The Promise of Health Information Technology: Ensuring that Florida's Children Benefit

A Report to the Agency for Health Care Administration

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Executive Summary

Introduction

Substantial policy interest in supporting the adoption of HIT by the public and private sectors over the last 5 – 7 years, was spurred in particular by the release of multiple Institute of Medicine reports documenting the widespread occurrence of medical errors and poor quality of care (Institute of Medicine, 1999 & 2001). However, efforts to focus on issues unique to children's health have been left out of many of initiatives. The purpose of this report is to identify strategies that can be taken by public and private entities to promote the use of HIT among providers who serve children in Florida.

Background

An oft stated concept in pediatrics is that children are not "little adults". However, this concept has real implications for the design and delivery of health care services for children and specific implications for health information technology solutions. For example, pediatric health information systems need the flexibility to address: adolescent privacy; genetic information; guardianship data; adoption issues; foster care; abuse and neglect; financial responsibility; functionality in a busy and sometimes noisy environments; have family member links; registry linkages; and national policy statements such as those made by the AAP (2001). Given these and many other factors, the end result is that too often nationally, and occasionally in Florida, child health and public programs serving children have been ignored, or specifically excluded from HIT efforts. In Florida, child focused attention to HIT has included a pediatric component to the Tampa Bay RHIO efforts, involvement of several child health experts in workgroups and activities of the Florida Health Information Network (FHIN), and the funding of this report. The fact that the State of Florida has recognized the need to include child health and child health providers in their plans is encouraging and affords the state an opportunity to build on this early investment.

Methods

This report was developed using quantitative as well as qualitative research (including literature review, three surveys, a focus group and 9 key informant interviews), and input from key stakeholders throughout Florida and national representatives. An advisory committee including individuals considered to be experts in their respective fields from around Florida was convened (see list in Figure 3). Participant expertise included, but was not limited to, pediatrics, pediatric specialties, health insurance, software development, epidemiology, and legal/legislative arenas. In 2006, the advisory committee met in person three times over a six month period to develop the report and a draft of the report was sent out in late 2006 for comments.

Findings

The overall finding was that HIT systems must be" built for children and they will work for everyone." While children have unique needs, a separate, independent strategy is not warranted. What is needed is integrated and early attention to these needs in the design, deployment, financing and sustainability plans so that children's needs are addressed. Five specific findings emerged. Another fundamental conclusion is that ambulatory child health providers lag behind others in their adoption of HIT and EHR.

Finding 1: HIT adoption by providers serving children in Florida, especially those in smaller practices, is different than for other populations.

Finding 2: Barriers affecting child health providers are the same as for other providers but more pronounced.

Finding 3: The use of HIT, especially EHR, will benefit children and CHPs as much *or more* as any other populations or provider.

Finding 4: Children's health care offers some opportunities for future efforts to promote HIT

Finding 5: The State of Florida, as a major payer of care for children in Florida, has the opportunity to accelerate the adoption of HIT to promote the safety, quality and efficiency of care for children in the State.

Recommendations

The advisory committee discussed numerous possible strategies. Those included here emerged as the most important.

Recommendation 1: Public and Private Sectors Should Explore Innovative Financing Strategies to Spur Adoption.

Recommendation 2: A number of non monetary incentives could accelerate adoption

Recommendation 3: A concerted effort at both the State and national levels is needed to promote the development and adoption of standards which are child sensitive.

Recommendation 4: Substantial provider and practice education, training and technical assistance is needed.

Recommendation 5: Consumers can and should help drive the adoption of HER, PHR and other HIT applications

Recommendation 6: Remaining gaps in our knowledge of the impact of EHR must be addressed.

Background

Health information technology (HIT) is a key tool for improving the quality and efficiency of care. HIT includes electronic health records, personal health records, use of personal digital assistants, health information exchange, computerized order entry systems, e-prescribing, and disease-specific or population-based registries.[1] Concurrent with the rapidly expanding availability of new technological functionalities, the interest in promoting HIT has also grown, spanning federal, state and local levels. Coordination of efforts across the mission and goals of the various entities can help to maximize precious resources and helps to facilitate substantive system change. For a more detailed description of these activities and the organizations involved, see Appendix 1.

