Vaccine-Preventable Diseases in Colorado's Children, 2005

James Todd MD and Carl Armon MSPH

Vaccines have been highly effective and very safe in Colorado having had a dramatic effect on reducing vaccine-preventable diseases such as diphtheria, tetanus, polio, measles, mumps, rubella, smallpox, and *Haemophilus influenzae* disease. For every one possible severe event reported in Colorado children in 2002-2003, vaccines prevented an estimated 4,000-8,000 severe vaccine-preventable illnesses. The 2002 and 2003 National Immunization Survey ranked Colorado 50th, and in 2004, 44th compared to other states in vaccinating its children. For some diseases, current vaccination rates in Colorado (e.g. pertussis, influenza) are not sufficient to prevent high rates of disease. Although immunization laws require complete vaccination by the time a child enters school, only 76% of Colorado children can be documented to have had all their vaccines. Even so, the greatest risk for many of these diseases is still in young infants and children under two years of age. For pertussis, varicella, influenza, *Streptococcus pneumoniae*, and *Haemophilus influenzae*, there were over $8 million of hospital charges for severe disease associated with these infections in Colorado children in 2004, with significant impact in both the public and private sectors. The odds of getting a VPD are 2.0 times more for children in Colorado with Medicaid/SCHIP or no coverage than for private insurance. Developing systems that assure timely access to vaccines for all children will be critically important, especially during the first 2 years of life, when children are at the highest risk of these diseases.
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Introduction

The Centers for Disease Control ranks vaccination as one of the top ten most effective public health measures in the last 100 years, and yet the 2002 and 2003 National Immunization Surveys (NIS) ranked Colorado as the worst of 50 states in overall childhood vaccination rates with some improvement to 44th in 2004. This ongoing analysis was undertaken to identify the consequences and risk factors associated with these illnesses.

Summary of Methods

The data sources and methods are summarized in previous yearly summaries (VPD in Colorado 2003, 2004)

