Characteristics Associated with Michigan Children Under-Immunized in their First Year of Life

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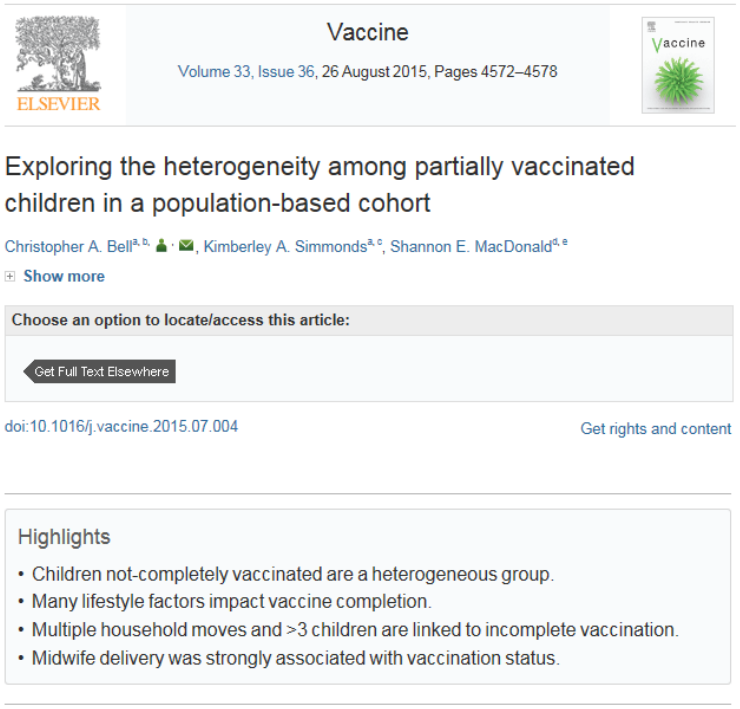
AIRA NATIONAL MEETING, APRIL 6, 2016

Presentation Outline

- Background
- Methods
- Results
- Discussion

Background

Our inspiration



Vaccine

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Exploring the heterogeneity among partially vaccinated children in a population-based cohort

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Highlights

- Children not-completely vaccinated are a heterogeneous group.
- Many lifestyle factors impact vaccine completion.
- Multiple household moves and >3 children are linked to incomplete vaccination.
- Midwife delivery was strongly associated with vaccination status.

- Assessed vaccination status at age 2 years
- 2008 Alberta Canada birth cohort
- Children not up-to-date on vaccinations described as
  - Selectively vaccinated
  - Incompletely vaccinated
  - Non-vaccinated
- Maternal and household characteristics used as predictors

National Immunization Survey 2014 Data

	U.S. Coverage	State Range	MI Coverage	MI Rank
4:3:1:3:3:1:4*	71.6 ± 1.5	63.4 – 84.7	65.0 ± 8.5	47th
3+ DTaP	94.7 ± 0.7	89.4 – 98.5	89.4 ± 6.1	50th
3+ Polio	93.3 ± 0.8	87.8 – 97.9	87.8 ± 6.5	50th
Hib – Primary Series	93.3 ± 0.8	88.9 – 98.4	88.9 ± 5.9	49th /50th
3+ Hep B	91.6 ± 0.9	82.6 – 97.6	89.2 ± 5.1	41st/42nd
3+ PCV	92.6 ± 0.8	85.2 – 98.1	85.2 ± 6.9	50th

*4 + DTaP, 3 + Polio, 1 + MMR, 3 + Hib / full series, 3 + HepB, 1 + Varicella, and 4 + PCV

Vaccination Status Assessment

Doses by age 12 months

3+ Hepatitis B (HepB)

3+ Diphtheria, Tetanus, and acellular Pertussis (DTaP)

