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Valuation of the Rochester-Area Program of Primary Care-Integrated Telehealth

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Abstract

Purpose: was to: (1) expand the Health-e-Access (HeA) telemedicine model; (2) assess its value to the healthcare system; (3) describe the process and assess the value of integrating telemedicine in primary care.

Scope: Acute illness in children remains a major morbidity, social and economic burden across the socioeconomic spectrum. Care outside the home has become the norm for pre-school children in the United States. Almost 50% of working women report they will need to miss work the next time a child is ill. Children account for almost 30% of all ED visits in the US. Families regularly resort to emergency department (ED) use for non-emergency problems despite inefficient and impersonal care. This constitutes compelling evidence of health system failure. To address these problems, we developed HeA, focused on promoting the right care, in the right place, at the right time.

Methods: Descriptive and cohort studies were employed.

Results: HeA was expanded to 22 child sites and 10 primary care practices and integrated, as demonstrated by 83% continuity and 97% visit completion rates. Substantial cost reduction occurred, due to 22% fewer ED visits among children with telemed access when compared to a closely matched control group.

Key Words: access to healthcare, telemedicine, child care, continuity of care, medical home, primary care, cost-effectiveness, socioeconomic disparities

Final Report

Purpose

Specific Aims of this research program were: (1) to expand Health-e-Access (HeA) as a telehealth model; (2) to assess the value of telehealth in child programs (childcare, schools) to the healthcare system; and (3) to describe the process of integrating telehealth in primary care and assess the value of integrated telehealth to (a) families and (b) clinicians. Expansion plans included the addition of 5 elementary schools to the 5 childcare telemedicine access sites already serving Rochester's northeast quadrant, and the addition of telemedicine access in 6 childcare and 5 elementary school sites in southeastern suburbs. Research was designed to assess the impact of HeA on utilization and costs, on continuity of care with the medical home, and on well child visit rates and immunization status. Specific aims were chosen to achieve our objectives of optimizing the Health-e-Access telehealth model by integrating telehealth into primary care practice and by ensuring the expansion and sustainability of this model. Keys to sustainability and expansion were identified as acceptance of HeA by primary care clinicians and reimbursement by both public and private insurance organizations. The goal of improved access to high quality health care drove this endeavor.

Hypotheses, study designs, populations studied, measures and analysis techniques differed among the studies undertaken to address each of these specific aims. The numbers/labels for these Specific Aims used below are (1) expansion, (2) value to health system, (3a) value to families, and (3b) value to clinicians.

Scope

Background on US Healthcare for Children

Tremendous socioeconomic disparities in childhood morbidity burden persist. Our own research in Rochester comparing hospitalization rates for impoverished, inner city, children with those of their more affluent suburban counterparts documents striking differences.[1,2] Treatment which is delayed or less appropriate also is likely to contribute to these disparities.[3,4,5,6] Less effective treatment is closely tied to difficulties in access to care. Inner city children not only endure a greater burden of morbidity, but their families have less social, material and financial resources to address this burden. Based on the US Census, for example, 42% of Rochester's inner city households had no automobile and 13% lacked a phone. These figures compared with 4.6% (no automobile) and 0.7% (no phone) for suburban households. Inner city families are served by health centers and hospital-based clinics whose strained resources can provide only limited continuity of care and limited evening office hours. Use of hospital emergency departments to address problems that could often be managed by phone, telehealth or office visits is a frequent consequence.

Acute illness in children remains a major morbidity, social and economic burden across the socioeconomic spectrum. Children under 15 years in the United States make an estimated 71 million office visits annually for acute illness.[7] These visits account for 48.8% of all office visits for children and 30.0% of office visits for individuals of any age.[7] In addition, children under 19 years make an estimated 29 million emergency department (ED) visits annually (estimate based on 2002 NHAMCS data),[8] a number that represents 27% of all ED visits. Approximately 20% of children make at least one ED visit yearly, and 7% make two or more.[8] Many costly ED visits occur because of barriers in access to more appropriate settings. Estimates for the proportion of children's ED visits that are non-urgent have ranged between 20% and 70%.[9,10,11,12] That families so often resort to emergency department (ED) use for non-emergency problems, despite the fact that care in the ED is inefficient, impersonal and burdensome for everyone involved, constitutes stunning evidence of system failure.

Background on Illness in Child Care and Elementary Schools

Care outside the home has become the norm for pre-school children in the United States. Already in 1995, 60% of children from birth to 5 years of age participated in a non-parental childcare or early education program.[13] With continuation of the trend for young mothers to join the work force and the advent of welfare-to-work programs throughout the US, this proportion is undoubtedly larger today. Acute, generally infectious illness is a very common and difficult problem for all involved in childcare centers. Higher incidence and greater severity of illness among children in childcare than among children in home care is well documented.[14,15,16,17] Economic burden of illness in day care is also substantial.[18,19,20]

The burden of illness among children in elementary schools is less well studied but also very substantial. Although the burden of illness falls gradually as children age, ages overlap between childcare and elementary school programs, especially with the adoption of pre-kindergarten programs by many school districts. Pre-K programs are universally available in the Rochester City School District.

Childcare programs and elementary schools have the difficult responsibility of determining whether to exclude a child due to illness. Almost all childcare programs and schools in Rochester adhere to recommendations of the American Academy of Pediatrics (AAP)[21] and the American Public Health Association (APHA).[22] We believe the AAP/APHA recommendations have been thoughtfully crafted to reduce the spread of serious infectious disease and to ensure that children who have treatable conditions are brought to medical attention. Nevertheless, exclusion policies are subject to judgment, and the decision to exclude a child because of illness is often a source of great tension between childcare staff and parents. Prevailing policies often require an office visit for a physician to certify readiness for return to childcare.

The AAP has also taken the following noteworthy position: "Exclusion is necessary when a student's illness: (1) requires a greater degree of observation or care than school staff can safely provide; (2) poses a threat to the health or safety of others; or (3) precludes any benefit of attending class because of inability to focus and learn. Relatively few illnesses mandate exclusion from school. Students with upper respiratory infections, stomachaches, or headaches are too often excluded because of the wishes of parents or school staff."[23]

Childhood illness places parents in a difficult situation. They are frequently called at their jobs to pick up ill children. One study found that a child's illness accounted for 40% of missed work for childcare parents.[19] Another study, based on a nationally representative sample of working women, found that only 39% had someone they could call on to help with childcare the next time their child is sick.[24] Most women reported either that they would need to miss work (49%) or that they would not know what to do (7%) when this occurs. Work absence due to care for a sick child means loss of pay for most women of lower socioeconomic status.[24] Inner city parents may jeopardize employment by leaving work as demanded. Other parents, anxious to keep jobs that they cannot afford to lose, try to avoid or delay pick-up and try to hasten the return of ill children to childcare. Compared to a professional and middle class parent, the typical inner city parent draws on far fewer resources when confronting the challenge of childhood illness. For example, inner-city parents are less likely to have flexible work hours and less likely to have their own means of transportation.

