COLORADO CHILDREN'S IMMUNIZATION COALITION

State of the State's Immunizations

A Report on Colorado's Vaccine Protection for Its Communities

SEPTEMBER 2017

Dear Coloradans,

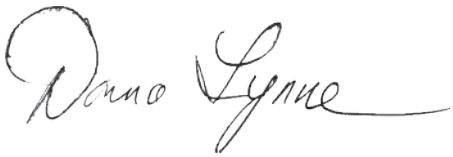
This is the first comprehensive effort to examine how vaccines are providing protection to our communities, families and children, and the immunization systems and policy that have shaped our successes and challenges in Colorado since the 2005 Colorado Health Institute whitepaper.

Anyone who works to increase the protection and safety of our communities and our children has seen substantial changes to Colorado's vaccination outlook. If we look back 15 years, we were among the states with the worst vaccine coverage rates. Now, we are above the national average and improving. Even so, we need to continue to address issues, including the fact that more than 50,000 children do not get immunized on time. We need to continue to trust and support our legislators, public health officials, our doctors, nurses and practitioners, and parents. They recognize the value of vaccines both for protecting our children and families as well as their economic and social value to keep Coloradans safe and productive.

This report is the result of a collaboration of Colorado experts in immunization data, delivery, policy, and advocacy who spent countless hours to provide us with an assessment of the importance of vaccination for public health. It offers insight on the status of immunization coverage and disease risk, as well as the interconnectedness of barriers, systems and policies that impact these outcomes in Colorado.

The Colorado Department of Public Health and Environment has, for the first time, publicly released school and child care-level immunization data on close to 1 million children. This new level of data accuracy and transparency is essential for guiding efforts to address the immunization challenges that still threaten the health of our communities, including gaps in coverage that exist in both rural and urban areas. Additionally, parents and the public now have a tool to better inform their decisions, including considering the level of vaccine coverage as a factor in their choices for child care or schooling.

Thank you to those who have worked on this initiative to spotlight an issue so important to the foundation of our public health system. As a public health advocate, I encourage you to reflect on the many gains and successes achieved in the past ten years, as well as the opportunities ahead of us to better protect our community members from unnecessary illness and related consequences.



Lieutenant Governor Donna Lynne
State of Colorado

Increasing numbers of Coloradans are safeguarding the health of their families and communities by vaccinating their children, although the state still falls short of recommended coverage levels and pockets of unvaccinated and undervaccinated populations are at risk for outbreaks of vaccine-preventable diseases.

Childhood vaccines are a safe and effective tool to prevent the spread of disease and keep children healthy as they grow. Vaccines are widely considered one of the most successful and cost-effective public health interventions – second only to clean water. Their introduction in the second half of the 20th century has prevented millions of cases of disease and saved countless lives.

Fifteen years ago, Colorado noticeably lagged behind the national average in vaccine uptake. Since then, the state has made considerable progress in improving vaccination rates, collecting and analyzing data to identify high-needs areas, and toward enacting stronger policies to encourage vaccinations. Colorado now exceeds the national average for children who are up to date on all recommended vaccines.

Despite progress, there is still much room to improve. Infectious diseases remain a source of illness and hospitalization, particularly for Colorado's youngest and most vulnerable populations. Colorado's current vaccination coverage levels fall short of the targets set by the U.S. Department of Health and Human Services' Healthy People 2020 goals for health promotion and disease prevention. Additionally, Colorado remains among the states with the highest rates of non-medical exemptions for vaccines.

The amassed public health success of vaccines relies on a variety of factors, including adequate support and funding, sound public policy, improved access to vaccination, a committed health and education sector, and community trust and confidence in the safety and importance of vaccination. Just like widespread vaccination programs have dramatically reduced the incidence of once-devastating illnesses, we too have the power to ensure all Colorado children get the healthy start they deserve.

Key Highlights

The benefits of vaccination are staggering. For each cohort of babies born in Colorado, vaccination saves 652 lives, prevents 310,608 cases of disease, and averts $1.07 billion in direct and indirect costs.

The health and economic costs of vaccine-preventable diseases are significant in Colorado. Recent and current outbreaks and investigations of measles, mumps, Hepatitis A and influenza (flu) have resulted in avoidable emergency room visits, hospitalizations and millions of dollars in healthcare costs. In 2015 alone, hospital and emergency department charges to treat children in Colorado for vaccine-preventable diseases totaled $35 million.

New data show that immunization rates vary widely across the state. Coverage has dropped to worrying levels in some counties, schools and child care facilities, leaving children and other vulnerable individuals exposed to dangerous and potentially life-threatening diseases. In 13 counties, less than half of children are up to date on routine immunizations. More than 57,000 students attending K-12 schools and over 8,000 children enrolled in licensed child-care facilities across the state are not up to date on required immunizations.

Variation in immunization rates is also visible within school districts. For example, in Loveland's Thompson R2-J School District, up-to-date student vaccination rates vary from 34 percent in one school

to 98 percent in another.

Vaccine financing and delivery in Colorado is complex and many healthcare providers face payment, logistical, and patient communication barriers. Even so, research indicates medical providers remain the most important influence on a parent's decision to vaccinate while a strong provider recommendation increases vaccination uptake.

Colorado's lenient non-medical exemption policies present a risk to children and communities. Colorado is one of only 18 states that allows parents to exempt their children from immunizations required for school and childcare for philosophical or personal belief reasons. Requiring only a parent signature, the state also has one of the most lenient methods for claiming such exemptions. Consequently, Colorado has consistently had one of the highest non-medical exemption rates in the nation with over 95 percent of exemptions at K-12 schools submitted for non-medical reasons. Charter and Waldorf schools make up nearly one-third of the 20 schools with the highest exemption rates in the state.

The Colorado Immunization Information System (CIIS) serves as the mainstay to the state's immunization infrastructure. In addition to allowing healthcare providers to adequately document and track immunizations and determine which immunizations are needed at office visits, the registry is an essential tool for outbreak investigations and disease surveillance.

VACCINE SCHEDULE

The Centers for Disease Control and Prevention (CDC) sets immunization schedules based on recommendations from the Advisory Committee on Immunization Practices (ACIP), a nonpartisan, unpaid group of medical and public health experts. ACIP uses the most recent scientific data to continuously review the schedule and make recommendations for administering vaccines. The childhood schedule is also approved by the American Academy of Pediatrics and the American Academy of Family Physicians (see Table A). Each vaccine's dose timing is determined by two factors: 1) At what age is a person most at risk for the disease? 2) At what age will the immune system respond best to the vaccine? Also among these factors for consideration are the severity of disease, vaccine safety, and how many children will get the disease if a vaccine is unavailable. By sticking to this schedule, parents can ensure their children have optimal and timely protection from diseases.

TABLE A.[1] List of Recommended Vaccines for Adults and Children and Diseases They Prevent

Diseases Prevented by Vaccines	Vaccines
Tetanus, Diphtheria and Pertussis (Whooping Cough)	DTaP, Tdap, DT and Td
Hepatitis A	Hep A
Liver cancer, cirrhosis	Hep B
Haemophilus influenzae B (Hib) (Meningitis, pneumonia, blood infections)	Hib
Cervical cancer, oral cancer	HPV
Influenza hospitalizations and death	Flu
Measles, Mumps and Rubella	MMR
Meningococcal (meningitis, blood infections)	MCV4, MPSV4 and MenB
Pneumococcal (pneumonia, meningitis, blood infections)	PCV13 and PPSV23
Poliomyeltitis (Polio)	Polio
Rotavirus (severe diarrhea)	Rotavirus
Varicella (Chicken pox)	Varicella

Section 1: Why Vaccinate? The Costs of Inaction

Vaccine-preventable diseases (VPDs) are illnesses that are common and dangerous enough to cause serious illness, disability, and even death, and can be combated with an effective vaccine.

The choice to avoid immunization carries health, economic, and social consequences. When parents choose to skip vaccinations for their children, the choice affects the individual child, their families, and entire communities, particularly those who cannot be immunized or have weakened immune systems.