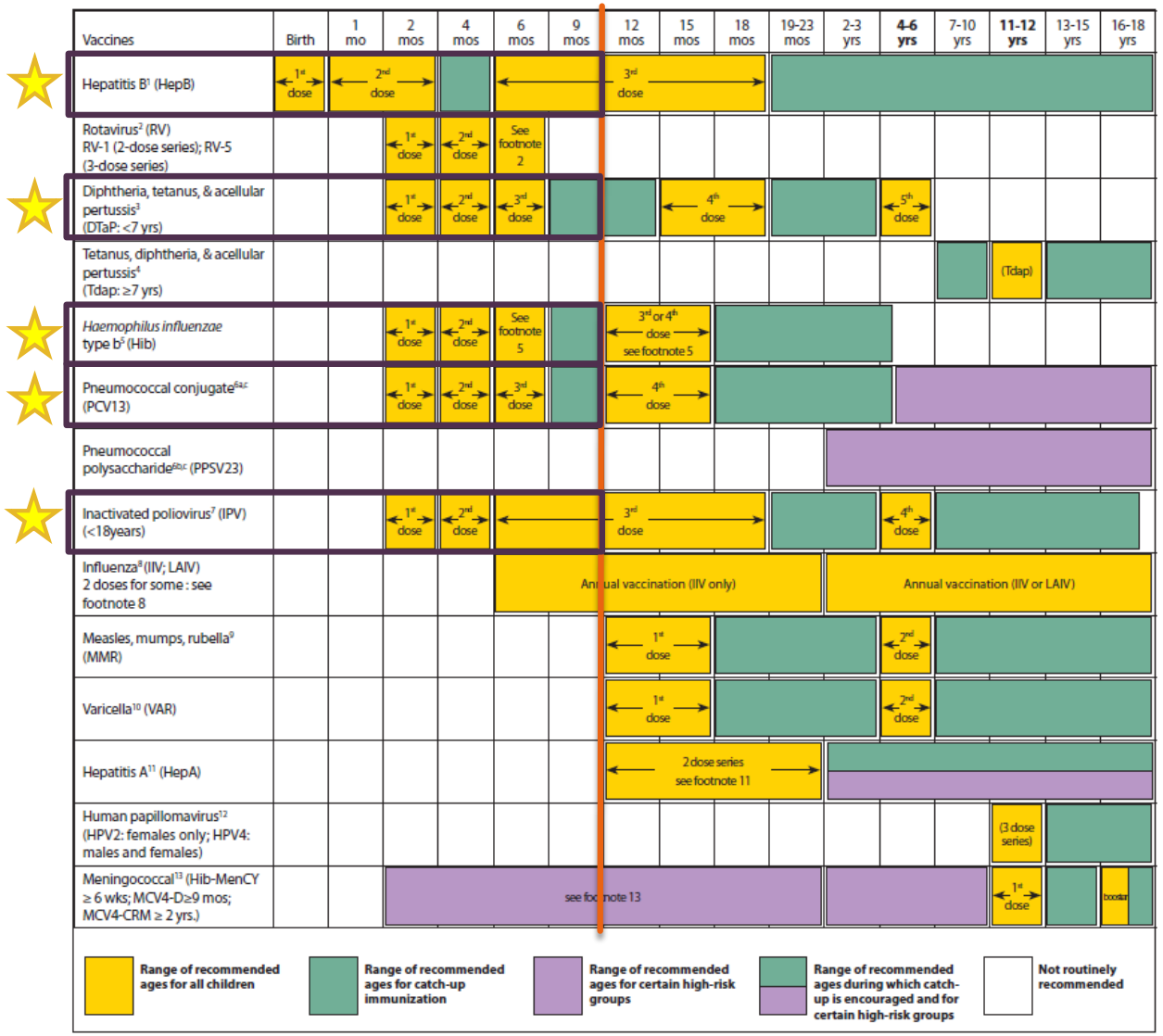
2+ / 3+ *Haemophilus influenzae* type b (Hib)

3+ Pneumococcal Conjugate (PCV)

3+ Inactivated Poliovirus (IPV)

FIGURE 1. Recommended immunization schedule for persons aged 0 through 18 years —2013 (for those who fall behind or start late, see the catch-up schedule [Figure 2])

These recommendations must be read with the footnotes that follow. For those who fall behind or start late, provide catch-up vaccination at the earliest opportunity as indicated by the green bars in Figure 1. To determine minimum intervals between doses, see the catch-up schedule (Figure 2). School entry and adolescent vaccine age groups are in bold.



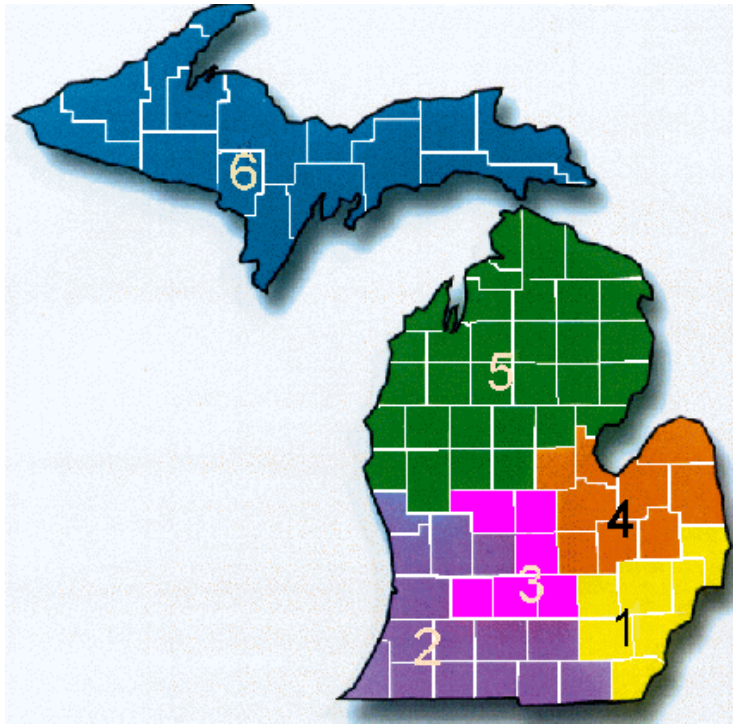
Methods

DATA SOURCES

STATISTICAL MODEL

MCIR Background

- The Michigan Care Improvement Registry (MCIR)
  - Michigan's IIS
- Web-based
- Populated with electronic birth records
- Operated with a regional approach
  - Provider recruitment and training
  - Help desk
  - Advisory boards



