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Abstract

Effective communication between providers and patients has been linked to improved outcomes. Previous reviews of quality improvement strategies, including health information technology (health IT), have not focused on the needs of low-income children. The authors conducted a systematic review of the literature on studies of communication surrounding the care of low-income children, with an emphasis on interventions and health IT. The search yielded six studies that focused on low-income children; three of the studies used health IT. Key informant interviews provided insight to the current use of health IT for provider–patient communication in geographically diverse, underresourced settings. The authors identify gaps between existing literature and clinical practice. Future research should focus on the specific impact of health IT in pediatric medicine, particularly in underresourced and safety net settings. These efforts should focus on the use of technological innovations to improve care for low-income children and their families.

Keywords

health information technology, health IT, HIT, children, special health care needs, low income, quality improvement

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Introduction

Patient-centered health care has been identified as a core component of quality care by the Institute of Medicine (IOM; 2001). The IOM defined patient-centered care as: “Care that establishes a partnership among practitioners, patients, and their families . . . to ensure that decisions respect patients’ wants, needs, and preferences and that patients have the education and support they need to make decisions and participate in their own care.” (p. 6). Patient-centered care cannot exist without good provider–patient communication. Furthermore, good communication between health care providers and their patients is a vital link to improved health outcomes. Good communication results in increased patient trust and satisfaction, which in turn leads to increased patient adherence to the medical regimen and decreased disease-related morbidity and mortality (Schechtman, Nadkarni, & Voss, 2002; Vik et al., 2006). In contrast, poor communication between providers and patients has been linked to medication errors and the lack of follow-up (Baker, Parker, Williams, Coates, & Pitkin, 1996; Gandhi et al., 2000). Thus, provider–patient communication is directly linked to health outcomes and a key component of quality medical care. Communication problems are reported more frequently among parents and children in low-income families compared with parents and children in high-income families (Agency for Healthcare Research and Quality [AHRQ], 2008). Furthermore, significant communication barriers have also been shown to occur between health care providers and the parents of children with special health care needs (AHRQ, 2008), who are represented in higher proportions among low-income families (van Dyck, Kogan, McPherson, Weissman, & Newacheck, 2004).

New Contribution

Although innovations in health information technology (health IT) have great potential to improve health communication and the quality of health care, certain vulnerable or disadvantaged populations may be “left behind” in the digital divide (U.S. Department of Commerce, 2000). Advances in health IT may not improve health care for these populations unless specific, targeted strategies are used. Through a systematic review of the literature and interviews with key informants, we identify challenges and potential areas for intervention that may improve provider–patient communication among parents and families of low-income children. We discuss how health IT and other quality improvement (QI) strategies may be used to reduce communication barriers. Finally, we make recommendations for the next steps in research and implementation to reduce health disparities.

Challenges Faced by Low-Income Children and Their Families

Families in the United States need approximately twice the income of the federally recognized poverty level to make ends meet (Bernstein, Brochct, & Spade-Aguilar, 2000).

Families living below this line are considered to be low-income families, and in 2005, 39% (29.4 million) of children in the United States were classified as such (Beadle, 2006). Slightly more than half of these children live with only one parent (Beadle, 2006). Most low-income children reside in low-income families, with the minor exception being children who reside in foster care. Low-income children are roughly divided evenly between Caucasian, Latino, and African American races, with a small number of other ethnicities (Bernstein et al., 2000). Lack of health insurance and lack of a regular source of care are major barriers to quality care for low-income children (Newacheck, Hughes, & Stoddard, 1996). Low-income children are more likely to move than higher income children, with 21% of low-income children having moved in a given year compared with only 10% of other children (Bloom, Dey, & Freeman, 2006).