Nature of the Intervention

To address these problems, we designed and developed a telemedicine network. We chose Health-e-Access (HeA) as the name for this organizational innovation because HeA is essentially a form of communications infrastructure that facilitates access to health services. The HeA mission, to enable healthcare when and where you need it, by people you know and trust, reflects its focus on promoting the right care, in the right place, at the right time. Accordingly, the organizational and technical design of HeA focuses on: (1) establishing and sustaining access sites in convenient community locations (e.g., childcare, schools, retail settings, group homes, fire stations, rescue squad stations, community centers, assisted living and skilled nursing facilities); (2) using information technology to enhance communication with clinicians (physicians, nurse practitioners, physician assistants) in a remote location; and (3) enabling connection with clinicians from the patient's own primary care medical home. In preliminary work among 5 inner-city childcare programs, prior to funding by AHRQ, a large reduction in absence due to illness (63%) was found for children served by Health-e-Access.[25]

Neither place nor time differences constrain participation of clinicians or patients in telemedicine transactions. Assumptions about these dimensions of communication are so fundamental to expectations about daily activities that many people fail to envision telemedicine's transformational potential. As a novel intervention designed to improve healthcare, fundamental research questions included feasibility, acceptability, quality, effectiveness and cost.

The Health-e-Access telemedicine model was designed to enable diagnosis and treatment decisions for acute problems that commonly arise in childcare and elementary school settings. Direct participants in telemedicine encounters include a child with a health problem, a telemedicine assistant and sometimes a parent, all at the child site, plus a telemedicine clinician at a remote site. Requests for a telemedicine visit generally came from the telemedicine assistant at the child site (childcare or school health aides trained by HeA for this responsibility). Requests went first to HeA Coordination and Control staff, who were responsible for checking the quality of media and other information captured by the telemedicine assistant as well as first-level technical and clinical troubleshooting. Coordination and Control staff then contacted the primary care practice or default clinician (for children whose primary care practice did not participate in HeA) to schedule a visit.

Visits were completed through real-time interactive (videoconference), store-and-forward, or both forms of telemedicine. The clinician site may be located anywhere with broadband internet access and modest personal computer equipment. Clinical, organizational and technical features of the system in use are described elsewhere.[25,26] Health-e-Access commenced operation in May 2001, with 6 inner-city childcare programs starting participation in stepwise intervals of 6 to 8 months to offer care via telemedicine over the first 3.5 years by 3 clinicians who were primary care providers with the Pediatric Practice of the Golisano Children's Hospital in the University of Rochester Medical Center (URMC).

Methods

Study designs, population studied, sample selection, instruments and analytic approach varied by hypothesis and thus are described separately for each of the three hypotheses.

Study Designs

1. Expansion. Our ability to expand HeA constitutes, in itself, an assessment of the feasibility and acceptability of integrating telemedicine services in childcare and elementary schools and in primary care practices in the Rochester area.

2. Value to Health System. The impact of HeA of utilization and costs was assessed through a prospective cohort study based on analysis of insurance claims files (secondary data analysis) and comparing utilization for the intervention group (children with access to telemedicine in childcare or school) versus that of a matched control group (children without telemedicine access). This study was designed to assess hypotheses that children served by Health-e-Access (a) received health care more often for acute illness, but had (b) fewer emergency department (ED) visits and (c) lower healthcare expenditures than children without access through this service.

3a. Value to Families. In this descriptive, observational study, acceptability and economic impact on parents was assessed based on surveys of a convenience sample of parents whose children had access to healthcare via HeA.

3b. Value to Clinicians. In this descriptive, observational study, acceptability and economic impact on primary care practices and providers was assessed based on surveys of all participating clinicians among all participating primary care practices.

Populations Studied

1. Expansion. Among participating primary care practices that care for children in the Rochester, NY area, 5 were located in eastern suburbs and 5 were located in the city of Rochester. After all these practices began providing telemedicine visits, participating practices located in the city provided primary care to children making 70.5% of telemed visits from participating city childcare and city elementary schools. Participating practices located in the suburbs provided primary care to children making 19.1% of telemed visits from participating suburban childcare and city elementary schools. Expansion was limited by two factors, scope that was acceptable to local insurance organizations, whose agreement to reimburse clinicians for telemedicine visits for the duration of the 3-year grant period, and grant funds that were available from various sources to purchase and service telemedicine equipment.

For city childcare and elementary school sites, we limited our choice to sites in or on the margin of Rochester's inner city. Based on the 2000 US Census, among families with children less than 5 years old who dwell in the four zip code areas comprising Rochester's inner city, 51.2% fell below the federal poverty level. Also, 59.8% of inner city families were African American, and 27.9% were Hispanic or Latino.

2. Value to Health System. To reduce extraneous influences on utilization, children participating in Health-e-Access were eligible for inclusion in analysis only if they were served for at least 6 consecutive months with simultaneous insurance coverage and telemedicine program participation. We also restricted analysis to observations in children younger than 13 years because mostly younger children attend elementary school or childcare. Given that utilization histories differed in length, we chose child-months as the unit of analysis. In defining child-months, we divided years into 13 equal 28-day periods. Insurance company claims data captured utilization for 80 months (using the 28-day definition), or 6.2 years, from May 2001 when telemedicine service began, through August 12, 2007, the last date for which billing claims were obtained. Use of child-months as the unit of analysis provided a standardized unit for length of observation and enabled adjustment for the effect of age on utilization. Capacity for the latter, which would have been lost with aggregation by child, was especially important given multiple years of observation in early childhood, a period when utilization rates vary widely.

During the 6.2-year study period, multiple events beyond investigator control determined availability of utilization data. As expected, many children enrolled in a different childcare program or school later in the study period. Some subsequent child sites participated in Health-e-Access, whereas others did not. A child contributed child-months to the intervention group when, concurrently, (1) she attended at a child site participating in Health-e-Access, (2) her parents had consented for participation, (3) she had insurance coverage, and (4) this insurance organization provided claims data. One major local insurance organization, which provided coverage for telemedicine visits and had originally agreed to provide billing claims data, was acquired during the study period by another insurance organization outside the Rochester area and ultimately failed to honor its commitment to provide claims data.

We selected control children from insurance company enrollment files to match intervention children on age, sex and postal zip code of residence. As with intervention children, a child needed at least 6 continuous months of insurance coverage to be contribute eligible control child-months. The computer matching algorithm matched periods of sequential child-months (of at least 6-months duration), which we termed segments. We matched segments rather than children because the unit of analysis was child-month, because segments for intervention children varied in length, and because some intervention children provided multiple segments. Segments ended when any of the four conditions, listed above, were no longer met.

Eligible control segments were supplied by a child with the same sex and zip code as those of matched intervention segments. Zip code served to define socioeconomic area, as discussed below. Age match requirements, based on age (in months) at the time the intervention segment began, were as follows: < 12, within 1 month; 12 through 24, within 2 months; 24 through 35, within 4 months; 36 or over, within 6 months. Attempts to match an intervention segment proceeded in chronological order, from first to last enrolled in Health-e-Access. If multiple segments met control criteria, the one selected was that which overlapped with the largest proportion of sequential intervention child-months (usually 100%) and matched most closely on age.

During the 6.2 year study period 4,701 children were enrolled at any time in one of the Health-e-Access childcare or elementary school programs. Among these, 2,255 (48.0%) were covered by insurance that provided claims data. Insurance types for the 2,255 we were able to study included Medicaid Managed Care (60.2%), commercial insurance (31.2%) and Child Health Plus (8.6%). Insurance types for the 2,446 we were not able to study included fee-for-service Medicaid (41.9%), Medicaid Managed Care (19.5%), commercial insurance (24.2%) and uninsured/missing insurance information (7.5%). After excluding 758 children because they failed to meet the upper age limit criterion (at least 6 consecutive months of observation prior to the 13th birthday) and 281 more children because a control segment lasting at least 6 consecutive matching child months in duration was not available, 1,216 met all criteria for analysis.