This substantial policy interest in supporting the adoption of HIT by the public and private sectors over the last 5 – 7 years, was spurred in particular by the release of multiple Institute of Medicine reports documenting the widespread occurrence of medical errors and poor quality of care (Institute of Medicine, 1999 & 2001). In 2004, the combined state and federal investments in HIT in Medicaid reached $2.7 billion for state Medicaid Management Information Systems (MMIS) (Alfreds et al, 2006). Some states have used these funds for innovative applications that support quality, such as immunization registries, beneficiary portals, and e-prescribing capacities. However, efforts to focus on issues unique to children's health have been left out of many of initiatives. The purpose of this report is to identify strategies that can be taken by public and private entities to promote the use of HIT among providers who serve children in Florida.

The Need for a Focus on Children

An oft stated concept in pediatrics is that children are not "little adults". However, this concept has real implications for the design and delivery of health care services for children and specific implications for health information technology solutions. Too often these unique features have been ignored leading to -- at best -- less than optimal match between children's needs and established strategies, or to children being completely left out of various initiatives (see below for IT examples). Children's differences are often summarized as the "Four D's" (Figure 1). Each of these characteristics also has implications for the extent to which HIT initiatives have addressed children's needs (AAP, 2001). For example, pediatric health information systems need the flexibility to address: adolescent privacy; genetic information; guardianship data; adoption issues; foster care; abuse and neglect; financial responsibility; functionality in a busy and sometimes noisy environments; have family member links; registry linkages; and national policy statements such as those made by the AAP (2001). More specifically, patterns of children's health, illnesses and conditions are dominated by an emphasis on prevention,

[1] For a description of key HIT applications, see Appendix 2 and refer to the Certification Commission for HIT at http://www.cchit.org/about/resources/glossary.htm

growth and development and while chronic illnesses as growing as a concern, they tend to include numerous behavioral health conditions. This results in care for children being dominated by the ambulatory, primary care sector, the sector that is slowest to adopt HIT solutions such as EHRs. In addition, children's health care contributes less than 10% to the total health care "bill" so that attention to children's health care issues has been less prominent among policymakers and the marketplace. The dependency of children on their parents, guardians and families, and the fact that for many these family structures change over time, has also meant that numerous confidentiality and privacy issues arise and these change as children age into adolescence and young adulthood (Rosenbaum, Abramson & MacTaggart, 2008).

Figure 1: The Four "D's" of Childhood and their Implications for Health Information Technology

Differential epidemiology

- Emphasis on prevention, growth & development
- Ambulatory & lower cost
  → *lack of attention (policy, purchasers, SDO's, vendors, etc…)*
  → *primary care and solo practices are HIT laggards*

Dependency

- Diverse and often unstable family structures
  → *Confidentiality, privacy issues e.g. divorced parents, emancipated adolescents*

Developmental trajectory

- Rapid change in health needs
  → *unique pediatric functionalities*
  → *reference values change over time*
  → *need for longitudinality*

Differential systems

- Heavy reliance on public systems
- Links to public systems, child care, schools, foster care
  → *low provider reimbursements & undercapitalized practices*
  → *high need for interoperability*

Children's growth and development over time is also a hallmark of pediatric care which calls for a dynamic response from the health care system. It also requires HIT systems to include specific pediatric functionalities (such as growth charts and BMI percentile curves) as well as an enhanced ability to monitor trends over time. Finally, because of children's disproportionate poverty and the history of public programs for children addressing many of their needs across sectors, children rely on publicly funded systems and also receive health care in many different settings. Public financing has led in many states to low provider reimbursements contributing to poor ability to invest in new technologies such as HIT at the practice level (see later for details on the situation in Florida). The complex set of providers of care to children actually makes the opportunity for coordination and information sharing offered by HIT and health information

exchange (HIE) initiatives particularly salient for children's health care. Recognition of these unique needs led to the establishment of the first population specific special interest group (SIG) in Health Level 7 (HL7) several years ago and their report on pediatric functional standards for the electronic health record.

