Title of Project
Facilitators and Barriers to Adoption of a Successful Urban Telemedicine Model

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ABSTRACT

Purpose: The goal of this primary care, connected health initiative is replacement of inconvenient, inefficient traditional models of care, such as the emergency department (**ED**), through more convenient, high quality, less expensive care models that leverage information technology (**IT**). This project was designed to evaluate facilitators and barriers to implementation of the Health-e-Access (**HeA**), a health IT model with established feasibility, efficacy, effectiveness and efficiency in management of acute childhood illness, and to expand HeA implementation. Knowing facilitators and barriers to adoption of this disruptive innovation will help similar models become established more quickly and efficiently.
Scope: *Specific aims* were to: (A) achieve substantial deployment and solidify sustainable business models for each of the 3 urban telemedicine service models; (B) identify facilitators and barriers; (C) monitor impact on utilization patterns; and (D) create and disseminate an implementation and sustainability toolkit.
Methods: Three service models, in various stages of development and deployment, had evolved in use of HeA at the time of project initiation: (1) child care, (2) school, and (3) after-hours neighborhood. Each model is highly flexible in meeting patient needs, in part because HeA technology is web-based and includes mobile patient access units. Models served families in Rochester, NY, a mid-sized city with marked racial and ethnic disparities in socioeconomic and health status.
Results:
This project: expanded HeA broadly into the Rochester City School District and selected neighborhood centers; identified major facilitators and barriers; and demonstrated impact of the HeA models on utilization patterns, including more equitable access. An implementation toolkit was developed.

Key Words: health information technology, connected health, telemedicine, acute illness, pediatrics, primary care

PURPOSE

The fundamental goal of our ongoing, primary care, connected health initiative is replacement of inconvenient, inefficient and expensive traditional models of care, such as the emergency department (ED), through more convenient, high quality, less expensive care models that leverage health information technology (**IT**). We proposed to evaluate facilitators and barriers to implementation of the Health-e-Access telemedicine network (**HeA**), a health IT application with established feasibility, reliability, efficacy, effectiveness and efficiency in management of acute childhood illness.[1, 2, 3, 4, 5, 6] The initial focus of HeA on acute childhood illness was chosen because the unpredictable occurrence and high incidence of this problem promotes acceptance of a model of care, however unfamiliar, that is distinguished by its convenience. We envision a broad range of additional applications of the HeA model eventually – applications across the life span to delivery of preventive services and chronic problem as well as acute problem management – once facilitators and barriers among all key stakeholders are fully explicated and financial sustainability is established.

The AHRQ Funding Opportunity (PAR-08-270) supporting this project was designed to promote implementation of health IT innovations that are effective and sustainable in the real world. HeA research and demonstration projects since 2001 had addressed many technical, social, organizational and financial challenges to HeA implementation. The logical next challenge was to integrate this network into the healthcare system in a way that optimized impact (maximizing benefits, minimizing costs) through sustainable service models. The highest level of implementation, we believe, is implementation that is sustained and replicated. Accordingly, we focused on identifying determinants (facilitators, barriers) of sustainability.

By the time this specific project was initiated, ***three service models*** had evolved in use of HeA to enable telemedicine access, (1) **child care**, (2) **school**, and (3) **after-hours neighborhood** (**AHN**) models. Each service model has distinct strengths and weaknesses in serving incentives of the primary stakeholders. Incentives vary among the stakeholder groups, including parent/patient, clinician, patient's telemedicine access site, provider organization, payers, and the community at large.

In urban, Rochester, NY where these models were deployed, families have several options for care of acute illness episodes. We have no evidence that children here go without care, although research on ED use had indicated that care is often not timely, convenient, or efficient. In such an environment, we expected that families would embrace new service models only if they recognized clear advantages over the traditional models of office, urgent care facility or ED care. We anticipated that widespread use of any of the HeA models would mean distinct reduction in use of traditional service models. These deeply-entrenched, traditional models are important to the financial interests of organizations that dominate the Rochester area health care system. Replacement of inconvenient, inefficient and expensive traditional models of care through more convenient, less expensive models enabled by HeA was, and remains, a fundamental goal of our initiatives. Thus, the effort to disseminate HeA may be described as an initiative focused on disruptive innovation.[7]

To be replicated, disseminated and sustained, new service models must be as good as or better than existing models in meeting the incentives of the various stakeholders whose influence determines acceptance and use. The features of these new, disruptive service models that meet these incentives must be identified and sufficiently well understood so they can be well articulated by individuals and organizations that would promote them.

Specific aims:

A. To achieve substantial deployment and solidify sustainable business models for of each of the 3 urban telemedicine service models. Models include *childcare* (**CC**) access, *school* (**S**) access and *after-hours neighborhood* (**AHN**) access. Extensive experience had already been gained with childcare and school models, but additional implementation activities and resources were required to disseminate these models throughout the 4 targeted inner city zip code areas. AHN telemedicine access had been piloted at 4 inner city neighborhood sites with funding from the NY State Health Department and the NY Health Foundation. Feasibility as well as key community and health system collaborations had been established.

B. To identify facilitators and barriers to dissemination of the 3 telemedicine service models. During Project Year 1 and Year 3, we identified facilitators and barriers for establishing and sustaining the telemedicine models.

C. To monitor impact of the HeA models on acute illness utilization patterns. We planned to obtain almost complete records of utilization for all children dwelling in targeted zips and use this analysis to: (1) guide our efforts at deployment through engaging collaborating community organizations, clinicians, and provider organizations and their staff in the change process, (2) identify opportunities to improve use of HeA, (3) inform the community at large, and (4) reassure insurance organizations, provider organizations and the community at large that the impact of HeA is, from their various perspectives, cost-neutral or better. A complete understanding of the on acute illness utilization requires complete, community-wide information on all types of health service encounters for acute illness.

D. To create and disseminate an implementation and sustainability toolkit. Based on results of qualitative and quantitative analysis of Aim B, best practices for establishing and sustaining HeA to replicate these models was incorporated into a toolkit.