These 1,216 intervention children contributed 19,652 child-months of observation, each matched by a control child-month. Mean (SD) ages of these children at the end of the first and last child-months observed were 6.15 (3.2) and 7.4 (3.1) years, respectively. The number of child-months observed per child ranged from 6 to 81 months, and the mean (SD) was 16.2 (9.4). Children first enrolled in Health-e-Access in city childcare, 566 (46.5%); city elementary schools, 499 (41.0%); suburban childcare, 34 (2.8%); and suburban elementary schools, 117 (9.6%).

Control child-months, provided by 1,410 different control children, matched the 19,652 intervention child-months. By virtue of the matching process, child-months from intervention and control children matched on sex, zip code and insurance type, whereas matching within specified age ranges allowed minor differences in age to occur. Child-months from children dwelling in inner city, rest of city, and suburban zips comprised 60.2%, 28.6% and 11.2% of months, respectively, for both the intervention and control groups. Females contributed 51.2% of child-months for both study groups. Child-months from children covered by Medicaid Managed Care and commercial or Child Health Plus insurance comprised 78.4% and 21.6% of months, respectively, for both study groups. Mean age at the end of each child-month was 6.72 years for the intervention group and 6.71 years for the control group.

3a. Value to Families. Parent surveys were administered and successfully completed in person or via telephone following enrollment, but prior to the first telemed visit, for 578 children. We attempted phone contact at various times of day, including evenings and weekends, until the child had a telemed visit and thus became ineligible for a pre-telemed survey, until a parent completed the survey, a parent refused, or until 3 unsuccessful attempts to contact were unsuccessful. Almost identical surveys were completed by 318 parents after their child had at least one telemedicine visit. A major objective in analyzing surveys was to compare parent impressions and family circumstances pre- vs. post-telemed experience. Post-telemed surveys were completed by 96 parents who had already completed a pre-telemed survey.

3b. Value to Clinicians. This study focused on a 24-month period in the development of Health-e-Access, termed the Primary Care Phase, which began after all 10 participating practices had completed at least one telemedicine visit. We elicited participation in a clinician survey by contacting all clinicians who had completed a telemedicine visit as of February 15, 2007.

Instruments and Measures

1. Expansion. Success in expansion of HeA was assessed based on our ability to establish a network of the scope circumscribed by insurance organization and funding constraints. Success in establishing the type of network envisioned (healthcare when and where you need it by people you know and trust) was also indexed by the response of participating primary care practices to requests to perform telemed visits (enabling continuity of care) and by their ability to complete telemed visits that they were requested to do. Continuity was defined, only for children whose primary care practice was participating, as a telemedicine visit attempted by the child's primary care practice. A completed telemedicine visit was defined as one for which (1) the clinician made diagnosis and management decisions and (2) treatment was instituted based entirely on telemedicine, i.e., no subsequent in-person care, including laboratory or imaging, was required for evaluation or treatment. Continuity and completed visit rates were calculated based on documentation in a log kept by the HeA coordination and control staff and by HeA electronic medical records (telemedicine software).

2. Value to Health System. The primary independent variable was telemedicine enrollment. Primary dependent variables included numbers of acute illness visits in various sites, i.e., primary care office (office), emergency department (ED), telemedicine, and overall utilization (sum of all three sites combined). Visits for chronic illness management and well childcare were excluded because the telemedicine model did not cover this service.

Potentially confounding variables were major determinants of utilization including child age, season of the year, sex, insurance type and socioeconomic status. All but the last of these could be assigned to child-months and utilization events based on information found in insurance files. Zip code of residence, also in insurance enrollment files, was used as an indicator of socioeconomic status and other socio-demographic attributes. Zip codes in the Rochester area correlate very highly with income, educational attainment, availability of transportation, race, ethnicity, and insurance type.[1,2,3] Three socioeconomic areas defined by zip codes were inner city, rest of city, and suburbs. Illness season was based on month of the year and dichotomized on the basis of overall illness utilization rates as low (months 7 through 12) or high (months 13 and 1 through 6).

3a. Value to Families. Queries addressed parent's work and/or student status, work responsibilities, access to healthcare for children, conflicts between work/school and child care during illness, and concerns and likes about telemedicine. Concerns and perceptions about telemedicine examination and communication were elicited through open-ended probes and specific queries (scored on Likert scales).

3b. Value to Clinicians. Acceptability and value to clinicians providing primary care for children was assessed through an on online survey. Requests to complete this survey were sent to all clinicians who had completed a telemed visit as of February 15, 2007. Survey items addressed ease of use, effectiveness, communications with telemedicine assistants and parents, and financing. Completion of visits and continuity of care, as defined above [(1) *Expansion*], are also measures of acceptability of this innovation to clinicians.

Analysis

1. Expansion. As appropriate for the study design and measures, rates were used to indicate success of expanding as planned; specifically, rates of continuity and visit completion.

2. Value to Health System. Because subjects were not randomly sampled nor randomly assigned to intervention or control groups, significance tests were included only to indicate the stability of associations. Average visits per child-year may be interpreted as the expected number of visits during a typical year for an average study child. Utilization rates for intervention and control children were compared first in bivariate analysis, then in multivariate analysis. Because each subject contributed multiple child-months, and each child-month had a corresponding matched control, we have multilevel data with repeatedly measured outcomes clustered within a subject. Analysis for such data needs to take into account for both within-subject and within-matched pair correlations. Within children, months may not be independent of each other unless one considers acute illness episodes as random events within a child. Generalized estimating equations (GEE)[1] with two levels of clustering were used to estimate the effect of telemedicine on numbers of visits of a particular type (e.g., ED visits, overall illness utilization) by fitting marginal Poisson regression models.[1] Sandwich estimators were calculated to generate robust estimation of standard errors. The advantage of GEE is that it provides consistent estimation even with a miss-specified correlation structure, and it is computationally feasible with the large numbers of observations and clusters. Multivariate analyses were performed with SAS.[1]

After minimizing potential effects of several sources of variation by matching, we used multivariate analysis to adjust for sources when matching was not perfect, such as age. The GEE method with a log link and Poisson errors were repeated adjusting for potentially confounding variables. To address the possibility that reduction was attributable to season despite matching, we included in regression models an indicator variable for each month of the year. Models also included indicator variables for insurance type. Matching by month and multivariate analysis minimized the potential for bias due to confounding variables.

3a. Value to Families and 3b. Value to Clinicians. As appropriate for the study designs, descriptive statistics (e.g., frequencies, proportions, means) were used to characterize findings on indicators of burden related due to child illness, especially with regard to work loss and the possibility that telemedicine might reduce this burden.

Results

1. Expansion

We achieved the level of expansion that we set out to achieve. As noted above, this was limited by agreements with insurance organizations and by grant funding for telemedicine equipment. The HeA Network expanded to include 22 child sites and 10 primary care practices serving the children at these sites. Child sites in the city included 5 childcare programs and 7 elementary schools. Suburban child sites included 5 childcare programs and 5 elementary schools. The 10 medical practices were equally split between those located in city and suburban areas.

Over the 7 years between May 1, 2001 when the first HeA visits were done and April 30, 2008 (end of the study observation period), 6,511 telemedicine visits were attempted. Stages in the development of HeA were as follows. The *Pre-Expansion Stage* began with the first telemedicine visits and continued until the *Expansion Stage*, which commenced with funding for expansion from AHRQ and MCHB, received 9/30/04. Expansion was based to a substantial extent on AHRQ funding. The first phase of the Expansion Stage was Technology Development Phase, in which a new software and hardware system was designed to create a functionally reliable, user friendly system that both telemed assistants and busy primary care clinicians could readily learn, dependably use and fully integrate in their day-to-day activities. Beginning in January 2005, child sites were gradually added to the network, including additional inner city elementary schools as well as suburban childcare and elementary schools, bringing the total to 22 neighborhood telemedicine access points. The PCP Installation/Training Phase began when new integrated software/hardware system was first available for deployment, 5/13/06. Beginning at this time, the number of provider sites gradually increased to include 9 additional city and suburban practices, bringing the total to 5 city and 5 suburban practices. We defined the PCP Ramp-Up Phase as beginning when all 10 PCP sites had completed installation and training and had completed their first visit. PCP Ramp-Up began 04/21/06.

