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Getting a Fair Shot: Progress and Disparities in Early Childhood Vaccination in New York State

NYS HEALTH FOUNDATION

Contents

Executive Summary

Vaccines are widely considered among the greatest public health achievements of the last century.[1] Diseases that previously killed thousands of children in the United States per year are now unheard of to most families.[2]

Over time, New York State has seen important increases in childhood vaccination rates. Yet, New York has also seen outbreaks of vaccine-preventable diseases in recent years.[3] In addition, children of color have historically faced barriers to vaccine access, creating disparities in vaccination coverage[4,5,6] It is critical to further increase vaccination rates to prevent the return of diseases we had relegated to the past.

An early childhood series of vaccines, as recommend by the Advisory Committee on Immunization Practices (ACIP), protects against 11 illnesses, including measles, mumps, and chickenpox. This report examines early childhood vaccination coverage in New York State from 2018 to 2020. Vaccination coverage refers to the percentage of children who completed the entire early childhood vaccine series by the age of 24 months.[7]

Data on childhood vaccination were made available through the New York State Immunization Information System (see more details on the data in the **Methods** section). *Data on New York City immunizations are maintained by a separate immunization information system and were not made available to the report authors. This report therefore represents trends for about half of the statewide population of children ages 24–35 months.*[8]

[1] Centers for Disease Control and Prevention, "Ten Great Public Health Achievements — United States, 1900-1999," *Morbidity and Mortality Weekly Report* 48(12), April 2, 1999, https://www.cdc.gov/mmwr/preview/mmwrhtml/00056796.htm.

[2] Centers for Disease Control and Prevention, "What Would Happen If We Stopped Vaccinations?" January 22, 2021, https://www.cdc.gov/vaccines/vac-gen/whatifstop.htm.

[3] Peter Hotez, "America and Europe's New Normal: The Return of Vaccine-Preventable Diseases," *Pediatric Research* 85, no. 7 (June 2019): 912–14, https://doi.org/10.1038/s41390-019-0354-3.

[4] Holly A. Hill et al., "Vaccination Coverage by Age 24 Months Among Children Born in 2016 and 2017 — National Immunization Survey-Child, United States, 2017–2019," *MMWR. Morbidity and Mortality Weekly Report* 69 (2020), https://doi.org/10.15585/mmwr.mm6942a1.

[5] Megan Anandappa et al., "Racial Disparities in Vaccination for Seasonal Influenza in Early Childhood," *Public Health*, Special issue on Migration: A global public health issue., 158 (May 1, 2018): 1–8, https://doi.org/10.1016/j.puhe.2018.01.030.

[6] Melissa L. Martinez and Sarah Coles, "Addressing Immunization Health Disparities," *Primary Care: Clinics in Office Practice* 47, no. 3 (September 2020): 483–95, https://doi.org/10.1016/j.pop.2020.05.004.

[7] Although a child who follows the recommended schedule for the early childhood vaccine series completes the series by 18 months, vaccination coverage for the series can be assessed by 24 months. See Hill et al., "Vaccination Coverage by Age 24 Months Among Children Born in 2016 and 2017— National Immunization Survey-Child, United States, 2017–2019."

[8] New York State Department of Health, "Table 1: Estimated Population by Age, Sex and Region, New York State - 2018," accessed June 2021, https://www.health.ny.gov/statistics/vital_statistics/2018/table01.htm.

Executive Summary (continued)

The report also presents disparities in vaccination coverage by race, ethnicity, and geography to identify communities of undervaccinated children in need of targeted outreach. Finally, the report discusses factors that may have increased vaccination coverage over time and suggests additional steps to protect all children from vaccine-preventable diseases.

KEY FINDINGS

- Overall early childhood vaccination coverage increased in New York State (all data are exclusive of New York City) from 2018 to 2020. In 2020, 64.5% of children ages 24–35 months had completed the entire early childhood vaccine series by age 24 months. By comparison, 59.4% of similarly aged children completed the early childhood vaccine series by age 24 months in 2018. These rates appear notably higher than rates reported in 2011—when only 47.6% of children ages 19–35 months had completed the vaccine series—suggesting an increasing trend through the last decade.[9]
- Early childhood vaccination rates have increased for children of all races and ethnicities. Rates improved the most for Asian children during the study period.
- While there was improvement across all groups, racial and ethnic disparities in early childhood vaccination coverage largely persisted. The gap between Black or African-American and white children increased slightly from 2018 to 2020 (from a rate 9% lower than their white counterparts to a rate 11% lower), remained consistent for Hispanic or Latino children (approximately 7% lower), and narrowed for Asian children (from 15% to 3% lower).
- There was substantial variation in early childhood vaccination coverage across counties in New York State, with more than half of counties having rates below the State's Prevention Agenda goal of 70.5%.[10] The 2020 coverage rate in the county with the lowest rate, Rockland, was approximately half as high as the county with the highest rate, Livingston (42% compared to 82%).
- The lowest regional rates of early childhood vaccination coverage were consistently found in the Lower Hudson and Long Island regions (in 2020, 54% and 59%, respectively).

[9] New York State Department of Health, "Percentage of Children with 4:3:1:3:3:1:4 Immunization Series - Aged 19–35 Months," November 2012, https://www.health.ny.gov/prevention/prevention_agenda/2013-2017/indicators/2013/p30.htm.

[10] New York State Department of Health, "New York State Prevention Agenda 2019–2024: Prevent Communicable Diseases Priority Action Plan," February 27, 2020, https://www.health.ny.gov/prevention/prevention_agenda/2019-2024/docs/ship/comm.pdf.

Executive Summary (continued)

New York State is making important progress in improving childhood vaccination rates; policy changes and public health interventions seem to be working. Factors that may have contributed to the recent increase in vaccination coverage include school-based efforts, such as eliminating religious exemptions to vaccine requirements, and public health- and provider-based efforts like improving information exchange between providers and the State's public health immunization information system.

Further progress is needed. Despite the notable gains, New York is still reaching to meet its public health targets for vaccinations. In some counties, the gap between current rates and the target is considerable. Although it is encouraging to see gains for children in all racial and ethnic groups, persistent disparities must be closed so that all children are equally protected.

Further action to increase early childhood vaccination rates can include bolstering efforts to combat vaccine hesitancy with effective health care provider communication with parents, using the State's immunization information system to identify children who fell behind on their vaccine series during the COVID-19 pandemic, and using standing orders that allow a wider range of health care professionals to administer vaccines.

The Importance of Childhood Vaccines

Vaccination is considered one of the greatest public health successes of the twentieth century. Before the invention of the measles vaccine in 1963, almost all children in the United States contracted measles before the age of 15, and hundreds of Americans died annually from the disease.[11] On a global scale, the smallpox vaccination campaign was so successful that the disease was declared eradicated in 1980, and no cases have occurred since.[12]

Vaccination benefits both the individual and the larger community. Individual children who are vaccinated are protected against diseases. When most of the population is immune to a disease via vaccination, it prevents the transmission of the disease to others who are not immune. This indirect protection, known as herd immunity, is critical for preventing outbreaks and protecting children who cannot be vaccinated for medical reasons. Herd immunity, however, is fragile. When the vaccination coverage of a specific community, like a neighborhood or a school, drops even a few percentage points, outbreaks can occur and we are reminded of vaccines' indispensability.

In recent years, vaccine-preventable diseases have been on the rise in communities throughout the United States.[13] From 2018–2019, undervaccination of children in communities across New York State accelerated a measles outbreak that infected hundreds of children in New York City, as well as Rockland, Orange, Sullivan, and Westchester counties.[14,15] Community undervaccination is often driven by vaccine hesitancy, whereby parents either refuse vaccines for their children or deviate from the recommended vaccine schedule. Communities of color have also historically faced disproportionate barriers to vaccination, putting children in these communities at increased risk.[16,17] In the face of these vulnerabilities, it is critical to improve vaccination coverage to protect all of our youngest New Yorkers from vaccine-preventable diseases.

[11] Centers for Disease Control and Prevention, "Measles History," November 5, 2020, https://www.cdc.gov/measles/about/history.html.

[12] Centers for Disease Control and Prevention, "History of Smallpox," February 20, 2021, https://www.cdc.gov/smallpox/index.html.

[13] Hotez, "America and Europe's New Normal."

[14] Jane R. Zucker et al., "Consequences of Undervaccination — Measles Outbreak, New York City, 2018–2019," *New England Journal of Medicine* 382, no. 11 (March 12, 2020): 1009–17, https://doi.org/10.1056/NEJMoa1912514.