Barriers to Provider–Patient Communication in Low-Income Children

The National Healthcare Disparities Reports (AHRQ, 2008, 2009) have shown that persistent disparities exist in provider–patient and provider–parent communication for children in low-income and uninsured families. Evidence suggests that provider–patient and provider–parent communication influences a wide array of outcome measures including adherence to treatment regimens (Dimatteo, 2004). Studies of children with chronic illnesses point to a significant gap between child and parent preferences and expectations for support and communication and the care they actually receive (Buford, 2005; Kieckhefer & Ratcliffe, 2000). Parents and children with chronic illnesses consistently show discrepancies between prescribed treatment regimens and their knowledge and understanding of these treatments (Drotar, 2009), perhaps as a result of inadequate communication (Ievers et al., 1999; Kieckhefer & Ratcliffe, 2000; Kyngas, Hentinen, & Barlow, 1998; Kyngas & Rissanen, 2001; Riekert et al., 2003).

In the 2002 National Survey of America's Families, nearly a quarter of parents of low-income children were primarily Spanish speaking and reported poor communication with health providers (Clemans-Cope & Kenney, 2007). Language barriers can lead to poor provider communication with patients and families. Furthermore, the lack of professional medical interpreter services can lead to medical errors (Flores, Abreu, Olivar, & Kastner, 1998; Flores & Tomany-Korman, 2008; Kilbourne, Switzer, Hyman, Crowley-Matoka, & Fine, 2006) and adverse events (Cohen, Rivara, Marcuse, McPhillips, & Davis, 2005). In addition to language issues, differences in cultural beliefs, understanding of illness, and differences in the societal standing and education levels of the parties involved can interfere with provider–patient communication and contribute to nonadherence to treatment regimens (Cooper-Patrick et al., 1999; Kilbourne et al., 2006). Low health literacy, more common among minority and low-income populations (Williams, Baker, Honig, Lee, & Nowlan, 1998), also has been shown to impact communication (Poureslami et al., 2007). Low health literacy has been shown to adversely affect patient–provider communication, resulting in a negative impact on patients' ability to manage their health (Williams et al., 1998).

In pediatrics, physicians tend to get information from their child patients but give information to family members (Korsch, Gozzi, & Francis, 1968; van Dulmen, 1998; Wissow & Bar-Din Kimel, 2002; Wissow et al., 1998). In some cases, a child may be too young or incapacitated to receive information even if the physician attempted to provide it. Thus, many interventions focus on physician communication with families only (Braner et al., 2004; Browne, Covington, & Davila, 2004; Clark et al., 1998; Clark et al., 2000; Gischler, Mazer, Poley, Tibboel, & van Dijk, 2008; Penticuff & Arheart, 2005) or with family members as integral components of care (Shiffman, Spooner, Kwiatkowski, & Brennan, 2001; van Dulmen & Holl, 2000).

Method

Literature Review

We conducted a systematic review of the literature to identify interventions that have been effective in improving provider–patient communication among low-income children. In addition, we identified health IT strategies to enhance and facilitate provider–patient communication.

Data sources and search strategy. Both standard and specialty literature databases were used to search for literature. We searched PubMed® (1965–July 2009), CINAHL® (1982–July 2009), PsycINFO® (1965–July 2009), ACM Portal® (1947–July 2009), Lecture Notes in Computer Science® (1973–July 2009), and The Cochrane Library (second quarter 2009). Our review focused on literature published in the past 15 years, from January 1, 1994, to July 1, 2009. The references of key studies were also examined for additional literature, and the coauthors provided input on additional citations. Finally, we examined relevant systematic review articles to find additional citations.

Inclusion and exclusion of literature. English-language abstracts were reviewed that contained information on patient–provider communication, disparities in health care and health communication, or health IT used to improve communication between health care providers and patients; 1,237 abstracts met these criteria. Those abstracts were then reviewed for presence of an intervention component. Full-text articles with any indication of an intervention component were retrieved and reviewed. The authors independently reviewed the full text of 112 articles to evaluate whether or not they met the inclusion criteria for systematic review (see Figure 1). The authors then met to discuss any disagreements and came to consensus on which articles to include in the systematic review. Eight articles met inclusion criteria for review.

Data abstraction. Each article was reviewed and abstracted independently by at least two authors. By consensus, we elected to evaluate the quality of the studies using the SQUIRE (Standard for Quality Improvement Reporting Excellence) guidelines (available at <http://www.squire-statement.org/>; Ogrinc et al., 2008). The SQUIRE guidelines provided structure for evaluating the studies in a systematic manner consistent with the unique features of QI interventions. By consensus, our research team used a scoring system in which higher scores on the 19 items of the SQUIRE guidelines indicated more thorough description of the QI intervention and its results.