SCOPE

We evaluated facilitators and barriers to implementation of the Health-e-Access Telemedicine Network (**HeA**), a health IT application with established feasibility, efficacy, effectiveness and efficiency in management of acute childhood illness. ***Three service models*** evolved in use of HeA to enable telemedicine access, (1) child care, (2) school, and (3) after-hours neighborhood models. Each model is highly flexible in meeting patient needs, in part because HeA technology is web-based and includes mobile patient access units. The three models served families in Rochester, NY, a mid-sized city with marked racial and ethnic disparities in socioeconomic and health status. Models were in various stages of development and deployment at time of study initiation. Each has distinct strengths and weaknesses in serving incentives of the primary stakeholders (parent/patient, provider, telemedicine access site, provider organization, payers, and the community at large). Incentives vary among these stakeholders. Children rarely go without care in this community, although care is often not convenient, not timely and not efficient.

METHODS - GENERAL

Definitions of key concepts, key terms and abbreviations:

Access: A means of approaching, entering, communicating with, or making use of health services.

Child Care: A facility that provides care for infants, toddlers, preschoolers, and/or school-age children all or part of the day. 31 different child care sites participated in the HeA program.

Connected health care: A term encompassing telemedicine, telehealth, mHealth, and use of telephone text-messaging, email, and electronic records. This generic term is useful in eliminating distractions that differentiation on the basis of technology, alone, sometimes engenders.

Emergency Department (**ED**): Only two hospitals in the City of Rochester provide emergency medical services for children, Rochester General Hospital (**RGH**) and the University of Rochester Medical Center (**URMC**).

Health-e-Access Telemedicine (**HeA**): A connected health model, focused on primary health care, with the goal ***to promote health care when and where you need it by providers you know and trust***. Consistent with that mission, HeA is designed to:

- incorporate devices and materials for information capture and exchange that enable appropriate diagnosis and management decisions for a large majority of problems seen in primary care office settings; †
- involve personal who are capable of using these devices to obtain diagnostic-quality clinical information;

- engage patients and families as much as possible in the care process, by videoconference when feasible and by telephone at least;
- promote participation of all primary care providers and primary care provider organizations throughout the community.

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† *In primary care for children, these devices include, at least, the capacity for clinically useful images of skin, conjunctivae, oral cavity, tympanic membranes, for stethoscope sounds of lung and heart, and to obtain specimens for rapid streptococcal antigen tests, throat cultures, and fungal cultures of skip or scalp.*

Clinical Telemedicine Assistant (**CTA**): A technician specially trained to gather clinical data on patients and input it into a secure electronic medical record system.

Key Informant Interviews (**KII**): One-on-one structured interviews with representatives of users considered to be crucial to the success of the program.

Neighborhood Access Sites: A facility providing social, cultural, economic and/or spiritual support to a defined residential area that offered space for neighborhood residents to use HeA. Four different neighborhood-based facilities, spread throughout the targeted inner city zip code areas, participated in HeA.

Primary health care: According to the World Health Organization, health services distinguished by its focus on achieving better health for all. WHO has identified the following five elements of primary health care:[8]

- reducing exclusion and social disparities in health (universal coverage reforms);
- organizing health services around people's needs and expectations (service delivery reforms);
- integrating health into all sectors (public policy reforms);
- pursuing collaborative models of policy dialogue (leadership reforms); and
- increasing stakeholder participation.

Primary care provider: Physician, nurse practitioner or physician assistant who aims to deliver primary health care. Behaviors of primary care providers and attributes of primary care provider organizations are most important to adequacy of primary care include:

(1) first point of contact and use;
(2) continuous (ongoing) care, offering a regular source of care that is person (rather than disease) focused care over time;
(3) comprehensiveness of services available and provided; and
(4) coordination (when care from other places is required).[9]

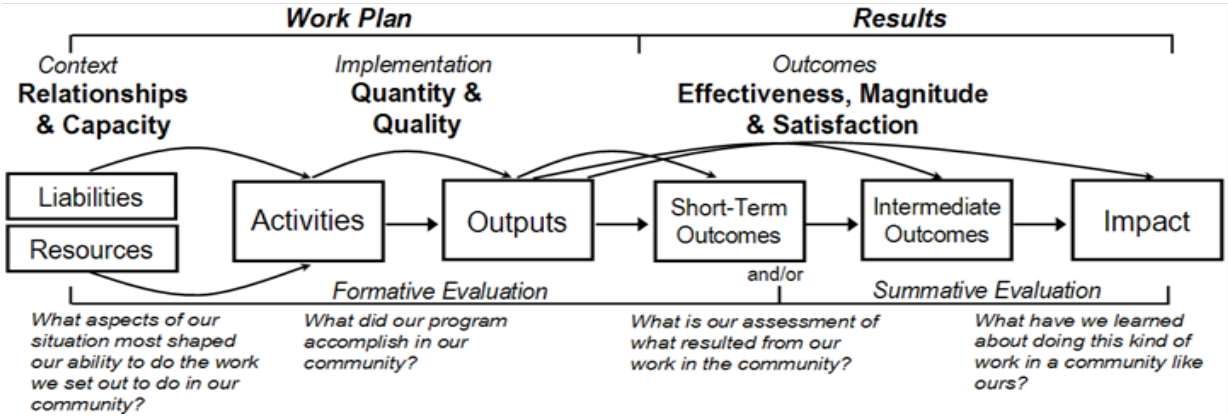
Rochester General Hospital – **RGH**

Schools: Facilities that provide educational services for children between 5 and 18 years of age in the Rochester City School District (RCSD), Rochester Parochial Schools and Rochester Charter Schools. Over 40 different schools of these types participated in HeA, including all RCSD schools.

University of Rochester Medical Center - **URMC**.

Conceptual model for program development, deployment and evaluation, and for identification of facilitators and barriers:

A program logic model, below, guided the HeA development and deployment process, the evaluation and analysis in identifying facilitators and barriers, and development of the implementation and sustainability toolkit. Program logic links the program work plan (activities and outputs in the context of available resources and liabilities) with results (short- and intermediate-term outcomes and long-term impact). Both qualitative and quantitative methods were used to guide program development, identify areas of focus for eliciting facilitators and barriers, and to assess results.



METHODS & RESULTS

In material that follows we address METHODS and RESULTS together for each Specific Aim.

Aim A – Deployment: Methods and Results

Methods. We anticipated that to achieve this aim it would be necessary to impart understanding of the usefulness of HeA among families, among staff at the various access sites, and among staff and providers and provider organizations; to gain full integration of HeA within the health system. Towards these ends, we focused considerable effort on imparting information about HeA throughout the general community, and on working with leadership and staff of Neighborhood Access Sites, School Sites and Child Care Sites so that they would understand the fit between their missions and the objectives of HeA. We assumed that the most effective way to communicate with families about benefits of this unfamiliar health service, and how to use it, was to use the communication systems already established by these organizations.

