “delivery,” “group B streptococcus,” “streptococcus,” “newborn,” “mothers,” “qualitative,” and “treatment.” The years considered for review were 2015 to 2022. (See Appendix A).

To search for the highest level of evidence, systematic reviews, meta-analysis studies, randomized control trials along with qualitative studies were reviewed to answer the PICOT

question. Kwatra et al., (2016) reported the frequency of Group B streptococcus colonization in pregnant women. Significant heterogeneity was noted across and within regions while differences in the timing of specimen collection in pregnancy, selective culture methods, and study sample size did not explain the heterogeneity (Kwatra et al., 2016). Within this study, six international studies were reviewed to reveal that different factors might have an influence of adherence to GBS screening protocols such as financial aspects and high caesarean section rates (Pangerl et al., 2021). Ding et al., (2020) found a global incidence rate of 0.49 cases/1,000 live births, with a rate of 0.55 cases/1,000 live births in China. Most countries are now treating GBS with antibiotics causing an increase in antibiotic resistant rates. The study recommends attempts to obtain additional preventive measures and proposing maternal vaccination with a GBS vaccine, as one becomes available (Ding et al., 2020).

Kolkman et al., (2017) provides a qualitative study to determine actions to prevent early onset GBS in newborns based on different strategies including antibiotic prophylaxis during labor. Strategies include administering antibiotic prophylaxis during labor in GBS positive women, women with risk factors, combination of positive GBS and risk factors, or the Dutch guideline. Focus group and personal interviews with care providers and women resulted in care providers identifying 3.6 times more factors to impede rather than facilitate adherence to the preventive strategies (Kolkman et al., 2017).

The commonality between all the studies reviewed relate to the importance of screening and treating GBS in the expectant woman. Regardless of which part of the country the expectant woman resides in, or whether financial reasons relate, education of GBS is necessary. Although delivery may occur at home or in a clinical facility, providers must be educated to appropriately inform the expectant woman of risks associated with GBS. Acceptance of screening and

adhering to antimicrobial therapy is more likely to occur when understanding of a diagnosis occurs.

Project Stakeholders

Linking those who have a vested interest in the proposed benchmark study is most important to ensure the successful implementation of this project. Stakeholders for this project include expectant mothers, newborns, labor/delivery nurses, NICU nurses, physicians, and nurse managers or directors for the labor/delivery units and the NICU. These stakeholders provide the means, the abilities, and the expertise for this project's completion.

Permission must be granted by all the stakeholders. The pregnant woman and her fetus are the most important stakeholders within this project due to the risk of neonatal sepsis from GBS. The labor/delivery and NICU nurses play a role as stakeholder to enact the change by collecting information, performing the screening tests on the pregnant woman, and in the care of the neonate. The physicians and nurse managers or directors have a stake in this project as they give the ultimate permission for the proposed project and support the nurses in the screening and documentation process. Also, the cost of the PCR screening test must be accepted and approved by the nurse managers or directors of the labor/delivery unit.

Implementation Plan

Steps and a timeline for the proposed change will take place over three months. These steps include contacting the facility to educate the stakeholders regarding the proposed change. Request for approval to utilize the PCR screening tests upon admission to the labor/delivery unit, along with the physician and nurses' agreements to perform the screening. Once agreed, requests will be made for the nurse manager/director to order the PCR screening tests. The facility will then utilize screenings on all pregnant women presenting to the labor/delivery unit in

true labor utilizing the PCR rapid screening tests and record all data on a prepared data collection document. Data collected will be patient's initials, gestational age, date and time labor began, history of GBS and treatment if any, screening date and time of PCR screening, PCR screening results, time of treatment with antibiotics if warranted, and date and time of delivery (see Appendix B). Follow-up documentation with the newborn will be noted if a transfer to NICU is initiated. Upon completion of ten weeks of implementation of the project, data will be gathered from the facility and analyzed for outcomes/changes. The proposed project director will meet with the physicians and nurse managers or directors for evaluation of data and discussion of effectiveness of the change project.