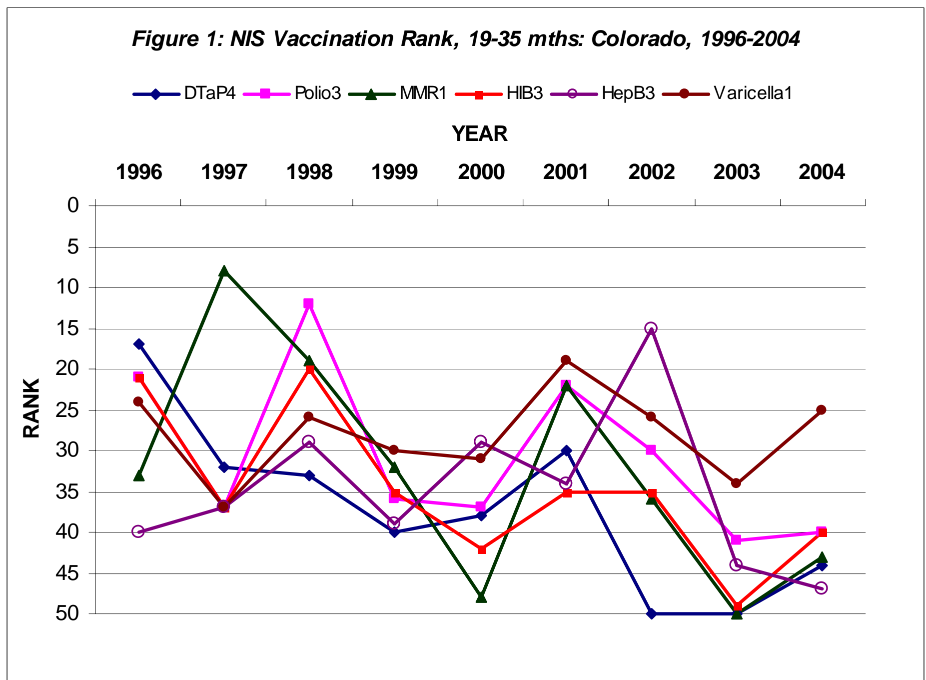
Results

Vaccines are highly effective. Previous summaries have shown the effect of vaccines on several of these diseases in Colorado from 1920-2002. Vaccines have reduced the incidence of many common and often fatal childhood infections by >99% in the United States. Similarly, the introduction of vaccines in Colorado has had a dramatic effect on reducing vaccine-preventable diseases such as diphtheria, tetanus, polio, measles, mumps, rubella, smallpox, and *Haemophilus influenzae* meningitis. If these vaccines were not routinely used, Colorado could expect more than *70,000* cases of vaccine preventable infections (DTP, MMR, Polio) in children per year (based on the assumptions that 22% of the population are children and that 75% of these diseases primarily occur in children).

Vaccines are very safe in Colorado. Severe adverse events to FDA-approved vaccines are very rare. As shown in Colorado data in 2002 and 2003 there were only 26 "severe" adverse events in children (resulting in hospitalization) reported to VAERS, resulting in no deaths as compared to thousands of illnesses prevented. For every one possible severe event reported, vaccines prevented an estimated 4,000-8,000 severe vaccine-preventable illnesses in Colorado children in 2002-2003.

Although some advocate against the use of vaccines, claiming their alleged role in the causation of various adverse events including asthma, autism and other neurological conditions, a rigorous review of evidence does not validate these hypotheses. As an example, a recent, thorough review by the Institute of Medicine concluded that "the body of epidemiological evidence favors rejection of a causal relationship between thimerosal-containing vaccines (and/or MMR) and autism" (Immunization Safety Review: Vaccines and Autism http://www.nap.edu/catalog/10997.html).

In spite of proven efficacy and safety, the 2004 National Immunization Survey (NIS) has ranked Colorado as 44th of 50 states in childhood overall vaccination rates. By 19-35 months of age, children should have received the following vaccine doses: 4 diph-



theria, pertussis, tetanus (DTP); 3 polio; 1 measles, mumps, rubella (MMR); 3 *Haemophilus influenzae* (Hib); and 3 hepatitis B. Colorado ranked the 44th (63%) of all states in 2004 in meeting this important 4:3:1:3:3 goal with an overall up-to-date . Although this low ranking in recent years may, in part, have been exaggerated by vaccine shortages, and Colorado has improved from its 50th ranking in 2002 and 2003, Colorado has consistently ranked in the bottom half of states for most vaccines since 1996 (Figure 1, page 1).

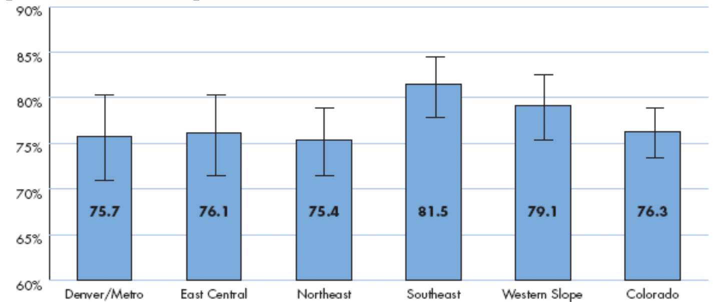
Additional evidence that the NIS rankings are, at the least, relative if not absolute indicators of the vaccination status of Colorado children include the results of a series of HEDIS audits of the vaccination status of Colorado children covered by Medicaid (Table 1) in 1999, 2001,and 2002. HEDIS reports document that children enrolled in Colorado's Unassigned Fee-for-service (UFFS) program compared to the PCPP program and HMO program are the least likely to have a visit with a primary-care physician, the least likely to receive preventive health care, and the least likely to be fully immunized [*Berman S, Armon C, Todd J. Impact of a decline in Colorado Medicaid managed care enrollment on access and quality of preventive primary care services Pediatrics 2005;116(6):1474-9.*]. In these surveys only 28.5% to 45.7% of two year old children without an assigned primary care provider had received 4 DTaP doses as compared to 76.2% in the Kaiser Medicaid managed care program. Vaccination rates worsened in 2002 for UFFS enrollees compared to 2001, perhaps because of shortages of DTaP. Compared to Kaiser Medicaid clients in 2001, UFFS clients had vaccination rates one and a half to three times lower, suggesting that it is not the patient but rather the system (or lack thereof) that most influences vaccination rates.