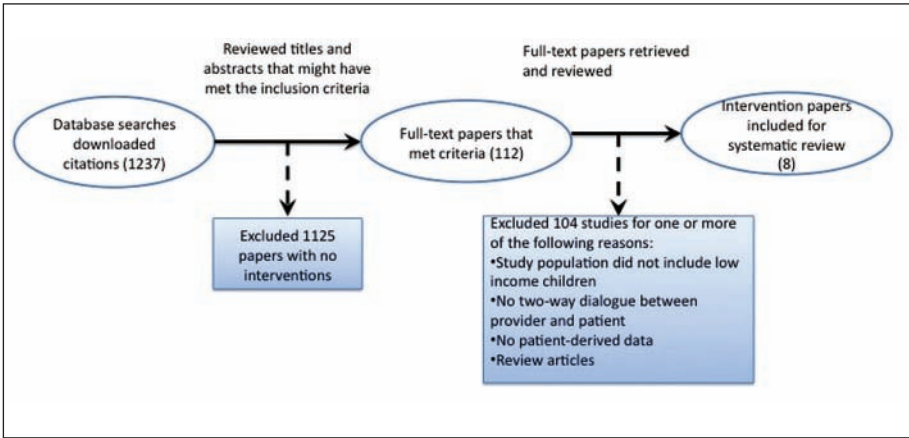


Figure 1. Literature search process

Key Expert Interviews

Qualitative, in-depth key informant interviews were conducted to add information about the actual experiences of individuals who deliver health care services to low-income children. Five key experts who provided health care services to low-income children in underresourced settings were interviewed. Underresourced settings were defined as settings in which the majority of patients receiving care lived in households with incomes at 100% to 200% of the poverty level or lower. In these settings, the majority of patients used Medicaid insurance, were uninsured, or were underinsured. We interviewed key informants who delivered health care in diverse geographical areas in the United States. After a review of the literature in the pertinent areas and identification of key topics for discussion, interview protocols were developed by the first author (QNM), with review and feedback from the coauthors. All key informants were then interviewed by telephone by the same interviewer (QNM) using this semi-structured, open-ended questionnaire. All interviews were audio recorded with permission and lasted approximately 1 hour. Analysis was conducted by two reviewers (QNM and CFG) and consisted of listening to each interview in its entirety, reviewing notes taken during the interview, and discussion between the two reviewers. Each reviewer had unique clinical and research expertise in low-income health care. Salient topics and emerging themes were identified and reported.

Results

Literature Search

The search yielded eight articles that described six intervention studies conducted among pediatric patients and their providers (see Table 1). Three articles documented

(text continues on p. 259S)

Table 1. Interventions to Improve Provider–Patient Communication in Pediatric Populations

Author (Year)	Population and Medical Condition	Setting	Study Methods and Improvement Strategy	Findings/Results	Challenges for Underresourced Settings	Effective for Reducing Disparities?	Health IT Used? How? Could Health IT Enhance?
Bartholomew et al. (2000)	Inner-city children aged 6–17 years	Outpatient pediatric primary care and specialty clinics	RCT	Intervention associated with:	Access to the computers and the CD-ROM/video game occurred in the clinics; trying to move this access out into the community may be difficult and require more support.	Yes. Many patients were Latinos and African Americans.	Yes, video game educational intervention occurred in the clinics.
	Includes Latinos and African Americans		Educational intervention for children based on a video game that taught about asthma control, including self-monitoring, problem solving, and skill building.	Fewer hospitalizations			Intervention could be expanded to be web based to allow access from home or school.
	Asthma		Children played asthma-related educational game after visits to the pediatrician; pre- and posttest for self-efficacy, knowledge of asthma management, and self-management skills	Better symptom scores			Enhancing intervention with e-mail or text messaging to a medical professional could provide ongoing instruction and feedback. Internet can also be used to monitor home symptoms, peak flows, and assist in symptom management between visits.