The 6,511 total telemedicine visits addressed in this report included Pre-Expansion, 1871, 28.7% and Expansion, 4640, 71.3%. Within the Expansion Stage, phases included Technology Development, 843, 13.0%; PCP Installation/Training 1243, 19.1%; and PCP Ramp-Up, 2554, 39.2.

Telemed visit completion rate was 97.3% overall and varied little among program development phases, with proportions not completed of 1.3%, 1.9%, 3.9% and 3.5%, respectively, for Pre-Expansion, Technology Development, PCP Installation/Training, and PCP Ramp-Up phases. Non-completion rose with the addition of providers from the 9 additional practices (i.e., providers not directly involved with development of HeA), but only modestly so.

For children with a participating PCP office, continuity of care for telemedicine visits was 83.2%. Among the 2554 telemed visits during the PCP Ramp-Up Phase, 1557 were made by children with a participating PCP, and 1296 of these (83.2%) were seen by a clinician from the primary care medical home. Continuity varied substantially among participating practices, ranging from 41.2% to 92.9% among city practices and from 28.1% to 92.3% among suburban practices.

2. Value to Health System

Associations between Potential Confounders and Utilization. Analysis demonstrated strong, and largely expected, relationships (P<.001) between several potentially confounding variables and utilization. An exception was the relationship between socioeconomic area and overall utilization rate, where there was no statistically significant difference. In stark contrast, ED utilization rates were much greater for inner city (57.2) and rest-of-city children (51.2) than for suburban children.

Table 1. Association of potential confounders with ED visits and overall utilization for illness‡

Variables	Categories	Child Months (N)	Child Months (%)	Visits among 39,304* matched child months: ED Utilization—Visits/100/Year†	Visits among 39,304* matched child months: Overall Utilization**—Visits/100/Year
Age (months)	Preschool (< 5 yr)	13,187	33.6	82.4	431.3
Age (months)	Young school-age (5 thru 8 yr)	15,821	40.3	34.8	238.9
Age (months)	Older school-age (9 thru 12 yr)	10,296	26.2	35.2	245.1
Sex	Female	20,151	51.3	48.9	299.9
Sex	Male	19,153	48.7	53.0	310.5
Insurance Type	Commercial, Child Health Plus	8,245	21.0	17.2	252.7
Insurance Type	Medicaid Managed Care	31,059	79.0	59.9	319.0
Illness Season§	Low: Months 7 thru 12	17,158	43.7	44.9	258.6
Illness Season§	High: Months 13, 1 thru 6	22,146	56.3	55.6	341.1
Socioeconomic area	Inner city	23,751	60.4	57.2	306.5
Socioeconomic area	Rest of city	11,145	28.4	51.4	308.2
Socioeconomic area	Suburb	4,408	11.2	15.6	289.9
All Child Months		39,304	100.0	50.9	305.1

‡ For each variable, differences in utilization rates among categories are all statistically significant at the .001 level or better, except as follows. ED utilization differs by illness season at the .006 level of significance. Overall utilization does not differ significantly by socioeconomic area.

* Includes 19,652 intervention child-months and 19652 matched control child-months.

** Overall utilization = all visits of any type (office, ED, or telemedicine) for illness.

† Visits per 100 children per year

§ Year divided into 13 equal “months”, each 28 days long. Low season began June 18. High season began December 3.

Intervention and Utilization—Bivariate Analysis. Overall illness utilization rates, including both visits to traditional sites (ED, office) and telemed visits were 22.9% greater for intervention than control children (336.4 vs. 273.7 visits per100 child-years). The higher overall utilization for intervention children is attributable to telemedicine utilization, at a rate of 83.6 per 100 child-years. Rates among intervention child-months for ED visits and illness office visits, however, were 23.7% less (44.1 vs. 57.7/100) and 3.3% less (208.8 vs. 216.0/100), respectively, than those for control child-months.

Table 2. Utilization patterns with (intervention group) & without (control group) telemed available

Visits for Illness	Control (C): 19,652 Child-months—Visits/mo	Control (C): 19,652 Child-months—Visits/100/year*	Intervention (I) 19,652 Child-months—Visits/mo	Intervention (I) 19,652 Child-months—Visits/100/year	Difference† (I - C) Visits/100/year	Difference† (I - C) %
ED	0.044	57.7	0.034	44.1	(14.7)	(23.7)
Office	0.166	216.0	0.161	208.8	(7.2)	(3.3)
Telemedicine	0	0	0.064	83.6	83.6	na
Overall Utilization**	0.211	273.7	0.259	336.4	62.7	22.9

( ) Negative values are in parentheses.
† All differences among categories for each variable are statistically significant at the .001 level or better.
* Projected visits per 100 children per year.
** Overall utilization = all visits of any type (office, ED, or telemedicine) for illness.

Intervention and Utilization—Multivariate Analysis. This table shows within-subject telemedicine effects on utilization, adjusted for season, health insurance type, child's age and socioeconomic area. After these adjustment, telemedicine did not have a significant effect on office utilization (P = 0.563; rate ratio = 0.968, no change) but was associated with a significant decrease in ED utilization (P = .036; rate ratio = 0.778, 22.9% decrease) and an increase in overall utilization (P = <.0001; rate ratio = 1.235, 23.5% increase).

Table 3. Poisson regression: telemedicine enrollment predicting utilization for illness after adjusting for potential confounders* (n = 39,304 child-months)

Effect in predicting visits to:	Estimate	SE of est.	95% Conf. Limits: lower	95% Conf. Limits: upper	P	Rate Ratio	95% CL lower	95% CL upper
Primary Care Physician Office (office)	-0.033	0.057	-0.144	0.078	0.563	0.968	0.87	1.08
Emergency Department (ED)	-0.251	0.119	-0.485	-0.017	0.036	0.778	0.62	0.98
Overall (ED, office or telemed)	0.211	0.053	0.108	0.315	<.0001	1.235	1.11	1.37

3a. Value to Families

The 896 completed surveys included 578 pre-telemedicine surveys and 318 surveys completed following at least one telemedicine. Surveys were completed by 800 unique individuals. Both pre- and post-telemedicine surveys were completed by 96 respondents, allowing 96 pre vs. post comparisons. Among all 800 respondents, 15% had < high school, 60% had completed 12 to 14 years of schooling, and 25% had a college education. Race/ethnicity was black, 43.6%; Hispanic, 22.9%; white, 30.0%; other, 3.5%. In statistics on the 800 unique respondents presented below, values presented are based on responses during the second interview wherever changes occurred among those interviewed both before and after.

Access to Healthcare. Almost all (94.5%) of the 800 respondents identified a source of primary care for their children, and for 57.4% this site participated in HeA. Children with a primary care practice located in the city were much more likely (P < .001) to use a primary care practice that participated in HeA (70.5) than children using a suburban practice (42.6). On average, parents estimated the total time (SD) for a doctor's office visit, including transportation, was 2.44 (1.24) hours. Most families used their own car (81.3%) to access the doctor's office, but a substantial proportion relied on a friend's care (3.4%) or bus or taxi (13.4%).