Based on the School Immunization Survey 2004-2005 of the Colorado Department of Environment and Health (http://www.cdphe.state.co.us/dc/immunization/schoolimmsurvey.pdf), at entry into kindergarten, 76.3 % of children were up to date for:

- **5 DTaP or 4 with the 4th on or after the 4th birthday**
- **2 MMR**
- **4 Polio or 3 with the 4th dose on or after the 4th birthday**
- **3 Hepatitis B**
- **1 Varicella or a history of disease**

One interpretation of the data suggests that this low rate is primarily due to poor documentation and/or lack of awareness or access to appropriate vaccines, not safety concerns.

Figure 2: Percentage of Children Up to Date at Kindergarten School Entry, by Region, School Survey 2004–2005 [Source: *CDPHE*]



Whatever the true vaccination rate in Colorado there is reasonable evidence that there are pockets of under-vaccination that may leave young children vulnerable to vaccine-preventable diseases.

Figure 3 : Age distribution of children hospitalized with vaccine-preventable diseases in Colorado, 2004. *[Source: CHA]*

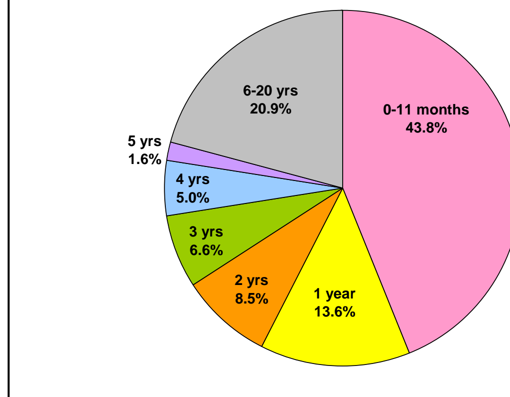


Table 1: HEDIS immunization rates for Medicaid enrollees in Unassigned Fee-for-Services for 1999, 2001, and 2002 as reported by the Colorado Department of Health Care Policy and Financing. [Data Source*: HCPF*]

Age 2 years	1999	2001	2002	Kaiser 2001
4:3:1:2:1	20.9%	33.8%	21.7%	66.2%
4 DTaP	31.9%	45.7%	28.5%	76.2%
1 MMR	49.4%	58.4%	62.0%	92.9%
3 OPV or IPV	37.0%	54.3%	60.1%	85.2%
2 HiB	36.7%	48.9%	50.4%	86.7%
3 Hepatitis B	29.9%	51.3%	53.5%	83.3%
1 VZV	33.6%	52.6%	55.5%	92.4%
Adolecents				
2MMR	29.7%	37.2%	44.0%	76.9%
1 Hepatitis B	21.4%	29.9%	35.3%	67.3%
MMR and Hep B	18.3%	26.3%	32.1%	61.5%
VZV	4.1%	11.4%	12.4%	57.7%

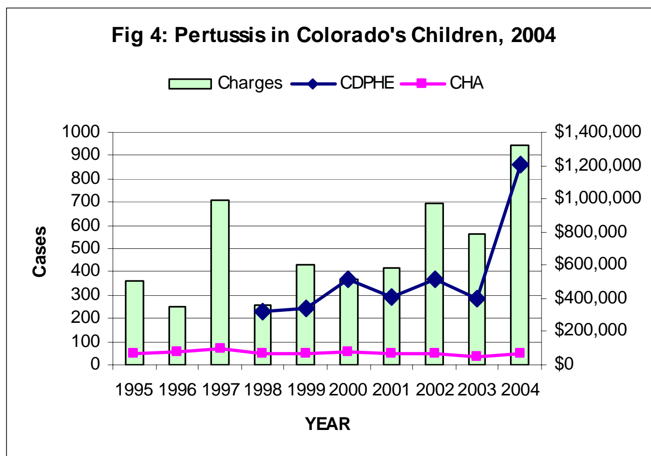
Delaying vaccination puts Colorado c hildren, especially the most vulnerable infants and young children, at risk for vaccine-preventable diseases and their complications. Figure 3 shows the age distribution of vaccine-preventable diseases in Colorado in 2004; over 60% of the cases occur in children under two years of age. This distribution showing the highest incidence of vaccine prevent-