(continued)

Table 1. (continued)

Author (Year)	Population and Medical Condition	Setting	Study Methods and Improvement Strategy	Findings/Results	Challenges for Underresourced Settings	Effective for Reducing Disparities?	Health IT Used? How? Could Health IT Enhance?
Van Dulmen and Holl (2000)	21 consulting pediatricians in the Netherlands	Outpatient practices	Parents' asthma management; child's functional status, hospitalizations, and ER visits were also tracked. Pretest, posttest control group design	Increased functional status Greater knowledge of asthma management Better child self-management behavior Trained pediatricians:	Time constraints and cost	Cultural and language differences between physicians and patients were not addressed in this study.	No, health IT may allow the training to be offered either online or by interactive CD-ROM. This will allow more flexibility with regard to when and where training can take place, especially for those with busy clinical practice.
			5-day communication training of pediatricians in classroom setting	Asked more psychosocial questions	Not every pediatrician was able to attend every training in this study; this challenge would likely grow in underresourced settings.		

(continued)

Table 1. (continued)

Author (Year)	Population and Medical Condition	Setting	Study Methods and Improvement Strategy	Findings/Results	Challenges for Underresourced Settings	Effective for Reducing Disparities?	Health IT Used? How? Could Health IT Enhance?
Clark et al. (1998); Clark et al. (2000); Brown et al. (2004)	Pediatric asthma	Pediatrician offices in Michigan	RCT	<p>Looked at the parents and patients more often</p> <p>Gave patients and parents more opportunity to talk during visits</p> <p>No change in length of outpatient visits</p> <p>Physicians in intervention were more likely to use protocols for delivering asthma education, write down instructions for patients to adjust medicines when symptoms change and provide more guidelines for modifying therapy.</p> <p>Children seen by intervention physicians had fewer hospitalizations, and those with high baseline use had fewer ED visits.</p>	Time and resources for training	Not specifically addressed.	No. Online courses and other online feedback could be used to make training more convenient for physicians compared with a face-to-face model.

(continued)

Table 1. (continued)

Author (Year)	Population and Medical Condition	Setting	Study Methods and Improvement Strategy	Findings/Results	Challenges for Underresourced Settings	Effective for Reducing Disparities?	Health IT Used? How? Could Health IT Enhance?
			Physician intervention in which physicians were trained in improving their communications for children with asthma	People have to be given the time to get this training; other staff could also benefit from the training	It certainly works for both sets of patients, but it does not seem to work better in low-income patients.		
			Lectures, video, case studies, and sample messages were used in the training.	No differences between intervention and control physicians in the number of office visits and visit lengths		Number of non-White children in study was small.	
			Patients and families were interviewed during first visit within 22 months of intervention and then again 1 and 2 years after.				
Patrick et al. (2001)	Adolescents aged 11-18 years including minorities	Four Primary care practices	Intervention with comparison groups	Adolescents who targeted moderate exercise improved significantly more than those who did not; slight nonsignificant	Staff intensive, cost of computer program	Study dropouts were significantly more likely to be African American and from the Pittsburgh site; other dropout factors were	Yes, computerized assessment helped patients to choose targeted behaviors. This assessment could be done online at home and repeated regularly for

(continued)

Table 1. (continued)

Author (Year)	Population and Medical Condition	Setting	Study Methods and Improvement Strategy	Findings/Results	Challenges for Underresourced Settings	Effective for Reducing Disparities?	Health IT Used? How? Could Health IT Enhance?
	Prevention of nutrition obesity		<p>Random assignment to one of four conditions (three experimental); assessment at baseline and 4 months later</p> <p>Computerized assessment on first day, followed by counseling (guidance from computer to pick two behaviors based on transtheoretical and social cognitive theory models)</p> <p>Computer counseling with various degrees of telephone and mail follow-up</p>	<p>changes in those who targeted fruit and vegetable consumption; no difference for those who targeted intense exercise</p>	<p>changing summer school or summer job schedule.</p>	<p>improved results; mail and telephone visits could be changed to online chats, e-mail, and other health IT-based interventions.</p>	

(continued)

Table 1. (continued)

