Using Longitudinal Data on Readmission Rates to Guide and Evaluate Interventions to Control Pediatric Asthma

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APHA Session 3213.0, Asthma Epidemiology
Nov 5, 2007, Washington, DC

Introduction: CARMA

- ***C***ontrolling ***A***sthma in the ***R***ichmond ***M***etropolitan ***A***rea
- CDC[1] funded project to improve management of pediatric asthma thru community-driven, evidence-based interventions
- Two-year planning phase began in 2001
- Six year implementation phase began in 2003

1. One of seven sites in the *Controlling Asthma in American Cities* project: http://www.cdc.gov/asthma/aag02.htm

Purpose

- Identify and describe population sub-groups at higher risk for multiple hospital admissions for asthma
- Compare findings in the *intervention group*
  - to the comparison group
  - to statewide values

Intervention Group

- Children aged 2 to 17
- Resident in the CARMA catchment area:
  - City of Richmond, Virginia
  - Surrounding counties of Henrico and Chesterfield

Intervention Group City

- Richmond, VA is an older urban area with a 2000 population of 198,000
  - 57% of population is Black
  - 21% with income below FPL
  - 20% of population are children
  - 10% of children below FPL

Intervention Group Counties

- Henrico and Chesterfield counties are primarily suburban:
  - high growth in the past 3 decades
- Total combined population in 2000: 522,000
  - 21% of population is Black
  - 5% with income below FPL
  - 25% of population are children
  - 7% of children below FPL

Comparison Area: A collection of 10 demographically similar cities and counties in Virginia

Census 2000 Indicators	CARMA	Comparison	Virginia
Total Population	719,993	703,208	7,078,515
% Urban	94.2%	95.4%	73.0%
% Children	23.8%	23.4%	24.6%
% Black	31.0 %	27.8 %	19.6%
% below FPL	9.7%	10.5%	11.9%
% Children below FPL	13.9%	15.6%	9.6%

Study Measures: Hospital Discharges

- Asthma is considered an ambulatory care sensitive condition
  - Hospitalizations should be largely avoidable with appropriate management by health care providers, families and the children themselves
- Therefore, hospital discharges with a primary diagnosis of asthma can be used as a population level impact measure for program evaluation

Study Measures: Multiple Admissions

- Common among children previously hospitalized for asthma but relatively uncommon among the total population of children with asthma
- Red flag for poorly controlled asthma
- Previous research suggests that asthmatic children who experience multiple admissions are more likely:
  - to be poor
  - to be from minority racial/ethnic groups
  - are often geographically concentrated in certain residential neighborhoods

Hospital Discharges[2]

Hospital Discharges and Discharge Rates for Children Age 2-17 with a Primary Diagnosis of Asthma from 1994 to 2005

	CARMA	Comparison	Virginia
Total D/C	6,510	4,415	34,380
Rate/10,000	34.8	23.94	18.8

2. Source: Virginia Health Information hospital discharge data, 1994-2005

Challenges: Missing Identifiers

- Unique identifiers were missing from 37% of all asthma discharges in the 12-year period
- Missing identifiers were more likely to be missing for
  - Younger children
  - Data from earlier years
  - Black children
  - Certain hospitals
- Will bias estimates of the total number of children with multiple admissions downward but may also bias the proportion of children with multiple admissions upward
- Assumption: the number of children with multiple discharges is similar in the group with no identifiers to the group with identifiers

Number of Children Aged 2-17 with and without Multiple Discharges for Asthma, 1994-2005

	CARMA	Comparison	Virginia
Number with one D/C	1,875	1,463	11,125
Number with more than one D/C	616	483	3,470
Percent with multiple asthma D/C	**25%**	**25%**	**24%**

Differences among groups are not statistically significant

Number of Discharges Attributable to Children Aged 2-17 with and without Multiple Discharges by Intervention and Comparison Group, 1994-2005