able diseases in the youngest children holds true even if influenza cases are excluded. In addition these diseases are commonly more severe in the youngest children. As an example, fatality rates are highest for whooping cough in children under one year of age. Although school immunization laws may improve vaccination rates by the time a child gets to school, the greatest risk for many of these diseases is in young infants emphasizing the critical need for a system to assure timely vaccination of our youngest children and not waiting until they become school-age.

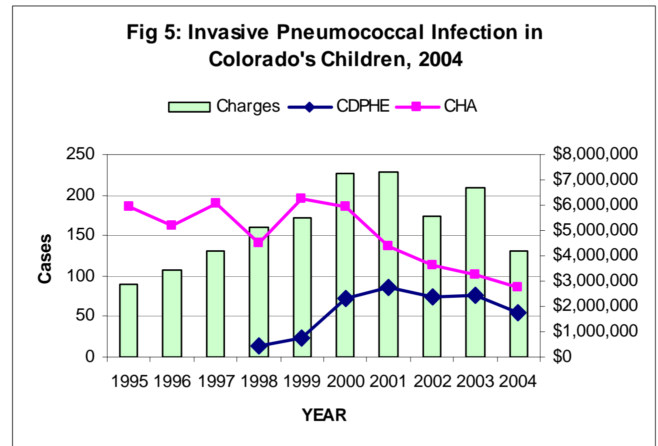
Reported NIS vaccination rates correlate with actual vaccine-preventable disease rates in Colorado (as vaccination goes up disease goes down). See VPD reports for 2003 and 2004.

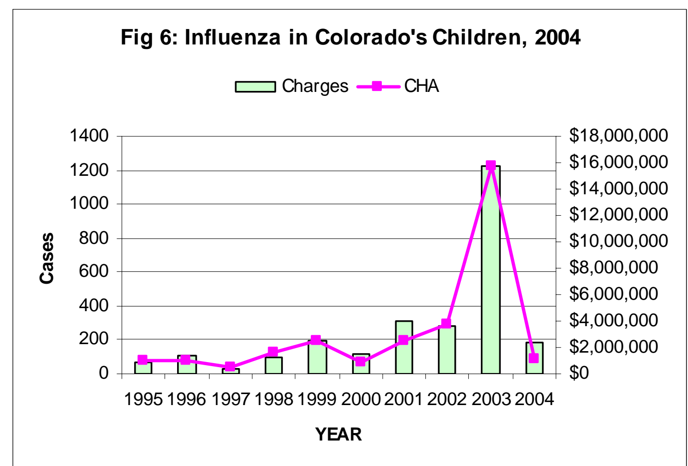
For some diseases, current vaccination rates in Colorado are not sufficient to prevent increasing rates of disease. Since 1920, vaccines have reduced the incidence of many common childhood diseases such as diphtheria in Colorado by 99% - especially those with rare external (imported) exposures; but those due to the more common, internal exposures (e.g. pertussis) and those diseases with vaccines that have not been widely implemented (e.g. influenza) continue to cause significant morbidity, mortality and cost. Even so, rare external exposures have caused outbreaks in Colorado children who haven't been vaccinated (e.g. diphtheria, measles).

Other diseases require on-going vigilance. Commensurate with Colorado's low NIS vaccination rates for pertussis, CDPHE data show a rising rate of whooping cough infection in children that is significantly higher and increasing faster than the rate for the entire United States (Figure 4). In 2004, Colorado had by far the greatest number of pertussis cases in many years. Many of these cases are in adolescents who may benefit from the recently approved Tdap booster vaccine.