Author (Year)	Population and Medical Condition	Setting	Study Methods and Improvement Strategy	Findings/Results	Challenges for Underresourced Settings	Effective for Reducing Disparities?	Health IT Used? How? Could Health IT Enhance?
Braner et al. (2004)	Children, their families, and primary care physicians of patients admitted to a single PICU	Referral center in Oregon	Prospective descriptive case study	Website was well accepted by parents and referring physicians.	Requires initial setup, system maintenance, training of families, time to upload information, monitoring for e-mail questions, and time to respond to inquiries—especially for those not computer literate and those with limited health literacy. Many families in the study had to be loaned laptops.	Not tested	Yes, web-based communication was used in study.
	Diverse conditions requiring intensive care medical and surgical units	Recovery center for most of a large state	Patients and families had access to website during PICU stay that allowed for communication with clinicians and so on.	Patients' families felt the site helped share information.		These findings should be tested with more children in low-income households and other underrepresented communities.	Broadband penetration is still not great in underresourced settings, and so mobile phone solutions should be considered.
	In PICU for at least 3 days		Website allowed patients to access information about care of patient.	Physicians liked getting information on patients compared with traditional phone/fax methods.			This system was really designed for acute inpatient care. It is possible that the sharing of information and training to use the system in the PICU could precipitate more use after discharge and perhaps even use for chronic care.

(continued)

Table 1. (continued)

Author (Year)	Population and Medical Condition	Setting	Study Methods and Improvement Strategy	Findings/Results	Challenges for Underresourced Settings	Effective for Reducing Disparities?	Health IT Used? How? Could Health IT Enhance?
Penticuff and Arheart (2005)	Parents of neonatal intensive care unit infants; Caucasian, African American, and Hispanic.	NICU in Texas	Website had different information for families and for referring physicians. Parent could send e-mail with questions and concerns and receive responses. The goal was to improve communication and information sharing. Surveys were used to assess the intervention	77% of families found the website useful for communication.			
			Quasi-experimental repeated measure design. Parents in control and intervention groups answered questions at three time periods (0-3 days, 9-12 days, and 25-28 days).	Intervention group had fewer unrealistic concerns, less uncertainty about infant medical conditions, less decision conflict, more satisfaction with medical	60-90 minutes of training by nurses of each mother	Yes, the intervention was effective in increasing collaboration for minorities.	No. The Infant Progress Chart could be in an online format that could be more interactive and that parents could access at a distance. Using this kind of solution at a distance, however, might introduce more disparities, depending on Internet access

(continued)

Table 1. (continued)

Author (Year)	Population and Medical Condition	Setting	Study Methods and Improvement Strategy	Findings/Results	Challenges for Underresourced Settings	Effective for Reducing Disparities?	Health IT Used? How? Could Health IT Enhance?
	Prematurity and very low-birth-weight infants.		Intervention group parents oriented to use of Infant Progress Chart, which was designed to help parents understand condition and make decisions; organizes medical information in graphical format.	<p>decision-making process, more satisfaction with amount of input, and reported more shared decision making with professionals.</p> <p>Limitation: Various maternal demographic and infant health variables confound these results.</p>	Staff intensive care meetings	Mothers with lower SES are less likely to collaborate initially and need this intervention even more.	
					Nurses must be available to train parents and work with them in the shared decision model.		

Note: ED = emergency department; NICU = neonatal intensive care unit; PICU = pediatric intensive care unit; RCT = randomized control trial.

the results of one study (Brown, Bratton, Cabana, Kaciroti, & Clark, 2004; Clark et al., 1998; Clark et al., 2000). Two of the studies targeted the patients themselves (Bartholomew et al., 2000; Patrick et al., 2001), two targeted providers (Brown et al., 2004; Clark et al., 1998; Clark et al., 2000; van Dulmen & Holl, 2000), and two targeted families (Braner et al., 2004; Penticuff & Arheart, 2005). In this section, we discuss each of these strategies in turn.