Parent Responsibilities. Among the 800 respondents, 71.5% worked at least part time and 15.4% were involved in some form of schooling. Parents both working and attending school comprised 7.9% of the 800, and parents neither working or attending school comprised 20.6% of the 800. All parents using childcare worked.

Conflicts between Parent Responsibilities and Care of Children. Among the 572 respondents working, 34.9% indicated they would lose pay when they missed work due to a child's illness. Among all 800 respondents, 61.3% had, at some time, picked up a child due to illness and 72.5% had, at some time, kept a child home from school or childcare due to illness. For parents who had missed work or school to pick up a child within the past 3 months, the estimated number of times averaged 1.79 and the estimate hours lost averaged 7.72. For parents who had missed work or school to keep an ill child home within the past 3 months, the estimated number of times averaged 1.77 and the estimated hours lost averaged 11.94. As shown in Table 4 (next page), whether the parent worked had little influence these values. Work status had a modest influence, however, on whether the parent had missed work the last time a child was sick, and whether the parent usually missed work when a child was sick.

Notably, most parents had given ibuprofen or Tylenol at some time in an attempt to hide a child's illness. There were significant differences between city (60.9%) and suburban (49.5%) parents (Chi Sq = 7.69, P = .007) and between childcare (61.7%) and school (53.8%) parents (Chi Sq = 6.06, P = .029). The likelihood that antipyretics were so used varied with responsibilities outside the home, from 73.3% for respondents with both school and work responsibilities, 603% with only work, 60.2% with only school, to 46.7% with neither of these responsibilities (Chi Sq = 15.6, P < .001).

Worries, Concerns and Perceptions about Telemedicine. Specific queries on worries and concerns about the HeA telemedicine model indicated that these were generally low and trended lower after experience. Among the 800 unique respondents, on 7-point Likert scales with anchor points of 1 (not at all worried or concerned) and 7 (very worried or concerned) mean values were generally below 3.0. An overall worry score, calculated as the sum of the 4 individual scores, averaged 11.16 among these respondents, representing an average of 2.79.

Table 4. Conflicts between care of children and other parent responsibilities

Table 4a. Conflicts between work/school and care of child

Question	N Valid*	Units	Lose Pay	Can make up lost time	Can work at home	Other	No impact
If working: Impact on pay when parent misses work due to child illness	565	%	34.9	9.9	2.3	4.2	48.7

Table 4b. Picked up child due to illness

Question	Sub-question	N Valid*	Units	Result
Ever had to pick up child due to illness		800	%yes	61.3
Ever had to pick up child due to illness	If yes: How many times in past three months?	385	mean	1.32
Ever had to pick up child due to illness	If working:	572	%yes	65.7
If had to pick up, missed work/school		490	%yes	65.3
If had to pick up, missed work/school	If working:	376	%yes	77.4
If missed work/school, how often missed in past 3 mo due to child illness		289	mean	1.79
If missed work/school, how often missed in past 3 mo due to child illness	If working:	267	mean	1.78
If missed work/school, how often missed in past 3 mo due to child illness	How many hours missed each time	259	mean	7.84
If missed work/school, how often missed in past 3 mo due to child illness	How many hours missed each time if working	241	mean	7.72

Table 4c. Kept child out due to illness

Question	Sub-question	N Valid*	Units	Result
Ever kept this child out due to illness		800	%yes	72.5
Ever kept this child out due to illness	If yes: How many times in past 3 months	580	mean	1.79
Ever kept this child out due to illness	If working:	433	mean	1.8
If kept out, missed work/school		580	%yes	56.9
If kept out, missed work/school	If working:	433	%yes	66.7
If missed work/school, how often missed in past 3 mo due to child illness		330	mean	1.77
If missed work/school, how often missed in past 3 mo due to child illness	If working	289	mean	1.85
If missed work/school, how often missed in past 3 mo due to child illness	How many hours missed each time	282	mean	11.94
If missed work/school, how often missed in past 3 mo due to child illness	How many hours missed each time if working	249	mean	12.27

Table 4d. Parent choices

Question	Sub-question	N Valid*	Units	Miss Work	Care by relative	Care by Friend	Other	Missing or N/A
What was done the last time child was sick		800	%	55.5	19.0	2.5	15.8	7.3
What was done the last time child was sick	If working:	572	%	63.6	23.1	3.5	6.8	3.0
What is usually done when child is sick		800	%	56.0	18.5	2.4	16.9	6.3
What is usually done when child is sick	If working:	572	%	64.5	22.4	3.0	8.4	1.7
Have given ibuprofen or Tylenol to hide child's illness		800	%yes	58.4				
Have given ibuprofen or Tylenol to hide child's illness	If working:	572	%yes	61.5				

* Total number of valid responses among the 800 responders.

Table 5. Worries and concerns about telemedicine

Worries and concerns (How worried or concerned are you about the following?)	N Valid*	Units	Likert Scale Anchor Points and Range	Mean	Median	SD
The doctor usually doesn't talk directly to me to tell me about the cause of the problem	784	score	1-not at all. 7-very	2.56	1.00	2.05
The doctor usually doesn't talk directly to me to tell me about how to treat the problem	785	score	1-not at all. 7-very	2.61	1.00	2.12
I'm not sure the doctor can examine my child as well using telehealth	784	score	1-not at all. 7-very	2.67	2.00	1.87
With telehealth, the daycare center sometimes keeps children around who might cause other children to get sick (who have a contagious condition)	784	score	1-not at all. 7-very	3.32	3.00	2.34
Worry score (sum of scores, 4 items above)	780	score	4-not at all. 28-very	11.16	10.00	6.68

* Total number of valid responses among the 800 responders.

Differences in worries and concerns following experience were not statistically significant in matched-pairs analysis for the 96 parents responding to both the before- and after-telemedicine surveys, as shown in Table 6.

Table 6. Change in worries &concerns following telemedicine experience, matched pair analysis

Worries and concerns (How worried or concerned are you about the following?)	Before or After†	N Valid*	Units	Likert Scale Anchor Points/Range	Mean	SD	t**	P***
The doctor usually doesn't talk directly to me to tell me about the cause of the problem	B	88	score	1-not at all. 7-very	2.34	1.84		
The doctor usually doesn't talk directly to me to tell me about the cause of the problem	A	88	score	1-not at all. 7-very	2.27	1.94	0.24	0.81
The doctor usually doesn't talk directly to me to tell me about how to treat the problem	B	87	score	1-not at all. 7-very	2.47	1.90		
The doctor usually doesn't talk directly to me to tell me about how to treat the problem	A	87	score	1-not at all. 7-very	2.26	2.06	0.67	0.50
I'm not sure the doctor can examine my child as well using telehealth	B	88	score	1-not at all. 7-very	2.55	1.85		
I'm not sure the doctor can examine my child as well using telehealth	A	88	score	1-not at all. 7-very	2.50	1.89	0.18	0.86
With telehealth, the daycare center sometimes keeps children around who might cause other children to get sick (who have a contagious condition)	B	88	score	1-not at all. 7-very	3.33	2.32		
With telehealth, the daycare center sometimes keeps children around who might cause other children to get sick (who have a contagious condition)	A	88	score	1-not at all. 7-very	2.90	2.22	1.23	0.22
Worry score (sum of scores, 4 items above)	B	87	score	4-not at all. 28-very	10.64	6.02		
Worry score (sum of scores, 4 items above)	A	87	score	4-not at all. 28-very	9.91	6.35	0.78	0.44

† Before (B) or After (A) respondent has had experience with telemedicine. * Number of valid paired responses among the 96 parent responding both before and after telemedicine experience. ** Paired samples t-test. *** 2-tailed significance.