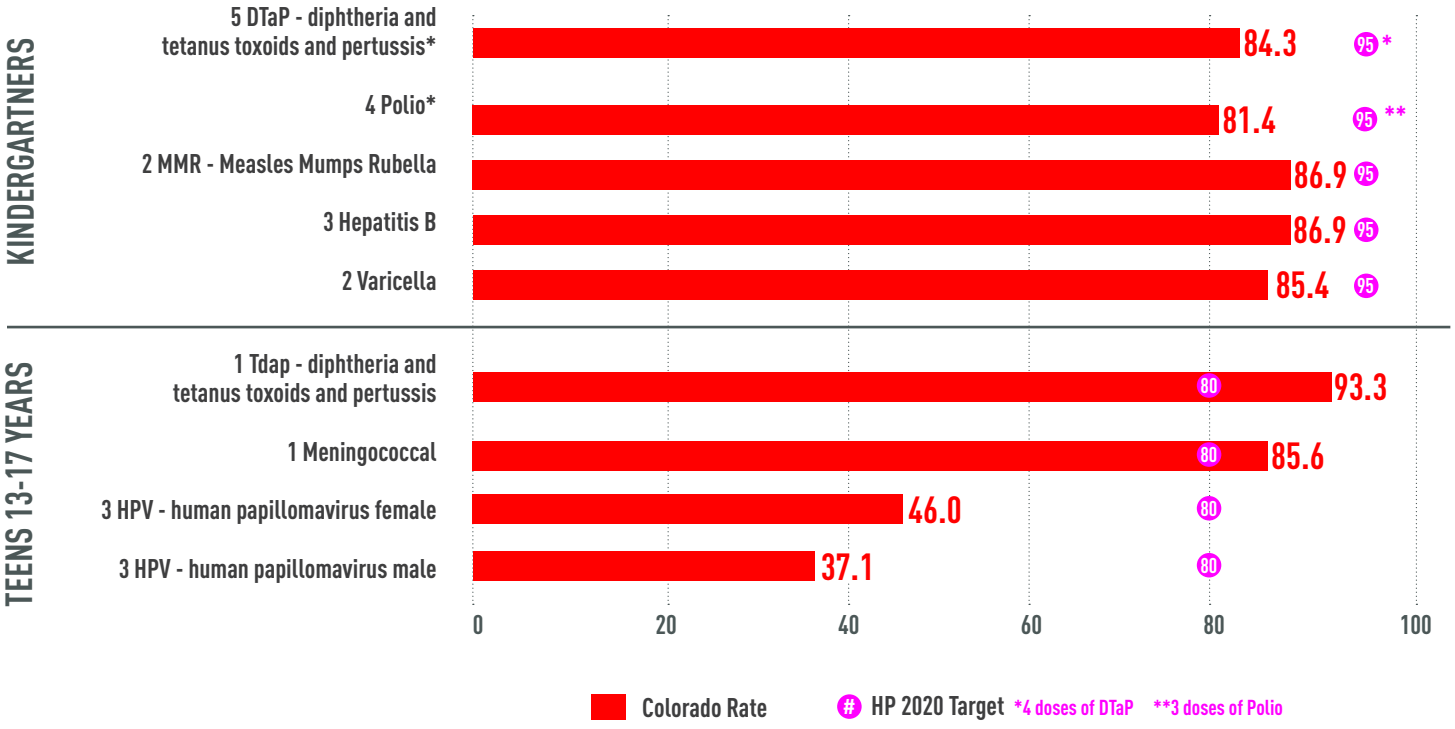
Community Protection

The concept of community protection — the incremental level of protection that is gained when a high proportion of people in a specific area are vaccinated — is central to understanding how Colorado is performing on immunization goals.

When enough people in a geographic area are immunized and protected against any given disease, they make it unlikely that a disease can enter and spread in their community. In addition, these high levels of vaccination can provide a shield for those who cannot be vaccinated for medical reasons or because they are still too young to receive vaccines. This is also known as community immunity or herd immunity.

The percentage of the population that must be vaccinated to achieve community protection varies for each disease, but meeting the highest thresholds means almost complete resistance against outbreaks. The federal government's Healthy People 2020 goals take community protection into account when setting target levels. Vaccine coverage in Colorado, like most states, falls short of these goals (see Figure A).

FIGURE A.[2] Vaccination Rates Compared With Healthy People 2020 Goals



Source: 2015 Colorado National Immunization Survey and Kindergarten Immunization Survey.
*Colorado rates reflect a different dose series than the Healthy People 2020 targets (5 vs 4 doses for DTaP, 4 vs 3 doses for polio)

Vulnerable Populations

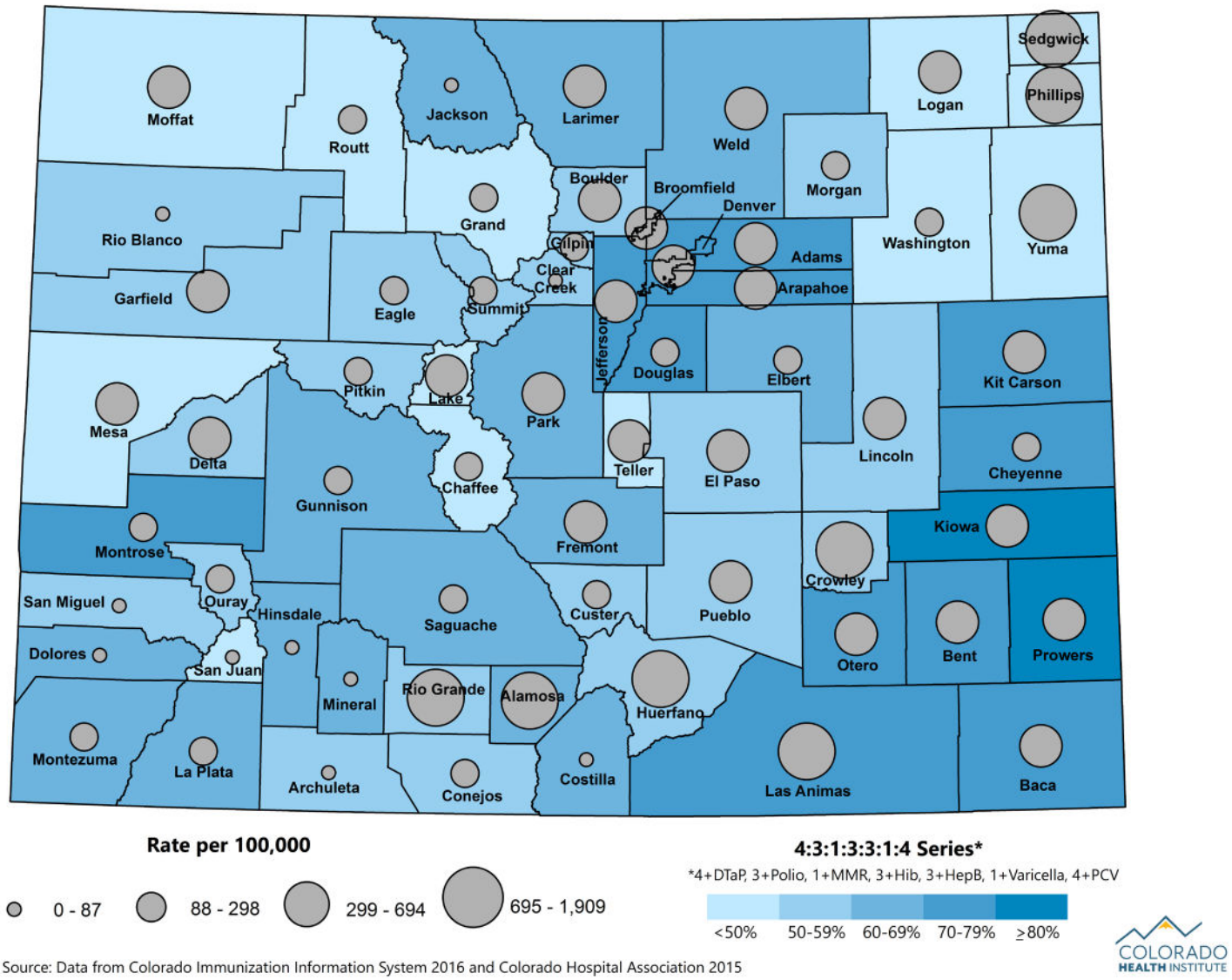
Some children cannot be vaccinated because of conditions or diseases that compromise their immune system, such as cancer. These kids are at higher risk of vaccine-preventable diseases. Infants too young to be fully vaccinated are also at higher risk. If, for example, a measles outbreak were to occur in counties with MMR vaccine coverage below the community protection threshold, these children will be at even higher risk of serious complications or even death.

Vaccine-Preventable Diseases Threaten Communities Statewide

Colorado has seen spikes in different vaccine-preventable diseases in the past six years, with cases popping up in communities where vaccination coverage is too low to protect against an outbreak (see Map A).

Despite near elimination of measles in the United States, recent outbreaks demonstrate measles still poses a real and significant threat to communities globally and nationwide, including Colorado.