MCIR Background

- Legislation passed 1996
  - Opt-out
  - Vital Records integration
  - Mandated reporting for childhood immunizations
    - Less than age 20 years
- First rolled-out to providers in 1998
- IIS Sentinel Site since 2004
- Became a lifespan registry in 2006
  - No mandated reporting for adult immunizations
    - Age 20 years or greater

Leveraging the EBC-IIS Linkage

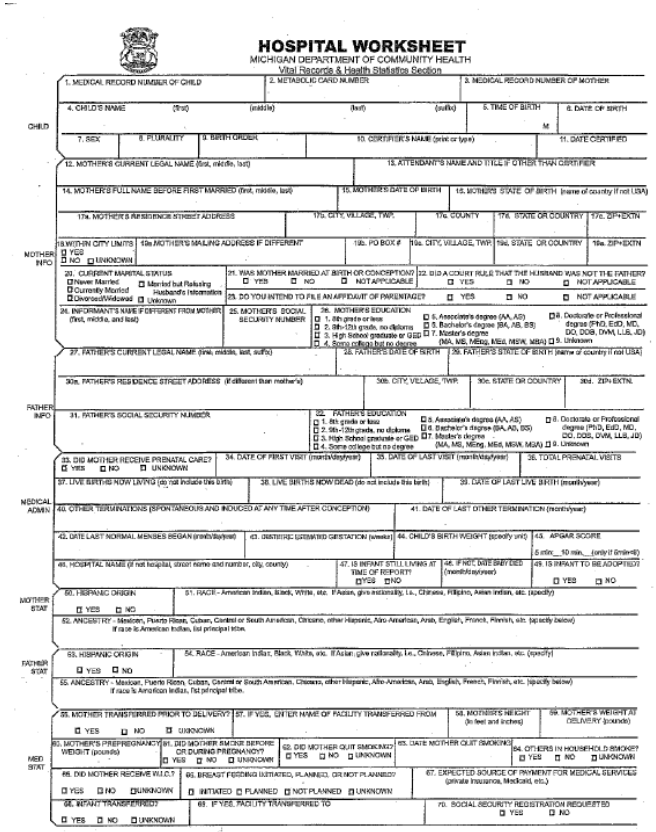
- Vital Records' Electronic Birth Certificate (EBC) integration part of legislation in 1996
- MCIR populated with EBC birth data from 1994 – current
- Information
  - Child
  - Responsible Party
  - Hepatitis B birth dose / HBIG
- This linkage has allowed MCIR to become the hub for clinics to obtain not only immunization records but also other public health data such as newborn screening and hearing.

EBC population of IIS

- In the past, there was a weekly transfer of data between systems.
- Currently, there is a daily query of a view in the Vital Records EBC system
  - New and updated records are considered for import into the IIS
  - Sometimes a new record in the vital records system is simply a new version of an existing record in our IIS
  - Updates are compared with previous versions
    - Material changes are added to existing records
    - Non-material changes are ignored
  - If a non-EBC record already exists, the EBC data is the default so an EBC ID will be present in the child's record.

Linkage to EBC data

- The numeric EBC identifier can be used to access *additional* fields available in the live birth file
- Use of these fields requires:
  - Review by the MDHHS Institutional Review Board (IRB) and
  - Review by the MDHHS Privacy Officer and
  - Execution of a Data Use Agreement (DUA) between Vital Records and Immunizations



HOSPITAL WORKSHEET

MICHIGAN DEPARTMENT OF COMMUNITY HEALTH

Vital Records & Health Statistics Section

CHILD

1. MEDICAL RECORD NUMBER OF CHILD
2. METABOLIC CARD NUMBER
3. MEDICAL RECORD NUMBER OF MOTHER
4. CHILD'S NAME (first) (middle) (last) (suffix)
5. TIME OF BIRTH
6. DATE OF BIRTH
7. SEX
8. PLURALITY
9. BIRTH ORDER
10. CERTIFIER'S NAME (print or type)
11. DATE CERTIFIED
12. MOTHER'S CURRENT LEGAL NAME (first, middle, last)
13. ATTENDANT'S NAME AND TITLE IF OTHER THAN CERTIFIER

