Advancing Public Health Outcomes Through Information Technology

"Uptake of Meningococcal Vaccine in Arizona School Children after Implementation of Immunization Requirements at School Entry"

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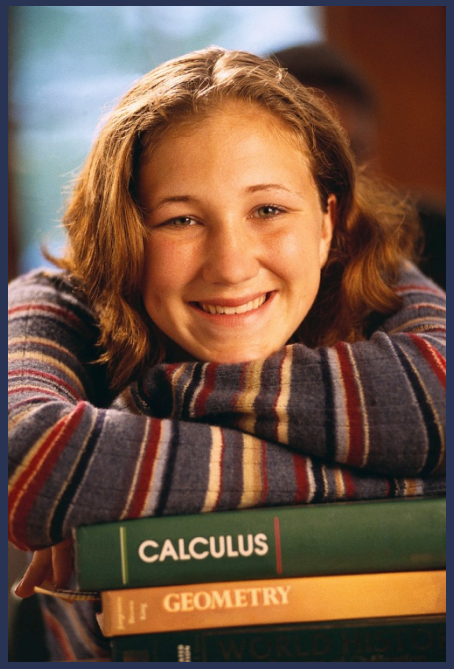
Overview

- Background and history
- Purpose and scope
- Methods
- Results
- Discussion
- Further directions



Background and history

- Infectious agent:
  - *Neisseria meningitidis*
    - A bacterium causing meningitis and bacteremia
    - Can result in brain damage, amputations, death (mortality is 10-14%)
    - Transmitted via droplet respiratory secretions of infected patients or asymptomatic carriers.
    - 3 vaccines are currently licensed in U.S.

Photo taken from:
http://www.austincc.edu/microbio/2993q/nm.htm

Arizona Immunization Information System (ASIIS)

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- Collects immunization data on individuals within the state.
- Providers are mandated under AZ Statute to report all immunizations administered to children from birth to 18 years of age to the state's health department.
- Pre-populated using birth records
  - Goal is to capture 95% of population under 18 yrs.
- As of Sept 2011: >4,875,000 individuals including 2,339,981 children under 18 yrs.

Background and history

- Vaccination recommendations and requirements timeline

1995

CDC ACIP recommendations: 1 dose quadrivalent conjugate vaccine for all children 11-12 yrs, those entering high school, and others at increased risk

1998

Arizona State Immunization Information System (ASIIS) used to track all vaccinations

2007

CDC ACIP recommendations include routine immunization of all 11-18 year olds at the earliest opportunity

2008

Arizona school-entry requirements changed: meningococcal vaccine required for children 11 years or older entering 6th grade

Research questions

- Although vaccination rates do appear to be increasing in Arizona, and nationally, questions remain regarding…
  1. How does policy (i.e. school-entry requirement) change affect overall vaccine uptake?

  and

  2. What are differences among sub-populations in terms of vaccine uptake as a response to policy?

Purpose and scope of this study

- This study describes patterns in meningococcal vaccine uptake in 11 and 12 year old children in Arizona.
- We determine the odds of on-schedule vaccination after school requirements changed to include meningococcal vaccination, as opposed to before the state statute change.
- We compare odds of on-schedule vaccination between several key demographic populations in Arizona.

Methods - overview

1. ASIIS records from 2006-2010 were used to compare on-schedule meningococcal vaccine coverage in 11 and 12 year olds.
2. Logistic regression modeling to determine odds of on-schedule vaccination following Arizona requirements change (post 2008).
3. Principle Component Analysis and hierarchical Cluster Analysis were used to identify and analyze 8 key demographic groups in AZ

   in terms of their response to requirements change.