MAP A. County-Level Immunization Rates Per 100,000 Children Age 19-35 Months and Vaccine-Preventable Disease Rates Per 100,000 Children Age 0-17 Years



Source: Data from Colorado Immunization Information System 2016 and Colorado Hospital Association 2015

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An unvaccinated Colorado child returned from a trip abroad in July 2016 and came down with measles, prompting an intense public health response that helped keep the case from mushrooming into an outbreak.[3] The Denver area's Marshallese community experienced a mumps outbreak early this year that grew to 47 cases — much higher than the six or so total cases Colorado sees in a typical year (see below). The most recent flu season also resulted in over 3,300 hospitalizations and two pediatric deaths in Colorado. An outbreak of pertussis, or whooping cough, peaked in 2012 and 2013, with more than 1,400 annual cases — the highest level since the 1950s. Although annual cases dropped to approximately 600 by late 2016, this number is still elevated compared with historic norms.[4] Further, the Front Range is currently experiencing a rise in hepatitis A infections, with 56 cases across 14 counties as of Sept. 1.[5] That's more cases by late spring than the state sees in an average year, and almost all cases reported being unimmunized.

Mumps on the Rise in the Denver Metropolitan Area

A mumps outbreak struck a Denver area early in 2017, concentrated mostly in the Marshallese community. Mumps is a highly contagious viral disease which most often causes swollen and painful cheeks and, in rare cases, testicular and brain inflammation. Although there is no treatment for mumps, the measles-mumps-rubella (MMR) vaccine prevents up to 88 percent of mumps infections after two doses.

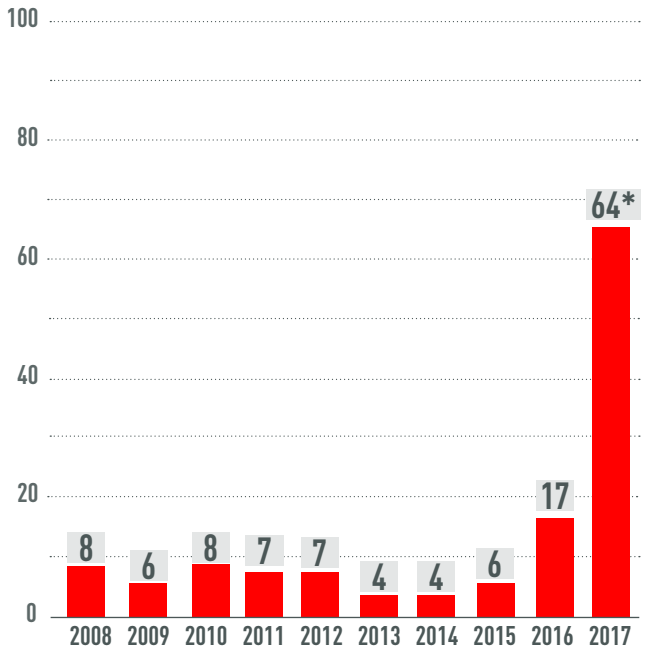
Many people in the affected community had not been vaccinated due to inadequate access to health care. However, workers from the local public health agency, Tri-County Health Department (TCHD), found that community members were generally open to vaccination.

Public health officials identified 47 cases of mumps linked to this outbreak. Historically, Colorado sees only six or so cases a year. Patients ranged in age from three months to 44 years, with a median age of 20. Seventy-two percent of the cases reported no or unknown prior mumps vaccination and had no MMR vaccination documented in the Colorado Immunization Information System.

In response, public health partners spread the word about mumps, the MMR vaccine, and vaccination clinics through social media, churches and Marshallese-language radio.

To control the outbreak, TCHD, in coordination with Colorado Department of Public Health and Environment (CDPHE) and Denver Public Health, organized four MMR vaccination clinics at Marshallese churches over the course of six weeks, and 118 people received the vaccine — 104 of whom had no prior vaccine documentation. After the church-based MMR vaccination clinics, cases in the community declined rapidly, suggesting that prompt control measures within the target population aided in curbing the outbreak.[7]

FIGURE B.[6] Mumps cases in Colorado: 2008–2017



*As of April 25, 2017

Economic Costs

Outbreaks carry health costs as well as economic costs. Hospitalizations, emergency department visits, and additional indirect, societal costs from vaccine-preventable disease inflict a significant economic burden for parents, businesses, taxpayers and the overall economy.

Hospital and emergency department charges to treat children with vaccine-preventable infectious diseases totaled more than $35 million in 2015. Influenza alone accounted for 369 hospitalizations and 4,045 emergency department visits among Colorado children in 2015, resulting in more than $25 million in charges.[8]

Even when an exposure does not result in transmission, the cost of investigation and prevention can amount to tens of thousands of dollars.

Research shows that the individual and societal costs for a single case of measles, including public health interventions, doctor visits, hospitalization and productivity losses, can quickly add up, totaling over $83,000 per case.[9]

THE ECONOMIC SAVINGS OF VACCINATING

As a result of vaccines, for every 69,135 babies born each year in Colorado[10]:

652 lives are saved

310,608 cases of disease are prevented

$211 million in direct costs are saved

$1.07 billion in direct and indirect (societal) costs are avoided

For the July 2016 measles case mentioned previously, Tri-County Health Department conducted a cost analysis of the time and effort of public health and hospital personnel involved in the investigation and the cost of prophylactic medication and vaccines. The cost estimate for this single measles case was just under $50,000, not including any direct medical costs for the care of the child with measles, according to TCHD.

Section 2. Immunizations in Colorado

As recently as 2002, Colorado ranked as one of the worst states for childhood immunization coverage. The state now ranks slightly above average for children 19 to 35 months who have received all their recommended vaccines.[11]

Uneven Progress

Colorado has made great progress in the past 15 years, but that progress has not been consistent across the state, demonstrated by gaps in coverage at the county and school levels. Colorado is still not meeting vaccine coverage targets needed to best protect its population.

The state has a lot of work to do to meet the Healthy People 2020 goals (See Table B). While most other states also fall short of the goals, strong strategies and policies can put the goals within reach for any state.

The Problem of Underimmunization

Underimmunized children are missing at least one vaccine dose required to be considered up to date on recommended vaccines. The recommended vaccine series for children aged 19-35 months — sometimes referred to as the 4:3:1:3:3:1:4 series* — includes four doses of DTaP, three doses for polio (IPV), one dose for measles/mumps/rubella (MMR), three doses for hepatitis B, the full series of Haemophilus influenzae type B (HiB), one dose of varicella and four doses of pneumococcal conjugate vaccine (PCV).[12] Children who miss one or more doses are potentially vulnerable to the harmful infectious diseases that these vaccines prevent.

Data have shown that about one in four Colorado children is underimmunized, and several regions of Colorado have pronounced problems with underimmunization. In 17 of the state's 64 counties, less than half of the children were up to date on their routine vaccinations in 2015. The significance of these delays in immunization and children being underimmunized become relevant as two of every five hospitalizations from vaccine-preventable diseases occur in children under 4 years of age. [13]

2016-2017 School and Child Care Immunization Coverage

Recent state legislation and subsequent Board of Health rulemaking requires all K-12 schools — public, private and parochial — as well as licensed child care facilities, Head Starts, and preschools that enroll 10 or more students to report immunization data to CDPHE annually.

These data were reported in December 2016 for the first time and made public in June 2017, offering an unprecedented look at local variations in vaccine coverage in Colorado. More than 86 percent of schools and 75 percent of child care centers and preschools that were expected to report to CDPHE did so. Colorado now has school and child care immunization status data for nearly 1 million children.[14]

The data put a spotlight on disparities between school types, with public schools outperforming private schools in both immunization rates and reporting of data. Ninety-two percent of public schools reported data compared with only 42 percent of the private schools that were expected to report.

TABLE B. Immunized Children Ages 19 – 35 Months in the United States and Colorado Vaccine Series for Children 19-35 Months.

	2011	2012	2013	2014	2015
United States	68.5	68.4	70.4	71.6	72.2
Colorado	65.7	71.7	69.2	72.8	75.4
HP 2020 Goal	80	80	80	80	80

* 4:3:1:3:3:1:4 series Includes 4 DTP, 3 Polio, 1 MMR, 3 Hib, 3 Hep B, 1 Varicella and 4 PCV

Source: National Immunization Survey, 2011-2015.

The average up-to-date rate among students for vaccines required to attend K-12 schools ranges from 89.9 percent to 94.8 percent, depending on the vaccine. Despite these coverage rates, 57,366 Colorado K-12 students were considered not up to date for the 2016-2017 school year.

