

Cost of Implementation Report for Dissemination and Implementation of Effective Childhood Obesity Treatment Innovations

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This Investigator received supplemental award funding to collect, measure, and report out the costs associated with implementing the intervention that is the focus of the PCORI-funded implementation project DI-2017C3-9005. These estimated costs are intended to serve as a useful resource to inform adoption decisions by future healthcare sites and systems.

This report was prepared by the Investigator and submitted to PCORI as a project deliverable. Please note that this report does not necessarily represent the views of PCORI and that PCORI cannot guarantee its accuracy or reliability. For more information about this report, please contact the Project Team at connectforhealth@partners.org.

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Summary of Results

Connect for Health is a pediatric weight management program that leverages clinical and community resources to improve outcomes for children with overweight and obesity. The program is intended for delivery in primary care for children ages 2-12 years with a BMI \geq 85th percentile during a well-child visit. Three sites implemented the *Connect for Health* program, using stakeholder engagement to tailor program resources and implementation strategies to their context. We found that the costs per healthcare organization to implement this program ranged from \$67,671 – \$128,070. Variation in costs was driven by contextual factors (e.g., type of care provided, available resources) and how sites chose to implement the program based on stakeholder input. Across all sites, major drivers of the costs include purchasing and maintaining the texting program, integrating the clinical tools into the electronic health record (EHR) system, and engaging stakeholders to adapt program materials and inform implementation strategies. Future sites should expect to pay for text-messaging startup costs, though the exact amounts will vary based on existing in-house technical capabilities, available vendors, and vendors' information security options. Sites should also expect to spend time tailoring the program to their local context and community resources, understanding how to integrate the clinical tools into their EHR system, and engaging clinicians and families to assess barriers, facilitators, and implementation readiness. Once the program has begun, the main costs to consider will be providing audit and feedback reports to clinicians throughout the active implementation period, providing training and practice facilitation where needed, and conducting maintenance of program materials and tools. Non-site-based costs are nominal and include the maintenance of the websites, the virtual learning community, and the family educational materials and community resource guide.

Overview of *Connect for Health*

Connect for Health is a pediatric weight management program that leverages clinical and community resources to improve family-centered outcomes for children with overweight and obesity. The program is intended for delivery in primary care for children ages 2-12 years with a BMI \geq 85th percentile during a well-child visit. A one-year randomized controlled, comparative effectiveness trial that enrolled 721 children found that both intervention arms improved family-centered outcomes and child body mass index (BMI).^{1,2} Based on the findings of the trial, the program was then adapted and implemented in three healthcare organizations that care for children from low-income communities and have a disproportionately high prevalence of obesity.^{3,4} The objectives of the program's implementation were to promote and facilitate the uptake of the evidence-based program generated by the trial and evaluate the effectiveness of the implementation strategies.⁴ The long-term goal is to reduce obesity prevalence and related disparities by systematically improving the care and outcomes of low-income children with obesity.

The three healthcare organizations (i.e., sites) that implemented *Connect for Health* were Denver Health, Massachusetts General Hospital (MGH), and Prisma Health. The sites all have community health centers or pediatric practices that serve children. Implementation occurred in practice types that include pediatric primary care, family-medicine, Med-Peds, and school-based. Implementation began in the fall of 2019 and ended in April 2021 for Denver Health and April 2022 for MGH and Prisma Health. Major characteristics of each site are shown in Table 1.

Table 1. Major characteristics and contextual information of implementing healthcare organizations

Characteristic	MGH	Prisma Health	Denver Health
Location	Boston, Massachusetts	Greenville, South Carolina	Denver, Colorado
Number of practices	6	8	29
Implementation end date	April 30, 2022 (30 months total)	April 30, 2022 (30 months total)	April 30, 2021 (18 months total)
Care model	Traditional primary care	Traditional primary care	Team-based

Characteristic	MGH	Prisma Health	Denver Health
Type of hospital	Academic medical center with community health centers	Academic medical center with community health centers	Safety-net hospital with large FQHC primary care system
Practice types	Pediatric primary care, family medicine, Med-Peds	Pediatric primary care	Pediatric primary care, family medicine, school-based
EHR vendor	Epic	Epic	Epic
Potentially eligible children	6,752	6,836	10,079

Notes: FQHC = federally qualified health center. Number of participating practices is a subset of total practices for MGH and Prisma Health. Potentially eligible children refers to the number of children aged 2-12 years with a body mass index of at least the 85th percentile who were seen for a well-child visit during the 15-month period prior to program implementation, among practices implementing *Connect for Health*.⁴

Program Components

Connect for Health has clinical- and family-facing tools.⁴ Clinical tools include electronic health record (EHR) clinical decision support tools that provide guidance regarding best practices for screening and management of childhood obesity. A flagging system (e.g., Best Practice Alert (BPA) in Epic) activates based on height and weight at a well-child visit that identifies children with elevated BMI. A note set (e.g., Smart Set in Epic) aids clinicians to engage in best practices, including documenting a diagnosis of overweight or obesity, discussing and documenting counseling on nutrition and physical activity, ordering laboratory evaluations and referrals, signing families up for a text-messaging program, providing educational materials and a community resource guide, and scheduling follow-up visits.

The *Connect for Health* family-facing tools include educational handouts that focus on behavioral change that can be printed or sent through the patient portal. The behavioral handouts include healthy drink choices, screen-time, physical activity, following a balanced nutrition plan, sleep, social-emotional wellness, and an overview handout of all six behavioral messages. A library of social and community-informed text messages that support behavior change is also available for parents to receive up to twice weekly for a year. The community resource guide connects families to local resources, such as food,

physical-activity, after-school programs, and housing and utilities. The family materials are available in English, Spanish, and Haitian-Creole.