Timetable/Flowchart

Two weeks prior to the first week of implementation a PowerPoint presentation will be presented to the labor/delivery unit managers or directors and physicians for approval. At this time the request to utilize PCR screening tests for all pregnant women presenting to the labor/delivery unit will be proposed with immediate order of PCR testing swabs. Upon this approval and order of PCR testing swabs, nursing staff will meet one week later to review and utilize the current training policy for collection of the specimen. At this time, education and instruction for data collection and documentation on provided forms will be introduced. The data collection form will be housed at the charge nurse's desk within the nurse's station. Effective the first day of the month, the use of PCR testing for GBS on all patients will be started on all patients admitted to the labor/delivery unit. This process will continue until the last day of the third month. Data as noted on the initial data sheet will be requested from the charge nurse regarding all positive GBS patients for the previous three months before the study begins. (See Appendix B).

The day following the last day of the month, the project director will collect the data forms, along with the previous three-month history, from the charge nurse. The project director will utilize Microsoft Excel to compare the PCR results with the data collected during the three months prior to determine if PCR testing decreases the risk of sepsis in neonates by effectively treating GBS positive mothers. After analyzation of these results, a meeting will be held to disseminate the evidence with the physicians and nurse managers/directors of the labor/delivery unit and the NICU to determine if the project may be implemented for a one-year trial basis. Each step along with the time frame needed is included in the flowchart (See Appendix C).

Data Collection Methods

Data collection for this benchmark project (if approved) will be through careful analysis of information based on the data form. The collected data will be transferred to a Microsoft excel spreadsheet for use in analysis. Comparison of the data using a T test (inferential statistics) will be used due to the large number of participants. Variables to consider will be patient history of positive/negative results along with patient gestation, stage and length of labor, previous history of GBS, and treatment if any, as well as the date and time of the screening and of the results. Determination from the collected data revealing the decreased rate of sepsis in neonates by using PCR screening tests during labor will be reflected on a line graph. All the collected data and results will be presented in a meeting with necessary stakeholders for review and continued approval for the benchmark project.

Cost/Benefit Discussion

The cost of this benchmark project focuses mostly on the price of the PCR rapid screening tests. Average costs are estimated between $100-$200 per test, with insurance covering this cost when considered routine screening. The testing procedure will be a portion of

the routine care and assessment of the pregnant woman, therefore, extra costs for staff need not be considered. The collection of the specimen by swab may be performed upon assessment as the pregnant woman is determined to be in true labor. Costs of antibiotic prophylaxis will be removed if the rapid GBS screening test is negative on a previously positive pregnant woman. On the other hand, costs of care in the neonatal intensive care unit for screening and prophylactic antibiotic therapy can reach thousands upon thousands of dollars when a neonate is exposed to GBS during delivery. The benefit exceeds the costs, due to the detection and treatment of GBS.

Discussion of Results

It was not possible to implement the proposed benchmark project due to the lack of approval and for funding for the PCR screening tests at a nearby facility. With prior approval and funding to implement this study, along with research data, it is understood this benchmark project would be a success and benefit newborns when screened with PCR screening tests. Clinical experience along with clinical judgement is needed to completely determine best practices. With continual changes in the field of medicine, evidence-based practice will continue to help practitioners know the best treatment and guidelines to use when treating laboring mothers who are GBS positive. According to Roca et al., (2015), the incidence of early onset neonatal sepsis caused by GBS was reduced from 1.8 per 1,000 live births in the early 90's to 0.28 per 1,000 live births in 2010 in the USA. Further studies using evidence-based practices are needed to completely irradicate illness and death from GBS.

