Economic Analysis of Implementing Five Practices for Increasing COVID-19 Pediatric Vaccine Coverage

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Project and Goal

- **Project.** In February 2023, the Association for Immunization Managers (AIM)—in partnership with Centers for Disease Control and Prevention—engaged Mathematica to identify promising practices used during the COVID-19 public health emergency (PHE) to improve COVID-19 vaccination uptake among children ages 6 months to 11 years. As part of this work, AIM and Mathematica conducted feasibility, policy, and economic analyses of these practices. This poster summarizes findings from the **economic analysis**.
- **Goal.** Our goal in conducting this economic analysis was to quantify *possible* costs and benefits for each of the promising practices under a hypothetical implementation scenario—with the longer-term aim of informing more rigorous (non-hypothetical) future economic analyses.
- **Promising practices.** The five promising practices included:
  - ***Targeted outreach***. Conducting targeted outreach to Medicaid beneficiaries, including children, by linking Immunization Information System and Medicaid data
  - ***Basic needs***. Partnering to connect opportunities to vaccinate children with the chance to address basic needs of families
  - ***Mobile clinics.*** Using mobile clinics to **offer vaccinations to children and others at community locations**
  - ***At-home visits.*** Delivering vaccinations to children at home
  - ***Provider support.*** Reducing operational barriers to help pediatric providers vaccinate children

Context and Assumptions

- **Context.** For each practice, we developed a hypothetical implementation scenario for an average county in the United States with 116,000 residents and a target population of nearly 15,000 children ages 6 months through 11 years, of whom 11,700 were not fully **vaccinated against COVID-19 (regardless of vaccine formula). Across all five practices, we considered major** benefits related to reduction in caretaker time, reduction in deaths, reduction in inpatient hospitalizations and other health care costs, and reduction in learning loss. Cost categories included program administration, vaccination, training, outreach, wastage, refrigeration and storage, and staff time, though some practices did not have costs in each category.
- **Key Assumptions.** We estimated that 78 percent of children were not fully vaccinated and that, during the pandemic, vaccine wastage rates were approximately 8 percent. Based on an estimate from the Kaiser Family Foundation, we assumed the average vaccine cost (per **dose**) was approximately $29, with the understanding that this cost increased substantially due to commercialization. Finally, a variety of assumptions applied to benefits estimated across all five practices, such as the economic value of a life saved ($1,655, 868).
- **Generalizability.** Costs and benefits were valued during the pandemic (2021); it is likely that the costs of administering programs (particularly the labor costs for nurses), health care costs, and the value of the benefits of receiving vaccinations will change after the pandemic. During the PHE, the federal government paid for all vaccines, but after the PHE, the federal government (through the Vaccines for Children program) and health insurance plans pay for vaccines. Jurisdictions implementing the basic needs, mobile clinics, at-home vaccination, and provider support practices after the public health emergency will need to consider how to support providers in billing multiple insurers and managing different stocks of vaccines.

About AIM

The Association of Immunization Managers (AIM) is a nonprofit membership association comprised of the directors of the 64 federally funded state, territorial, and local public health immunization programs. AIM is dedicated to working with its partners nationwide to reduce, eliminate, or eradicate vaccine-preventable diseases. AIM also works to ensure the success of its members by providing support in their programming interests. Since 1999, AIM has enabled collaboration among immunization managers to effectively control vaccine-preventable diseases and improve immunization coverage in the United States.

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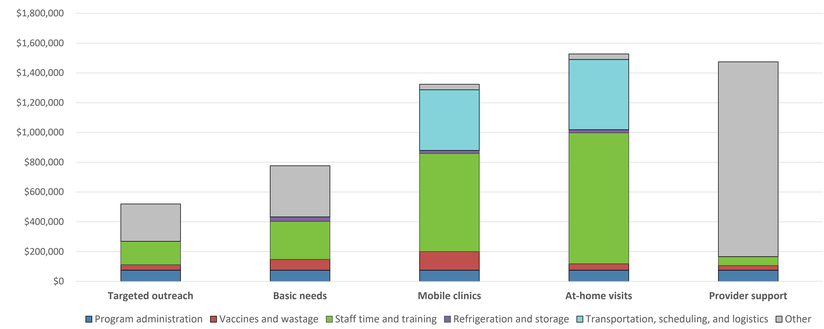
Results

Costs. For each practice, we estimated the costs for the categories that were applicable to that practice. We calculated programmatic costs incurred by immunization programs and partners, and the total costs (including programmatic costs and the costs of vaccine and wastage). Figure 1 presents the total cost perspective, which includes all costs that we could measure regardless for who **paid for or incurred them.**

Figure 1. Summary of costs for delivering each promising practice, by major cost category



Notes: (1) the "Other" category includes all costs that were not common across more than two practices; (2) some practices, such as the provider support, were dominated by "Other" costs idiosyncratic to that practice, such as the cost of funding and managing the grant programs; (3) see references for additional sources.

Benefits. We assume each practice incurred the same benefits per 1,000 vaccinations administered. This means that practices that result in more vaccinations generate greater benefits. Table 1 describes our assumptions and calculations surrounding the adverse events prevented per 1,000 vaccinations.