Implementation Strategies

To implement the program, each site developed an implementation-support team comprised of a project lead(s) (PI or Co-I of grant/subcontract or project director, in the current project), an Information Technology (IT) analyst, a project manager, administrative staff (research assistants, in the current project), a clinician champion, and practice coach to work directly with clinicians. This team refined a set of initial implementation strategies based on the Expert Recommendations for Implementing Change (ERIC)⁵ provided by the *Connect for Health* research team. Strategies included assessing for readiness and identifying barriers and facilitators; informing local opinion leaders; involving patients, consumers, and family members; conducting ongoing training; providing local technical assistance and consultation; creating a virtual learning community; altering allowances and incentive structures; auditing and providing feedback; and practice facilitation.⁴⁻⁶ The implementation strategies were refined specifically for this program using stakeholder input and customized for each organization.³ During the pre-implementation phase, the core functions (“purpose”) of the program were identified and then sites conducted extensive stakeholder engagement, including clinician interviews, parent surveys, and attending leadership and council meetings.³ When conducting interviews and attending meetings, sites probed for strategies to best support clinicians and staff in the adoption of the program. Based on the findings, sites adapted the program and customized their implementation strategies to suit the local context.

Costing Methods

We used time-driven activity-based costing methods (TD-ABC)⁷ to assess the costs of implementation across sites, being attentive to heterogeneity. TD-ABC (also called micro costing) requires collating all ‘activities’ taken to accomplish something (e.g., implementing a program) as well as

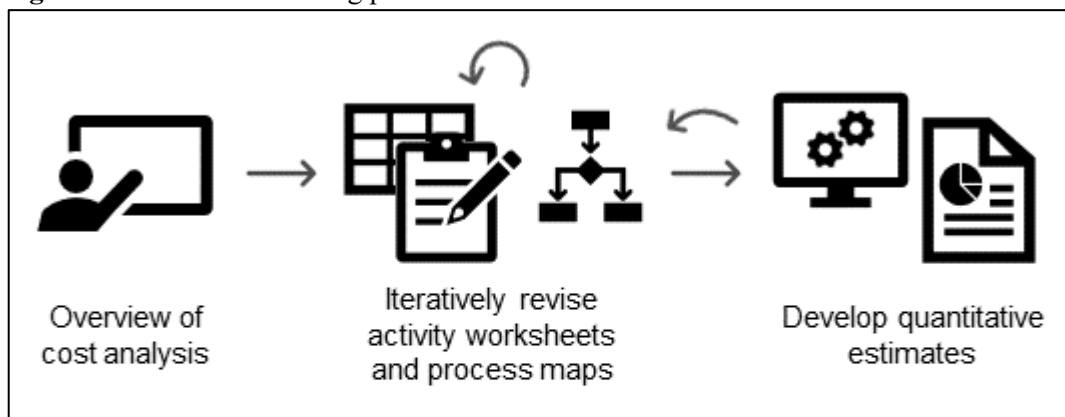
who participated in each activity.^{7,8} Activity costs are calculated by multiplying time by position-specific wages, and then activity costs can be summed to calculate total costs. Acknowledging that site personnel were the best able to identify different actions taken throughout implementation, we used an iterative process to develop final estimates, and sought to be mindful about the likely needs of final users of these estimates across all steps.

We used a structured process to develop cost estimates (Figure 1). First, we ensured all implementation support team and research team members were familiar with the basics of cost analysis through a short presentation at a regularly scheduled site meeting (~30-minute presentation). To guide sites through identifying the needed inputs for TD-ABC, we also developed a structured excel spreadsheet (i.e., worksheet) that sites used to report on actions taken to implement the *Connect for Health* program in their context. Aligned with best practices for assessing the costs of implementation,^{7,8} this worksheet guided sites to identify (a) actions taken across pre-implementation and implementation, (b) who performed those actions, (c) time estimates for those actions, and (d) wages for individuals performing actions. This information was recalled by the implementation team at each site and verified with email, meeting minutes, and calendar data when available. We did retrospective cost analyses because funding was awarded for cost assessment after implementation was underway. Initial drafts were presented to the group for feedback, revised by sites, reviewed for content by the research study team, and revised by sites again.

We then used these worksheets to develop quantitative estimates of costs. For each action that sites identified, we used person-specific estimates of time to calculate person-specific costs (time*hourly wage), and then summed across personnel to calculate action-specific costs. If the implementation-support team was able to take advantage of existing meetings or training opportunities for program needs, then we did not include the time of those individuals already in the meeting. Where relevant, we discuss the time required for trainings so future sites unable to take advantage of existing, set-aside opportunities, can understand potential costs for clinical personnel to train.

During this step we noted whether costs were site-based, non-site-based, or developmental. Aligned with PCORI guidance, site-based costs were those that sites would need to expend to implement the program. These included costs such as programming the BPA in Epic or training clinicians to use the BPA and Smart Set and could be one-time or ongoing. Non-site-based costs are those that individual sites would generally not take on but are essential for overall implementation. We conceptualized these costs as likely accruing to a coordinating center for future implementation efforts. A major non-site-based cost for *Connect for Health* is maintaining the Virtual Learning Community. Developmental costs were also noted; these costs are one-time and would not be repeated over the course of scaling up the intervention. These costs included work to develop the content for the program text messaging program, and initial costs to set up the program’s website. We also assigned actions to broader categories of costs. Categories were used to aggregate similar actions with a goal of improving interpretability and aligning with *Connect for Health’s* chosen ERIC implementation strategies where possible. They were iteratively developed by personnel responsible for both program implementation and economic evaluation by the research team and are defined in Table 2.

Figure 1. Overview of costing process



We returned spreadsheets with these calculations and classifications to sites for review and feedback. During this step, we sent a specific memo to sites with overall requests for review (e.g., review all classifications to themes) as well as specific questions and requests for clarifications (e.g., further

describing an action). We summarized costs of implementation by summing up action-specific costs, and present results separated into site-based, non-site-based, and developmental costs.

