



# Closing the Gap: Enhancing Perinatal Hepatitis B Surveillance and Intervention Through an Automated Detection System

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# Enhanced Maternal Case Management (ECM) since 1990 in AL



- Counseling of identified mothers on risks to newborns and household or sexual contacts
- Vaccination and testing of household and sexual contacts where possible
- Prenatal and antenatal follow-up of exposed infants to ensure optimal prophylactic care given
- Education of prenatal care providers, delivery facilities (n = 65), and pediatricians
- 2.5 FTEs dedicated to Maternity Hepatitis B Program, same 3 nurses since 1990 – 2001.



# AL Retrospective Review Studies, 1999 – 2002



- Ascertain completeness of perinatal hepatitis B surveillance network reporting in Alabama (obstetricians, hospitals, state epi, and county health departments).
- Compare outcomes with and without public health department interventions in Alabama
- Determine potential impact of implementing a universal birth dose policy in Alabama
- Assess the feasibility of automated active surveillance for missed births to chronic HBsAg carrier women.



# AL Retrospective Review Studies, 1999 – 2002



- 1999-2000 Manual Retrospective Search
- Jan 2002 Automated Algorithm Test Study for 1993 – 2001 birth data.
- Continuous 2002 Study of Automated Surveillance System to verify Algorithm results
- 2000-2001 Survey of Pediatricians for documentation transfer from hospitals.



# Manual Review Process 1999 Retrospective Study



- A listing of women (n = 852) over 15 years of age with at least 1 positive HBsAg test compiled along with all known births in Maternity Hepatitis B Program.
- Initial search matching criteria used mothers first name, date of birth to cross reference the state immunization registry (populated with birth data from 1993 – present).
- Using additional information such as infant names, SSN, address, maiden/last name, other information it was determined whether the woman was a match.
- Known births to the HBsAg positive mother were compared to all found children in the registry.



# 1999 Retrospective Study Barriers



- 80 Women (approx 10%) known to have moved out of state, how many more is unknown.
- 2% of women no longer of child bearing age (assumed at 50)
- 3% of women had no date of birth and this prevented cross referencing.
- No birth data available for 1990, 1991, and 1992 to cross reference.
- Hospital records unavailable on most births older than 5 years.



# 1999 Retrospective Outcomes



- Total HBsAg positive women on record
  - ◆ 785 Women with single positive HBsAg
  - ◆ 230 Women confirmed chronic
  
- 186 confirmed matches were made between Maternity Hep B Program records and vitals statistic records for unknown births.
  
- Of the 785 women with a single HBsAg positive, 67 (8.5%) had a subsequent delivery with a negative HBsAg, 50 women reclassified to Acute Resolved, remainder were False Positive.
  
- 119 births to HBsAg positive women entered into database, 35 entered into active case management (within last 2 years) and 56 women reclassified as chronic confirmed from unconfirmed.



# Perinatal Surveillance Data of Infants born to HBsAg positive women before and after 1999 Manual Retrospective Review



YEAR	Before Retrospective Review	After Retrospective Review
1990	92	82
1991	122	106
1992	111	113
1993	107	110
1994	90	89
1995	73	86
1996	80	89
1997	88	94
1998	95	108
Totals	758	877

After removing the Acute Resolved and False Positive cases identified (n = 67), case finding still increased by net of 13.5% (n = 119)



# Retrospective Surveillance

## Pros

- Allows public health intervention for missed dose 1, timely follow-up of dose 2 and 3, and post vaccination serology
- Can identify weaknesses in the perinatal hepatitis exposure reporting network to enable an educational outreach
- More accurate case finding figures for project areas, adds new cases while weeding out acute resolved or false positive cases from prior years.

## Cons

- Usually decreases the overall performance figures for vaccination timeliness / completion by health department which state programs may not like.
- Potential liability when identifying an infant not vaccinated appropriately.



# 2000 Construction of ARTEMIS



Initiative to perform detailed quality assurance

- Comprehensive perinatal hepatitis B case management application
- All records reentered, women and infants classified by new criteria.
- Plans for automated retrospective surveillance created, algorithm designed and tested
- Application is public domain, logic, software code and features can be used in other state programs even if the software itself is not.
- Designed to work in large or small projects, data sharing enabled with flexible reports.





# New diagnostic classification of case mothers and infants



- Previously women were classified as either acute, false positive or chronic carriers
- New classification system introduced in 1999 categorized women as Acute Resolved, False Positive, Confirmed Chronic or Unconfirmed Chronic (single HBsAg)
- Infant classification system was introduced to enable further analysis of data. Infants categorized as Prospective, Retrospective, or Contact.



# Definitions in Study Mother Classifications



- **Chronic Confirmed** – full hepatitis B panel results indicating carrier state or 2 HBsAg + test results at least 180 days apart.
- **Chronic Unconfirmed** – single HBsAg + or a full hepatitis B panel indicating a current acute infection.
- **Acute Resolved** – negative HBsAg, positive Anti-HBc, positive Anti-HBs or positive HBsAg followed by a negative HBsAg with or without positive Anti-HBc
- **False Positive** – positive HBsAg followed by negative HBsAg, negative Anti-HBc and negative Anti-HBs panel.



# Definitions in Study Infant Classifications



- **Prospective Infant** – mother identified to the health department as chronic carrier (confirmed or not) prior to delivery.
- **Retrospective Infant** – mother identified to the health department as chronic carrier (confirmed or not) after delivery.
- **Contact Infant** – previous infant born to a woman currently known to HBsAg positive but status was unknown at that child's birth.