The Neighborhood Access Sites included four family and community service agencies, one located in each of Rochester's four inner city zipcode areas, Grace United Methodist Church, Wilson Commencement Park, Ibero Hispanic-American Action League, and Charles Street Settlement House. Although occasionally used during regular working/school hours, these sites were largely used during after-hours periods. These after-hours periods (both evenings and weekends) are not served by child care or school HeA sites, and they include times when children with minor acute problems are most likely to taken to emergency departments and urgent care centers.

Methods for deployment also involved refinement of protocols and procedures to optimize experience among patient and provider participants. Finally, we promoted change management programs among provider organizations to enable these organizations to integrate HeA among their day-to-day services.

Software used to capture clinical information (text, images, video-clips, lung sounds) enabled us to quantify and characterize services delivered, to describe the population served and the locations where patients were served.

Results. The HeA program **completed 13,566 visits** between May 2001 and June 2013. Of those, 4,985 were delivered during this grant period. The population served reflected the population in the target area. Among the 13,566 visits, children seen were largely black (58.0%) or Hispanic (26.5%). An additional 11.5% were for white children, and 4.0% were for children of another race or ethnicity. Most visits were made by children dwelling in the inner city target area (54.5%). The proportion of visits by children dwelling in the city of Rochester but outside the inner city was 36.3%. The remaining 9.2% of visits were made by suburban children, mostly suburban children attending city child care center close to a parent's place of employment in the city.

As shown in the table above, among the 14,075 of situations in which the process designed to lead to a HeA visit was initiated, the process was completed for 13,566 (96.4%). For the 509 situations in which the process was not completed, in only 68 (13.4%) was the problem beyond the scope of the model, and for only 46

(9.1%) might the performance of the telemedicine assistant at the child explained failure to complete the visit (child not cooperative, 13 [2.6%]; poor quality of images or sounds captured, 33 [6.5%]).

Completion of HeA Visits Among 14,075 Situations Where the Process Leading a HeA Visit Was Initiated

	N	%
Completed	13566	96.4
Not completed	509	3.6
	14075	100.0
Reason not Completed		
♦ No show, cancel, picked up before visit, symptoms resolved before visit	257	50.5
♦ Reason not documented	94	18.5
♦ Diagnosis or management beyond scope of HeA model	68	13.4
♦ Provider refused for administrative reason	43	8.4
♦ Poor quality of images or sounds captured	33	6.5
♦ Child not cooperative	13	2.6
♦ Language barrier	1	0.2
	509	100.0

Change in visits over time. The following table shows the change in visits over time. Changes over time reflect program expansion, changes in staffing at child sites which often was associated with change in understanding of HeA services and/or change in commitment to help families through use of this service. Change in commitment sometimes reflected change in attitudes of site staff, generally associated with staff turnover. At other times, change in commitment was the consequence of changes in funding for child care programs in general, or changes in funding for school health services.

Early experience with HeA in schools revealed that at most city schools, where one school nurse was generally shared among two or three schools, on-site staff felt too burdened with existing responsibilities to find time to perform HeA visits for children under their care. HeA did not develop substantially in schools until HeA modified its care model to accommodate the fact that service in these settings could not rely upon on-site staff to fulfill this essential function.

This situation in schools was in distinct contrast to the situation we had previously experienced in child care programs where there was generally an on-site person with health-related responsibilities (usually someone with prior experience as a home health aide or certified nursing assistant). Child care staff where we first initiated HeA welcomed the additional responsibilities of serving as a Clinical Telemedicine Assistant (**CTA**), in part because child care program leadership made it clear that they considered development of HeA was a priority. A primary reason for selecting the child care programs where we initiated HeA was our impression that leadership at these specific programs held the view that a primary benefit of child care was enabling parents to work, and that they believed that the ability of HeA to help them manage the difficult issue of illness in child care would enhance their ability to serve parents in this way. We also believe that staff at child care sites were generally more likely to have a personal relationship with parents than staff at school sites. This may have been another reason why child care staff appeared more likely to feel a sense of responsibility for helping parents deal with the issue of childhood illness.

Completed Health-e-Access Telemedicine Visits by Year and Quarter*

Year of visit	Quarter of Year 1	2	3	4	Total	Change vs. Prior Year** N	%
❖2001	-	33	40	100	173	-	-
2002	120	93	109	123	445	152	87.9
2003	139	182	114	140	575	130	29.2
2004	215	260	185	321	981	406	70.6
2005	372	282	225	289	1168	187	19.1
2006	434	342	309	349	1434	266	22.8
2007	461	346	177	341	1325	-109	-7.6
2008	302	202	140	195	839	-486	-36.7
2009	280	250	140	219	889	50	6.0
2010	394	499	262	439	1594	705	79.3
2011	598	576	284	470	1928	334	21.0
2012	464	423	242	455	1584	-344	-21.6
✓2013	361	270	-	-	631	-256	-13.3
Total	4140	3758	2227	3441	13566		
Row %	30.5	27.7	16.4	25.4	100.0		

* Startup (May 2001) through June 2013
❖ 8 months in 2001
✓ 6 months in 2013
** For partial years, comparison with prior years include only identical quarters.

When we found that HeA was used relatively little in most schools where it was available and that level of use was highly variable from one school to another, after consultation with school health leadership we made two major changes to our model, one relating to equipment and the other relating to personnel. Instead of school personnel serving as CTAs, we relied on CTAs who worked directly for HeA and were dedicated to CTA responsibilities. CTA's serving in schools had no other function. They moved from school to school as requests for HeA visits arose. We found that existing school health personnel (nurses and school health aides) could usually be relied upon to initiate requests for visits as long as they did not need to perform the visits themselves.

In order to accommodate that critical change in staffing, with CTAs roaming from site to site in response to requests, mobile telemedicine units were developed. With mobile units, laptop computers drove peripheral devices for videoconferencing and for capturing images, video clips and stethoscope sounds. To enable this type of model to function, the ubiquitous availability of wireless broadband connectivity throughout the city of Rochester and the relatively close proximity of child sites (generally less than 15 minutes by automobile) were critical attributes of the operational environment.