To understand how the program interacted with standard well-child visits, sites also developed process maps illustrating how the program integrated with their standard well-child visit procedures for in-person and telehealth visits. These allowed us to assess if and how the program would change the time and costs associated with these visits.

Table 2. Site-based cost categories: definitions, actions, and personnel

Category	Definition	Actions	Personnel ^A
Adapt family educational materials and community resource guide	Tailor program materials to reflect local community resources, etc.	<ul style="list-style-type: none"> Adapt library of patient educational materials and community resource guide template for local context Translations (flat fee) 	<ul style="list-style-type: none"> Project lead(s), project manager, administrative staff, practice coach
Alter incentive/allowance structures ^B	Work to incentivize the adoption and implementation of the clinical innovation	<ul style="list-style-type: none"> Meetings to align program with MGH quality improvement (QI) bonus program and make childhood obesity a focus area Communicate about QI bonus opportunity to practice staff (practice-based clinician champions) 	<ul style="list-style-type: none"> Project lead(s), project manager, practice coach, clinician champion
Assess for readiness and identify barriers/facilitators ^B	Assess various aspects of an organization to determine its degree of readiness to implement, barriers that may impede implementation, and strengths that can be used in the implementation effort	<ul style="list-style-type: none"> Conduct, transcribe, and analyze clinician interviews (10-20 interviews/site conducted) Incentives for clinician interviews Conduct environmental audits and workflow observations at practices 	<ul style="list-style-type: none"> Project lead(s), administrative staff, and IT staff Practice coach
Audit and feedback ^B	Collect and summarize clinical performance data over a specified time period and give it to clinicians and administrators to monitor, evaluate, and modify provider behavior	<ul style="list-style-type: none"> Identify EHR success metrics and develop templates for monitoring program uptake and clinician feedback reports Generate and distribute clinician feedback reports (generally monthly throughout active implementation) Present to practice QI or clinician teams (generally quarterly throughout active implementation) 	<ul style="list-style-type: none"> Project lead(s), project manager, administrative staff, practice coach, IT staff and/or contractor Project manager, practice coach, and administrative staff Project manager, practice coach, administrative staff

Category	Definition	Actions	Personnel ^A
COVID-19/telehealth adaptation ^C	Adapt program delivery for telehealth, as a result of COVID-19.	<ul style="list-style-type: none"> • Revisions to community resource guide and patient educational materials 	<ul style="list-style-type: none"> • Project lead(s), project manager, administrative staff
		<ul style="list-style-type: none"> • Updating patient educational materials in Epic Smart Set 	<ul style="list-style-type: none"> • IT staff
Design and build of EHR tools	Design, build, and deploy the EHR tools.	<ul style="list-style-type: none"> • Obtain approval of BPA and Smart Set in Epic 	<ul style="list-style-type: none"> • Project lead(s)
		<ul style="list-style-type: none"> • Plan for BPA and Smart Set (developing core components of EHR tools, lab referral guidelines, referral guidelines) 	<ul style="list-style-type: none"> • Full implementation-support team
		<ul style="list-style-type: none"> • IT build of BPA and Smart Set in Epic 	<ul style="list-style-type: none"> • IT staff
		<ul style="list-style-type: none"> • Update BPA and Smart Set as needed (logic, patient educational material updates) 	<ul style="list-style-type: none"> • IT staff
Educate, inform, and train clinicians on the intervention	Train providers who would be using the program, typically covering how to use the BPA and Smart Set in Epic, or how to use the text message referral system.	<ul style="list-style-type: none"> • Prepare ‘tip sheets’ on workflows and tools for clinicians 	<ul style="list-style-type: none"> • Project manager, practice coach, administrative staff
		<ul style="list-style-type: none"> • Pre-training for clinicians on importance of addressing childhood obesity and program foundations (short, <30-minute meetings at practices) 	<ul style="list-style-type: none"> • Practice coach, clinician champion, administrative staff
		<ul style="list-style-type: none"> • Train clinicians <ul style="list-style-type: none"> • Denver Health: short training (15-30 minutes) at a Medical Assistant all-day training and creating a short video for Medical Assistants to watch (~10 minute video) • MGH and Prisma Health: In-person practice kick-off meetings where BPA, SmartSet, and texting referral program were reviewed (1 hour trainings) 	<ul style="list-style-type: none"> • Project manager, practice coach, clinician champion, administrative staff

Category	Definition	Actions	Personnel ^A
Identify and prepare implementation team ^B	Identify and prepare individuals who dedicate themselves to supporting, marketing, and driving through an implementation, overcoming indifference or resistance that the intervention may provoke in an organization	<ul style="list-style-type: none"> Identifying clinician champion and practice coach 	<ul style="list-style-type: none"> Project lead(s)
		<ul style="list-style-type: none"> Team meetings to prepare for program implementation Denver Health convened a large implementation team for quarterly pre-implementation meetings 	<ul style="list-style-type: none"> Full implementation-support team
		<ul style="list-style-type: none"> Prepare clinician champions and practice coaches (overview of childhood obesity, program and role as clinician champion or practice coach) 	<ul style="list-style-type: none"> Practice coach, clinician champion, program coordinator
Inform local opinion leaders ^B	Inform providers identified by colleagues as opinion leaders or “educationally influential” about the clinical innovation in the hopes that they will influence colleagues to adopt it	<ul style="list-style-type: none"> Attending meetings of various thought partners, committees, teams, or practices to inform them of the program and get their input on implementation 	<ul style="list-style-type: none"> Project lead(s), project manager, administrative staff
Involve patients, consumers, and family members ^B	Engage or include patients/consumers and families in the implementation effort	<ul style="list-style-type: none"> Conduct and analyze pre-implementation parent surveys (and provide incentives). These surveys should be used to incorporate families’ needs, perspectives, and preferences into implementation efforts. 	<ul style="list-style-type: none"> Project lead(s), project manager, administrative staff
		<ul style="list-style-type: none"> Conduct and analyze family experience of care surveys (and provide incentives). The purpose of these surveys is to ensure that families are being supported through program implementation and are important for ongoing QI. 	<ul style="list-style-type: none"> Project lead(s), project manager, administrative staff