Finally, open-ended probes revealed strongly positive attitudes and perceptions among the 318 respondents who had experienced telemedicine. Among the 532 comments from these respondents, likes (positive responses) predominated (84.6%). Likes most commonly included convenience/time saved (33.6% of all comments), parent stayed at work (13.5%), drug delivered to child site (7.1%) or called ahead to pharmacy (4.9%), and confidence in care (2.3%). Concerns (15.4%) most commonly included reliability of diagnosis (2.6%), technical problems (1.3%), and preference for in-person care (0.8%).

3b. Value to Clinicians

The mean (SD) number of visits managed per clinician was 53.2 (149.6), 24 clinicians managed 10 or more visits, and 12 managed 50 or more. Among the 47 clinicians in the 10 participating primary care practices, 40 responded to a survey in February 2007 regarding their experience. Most survey items applied only to the 30 (23 pediatricians, 7 mid-level practitioners), among these 40, that had completed at least one telemedicine visit at the time the survey was distributed (February 1, 2007).

As shown in Table 4 below, survey responses indicated that clinicians generally found the telemedicine software easy to learn (mean 3.8) and that technical problems interfered with their ability to complete telemedicine visits less often than "sometimes" (mean 2.4).

The mean time clinicians required *for decision making* with telemedicine visits was estimated at 10.3 min per visit. As a group, clinicians estimated this time was slightly less than that for similar office visits (mean 2.9, with a value of 3 indicating "about the same"). They estimated a mean *total time* for completing the entire visit via telemed (including documentation and contacts with pharmacy, parents and telemedicine assistants) of 19.8 min per visit. Total time required for completing the visit via telemedicine was longer (mean 3.5, with 3 indicating "about the same"). Among the 6 clinicians who had completed 50 or more telemed visits, mean estimates for time involved in decision making and total time were 7.2 and 15 min per visit, respectively.

Confidence in diagnosis was somewhat less with telemedicine than with usual care (mean 2.4). Overall, 46.3% of clinicians were at least as confident of diagnoses made via telemedicine. Among the 6 clinicians who had completed 50 or more telemed visits, 83.3% were at least as confident of diagnoses made via telemedicine as in person.

Clinicians generally were comfortable collaborating with telemedicine assistants (mean 4.1), although clinicians were less enthusiastic about completeness of the information that the telemedicine assistants provided. Clinician confidence that their communication met patient needs was relatively high (mean 3.7).

Table 7. Clinician survey responses

Table 7a. Experience with telemedicine

Survey question	Clinicians responding*	Units	none	<20	20-49	50-99	100-199	200-500	>500
About how many visits has your practice done?	40	%	0.0	32.5	2.5	10.0	7.5	10.0	27.5
About how many visits have you done, yourself?	40	%	25.0	32.5	37.5	2.5	0	5	7.5

* Responses to queries about time for visits, effectiveness, training and use, and communication with telemedicine assistants and parents were relevant only for the 30 clinicians who had performed at least one telemedicine visit, rather than the 40 total respondents.

Table 7b. Ease of use

Survey Question	Clinicians responding*	Likert Scale Anchor Points	Units	Mean	Median	SD
How hard would you say it is to learn to use the telemedicine software?	30	1 very difficult, 5 very easy	score	3.8	4	1.10
How often do technical problems interfere with ability to do visits?	30	1-rarely, 3-sometimes, 5-every visit	score	2.4	2	1.10

Table 7c. Efficiency and effectiveness

Survey Question	Clinicians responding*	Likert Scale Anchor Points	Units	Mean	Median	SD
Time required for medical decision making	25		min	10.3	10	5.44
Total time for telemedicine visit	23		min	19.8	20	5.11
Telemedicine vs In-person: time for medical decision making	28	1-less, 3-same, 5-more	score	2.9	3	1.18
Telemedicine vs In-person: total time for visit	29	1-less, 3-same, 5-more	score	3.5	4	1.15
Telemedicine vs In-person: confidence in diagnosis	30	1-much less, 3-about same, 5-much more	score	2.4	2	0.94

Table 7d. Communication with telehealth assistants and parents

Survey Question	Clinicians responding*	Likert Scale Anchor Points	Units	Mean	Median	SD
Information provided by telemedicine assistants is usually complete enough	30	1-strongly disagree, 3-neither agree nor disagree, 5 strongly agree	score	3.4	4	0.90
Overall, I feel comfortable collaborating with telehealth assistants	30	1-strongly disagree, 3-neither agree nor disagree, 5 strongly agree	score	4.1	5	1.17
Confident with telemedicine that communication with parents meets their needs	30	1-strongly disagree, 3-neither agree nor disagree, 5 strongly agree	score	3.7	4	0.94

Table 7e. Acceptability

Survey Question	Clinicians responding*	Likert Scale Anchor Points	Units	Mean	Median	SD
Our practice can use this telemedicine application to reduce clinician time required for visits	39	1-strongly disagree, 3-neither agree nor disagree, 5 strongly agree	score	2.7	3	1.05
We know how we could use a telemedicine application like this to reduce our costs in doing illness visits	39	1-strongly disagree, 3-neither agree nor disagree, 5 strongly agree	score	2.8	3	1.11
Compared to an in-person visit, what level of reimbursement do you think is fair for telemedicine visits?	39	1-much less, 3-about the same, 5 much more	score	3.0	3	0.36
How would you describe the attitude or level of interest in Health e-Access by other clinicians in your practice?	29	1-very negative, 5 very positive	score	3.0	3	1.25
Would it be fair for some of the total reimbursement to go to the originating site? (38 responded, 23.7% said no, 76.3% said yes) Sub-question: If yes to the above: Assuming that total insurance company payment for a telemedicine visit were $45, how much of that would be fair to pay the originating site for their contribution to the visit?	27		$	11.5	10.0	8.4

Responding to queries related to acceptability, clinicians had no strong opinions on their ability to use Health-e-Access to save time (mean 2.7) or reduce their costs (mean 2.8), nor on the level of interest in telemedicine by their practice colleagues (mean 3.0). They believed fair reimbursement for telemedicine visits was the same as for usual visits (mean 3.0), and that fair payment to the originating site for their part in completing a telemedicine visit was $11.50.

Conclusions and Implications: 1. Expansion

Attaining expansion goals, while achieving high rates of telemedicine visit completion and continuity with the primary care medical home, substantially strengthens the body of evidence supporting the acceptability of the Health-e-Access telemedicine model and its effectiveness in on promoting the right care, in the right place, at the right time.

Conclusions and Implications: 2. Value to Health System

Impact on ED Utilization. Multivariate analysis indicated that telemedicine access was associated with substantially less ED utilization. Although demonstrating 22.2% fewer ED visits among children with access to telemedicine, we also found 23.5% more visits for illness, overall. Findings are likely to be generalizable to urban areas throughout the United States. The observed overall utilization rate for illness among control children, 273.7 visits per 100 children per year, was similar to US acute illness utilization rates reported at 291.4, 148.0 and 100.5, respectively, for children in their first year, 1 through 4 years of age, and 5 through 14 years of age.[1]

Additional overall utilization due to telemedicine visits was a large part of the cost of reducing ED utilization through this telemedicine model. To provide a metric for the tradeoff between reduced ED visits and increased overall visits, we multiplied utilization rates in the control group (i.e., taking control group rates as baseline values) by rate ratios from multivariate analysis, thus calculating the projected increase in annual overall visits per 100 children (64.3) and the projected decrease in ED visits (12.8). Based on these projected changes, the tradeoff was 5.0 more visits overall per ED visit avoided.