Methods – on-schedule vaccination coverage

- We calculated on-schedule coverage as
  - proportion of children vaccinated at 11 and 12 years of age for each school year (SY) from 2006 through 2010.
  - Children receiving the meningococcal vaccination during their 11^{th} or 12^{th} years were considered on-schedule.
  - Vaccine coverage for children ages 11 and 12 years was calculated both prior to, and after, implementation of the school requirement
- Coverage = $\frac{\text{\# children age11 or 12 and vaccinated}}{\text{Total \# children in ASIIS 11 or 12 years old}}$

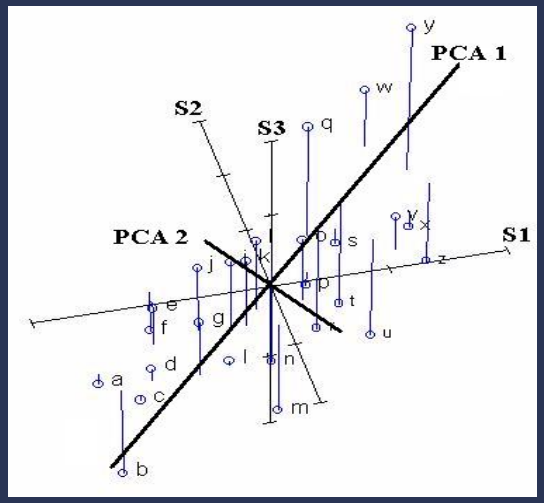
Methods – Odds Ratios

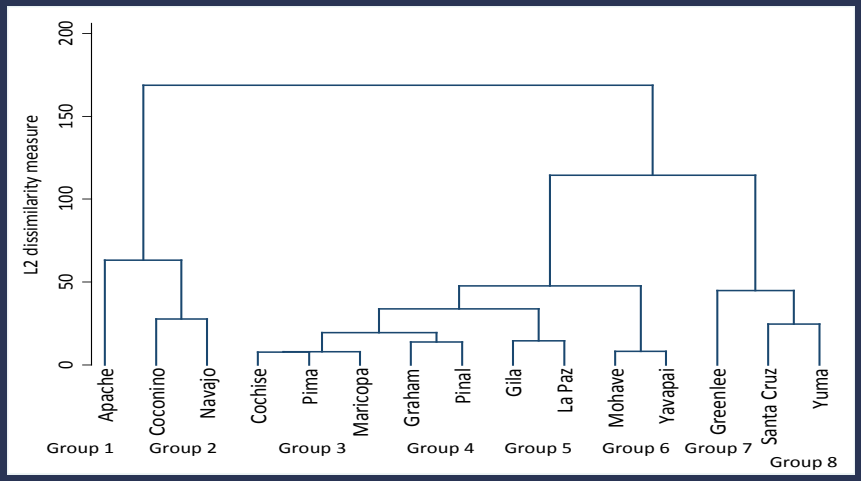
- Odds Ratio (OR)
  - measure of the size of an effect
  - In statistics, the *odds* of an event occurring is the probability of the event, divided by the probability of an event *not* occurring (this is different than the colloquial "odds")
  - a descriptive statistic that plays an important role in logistic regression.
  - can be estimated when using non-random samples.
  - Ranges between 0 to ∞.

"For most clinicians, odds ratios will remain . . . well, odd."
-- Grimes & Schulz, 2008

Methods – PCA and Cluster Analysis

- PCA –
  - Rotates your multi-dimensional data points to identify most important gradients
- Cluster Analysis –
  - groups geographic areas according to similarities in variables with most important gradients (from the PCA)





Results – Coverage, on-schedule vaccinations

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Characteristic	School Year 2006–2007[b]	2007–2008[b]	2008–2009[b]	2009–	2010 Census[c]
Age: 11 years					
Total Pop. Sept.1	133,306	135,107	138,634	139,747	89,797
Vacc. by Sept. 1	26,852 (20.1%)	65,075 (48.2%)	67,019 (48.3%)	68,167 (48.8%)	67,230 (74.9%)[d]
Vacc. b/w Sept. 1 and recent birthday	26,509 (19.9%)	62,669 (46.4%)	62,833 (45.3%)	64,190 (45.9%)	
Age: 12 years					
Total Pop. Sept.1	142,097	133,306	135,107	138,634	89,061
Vacc. by Sept. 1	29,882 (21.0%)	53,725 (40.3%)	75,015 (55.5%)	75,962 (54.8%)	76,425 (85.8%)[e]
Vacc. b/w Sept. 1 and recent birthday	24,053 (16.9%)	26,873 (20.2%)	9,940 (7.4%)	8,943 (6.5%)	