Category	Definition	Actions	Personnel ^A
Ongoing training, facilitation, and technical assistance ^B	Facilitation: A process of interactive problem solving and support that occurs in a context of a recognized need for improvement and a supportive interpersonal relationship	<ul style="list-style-type: none"> Periodically touch base with clinicians about Connect for Health tools 	<ul style="list-style-type: none"> Practice coach, clinician champion, project manager (as needed), administrative staff (as needed)
		<ul style="list-style-type: none"> Real-time support for clinicians during launch of program 	<ul style="list-style-type: none"> Clinician champions, practice coach
		<ul style="list-style-type: none"> Refresher practice trainings 	<ul style="list-style-type: none"> Practice coach, clinician champion
Text messaging licensing and operating expenses	Costs to set up and maintain the text messaging component of the program.	<ul style="list-style-type: none"> MGH and Prisma Health used an external text-messaging vendor and costs included start-up fees and then ongoing monthly costs for the service. 	<ul style="list-style-type: none"> Project lead(s), project director, project manager, administrative staff
		<ul style="list-style-type: none"> Denver Health used an in-house text-messaging system. This includes purchasing two licenses for program personnel to use, building the software to enroll referred patients into the texting program, running enrollment software weekly, and other ongoing troubleshooting/updates as needed. 	<ul style="list-style-type: none"> Project manager, IT staff (applications analyst and Epic analyst, applications administrator), administrative staff

Notes: ^APersonnel standardized across sites when possible and options include project leads (PI or Co-I of grant/subcontract or project director, in the current project), project manager, practice coach, clinician champion, administrative staff (research assistants, in the current project), and IT staff. ^BDefinition of implementation strategy taken from Powell et al., 2015⁵ ^CMGH and Prisma Health elected to move forward with telehealth program delivery while Denver Health did not.

Results

Site-based Costs

There was a large range of site-based costs, reflecting the heterogeneity in sites and how sites chose to implement the program based on stakeholder feedback. For example, Denver Health partnered with researchers at the Harvard TH Chan School of Public Health to conduct a cost-effectiveness study prior to the pre-implementation phase and focused significant time informing opinion leaders and getting feedback from stakeholders to guide adaptations throughout the health system about the program. Prisma Health spent more time on training and facilitation throughout the program implementation period, and MGH's team spent time working with hospital personnel to align the program with local quality improvement (QI) bonus opportunities. Overall costs ranged from \$67,671 (Denver Health) to \$69,611 (Prisma Health) to \$128,070 (MGH). Explanation of each category of total costs, along with actions and relevant personnel is shown in Table 2. Table 3 shows the breakdown of costs for each site, across categories of activities that were taken for implementation (these costs are further broken out by phase of implementation in Table S1).

Major cost drivers included the program's technical requirements – specifically, the text messaging component of the program and creating the EHR tools. Costs when using an in-house text messaging system at Denver totaled approximately \$8,000, including licensing fees and ongoing technical requirements. Conversely, MGH and Prisma used an outside text messaging vendor, which cost \$6,000 in one-time start up fees and yearly costs of \$11,250 per site, plus an \$18,000 one-time execution fee (paid by MGH).

Sites also spent time working to design and build the EHR tools, generally by conducting planning meetings with IT staff and incurring programming costs. MGH has higher costs that reflect their larger amounts of time spent in planning and discussion to provide guidance on implementation at other sites (i.e., a developmental cost) in addition to MGH-specific work (i.e., a site-based cost). We were not able to disentangle these costs and would not expect future sites to incur these high costs.

Table 3. Site-based costs by category, across pre-implementation and implementation

Category	MGH	Prisma Health	Denver Health
Total	\$128,070	\$69,119	\$67,671
Adapt family educational materials and community resource guide ^A		\$1,489	\$1,242
Alter incentive/allowance structures ^A	\$2,153		
Assess for readiness and identify barriers/facilitators	\$8,237	\$1,474	\$5,642
Audit and feedback	\$14,830	\$17,750	\$836
COVID/telehealth adaptation ^A		\$598	\$502
Design and build of EHR tools	\$31,519	\$1,871	\$7,089
Educate, inform, and train clinicians on the intervention	\$2,612	\$4,514	\$4,246
Identify and prepare implementation team	\$210	\$1,154	\$4,528
Inform local opinion leaders	\$945	\$1,386	\$4,456
Involve patients, consumers, and family members	\$14,476	\$5,553	\$17,122
Ongoing training, facilitation, and technical assistance	\$874	\$1,459	\$2,569
Other ^B			\$11,615
Text messaging licensing and operating expenses ^C	\$52,214	\$31,870	\$7,823

Notes: ^AMGH does not have values for 'adapt family educational materials' and 'COVID-19/telehealth adaptation' because their activities fell under developmental costs, which this site undertook for the project as a whole; MGH also was the only site to incorporate altering incentive/allowance structures into their implementation process. ^BThe 'other' cost incurred by Denver Health is a cost-effectiveness analysis the team worked on during pre-implementation. ^CMGH's texting costs are greater than Prisma Health's because MGH incurred an \$18,000 texting execution fee, and Prisma Health began the texting program later because of an internal security assessment.