The interventions that targeted the patients themselves tended to focus on self-efficacy and patients' understanding of their diseases in addition to health outcomes. In children, video games and social media can be points of entry into discussions about health issues and concerns. For example, in one study, inner-city children played an asthma-related educational game after visits to their pediatricians. This intervention was associated with fewer hospitalizations, better symptom scores, increased functional status, greater knowledge of asthma management, and better child self-management behavior (Bartholomew et al., 2000). Similarly, in a study focused on adolescents, a treatment intervention that included an initial computerized assessment was used. Following this initial intervention, participants were randomly assigned to one of four groups for extended intervention: no follow-up, mail only, infrequent telephone and mail, or frequent telephone and mail (Patrick et al., 2001). In this intervention study, which targeted nutrition and fitness, the adolescents in the extended intervention groups did not improve significantly more than those in the control group, but the feasibility of such an intervention was demonstrated. Furthermore, the initial computerized assessment may have been the primary intervention at work, but a control group without the assessment was not tested (Patrick et al., 2001).

Although some may argue that training already-practicing physicians to communicate differently is incredibly challenging, two of the studies in our review had success in changing behaviors and health outcomes with fairly minimal clinician training. For example, Clark et al. (1998) found that physicians were more likely to provide written instructions and communicate more clearly after an interactive training seminar focused on communication. Furthermore, these effects were evident for low-income populations and persisted for 1 to 2 years (Clark et al., 1998; Brown et al., 2004). Another study, completed in the Netherlands, demonstrated that a 5-day training program had positive impact on pediatricians' verbal and nonverbal communication skills (van Dulmen & Holl, 2000).

Given the amount of care that must be provided by families and the challenges associated with parental understanding and involvement in pediatric care, it is not surprising that some of the interventions focused on families. Braner et al. (2004) showed that both families and referring physicians found a web-based communication portal helpful during a child's stay in the pediatric intensive care unit. In another study, Penticuff and Arheart (2005) focused on empowering families to engage in communication and decision making while their children were in the neonatal intensive care unit. In this work, use of an "Infant Progress Chart" with families helped them to have fewer unrealistic concerns, less uncertainty about the infants' medical conditions, less decision conflict, and more shared decision making.

Each of these three strategies was effective in its own way, and all were demonstrated to be feasible. Thus, combining these strategies should be investigated, as health IT may make the interventions simpler and less expensive to deploy, a topic we discuss in the next section.

The role of health IT and other QI strategies in improving communication. Both of the child-centered intervention studies (Bartholomew et al., 2000; Patrick et al., 2001) and one of the family-centered studies (Braner et al., 2004) in our review explicitly used health IT. In the Bartholomew et al. (2000) study, low-income inner city children—53% African American and 42% Latino—were explicitly targeted for a video game asthma intervention. They found that the use of the video game over several months could decrease hospitalization rates and improve children's knowledge of their illness and treatment plans. Patrick et al. (2001) demonstrated that clinician follow-up with adolescent patients who set nutrition and fitness goals using a computerized assessment program was possible. Multiple challenges interfered with these interventions, notably logistical items such as scheduling phone calls. Moving to an asynchronous mode of communication (e.g., e-mail or social networking sites) could address these challenges. Finally, Braner et al. (2004) used an interactive website to allow families and referring physicians to communicate with and understand the results and prognosis of a child admitted to the pediatric intensive care unit. Families and referring physicians alike reported that they enjoyed using the site and that it helped them to share information, but access to computers was a challenge for the families.

Those studies that did not employ health IT, however, indicated ways that health IT could and should be incorporated into similar future interventions. For example, the studies that focused on physician training (Brown et al., 2004; Clark et al., 1998; Clark et al., 2000; van Dulmen & Holl, 2000) suffered from the challenge of getting physician attendance at in-person training sessions. Computer-based training might allow individual physicians to participate in training at a time and place that is most appropriate for them, rather than requiring scheduling of multiple individuals at once. Furthermore, the Infant Progress Chart used in the Penticuff and Arheart (2005) study can be digitized to create a more flexible documentation and communication tool for families and providers.

Key Informant Interviews

The five key experts interviewed for this article are clinicians who care for low-income children in underresourced clinics or in clinics affiliated with academic medical centers in diverse areas across the United States. The participants brought unique perspectives from their responsibilities as clinical administrators or specialists; four of the experts also hold master's in Public Health degrees.