Deployment of HeA among various community access sites. As illustrated in the following table, following initiation of HeA in city child care programs in 2001, service was initiated in city schools in 2005, a large child development center for children with special needs in 2006 and Neighborhood Access Sites (largely during after-hours periods) in 2009. Additional, minor deployments, including summer camps, suburban elementary schools and other (visits in a child's home), were initiated in response to requests by interested individuals who were providing strategic guidance on implementation throughout the community.

Type of Access Site by Year

		City child care	Suburban child care	City elementary #	city high/Jr high #	Child Devt Centers	Summer Camps	Suburban elementary #	Other	Neighborhood / After-Hours	Total
2001	**N**	*173*	0	0	0	0	0	0	0	0	173
	%	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
2002	**N**	445	0	0	0	0	0	0	0	0	445
	%	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
2003	**N**	571	0	0	0	0	*4*	0	0	0	575
	%	99.3	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0	100.0
2004	**N**	981	0	0	0	0	0	0	0	0	981
	%	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
2005	**N**	1094	*20*	*54*	0	0	0	0	0	0	1168
	%	93.7	1.7	4.6	0.0	0.0	0.0	0.0	0.0	0.0	100.0
2006	**N**	1086	48	273	0	*7*	0	*20*	0	0	1434
	%	75.7	3.3	19.0	0.0	0.5	0.0	1.4	0.0	0.0	100.0
2007	**N**	742	43	382	0	105	0	53	0	0	1325
	%	56.0	3.2	28.8	0.0	7.9	0.0	4.0	0.0	0.0	100.0
2008	**N**	519	22	194	0	87	0	17	0	0	839
	%	61.9	2.6	23.1	0.0	10.4	0.0	2.0	0.0	0.0	100.0
2009	**N**	448	26	218	0	70	0	2	0	*125*	889
	%	50.4	2.9	24.5	0.0	7.9	0.0	0.2	0.0	14.1	100.0
2010	**N**	618	20	427	*16*	75	0	0	0	438	1594
	%	38.8	1.3	26.8	1.0	4.7	0.0	0.0	0.0	27.5	100.0
2011	**N**	597	7	766	60	76	0	0	*1*	421	1928
	%	31.0	0.4	39.7	3.1	3.9	0.0	0.0	0.1	21.8	100.0
2012	**N**	378	0	758	79	53	0	0	1	315	1584
	%	23.9	0.0	47.9	5.0	3.3	0.0	0.0	0.1	19.9	100.0
2013	**N**	119	0	375	35	25	0	0	0	77	631
	%	18.9	0.0	59.4	5.5	4.0	0.0	0.0	0.0	12.2	100.0
Total		7771	186	3447	190	498	4	92	2	1376	13566

Included city (or suburban town) school discrict, charter and parochial schools.

Highlighted numbers (gray background) indicate the year that service was initiated at a particular type of site.

Insurance coverage. Patients had public and Medicaid insurance coverage for the vast majority of HeA visits, with only 15.3% covered by private insurance.

Type of Health Insurance

	%
Fee-For-Service Medicaid	22.6
Medicaid Managed Care	51.1
Commercial	15.3
Child Health Plus/FamHealth Plus	6.1
Uninsured or missing	4.9
	100.0

Problems addressed. As below, among primary parent concerns addressed at HeA visits, 32% focused on the ear, 31% focused on the upper respiratory system, 20% focused on the skin, 11.0% focused on the eye, and 2.2% of those visits involved the lower respiratory system. This information provides clear guidance about the capacity for information acquisition (e.g., cameras, sound capture) required and clinical protocols that should be included in telemedicine initiatives that might seek to replicate the services provided through HeA.

Telemedicine-Related Groups:
Identification of problems appropriate for the Health-e-Access Telemedicine Model based on chief complaint+

Focus of Chief Complaint:	N	%	Cum %	Examples, Exclusions
Ear	4149	31.9	31.9	pain, drainage, or recent onset of hearing loss
Other Upper Respiratory*	4073	31.3	63.1	cough or nasal discharge with or without fever
Skin	2638	20.3	83.4	lesions, rash, itching or pain
Eye	1433	11.0	94.4	drainage, redness, persistent rubbing, itching
Lower respiratory	281	2.2	96.6	cough, mild or moderate wheezing, exclude if breathing is rapid or labored
All other	449	3.4		
	13023	100.0		

+ Based on analysis of all telemedicine visits May 2001 through December 2012
* Includes nose, mouth and throat; not ear

The distribution of specific diagnoses at HeA visits, shown in the following table, was similar to that found in pediatric primary care practice office settings.[10]

All Health-e-Access Telemedicine Visits from Initiation (May 2001) through December 2012

RANK	Top 19 Diagnoses Diagnosis*	N	%
1	acute otitis media	2449	21.8
2	upper respiratory tract infection	1240	11.0
3	conjunctivitis	751	6.7
4	pharyngitis NOS#	730	6.5
5	strep pharyngitis	563	5.0
6	viral illness	477	4.2
7	otitis media with effusion	415	3.7
8	ear pain	399	3.6
9	tinea corporis	336	3.0
10	conjunctivitis	271	2.4
11	atopic dermatitis	270	2.4
12	dermatitis NOS	245	2.2
13	tinea capitis	215	1.9
14	diaper dermatitis	214	1.9
15	impetigo	150	1.3
16	rash, etiology unknown	142	1.3
17	insect bite	132	1.2
18	allergic rhinitis	124	1.1
19	asthma, acute exacerbation	96	0.9
	missing diagnosis (sent to higher level of care)	96	0.9
	all other	1921	17.1
		11236	100.0

* Includes all diagnoses comprising at least 0.9% of the total
# Not Otherwise Specified

Primary care practice participation. Children from a total of 84 different primary care practices throughout Monroe County were seen. A modest number of practices (12) participated actively at one time, although only one of the seven primary care practices primarily serving inner city children failed to participate. By far the largest number of visits was performed by providers of the Strong Pediatric Practice at URMC. To a substantial extent, this reflects the fact that visits were done exclusively by URMC-based providers until 2006. Until 2006, all URMC-based providers doing HeA visits were committed to HeA, and most HeA visits were done by one nurse practitioner for whom HeA visits was their primary responsibility. This also reflects the fact that HeA leadership and clinical champions continued to be based at URMC from 2006 and beyond. Largely for this reason, URMC was willing and able to routinely do visits for patients of other practices. Also, URMC almost always accommodated requests to see its own patients, whereas most other participating practices saw their own patients by HeA only if the HeA visit could easily be accommodated in the morning's or afternoon's schedule (e.g., because there had been a cancellation).