The contribution of other categories to total site-based costs differed based on what sites selected for their focus areas based on initial stakeholder engagement. For example, Denver Health, as an FQHC network with a strong history of team-based care, a robust collection of pre-existing programs to support pediatric healthy weight, and a culture of quality improvement, engaged a wide range of stakeholders initially to ensure greater buy-in and ultimately sustainability (e.g., pediatric QI meetings, system-wide QI champion calls, MA council meetings, leadership meetings, all provider meetings). Their costs here

reflect the number of meetings implementation-support team members attended. The implementation-support team was able to use existing meetings for these purposes, and so there was no time incurred by Denver Health providers to attend these meetings above and beyond their usual meeting attendance. However, if future sites could not take advantage of existing meetings, then additional provider-time costs would be incurred. Time spent in these meetings was generally quite short (~15-30 minutes, and number of attendees varied from 10-50 depending on whether the meeting was committee specific or a larger ‘all provider’ meeting), but the implementation-support team incurred time costs preparing for and attending each meeting. Denver Health also spent time and effort prior to pre-implementation conducting a cost-effectiveness study, critical for generating organizational buy-in.⁹

Both MGH and Prisma Health spent significant resources on audit and feedback compared to Denver Health, but each operationalized audit and feedback differently. Based on clinician and practice requests, Prisma Health’s project manager and practice coach monitored EHR metrics and communicated via email with practices and clinicians about their use of the tool each month. MGH provided three feedback reports to clinicians throughout implementation (hard copy reports, rather than via email). They also incurred additional cost through payments to an outside contractor to pull in-depth EHR metrics and create practice dashboards, which were used to develop clinician feedback reports and determine where facilitation or technical assistance by the practice coach could be used.

Training clinicians on the program is an important component of implementation where costs will vary based on existing opportunities or resources. All sites tried, whenever possible, to take advantage of existing opportunities where clinicians were convened. For example, Denver Health was able to capitalize on existing, required trainings for the system’s medical assistants. Training costs (\$4,426) represent the time for the implementation team to prepare for, present at, or develop content for (e.g., videos) these trainings, but not the cost of the time spent by medical assistants at these trainings. If the time costs for medical assistants were included, we estimate this would increase costs to \$6,097 (218 medical assistants * (15 minutes for initial training + 10 minute video) * \$20.38/hour = \$1,851 in additional costs).

Non-site-based Costs

We conceptualized non-site-based costs as those likely to be borne by a central coordinating center who would serve as the hub for future implementations scale-up efforts (Table 4). Creating and maintaining the Virtual Learning Community (VLC) was the largest non-site-based cost at nearly \$11,000 (<https://cpd.partners.org/content/connect-health-virtual-learning-community>). Costs included as part of the VLC were honoraria for presenters who made short videos, payment to an external video production company for animated videos, and payment for the hosting and development of the VLC by a continuing professional development service. Other non-site-based costs were train-the-trainer costs: a series of three trainings were conducted to prepare clinicians and staff to serve as clinician champions and practice coaches. The trainings included information about childhood obesity, an overview of *Connect for Health*, and best practices for providing practice facilitation and technical assistance. Other time or personnel costs not included in the totals presented in this report may arise as future non-site-based costs may include additional translations, updating family educational materials if best practices or guidelines change, and updating the clinician/ patient facing website (www.c4hprogram.com) or implementation guide website (www.c4hprogramguide.com). These are shown in the table but do not have any costs associated with them for the current three-site analysis.

Table 4. Non-site-based costs

Category	Action	Cost
Adapt family educational materials and community resource guide	Additional language translations as needed	\$0
	Periodic updates to materials as needed	\$0
Create a virtual learning community	Creation of VLC (video modules and educational activity hosting)	\$10,730
	Promote VLC/CME trainings	\$25
Identify and prepare implementation team	Practice coach and clinician champion training	\$865
Other technical needs	Maintenance of <i>Connect for Health</i> websites as needed	\$0

Notes: VLC = virtual learning community. Costs shown as \$0 indicate potential future non-site-based costs that would be incurred as *Connect for Health* is maintained and expanded.

Developmental Costs

Developmental costs, or those that are one time and would not be repeated, are shown in Table 5. These costs predominantly occurred during the pre-implementation phase and include adaptation costs from the original clinical trial for implementation,³ survey and interview development for engaging parents and clinicians in pre-implementation assessments and quality improvement, making adaptations for telehealth as a result of the COVID-19 pandemic, and building the family- and clinician-facing website.

Table 5. Developmental costs

Category	Action	Cost
Adapt family educational materials and community resource guide	Adaptation of patient educational materials and community resource guide template.	\$2,433
	Develop text message library	\$1,799
	Translations	\$1,525
Assess for readiness and identify barriers/facilitators	Develop clinician interview guide	\$2,405
COVID-19/telehealth adaptation	Adjusted text messaging for COVID-19	\$16
	Creating multimodal - patient educational materials (video)	\$6,623
	Telehealth adaptations stakeholder engagement	\$3,054
	Telehealth clinician and patient educational material updates	\$564
	Telehealth clinician surveys - Incentives	\$3,750
	Telehealth clinician surveys - Time to conduct	\$1,226
	Telehealth parent surveys - Incentives	\$5,000
	Telehealth parent surveys - Time to conduct	\$2,375
	Telehealth site meetings	\$544
Translations	\$2,566	
Involve patients, consumers, and family members	Develop family experience of care survey	\$2,421
	Development of parent stakeholder surveys	\$2,421
Other technical needs	Building program website (clinician/patient facing website)	\$4,666

Process Maps

Sites' process maps are shown in Figures 2-5. Overall, the program integrated easily within well-child visits across sites, though the specifics of how the program was operationalized depended on the health system. As previously described, all sites engaged key stakeholders and in this process, they examined how the *Connect for Health* program could best fit within the existing workflow (interviews with clinicians, workflow and environmental audits, provider meetings).³ The sites then tailored the program based on their organization's workflow. For example, Denver Health used a team-based care approach and adapted the program to include roles for medical assistants and clinicians. For MGH, clinicians have individual preferences for using the EHR, therefore that site provided multiple options of how to access and use the tools. Figures 4 and 5 both depict processes from MGH and allow for comparisons between in-person (Figure 4) and virtual (Figure 5) visits. Overall, the biggest difference were how height and weight were updated.