Patient-related challenges. Challenges related to poverty were seen as major barriers to effective health care between providers and patients. Health and health care are often low priorities for people struggling to get by from one day to the next. Communication barriers such as patients' low health literacy levels and limited English proficiency

also affect the ability to provide quality care. Using e-mail or text messaging to communicate with low-income patients was not reported to be common because of the perception that patients lack reliable access to these technologies. However, participants reported that the majority of their patients had access to high-speed Internet via libraries or schools.

Participants reported that access to care remains an issue for low-income children and their families, irrespective of whether health IT is available where they receive care. For many children, the care they receive can be fragmented, taking place at any number of health clinics and often without the regularity suggested by pediatric guidelines or desired by the clinicians. Furthermore, many poor families lacked stable living arrangements and employment, and this perpetual transitional state made timely access and continuity of care difficult. Ideally, health IT would allow for maintaining continuity of care across the different sites in which low-income patients receive care.

Providers and systems-related challenges. A concern of the key informants is that the delivery of pediatric care sometimes occurs in centers dominated by adult medicine. In such centers, children can be low on the list of priorities, in part because many adult medicine issues seen in general hospitals require intense resources, making QI (and the potential for cost savings) for diseases such as adult diabetes or acute cardiac events the first priority for health IT attention. The key informants identified developmental and preventive screenings and vaccination administration as key health IT opportunities for improvement in pediatrics.

The cost of implementing new health IT was seen as a major challenge, along with the cost for further innovation and integration across the system. In addition to financial and time costs involved with implementing electronic medical records (EMR) and health IT, participants were concerned with the lack of straightforward reimbursement models for time spent using health IT to communicate, such as e-mails and text messaging between patients and providers.

Current Innovative Practices Using Health IT

The diffusion of health IT into clinical settings has led to several innovations designed to address some of the challenges of providing care to low-income children. For example, the Washington State Department of Health (2009) has a program called "Child Profile" that features health promotion and a statewide vaccine registry system that is web based. The overwhelming majority of public vaccine providers throughout the state use the system. With this system, a low-income family who may be transient can still maintain for their children a vaccination record that is accessible across the state. By having a universal identifier that is not tied to one particular chart in one clinic or to a home address that may change, health information such as immunizations, access, and prevention can be tracked in a mobile and at-risk population. As another example, one of our key informants who practices in Arkansas, described an asthma intervention using telemedicine and streaming video to conduct asthma education and health promotion is currently undergoing pilot testing (T. Perry, personal communication,

August 25, 2009). Because technology is scarce in this area, the pilot program relies on local schools with the technological requirements necessary for the intervention rather than depending on home Internet connectivity. These schools also serve as community focal points.

Although health IT interventions can be helpful in improving provider–patient communication and care in general, the cost of these interventions can be prohibitive to clinics in underresourced settings, such as those that serve low-income children. Costs include not only hardware, software, technical support, and maintenance but also time spent to train staff and providers who will have to take time away from patient care to learn the new technology. In particular, many smaller institutions have limited capacity for in-house IT support. The most effective health centers have participated in data networks and collaboratives to enhance their ability to use and analyze electronic health data for QI efforts. Participating in these data networks can help reduce the challenges of interoperability between EMR systems from multiple health care providers (in both public and private settings). The lack of EMR systems interoperability may be particularly detrimental for the health care of low-income children and families because they tend to be very mobile and may lack continuous care at one location. Like most health IT interventions, however, these collaborative efforts have tended to focus on efficiency for the provider and the network and have done little in terms of creation and use of novel health IT strategies for communicating with patients and families.

Conclusions and Future Directions

In the past few decades, a worldwide move toward health IT has pushed a variety of research and clinical agendas. For the most part, however, in these efforts, pediatric care has been treated as just another specialty to be handled similar to other efforts. Shiffman et al. (2001) argued nearly a decade ago, however, that a pediatric health IT agenda should be crafted that gives special consideration to the needs of children and focuses on improved access for children—including those from underresourced areas and low-income families. They note that children possess unique physiology, come from a wide range of backgrounds, experience diseases that are largely unique to them, and develop rapidly. Together, these factors make for particularly unique and complex patients and interventions. Furthermore, pediatric health practices and pediatricians in particular can be slow adopters of health IT (Menachemi, Ettel, Brooks, & Simpson, 2006). Nevertheless, children and adolescents often lead the charge for technology adoption, bringing along their elders (Horrigan, 2005). Therefore, specific research into the impact of health IT in pediatric medicine, in particular for underresourced settings, may hold promise and is worth engaging.