Conclusions/Recommendations

Roca et al., (2015) reports bacterial sepsis is a leading cause of neonatal mortality. GBS in a pregnant woman does not cause any problems or harm to the patient, however we know it can have severe effects on the newborn. Because GBS infections may occur after the pregnant woman

is screened at thirty-five-to-thirty-seven-weeks gestation and before delivery of the newborn, recommended screening upon admission to the labor/delivery unit with PCR screening tests is necessary. With PCR testing, the results are rapid, and the patient may be administered intravenous antibiotics before delivery, lessening the risk to the newborn. In the event the pregnant woman has a history of GBS positive testing and previous treatment, then repeat antibiotic administration is unnecessary during labor if a PCR screening test results negatively. Awareness, screening, and treatment of GBS upon admission to the labor/delivery unit is essential in decreasing the risks to the newborn while potentially saving hundreds of thousands of dollars in medical costs. Screening every laboring mother with a PCR screening test allows for swift intravenous antibiotic prophylaxis. Quick and effective screening and treatment of GBS is vital to the health of the neonate. As further research and evidence to prevent neonatal injury and death related to GBS infection is available, even one more statistic is unacceptable.

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Appendix A

Evaluation Table

Clinical Question (PICOT): In delivery (P), how does screening every patient during labor for Group B streptococcus regardless of previous results (I) compared to the recommended screening (C) decreases sepsis in the neonate (O) within a three-month period (T)?

Citation: Author, Date of Publ. & Title	Purpose of Study	Conceptual Framework	Design/ Method	Sample/Setting	Major Variables Studied and Their Definitions	Measurement of Major Variables	Data Analysis	Study Findings	Worth to Practice: LOE Strengths/Weaknesses Feasibility Conclusion RECOMMENDATION
(Study #1) Ding (2020), Systematic Review and Meta-Analysis of Incidence for Group B Streptococcus Disease in Infants and Antimicrobial Resistance, China	To determine the incidence, CFR, IARP, & SST distributions for GBS in infants <89 days of age in China.	None	SR MA 4 databases searched: PubMed/ Medline, Embase, Wanfang, & China National Knowledge Infra-structure	N= 64 studies Age range: <1-89 days Studies reported: I, D, ADR, serotypes, MLST of GBS isolates from 2000-2018 G: China	IV1: I IV2: CFR IV3: IARP IV4: SST DV1: CFR	DV1: ADR	No analysis	IV 95% > DV 5%	Level 1 Evidence Strengths: Statistical analysis used to measure outcome; multiple levels of evidence used Limitations: Heterogeneity among studies; no search for unpublished studies; time of sample collection not noted; only recorded CFR in hospitals Feasibility: Use to decrease cases of GBS Recommendation: Implementation of additional GBS prevention efforts in China would be beneficial.
(Study #2) Roca (2015), Prevention of bacterial infections in	To assess antibiotic preventive treatment	None	RCT Controlled Phase III, double-	N=830 Ages 18-45 in labor Positive BI	IV1:2 g oral AZI IV2: placebo DV: Positive culture	DV: VS and BM	CI	CI (10%)	Level II Evidence Strengths: Proof of concept study, statistical analysis will be used to measure outcome

TADR=Antimicrobial Drug Resistance; AP=Antibiotic Prophylaxis; AS=Apgar Score; AZI=Azithromycin; BI=Bacterial Infections; BM=Breast Milk; C=Countries; CFR=Case Fatality Rate; CI=Confidence Interval; D=Deaths; DX=Diagnosis; E=Experiences; EOGBS=Early Onset Group B Streptococcus; GBS=Group B Streptococcus; G=Geographic Area; Ge=Gestation; GT=Grounded theory; I=Incidence; IARP=Isolate Antimicrobial Resistance Patterns; IAU=Intrapartum Antibiotic Usage; ICR=Informed Consent Received; IS=Intrapartum screening; L=Labor; MA=Meta-Analysis; MLST=Multilocus Sequence Typing; MOD=Mode of Delivery; MU=Maternity Units; NBC=Nasopharyngeal Bacterial Carriage; P=Pregnancy; PP=Post-Partum; PS=Phenomenological Study; QS=Qualitative Study; S=Screened; SR=Systematic Review; SST=Serotype & Sequence Type; T=Time; TX=Treatment; VS=Vaginal Swab;WHO=World Health Organization