# 1993 – 2001 Automated Retrospective Study



567,000 Birth Records  
from 1 Jan 93 - 31 Dec 01

Pre Study 1993 - 2001  
1149 Known Infants born to HBsAg  
Positive Mother in ARTEMIS  
(Confirmed and Unconfirmed)

**Screening for Suspect Infants**  
 Cross match based on mothers date of birth and first name between the two databases, any infants born to a match in the birth record data is a suspect infant.

Suspect Infants born to known HBsAg + women = 1686  
 Sensitivity = 1115 infants detected / 1149 known infants = 97%

34 Infants not found due to mother first name spelling variations or date of birth data errors in ARTEMIS or birth record.

772 women were chronic unconfirmed at start of study, 10% were subsequently converted to either False Positive or Acute Resolved

**Filtering out of known infants**  
 Infants already in the ARTEMIS database are rejected if the infant first name and date of birth are for birth data and Artemis database records are the same for HBsAg positive mothers

Suspect Infants n = 1686  
 less  
 Infant records matched and rejected = 1115  
 equals  
 Suspect Infant Records Remaining = 571

Positive Predictive Value = .62  
(95% CI .58 - .66)

Sensitivity = .97  
(95% CI .96 - .98)

**Suspect Infants Nursing Reviewed and Rejected (n = 216)**

21 Births to women that were already known to the program but there were first name variations in 17 cases and date of birth data entry errors on 4 records

195 Births to HBsAg negative women not actually in Artemis database but whose births were flagged due to a coincidental name and date of birth match with an HBsAg positive woman in Artemis database.

**Suspect Infants Nursing Reviewed and Accepted for Investigation (n = 355)**

156 Unknown births to chronic- confirmed (n=131) and chronic-unconfirmed (n=25) women that were subsequently entered into ECM.

120 Unknown births to chronic-unconfirmed (n=109) women and chronic-confirmed (n=11) but not entered into ECM since 2 years had passed since the time of discovery.

79 Unknown births to the program but when investigated the mother was found to be HBsAg negative and the mother was reclassified to acute resolved or false positive



# 2002 Verification Study



- 65,809 birth records matched against 1336 women in Artemis
  - ◆ 644 Women classified as Chronic Unconfirmed
  - ◆ 692 Women classified as Chronic Confirmed
  
- 59 Automated Matches
  - ◆ 21 discarded as coincidental matches of first name/dob
  - ◆ 38 confirmed matches for mothers in 2002
    - ★ 18 births to existing chronic carriers, no reclassification
    - ★ 5 births to chronic unconfirmed converted to confirmed with additional lab values for recent birth
    - ★ 3 births to chronic unconfirmed women, no additional lab values (no prenatal care), no reclassification
    - ★ 9 matched cases with chronic unconfirmed converted to Acute Resolved based on negative HBsAg
    - ★ 3 matched cases with chronic unconfirmed converted to False Positive based on negative hep B panel
  
- Algorithm Performance
  - ◆ Positive Predictive Value = .62
  - ◆ Sensitivity = 98%



# Prophylactic treatment of identified infants born to HBsAg positive women in Alabama January 1990 – August 2002



	HBIG/Hep B within 24 hours	HBIG only within 24 hours	Hep B only within 24 hours	No treatment within 24 hours
<b>Prospective</b> (n = 984) 78% of total cases	895 (91%)	19 (1.9%)	25 (2.5%)	45 (4.6%)
<b>Retrospective</b> (n = 278) 22% of total cases	181 (65.1%)	8 (2.9%)	32 (11.5%)	57 (20.5%)
<b>Total</b> (n = 1262)	1076 (85.3%)	27 (2.1%)	57 (4.5%)	102 (8.1%)

Impact of a statewide universal hepatitis B birth dose policy in Alabama estimated to impact 12.6% of infants born to HBsAg positive mothers. This arrived at by the combination of the 4.5% given only hepatitis B vaccine in AL hospitals with a universal birth dose policy and the 8.1% that delivered in hospitals currently without a universal birth dose policy and were given no treatment.



# Public Health Department Follow-up Intervention Effectiveness



- In a sample of 2000-2001 retrospective births examined where the hospital was aware of the mother's HBsAg positive status (n = 42), only 55% had documentation of the mothers HBsAg positive status in the pediatric record.
- In a sample of 2000-2001 prospective births followed by the health department (n = 150), 100% of pediatricians were aware of the mother's HBsAg status and were following prevention protocols.
- Dose 2 Completion: Since 1990 to August 2002, 83.4% (n = 982) of infants with ECM completed dose 2 by 2 months compared to 54.5% (n = 318) of infants without ECM.
- Dose 3 Completion: Since 1990 to August 2002, 89.8% (n = 922) of infants with ECM have completed the third dose of hep B vaccine by eight months compared to 60.2% (n = 118) for infants without ECM.



# Worth Considering



- Funding of additional retrospective studies in states such as Texas, Ohio, California, New York for larger cohorts
- Funding enhanced case management systems to replicate the ARTEMIS retrospective surveillance methodology.





# In Summary . . .



## Needed recommendations:

- ◆ Obstetricians and health departments should require a confirmation hep B serology panel for all women with a single positive HBsAg marker (ACIP/ACOG);
  - ★ “Do no harm” also includes the ethical responsibility to advise the mother of her carrier state based on confirmed lab results.
- ◆ Universal birth dose policies should be required to protect women acutely infected during second and third trimester (ACIP/ACOG);
  - ★ First trimester screening may leave some infants at risk, albeit a small number.
- ◆ Greater emphasis placed on vaccination of susceptible household contacts as a method hepatitis B elimination (ACIP);
- ◆ Implementation of centralized state Maternity Case Management systems with automated surveillance linkages to birth data (NIP);