[15] New York State Department of Health, "Statement from New York State Health Commissioner Dr. Howard Zucker on New York State's Public Health Response to Measles," October 2019, https://www.health.ny.gov/press/releases/2019/2019-10-03_response_to_measles.htm.

[16] Martinez and Coles, "Addressing Immunization Health Disparities."

[17] Hill et al., "Vaccination Coverage by Age 24 Months Among Children Born in 2016 and 2017 — National Immunization Survey-Child, United States, 2017–2019."

Early Childhood Vaccination Coverage in New York State

In the United States, the Advisory Committee on Immunization Practices (ACIP) issues recommendations to the Centers for Disease Control and Prevention (CDC) to determine which vaccinations children should receive.[18] A 7-vaccine series recommended by ACIP protects against 11 illnesses (see **Table 1**).[19,20] In this report, this vaccine series is referred to as the early childhood series.

TABLE 1: Vaccines Contained in 4:3:1:3:3:1:4 Vaccine Series ("Early Childhood Series")

VACCINE	DTaP	IPV	MMR	Hib	HepB	Varicella	PCV
Doses required	≥4	≥3	≥1	≥3 or ≥4 doses (depending on product type)	≥3 or documented immunity	≥1 or documented immunity	4
Protects Against	Diphtheria, Tetanus, and Pertussis (whooping cough)	Polio	Measles, Mumps, and Rubella	Haemophilus influenzae type B	Hepatitis B	Varicella (chickenpox)	Pneumo-coccal disease

Source: Centers for Disease Control and Prevention. "Recommended Child and Adolescent Immunization Schedule for Ages 18 Years or Younger, United States, 2020," February 2021. https://www.cdc.gov/vaccines/schedules/hcp/imz/child-adolescent.html.

In this analysis, early childhood vaccination coverage was assessed among 3 cohorts of children ages 24–35 months (see **Table 2**) in 2018, 2019, and 2020. Among the children in this age range, the vaccination coverage rate measures whether they completed the early childhood vaccine series before the age of two years. For example, children in the 2018 cohort were born from July 2, 2015–July 1, 2016. On July 1, 2018, when the children in this cohort were between the ages of 24 and 35 months, their vaccination coverage was assessed to determine if they completed the early childhood vaccine series before the age of 2 years. Only children with at least one administered childhood series vaccine recorded in the New York State Immunization Information System are included in each cohort.

[18] Centers for Disease Control and Prevention, "ACIP Recommendations," March 4, 2021, https://www.cdc.gov/vaccines/acip/recommendations.html.

[19] Centers for Disease Control and Prevention. "Recommended Child and Adolescent Immunization Schedule for Ages 18 Years or Younger, United States, 2020," February 2021. https://www.cdc.gov/vaccines/schedules/hcp/imz/child-adolescent.html.

[20] Centers for Disease Control and Prevention, "Technical Notes for NIS Data Tables," October 2016, https://www.cdc.gov/vaccines/imz-managers/coverage/nis/child/tech-notes.html.

Early Childhood Vaccination Coverage in New York State (continued)

TABLE 2: Cohorts of Children Studied

Cohort Name	Coverage assessed on July 1 of (within age range of 24–35 months on this date)	Children born	Number of children in cohort
2018 Cohort	2018	July 2, 2015–July 1, 2016	132,538
2019 Cohort	2019	July 2, 2016–July 1, 2017	123,976
2020 Cohort	2020	July 2, 2017–July 1, 2018	122,235

Source: NYSHealth analysis of New York State Immunization Information System data.

OVERALL RESULTS

Early childhood vaccination coverage increased across the three cohorts. Children in the 2020 cohort had a vaccination coverage rate approximately 9% higher at age 24 months than children born two years earlier (64.5% compared with 59.4%) (see **Figure 1**).

A prior analysis found that the New York State (also exclusive of New York City data) early childhood vaccination coverage rate among children ages 19–35 months was 47.6% in 2011.[21] Although the data for 2011 were assessed using a wider age cohort of children (with a portion of the children measured prior to reaching 24 months), the data are suggestive of notable gains in early childhood vaccination coverage over the last decade.[22]

Despite these improvements, New York State's vaccination coverage remains below the State's Prevention Agenda 2019–2024 target of 70.5% for 24–35-month-olds, and even further below the federal Healthy People 2020 target of 80% for 19–35-month-olds.[23,24]

[21] New York State Department of Health, "Percentage of Children with 4:3:1:3:3:1:4 Immunization Series - Aged 19–35 Months."

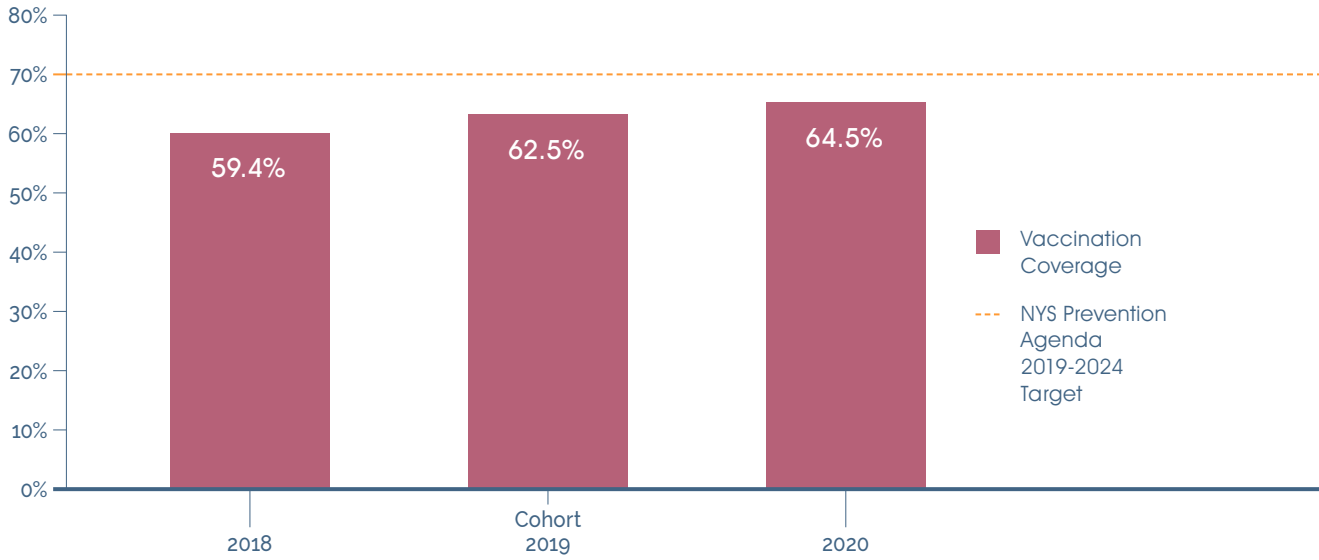
[22] Because the 2011 estimate is measured using children aged 19–35 months, a portion of children were assessed before meeting the 24-month milestone. It is likely that the rate in 2011 would have been higher if limited to children aged 24–35 months. However, given the differential between the 2011 rate and the 2018–2020 rates, a substantial gap would likely remain.

[23] New York State Department of Health, "New York State Prevention Agenda 2019–2024: Prevent Communicable Diseases Priority Action Plan."

[24] U.S. Department of Health & Human Services Office of Disease Prevention and Health Promotion, "Healthy People 2020: Immunization and Infectious Diseases - Objectives," accessed June 2021, https://www.healthypeople.gov/node/3527/objectives#4722.

Early Childhood Vaccination Coverage in New York State (continued)

FIGURE 1: Percentage of Children Completing the Early Childhood Vaccine Series by Age 24 Months in New York State



Note: Data do not include New York City vaccinations. See **Table 2** for details on children in each cohort.

Source: NYSHealth analysis of New York State Immunization Information System data.

Difference Between Early Childhood Vaccine Series & School Vaccination Requirements

These vaccination rates—including the State and federal targets—may seem lower than expected. However, this is because the vaccination coverage rate is a strict measure, assessing completion of all 7 vaccines by no later than the age of 24 months. Although all seven vaccines are recommended to children, only five of the vaccines are required for school attendance in grades kindergarten and up. Children who complete only the five vaccines required for kindergarten would therefore not be counted as having completed the early childhood vaccinations. Other children complete the full seven-vaccine series, but do so after the age of 24 months. These children would also not be counted in the vaccination rates in this report.

