

Vaccine-Preventable Diseases in Colorado's Children, 2006

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, chickenpox, *Streptococcus pneumoniae*, and *Haemophilus influenzae* disease. Vaccines are very safe; 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. Colorado has made progress in 2005 in vaccinating its children but still has not achieved the national goal of 90%. For some diseases, current vaccination rates in Colorado (e.g. pertussis, influenza, viral gastroenteritis) are not sufficient to prevent high rates of disease. Although immunization laws require complete vaccination by the time a child enters school, the greatest risk for many of these diseases is still in young infants and children under two years of age. For pertussis, varicella, influenza, viral gastroenteritis, *Streptococcus pneumoniae*, and *Haemophilus influenzae*, there were still over \$25 million of hospital charges for severe disease associated with these infections in Colorado children in 2005, with significant impact in both the public and private sectors. The odds of getting a VPD are 3.6 times more for children in Colorado with Medicaid/SCHIP or no coverage than for private insurance and VPD rates are higher in counties with a high percentage of children living under two times the Federal Poverty Level. Implementing 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. **SHCC, 2007;4(1):1-4**

Introduction

The Centers for Disease Control ranks vaccination as one of the top ten most effective public health measures in the last 100 years. To assure the maximum benefit of this most important preventive health resource, the national Childhood Immunization Initiative goal, as set in 1993, was “by 2000, [to] ensure that at least 90 percent of all two-year-olds receive the recommended series of vaccinations, and that a system is in place to sustain high immunization coverage.” Although the 2002 and 2003 National Immunization Surveys (NIS) ranked Colorado as the worst of 50 states in overall childhood vaccination rates, there has been some improvement in 2005 (Figure 1), although our State has yet to achieve the desired 90% benchmark. This ongoing analysis of Colorado data is undertaken to evaluate the progress, consequences and opportunities that exist in preventing vaccine-preventable diseases for Colorado’s children.

Summary of Methods

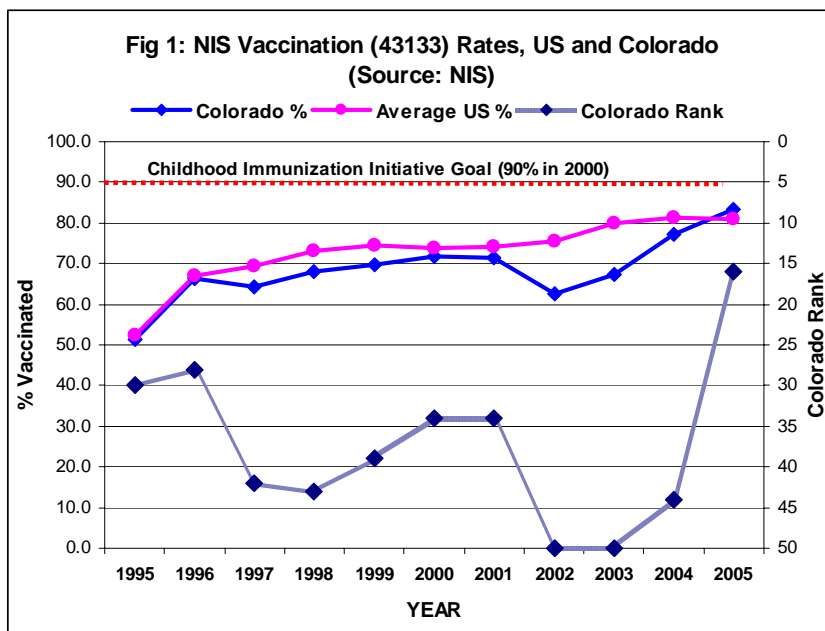
The data sources and methods are summarized in previous yearly reports (*Vaccine-Preventable Diseases in Colorado’s Children, 2003; 2004*).