These explanations account for observations in the following table. Among the 11,318 visits provided by URMC, for example, 66.5% were provided to patients of other practices. Most other participating practices provided less than 10% of all HeA visits by patients in their practice since HeA initiation in 2001, but this proportion increased substantially after these other primary care practices began participating in HeA.

Continuity of Care Among Participating Practices

	Visits Provided by this Practice				Visits Provided to Children Enrolled in this Practice			
	Total provided[1]	*... to own patients*		*... to patients of other practices*	*Total provided*[2]	*... by practice, itself*		*... by other practices*
	N	*N*	%	%	*N*	*N*	%	%
URMC	11318	3789	33.5	66.5	4248	3789	89.2	10.8
RGH	946	887	93.8	6.2	1929	1456	75.5	24.5
Genesee	312	291	93.3	6.7	1382	1027	74.3	25.7
AJHC	48	42	87.5	12.5	1090	821	75.3	24.7
Lifetime-Wilson	192	178	92.7	7.3	604	543	90.0	10.0
Clinton	285	75	26.3	73.7	177	173	97.6	2.4
Totals	13101	5262	40.2	59.8	9430	6423	68.1	31.9

[1] Telemedicine visits provided by this participating practice to any patient. Includes visits provided to children enrolled in other practices.

[2] Number of all telemed visits provided by all participating practices to children enrolled in this practice.

Health insurance. Confirming the fact that HeA served an underserved group of children, the vast majority of visits were provided to families covered by Medicaid (fee-for-service, 22.6%; Medicaid Managed Care, 51.1%) or other public insurance plan (Child Health Plus or Family Health Plus, 6.1%). Only 15.3% of children were covered by commercial health insurance.

Type of Health Insurance

	%
FFS Medicaid	22.6
Medicaid Managed Care	51.1
Commercial	15.3
ChildHlth/FamHlth Plus	6.1
Uninsured or missing	4.9
Total	100.0

Aim B – Identify facilitators and barriers: Methods and Results

We achieved this Aim through an array of qualitative methods including interviews administered to key informants and focus groups including representative of from major stakeholder groups. Stakeholders included parents, telephone management nurses ("phone triage nurses") from pediatric offices, CTAs, HeA visit coordinators and providers (physicians, nurse practitioners).

Key Informant Interviews - Methods. With the expansion of HeA in 2010 to include after-hours care at four sites at family service agencies in inner city neighborhoods, we conducted a qualitative study focused on identifying facilitators and barriers to use of HeA model in this new setting. We incorporated key informant interviews and a small group interview with each category of participants involved in a telemedicine visit. Participant categories included family caregivers, telemedicine assistants, phone triage nurses, providers and telemedicine coordinators. A completed case was defined as one in which an actor from all of these categories provided information. The study sample was recruited over a period of several weeks from late April through mid-June 2012.

Data were analyzed within the framework of the Diffusion of Innovations Theory. Common themes were identified from interviews with 22 individuals from six complete cases and from eight additional individuals from six incomplete cases. Facilitators and barriers were identified from those themes.

Key Informant Interviews - Results.

Facilitator and Barriers: Domains, Corresponding Themes and Examples

Key Terms:

Coordinator – HeA staff person who receives a call about a patient concern, either from school nurse, child care staff or

CTA – Clinical Telemedicine Assistant.

Provider – Physician or nurse practitioner responsible for diagnosis and management decision-making for the telemedicine visit.

Triage Nurse - Office nurse providing guidance on illness management via telephone.

	DOMAIN: RELATIVE ADVANTAGE
Convenience	Strong (Hospital) is too far. This is more convenient for me. ***Parent A*** It works great because it saves me a *whole* lot of time and they have the prescription ready. ***Parent B*** I was just getting out of work and you guys had an appointment. It's very convenient. ***Parent C***
Effectiveness of care	It's the same thing as the hospital. ***Parent A*** It was wonderful. You got your answers. ***Parent B*** The doctor told me everything, that he just needed to have a steroid. ***Parent C***
	DOMAIN: OBSERVABILITY

Satisfaction	I'm very satisfied. I did not have to wait for five hours for a doctor and then another five hours for discharge. ***Parent D*** I'm very pleased. ***Parent C*** It was good, comfortable. ***Parent A***
Technical issues	We could see and hear him, but he couldn't see us. ***Parent B*** From my end, the audio was great, but the video disappeared altogether for a brief period. ***Provider 3*** *about visit with Parent B and her grandson*. We could see the provider, but she couldn't see us most of the time. ***CTA 1*** *about visit with Anna and her grandson*. Skype on their end, the connection was slow … I just ended up leaving it on and talking to a blank screen. I think they liked it. ***Provider 1*** *about the visit with Parent A and her grandson.*

	DOMAIN: COMPLEXITY
Challenge of referrals and scheduling	I think it works, but I have had many times that parents call us back to complain that they do not get a call back from the scheduler. They give up and then want to come in here. **Triage Nurse 5** It depends on the phone nurse that's referring – how much the phone nurse buys into telemedicine or understands telemedicine. But at the same time, even if they, you know, support telemedicine to the fullest, they may not always have enough time to go into detail so they don't make the referral. ***Coordinator 2***
Some aspects of telemedicine are hard to understand.	How they're going to be seen by the doctor. ***Coordinator 3*** I wish we had a way to let families see what a telemedicine visit is actually like so they would have a better understanding of it. ***Triage Nurse 6***
	DOMAIN: TRIALABILITY
First-time users	
Telemedicine as an option	I usually say, 'We have a few options – one of which is our telemedicine program. Are you familiar with our telemedicine program?' And then explain it if they don't know about it. ***Triage Nurse 6*** I asked, "Are you interested in hearing about telemedicine?" ***Triage Nurse 5***
	DOMAIN: COMPATIBILITY
Confidence	The doctor was helpful, too. He wasn't someone I was familiar with but he really took the time to explain asthma to me. ***Parent C*** I was very comfortable (gathering the necessary information). His mother (***Parent C***) was very informed. She is a very attentive parent. She explained everything for me from A to Z. ***CTA 1*** I can get all information I need without videoconferencing almost all the time. ***Provider 3***
Familiarity with telemedicine	We went with it because I was familiar with it and we wanted to figure out what was going on with whatever is going on with him. ***Parent B*** She asked for it and said she wanted to go to the one on Clinton. ***Triage Nurse 2*** *about Parent A calling for granddaughter's appointment* She requested telemedicine up front. It was easy and they'd been before. ***Triage Nurse 4*** *about Parent C calling for her child's appointment*
Appropriateness for telemedicine	She had visible symptoms and since telemedicine is all about conveying visual information, I felt it was good. ***CTA 1*** *about the visit with Parent 1 and her granddaughter* It was a straightforward problem and something that would be identified by pictures. ***Provider 1*** about the visit with Parent A and her granddaughter