[b] According to records in the ASIIS; [c] The U.S. Census Bureau measures decennial census data, thereby limiting U.S. Census-derived immunization rate comparison with 2010; [d] Vaccinated by 11 years of age; [e] Vaccinated by 12 years of age.

*Increase in coverage from 2007 to 2008 ($p < 0.0001$ @ $\alpha=0.95$)

Results – demographic groups

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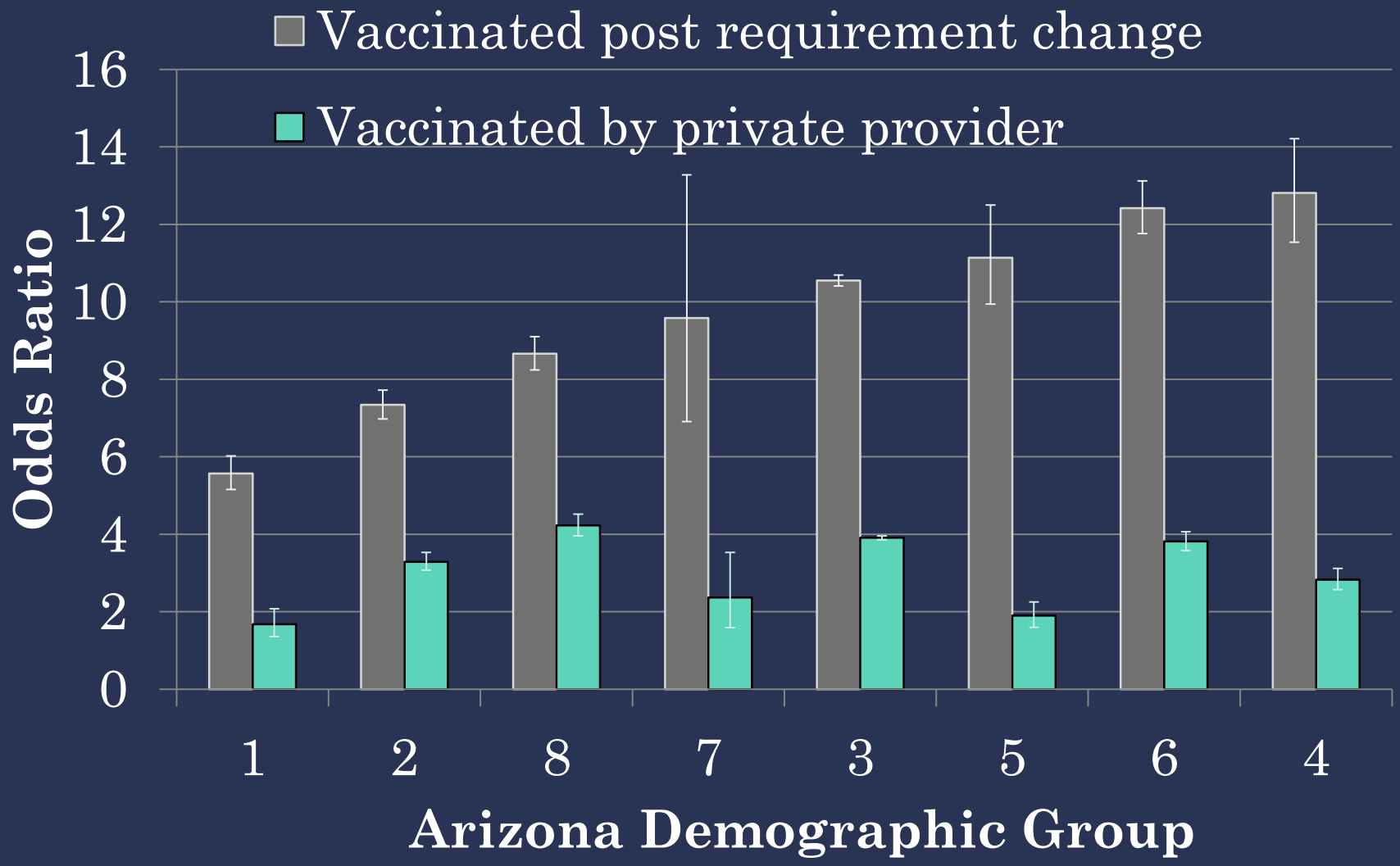
	ODDS	*Children*		*Education*			*Income*			*Race*		
	Post rule odds vacc'd by 12 yrs	Pers per house >2.76	Under 18 yrs >25.5%	High school grads <83.9%	College grads < 25.7%	Pov-erty >16.5 %	Own home <68.3 %	Median house-hold income < 40K	Nat. Amer. >4.6%	Hisp. >29.6 %	white >73%	Demo-graphic Profile
Group 1	5.57	Y	Y	Y	Y	Y		Y	Y			More children, less education, more poverty, more native American, less white
Group 2	7.34	Y	Y	Y	Y	Y	Y		Y			
Group 8	8.66	Y	Y	Y	Y	Y		Y		Y		
Group 4	12.81		Y	Y	Y	Y			Y			Somewhat more children, more HS education, more poverty, racially diverse
Group 5	11.14			Y	Y	Y		Y	Y		Y	
Group 7	9.58		Y		Y		Y			Y	Y	
Group 3	10.55					Y				Y	Y	Less children, more educ., less poverty, more white
Group 6	12.42										Y	