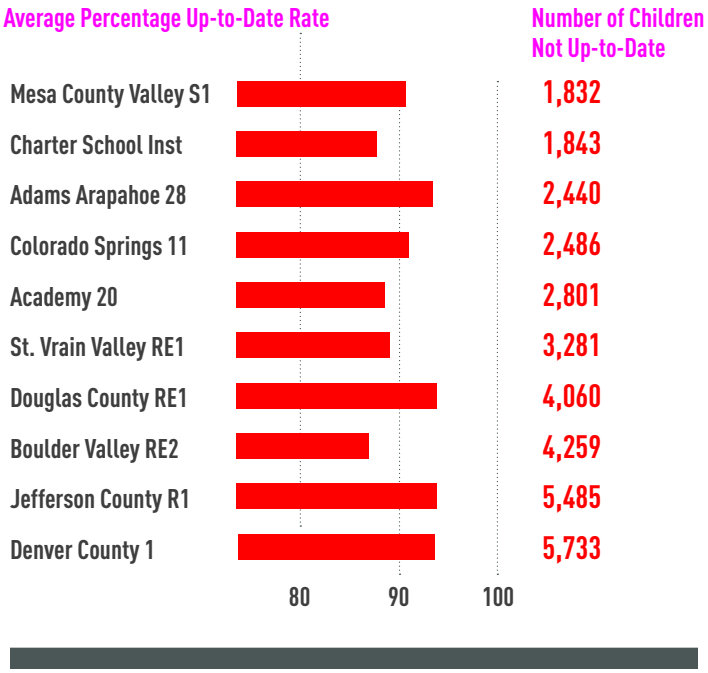
Figure C shows the districts with the largest number of students not up to date and their respective average up-to-date coverage rates.

Some districts, such as in Boulder and Colorado Springs, struggle with incomplete vaccinations.

Boulder Valley RE2's enrollment of 30,385 is only about one-third of the size of both Denver County 1 (85,343) and Jefferson County R1 (83,843). Yet, the number of Boulder students behind on their vaccines approaches the same numbers for each of those larger districts.

Additionally, Academy 20 (24,646) and Colorado Springs District 11 (26,406) have a combined public enrollment of about two thirds that of Denver yet have approximately the same number of non-up-to-date children.

Figure C[16]: Major Colorado School Districts With Largest Numbers of Not Up-To-Date Children And Their Average Immunization Up-To-Date Coverage, 2016.



For the child care- and preschool-required vaccines, the average up-to-date rate among children ranges from 91.3 percent to 93.1 percent. The data show 8,001 Colorado children in child care or preschool were considered not up to date for all required vaccines, with the greatest numbers in the counties of El Paso (1,281), Denver (951), Arapahoe (783), Boulder (753) and Jefferson (699), respectively.

Colorado allows vaccine exemptions for three broad reasons: religious, medical or personal belief. The overwhelming majority of exemptions are for reasons of personal belief. Table C shows the percentage of all exemptions that were personal, religious or medical for the 2016-2017 school year, based on reported data. The overall number of children with vaccine exemptions totaled 22,381 in K-12 and 2,480 in child care.

Exemptions

All 50 states require vaccines for children prior to attending school and child care, although every state grants exemptions to children for medical reasons. Almost all states also grant exemptions for people whose religious beliefs oppose immunizations. But Colorado is one of only 18 states that also allows parents to exempt their child from required immunizations based on personal or philosophical reasons. California, West Virginia and Mississippi are the only three states that do not allow exemptions for any non-medical reason.[15]

TABLE C . Vaccination Exemptions by Type and School Setting for the 2016-17 School Year

	K-12 Schools	Preschools & Child Care
Personal Belief Exemptions	88.1%	89.8%
Religious Exemptions	7.4%	6.8%
Medical Exemptions	4.5%	3.4%

Section 3. Variations in Immunizations

Geographic variability in immunizations makes certain communities even more vulnerable.

Measles is one of the most infectious agents on the planet and coverage rates of around 90-95 percent are needed to protect a community from an outbreak. Map B shows that in at least 16 counties, school-reported measles immunization rates are below 90 percent with at least four of these counties (Chaffee, Saquache, Ouray, and Hinsdale) below 79 percent.

The nature of these mixed results among counties suggests different reasons for the disparities.

Health care access in the Denver Metro area plays a role in the area's higher immunization rates, while difficult access to health care impedes vaccinations in rural counties. But some rural counties — especially those on the southern half of Eastern Plains — do better than others. Boulder and El Paso counties have health access comparable with Denver, yet they lag in vaccine coverage and protection. This likely stems from decisions by parents to not vaccinate or use alternative vaccination schedules for their children, which leads to underimmunization and consequently puts their communities at risk.

MAP B[17]:
MMR Vaccine Up-to-Date Rates for the 2016-2017 School Year

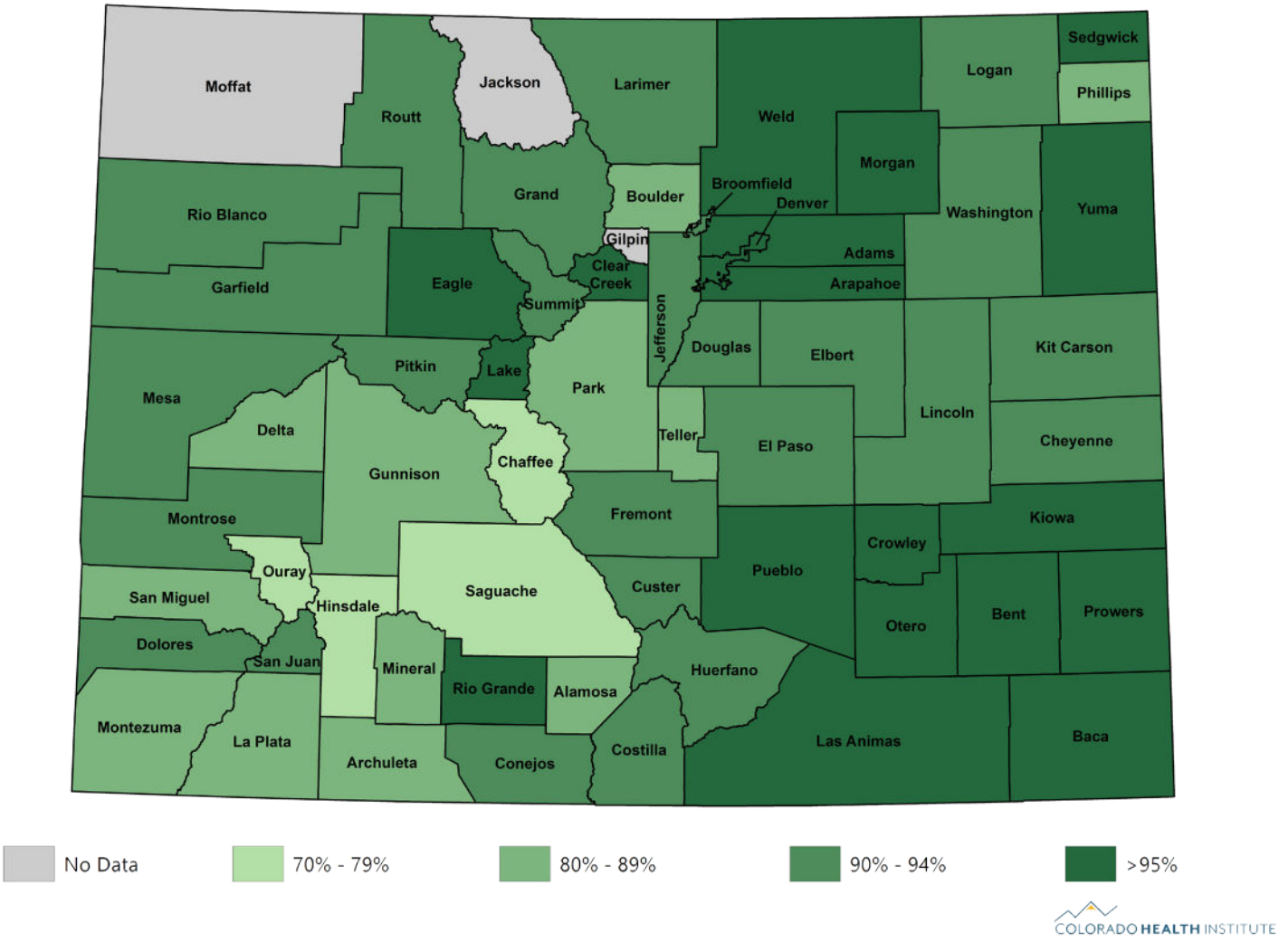


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TABLE D.[18] Variation of Average Up-to-Date Rates and Exemption Rates of Schools Within Select Colorado School Districts, 2016-2017 School Year

	Lowest School Average Up-to-Date Rate (%) within District	Highest School Average Up-to-Date Rate (%) within District	Lowest School Average Exemption Rate (%) within District	Highest School Average Exemption Rate (%) within District
Boulder Valley RE2	41.6	95.56	0	52
Cherry Creek 5	74.35	99.57	0	15.61
Colorado Springs 11	40.93	96.43	.07	45.12
Denver County 1	66.26	100	0	24.68
Jefferson County R1	48.31	98.74	0	36.35
Mesa County Valley 51	64.2	97.62	0	10.39
Montezuma-Cortez RE-1	52.76	96.4	1.42	43.79
Poudre R1	56.02	98.14	1.32	25.31
Roaring Fork RE-1	45.79	97.5	.94	54.21
Salida R-32	65.35	86.55	8.57	17.98
St. Vrain RE 1J	44.14	100	0	50.45
Telluride R-1	70.65	83.71	12.05	15.69
Thompson R2-J	34.29	97.77	0	14.86

The newly available school-level data provide greater insights on variation among individual school districts. These data show many schools are much lower or higher than the overall district, county and state rates of students with up-to-date immunizations or those with exemptions.