Facilities	I heard from one woman that it was dirty, there was no exam table. It didn't feel like an office. ***Provider 2*** Especially during the summer. They don't have as many programs, the office staff isn't always there, so we could tell a parent to meet us at Grace at 10 o'clock but the doors might be locked and we can't get in. ***Coordinator 4***

Focus Groups - Methods. Two focus groups were conducted, one with six physicians representing six different participating primary care practices and one with nine female caregivers who had at least one child age 14 or younger dwelling in their household and living in one of the 4 targeted inner city neighborhoods.

Focus Groups - Results. Information acquired through this method is summarized below.

Facilitators of implementation

a. Convenience: The opportunity for parents to have their child seen while at school is of great value, not only because the child won't miss class time but also because the parent won't miss work. Without telemedicine, the parent must leave work, collect the child from school and then get to the clinic. If a same-day clinic appointment is not available, the parent is faced with the decision to either miss another day of work or waste an evening in the ER or urgent care. Once parents realize how much more convenient and efficient a HeA visit is they will spread the word to others.
b. Speed: Children can be seen and start treatment faster when they can stay at school or daycare than when they are seen at the clinic. The child is called to the nurse's office when the telemedicine assistant arrives and returns to class directly after the visit.
c. Proximity to patient's school, day care, neighborhood etc.: The parent has the option for an evening telemedicine visit as well as daytime school or childcare.
d. Provider commitment and promotion: Parents are much more likely to try telemedicine when their own provider explicitly supports it. It is important that the participating providers educate and offer their patients telemedicine visits.

Barriers to implementation

a. Non-compatibility of provider's EMR with the telemedicine EMR, or provider's lack of EMR. Although the TeleAtrics telemedicine system that we used generated a PDF copy of the HeA visit record that could be uploaded to the provider's primary EMR, this is not the same thing as full integration with the EMR. Moreover, providers would prefer not to use one EMR to conduct regular, in-person office visits and then move to another system for documenting telemedicine visits.
b. Provider scarcity: As a scarce resource, providers feel that they have more than enough to do given existing responsibilities. There is no financial incentive for them to try new and unfamiliar approaches to health care delivery, such as HeA.
c. The telemedicine EMR needs to be intuitive to use and easy for providers to learn quickly.
d. Lack of provider communication of telemedicine availability to patients: Because patients know and generally trust their doctors, the doctor is a necessary part of the acceptance process.
e. Discomfort with the unknown. Both providers and patients with prior experience in telemedicine are more positive.

Aim C – Monitor impact: Methods and Results

To ensure complete records of all utilization for all children dwelling in targeted zips, three data sources would be optimal: (1) insurance claims, (2) ED encounter/accounting files, and (3) HeA electronic records. Complete records of all utilization are essential to determine whether there was a change in overall utilization rates following introduction of telemedicine and whether there was a shift from impersonal, less convenient and more costly services (e.g., the ED) to less costly, more convenient care provided via HeA by the patient's

primary care provider. Denominators for calculations of key, zip-specific, utilization rates (ED, HeA service model) for periods of time under consideration were available as Year 2000 US Census data.

We have obtained and analyzed data of each of these types in the past, but, for several reasons, we have so far been unable to assemble a complete data set for participants during the project period specified in this proposal. Given our efforts to deploy HeA to all city schools and multiple community service agencies, it was impractical to obtain formal written consent, from each participating family, for acquisition of billing claims data from insurance organizations. While that would have been ideal (ensuring almost complete utilization data), we have hoped, nevertheless, to obtain nearly complete utilization data for a substantial proportion of participants from: (1) complete ED encounter data from the only two hospitals that provide emergency medical services for children, RGH and URMC; (2) primary care office visits for the two largest practices providing primary care for targeted children, Rochester General Pediatric Associates (RGPA) at RGH and Strong Pediatric Practice (SPP) at URMC; and (3) telemedicine visit records. From URMC, we have obtained requested ED and SPP encounter data. Despite several contacts, we have been unable so far to obtain RGH ED and RGPA encounter data. Based on prior analyses of insurance organization billing claims, together these data sets would give us almost all ED encounter data and about two-thirds of primary care office visit data for targeted children.

Impact of HeA on equity in access

Methods. Although we have so far been unable to assess impact to the extent we had anticipated, substantial analysis of community-wide data has been performed. In prior concurrent comparisons of utilization among children with versus without HeA availability, we demonstrated 22% less ED use among intervention children. But these data also revealed a 24% increase in overall acute care use among the intervention group, raising concern that HeA might lead to overuse. In response to this concern, in recent analysis we assessed the alternative hypothesis that this increase in overall use among children with HeA access actually reflects that fact that HeA reduces disparities in access between largely impoverished inner-city children and more affluent suburban children.

Based on 152,802 child-months of billing claims-based observation, utilization was compared among inner-city, rest-of-city and suburban children with and without telemedicine access for 106 months before and 80 months after introduction of HeA in May 2001. Observation ended August 2007. HeA was initiated in staggered fashion and available at a limited number of child care centers and elementary schools (**CCS**) during the intervention period.[Error! Bookmark not defined.8] Because children were eligible for analysis for varying periods, the unit of analysis was child-month. Child-months were defined by dividing calendar years into 13 equal 28-day periods. Because of HeA's staggered initiation, an individual child continuing to attend the same site during the intervention period could contribute concurrent control child-months and, later, intervention child-months. Total acute visit rates (expressed as visits/100 child-years) are adjusted in multivariate analysis.