Given these and many other factors, the end result is that too often nationally, and occasionally in Florida, child health and public programs serving children have been ignored, or specifically excluded from HIT efforts. Much of the attention has been on high-cost populations (e.g., the elderly and those with special health care needs) and chronic or high-cost medical conditions. Little attention has been given to health care related to children's development. For example, President Bush's August 22, 2006, Executive Order calling for federal health care programs to promote quality and efficient delivery of health care through the use of HIT systems that meet recognized interoperability standards specifically excluded SCHIP and Medicaid (Executive Order, 2006). Recently, pediatric organizations, the Maternal and Child Health Bureau, and AHRQ, among others, have led efforts to examine in the particular needs for HIT in children's health care. These efforts have largely focused on the immunizations, newborn screenings, and pediatric standards to be included in electronic health records, and the exchange of health information through state-based regional health information organizations. One promising example is the proactive design of decision-support systems for the implementation of the new Bright Futures guidelines on well-child care, which will be released by the AAP later this year.

The Florida Context

In addition to the numerous national initiatives designed to promote patient safety and quality through the adoption of HIT summarized in Appendix I, efforts are also attempting to promote adoption based on the specific needs of each state. In Florida, Governor Jeb Bush issued an executive order (5/4/2004) which created the Governor's Health Information Infrastructure Advisory Board (GHIIAB) to advise and support the Agency for Health Care Administration (AHCA) in creating a plan to promote the development and implementation of a Florida HIT infrastructure and the Florida Health Information Network (FHIN), a state-level corollary of the National Health Information Network (see Appendix 3). AHCA has served as the lead for any projects designed to promote the adoption and utilization of EHR systems as well as coordinate any state and regional HIT activities. In regard to public health and disease surveillance, Florida is unique from most other states because the county health departments are all contained within the umbrella of the state Department of Health (FLDOH) allowing for greater ease of sharing information and relative uniformity of the HIT infrastructure state-wide.

Similar to the NHIN and FHIN technological frameworks, and key to their successful implementation, Regional Healthcare Information Organizations (RHIOs) focus on the data needs and architectural standards at the local level. RHIOs can act as catalysts for linking data and as a gatekeeper to the information network by ensuring proper security agreements are maintained with providers and users of the information. Current Florida RHIOs include: Big Bend, Central Florida (Orlando and surrounding counties), Escambia/Panhandle, Jacksonville, South Florida (Miami-Dade), Space Coast, Tampa

Bay, and West Palm Beach. In Florida, child focused attention to HIT has included a pediatric component to the Tampa Bay RHIO efforts, involvement of several child health experts in workgroups and activities of the Florida Health Information Network (FHIN), and the funding of this report. The fact that the State of Florida has recognized the need to include child health and child health providers in their plans is encouraging and affords the state an opportunity to build on this early investment.

Health Information Technology

HIT can include a variety of functions such as specific linkages between electronic health information in offices, hospitals, and other health care providers, registries (i.e., immunization, cancer), population surveys (BRFS, PRAMS), environmental applications, and telemedicine (Struchen-Shellhorn & Simpson, 2006) (see Appendix 2 for more details) . In the exploration of approaches to improving quality of care, studies are beginning to show that the use of information technology in the healthcare arena can improve patient safety and quality by allowing for a more comprehensive medical record to drive informed decisions, reducing medical errors and reducing duplication of services due to inaccessibility issues (Adams, Mann & Bauchner, 2003; California Health Care Foundation, 2006; Jha, et al, 2006; Leape and Berwick, 2005). It is also believed that health information technology (HIT) improves the efficiency and effectiveness of health care by reducing the duplication of services and providing clinical decision support (Centers for Medicare and Medicaid Services, 2006). Two primary applications, electronic health records and personal health records, are the focus of this report, as well as health information exchange activities (Figure 2).

In 2005, approximately 24% of the nation's physicians reported using an electronic health record (Jha AK, et al., 2006). Generally speaking, an EHR system contains a personal medical record, accessed on a computer or through a network. EHR systems should also allow data to be merged with that from other providers and offer an easily transferable medical history (Huchinson J & DeLorimier A., 2006). Currently, EHR use tends to focus initially around the office management with tools that promote quality and safety being some of the last functionalities to be implemented (Audet et al, 2005).