When just the five vaccines required for school attendance are studied among kindergarten-aged children in New York, the coverage rate for each vaccine is significantly higher, each above 97.0% for the 2019–2020 school year.[25] In other words, nearly all children in New York receive the vaccines required for school by the time they are in kindergarten. Many fewer (e.g., 64.5% among the 2020 cohort studied) receive all seven recommended vaccines by the age of 24 months.

[25] Centers for Disease Control and Prevention, "Estimated Vaccination Coverage among Children Enrolled in Kindergarten by State and the United States, School Vaccination Assessment Program 2019-20 School Year," January 21, 2021, https://www.cdc.gov/vaccines/imz-managers/coverage/schoolvaxview/data-reports/coverage-dashboard/2019-20.html.

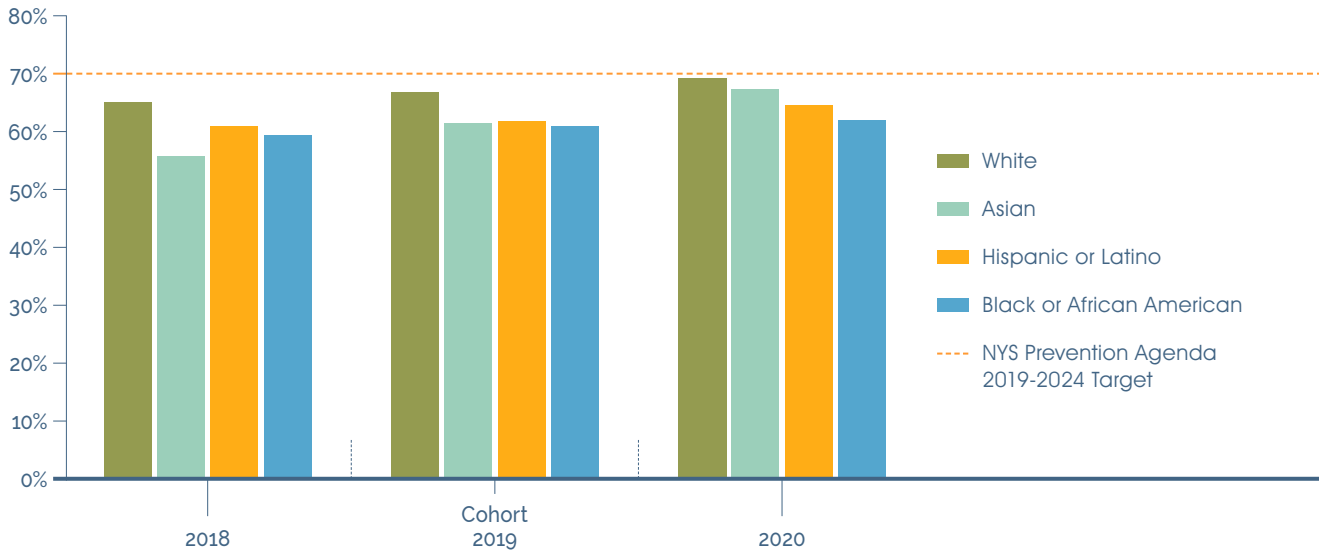
Early Childhood Vaccination Coverage in New York State (continued)

RESULTS BY RACE/ETHNICITY

The vaccination coverage rate for all races and ethnicities increased from the earliest to the most recent cohorts studied, with the largest improvement among Asian children (see **Figure 2**). Despite these encouraging gains, troubling disparities by race and ethnicity remain. Among the 2020 cohort of children, Black or African-American children had the lowest vaccination coverage rate (62.0%) of the races and ethnicities studied, followed by Hispanic or Latino children (64.7%) and Asian children (67.4%). These rates were notably lower than the rate among white children (69.4%). (Note: The data used for this report do not include information on vaccinations for children in New York City, which is home to a higher proportion of New Yorkers of color than the rest of the State. Data from the rest of the State may not be reflective of vaccination coverage in New York City.)

While the vaccination coverage rate for all races and ethnicities increased between the 2018 and 2020 cohorts, the disparities also persisted, with the exception of Asian children. The gap between Black or African-American and white children increased slightly from 2018 to 2020 (from a rate 9% lower than their white counterparts to a rate 11% lower), remained consistent for Hispanic or Latino children (approximately 7% lower in 2018 and 2020), and narrowed for Asian children (from 15% to 3% lower).

FIGURE 2: Percentage of Children Completing the Early Childhood Vaccine Series by Age 24 Months in New York State, by Race/Ethnicity



Note: Data do not include New York City vaccinations. Children with an ethnicity of Hispanic or Latino in the data were categorized as Hispanic or Latino. Children with an ethnicity of Non-Hispanic or Ethnicity Unknown were categorized as Black or African American, white, or Asian, according to their race identified in the data. See **Appendix** for counts and rates for each cohort.

Source: NYSHealth analysis of New York State Immunization Information System data.

Early Childhood Vaccination Coverage in New York State (continued)

RESULTS BY COUNTY/REGION

There are significant differences in vaccination coverage across counties in New York State. Among the 2020 cohort of children, the vaccination coverage rate in the county with the lowest rate, Rockland (42%), was approximately half as high as the county with the highest rate, Livingston (82%) (see **Figures 3** and **4A**). More than half of the counties outside of New York City (32 of 57) had vaccination coverage rates below the Prevention Agenda's target of 70.5%.

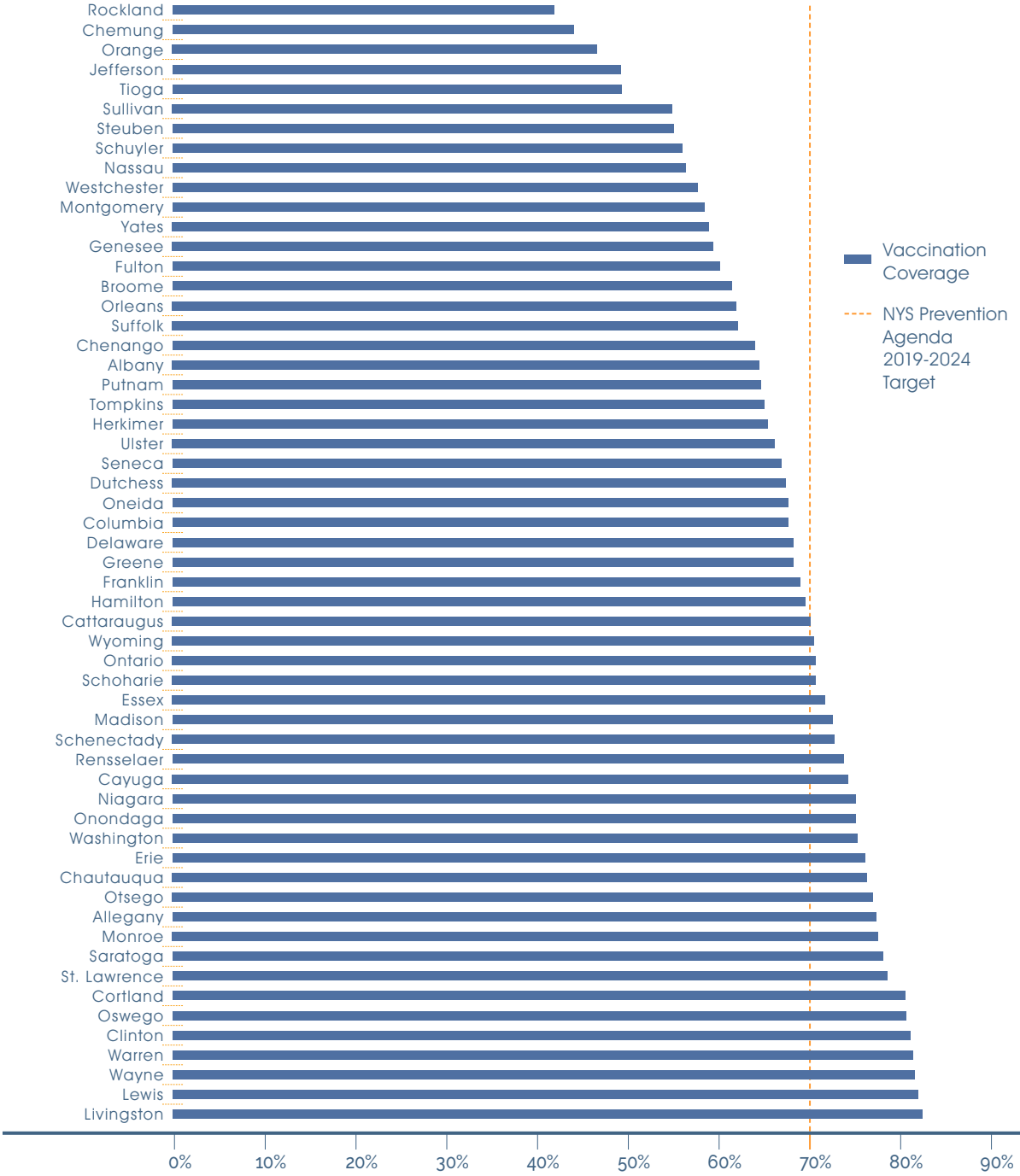
Counties with the lowest vaccination coverage tend to cluster in the Lower Hudson, Long Island, and Central regions of New York State. The Lower Hudson and Long Island regions had the lowest vaccination coverage (54% and 59%, respectively) among the most recent cohort of children studied (see **Figure 4B**). These rates were substantially lower than the rate in Western New York (74%), which exhibited the highest regional coverage rate. Long Island and Lower Hudson have consistently had the lowest vaccination coverage rates in the State since at least 2011.[26,27]