This may be considered a cost-effectiveness measure, with overall visits added as the unit of cost and ED visits avoided as the unit of effectiveness. Thus, if the mean payment for the ED visits avoided is at least 5-fold greater than the mean payment for added visits (i.e., telemedicine visits), then the healthcare system will at least break even on the introduction of telemedicine. Evidence suggests that relative mean payments exceeding this break-even ratio can be expected. In another study,[1] we estimated that mean payment in Rochester for ED visits with potential to be replaced by telemedicine was at least $355, a value that is 7-fold greater than the $51 mean payment for telemedicine visits.

We speculate that the increase in overall utilization associated with telemedicine reflects the use of telemedicine for illness for which families with better access generally receive telephone advice or in-person care. A firm body of evidence indicates that impoverished, urban children endure a substantially greater morbidity burden than their more economically advantaged suburban counterparts.[29] This evidence includes findings for this community that the hospitalization rate for asthma was 5-fold greater for inner-city than suburban children, but severity of illness for these hospitalized children did not vary by socioeconomic area.[1] Supporting our speculation, although ED utilization in the present analysis differed almost 4-fold between inner city and suburban areas, *overall* utilization was indistinguishable between city and suburban children.

Implications. We expect the cost-effectiveness metric (increase in the overall number of illness visits per ED visit avoided) of 5.0 would improve over time as telemedicine becomes more commonly used. We placed no constraints on requests for telemedicine visits because constraints – especially at a time when telemedicine was new to all participants – might discourage use.

If Health-e-Access were fully integrated into the community's health system, we believe a substantial proportion of telemedicine visits occurring during the study period would be averted through telephone management, a less expensive service already provided by most pediatric practices. This belief assumes that full integration will include telephone management, by a clinician or phone nurse, as part of a process that would lead to telemedicine access only if appropriate care were beyond the scope of phone management. The belief that phone management will narrow the use of telemedicine is consistent with observations indicating that many illness episodes that would otherwise lead to office or ED visits can be managed safely and effectively via telephone.[1]

Authors reviewing the effectiveness of various strategies to improve access[1] concluded, "We should aim to develop systems of care that are timely rather than delayed, with a personal clinician rather than a "doctor on call," and in the medical home rather than in other settings such as urgent care centers or emergency departments." Health-e-Access aims to do precisely that, defining its mission as "enabling healthcare when and where you need it, by providers you know and trust". Although no single solution will optimize access, we believe that expanding the Health-e-Access telemedicine model holds transformational potential.

Four next steps towards broadening the impact of telemedicine appear logical. These include: (1) establishing telephone management as the gateway to telemedicine access; (2) mobile telemedicine units; (3) after-hours neighborhood telemedicine access; and (4) adopting Health-e-Access lines of communication for childcare and school settings. The rationale for the *telephone gateway* has been discussed. We elaborate on remaining proposals.

Mobile Telemedicine Access. Mobile telemedicine units manned by roaming telemedicine assistants could move among multiple sites using wireless broadband connectivity. Mobile units would allow children attending smaller childcare and school sites to be served. Small family-home childcare accounts for one-third of childcare.

After-hours neighborhood telemedicine access might have an even greater impact in reducing ED visits than childcare or school access because most ED visits occur in the evening.

Adopt Health-e-Access lines of communication: The impact of Health-e-Access, especially the 63% reduction in absence from childcare due to illness,[25] is partly attributable to protocols and procedures adopted in telemedicine implementation. Our clinical experience suggests that school nurses most commonly use the telephone to demand children's removal. Lines of communication and expectations established through Health-e-Access encouraged child-site staff to engage clinicians and parents directly in more useful communication, centered on management of the child's health problem on-the-spot. This focus is consistent with the position of the American Academy of Pediatrics that "relatively few illnesses mandate exclusion from school."[1]

The rapid emergence across the US of retail-based clinics suggests a great, unmet need for convenient access to care for acute illness. The American Academy of Pediatrics opposes retail-based clinics, explaining their position based on concerns about disruption in continuity with the medical home and about quality of care.[1] Retail-based clinics have continued to spread, nevertheless, with claims that more nearly 900 existed in the US as of April 2008.[1, 2] Telemedicine access might be provided in these same retail settings, or in other neighborhood settings. Lack of continuity with the primary care medical home is inherent to retail-based clinics, whereas many primary care practices might, for several reasons, be willing to provide telemedicine visits for their patients presenting to telemedicine access points. Clinicians already provide telephone management during regular hours and after-hours. This service involves a careful history and thus already encompasses a time-consuming portion of any telemedicine visit. Telemedicine capability, which can readily be established on the clinician's home personal computer, enables the practice to reduce loss of revenue to the ED, urgent care center, or retail-based clinic.

This study validates commitment to family convenience as an effective means to decrease costs while improving access. Findings on utilization are especially important to the acceptance of telemedicine by US health insurance organizations. Assuming that the observed value of 5.0 for the cost-effectiveness metric represents a worst-case estimate, as we believe, this value can be interpreted by payers as a worst-case, break-even ratio.

Conclusions and Implications: 3. Value to Families

Findings indicated the HeA telemedicine model was well accepted by a substantial, diverse group of parents despite lack of prior familiarity with this approach to care.

About 72% of respondents worked at least part time, and about 21% neither worked or went to school. Although almost all families identified a source of primary care for their child, observations provided ample evidence that more convenient access would have a substantial impact on quality of life. Most parents had missed some work because of a child's illness, either because they felt obliged to stay home with a sick child or were required to pick up a sick child from childcare or school. Attempts to mask a child's illness through antipyretic use was common among suburban (50%) and city parents (61%).

Prior analyses have already developed a body of evidence indicating that HeA was well accepted and highly valued by families. We previously documented a 63% reduction in absence due to illness from inner-city childcare for families that had telemedicine access,[25] and 94% of these parents, when interview following their child's first HeA visits, indicated that telemedicine had saved them a visit to the office or ED. The amount of time thus saved, per telemedicine visit, was estimated at 4.5 hours.

Surveys administered for purposes of the present study add to the body of evidence on acceptance and value in several ways. Surveys conducted for the present study included much broader sociodemographic representation. These surveys included 800 different families, and 318 families were interviewed following telemedicine experience. Parents had only modest worries and concerns about the quality of care available through telemedicine. Finally, positive comments about experience with telemedicine predominated heavily over comments reflecting concerns. Most comments highlighted convenience and time saved, including reduction in time lost from work.

Conclusions and Implications: 3. Value to Clinicians

Performance measures indicated that clinicians accepted the Health-e-Access telemedicine model well. They completed almost 97% of telemedicine visits and provided continuity of care for over 80%. Continuity varied among practices. Lack of continuity was attributable generally to a decision by the child's practice not to perform the telemedicine visit, rather than failure of Health-e-Access to enable to the child's primary care practice to perform the visit. Survey results also supported acceptability in general.

Limitations. We report on a substantial case study in a single community. Feasibility and acceptability of a health services innovation reflect many factors in addition to design of the technology and the organizational architecture. For this innovation, these include community-specific attributes such as commitment to primary care within the healthcare community; interest and commitment of childcare programs, school personnel and other potential neighborhood access points; program leadership; and local healthcare-related politics. Thus, while the design of Health-e-Access should be readily generalizable to other communities, execution of the design depends significantly on community-specific attributes.