Number of D/Cs:	**CARMA**	**Comparison**	**Virginia**
among children with only one D/C	1,875	1,463	11,125
among children with more than one D/C	1,960	1,527	10,468
Total D/Cs	3,832	2,977	21,593
Percent of all D/C for children with multiple asthma D/C	**51%**	**51%**	**49%**

Differences among groups are not statistically significant

Children with multiple discharges:

- The total number of hospitalizations ranged from 2 to 20
  - No differences between CARMA, Comparison, and state values
- Average time between hospitalizations ranged from 460 (Comparison) to 487 (CARMA) days
  - No differences between CARMA, Comparison, and state values
- Length of stay (LOS) was longer in the multiple D/C group
- Multiple D/C patients in CARMA area had longer LOS
- This remained true in a multivariate model controlling for patient age, race, gender and year of D/C

Differences in Length of Stay (LOS) Among Children with multiple discharges

Group	LOS (No Multi-D/Cs)	95% CIs	LOS (Multi-D/C Group)	95% CIs
CARMA	2.44	2.36-2.51	2.8	2.7-3.0
Comparison	2.06	1.99-2.1	2.2	2.1-2.4
Virginia	2.19	2.16-2.21	2.5	2.4-2.6

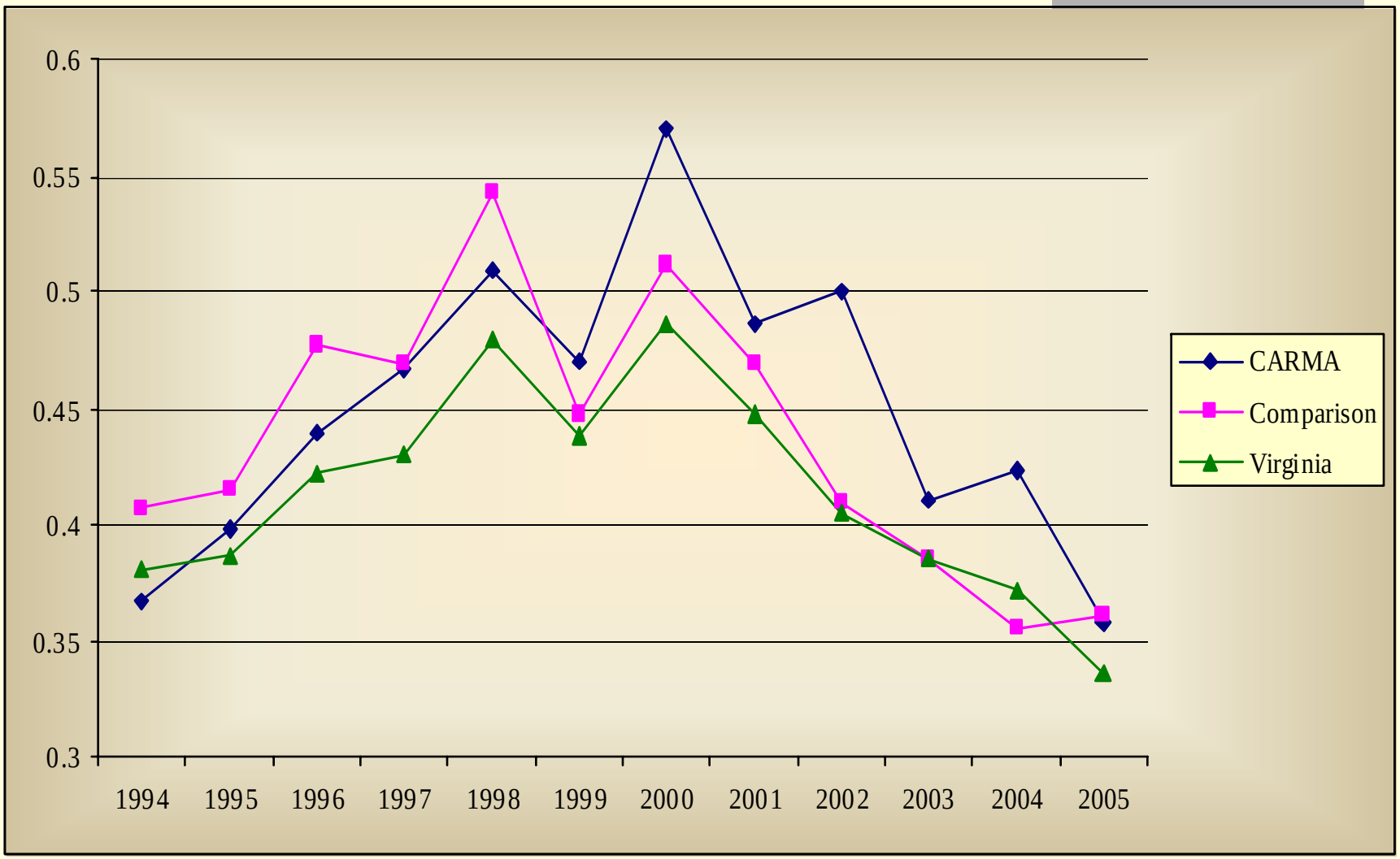
Differences in LOS, Time Between D/Cs and Number of D/Cs Among Children with Multiple Discharges