[26] New York State Department of Health, "Percentage of Children with 4:3:1:3:3:1:4 Immunization Series - Aged 19-35 Months."

[27] Dina Hoefer, "Immunization Coverage in NYS: Impact of Programmatic Activities and Policies on 4:3:1:3:3:1:4 Rates" (2015 National American Immunization Registry Association Meeting, New Orleans, LA, April 2015), https://repository.immregistries.org/resource/track-d-promoting-partnerships-assessing-outcomes-1/from/type:national-meeting-presentations.

Early Childhood Vaccination Coverage in New York State (continued)

FIGURE 3: Percentage of Children Completing the Early Childhood Vaccine Series by Age 24 Months in New York State, by County (2020 Cohort)

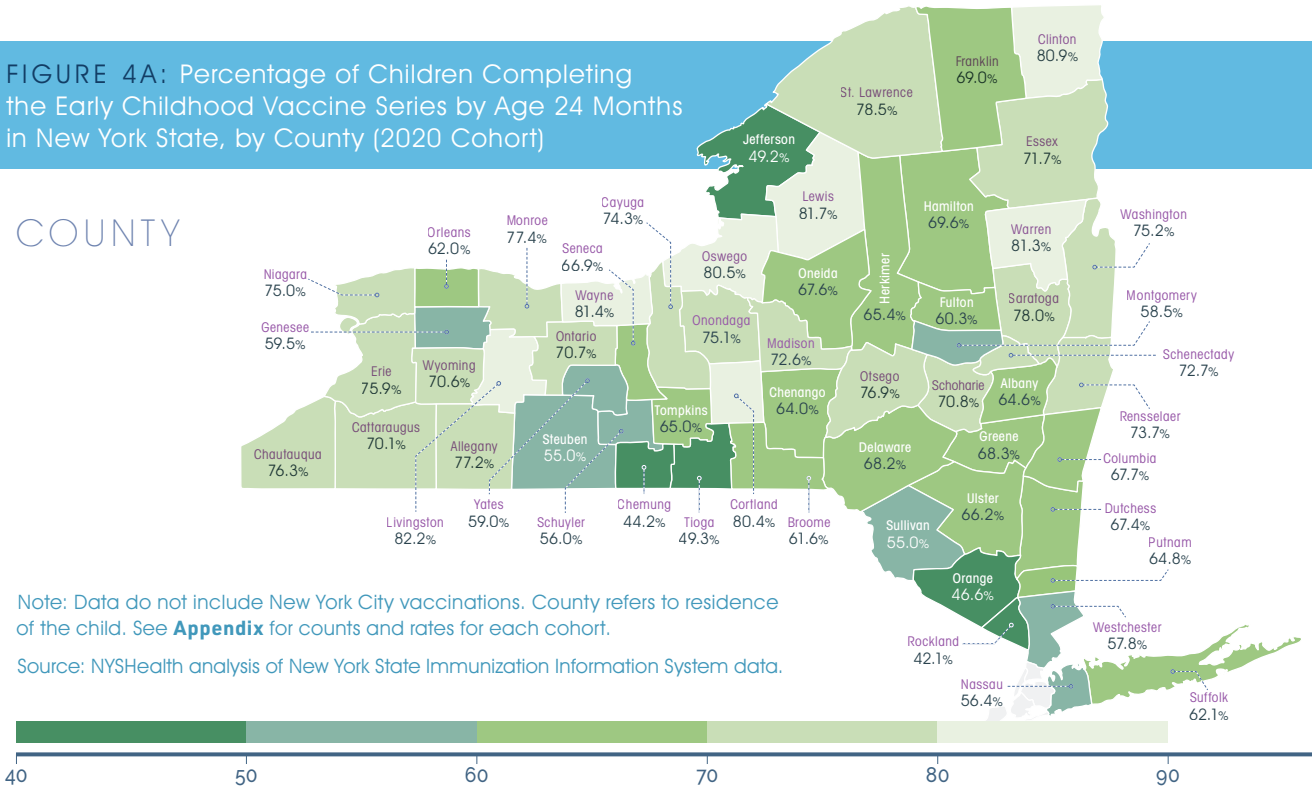


Note: Data do not include New York City vaccinations. County refers to residence of the child. See **Appendix** for counts and rates for each cohort.

Source: NYSHealth analysis of New York State Immunization Information System data.

Early Childhood Vaccination Coverage in New York State (continued)

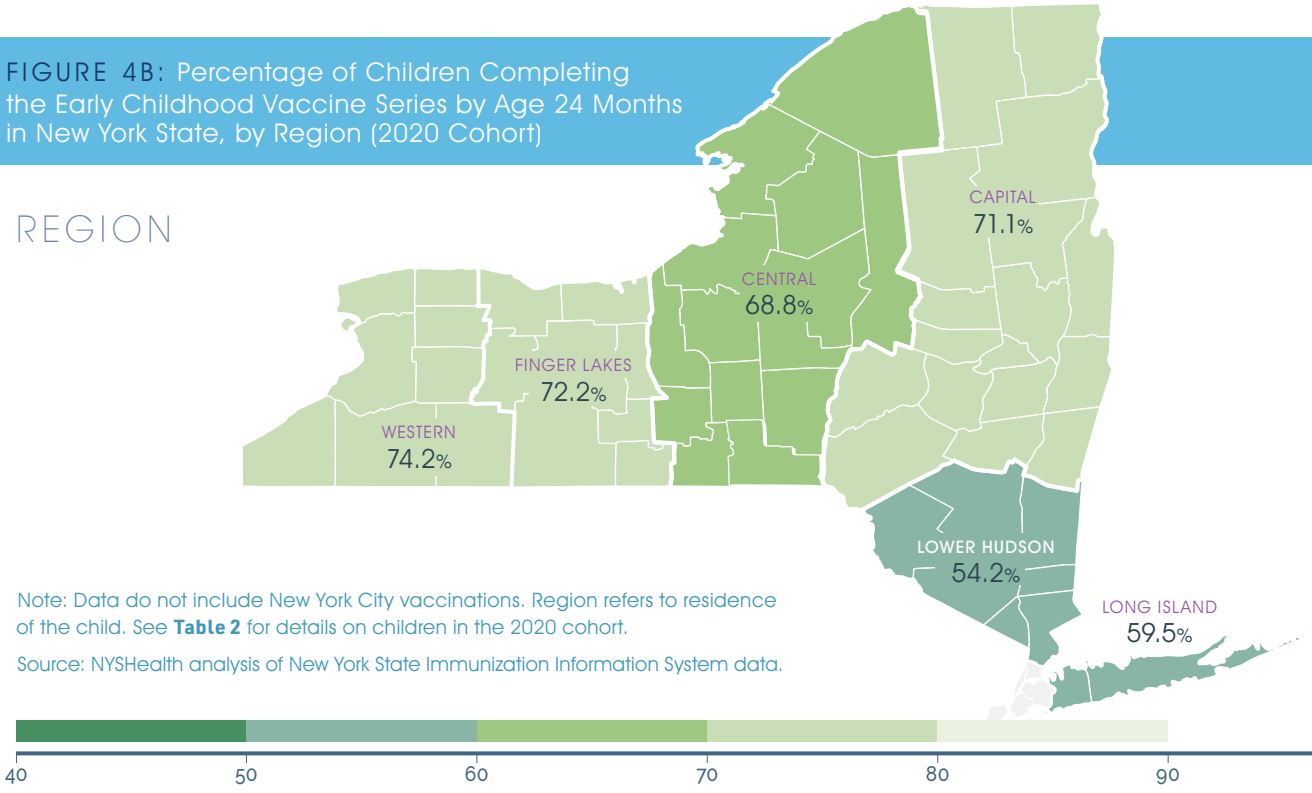
FIGURE 4A: Percentage of Children Completing the Early Childhood Vaccine Series by Age 24 Months in New York State, by County (2020 Cohort)



Note: Data do not include New York City vaccinations. County refers to residence of the child. See **Appendix** for counts and rates for each cohort.