Results

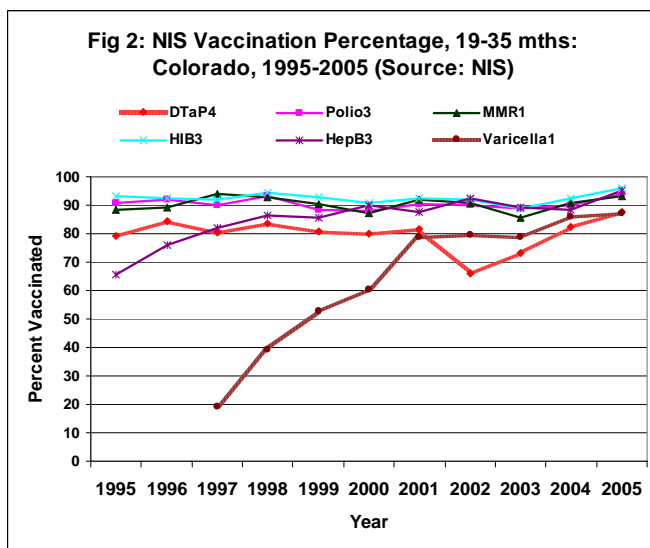
Vaccines are very effective in Colorado. Vaccines are highly effective having reduced the incidence of many common and often fatal childhood infections by >99% in the United States. Previous yearly summaries have documented the dramatic effect of vaccines on several of these diseases in Colorado from 1920-2002. The introduction of vaccines in Colorado had a dramatic effect on reducing vaccine-preventable diseases such as diphtheria, tetanus, polio, measles, mumps, rubella, smallpox, and, more recently, *Haemophilus influenzae* meningitis, pneumococcal disease and chickenpox. If these vaccines were not routinely used, Colorado could expect more than 70,000 cases of these infections in children per year (*Vaccine-Preventable Diseases in Colorado’s Children, 2003*).

Vaccines are very safe in Colorado. Severe adverse events associated with FDA-approved vaccines are very rare. As shown by Colorado data in 2002 and 2003 there were rare “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 (*Vaccine-Preventable Diseases in Colorado’s Children, 2003;2004*).

Although some advocate against the use of vaccines, claiming their possible 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>).



The 2005 National Immunization Survey (NIS) shows Colorado has made some improvement in vaccination rate but we still lag behind national goals. By 19-35 months of age, children should have received the following vaccine doses: 4 diphtheria, pertussis, tetanus (DTP); 3 polio; 1 measles, mumps, rubella (MMR); 3 *Haemophilus influenzae* (Hib); and 3 hepatitis B. As shown in Figure 1, Colorado has consistently ranked in the bottom half of states in the percentage of children with complete 4:3:1:3:3 coverage but made some progress in 2005 now ranking 16th. The rank is less informative than the absolute vaccination rate of 83.4% (estimated range 79.2-86.9%) still below the year 2000 target of 90%. If the highly effective chickenpox vaccine is included (4:3:1:3:3:1), Colorado had a predicted 2005 vaccination rate of 78.6%. Figure 2 suggests that our extremely low rankings in 2002 and 2003 in part may have been exaggerated by DTaP vaccine shortages but the overall ranking increase in 2005 compared to prior years, in all probability, has been due to some progress in awareness of the importance of vaccines and efforts to track and improve vaccination status.



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, 2004 and 2005.

Vaccine-preventable diseases occur in all parts of Colorado, both urban and rural but are more common in children living in poverty. Figure 6 (on page 4) shows the average VPD hospitalization rates in Colorado counties for 2004-2005. The rate of VPD is higher in Colorado children who have public or no health insurance coverage than those with private insurance (Table 1). In fact, the odds in 2005 of being hospitalized for a VPD are 3.6 times higher for children in Colorado with Medicaid/SCHIP/None than private insurance. The strongest correlate of the incidence of VPD in Colorado counties with populations > 5,000 children < 18yrs of age is the % of children in that county in families with incomes less than two times the Federal Poverty Level (p=0.004). Possible explanations for this observation include lack of insurance, lack of access to care givers, and/or delays in implementing the immunization schedule.

Evidence that the NIS rankings may not reflect gaps in 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 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.

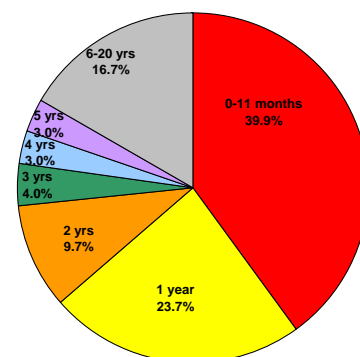
Table 1: Rates of hospitalization of Colorado children for VPD in 2005 (Data Source: CHA, US Census)

Insurance	Total VPD	Insurance Coverage	VPD Rate per 100,000
Public/No Insurance	90	422,089	21.3
Private Insurance	60	1,015,514	5.9

Vaccination timing is important.

Delaying vaccination puts Colorado children, 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 2005; almost two thirds of the cases occur in children under two years of age. This distribution showing the highest incidence of vaccine preventable 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.

Fig 3: VPD hospitalizations of Colorado Children in 2005, including influenza and rotavirus (Source: CHA)



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, rotavirus) 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).

CDPHE data show the 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 2005, Colorado had 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.