MOTHER INFO

14. MOTHER'S FULL NAME BEFORE FIRST MARRIED (first, middle, last)
15. MOTHER'S DATE OF BIRTH
16. MOTHER'S STATE OF BIRTH (name of country if not USA)
17a. MOTHER'S RESIDENCE STREET ADDRESS
17b. CITY, VILLAGE, TWP.
17c. COUNTY
17d. STATE OR COUNTRY
17e. ZIP+EXTN
18. WITHIN CITY LIMITS ☐ YES ☐ NO ☐ UNKNOWN
19a. MOTHER'S MAILING ADDRESS IF DIFFERENT
19b. PO BOX #
19c. CITY, VILLAGE, TWP.
19d. STATE OR COUNTRY
19e. ZIP+EXTN
20. CURRENT MARITAL STATUS ☐ Never Married ☐ Married but Refusing Husband's Information ☐ Currently Married ☐ Divorced/Widowed ☐ Unknown
21. WAS MOTHER MARRIED AT BIRTH OR CONCEPTION? ☐ YES ☐ NO ☐ NOT APPLICABLE
22. DID A COURT RULE THAT THE HUSBAND WAS NOT THE FATHER? ☐ YES ☐ NO ☐ NOT APPLICABLE
23. DO YOU INTEND TO FILE AN AFFIDAVIT OF PARENTAGE? ☐ YES ☐ NO ☐ NOT APPLICABLE
24. INFORMANT'S NAME IF DIFFERENT FROM MOTHER (first, middle, and last)
25. MOTHER'S SOCIAL SECURITY NUMBER
26. MOTHER'S EDUCATION ☐ 1. 8th grade or less ☐ 2. 9th-12th grade, no diploma ☐ 3. High School graduate or GED ☐ 4. Some college but no degree ☐ 5. Associate's degree (AA, AS) ☐ 6. Bachelor's degree (BA, AB, BS) ☐ 7. Master's degree (MA, MS, MEng, MEd, MSW, MBA) ☐ 8. Doctorate or Professional degree (PhD, EdD, MD, DO, DDS, DVM, LLB, JD) ☐ 9. Unknown

FATHER INFO

27. FATHER'S CURRENT LEGAL NAME (first, middle, last, suffix)
28. FATHER'S DATE OF BIRTH
29. FATHER'S STATE OF BIRTH (name of country if not USA)
30a. FATHER'S RESIDENCE STREET ADDRESS (If different than mother's)
30b. CITY, VILLAGE, TWP.
30c. STATE OR COUNTRY
30d. ZIP+EXTN.
31. FATHER'S SOCIAL SECURITY NUMBER
32. FATHER'S EDUCATION ☐ 1. 8th grade or less ☐ 2. 9th-12th grade, no diploma ☐ 3. High School graduate or GED ☐ 4. Some college but no degree ☐ 5. Associate's degree (AA, AS) ☐ 6. Bachelor's degree (BA, AB, BS) ☐ 7. Master's degree (MA, MS, MEng, MEd, MSW, MBA) ☐ 8. Doctorate or Professional degree (PhD, EdD, MD, DO, DDS, DVM, LLB, JD) ☐ 9. Unknown

MEDICAL ADMIN

33. DID MOTHER RECEIVE PRENATAL CARE? ☐ YES ☐ NO ☐ UNKNOWN
34. DATE OF FIRST VISIT (month/day/year)
35. DATE OF LAST VISIT (month/day/year)
36. TOTAL PRENATAL VISITS
37. LIVE BIRTHS NOW LIVING (do not include this birth)
38. LIVE BIRTHS NOW DEAD (do not include this birth)
39. DATE OF LAST LIVE BIRTH (month/year)
40. OTHER TERMINATIONS (SPONTANEOUS AND INDUCED AT ANY TIME AFTER CONCEPTION)
41. DATE OF LAST OTHER TERMINATION (month/year)
42. DATE LAST NORMAL MENSES BEGAN (month/day/year)
43. OBSTETRIC ESTIMATED GESTATION (weeks)
44. CHILD'S BIRTH WEIGHT (specify unit)
45. APGAR SCORE 5 min.__ 10 min.__ (only if 5min<6)
46. HOSPITAL NAME (if not hospital, street name and number, city, county)
47. IS INFANT STILL LIVING AT TIME OF REPORT? ☐ YES ☐ NO
48. IF NOT, DATE BABY DIED (month/day/year)
49. IS INFANT TO BE ADOPTED? ☐ YES ☐ NO

MOTHER STAT

50. HISPANIC ORIGIN ☐ YES ☐ NO
51. RACE - American Indian, Black, White, etc. If Asian, give nationality, i.e., Chinese, Filipino, Asian Indian, etc. (specify)
52. ANCESTRY - Mexican, Puerto Rican, Cuban, Central or South American, Chicano, other Hispanic, Afro-American, Arab, English, French, Finnish, etc. (specify below) If race is American Indian, list principal tribe.

FATHER STAT

53. HISPANIC ORIGIN ☐ YES ☐ NO
54. RACE - American Indian, Black, White, etc. If Asian, give nationality, i.e., Chinese, Filipino, Asian Indian, etc. (specify)
55. ANCESTRY - Mexican, Puerto Rican, Cuban, Central or South American, Chicano, other Hispanic, Afro-American, Arab, English, French, Finnish, etc. (specify below) If race is American Indian, list principal tribe.