Source: NYSHealth analysis of New York State Immunization Information System data.

FIGURE 4B: Percentage of Children Completing the Early Childhood Vaccine Series by Age 24 Months in New York State, by Region (2020 Cohort)



Note: Data do not include New York City vaccinations. Region refers to residence of the child. See **Table 2** for details on children in the 2020 cohort.

Source: NYSHealth analysis of New York State Immunization Information System data.

Discussion

Steady improvement in childhood vaccination rates is welcome news. Below we examine factors that may have influenced the recent increase in early childhood vaccination coverage. We focus on school vaccination requirements, as those are a driving force for high compliance for childhood vaccines. Moreover, recent changes to the requirements for school-based vaccines may be partially accountable for the increase in vaccination coverage during the 2020 cohort of children studied. We also look at the role of providers and the public health system and provide specific recommendations on how to further improve vaccination coverage.

SCHOOL-BASED FACTORS INFLUENCING RECENT INCREASES IN EARLY CHILDHOOD VACCINATION COVERAGE

Vaccination requirements for daycare, prekindergarten (pre-K), and school attendance are extremely effective mechanisms to ensure that children are receiving their recommended vaccinations. The U.S. Community Preventive Services Task Force recommends such school-based vaccine requirements based on the strong body of evidence demonstrating their effectiveness.[28] To attend daycare or pre-K in New York State, children must receive all seven vaccines within the childhood series (see **Table 3**).[29] To attend grades kindergarten and up, children must receive five out of the seven vaccines (the other two vaccines, PCV and Hib, are recommended only for children under age 5).[30,31]

TABLE 3: School Immunization Requirements in New York State

VACCINE	Required for Daycare or Pre-K	Required for Kindergarten and Up
DTaP	X	X
IPV	X	X
MMR	X	X
Hib	X	
HepB	X	X
Varicella	X	X
PCV	X	

Source: New York State Department of Health. "School Immunization Requirements." New York State Department of Health, September 2020. https://www.health.ny.gov/prevention/immunization/schools/school_vaccines/.

[28] U.S. Community Preventive Services Task Force, "Increasing Appropriate Vaccination: Vaccination Requirements for Child Care, School, and College Attendance - Task Force Finding and Rationale Statement," October 31, 2016, https://www.thecommunityguide.org/sites/default/files/assets/Vaccination-Requirements-for-Attendance_1.pdf.

[29] New York State Department of Health, "School Immunization Requirements," New York State Department of Health, September 2020, https://www.health.ny.gov/prevention/immunization/schools/school_vaccines/.

[30] New York State Department of Health. "School Immunization Requirements."

[31] Centers for Disease Control and Prevention, "Recommended Child and Adolescent Immunization Schedule for Ages 18 Years or Younger, United States, 2020."

Discussion (continued)

Elimination of Non-medical Exemptions

Until recently, religious exemptions from school vaccine requirements meant that tens of thousands of children attended school unvaccinated in New York State. During the 2017–18 school year, more than 26,000 students in New York State (New York City included) had religious exemptions from vaccine requirements.[32] A prior NYSHealth analysis documented the number of religious exemptions per county and the rate of religious exemptions by school, finding the highest rates in the Lower Hudson and Long Island regions.[33]

New York State joined four other states in June 2019 by passing legislation eliminating all non-medical exemptions from school vaccination requirements.[34,35] This new law likely contributed to the increase in the vaccination coverage rate among the 2020 cohort studied, whose vaccination coverage was assessed approximately one year after the law was passed (the rates for the other cohorts of children were assessed either before or immediately after the passage of the law). The law appears to have had the most effect increasing vaccination coverage in regions of the State that previously had the highest rates of religious exemptions, Lower Hudson and Long Island. While the statewide (New York City excluded) vaccination rate increased by 3.2% between the 2019 and 2020 cohorts, the vaccination rates for Long Island and Lower Hudson increased by 6.1% and 4.6%, respectively—a greater percentage increase than any other region.

Improving Access to Daycare and Pre-K

Increases in daycare and pre-K enrollment may explain some of the gains in vaccination coverage from 2018 to 2020, given that the full seven-vaccine early childhood series is required for attendance. Daycare and pre-K attendance ensure that children are protected against all seven vaccine-preventable diseases (whereas grades kindergarten and up only require protection against five). Daycare attendance, which can start before the age of 2 years, also helps ensure that children complete the vaccine series by the age of 2 years, protecting them at an earlier age.

[32] Jesse McKinley, "Measles Outbreak: N.Y. Eliminates Religious Exemptions for Vaccinations (Published 2019)," *The New York Times*, June 13, 2019, sec. New York, https://www.nytimes.com/2019/06/13/nyregion/measles-vaccinations-new-york.html.

[33] NYSHealth, "Potential Impact of Ending Religious Exemptions from School Vaccination Requirements in New York State," July 23, 2019, https://nyshealthfoundation.org/resource/potential-impact-of-ending-religious-exemptions-from-school-vaccination-requirements-in-new-york-state/.

[34] National Conference of State Legislatures, "States With Religious and Philosophical Exemptions From School Immunization Requirements," January 29, 2021, https://www.ncsl.org/research/health/school-immunization-exemption-state-laws.aspx.

[35] S. 2994, 2019-2020 Leg., Reg. Sess. (N.Y. 2019).

Discussion (continued)

Pre-K enrollment increased statewide by approximately 13% from the 2017–18 to 2019–20 school years.[36] Recent investments in pre-K access are likely driving these trends. In 2019, the State invested $15 million in select school districts to increase access to pre-K.[37] The FY 2022 State Budget also directs $105 million of federal funds to expand access to full-day pre-K programs for the 2021–22 school year, providing pre-K funding to 210 districts that do not currently receive State-funded full-day pre-K.[38,39] This additional investment will likely further increase vaccination rates, especially among populations with historically lower rates of vaccination.

PUBLIC HEALTH AND PROVIDER-BASED FACTORS INFLUENCING RECENT INCREASES IN EARLY CHILDHOOD VACCINATION COVERAGE

Advancements of Electronic Health Records and Immunization Information Systems

A key step to increasing vaccination coverage rates is identifying subsets of a patient population that are due or overdue for vaccinations. With technological advancements of electronic health records (EHRs) and immunization information systems, providers can more easily create reports of patients due or overdue for vaccines. Sophisticated EHRs support bidirectional information exchange, allowing providers to submit immunization data from their EHR to the New York State Immunization Information System (NYSIIS) and to request that immunization data from NYSIIS be sent to their EHR.[40] NYSIIS and some EHR systems can also automatically send reminders to parents for upcoming and overdue vaccines.[41]

Reminders can be via mail, phone, or text, and are recommended by the U.S. Community Preventive Services Task Force based on the wide body of research demonstrating their

[36] New York State Education Department, "Archive: Enrollment Data," accessed June 2021, http://www.p12.nysed.gov/irs/statistics/enroll-n-staff/ArchiveEnrollmentData.html.

[37] New York State Office of the Governor, "Governor Cuomo Announces $15 Million to Support Pre-Kindergarten Programs Statewide," December 18, 2019, https://www.governor.ny.gov/news/governor-cuomo-announces-15-million-support-pre-kindergarten-programs-statewide-0.

[38] State of New York Division of the Budget, "Governor Cuomo Announces Highlights of the FY 2022 State Budget to Reimagine, Rebuild and Renew New York," April 6, 2021, https://www.budget.ny.gov/pubs/press/2021/fy22-enacted-budget-highlights.html.

[39] New York State Senate, "Senate Majority Announces Highlights of 2021-22 Budget," April 6, 2021, https://www.nysenate.gov/sites/default/files/press-release/attachment/2021_budget_release.pdf.