Group	Mean LOS (95% CI)	Mean Days Between D/C (95% CI)	Mean No. of D/C (95% CI)
CARMA (n=1008)	2.8 (2.7-3.0)	487 (454-519)	4.9 (4.8-5.1)
Comparison (n=770)	2.2 (2.1-2.4)	460 (424-496)	5.0 (4.7-5.3)
Virginia (n=)	2.5 (2.44-2.56)	451 (437-464)	5.1 (4.9-5.2)

Differences in Length of Stay (LOS) Among Children with multiple discharges

Variable	Estimate	t-value	p-value
Intercept	-56.85	-2.85	.0045
CARMA	.42	6.6	<.0001
Black	.09	1.3	.19
Year	.03	2.9	.003
Age	.03	4.2	<.0001
Male	-.01	-.26	.79

Proportion of Children Each Year that Had a Subsequent Asthma Admission, 1994-2005



Children with Multiple Discharges and with a Gap between Discharges of 30 Days or Less

- 527 children had less than 31 days between hospitalizations
- Mean number of hospitalizations per child in this group ranged from 4.0 to 4.5
  - Difference across groups did not reach statistical significance
- Mean Length of stay ranged from 2.5 to 3.4 days
  - CARMA values are higher than the entire population but difference did not reach statistical significance

Differences in LOS, Time Between D/Cs and Number of D/Cs Among Children with Multiple Discharges and with a Gap between Discharges of 30 Days or Less