Successful communication interventions have been carried out across a variety of media (face-to-face, paper, telephone, mail, e-mail, and the Internet) for low-income children, adolescents, and families of pediatric patients. In particular, health IT communication solutions using hardware that is more accessible to low-income families, such as mobile phones, television, and office-based kiosks, may be more effective than

Internet-based communication. Mobile phone-based interventions have been tried in small populations to support adolescents (Puccio et al., 2006; Rogers et al., 2001). Another solution that holds promise is to engage the community, including leveraging their infrastructure to provide health IT interventions (Shiffman et al., 2001). Children have access to computers and the Internet in schools, libraries, community centers, and after-school programs. Likewise, low-income parents may access these technologies in language learning centers, libraries, schools, and other community programs. However, much more research is still needed in this area.

Furthermore, children tend to answer only what they are asked and are not given very much information during their visits with pediatricians. Thus, children may not be comfortable asking questions or providing additional relevant information to providers. Further research is needed to explicitly empower children to ask questions and have greater involvement in decisions about their own care. This research must include children of varying ages, especially adolescents, and also should include their families and care networks. Additionally, more research is needed to examine the impact of health literacy and cultural differences between children, parents, and medical providers.

Multitiered interventions that focus on the providers, patients, and families simultaneously should be explored to supplement research on interventions that simply focus on one of these groups. Older children may be more comfortable sending private messages to clinicians without parental oversight. The ethics, feasibility, and implementation of health IT solutions to provide this type of private messaging should be explored. Specifically, the safe use of technology, in terms of security and exposure to unwanted or malignant information on the Internet, must be a focus of future research. Multigenerational health IT interventions should be explored to bridge the gap between parental and child knowledge. At the same time, web-based communication can support connections between providers and families and should be used to enable communication with parents who may not be able to visit clinicians in person.

More research is needed to see if a universal, integrated system could decrease health disparities for populations that are highly mobile, such as low-income families. For example, health IT solutions should be explored that integrate data from school health records, outpatient care, and inpatient settings. The most effective health IT strategies include user involvement from the beginning, including clinicians, patients, and parents. The issues to be considered include patient and family computer literacy levels and their access to technology. Furthermore, the use of personal health records (PHR), both before and after office visits, needs to be further studied in under-resourced settings. PHR are usually updated and maintained by the patient and are separate and distinct from the providers' EMR, which are updated and maintained by providers for recording and billing purposes. PHR may decrease disparities in communication by decreasing the variability associated with the ability of individual patients and their families to express their symptoms and the ability of individual providers to elicit information from their patients. In addition, given recent evidence of the much higher availability of mobile phones than landline or broadband connectivity

for low-income families (Horrigan, 2008), communication interventions that rely on these platforms must be investigated more fully. More research also is needed about the cultural concerns and roles of technology in people's homes and other community settings such as schools. Finally, health IT interventions for schools, community clinics, and hospitals should be designed with the organizational context of under-resourced settings in mind, including starting with low-risk efforts and moving to more radical changes over time.

The future of health IT for low-income children looks promising. In the past, most health information has taken the form of written communications such as handouts or brochures and occasionally a CD-ROM. Now, with the growing use and application of health IT, new areas of study are being formed, and new questions are being asked. For example, can appropriate health IT be used not only with parents but with children? If so, which is the best modality to employ? What information should be imparted to children and at what ages? Using DVDs, streaming video, or web-based programs may allow practitioners to improve health promotion communication with children at younger ages than ever expected. Innovations that are age and developmentally appropriate and delivered through a variety of venues including clinics, schools, and the Internet hold tremendous promise for taking health IT from the health care setting to patients and families in their communities.

Authors' Note

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