For example, schools in Loveland's Thompson R2-J school district vary from having just over one-third of their students up to date on vaccinations to nearly 98 percent up to date. And exemption rates by school in Boulder County's St. Vrain district vary from zero percent to more than 50 percent (see Table D.)

A look at the 20 schools with the highest reported exemption rates show a mix of public and private schools, although charter and Waldorf schools together make up nearly a third of the list. These schools are located across the state — from diverse locations including Cortez, Aspen, Salida, and Boulder. The diversity of school types and locations highlights that high exemption rates are a statewide problem and not confined to one or two pockets.

Access the data on the Colorado Department of Public Health and Environment's website by going to **www.cohealthdata.dphe.state.co.us** and searching for school and child care immunization data.

With these newly available data, additional analyses will be possible to see what's behind low vaccination and high exemption rates, such as geographic, demographic, cultural and socioeconomic factors. School policies and funding issues, such as the impact of school nurses and the role of school-based health centers, also need to be explored.

TABLE E.[19] 20 Schools With Highest Vaccination Exemption Rates, 2016-17 School Year

School Type	School District	School Name	Average Up to Date Rate	Average Exemption Rate
Private	Roaring Fork Re 1	Waldorf School On Roaring Fork	45.79%	54.21%
Public	Boulder Valley Re 2	Gold Hill Elementary School	41.60%	52.00%
Private	St. Vrain Valley Re 1J	Shepherd Valley Waldorf School	44.14%	50.45%
Public	Moffat 2	Crestone Charter School	29.48%	47.01%
Private	Colorado Springs 11	Springs Baptist Academy	40.93%	45.12%
Public	Montezuma-Cortez Re 1	Battle Rock Charter School	52.76%	43.79%
Public	Delta County 50(J)	North Fork School Of Integrated Studies	27.78%	39.44%
Public	Estes Park R3	Estes Park Options School	49.17%	38.67%
Public	Charter School Institute	Mountain Song Community School	61.71%	37.84%
Public	Adams-Arapahoe 28J	Options School	50.43%	37.75%
Private	Jefferson County R1	Hope Academy	53.72%	36.35%
Private	Boulder Valley Re 2	The Joshua School – Boulder	68.92%	31.08%
Public	Jefferson County R1	Mountain Phoenix Community School	63.39%	30.61%
Public	Gunnison Watershed Re 1J	Marble Charter School	65.70%	30.43%
Private	Falcon 49	Falcon Home School Program	69.80%	30.20%
Public	Delta County 50(J)	Delta Vision School	66.00%	29.75%
Public	Charter School Institute	Salida Montessori Charter School	61.25%	28.31%
Public	St Vrain Valley Re 1J	Apex Home School Enrichment Program	53.61%	25.35%
Public	Poudre R1	PSD Options School	74.69%	25.31%
Public	Park County Re 2	Guffey Charter School	60.38%	25.16%

Section 4: Why isn't Colorado Meeting Individual and Community Protection Goals?

There's no single answer to boosting immunization levels around the state. Multiple logistical, access, attitudinal, and policy-related challenges influence vaccine coverage rates. These challenges make it difficult, but not impossible, to reach the remaining unimmunized population.

Figure F on pp. 18-19 illustrates Colorado's complex immunization system.

Providers: Facing Payment, Logistical and Communication Barriers

Physicians face various barriers to providing immunizations. They administer vaccines through a complex system of financing and delivery.

Results from a national survey recently showed 10 percent of family physicians do not administer vaccines to patients younger than 18 years of age. Overall, 34 percent of physicians reported that they had considered or seriously considered in the last year discontinuing providing all childhood vaccines to privately insured patients because of costs.[20]

Why is this? Physicians can have a hard time dealing with financing and insurance coverage for vaccines. Clinics, especially small ones, can find it burdensome to manage the complexities of providing vaccines, including enrollment in programs, billing insurance companies, paying for vaccines, and inventory management. According to some studies, nearly a quarter of doctors have stopped seeing patients because their insurers did not reimburse well enough to cover the costs of providing and administering vaccines.[21]

Table F describes the six main avenues for providers to deliver vaccines in Colorado by financing source. The table also identifies the population eligible to be served by that funding source, the major participating providers and how the funding is administered.

Providers also face challenges of serving a patient population with concerns and questions about vaccinations. Health care providers say they have to take extra time to address parents' complex concerns about vaccines. Research surveys have shown that almost all physicians say they've been asked by parents to spread out their children's vaccines. About half of doctors say they spend more than 10 minutes talking to families who have concerns about vaccines, which is a considerable amount of time in the context of a typical 15- to 20-minute well-child check.[22] Providers may not have the time or the communication skills to make a strong recommendation, and, as a result, they can miss opportunities to vaccinate.

A strong provider recommendation is a well-documented influence on parents' decisions to vaccinate their children. CCIC's recent survey of Colorado parents conducted by Corona Insights showed medical doctors are the most influential source for parents in planning for their child's immunizations, followed by family members.

A 2015 pilot project led by CDPHE and implemented by CCIC explored the use of third-party billing, ordering, and inventory management vendors to assist small or rural doctors' offices and local public health agencies in providing vaccines. The results showed increased satisfaction and improved vaccine administration with management from third-party vendors.[23]

Parents: Trust and Concerns

Most parents vaccinate their children following the schedule recommended by the Centers for Disease Control and Prevention (CDC). But a minority refuse or delay vaccinations for their children. Parents' reasons are complex, ranging from fears about safety of vaccines, distrust of government and medical providers, misinformation and knowledge gaps, attitudes and beliefs about the benefits versus risks of vaccines, low perceived risk of disease, concerns about personal freedoms, and more.

TABLE F. Vaccine Financing and Delivery in Colorado

Vaccine Financing	Population Served	Major Participating Providers	Administration Management
Private Insurance	Adults and children with private health insurance coverage	• Private practices • Federally Qualified Health Centers (FQHCs) and Rural Health Clinics (RHCs) • Some Local Public Health Agencies (LPHAs) • Pharmacies	Providers purchase vaccine upfront and are reimbursed by billing insurance for cost of vaccine and administration fee.
Vaccines For Children (VFC)	Children 18 and younger who are Medicaid eligible, uninsured or underinsured, or American Indian or Alaska Native	• Most providers, but not all, who serve Medicaid patients • LPHAs • FQHCs and RHCs • Most School-Based Health Centers	CDPHE manages the program. Vaccines are provided at no cost to participating providers. Providers can bill Medicaid for office visits and vaccine administration.
Section 317	Uninsured or underinsured adults Anyone during outbreaks or disaster relief	• LPHAs	Federal program. Managed by CDPHE.
Medicaid	Low-income adults	• Any provider who serves Medicaid enrollees.	State Medicaid department manages the program. Providers purchase vaccine upfront and are reimbursed by Medicaid for cost of the vaccine and an administration fee.
Medicare	Eligible adults 65 and older	• Any provider who serves adults on Medicare • Pharmacies	Federal program
Out of Pocket	Uninsured and underinsured children and adults Adults and children covered by non-compliant ACA insurance plans	• Any provider who serves uninsured • LPHAs • Pharmacies	Payments, co-payments, and deductibles are collected at point of service.

One in five parents (22 percent) believe the CDC schedule is not the best one to follow, and 28 percent believe delaying vaccines is safer for their children.[24]

In a 2017 survey of over 400 Colorado parents, 29 percent of respondents said they had delayed or refused one or more vaccinations for their child. Some responses indicated a lack of understanding of the CDC-recommended schedule. More than one in three parents has concerns about the safety of immunizations, and nearly all parents see it as their role to question the safety of vaccines.[25]

Some parents intend to vaccinate according to schedule, but they may face barriers such as transportation, lack of insurance, cost, cultural and language barriers, and access to providers who offer vaccines.

Colorado parents also underestimate the required vaccination coverage levels to achieve community protection, particularly those who delay or refuse vaccinations.

Parents need more education and information from trusted sources to understand the overwhelming benefits of vaccines compared with risks to their children and community. Such knowledge can lead to a greater understanding of the complex vaccination schedule and how concepts such as community protection play out in their schools and communities.