MED STAT

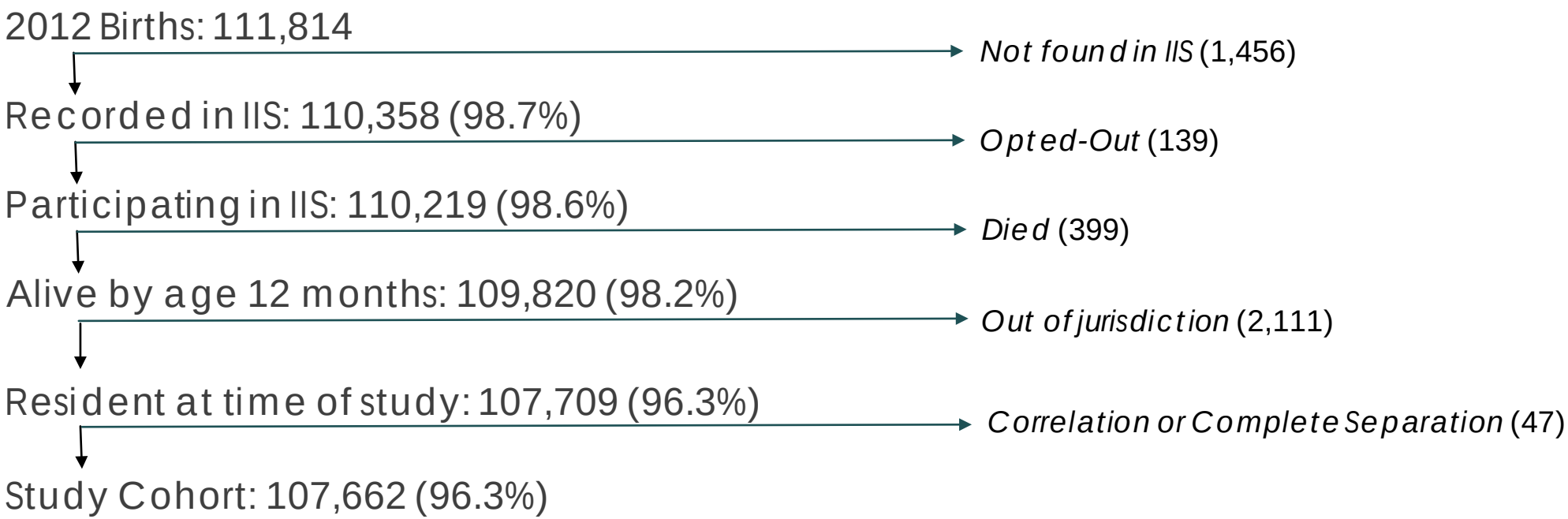
56. MOTHER TRANSFERRED PRIOR TO DELIVERY? ☐ YES ☐ NO ☐ UNKNOWN
57. IF YES, ENTER NAME OF FACILITY TRANSFERRED FROM
58. MOTHER'S HEIGHT (in feet and inches)
59. MOTHER'S WEIGHT AT DELIVERY (pounds)
60. MOTHER'S PREPREGNANCY WEIGHT (pounds)
61. DID MOTHER SMOKE BEFORE OR DURING PREGNANCY? ☐ YES ☐ NO ☐ UNKNOWN
62. DID MOTHER QUIT SMOKING? ☐ YES ☐ NO ☐ UNKNOWN
63. DATE MOTHER QUIT SMOKING
64. OTHERS IN HOUSEHOLD SMOKE? ☐ YES ☐ NO ☐ UNKNOWN
65. DID MOTHER RECEIVE W.I.C.? ☐ YES ☐ NO ☐ UNKNOWN
66. BREAST FEEDING INITIATED, PLANNED, OR NOT PLANNED? ☐ INITIATED ☐ PLANNED ☐ NOT PLANNED ☐ UNKNOWN
67. EXPECTED SOURCE OF PAYMENT FOR MEDICAL SERVICES (private insurance, Medicaid, etc.)
68. INFANT TRANSFERRED? ☐ YES ☐ NO ☐ UNKNOWN
69. IF YES, FACILITY TRANSFERRED TO
70. SOCIAL SECURITY REGISTRATION REQUESTED ☐ YES ☐ NO

Analysis

- Univariate analysis:
  - Multinomial logistic regression to estimate the odds ratios, 95% confidence limits, and p values of each variable against each incomplete vaccination outcome compared to complete.
  - Variables significant in the univariate analysis were included in a multivariable model
- Multivariable analysis:
  - Multinomial logistic regression to estimate the adjusted odds ratios (aOR), 95% confidence limits, and p values of each variable, adjusted for all the other variables in the model.