[Figures in separate section]

Additional Considerations

When considering how much this program would cost to implement at future sites, Prisma and Denver Health are useful case studies. Each site implemented the program quite differently, so the costs across categories can provide a sense of the varying ways implementation dollars could be spent (e.g., more resources expended for text-messaging programs or audit and feedback like Prisma Health, versus conducting up-front work to ensure buy-in like Denver Health). MGH, on the other hand, served as a 'coordinating center' and many of their activities served both the full implementation effort as well as MGH's implementation effort – making it impossible to precisely disentangle what proportion of their costs were site-based, non-site-based, or developmental. For example, their site-based costs do not include any adaptation costs, because their adaptation work overlapped with the initial adaptation from the clinical trial and was thus categorized as a developmental cost. They also have significantly larger

EHR costs/time because they conducted pre-implementation planning on how to integrate the tool into existing practices and provided guidance for the other two sites, informing both their own implementation as well as Prisma Health's and Denver Health's work. MGH also incurred the \$18,000 'execution fee' for the texting service used by both MGH and Prisma. While this is included as a site-based cost for MGH, it also benefited Prisma Health: if MGH had used another texting vendor, then Prisma Health would have been responsible for paying the \$18,000.

The cost estimates reported here are based on retrospectively-collected activity and time estimates, meaning that some time may have been over- or under-estimated. All individuals involved in the cost data collection used calendar and email data to inform their estimates of time use when possible and estimates went through multiple rounds of revision allowing for triangulation between sites' estimates. In addition, the retrospective nature of the data collection means that some informal implementation activities may not have been included, such as conversations between clinicians. We also did not capture amounts of time associated with small, *ad hoc* activities, and future sites should expect that, like any program, periodic maintenance of materials will be needed. Importantly, estimates of site-based costs also reflect time and context-specific wage rates, which may be different in the future and in other contexts.

Health systems considering adopting the *Connect for Health* program in the future may find these cost estimates helpful in benchmarking the financial support that might be needed. Given our results, future sites should expect to pay for text-messaging startup costs, though the exact amounts will vary based on existing in-house technical capabilities, available vendors, and vendors' information security options. Sites should also expect to spend time tailoring the program to their local context and community resources, understanding how to integrate the clinical tools into their EHR system, and engaging clinicians and families to assess barriers, facilitators, and implementation readiness. Depending on the scope and nature of these adaptations, costs may shift outside the range of costs described in this report. Once the program has begun, the main costs to consider will be providing audit and feedback reports to clinicians throughout the active implementation period and conducting *ad hoc* maintenance of materials.

Ongoing QI evaluation work should also be undertaken to ensure that the program is meeting family's needs.

Conclusions

The prevalence of childhood obesity is high and racial, ethnic, and socioeconomic disparities continue to widen.^{10,11} Healthcare organizations need effective programs to support health outcomes of children, particularly those like *Connect for Health* that align with the American Academy of Pediatrics' Stage 1 weight management and treatment strategy that emphasizes healthy behaviors and lifestyle changes.¹² The *Connect for Health* program integrates well with clinical workflows, aligns with key organizational metrics (i.e., quality goals, performance metrics), and is reimbursable as the program is intended to be used during well-child visits. To support sites interested in implementing this program, we have now created an implementation guide with all the family-facing materials, EHR specifications, clinician-training tools, and methods for engaging stakeholders, available at www.c4hprogramguide.com. The implementation guide, along with the detailed results reported here, can help future sites plan for implementation and understand 'what it would take' to implement the program in their own context. We found that the costs to implement this program ranged from \$67,671 – \$128,070 across three distinct contexts, with variation driven by contextual resources and how sites chose to implement the program and expend resources. Major drivers of the costs include purchasing and maintaining the texting program, integrating the clinical tools into the EHR system, and engaging stakeholders to adapt program materials and inform implementation strategies.