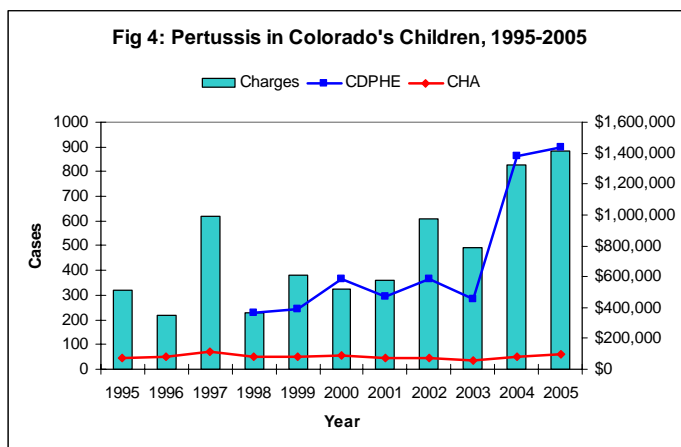
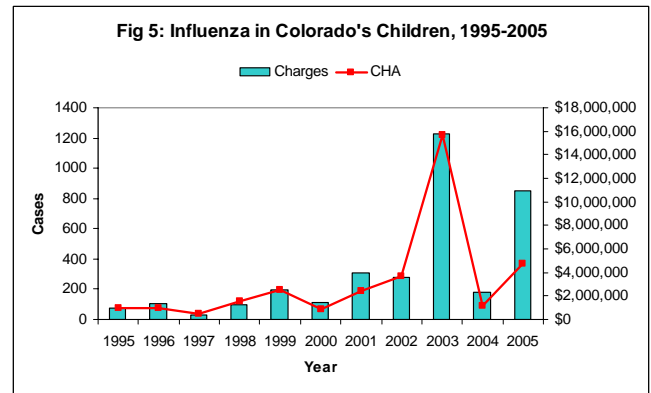


Figure 5 shows similar data for Colorado children with influenza. Although the 2004 and 2005 influenza seasons were much milder than that of 2003, hospitalization charges still exceeded \$9 million in 2005 and the experience of 2003 shows the impact if (or when) a more virulent epidemic strain (e.g. 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, for pertussis, varicella, influenza, viral gastroenteritis, *Streptococcus pneumoniae*, and *Haemophilus influenzae*, there was over \$25 million (\$12 million in public support) in hospital charges for severe disease associated with these infections in Colorado children in 2005. 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 vaccine and a system to quickly deliver it to Colorado's children.

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.

Vaccine	CDPHE Reportable 0-19yrs	CHA Hospitalized 0-20 yrs	CHA Hospitalized Charges	CHA Hospitalized Public Cases	CHA Hospitalized Public Charges
Pertussis	901	61	\$1,415,174	42	\$762,568
Pneumococcal Disease	71	71	\$3,849,767	35	\$1,900,092
Influenza	268	367	\$9,618,008	203	\$4,905,408
H.influenzae	13	3	\$156,572	1	\$49,693
Varicella	1746	13	\$170,918	9	\$120,560
Viral Gastroenteritis	not reported	881	\$9,967,938	403	\$4,639,725
Total Charges			\$25,178,377		\$12,378,046

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

New vaccines can further reduce the rate of VPDs in Colorado.

Besides the recommended Tdap booster in adolescence, other opportunities for preventing disease in older children include the meningococcal vaccine and the human papillomavirus vaccine (HPV). The new rotavirus vaccine shows great promise in reducing hospital morbidity and mortality especially in young children.

System improvements are also necessary to reduce the rate of VPDs in young children. Since many of the most effective vaccines must be given in the first year of childhood, a more efficient and effective early delivery system is essential. There are an estimated 140,000 uninsured children in the Denver Metro area – half are eligible but not enrolled in Medicaid/CHP+. The majority of children who are enrolled are in the Unassigned-Fee-For-Service (UFFS) program and do not necessarily have a regular source of

primary care and/or vaccination. Implementing statewide newborn enrollment, vaccination registration and a reminder-recall program via the Colorado Immunization Information System (CIIS) could improve vaccination rates and simultaneously could provide information to parents about the importance of (and access to) primary preventive care for their children.

■ **Summary:**

There is clear evidence in Colorado of the safety and efficacy of vaccines in preventing many severe childhood illnesses. Although progress has been made in the past several years in improving vaccination rates, Colorado still has not met the national target of 90%. There remains a disparity in vaccinating our youngest and poorest children. The hospital-related charges for treating these vaccine-preventable diseases in children still runs in the tens of millions of dollars yearly, significantly impacting both the public and private sectors. 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. Implementing 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. Such systems may have the added benefit of educating families about the importance of and access to primary preventive health care.

Fig 6: Average VPD Hospitalization Rates by County, 2004-2005