Results

Study population

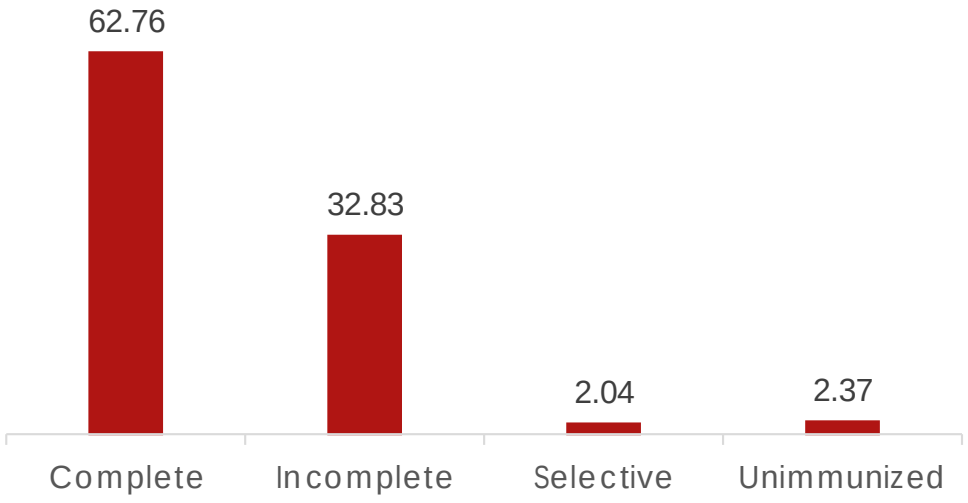


Immunization Coverage by Age 12 Months

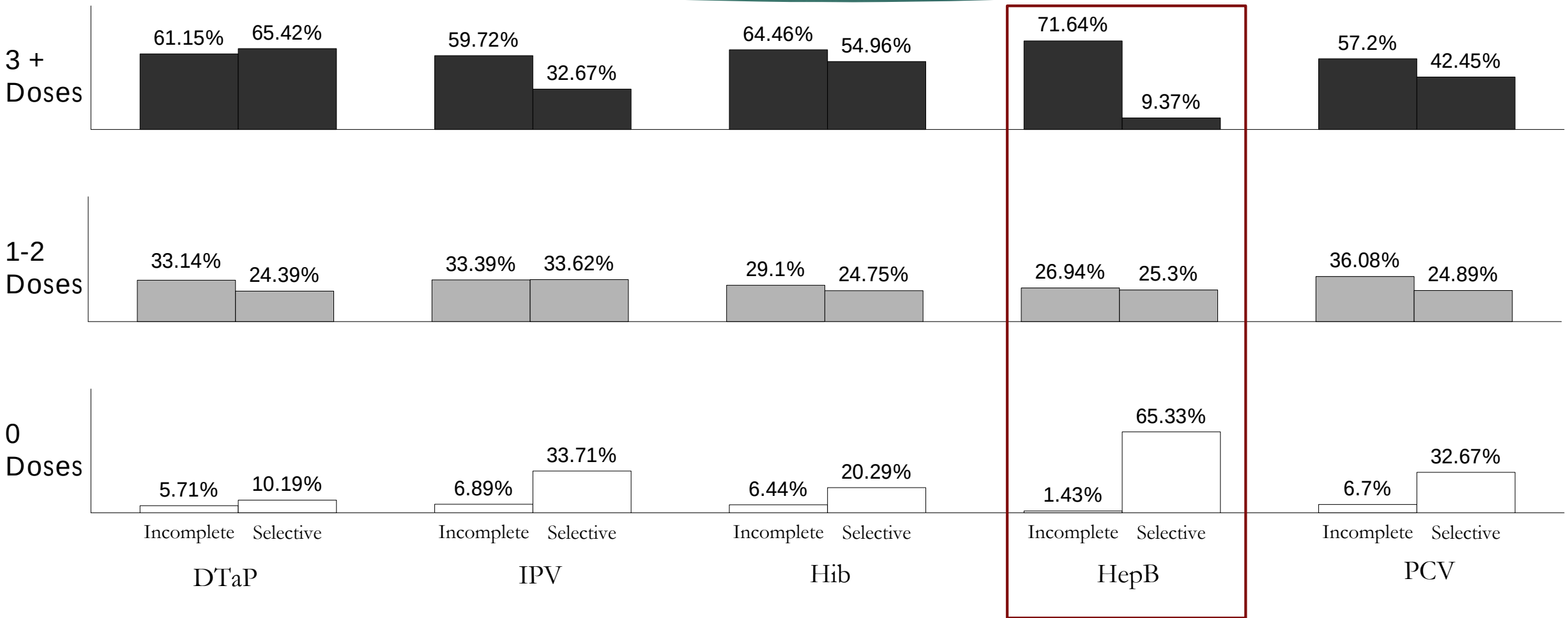
Vaccine	0 / None N (%)	1 or 2 / Not Up-to-Date N (%)	3 or more / Up-to-Date N (%)
DTaP	4,791 (4.45)	12,246 (11.38)	90,590 (84.17)
Polio	5,725 (5.32)	14,413 (13.39)	87,489 (81.29)
Hib	5,271 (4.90)	11,769 (10.93)	90,587 (84.17)
HepB	4,489 (4.17)	14,549 (13.52)	88,589 (82.31)
PCV	5,635 (5.24)	13,297 (12.35)	88,695 (82.41)