Results. As shown in the table below, based on multivariate analysis, total acute care utilization ***before*** HeA was 41% less for inner-city intervention (316) than for suburban (533) children (rate ratio 0.59, 95% CI:0.44-0.80). ***With*** HeA, telemedicine accounted for 15.3% of acute care visits for inner-city intervention children, and there was *no significant difference in acute visits between suburban control (446) and inner-city intervention children (426)*. Also, acute visits remained less for inner-city control than suburban controls (rate ratio: 0.80, 95% CI:0.70-0.92). Findings indicate that before HeA, acute illness care of suburban children exceeded that of inner city children substantially. In contrast, with HeA utilization by inner-city children increased to the level of suburban controls, but use among inner-city controls remained less than among suburban counterparts. Findings indicate that availability of HeA redresses disparities in acute care access.

Rate Ratios for All Rate Comparisons

Comparisons‡	All Acute Visits**				ED				Office			
	rate ratio	95% CL Lower	95% CL Upper	P	rate ratio	95% CL Lower	95% CL Upper	P	rate ratio	95% CL Lower	95% CL Upper	P
Before - After comparisons within each socioeconomic group												
Inner-C: After/Before	0.97	0.89	1.07	NS	1.27	1.08	1.49	0.003	0.88	0.80	0.98	0.02
Inner-I: After/Before	1.35	1.05	1.74	0.02	1.14	0.78	1.68	NS	1.16	0.90	1.49	NS
Rest-C: After/Before	0.91	0.76	1.09	NS	1.21	0.90	1.63	NS	0.83	0.69	1.01	0.06
Rest-I: After/Before	1.02	0.75	1.38	NS	0.96	0.53	1.73	NS	0.84	0.61	1.14	NS
Suburb-C: After/Before	0.84	0.70	1.00	0.05	0.66	0.40	1.08	NS	0.80	0.68	0.95	0.01
Before initiation: All study groups compared												
Inner-C/I-Inner-I	1.17	0.89	1.53	NS	0.94	0.63	1.39	NS	1.26	0.96	1.65	NS
Inner-C/Rest-C	0.84	0.69	1.01	NS	1.05	0.78	1.41	NS	0.79	0.64	0.97	0.02
Inner-C/Rest-I	0.93	0.68	1.27	NS	0.95	0.54	1.67	NS	0.93	0.67	1.29	NS
Inner-C/Suburb-C	0.69	0.57	0.84	<.001	1.60	0.97	2.64	0.06	0.59	0.49	0.71	<.0001
Inner-I/Rest-C	0.72	0.53	0.97	0.05	1.12	0.71	1.78	NS	0.63	0.46	0.85	<.01
Inner-I/Rest-I	0.80	0.54	1.18	NS	1.01	0.52	1.97	NS	0.74	0.49	1.11	NS
Inner-I/Suburb-C	0.59	0.44	0.80	<.001	1.71	0.93	3.14	0.08	0.47	0.35	0.63	<.0001
Rest-C/Rest-I	1.12	0.79	1.57	NS	0.90	0.49	1.67	NS	1.18	0.82	1.70	NS
Rest-C/Suburb-C	0.83	0.65	1.05	NS	1.53	0.88	2.65	NS	0.75	0.59	0.96	0.02
Rest-I/Suburb-C	0.74	0.52	1.05	NS	1.69	0.81	3.52	NS	0.64	0.45	0.91	0.01
After initiation:All study groups compared												
Inner-C/Inner-I	0.84	0.75	0.94	0.003	1.04	0.87	1.25	NS	0.96	0.84	1.10	NS
Inner-C/Rest-C	0.89	0.80	1.00	0.05	1.10	0.93	1.30	NS	0.84	0.74	0.95	<.01
Inner-C/Rest-I	0.89	0.78	1.02	NS	1.26	1.00	1.59	0.05	0.98	0.85	1.13	NS
Inner-C/Suburb-C	0.80	0.70	0.92	<.01	3.11	2.32	4.17	<.001	0.65	0.57	0.75	<.001
Inner-I/Rest-C	1.06	0.93	1.21	NS	1.06	0.86	1.29	NS	0.87	0.75	1.02	0.09
Inner-I/Rest-I	1.06	0.91	1.24	NS	1.21	0.93	1.58	NS	1.02	0.86	1.21	NS
Inner-I/Suburb-C	0.96	0.82	1.12	NS	2.99	2.17	4.10	<.001	0.68	0.58	0.80	<.001
Rest-C/Rest-I	1.00	0.86	1.17	NS	1.15	0.89	1.48	NS	1.17	0.99	1.38	0.07
Rest-C/Suburb-C	0.90	0.77	1.05	NS	2.83	2.08	3.85	<.001	0.78	0.67	0.91	<.01
Rest-I/Suburb-C	0.90	0.76	1.06	NS	2.46	1.74	3.50	<.001	0.67	0.56	0.80	<.001

‡ Inner = Inner City, Rest = Rest-of-City, I = intervention; C = Control.

* **Adjusted Rate Ratios** - Interaction between group and study period was tested after adjusting for within-subject clustering and controlling for covariates age, sex, illness season.

** **All acute visits** - Includes office, ED, and telemedicine. Telemedicine was available to intervention only after initiation.

Value of neighborhood after-hours service delivered through HeA

Impact is also reflected simply in the service provided through HeA and assessments of effectiveness, safety and satisfaction with that service. Data regarding describing deployment (Aim A), including all HeA encounters through June 2013, was acquired through the process of delivering care using an electronic record that was key component of the telemedicine system.

Methods. A parent satisfaction instrument was developed with input from parents and providers. Neighborhood telemedicine was initiated January 2009 and totaled 1362 visits through November 2013. During a 29 month survey period through January 2012, 3871 acute illness telemedicine visits were completed, 908 (23.5%) of them via neighborhood telemedicine. Instruments were completed for 392 (43.2%) of 908. Parent

interviews addressed satisfaction with the multiple steps in the process of obtaining care via telemedicine, with other means of access, and with their overall experience with care for acute problems for their child.

Results. Neighborhood telemedicine comprised 27% of all telemedicine visits during the year of peak neighborhood activity. Most parents became aware of the neighborhood telemedicine option in a phone interaction with PCP office staff (73.6%), generally a phone nurse. Other sources included school or childcare staff (12.3%), a brochure or poster at the PCP office or elsewhere (4.1%), other unspecified source (2.6%), word of mouth from a friend or relative (1.8%), and staff at the neighborhood site (1.3%). The remaining 4.4% had previously used the neighborhood service. Almost all parents (86.8%) indicated that they would have obtained care elsewhere.