Results – OR on-schedule vaccination coverage



Results – demographic groups

- All demographic groups had higher odds of an on-schedule vaccination after the school entry requirement change than prior to rule.
  - ORs range = 5.57 to 12.81 ($p<0.0001$)
- Counties' demographic factors associated with lower odds of on-schedule vaccination included:
  1. higher poverty rates
  2. more children <18 (more children per household)
  3. fewer high-school graduates
  4. higher proportion of Native American population

Discussion

- Our analysis suggests that implementation of school immunization requirements resulted in increased meningococcal vaccination rates in Arizona.

- One challenge is to identify appropriate methods that control for over-estimates of total population in IIS data.
  - Census is not necessarily the answer.

Discussion

- Our study represents an investment in data and analytics by AZ.
  - Using data they already have to explore the influence of immunization policies on vaccine up-take.
  - An applied use of IIS data sets.

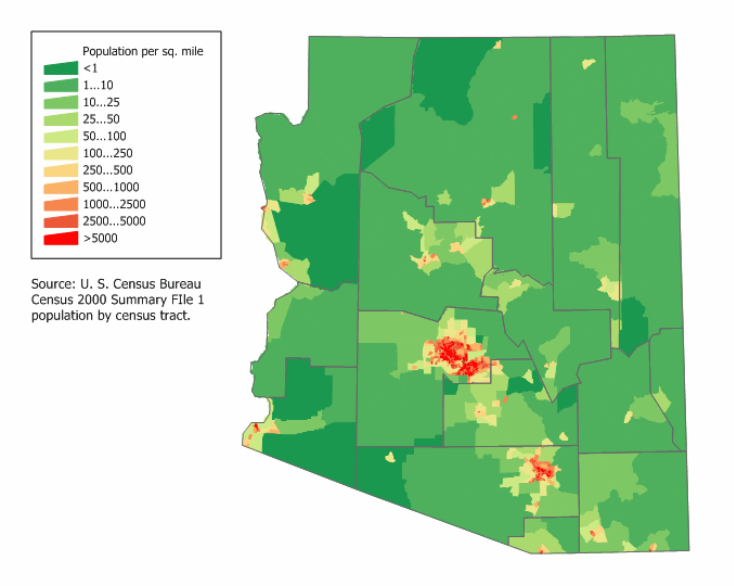
- Lower magnitude of response to rule change does not equate to lower overall immunization rates
  - Outreach and education programs may influence rates prior to a policy or rule change.
  - We are evaluating the magnitude of a response.