Vaccination Status by Age 12 Months

- 62.76% Completely Immunized
  - 3+ Hepatitis B (HepB) *and*
  - 3+ Diphtheria, Tetanus, and acellular Pertussis (DTaP) *and*
  - 2+ / 3+ Haemophilus influenzae type b (Hib) *and*
  - 3+ Pneumococcal Conjugate (PCV) *and*
  - 3+ Inactivated Poliovirus (IPV)
- 2.04% Selectively Immunized
  - All doses of one or more vaccines *and*
  - No doses of one or more vaccines
- 2.37% Unimmunized
  - No doses HepB, DTaP, Hib, PCV, or IPV
- 32.83% Incompletely Immunized



Individual Vaccine Coverage Among the Selectively and Incompletely Vaccinated



Multivariable Analysis (1)

	Incomplete *v.* Complete			Selective *v.* Complete			Non-Vaccinated *v.* Complete		
	aOR	(95% CI)	P-value	aOR	95% CI	P-value	aOR	95% CI	P-value
Birth Attendant / Facility (ref=hospital/physician)									
Home	2.116	(1.664,2.690)	<.0001	16.643	(12.479,22.196)	<.0001	1.711	(0.956,3.063)	0.0706
Hospital / midwife	1.248	(1.181,1.318)	<.0001	2.492	(2.164,2.870)	<.0001	3.288	(2.923,3.698)	<.0001
Prenatal care 1st trimester	0.761	(0.736,0.786)	<.0001	0.811	(0.717,0.918)	0.0009	0.642	(0.578,0.713)	<.0001
Maternal age (ref= < 21)									
aged 21-25 years	0.938	(0.895,0.984)	0.0088	0.943	(0.737,1.205)	0.6376	1.076	(0.862,1.343)	0.5171
aged 26-29 years	0.767	(0.728,0.809)	<.0001	1.136	(0.887,1.456)	0.3129	0.832	(0.661,1.047)	0.1172
aged 31-35 years	0.699	(0.658,0.741)	<.0001	1.311	(1.013,1.698)	0.0396	0.728	(0.571,0.927)	0.0101
aged 36-40 years	0.663	(0.618,0.713)	<.0001	1.423	(1.076,1.880)	0.0132	0.823	(0.633,1.069)	0.1445
aged 41 years or more	0.706	(0.625,0.796)	<.0001	1.601	(1.110,2.308)	0.0117	1.150	(0.826,1.600)	0.4088
WIC enrollment (ref=never)	0.943	(0.908,0.979)	0.0020	0.433	(0.381,0.492)	<.0001	0.390	(0.350,0.435)	<.0001

Multivariable Analysis (2)

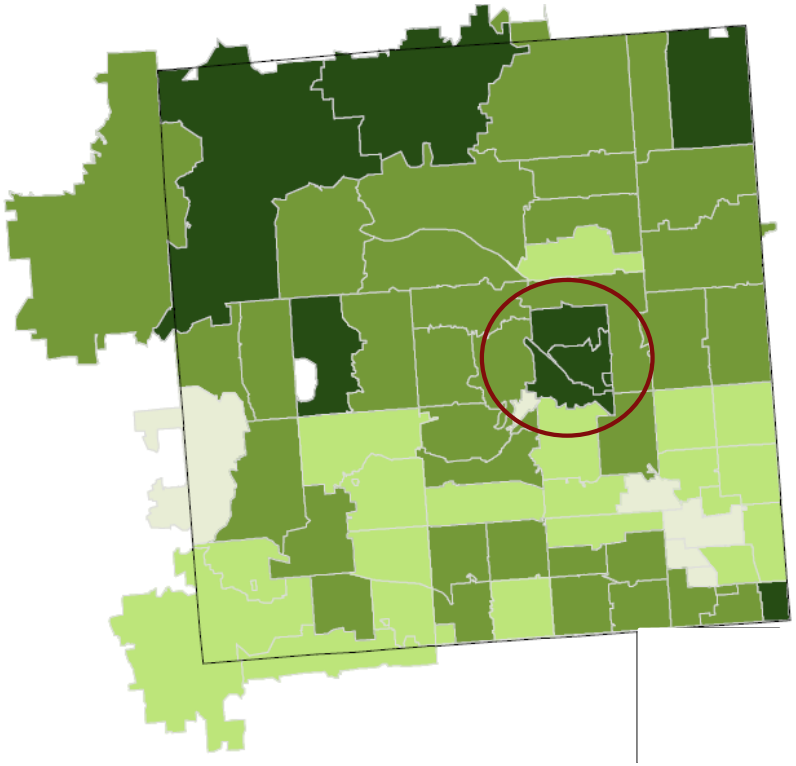
	Incomplete *v.* Complete			Selective *v.* Complete			Non-Vaccinated *v.* Complete		
	aOR	(95% CI)	P-value	aOR	95% CI	P-value	aOR	95% CI	P-value
Number of Siblings (ref=0)									
one	1.334	1.291 1.379	<.0001	1.031	0.929 1.144	0.5689	1.281	1.153 1.424	<.0001
two	1.554	1.491 1.620	<.0001	1.064	0.931 1.216	0.3647	1.894	1.675 2.142	<.0001
three	1.810	1.709 1.917	<.0001	1.029	0.839 1.261	0.7849	2.498	2.121 2.941	<.0001
four or more	2.238	2.083 2.403	<.0001	1.534	1.210 1.944	0.0004	5.128	4.298 6.119	<.0001
Maternal education (ref=college degree)									
Less than high school	1.253	1.182 1.328	<.0001	0.564	0.445 0.713	<.0001	0.675	0.545 0.837	0.0003
High school graduate	1.102	1.049 1.157	<.0001	0.617	0.526 0.724	<.0001	1.018	0.886 1.170	0.8002
Some college	1.042	0.998 1.089	0.0627	0.818	0.727 0.919	0.0007	1.297	1.163 1.447	<.0001
Post-graduate degree	1.051	0.994 1.111	0.0795	1.004	0.883 1.141	0.9548	0.719	0.617 0.838	<.0001
Not married (ref=married)	1.092	1.054 1.131	<.0001	0.836	0.728 0.960	0.0111	0.574	0.507 0.650	<.0001