Total time required to complete visits probably has diminished since the clinician survey was conducted. Software was upgraded in June 2007 to allow easier navigation and documentation, and to allow prescriptions to be faxed directly to pharmacies.

Implications. Based on a recent synthesis of evidence on the effectiveness of strategies to improve access,[1] authors concluded, "We should aim to develop systems of care that are timely rather than delayed, with a personal clinician rather than a "doctor on call," and in the medical home rather than in other settings such as urgent care centers or emergency departments." Health-e-Access, which defines its mission as *enabling healthcare when and where you need it, by providers you know and trust*, aims to do precisely that.

Findings indicate a high level of fidelity to this mission. High rates of completion suggest Health-e-Access almost always enables clinicians to have the information that they need to make diagnosis and management decisions about problems emerging in childcare and school settings. High levels of continuity reflect both clinician commitment to provide convenient care for their patients and capability of the telemedicine system to allow information to flow among participants efficiently enough so that most visits can be integrated in busy primary care practices.

Great demand exists for convenient access to care for acute problems. High estimates for the proportion of children's ED visits that are for non-emergency problems, ranging between 20% and 70%,[1,2,3] suggest that many costly ED visits occur because of barriers to more appropriate access. Inefficient, costly, and impersonal care results from the mismatch between ED resources and the resources required for optimal care of non-emergencies. This demand has also led to the rapid emergence across the US of retail-based clinics, with claims that more nearly 900 existed in the US as of April, 2008.[1,2] The American Academy of Pediatrics opposes retail-based clinics based on concerns about disruption in continuity with the medical home and about quality of care.[1] Neighborhood telemedicine access points – including these same retail settings, childcare programs, schools, community centers and other neighborhood settings – might enable care that is at least as convenient as retail based clinics. At the same time, the Health-e-Access telemedicine model might enable primary care practices to avoid revenue loss while offering continuity of care with the medical home that is inherently absent in retail based clinics, as currently structured.

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List of Publications and Products

Peer-Reviewed Publications

McConnochie KM, Wood NE, Herendeen NE, Ng PK, Roghmann KJ. Changes in the care pattern for illness visits due to telemedicine. *Pediatrics* 2008, in press

McConnochie KM, Tan J, Wood NE, Herendeen NE, Kitzman HJ, Roy J, Roghmann KJ. Acute illness utilization patterns before and after telemedicine in childcare for inner-city children: A cohort study. *Telemedicine and e-Health* 2007,13:381-390

Kopycka-Kedzierawski D, Billings R, McConnochie KM. Dental screening of preschool children using teledentistry: A feasibility study. *Pediatric Dentistry* 2007 (May-Jun); 29:209-213.

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McConnochie KM, Conners GP, Brayer AF, Goepp J, Herendeen NE, Wood NE, Thomas A, Ahn DS, Roghmann KJ. Effectiveness of telemedicine in replacing in-person evaluation for acute childhood illness in office settings. *Telemedicine and e-Health.* 2006; 12: 308-316

McConnochie KM, Wood NE, Kitzman HJ, Herendeen NE, Roy J, Roghmann KJ. Telemedicine reduces absences due to illness in urban childcare: Evaluation of an innovation. *Pediatrics* 2005; 115: 1273-1282

Abstracts, Presentations

McConnochie KM, Wood NE, Herendeen NE, Ng PK, Roghmann KJ. Telemedicine Reduces Emergency Department Utilization in Urban Children. Platform Presentation, Pediatric Academic Societies' Annual Meeting, May 2008, Honolulu

McConnochie KM, Feng Qian J, Noyes K, Wood NE, Roghmann KJ. Potential to Reduce Healthcare Costs by Replacing Emergency Department with Telemedicine Visits. Platform Presentation, Pediatric Academic Societies' Annual Meeting, May 2008, Honolulu

McGowan JJ, Dixon BE, McConnochie KM, Scheideman-Miller C, Bryant CA. Impacting Quality and Safety via Telehealth. Panel presentation at the annual Fall meeting of the American Medical Informatics Association, November 2007, Chicago

McConnochie KM, Herendeen NE, Wood NE, Roghmann KJ. Health Care When and Where You Need It, By People You Know and Trust. Poster presentation, AHRQ Annual Meeting, September 2007, Washington, DC

McConnochie KM, Herendeen NE, Wood NE, Denk L, tenHoopen CB, Neuderfer JS. Can telemedicine for children in inner-city child care be integrated in the primary care medical home? Platform presentation, Pediatric Academic Societies' Annual Meeting, May 2007, Toronto

McConnochie KM, Potential of Telemedicine for Developmentally Disabled Children and Adults. Invited teleconference presentation to the New York State Office of Mental Retardation and Developmental Disabilities Commissioner's Taskforce on Aging, March 9, 2007

McConnochie KM, Herendeen NE. Clinical and Economic Impact of the Health-e-Access Telemedicine Model. December, 2006. Emergency Medicine Department Grand Rounds, University of Rochester Medical Center

McConnochie KM. Clinical and Economic Impact of the Health-e-Access Telemedicine Model. October 17, 2006. National Virtual Telehealth Grand Rounds, sponsored by East Carolina University

McConnochie KM. The Health-e-Access Telemedicine Model: Measuring the Impact. Invited panel presentation at the annual Spring meeting of the American Medical Informatics Association, May 2006, Phoenix, AZ

McConnochie KM. Economic Model of Organizational Architecture to Guide Design and Performance Evaluation in an Urban, Primary Care Telemedicine Network. Platform presentation. Patient Safety and Health Information Technology Annual Meeting, Agency for Healthcare Research and Quality. Washington, DC, June 2005

McConnochie KM, Tan J, Wood NE, Herendeen NE, Kitzman HJ, Dick AW, Roy J, Roghmann KJ. Telemedicine in Inner-City Childcare Reduces Utilization for Acute Illness. Platform presentation, Pediatric Academic Societies, May 2005, Washington, DC

McConnochie KM, Wood NE, Kitzman HJ, Herendeen NE, Roy, J, Roghmann KJ. Telemedicine Reduces Absences Due To Illness in Urban Childcare: Evaluation of an Innovation. Poster presentation, American Telemedicine Association Annual Meeting, Denver, April 2005

McConnochie KM, Tan J, Wood NE, Herendeen NE, Kitzman HJ, Dick AW, Roy J, Roghmann KJ. Telemedicine in Inner-City Childcare Reduces Utilization for Acute Illness. Poster presentation, American Telemedicine Association Annual Meeting, Denver, April 2005

McConnochie KM, Brayer AF, Conners GP, Goepp J, Herendeen NE, Wood NE. Reliability And Efficacy Of Telemedicine In Diagnosis And Management Of Common Acute Childhood Illness. Poster presentation, American Telemedicine Association Annual Meeting, Denver, April 2005 (Winner of Blue Ribbon Award from ATA)

McConnochie KM, Wood NE, Kitzman HJ, Herendeen NE, Roy, J, Roghmann KJ. Telemedicine Reduces Absences Due To Illness in Urban Childcare: Evaluation of an Innovation. Platform presentation, Pediatric Academic Societies, May 2004, San Francisco

McConnochie KM, Brayer AF, Conners GP, Goepp J, Herendeen NE, Wood NE. Reliability And Efficacy Of Telemedicine In Diagnosis And Management Of Common Acute Childhood Illness. Poster presentation, Pediatric Academic Societies, May 2004, San Francisco

McConnochie KM. Telehealth Services in Rochester (NY) Head Start. Poster presentation at Head Start's 7th National Research Conference, Washington, DC, June 28, 2004