Figures

Figure 2. Denver Health process map

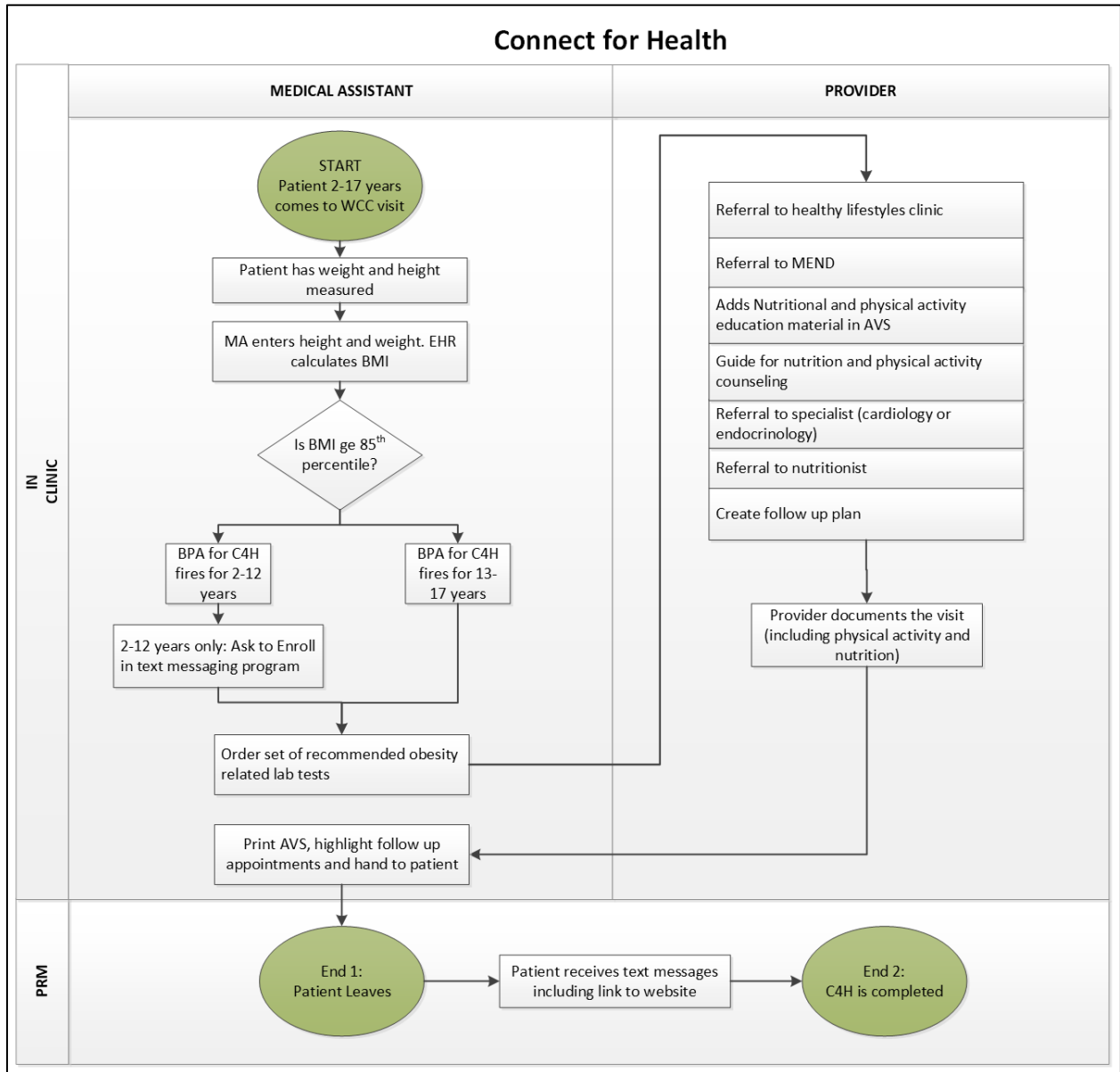


Figure 3. Prisma Health process map

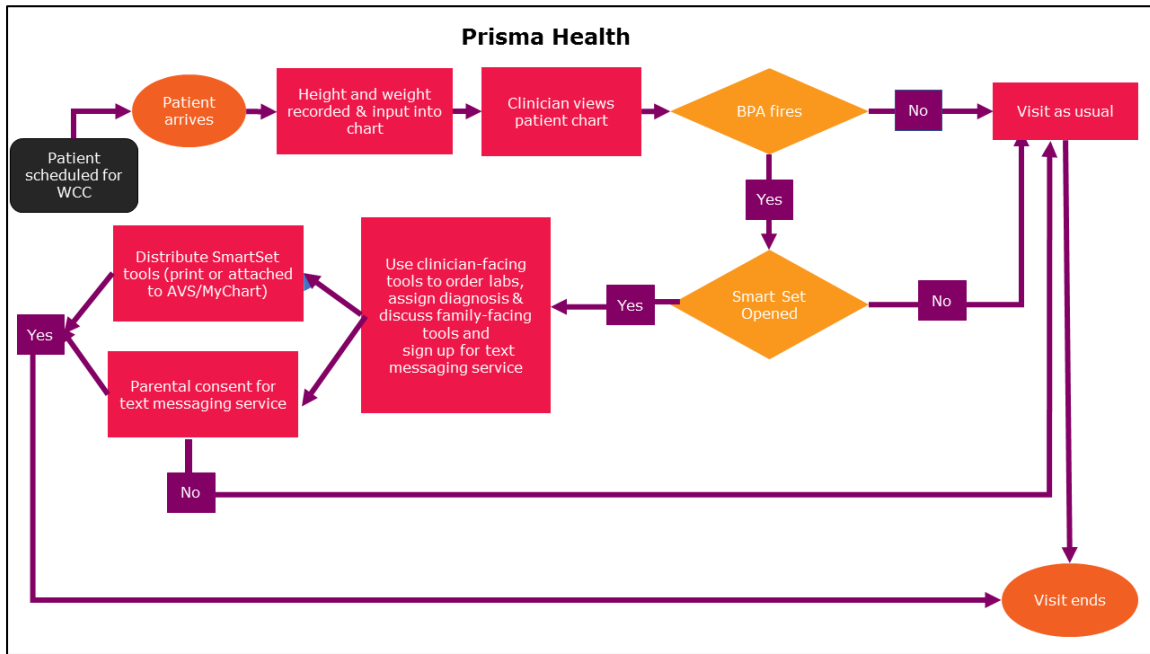


Figure 4. MGH process map for in-person visits

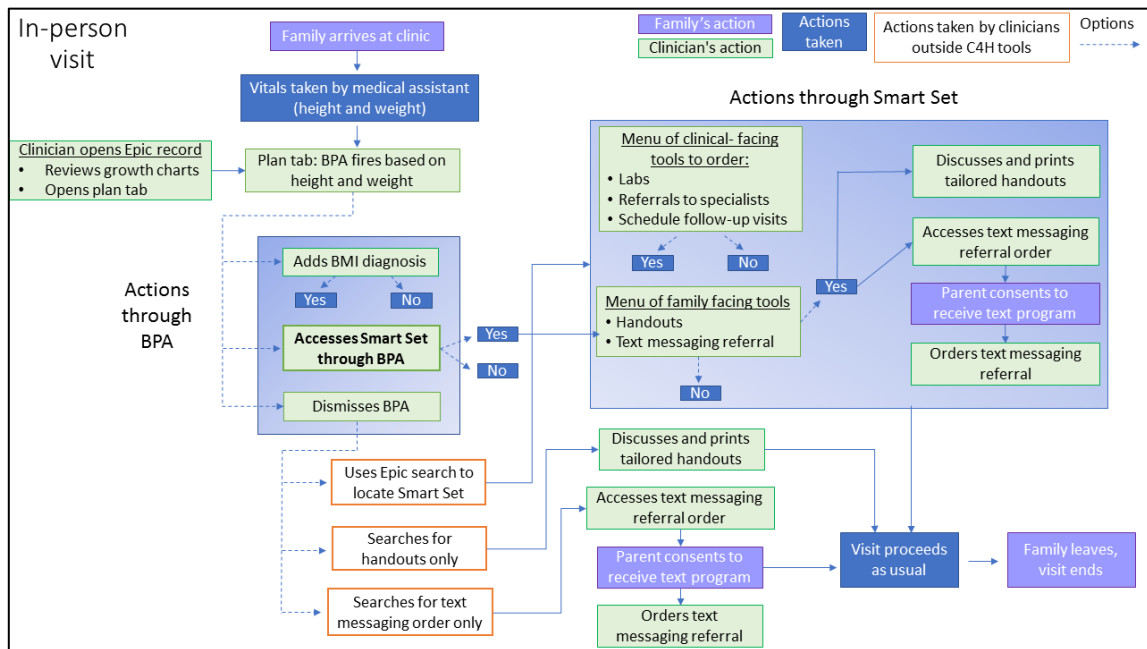
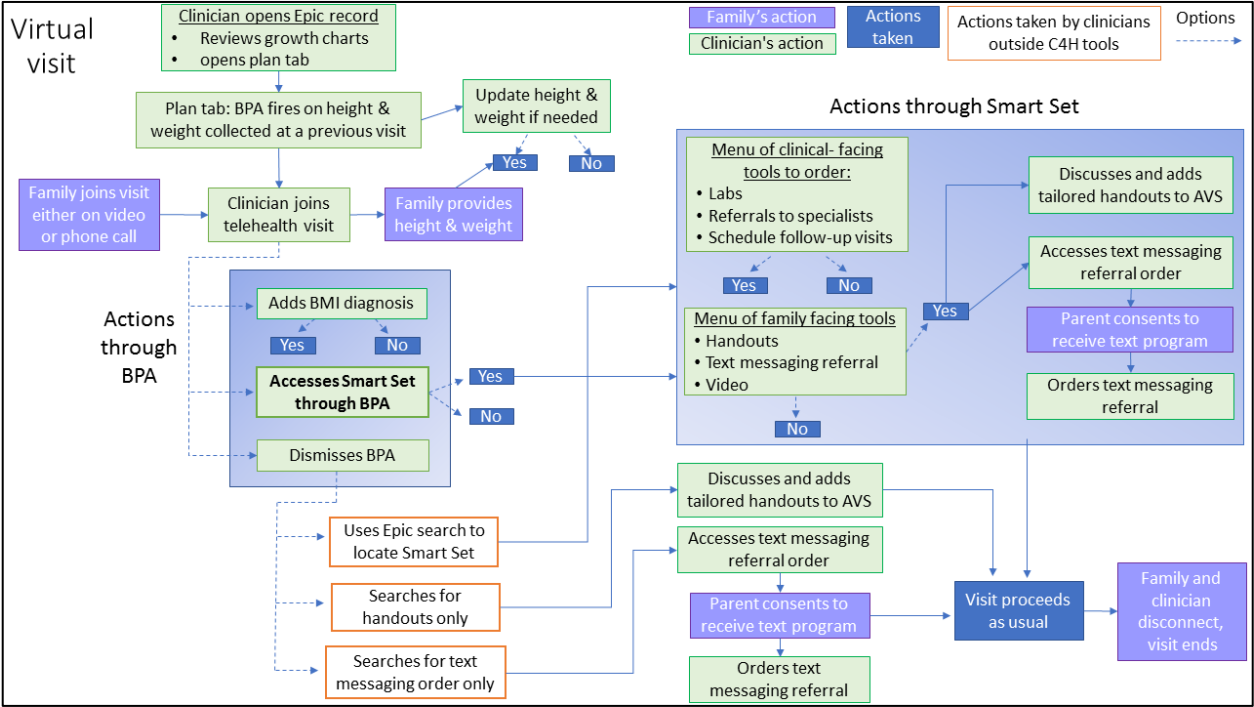


Figure 5. MGH process map for virtual/telehealth visits



Appendix

Table S1. Site-based costs by phase of implementation and category

Phase and Category	MGH	Prisma Health	Denver Health
Pre-Implementation			
One-time			
Adapt family educational materials and community resource guide		\$1,489	\$1,242
Assess for readiness and identify barriers/facilitators	\$8,237	\$1,474	\$5,642
Design and build of EHR tools	\$31,519	\$1,295	\$6,217
Educate, inform, and train clinicians on the intervention	\$385	\$649	\$3,522
Identify and prepare implementation team	\$210	\$1,154	\$4,528
Inform local opinion leaders	\$945	\$1,386	\$4,456
Involve patients, consumers, and family members	\$6,610	\$1,835	\$5,708
Other			\$11,615
Text messaging licensing and operating expenses	\$24,000	\$6,444	\$3,538
Implementation			
One-time			
Alter incentive/allowance structures	\$2,153		
COVID/telehealth adaptation		\$598	\$502
Educate, inform, and train clinicians on the intervention	\$2,227	\$3,865	\$724
Involve patients, consumers, and family members	\$7,865	\$3,718	\$11,415
Ongoing			
Audit and feedback	\$14,830	\$17,750	\$836
Design and build of EHR tools	\$0	\$576	\$872
Ongoing training, facilitation, and technical assistance	\$874	\$1,459	\$2,569
Text messaging licensing and operating expenses	\$28,214	\$25,426	\$4,286

Notes: Ongoing costs are presented as totals across active implementation. Approximate monthly costs can be calculated by dividing by months of implementation (30 months for MGH and Prisma Health, and 18 months for Denver Health). The only exception to this is Prisma Health's text messaging costs, which were incurred over 23 months because of an internal security assessment.

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