[40] Neil Murthy et al., "Progress in Childhood Vaccination Data in Immunization Information Systems — United States, 2013–2016," *MMWR. Morbidity and Mortality Weekly Report* 66, no. 43 (November 3, 2017): 1178–81, https://doi.org/10.15585/mmwr.mm6643a4.

[41] New York City Department of Health & Mental Hygiene, Bureau of Immunization, "New York City Citywide Immunization Registry, Online Registry: Coverage Reports, Reminder/Recall and Text Messaging," https://www1.nyc.gov/assets/doh/downloads/pdf/cir/cir-recall-guide.pdf.

Discussion (continued)

effectiveness.[42] Maximizing the use of New York State's and New York City's immunization information systems to generate vaccine reminders is one of the interventions included in New York's 2019–2024 Prevention Agenda to increase vaccination rates and reduce vaccination coverage disparities.[43]

Quality improvement initiatives are increasing the use of NYSIIS among providers to better track their patients due or overdue for vaccines and generate reminders. The CDC has designed an immunization quality improvement program, known as IQIP, to increase on-time vaccination of children and adolescents among providers that participate in the Vaccines for Children (VFC) program.[44,45] Local health departments in New York State implement the IQIP program and conduct site visits annually to one-quarter of their county's VFC providers.[46] During these visits, local health departments support VFC providers in leveraging NYSIIS to increase vaccination coverage. Continued technical assistance will help providers make full use of NYSIIS to increase vaccination coverage.

Creative Solutions Mitigated Drops in Vaccination Coverage During the COVID-19 Pandemic

Early childhood vaccination coverage for the 2020 cohort increased from the prior year's cohort despite the onset of the COVID-19 pandemic. This is likely, at least in part, because of providers' implementation of creative solutions to continue vaccinating children during the pandemic.[47] Some providers have been administering vaccines via drive-through clinics so children do not need to enter the building. Other clinics have asked patients to wait in their cars until the exam room for their appointment is ready, eliminating time spent in waiting rooms where COVID-19 transmission could occur. Clinics have also been modifying

[42] U.S. Community Preventive Services Task Force, "Increasing Appropriate Vaccination: Client Reminder and Recall Systems - Task Force Finding and Rationale Statement," July 15, 2015, https://www.thecommunityguide.org/sites/default/files/assets/Vaccination-Client-Reminders.pdf.

[43] New York State Department of Health, "New York State Prevention Agenda 2019-2024: Prevent Communicable Diseases Priority Action Plan."

[44] The Vaccines for Children program provides vaccines purchased by the federal government to providers to administer to low-income children. See: Centers for Disease Control and Prevention, "Vaccines for Children Program," February 18, 2016, https://www.cdc.gov/vaccines/programs/vfc/index.html.

[45] Centers for Disease Control and Prevention, "Immunization Quality Improvement for Providers," July 13, 2020, https://www.cdc.gov/vaccines/programs/iqip/index.html.

[46] New York State Association of County Health Officials. "Update LHD IAP Work Plan (for the period starting 4/1/20)." Document obtained via email correspondence with NYSACHO.

[47] Advisory Board, "More Kids Are Going Unvaccinated Due to Lockdowns. Here Are the Creative Ways Providers Are Tackling the Problem.," April 27, 2020, https://www.advisory.com/Daily-Briefing/2020/04/27/vaccination-rates.

Discussion (continued)

their appointment scheduling to minimize risk, scheduling well-child visits in the morning and sick visits during the afternoons. Some providers have been bringing vaccines into the community, using mobile vaccination units and at-home visits.[48]

WHAT MORE CAN BE DONE TO INCREASE VACCINATION COVERAGE AND ELIMINATE DISPARITIES?

While New York State has made progress in recent years, disparities remain in early childhood vaccination rates by race, ethnicity, and geography. Vaccination initiatives should consider the following strategies to close disparities and protect more children from vaccine-preventable disease.

Track Vaccine Hesitancy and Combat it with Effective Provider Communication

New York is not immune to the growing national trend of vaccine hesitancy, defined by the World Health Organization as the "the reluctance or refusal to vaccinate despite the availability of vaccines."[49] The COVID-19 pandemic has possibly increased rates of vaccine hesitancy by increasing public distrust in the scientific community. Furthermore, the rapid development of COVID-19 vaccines has generated significant distrust in their safety. It is possible vaccine hesitancy specific to COVID-19 vaccines will create spillover effects impacting public opinion of other vaccines.

Vaccine hesitancy and opposition thrive online, with the ability to reach all corners of the State. Tracking "outbreaks" of vaccine hesitancy online is vital to anticipate where vaccination rates are at risk of dropping. The Public Good Projects, a public health nonprofit, tracks communications spread by anti-vaccine organizations and bots through a media surveillance system called Project VCTR. This information can better equip public health officials, health care systems, and health care providers to counter vaccine disinformation.

Vaccine hesitancy can be resistant to compliance mechanisms discussed in the previous section. For example, after the elimination of non-medical exemptions to school vaccination requirements in New York State in 2019, data suggest that some families of children who had non-medical exemptions took other measures to avoid vaccination. A November 2019 survey of public and private schools in upstate New York found that 57% of nonpublic schools and

[48] Jan Hoffman, "Vaccine Rates Drop Dangerously as Parents Avoid Doctor's Visits," *The New York Times*, April 23, 2020, sec. Health, https://www.nytimes.com/2020/04/23/health/coronavirus-measles-vaccines.html.

[49] World Health Organization, "Ten Threats to Global Health in 2019," accessed June 2021, https://www.who.int/news-room/spotlight/ten-threats-to-global-health-in-2019.

Discussion (continued)

38% of public schools reported decreases in student enrollment because of the law, while 17% of both types of schools reported increases in medical exemptions.[50]

Vaccine hesitancy is responsive to effective communication strategies, particularly by physicians and other health care providers. Evidence shows that a strong provider recommendation is one of the most influential factors determining a parent's likelihood to vaccinate their child.[51,52] New York State providers should be trained in effective communication strategies to maximize the likelihood that their patients will be immunized. For example, vaccine uptake is more likely when a provider recommends a vaccine using a presumptive approach (e.g., "Today, we'll do the Hep A vaccine") instead of a participatory approach (e.g., "Are we going to do the Hep A vaccine today?").[53] Motivational interviewing techniques, a communication approach that leverages a patient's inherent motivations, is also effective in vaccine uptake.[54] Local health departments in New York State currently provide annual trainings to pediatricians, family practitioners, and school nurses about such evidence-based strategies to increase vaccination among populations with low or lagging rates. Trainings specific to communication strategies to mitigate vaccine hesitancy will be particularly important in the coming year. Trainings can also be targeted to areas of the State identified as hotspots for vaccine hesitancy.

Catch Up Children Who Have Fallen Behind on Vaccine Series During COVID-19 and Build Upon Innovative COVID-19 Interventions That Work

In April 2021, nearly 1 in 4 adults living with children in the household reported that at least one child missed, delayed, or skipped any preventive check-up in the last 12 months

[50] Margaret K. Doll et al., "Impact of the New York State Repeal of Nonmedical Vaccination Exemptions on Schools: Perspectives from a Survey of School Administrators," 2020, https://acvr.nfid.org/wp-content/uploads/2020/06/Maggie-Doll-Doll-et-al _ NYS-religious-exemptions-NFID.pdf.

[51] Amanda F. Dempsey and Gregory D. Zimet, "Interventions to Improve Adolescent Vaccination: What May Work and What Still Needs to Be Tested," *American Journal of Preventive Medicine* 49, no. 6 Suppl 4 (December 2015): S445-454, https://doi.org/10.1016/j.amepre.2015.04.013.

[52] Carol M. Kao, Rebecca J. Schneyer, and Joseph A. Bocchini, "Child and Adolescent Immunizations: Selected Review of Recent US Recommendations and Literature," *Current Opinion in Pediatrics* 26, no. 3 (June 2014): 383–95, https://doi.org/10.1097/MOP.0000000000000093.

[53] Annika M. Hofstetter et al., "Clinician-Parent Discussions about Influenza Vaccination of Children and Their Association with Vaccine Acceptance," *Vaccine* 35, no. 20 (May 9, 2017): 2709–15, https://doi.org/10.1016/j.vaccine.2017.03.077.

[54] Douglas J Opel et al., "'Presumptively Initiating Vaccines and Optimizing Talk with Motivational Interviewing' (PIVOT with MI) Trial: A Protocol for a Cluster Randomised Controlled Trial of a Clinician Vaccine Communication Intervention," *BMJ Open* 10, no. 8 (August 2020): e039299, https://doi.org/10.1136/bmjopen-2020-039299.