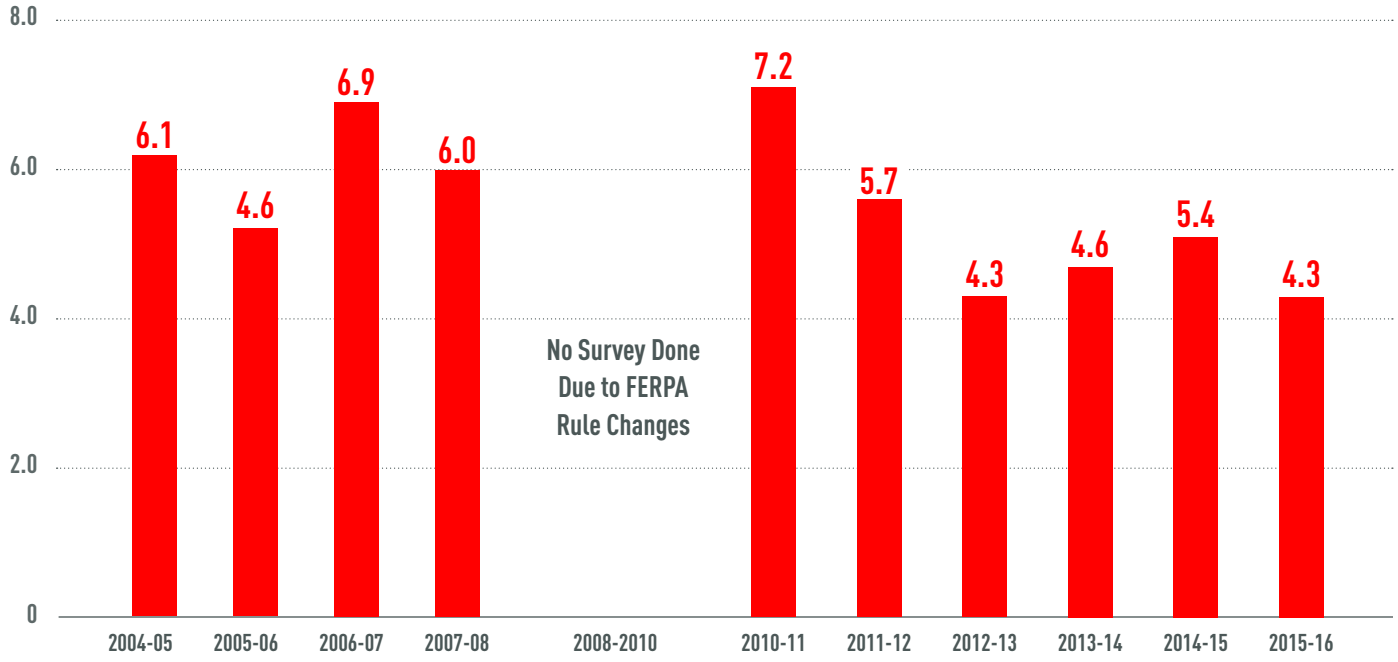
Exemptions: A Challenge to Informed Decisions

Vaccines are required to enroll in school or child care. However, parents can secure medical, religious or personal belief exemptions for their children in Colorado.

Prior to 2002, vaccine exemption rates for kindergartners in Colorado did not surpass three percent.[26] But exemption levels have climbed (see Figure D). The reasons include a growing emphasis among parents on personal freedom and individual rights, the louder voices of people opposed to vaccines, and simple convenience — in states with lenient exemption policies such as Colorado, filling out an exemption form may be more convenient than compiling and submitting vaccination paperwork.

Virtually all of Colorado's exemptions are for non-medical reasons, which comprise over 95 percent of the exemptions at K-12 schools for the 2016-17

FIGURE D.[27] Percentage of Kindergartners Claiming Exemptions from Required Immunizations



Source: CDPHE

school year. Researchers have found that states with lenient exemption policies, such as Colorado, tend to have higher disease rates.[28]

A 2016 analysis of data by Chalkbeat Colorado demonstrated the importance of a dedicated school nurse trained on immunizations. It found the presence of a school nurse had a significant impact on higher immunization coverage and lower exemption rates. The median exemption rate in schools with a nurse was 4.14 percent compared with 6.15 percent in schools without a nurse. Despite the clear impact the presence of a nurse can have on school health, Colorado ranks No. 39 in the United States for its low ratio of nurses to students, one school nurse for every 1,982 students.[29]

Compliance

The difficulties school nurses, staff and parents face interpreting the complex immunization schedule and school vaccination requirements make compliance a challenge. A compliant school has on file all necessary vaccine records or exemption materials required by law for all students. A student may also be "in process," indicating a written plan is in place for obtaining required vaccines. An "in process" student is considered compliant.