Citation: Author, Date of Publ. & Title	Purpose of Study	Conceptual Framework	Design/ Method	Sample/Setting	Major Variables Studied and Their Definitions	Measurement of Major Variables	Data Analysis	Study Findings	Worth to Practice: LOE Strengths/Weaknesses Feasibility Conclusion RECOMMENDATION
the newborn by pre-delivery administration of azithromycin: Study protocol of a randomized efficacy trial	of women in L with BI		blind, AZI: placebo 1:1 ratio	G=Health Centers in Western Gambia ICR Characteristics: Ethnicity, age, time from TX to delivery, MOD, AS					Limitations: If study nurse is unavailable, participant withdrawn from study Feasibility: Use to determine antibiotic tx to prevent problems associated with GBS Recommendation: To assess the impact on antibiotic preventive treatment in women during labor to prevent GBS in the newborn.
(Study #3) Kolkman (2017), Barriers and facilitators related to the uptake of four strategies to prevent neonatal early-onset group B haemolytic streptococcus disease: a qualitative study	To assess determinants that influence the implementation of four preventive strategies for EOGBS.	None	QS Stratified care model	5 focus group interviews 12 personal interviews 27 care providers 14 women	IV1: Screening Strategy IV2: Risk-based strategy IV3: Combination strategy IV4: Dutch guideline DV1: Combination strategy	DV1: Care providers 74%; Women 86%	No analysis	IV3>IV1 & IV 2	Level VI Evidence Strengths: IV3 Weaknesses: Screening strategy Limitations: Interview numbers relatively small Feasibility: Use to determine effectiveness in treatment of GBS positive women Recommendations: For effective treatment in pregnant women who test positive for GBS.

TADR=Antimicrobial Drug Resistance; AP=Antibiotic Prophylaxis; AS=Apgar Score; AZI=Azithromycin; BI=Bacterial Infections; BM=Breast Milk; C=Countries; CFR=Case Fatality Rate; CI=Confidence Interval; D=Deaths; DX=Diagnosis; E=Experiences; EOGBS=Early Onset Group B Streptococcus; GBS=Group B Streptococcus; G=Geographic Area; Ge=Gestation; GT=Grounded theory; I=Incidence; IARP=Isolate Antimicrobial Resistance Patterns; IAU=Intrapartum Antibiotic Usage; ICR=Informed Consent Received; IS=Intrapartum screening; L=Labor; MA=Meta-Analysis; MLST=Multilocus Sequence Typing; MOD=Mode of Delivery; MU=Maternity Units; NBC=Nasopharyngeal Bacterial Carriage; P=Pregnancy; PP=Post-Partum; PS=Phenomenological Study; QS=Qualitative Study; S=Screened; SR=Systematic Review; SST=Serotype & Sequence Type; T=Time; TX=Treatment; VS=Vaginal Swab;WHO=World Health Organization

Citation: Author, Date of Publ. & Title	Purpose of Study	Conceptual Framework	Design/ Method	Sample/Setting	Major Variables Studied and Their Definitions	Measurement of Major Variables	Data Analysis	Study Findings	Worth to Practice: LOE Strengths/Weaknesses Feasibility Conclusion RECOMMENDATION
(Study #4) Kwatra (2016) Prevalence of maternal colonization with group B streptococcus: a systematic review and meta-analysis	To assess whether differences in colonization drive regional differences in the incidence of early-onset invasive disease.	None	SR MA 5 databases (Medline, Embase, Pascal Biomed, WHOLIS, and African Index Medicus)	N=221 Age-Range: none Studies reported: G: WHO	IV: Regions DV1: Socio-demographic DV2: Clinical risk factors DV3: Population	IV: 37 C	CI	CI (95%)	Level 1 Evidence Strengths: Multiple types of evidence used. Limitations: Due to studies published 1997-2015 Feasibility: Could use due to positive GBS regions. Conclusion: Location can affect GBS colonization. Recommendation: Further investigation to understand regional differences in GBS maternal colonization and early-onset disease.
(Study #5) Sharpe (2015), Deconstructing Dissonance: Ontario Midwifery Clients Speak about Their Experiences	To explore the experiences of six midwifery clients in southern Ontario who tested GBS-	None	QS PS GT used to generalize descriptive theory when little is known about a	N= 6 G=Toronto, Ontario Studies within 6 months PP	IV1: Prior to testing IV2: After being tested IV3: During labor/delivery DV1: Positive GBS culture	DV1: 6	No analysis	E relate to IV1, IV2, IV3	Level VI Evidence Limitations: small number participants Strengths: GT Feasibility: Use to emphasize sensitive, inclusive, and appropriate care. Conclusion: To consider client's emotion, thoughts, in DS and TX of GBS.