Almost all survey respondents were satisfied or highly satisfied with neighborhood visits (97.6%) and endorsed greater convenience than alternatives (94.5%). Findings indicated that service provided by neighborhood telemedicine holds potential to meet a large demand for care of acute childhood illness. Financing reform to support patient centered care (e.g., bundled payments) should encompass sustainable business models for this service.

Table 3. Satisfaction with the telemedicine visit

Survey Item	Range of Responses	Responses	Scores:						
			1	2	3	4	5	Median	Mean
	1 = worst, 5 = best	N	%	%	%	%	%		
Pre-visit									
• How important was convenience to you in deciding to use telemedicine today?	not at all to very important	381	0.3	0.5	3.2	10.2	85.3	5	4.81
Post-visit									
• How satisfied are you with the care your child received here?	highly unsatisfied to highly satisfied	377	0.0	0.8	1.6	13.5	84.1	5	4.81
• Would you be interested in using telemedicine for routine healthcare visits for ...									
• your child?	not at all to very interested	375	4.8	1.9	10.4	13.9	69.1	5	4.41
• yourself?	not at all to very interested	372	8.9	1.9	10.5	17.7	61.2	5	4.20
• Do you feel this visit was more convenient than [specified alternative]?	not at all to very much more	373	1.1	0.3	4.0	13.1	81.5	5	4.74

What was better or worse about this telemedicine visit?[A]

Response Categories	Among All Responses N	Among All Responses %	Among All Respondents[B] %
Positives			
Convenience	297	65.7	75.8
Service	95	21.0	24.2
Location	60	13.3	15.3
	452	100.0	
Negatives			
Service	38	73.1	9.7
Location	9	17.3	2.3
Equipment	5	9.6	1.3
	52	100.0	

[A] Respondents were asked to compare their experience with this telemedicine visit to what they would expect from the care option they would have chosen, had telemedicine not been available. The distribution of these alternative care options is presented in Table1.

[B] The total number of survey respondents was 392. For positive respondents, the sum of percents exceeds 100 because many parents offered positive observations in more than one category. Relatively few respondents offered negative observations.

Advantages: There were a total of 452 positive comparisons. Among the 392 parents responding to the survey, 355 (90.6%) of them offered at least one type of positive observation.
Represenative examples among positives -
More convenient - quicker, seen right away. didn't have to miss work
Better service - not crowded, relaxed atmosphere, friendly and caring staff, you can see what the doctor sees, gave me a lot of information, amazing technology, better communication with doctor.
Better location - close to home, parking free, parking convenient.

Disadvantages: There were a total of 53 negative comparisons or suggestions for improvement from 52 parents. All except 4 of the 52 parents with a negative observation also offered a positive observation.
Represenative examples among negatives -
Worse service - doctor didnot examine the child in person, took a long time for the doctor to call, need edto go elsewhere for the prescription.
Worse location - no toys were in the waiting area, no vending machine, need better signage.
Equipment problem - parent noted that such a problem occurred.

Value for children attending regular schools (**CRS**) and for children attending a schoolfor children with special health care needs (**CSHCN**)

Methods: We conducted this study assess the hypothesis that value of HeA, based on measures of effectiveness and safety of care for acute illness, was equivalent for CSHCN and CRS. We examined healthcare use through insurance claims and HeA records spanning 5.7 and 7.3 years for CSHCN and CRS,

respectively. Effectiveness was measured as HeA visit completion rate, HeA visit duplication and adverse events. Completed visits included those with diagnosis and management decisions made, and treatment implemented, based solely on the HeA model. Duplicating visits were in-person visits addressing a related problem and following HeA visits within 1 day (narrow definition) or 3 days (broad definition). An adverse event was defined as an ED visit following a HeA visit within 3 days for a problem probably related.

Results: Comparisons addressing these measures included 483 and 10,008 HeA visits by CSHCN and CRS, respectively. Claims files captured health services use for varying periods of time among 300 different CSHCN and among 1,950 different CRS. Among the 483 HeA telemedicine visits initiated for CSHCN over their 5.7 year observation period, 9 were not completed. The CSHCN completion rate of 98.1% equaled the 97.6% completion observed among CRS.

Based on the broad definition, in-person visits duplicated 16.1% of HeA visits for both CSHCN and CRS. Based on the narrow definition, in-person visits duplicated 5.3% and 8.9% of HeA visits for CSHCN and CRS, respectively. A substantial proportion of subsequent visits within three days might have been avoided with more effective counseling at the initial visit, but they might also have provided reassurance that the family considered important.

The completion rate of 98.1% for CSHCN was similar to that observed for CRS (97.6%). This was accomplished despite more underlying chronic problems, less physiological resilience, and greater challenges in eliciting cooperation with examinations among CSHCN. Detailed, case by case examination of reasons for failure to complete CSHCN visits suggested that non-completion might occur even less frequently if parents and providers were more familiar with this care model.

Adverse events following HeA visits included 0.3% of HeA visits for CSHCN and 0.5% for CRS. Adverse events were not only uncommon among both CHSCN and CRS; in addition, the adversity was limited to financial and psychological effects; physiologic deterioration did not occur.

This set of observations support safety and effectiveness of HeA for both CSHCN and CRS.

Aim D – Implementation and sustainability toolkit

This Toolkit, a primary product of this AHRQ-funded initiative, is available as a separated document. We would like to make this product freely available through AHRQ.

LIST OF PUBLICATIONS AND PRODUCTS

Web-based tool

Health-e-Access Telemedicine Replication Toolkit. This Toolkit, a primary product of this AHRQ-funded initiative, is available as a separate document. We would like to make this product freely available through AHRQ.

Manuscripts published or in press

McIntosh S, Cirillo D, Wood N, Dozier AM, Alarie C, McConnochie KM. Patient evaluation of an acute care pediatric telemedicine service in urban neighborhoods. *Telemedicine and e-Health* 2014; in press.

Manuscripts under review

McConnochie KM, Ronis SD, Wang H, Wood NE, McIntosh S. Urban telemedicine increases equity in access to acute illness care. *Pediatrics* 2014, under review.

McConnochie KM, Ronis SD, Wood NE, Ng PK. Effectiveness and Safety of Acute Care Telemedicine for Children with Regular and Special Health Care Needs. *Telemedicine and e-Health* 2014, under review.

Presentations at National Meetings

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