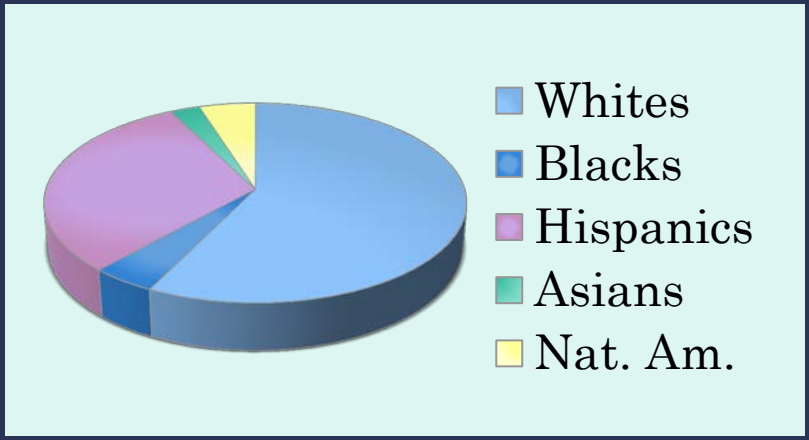
Discussion – demographic groups

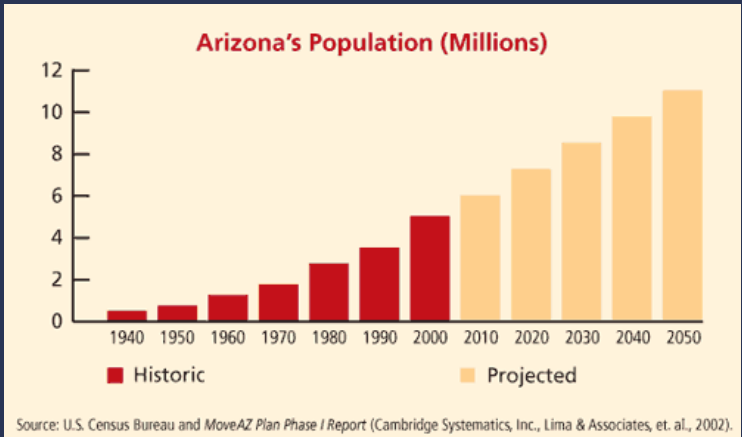
	AZ	USA
Population Change April 2010 to July 2011	1.4%	0.9%

The Arizona population can be characterized by high racial and geographic diversity.

Differences in vaccine uptake occur geographically, and this is related to demographic heterogeneity across space.







Discussion – final remarks

- Presentation of important population-level information about changes in vaccine coverage in Arizona in response to a new statewide meningococcal vaccination mandate.
- Make use of the ASIIS, a rich and valuable data source, and used novel methods that allowed for flexible analyses of changes to coverage estimates.
- Identified demographic characteristics of populations that may be less likely to respond to state mandates for vaccinations.
- Methods we used may be useful to other immunization programs in which similar initiatives and rules may be under consideration,

Future Directions

- Examine additional factors such as:
  - the year the child entered sixth grade
  - provider demographics,
  - child's school (school districts),
  - differences in school practices regarding immunization requirements and exemptions
  - Account for children exempt from the immunization requirement (3,026 of 3,428 exemptions religious/philosophical)

- Provider factors:
  - School district-level and detailed demographic data on providers
  - exploration into other important areas that may influence immunization coverage.

- Explore factors responsible for denominator inflation observed in ASIIS (as compared to 2010 Census).

Acknowledgments

Thank you! Questions?

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Questions?