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of Testing Group B Streptococcus-Positive	positive in 2009		phenomenon						Recommendation: Further investigation of emotional/physical response to positive GBS DX.
(Study #6) Pangerl, (2021) Group B Streptococcus screening guidelines in pregnancy: a critical review of compliance	To provide a synthesis of what is known about compliance with Group B Streptococcus screening protocols in a variety of global settings, including maternity homes, private obstetric practice, and hospital clinical	None	SR 6 Databases searched: CINAHL, PubMed, Medline, Cochrane, Google Scholar, and hand-searching of reference lists of relevant articles	N=6 studies Focuses on adherence to GBS screening guidelines	IV=Compliance with GBS protocols	DV= Education	No analysis	IV=DV	Level 1 Evidence Strengths: Large sample sizes in reviewed articles; using appropriate and valid methods for measuring data Weaknesses: Response rates; explanation of inclusion/exclusion criteria Feasibility: Use to educate properly on GBS protocols Recommendation: To use educational interventions to improve compliance with GBS protocols

TADR=Antimicrobial Drug Resistance; AP=Antibiotic Prophylaxis; AS=Apgar Score; AZI=Azithromycin; BI=Bacterial Infections; BM=Breast Milk; C=Countries; CFR=Case Fatality Rate; CI=Confidence Interval; D=Deaths; DX=Diagnosis; E=Experiences; EOGBS=Early Onset Group B Streptococcus; GBS=Group B Streptococcus; G=Geographic Area; Ge=Gestation; GT=Grounded theory; I=Incidence; IARP=Isolate Antimicrobial Resistance Patterns; IAU=Intrapartum Antibiotic Usage; ICR=Informed Consent Received; IS=Intrapartum screening; L=Labor; MA=Meta-Analysis; MLST=Multilocus Sequence Typing; MOD=Mode of Delivery; MU=Maternity Units; NBC=Nasopharyngeal Bacterial Carriage; P=Pregnancy; PP=Post-Partum; PS=Phenomenological Study; QS=Qualitative Study; S=Screened; SR=Systematic Review; SST=Serotype & Sequence Type; T=Time; TX=Treatment; VS=Vaginal Swab;WHO=World Health Organization

Citation: Author, Date of Publ. & Title	Purpose of Study	Conceptual Framework	Design/ Method	Sample/Setting	Major Variables Studied and Their Definitions	Measurement of Major Variables	Data Analysis	Study Findings	Worth to Practice: LOE Strengths/Weaknesses Feasibility Conclusion RECOMMENDATION
	environments								
(Study #7) Daniels et al., 2022) Rapid intrapartum test for maternal group B streptococcal colonization and its effect on antibiotic use in labouring women with risk factors for early-onset neonatal infection (GBS2): cluster randomized trial with nested test	To determine if the use of point-of-care intrapartum rapid test for maternal GBS colonization can reduce maternal and neonatal antibiotic exposure.	None	Parallel-group cluster randomized trial	G=3 MU=20 Used region, pre-trial IAU rate, number of vaginal or Caesarean births	IV=rapid test DV= risk or history	DV=2	No analysis	No increased exposure to neonatal antibiotic exposure	Level Evidence Strengths: Risk factors align with national recommendations, sufficient sample size Weaknesses: Participants not blinded Feasibility: No previous randomized trials Recommendation:

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Citation: Author, Date of Publ. & Title	Purpose of Study	Conceptual Framework	Design/ Method	Sample/Setting	Major Variables Studied and Their Definitions	Measurement of Major Variables	Data Analysis	Study Findings	Worth to Practice: LOE Strengths/Weaknesses Feasibility Conclusion RECOMMENDATION
accuracy study									
(Study #8) Kunze et al., (2015) Comparison of pre- and intrapartum screening of group B streptococci and adherence to screening guidelines: a cohort study	To determine if rapid point-of-care screening decreases use of intrapartum abx compared with tx for risk factors	None	Surveillance cohort study	T=12 months PS=35-37 wks IS=within 7 days of delivery P=937	IV=P screened within 5 wks delivery DV=P screened within 7 days delivery	DV=2	No analysis	IV=DV=improved strategies are needed	Level 3 Evidence Weaknesses: Limitation of design as a single-center study Feasibility: Use to determine need of timely GBS screening Recommendation: To use to prove need of improved strategies of prepartum GBS screening
(Study #9) Moorhead et al., (2019) Compliance with screening for and recommender management of maternal group B streptococcus carriage	To observe practice and compliance with obstetric GBS management guidelines	None	Retrospective audit	S=558 GBS Carrier =109 Ge=>35 weeks	IV=Compliance education and TX DV=Decrease in GBS + newborns	DV=93/94 and 39/47	No analysis	IV=DV	Level 3 Evidence Strengths: Backs up evidence that screening done >35 wks Feasibility: verifies screening recommendations Recommendation: To screen >35 wks Ge and treat within 4 hrs prior to delivery

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in pregnancy									
(Study #10) Virranniemi et al., (2019) The effect of screening-to-labor interval on the sensitivity of late-pregnancy culture in the prediction of group B streptococcus colonization at labor: A prospective multicenter cohort study	To study the rate of GBS colonization, sensitivity, specificity of late-pregnancy culture and increased screening-to-labor interval compared with intrapartum GBS DX by RT-PCR and culture	None	Prospective multicenter cohort study	37 wks Ge Onset of labor 2 delivery units	IV=late pregnancy or intrapartum DV=number of +GBS newborns	IV=2	No analysis	Late pregnancy screening >37 wks Ge	Level 3 Evidence Strengths: Use RT-PCR testing if labor begins before culture results are back Feasibility: provide evidence of needed screening during labor Recommendation: To reinforce validity of performing GBS screening during labor
(Study #11) Johansen et al. (2019) Prevalence and treatment of	To estimate prevalence of GBS at onset of	None	Cross sectional study	P=642 DX=17.8 % onset of labor	IV=Time of GBS culture DV=Negative GBS culture		No analysis	Predicting risk factors is not as precise as screening	Level 3 Evidence Strengths: Screening is more precise with accurate results

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group B streptococcus colonization based on risk factors versus intrapartum culture screening	labor and compare accuracy of intrapartum AP based on risk factor vs IS				at time of delivery				Weaknesses: Treating based on risk factors only increased risk to newborn Feasibility: To provide valid information on accuracy of screening vs. risk factors Recommendation: To treat only positive screenings for GBS, not on risk factors alone
(Study #12) Kaambwa et al., (2010) Cost-effectiveness of rapid tests and other existing strategies for screening and management of early-onset group B streptococcus during labour	To determine the cost-effectiveness of alternative screening prevention strategies	None	Decision model	S=1400 women Risk factors = 308	IV= Cost of testing before delivery DV=treat with AP, do nothing, or screen for GBS	DV=3	No analysis	Screen, treat, if GBS +, more cost efficient than no treatment	Level 4 Evidence Strengths: Screening cost less than treatment of GBS+ newborns Feasibility: To prevent GBS in newborn Recommendation: To decrease potential cost of treatment for GBS + newborn

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Appendix B

Instrument

Data Form – GBS Study with PCR Screening Test

Patient Initials	Gestational Age	Date/Time Labor Began	History of GBS/Treatment if any	Screening Date/Results	Time of Treatment	Date/Time of Delivery

Appendix C

Flowchart