Figures 5 and 6 show similar data for Colorado children with invasive pneumococcal infections and influenza. Pneumococcal infections have decreased commensurate with increasing vaccination rates. Even so hospitalization charges for children with pneumococcal infection still exceed $4 million per year. Although the 2004 influenza season was much milder than that of 2003, hospitalization charges still exceeded $2 million and the experience of 2003 shows the impact if (or when) a more virulent epidemic strain (e.g. avian influenza) emerges.





Besides the morbidity and mortality associated with vaccine-preventable diseases, delaying or not giving vaccines costs all the people of Colorado money. As shown in Table 2 (next page), for pertussis, varicella, influenza, *Streptococcus pneumoniae*, and *Haemophilus influenza*e, there was over $8 million in hospital charges for severe disease associated with these infections in Colorado children in 2004. The table actually underestimates the potential cost savings, since it does not include those hospitalized children with respiratory disease that can be attributed to influenza, or children with vaccine-preventable diseases who are not admitted to the hospital – in the case of influenza and pertussis this may be as much as ten to twenty-fold higher. Better immunization of children will also lead to less exposure of adults -- resulting in an even greater cost savings, and reduced work absenteeism. This has especially been shown for influenza and may be of great importance in mitigating the impact of influenza outbreaks in the US in the future. To be a reality, we must have access to appropriate vaccine and a system to quickly deliver it to Colorado's children.

Table 2: Cases and charges for hospitalized children in Colorado with vaccine-preventable diseases. [Source: *CHA*]

Vaccine	CDPHE 0-19 yrs	CHA	Total Charges	CHA Public Cases	Total Public Charges
Pertussis	861	51	$1,326,835	28	$1,039,093
Pneumococcal	54	85	$4,156,761	36	$1,505,374
Influenza	not reported	92	$2,333,098	39	$750,303
H. .influenzae	7	3	$302,559	2	$215,273
Varicella	1988	23	$278,286	11	$188,213
Total			$8,397,539		$3,698,256

As shown in Table 3, high benefit/cost ratios can be achieved by many recommended vaccines as estimated by the Institute of Medicine (http://www.iom.edu/report.asp?id=14451). Excess benefit ranges from 27-fold for DTaP to 1-fold for the pneumococcal conjugate vaccine.

Table 3: Benefit-cost ratios for selected vaccines [Source: *Financing Vaccines in the 21st Century. The National Academies Press, 2004*]

Vaccine	Benefit / Cost Ratio
DTaP	27.0
Hib	5.4
MMR	23.3
Polio (inactivated)	5.5
Perinatal Hepatitis B	14.7
Varicella	4.76-5.61
Hepatitis A	1.96
Pneumococcal conjugate	0.7-1.1

Vaccine-preventable disease occurs in all parts of Colorado, both urban and rural, and all social strata. The rate of VPD is higher in children who have publicly funded coverage than those with private insurance (Table 4). In fact, the odds of getting a VPD are twice as high for children in Colorado with Medicaid/SCHIP/None coverage than private insurance. Possible explanations for this observation include problems in access to care and/or delays in implementing the immunization schedule.

Table 4: Rates of hospitalization of Colorado children for VPD in 2004 (Data Source: *CHA, US Census*)

Insurance	Total VPD	Insurance Coverage	VPD Rate per 100,000
None/Govt. Insurance	114	384,610	29.6
Private Insurance	136	940,783	14.5

■ Summary:

There is a clear association between vaccine-preventable diseases and low vaccination rates in Colorado's children. This appears to be a state-wide issue. The hospital-related charges for treating these vaccine-preventable diseases in children run in the millions of dollars yearly, and significantly impact both the public and private sectors. The fact that Colorado compares poorly in its vaccination rates suggests that proven approaches might be effectively adopted from other states. Although requiring vaccinations prior to school entry ensures that most school-aged children are ultimately protected, most vaccine-preventable diseases occur prior to school age. ***Developing systems that assure access to vaccines for all children, as well as timely vaccination will be critically important, especially during the first two years of life, when children are at the highest risk of these diseases.***