Table 1. Benefits due to adverse events prevented per 1,000 vaccines, for the five practices

Events	Events averted / 1000 vaccines	Cost / event	Total benefit	Targeted Outreach (1,170 vaccinations)	Basic Needs (2,340 vaccinations)	Mobile Clinics (4,000 vaccinations)	At-home Visits (1,400 vaccinations)	Provider Support (1,000 vaccinations)
Deaths	0.54	$1,655,858	$894,169	$1,046,178	$2,092,355	$3,576,676	$1,251,837	$894,169
Hospitalizations	3.10	$24,826	$76,961	$90,044	$180,089	$307,844	$107,745	$76,961
Reduction in other health care costs	28.41	$1,008	$28,637	$33,505	$67,011	$114,548	$40,092	$28,637
Reduction in learning loss	28.41	$378	$10,739	$12,565	$25,129	$42,956	$15,035	$10,739
Reduction in caretaker time	28.41	$975	$27,700	$32,409	$64,818	$110,800	$38,780	$27,700
Total benefits per 1,000 vaccinations administered			**$1,038,205**	**$1,214,700**	**$2,429,400**	**$4,152,821**	**$1,453,487**	**$1,038,205**

Notes: (1) Column totals may not sum exactly due to rounding; (2) Borchering (2023) estimated the number of adverse events (cases, hospitalizations, and deaths across all age groups) that would be prevented by a childhood vaccination campaign within a 6-month time-frame, assuming 54% of the 28 million children ages 5 to 11 in the US would be vaccinated; (3) see references for additional sources. Benefits for each practice are scaled by the number of vaccinations administered by that practice (so those practices that administered more than 1,000 vaccines generated higher benefits).

Summary. After calculating the key costs and benefits, three practices—mobile clinics, basic needs, and targeted outreach—had a benefit-cost ratio greater than 1, indicating the benefits outweighed the costs. Table 2 summarizes the ranking of practices by cost-benefit ratio from the perspective of the total costs and benefits.

Table 2. Summary and ranking of promising practices by benefit-cost ratio from the perspective of the total costs (including programmatic and vaccine costs)

Cost/benefit	Targeted outreach	Basic needs	Mobile clinics	At-home vaccination	Provider support
Ranking	**3**	**2**	**1**	**4**	**5**
Vaccines delivered by practice	1,170	2,340	4,000	1,400	1,000
Total costs of practice, programmatic perspective (excludes costs of vaccines and waste)	$408,750	$809,000	$1,199,058	$1,484,216	$1,443,000
Total costs of practice, societal perspective (includes programmatic costs and costs of vaccines)	$445,255	$776,711	$1,323,863	$1,527,898	$1,474,601
Total benefits of practice	$1,214,700	$2,429,400	$4,152,821	$1,453,487	$1,038,205
Net benefits (not discounted, equal to total benefits minus total costs)	$769,445	$1,652,690	$2,828,959	($74,410)	($436,396)
Present value of net benefits (assuming 1.33 percent annual discount rate)	$763,686	$1,640,594	$2,808,262	($76,236)	($435,750)
Benefit-cost ratio	**2.73**	**3.13**	**3.14**	**.95**	**.70**

Notes: Benefit-cost ratio is the ratio of present value benefits to costs for the practice. A ratio greater than 1 indicates a favorable outcome. The benefit-cost ratio is less biased than the net present value toward practices with larger overall costs but does not indicate the magnitude of a practice's economic impact in dollars. Total benefits are calculated by multiplying $1,038,205 per 1,000 vaccines by the number of vaccines (in thousands) delivered by the Practice.

Conclusions and Sensitivity Analysis

Conclusions. The mobile clinics practice had the largest benefit-cost ratio, 3.14. This practice is associated with moderate-to-high implementation costs (over $1 million) and was approximately twice the cost to implement as the lowest-cost practice (targeted outreach), which was ranked third. However, it had a high benefit-cost ratio due to the large number of vaccinations generated by this practice (based on interviews we conducted with the Los **Angeles County Department of Public Health in the Vaccine Preventable Disease Control Unit, we assumed a mobile clinic could serve 20 patients a day); this** in turn generated the largest benefits (through reducing deaths, inpatient hospitalizations, other health care costs, learning loss, and caretaker time). It also has the advantage of bringing vaccination clinics to locations (such as supermarkets) that children and families frequently visit, rather than encouraging families to travel to a new, potentially out-of-the-way, location.

The basic needs and targeted outreach practices showed the second and third highest benefit-cost ratios, respectively. The basic needs practice benefits from the use of community-based locations which reaches a greater population of children and families, thereby increasing overall benefits. The provider support practice had the lowest benefit-cost ratio (0.70) which was due to limited evidence of a large increase in vaccinations for this type of practice.

Sensitivity Analysis. To assess the robustness and reliability of the practice benefit-cost ratios and rankings, we conducted a sensitivity analysis by systematically varying key assumptions, such as those related to the reduction in deaths. The overall cost-benefit ratios are quite sensitive to our assumptions related to the number and value of deaths averted, as the benefit due to deaths averted is the largest driver of benefits. However, while altering this assumption has a substantial impact on the magnitude of the cost-benefit ratios, it does not impact the relative ranking of practices.

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