Discussion (continued)

because of the coronavirus pandemic.[55] Immunizations are a key part of preventive check-ups for young children. New York State and New York City should maximize use of their immunization information systems to identify which children are behind on their vaccinations because of the coronavirus pandemic and conduct targeted outreach to vaccinate them. Local health departments should consider providing additional technical assistance to providers to identify these children. Once children who have missed vaccinations have been identified, innovative strategies launched during the pandemic—like drive-through vaccinations, mobile vaccination units, and at-home visits—can be built upon to catch up this population. These strategies can also help bring up vaccination rates among communities with historically lower coverage, including communities of color and certain geographic areas.

Use Standing Orders in High-need Areas to Expand Vaccination Availability

Standing orders permit nurses, pharmacists, and other health care personnel to assess a patient's immunization status and administer vaccinations according to a protocol approved by their institution. Signed by a medical director in a health care setting, a physician, or another authorized practitioner, standing orders waive the need for examination or direct order from the attending provider during the patient visit. The U.S. Community Preventive Services Task Force found strong evidence for the effectiveness of standing orders in increasing vaccination rates among children and recommends their use.[56] Implementing and promoting the use of standing orders is one of the interventions included in New York State's 2019–2024 Prevention Agenda to increase vaccination rates and reduce vaccination coverage disparities.[57] In areas of the State with provider shortages, standing orders may be particularly effective to increase the number of health care personnel authorized to administer vaccinations. Clinics run by local health departments face particular barriers to implementing standing orders, as not all county health departments have the authority to issue standing orders. A statewide blanket standing order, or a change to public health law, would allow more health care personnel to administer vaccines to children at county-run clinics, maximizing their impact.

[55] NYSHealth analysis of weeks 28 and 29 of Household Pulse Survey data. Data available from: U.S. Census Bureau, "Household Pulse Survey Public Use File (PUF)," accessed June 2021, https://www.census.gov/programs-surveys/household-pulse-survey/datasets.html.

[56] U.S. Community Preventive Services Task Force, "Increasing Appropriate Vaccination: Standing Orders - Task Force Finding and Rationale Statement," January 20, 2016, https://www.thecommunityguide.org/sites/default/files/assets/Vaccination-Standing-Orders.pdf.

[57] New York State Department of Health, "New York State Prevention Agenda 2019-2024: Prevent Communicable Diseases Priority Action Plan."

Discussion (continued)

Study Potential for Pharmacists as Pediatric Vaccinators

In recent years, many states have begun expanding the types of providers who can administer vaccinations, either by expanding a licensure's scope of practice or through standing order procedures.[58] While all states grant the authority to pharmacists to vaccinate, each state has different rules regarding the vaccines they can administer and the age groups they can vaccinate. About half of U.S. states allow pharmacists to administer vaccines to patients of any age; however, in New York State, certified pharmacists are only authorized to administer one vaccine to children—the seasonal flu shot.[59,60]

Recognizing the potential of pharmacists to increase childhood vaccination coverage during the coronavirus pandemic, the U.S. Department of Health and Human Services (HHS) issued a directive in August 2020 authorizing state-licensed pharmacists in all 50 states to administer vaccines to children ages 3–18 years.[61] In September 2020, HHS also authorized state-licensed pharmacists in all states to administer the COVID-19 vaccine to persons ages 3 and older, as ages are authorized by the U.S. Food and Drug Administration (as of June 2021, pharmacists may administer COVID-19 vaccines to children ages 12 and up).[62,63] New York State should conduct an assessment of pharmacists providing pediatric vaccinations under this authorization to evaluate its outcomes. If the benefits to vaccination coverage are large, and the risks minimal, the evidence may point in favor of permanently authorizing pharmacists to provide pediatric vaccines.

[58] National Council of State Legislatures, "State Immunization Policy Overview," accessed June 2021, https://www.ncsl.org/research/health/immunizations-policy-issues-overview.aspx.

[59] APhA and National Alliance of State Pharmacy Associations, "Pharmacist-Administered Vaccines: Based on APhA/NASPA Survey of State IZ Laws/Rules," September 2020, https://naspa.us/wp-content/uploads/2020/08/IZ-Authority-9_2020.pdf.

[60] New York State Education Department, Office of the Professions, "NYS Pharmacy: FAQ: Administration of Immunizations," accessed June 2021, http://www.op.nysed.gov/prof/pharm/pharmimmunizationfaq.htm#.

[61] U.S. Department of Health & Human Services, "HHS Expands Access to Childhood Vaccines during COVID-19 Pandemic," August 19, 2020, https://www.hhs.gov/about/news/2020/08/19/hhs-expands-access-childhood-vaccines-during-covid-19-pandemic.html.

[62] U.S. Department of Health & Human Services, Office of the Assistant Secretary for Health, "Guidance for Licensed Pharmacists and Pharmacy Interns Regarding COVID-19 Vaccines and Immunity under the PREP Act," September 3, 2020, https://www.hhs.gov/guidance/sites/default/files/hhs-guidance-documents/licensed-pharmacists-and-pharmacy-interns-regarding-covid-19-vaccines-immunity.pdf.

[63] Centers for Disease Control and Prevention, "COVID-19 Vaccination Federal Retail Pharmacy Partnership Program," April 12, 2021, https://www.cdc.gov/vaccines/covid-19/retail-pharmacy-program/index.html.

Conclusion

From 2018 to 2020, New York State made progress increasing early childhood vaccination coverage rates that appear to be part of a decade-long trend. The improvement may have been influenced by school-based factors, like the elimination of non-medical exemptions to vaccine requirements and increased enrollment in pre-K programs. Public health and provider-based factors likely helped increase vaccination coverage, as technological advances allow providers to better identify children due or overdue for vaccinations and generate parent reminders.

Despite this progress, New York's overall vaccination coverage rate falls short of State and federal objectives, and is far below target in pockets of the State. Furthermore, disparities by race and ethnicity have not closed despite overall increases in vaccination coverage. These gaps in vaccination coverage leave communities of New Yorkers more susceptible to preventable disease and can result in outbreaks such as the recent measles outbreaks in parts of the State. New York should expand upon school-, public health-, and provider-based strategies shown to improve vaccination coverage to help keep our youngest New Yorkers healthy and protected against vaccine-preventable diseases.

Methods

DATA

The data used for the analysis were obtained from the New York State Immunization Information System (NYSIIS). We are grateful to Claire McGarry, Research Scientist at NYSIIS, for fulfilling the data request.

Since January 1, 2008, all health care providers in New York State are required to report all immunizations administered to persons less than 19 years of age to the State Department of Health via NYSIIS.[64] NYSIIS does not contain data for immunizations administered in New York City, which manages its own immunization registry.

See **Appendix** for the denominator and vaccination coverage rate for the groups of cohorts studied (overall, by race/ethnicity, and by county).

CALCULATION OF RATES

For each cohort analyzed in this report (see next section), the early childhood vaccination coverage rate is calculated as the percentage of the applicable population (children ages 24 through 35 months with a record in NYSIIS and part of the specific birth cohort) that completed the vaccine series before the age of 2 years.

$$\text{vaccination coverage} = \left(\frac{\text{children ages 24-35 months who completed childhood series before age 2 years}}{\text{all children ages 24-35 months with } \geq 1 \text{ administered childhood series vaccine recorded in NYSIIS}} \right) \times 100$$

Vaccination coverage analyses typically use data from an immunization information system or census data for the denominator.[65] In this analysis, the data for the denominator is based on NYSIIS.

Vaccination coverage was assessed using a point-in-time assessment, as of July 1st of each year. A point-in-time assessment is an appropriate method to track coverage rates over time, as it allows cohorts from one assessment period to the next to be held to the same age range.[66]

[64] New York State Department of Health, "New York State Immunization Information System (NYSIIS)," accessed March 30, 2021, https://www.health.ny.gov/prevention/immunization/information_system/.

[65] American Immunization Registry Association, "Analytic Guide for Assessing Vaccination Coverage Using an IIS," November 2015, https://repository.immregistries.org/resource/analytic-guide-for-assessing-vaccination-coverage-using-an-iis/.

[66] American Immunization Registry Association, "Analytic Guide for Assessing Vaccination Coverage Using an IIS."

Methods (continued)

COHORTS STUDIED

Vaccination coverage was assessed among the three cohorts of children in the following table. Only children with at least one administered childhood series vaccine recorded in NYSIIS are included in each cohort.