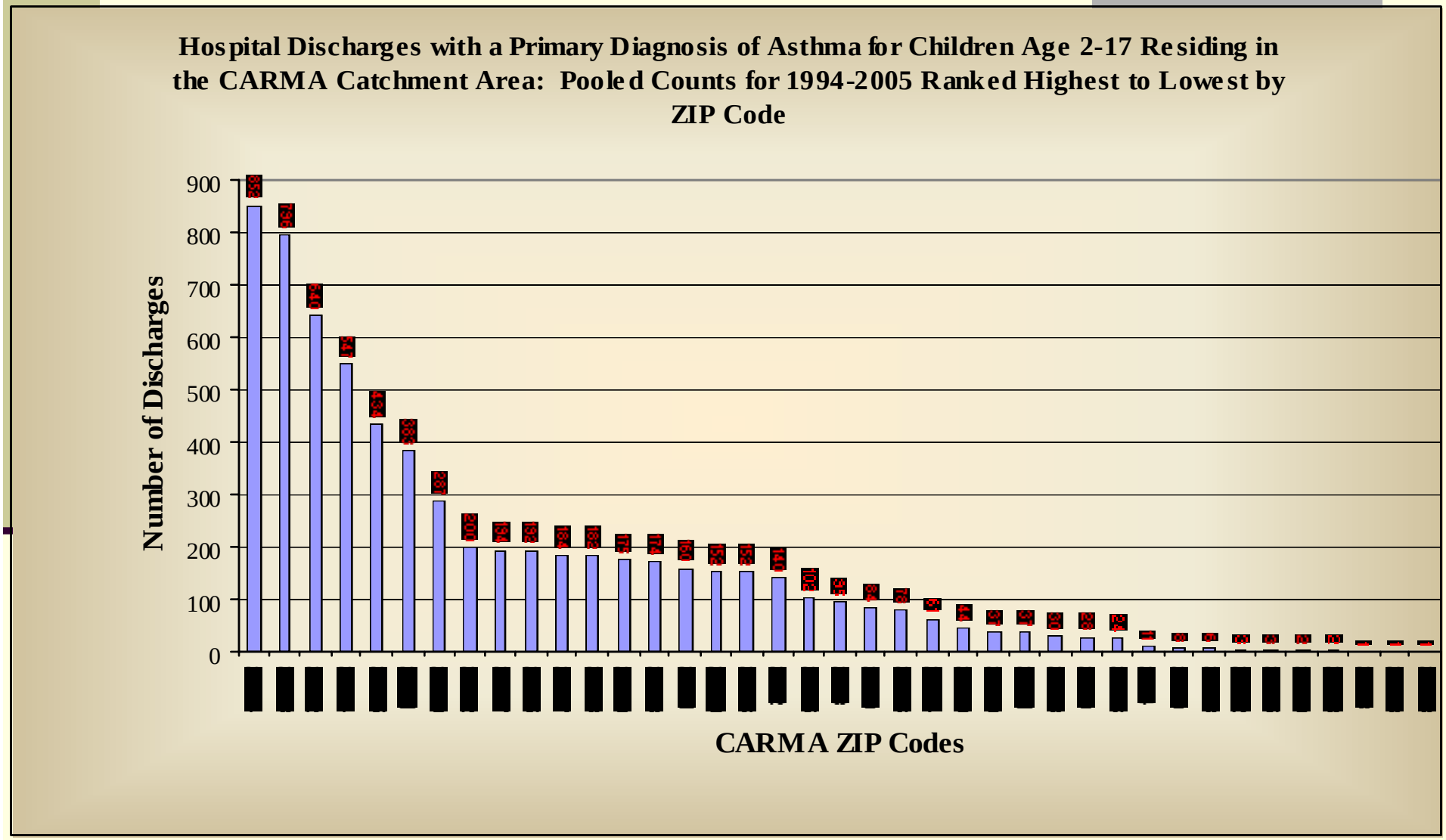
Group	Mean LOS (95% CI)	Mean Days Between D/C (95% CI)	Mean No. of D/C (95% CI)
CARMA (n=96)	3.4 (2.7-4.0)	13.3 (11.4-15.3)*	4.0 (3.6-4.4)†
Comparison (n=70)	2.5 (1.9-3.1)	11.8 (9.4-14.1)*	4.2 (3.3-5.0)
Virginia (n=361)	3.1 (2.9-3.4)	11.9 (10.9-13.0)*	4.5 (4.1-4.5)†

*Higher than total multiple D/C group (p<.05) † Lower than total multiple D/C group (p<.05)

Residential ZIP Code and Multiple Admissions

- 75% of Children with multiple admissions in the CARMA area live in 9 Postal ZIP Codes
- These same 9 ZIP codes had the highest total admissions for the 1994-2005 period

Concentration of Pediatric Asthma Hospitalizations by Residential ZIP Code of the Patient, 1994-2005



How this Information was Used

- To guide implementation plan:
  - Begin interventions for highest risk population in zip codes with highest rate of discharges and multiple admissions
  - Concentrate most intensive interventions in those zip codes:
    - Case management services
    - Academic detailing for physicians

Limitations

- Missing individual identifiers
- Cohort bias, more likely to observe multiple admissions in children followed for more years
- Likelihood that multiple asthma admissions is correlated within persons and groups across times:
  - Can inflate confidence intervals.
  - Subsequent analysis will address this issue.

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