FIGURE E.[30] Rates of Kindergartners In Compliance for All Required Vaccines

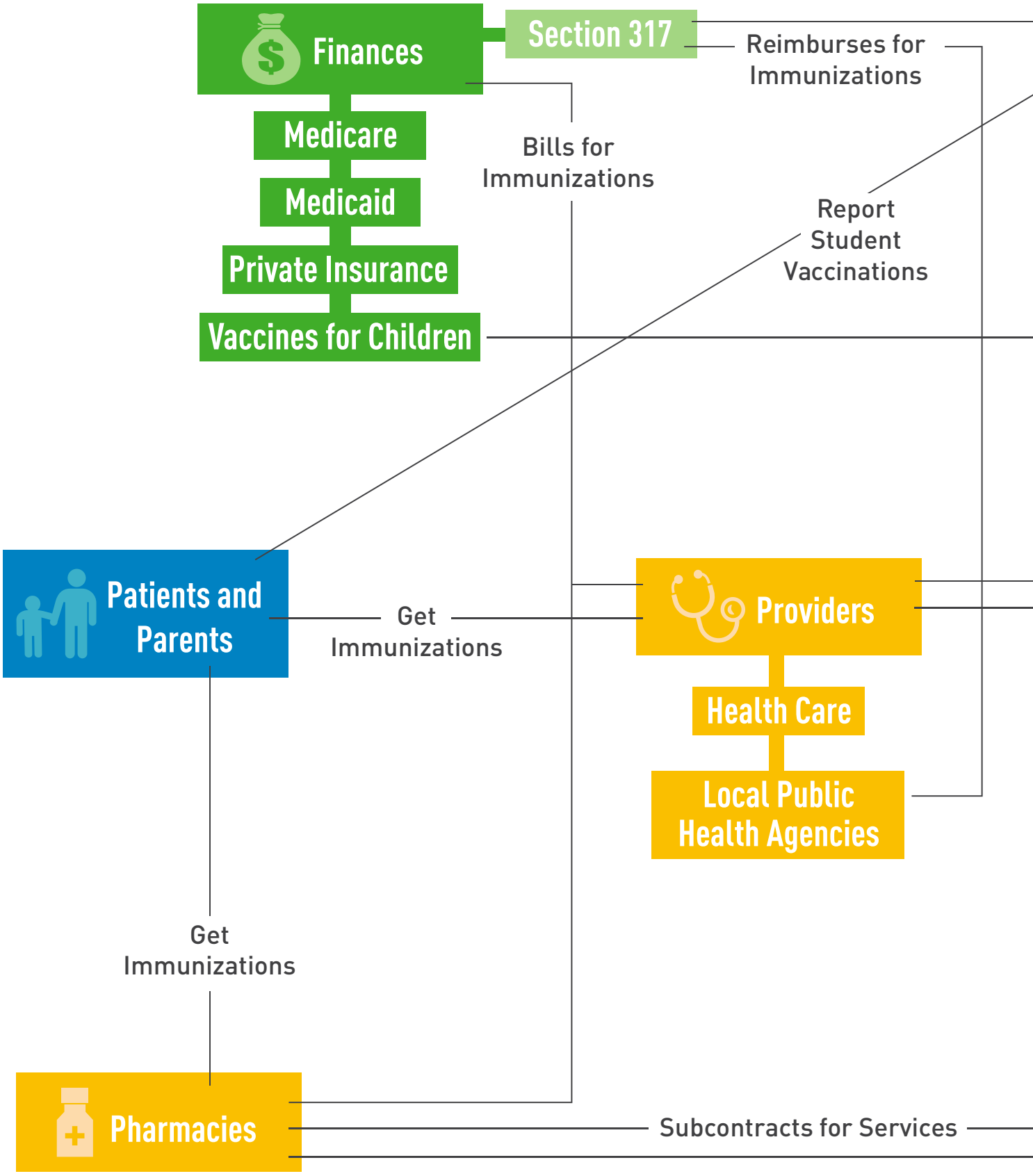
2014-15	2015-16
78.9	79.8

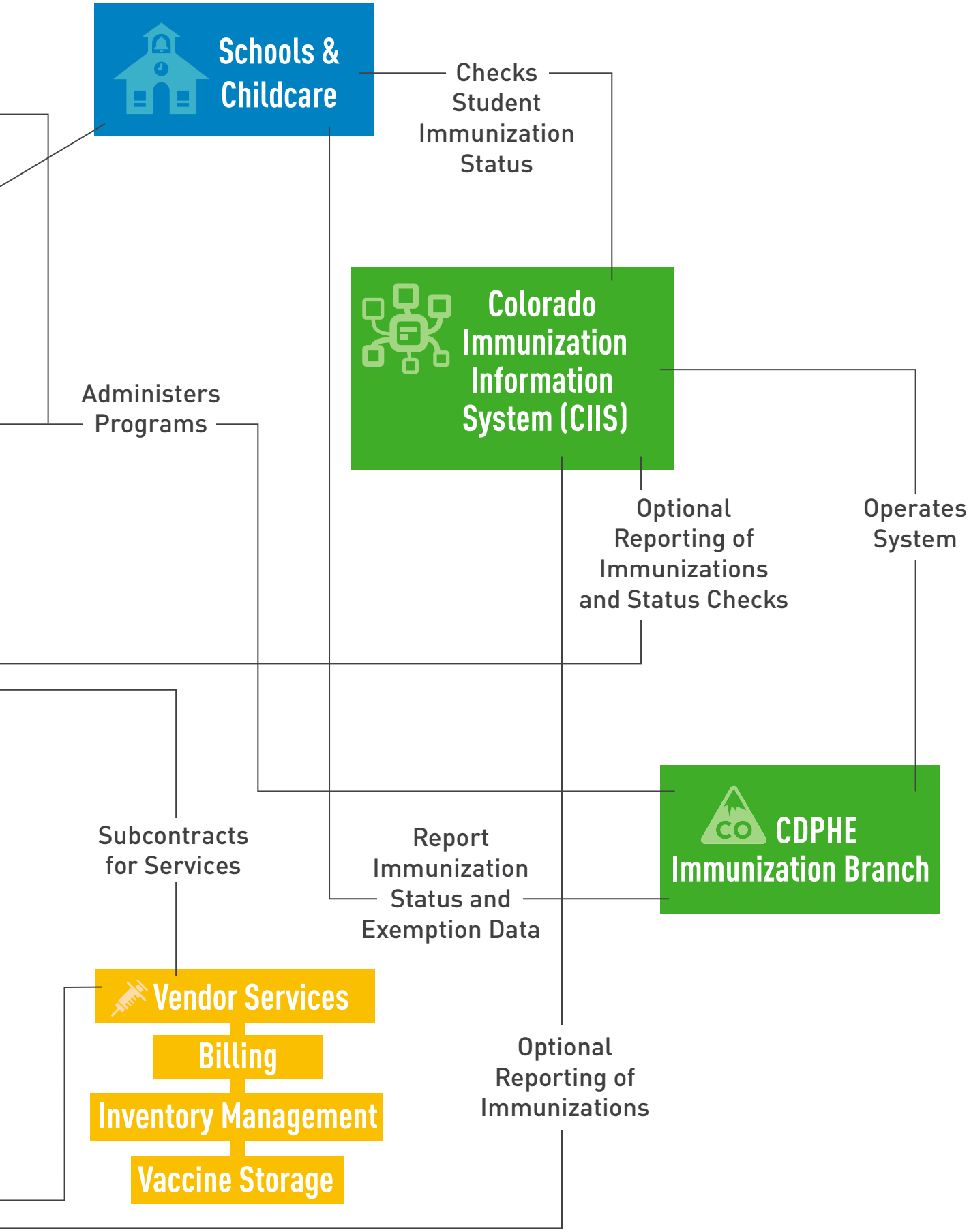
Figure E shows the percentage of kindergartners who complied with school requirements for the 2014-15 and 2015-16 school years. It indicates that over 20 percent of kindergartners each year were underimmunized or had unknown vaccination status due to incomplete records.

Schools are now required, per Colorado Board of Health rule, to report these data annually, making the Colorado Immunization Information System a valuable tool in assisting schools with reviewing individual student records to ensure compliance with requirements, as well as to calculate accurate immunization rates.

FIGURE F.

Colorado's Complex Immunization System




Schools & Childcare
Checks Student Immunization Status
Colorado Immunization Information System (CIIS)
Administers Programs
Optional Reporting of Immunizations and Status Checks
Operates System
CDPHE Immunization Branch
Subcontracts for Services
Report Immunization Status and Exemption Data
Vendor Services
Billing
Inventory Management
Vaccine Storage
Optional Reporting of Immunizations

THE COLORADO IMMUNIZATION INFORMATION SYSTEM (CIIS):

The Immunization Backbone in Colorado

The Colorado Immunization Information System (CIIS) is a confidential, computerized, population-based system operated by the Immunization Branch at the state health department.

Health care providers participate in CIIS by recording immunizations administered to their patients of all ages. All 50 states operate immunization information systems like CIIS because they are considered an essential public health tool for clinical decision making, outbreak investigations, disease surveillance, vaccine ordering and management and other services. The Community Preventive Services Task Force, an independent, nonfederal, unpaid panel of public health and prevention experts that provides evidence-based findings and recommendations about services that improve health, strongly recommends immunization information systems. The recommendation is based on more than 100 published studies showing effectiveness in increasing vaccination rates and reducing vaccine-preventable disease.[31]

As of June 30, 2017, CIIS contained data on more than 59.6 million immunizations for more than 5.3 million Coloradans, more than 32 percent of whom were under age 19. Patients have the option to exclude their immunization data from CIIS at any time.

In Colorado, it is not mandatory for providers to participate in CIIS. Currently, CIIS has between 4,000 and 5,000 active users, including providers, local public health agencies, Indian Health Service clinics, schools, child care facilities, pharmacies, WIC clinics, health plans, and social service entities across the state. Most pediatricians and many family practice providers participate. At one time, approximately 640 provider organizations were on the waiting list for an electronic interface with CIIS. Since the recent implementation of an online testing tool, 56 percent of the provider organizations on the wait list have actively started the CIIS pre-testing requirement. For those that have passed the pre-testing requirement, 336 provider sites have developed a live interface or are actively working on an interface project. CIIS also works with the Colorado Regional Health Information Organization (CORHIO), a comprehensive regional health information exchange organization, to allow the secure sharing of data among a variety of health systems.

Schools, child care centers, and WIC clinics access CIIS to assist with ensuring compliance with state and federal immunization laws and reporting requirements. Schools can enter immunization data into CIIS after obtaining written consent from parents under the Family Educational Rights and Privacy Act (FERPA). Child care centers can also enter immunization data into CIIS.

CIIS is one of the most important tools the state can employ to ensure kids get timely and appropriate vaccinations to be protected from deadly communicable diseases. Increased support for CIIS and provider enrollment in the system allows for the consolidation of immunization records for children and enhanced capability to conduct vaccination recalls and reminders, reducing missed opportunities and increasing vaccination rates. In 2017, CDPHE received the Governor's *Elevation* Award in High Impact Performance Improvement for improving the immunization data exchange processes used by health care clinics to electronically connect with CIIS. By implementing an online testing tool and streamlining its interface project process, CIIS has reduced the length of time it takes to complete each project by 58 percent.

"The biggest benefit of CIIS is to parents and children. CIIS makes life so much easier for parents in the event of lost records or whenever parents need to provide an updated immunization record, such as when starting child care, school, summer camp or a sports team, " stated Colorado pediatricians Dr. Matt Daley, Dr. Matt Dorighi and Dr. Sean O'Leary.[32]

Section 5. Immunization Policies

While Colorado has made recent improvements in vaccine policy, the state's relatively easy exemption rules put children at increased risk for disease outbreaks. However, given the current political climate and increasing spotlight on vaccines, pro-vaccine legislation can be difficult to advance.

Key Recent Milestones in Immunizing All Colorado Children

- **2007:** Colorado Immunization Registry Act designated CIIS as Colorado's lifelong immunization record tracking system.
- **2008:** State budget funds CIIS operations and staffing within the Colorado Department of Public Health and Environment.
- **2010:** Senate Bill 56 lists required vaccines in a letter that Colorado parents receive at the beginning of the school year.
- **2012:** The Colorado Board of Health passes a rule to require that certain health care facilities ensure annual influenza vaccination of employees.
- **2013:** Senate Bill 222 creates the Vaccine Access Taskforce to improve access through public/private partnerships. The taskforce brought about a peer mentoring network among providers, an evaluation of the vaccine supply chain and contracting and a resource hub for providers.
- **2013:** The Affordable Care Act requires new health plans to cover recommended preventive services — including vaccines recommended by the Advisory Committee on Immunization Practices — without charging a deductible, copayment or coinsurance.
- **2014:** House Bill 1288 requires schools and licensed child care centers to disclose, upon request, their immunization and exemption rates, and directs the Colorado Board of Health to promulgate rules regarding the frequency and process of submitting non-medical exemptions for school and child care. Additionally, HB 1288 requires CDPHE to create an online immunization education module.