Multivariable Analysis (3)

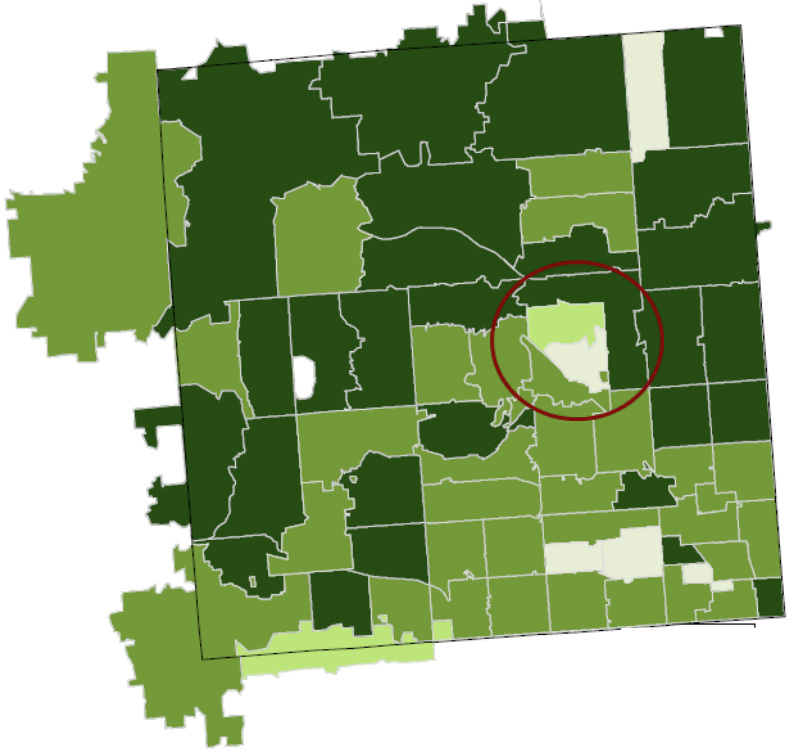
	Incomplete *v.* Complete			Selective *v.* Complete			Non-Vaccinated *v.* Complete		
	aOR	(95% CI)	P-value	aOR	95% CI	P-value	aOR	95% CI	P-value
Maternal Race (ref=white)									
Native American	★ 1.290	1.165 1.428	<.0001	1.080	0.741 1.575	0.6883	0.888	0.618 1.278	0.5240
Asian / Pacific Islander	★ 1.207	1.117 1.305	<.0001	0.313	0.221 0.443	<.0001	0.315	0.219 0.454	<.0001
Black	★ 1.134	1.094 1.175	<.0001	0.699	0.589 0.828	<.0001	0.522	0.443 0.616	<.0001
Other	0.942	0.886 1.003	0.0603	0.658	0.507 0.853	<.0001	0.407	0.310 0.535	0.0016

Zip Code Maps

Incomplete



Non-Vaccinated



Discussion

Discussion

- Most children are completely immunized by age 12 months
- Of those children not up-to-date by age 12 months, the majority are incompletely immunized
  - 4% have completely omitted some or all vaccines
- Risk factors for having an incompletely rather than a completely vaccinated child are
  - Midwife-attended birth
  - Youth
  - Other children in the household
  - Having obtained less than a college education
  - Single marital status
  - Non-white race

Discussion

- These data were shared at regional conferences and immunization stakeholders' meetings to promote discussion and identify strategies.
- Small-area data are useful for local health jurisdictions
- Interventions to improve coverage should be appropriate for the targeted population
  - Recall letters
  - Reminders
- Explore and / or expand partnerships with obstetricians, midwives, birthing hospital staff

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