Cohorts of Children Studied

Cohort Name	Coverage assessed on July 1 of (within age range of 24–35 months on this date)	Children born	Number of children in cohort
2018 Cohort	2018	July 2, 2015–July 1, 2016	132,538
2019 Cohort	2019	July 2, 2016–July 1, 2017	123,976
2020 Cohort	2020	July 2, 2017–July 1, 2018	122,235

Source: NYSHealth analysis of New York State Immunization Information System data.

CATEGORIZATIONS

For analyses by race and ethnicity, children with an ethnicity of Hispanic or Latino recorded in NYSIIS were categorized as Hispanic or Latino. Children with an ethnicity of Non-Hispanic or Latino or Ethnicity Unknown were categorized as Black or African American, white, or Asian, according to their race identified in NYSIIS. Children with an ethnicity of Ethnicity Unknown were categorized by race to maintain as much race data as possible. An analysis was also conducted where children with an ethnicity of Ethnicity Unknown were excluded from the analysis, and the vaccination coverage trends by race and ethnicity were similar to those produced by the less restrictive categorization approach. Geographic analyses are based on the residence of the child recorded within NYSIIS.

Limitations

All findings in this report describe vaccination coverage for New York State, exclusive of New York City. Readers should interpret the findings as representative of only the 57 counties outside of New York City, which represent about half of the statewide population of children ages 24–35 months.[67]

A widely used data source for immunization rate surveillance is the National Immunization Surveys (NIS), which are telephone surveys conducted by the CDC's National Center for Immunization and Respiratory Diseases. However, NIS data are reported with a two-year lag and confidence intervals for local estimates are often wide, limiting their usefulness for vaccination program design.[68]

In this analysis, NYSIIS data were used to provide a more timely analysis of vaccination coverage trends. Rates calculated from NYSIIS data have been historically lower than rates calculated from annual NIS data, in part because of incomplete reporting.[69] It has also been shown that the denominator for measures based on immunization information systems may be overestimated because of movement out of state (i.e., children who move into a state have records added to the immunization information system, while children who move out of that state may not be immediately removed from the system) and duplicate records.[70] However, aside from being more timely, another key advantage of using the immunization information system data to analyze coverage rates is that the same data source can be used for the denominator and the numerator. Also, a national comparison of immunization information systems and NIS data found that immunization information systems are becoming more complete over time and vaccination coverage estimates from immunization information systems are becoming increasingly close to NIS estimates.[71]

From 2018 to 2020, between 21% and 25% of records in NYSIIS were missing both a race and an ethnicity categorization; these gaps may have affected the vaccination rates in the race and ethnicity analyses. However, a nationwide study found similar disparities by race and ethnicity.[72]

[67] New York State Department of Health, "Table 1: Estimated Population by Age, Sex and Region, New York State - 2018."

[68] Centers for Disease Control and Prevention, "Validation of an Immunization Information System Against the National Immunization Survey and Improvement of Hepatitis B Birth Dose Coverage in New York City," accessed April 13, 2021, https://cdc.confex.com/cdc/nic2008/techprogram/P15344.HTM.

[69] Hoefer, "Immunization Coverage in NYS: Impact of Programmatic Activities and Policies on 4:3:1:3:3:1:4 Rates."

[70] American Immunization Registry Association. "Analytic Guide for Assessing Vaccination Coverage Using an IIS.

[71] Murthy et al., "Progress in Childhood Vaccination Data in Immunization Information Systems — United States, 2013–2016."

[72] Hill et al., "Vaccination Coverage by Age 24 Months Among Children Born in 2016 and 2017 — National Immunization Survey-Child, United States, 2017–2019."

Appendix

	2018 Children born between Aug 1, 2015–Jul 1, 2016		2019 Children born between Aug 1, 2016–Jul 1, 2017		2020 Children born between Aug 1, 2017–Jul 1, 2018	
	Total	Vaccination Coverage (%)	Total	Vaccination Coverage (%)	Total	Vaccination Coverage (%)
OVERALL	132,538	59.4	123,976	62.5	122,235	64.5
RACE/ETHNICITY						
White	63,936	65.2	59,140	67.0	56,208	69.4
Hispanic or Latino	13,714	61.0	12,095	61.9	11,079	64.7
Black or African American	11,529	59.5	11,092	61.1	10,222	62.0
Asian	4,354	55.8	3,812	61.6	3,567	67.4
COUNTY						
Albany	3,925	59.9	3,780	62.2	3,516	64.6
Allegany	483	74.7	424	76.7	417	77.2
Broome	2,144	58.9	2,124	54.7	2,024	61.6
Cattaraugus	843	68.0	772	72.8	748	70.1
Cayuga	760	71.4	760	70.1	717	74.3
Chautauqua	1,492	71.0	1,334	72.9	1,315	76.3
Chemung	946	65.2	1,107	52.3	1,069	44.2
Chenango	540	66.7	581	61.3	525	64.0
Clinton	828	76.9	854	78.0	787	80.9
Columbia	522	65.7	491	74.9	467	67.7
Cortland	518	79.2	501	74.7	445	80.4
Delaware	307	67.4	330	66.7	343	68.2
Dutchess	3,045	57.0	2,768	63.4	2,788	67.4
Erie	10,864	72.6	10,244	75.7	10,226	75.9
Essex	302	63.2	282	60.3	269	71.7
Franklin	481	63.6	486	66.0	419	69.0
Fulton	559	65.3	487	58.7	519	60.3
Genesee	618	80.4	677	67.7	839	59.5
Greene	425	63.1	383	58.2	410	68.3
Hamilton	27	66.7	24	66.7	23	69.6
Herkimer	590	67.3	622	65.9	610	65.4
Jefferson	2,259	44.3	2,073	47.4	1,981	49.2
Lewis	322	80.1	302	81.8	295	81.7
Livingston	607	77.1	513	84.2	501	82.2
Madison	683	70.7	634	74.6	676	72.6

continued

Appendix (continued)

	2018 Children born between Aug 1, 2015–Jul 1, 2016		2019 Children born between Aug 1, 2016–Jul 1, 2017		2020 Children born between Aug 1, 2017–Jul 1, 2018	
	Total	Vaccination Coverage (%)	Total	Vaccination Coverage (%)	Total	Vaccination Coverage (%)
Monroe	8,712	74.3	8,268	76.8	8,373	77.4
Montgomery	685	57.7	622	62.5	622	58.5
Nassau	15,509	48.1	14,317	52.1	14,050	56.4
Niagara	2,274	68.1	2,235	74.0	2,164	75.0
Oneida	2,658	69.6	2,526	69.6	2,665	67.6
Onondaga	6,455	66.8	5,721	70.9	5,534	75.1
Ontario	1,152	63.3	1,063	70.7	1,052	70.7
Orange	5,354	43.1	5,191	45.4	5,069	46.6
Orleans	441	65.3	404	65.3	471	62.0
Oswego	1,433	69.3	1,352	74.7	1,232	80.5
Otsego	520	74.2	510	76.7	464	76.9
Putnam	956	59.5	893	62.3	982	64.8
Rensselaer	1,757	69.2	1,700	72.6	1,608	73.7
Rockland	5,820	40.9	5,533	42.7	5,411	42.1
Saratoga	2,692	73.8	2,379	76.3	2,237	78.0
Schenectady	1,907	70.1	1,741	73.1	1,868	72.7
Schoharie	283	67.8	248	66.9	277	70.8
Schuyler	184	72.3	151	73.5	134	56.0
Seneca	301	42.9	309	59.2	332	66.9
St. Lawrence	1,089	70.8	1,015	74.4	982	78.5
Steuben	1,082	66.2	1,085	61.8	1,140	55.0
Suffolk	17,707	52.0	16,177	59.6	16,015	62.1
Sullivan	930	44.7	918	48.7	857	55.0
Tioga	527	48.6	478	48.3	489	49.3
Tompkins	947	66.3	910	64.2	845	65.0
Ulster	1,647	54.8	1,566	59.0	1,470	66.2
Warren	803	64.6	599	76.5	576	81.3
Washington	729	58.3	612	71.2	532	75.2
Wayne	1,109	75.6	967	75.9	1,037	81.4
Westchester	11,391	55.2	10,770	55.0	10,750	57.8
Wyoming	393	71.5	383	77.3	428	70.6
Yates	272	44.5	278	55.8	266	59.0

Source: NYSHealth analysis of New York State Immunization Information System data.

Note: The population sizes by subgroup may not add up to the total because of missing race/ethnicity and geographic information. See Methods in main report for more details on the data.

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