Colorado Gov. John Hickenlooper signs Senate Bill 222 in 2013.

- **2015:** Per HB 1288, the Colorado Board of Health passes rules to increase the frequency of submitting non-medical immunization exemptions for school and child care and requires schools and child care centers to annually report aggregate immunization and exemption information to CDPHE, to be made publicly available.
- **2015:** Following the end of 2013-14 federal Medicaid primary care funding reimbursement rate increases, the Colorado Department of Health Care Policy and Financing receives authority to continue increased reimbursement for office visits and vaccine administration.
- **2015:** Colorado lawmakers approve $1.2 million in both one-time new and ongoing funding for CIIS and $500,000 for local public health agencies to bolster their vaccine programs.
- **2015:** Only 2.5 percent of Colorado children under age 19 remain uninsured — down from a high of 8.2 percent in 2011. Most insurance plans cover recommended vaccines with no out-of-pocket costs.
- **2016:** The Colorado Department Human Services Office of Early Childhood adds licensing rules requiring some child care employees to annually complete the CDPHE child care/preschool immunization course.
- **2017:** CDPHE releases publicly available data on school and child care immunization and exemption rates.

TABLE G. Impact of House Bill 1288

Topic	Pre HB 1288	Post HB 1288 and Board of Health rules
Education	NA	CDPHE required to create an online education module on the benefits and risks of vaccines.
Pre-Kindergarten Exemptions	Exemption form signed and submitted once	Parents submit official exemption forms at each age when vaccines are due. The rule requires a non-medical exemption form at 2 months, 4 months, 6 months, 12 months and 18 months of age.
K-12 Exemptions	Exemption form signed and submitted once	Non-medical exemption forms must be submitted during annual enrollment/registration.
School and Child Care Data Reporting	No immunization reporting required	Schools and licensed child care centers with children birth through 12th grade are required to annually report aggregate immunization and exemption information to CDPHE via an online form by December 1 of each year.
State Data Reporting	No public school and child care immunization data required	CDPHE publishes school and child care immunization rates annually.
Medical Exemptions	Medical exemptions submitted only once	No change

Making Progress on School and Child Care Policies

Colorado allows parents to exempt their children from required school vaccines for personal, religious or medical reasons. Until the passage of HB 1288 in 2014, Colorado had one of the most lenient methods in the country for allowing parents to claim a non-medical exemption, only requiring a one-time, single signature.

Table G identifies how HB 1288 strengthened the non-medical exemption process in Colorado.

HB 1288 – Not Far Enough?

Surveys and studies show support for stronger vaccine policies, suggesting that legislators overestimate the opposition to pro-vaccine policies. A high level of support exists among Colorado parents for future legislation to limit or eliminate personal belief exemptions, in addition to strengthening other immunization policies.

A 2016 study of mothers in the Denver metro area suggests that parents want stronger immunization policies. They value vaccine coverage information, and they might use it to make decisions about the schools and child care centers their children attend. The availability of coverage data may also encourage parents to talk to their child's school or child care center about their coverage rates.[33]

Sixty percent of parents who answered this survey would support or strongly support a law making it more difficult to obtain non-medical exemptions to vaccination in Colorado, and 52 percent would support a law eliminating all non-medical exemptions.

In a separate 2017 survey of Colorado parents conducted by Corona Insights for the CCIC, 63 percent of parents somewhat or strongly support policies that would eliminate non-medical exemptions for school or child care entry. Four of five would somewhat or strongly support policies that require a health care provider signature or completion of online education to obtain a non-medical exemption, and 74 percent somewhat or strongly agree they would support policies to enhance enforcement of laws that require vaccinations for a child to enroll in school.[34]

More than 90 percent agree or strongly agree that knowing school and child care vaccination rates would influence their level of concern about their child getting sick. Eighty-two percent of parents agree or strongly agree that reporting of school and child care vaccination rates would influence where they would enroll their child.

Most parents agree or strongly agree that reporting vaccination rates would encourage them to talk with

their school or child care provider and with other parents about vaccines. This is more so among parents of child care age children than school age children.

Other results from the Corona Insights survey include:

- Seventy percent somewhat or strongly support requiring additional vaccines, such as meningococcal, HPV and flu, for school or child care entry.
- Eighty-six percent somewhat or strongly support increased funding to support statewide immunization programs.
- Eighty-seven percent somewhat or strongly support requirements for school staff to be vaccinated.
- Ninety-one percent somewhat or strongly support policies that would increase access to vaccines for uninsured or underinsured children and those living in poverty.

Section 6. Mobilizing the Vaccinated Majority

Most Colorado parents vaccinate their children.

However, vaccines are increasingly in the spotlight, with negative media attention and commentary from public figures. Some celebrities are vocal about questioning the safety of vaccines or using an alternative schedule, bringing attention to and normalizing the anti-vaccine movement.[35]

There's an important need for pro-vaccine advocacy and mobilizing the vaccinated majority. Anti-vaccine sentiments are misinformed, but they are effective because at their core they are about parents protecting their children. The power of parental responsibility can also be harnessed to promote vaccinations. Parents who choose to vaccinate their children do so because they want to avoid painful or even life-threatening vaccine-preventable diseases. The reality of community immunity means that a child's overall protection rises when more nearby children are vaccinated. Similarly, more children in a community are put at risk when some parents refuse to vaccinate their kids.

A 2017 survey found that awareness of recent policy changes related to vaccination was low among all parents. Awareness of policy affecting K-12 immunization exemption forms was somewhat higher, possibly reflecting information coming from schools and underscoring the importance of providing resources and tools to inform parents.[36]

Parents who vaccinate should be considered an untapped resource for public health. Colorado Parents for Vaccinated Communities, a new parent advocacy campaign launched by CCIC, is activating parents to provide a voice representing the majority of parents in favor of policies and initiatives that

- Maintain and enhance Colorado's vaccine and disease surveillance infrastructure, especially CIIS.
- Address the state's high rate of non-medical exemptions.
- Continue to inform the public of the importance of vaccinations.
- Maintain confidence in vaccines as safe and effective.

Conclusion. Opportunities to Reach the Underimmunized and Achieve Necessary Protection: A Call to Action

Vaccines are a cornerstone to public health, saving millions of lives worldwide each year. Colorado has had many successes in achieving high vaccination rates, but challenges remain. To fully protect Colorado's population against vaccine-preventable diseases, gaps in vaccination coverage as described in this report must be addressed.

Just as the reasons for insufficient vaccination coverage levels vary widely – from lack of infrastructure to access barriers and general noncompliance – the solutions to improving community protection require coordinated efforts across multiple sectors and stakeholders.

Colorado has numerous critical opportunities to reach the underimmunized. Recommendations are as follows:

• Researchers and public health officials should continue to collect and share data on the unnecessary economic, health and societal costs of vaccine-preventable disease in Colorado, and continue to analyze and use newly-available local immunization data to better understand how geographic, demographic, cultural and socioeconomic factors influence immunization rates and explain variations across the state. Further, vaccine advocates need to develop tools and resources to translate and use the new data in order to educate the public and spur action.

• Public health and healthcare systems should target improvement efforts based on a better understanding of the causes for gaps and share best practice strategies employed by counties, schools and childcares with exemplary immunization rates. School and childcare policies and funding issues, such as the impact of school nurses and the role of school-based health centers, also need to be explored.

• Public and private support and oversight are needed to ensure adequate training, resources and capacity for school nurses and childcare administrators to accurately and effectively document and track immunization status in CIIS. Expanded delivery options such as school-located immunization clinics, should be explored. More needs to be learned about schools and child care centers that did not report immunization data or do not participate in CIIS so they can be encouraged to make this new data stronger.

• Policymakers must address ease of exemptions. Rigorous, science-based immunization laws and policies are necessary to reduce the number of children who are exempted from vaccines for non-medical reasons.

• Lawmakers must provide continued state funding to operate and optimize Colorado's vaccine and disease surveillance infrastructure, specifically CIIS. Lawmakers should also continue to support requirements for insurance plans to cover the cost of vaccinations, as well as payment reform models that incentivize patients and doctors for preventive care, such as vaccines.

• Healthcare providers must have the tools, training and resources to effectively recommend and provide vaccines, and support on-site strategies in medical offices, health centers, pharmacies and local public health agencies that aim to increase immunization rates.

• The media must give voice to the silent majority of vaccinating parents, as well as medical experts and parents whose families rely on community-wide vaccination to shield them from serious illness.

• Vaccinating parents must voice their support for vaccination and make their presence known to peers, lawmakers, public officials, the media, and school and childcare administrators.

• Public health and vaccine advocates must implement community outreach campaigns to increase awareness of recent policy changes. These organizations should also focus on making medically-accurate, scientific information about vaccines from trusted sources readily available to parents and the public.

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Keeping Colorado kids healthy!

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