Transforming medical records into electronic formats is only the first step in maximizing health information. Although the potential benefits of EHR systems are great, one restrictive issue facing them is that they are generally housed at the provider's facility and do not adequately interconnect with health information from other providers, hospitals, and labs. Once health care records have been developed in a completely electronic media, their information can be merged together into a more comprehensive personal health record (PHR) that can then be accessed by anyone with the proper permissions (Brune B., 2006). According to the Markle Foundation PHR Working Group, "PHRs offer an integrated and comprehensive view of health information, including information people generate themselves such as symptoms and medication use, information from doctors such as diagnoses and test results, and information from their pharmacies and insurance companies. […] People can use their PHR as a communications hub: to send email to doctors, transfer information to specialists, receive test results and access online self-help

tools." Because of potential power of such as system, findings from a National Committee on Health and Vital Statistics study (2006) found that for PHRs to be fully accepted and utilized, respective rights, obligations, and potential liabilities of all stakeholders must be clarified. Additionally, consumers should have the right to control access to their health data. Finally, security and interoperability with EHR systems is needed.

Figure 2

Electronic Health Records: The IOM identified eight core functionalities systems should include: health information data, results management, clinical decision support, computerized physician order entry (COPE), electronic communications, patient education, administrative functions, and public reporting (Institute of Medicine, 2003)

Personal Health Records: The Markle Foundation defines the Personal Health Record (PHR) as an "Internet-based set of tools that allows people to access and coordinate their lifelong health information and make appropriate parts of it available to those who need it." (Markle Foundation, 2003)

Other Health Information Technologies: HITs can take many forms spanning across all aspects of health care. For example, *Telemedicine* refers to the electronic communications and information technologies that allow for the provision of clinical care when the patient and provider are in different locations can reduce geographical and transportation barriers to receiving care (American Telemedicine Association, 2006). *Telehealth* involves a broader range of activities such as distance education, remote monitoring of vital statistics and consumer outreach. Another type of health information technology is the *personal digital assistant* (PDA). PDAs are often used for accessing reference materials and administrative functions such as time management and can also allow PDAs to wirelessly access "live" data such as from EHR systems (CureMD, 2006, Garritty & El Emam, 2006). Other technologies being used include *CPOE*, *radiofrequency identification tags* for tracking purposes, *bar-coding* and cross-referencing prescriptions, the use of *IPODs/MP3 players* to provide health education, and *new operating systems* that promote more communication with common consumer devices (Coye, 2006). There are also *bio-monitoring devices* that can send health information wirelessly such as watches that monitor glucose as well as vests that monitor heart rhythms and pulmonary function (Key Informant Interviews, 2006; Zhao, Fafiq, Hummel, Fei and Merrell, 2006).

Data Standards: One of the important issues that came up repeatedly during this project was the need for data standards that were inclusive of child health concerns. Because of the variety of data technologies and sources, there is a need to standardize the way in which data is shared across systems. Some of these data exchange standards have begun to be developed. For example, LOINC (Logical Observations Identifiers, Names, Codes) provides a universal coding system used for lab reporting, networking, security and authentication (RHIO Wiki, 2006d). LOINC identifies specific observations within electronic messages so that when data from multiple sources is merged, elements are filed in the appropriate places within the merged record (McDonald, et al., 2003). SNOMED CT is another universal format which has been licensed by the federal government as a

standard for clinical health information exchange. SNOMED is available to consumers at no charge through the National Library of Medicine (NLM). RxNorm, which provides standard names for medications and dosing, is also available through the NLM (RHIO Wiki, 2006e). Finally, Health Level Seven (HL7) is an American National Standards Institute (ANSI)-accredited Organization in the clinical and administrative data domains of health care. It involves the collaboration of healthcare subject matter experts and information scientists to create standards for data exchange, management and integration (http://www.hl7.org/).

Methodology for Developing This Report

This report was developed using quantitative as well as qualitative research, and input from key stakeholders throughout Florida and national representatives. An advisory committee including individuals considered to be experts in their respective fields from around Florida was convened (see list in Figure 3). Participant expertise included, but was not limited to, pediatrics, pediatric specialties, health insurance, software development, epidemiology, and legal/legislative arenas. In 2006, the advisory committee met in person three times over a six month period to develop the report and a draft of the report was sent out in late 2006 for comments.

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Data for the report includes an extensive literature search of patient safety, quality and HIT issues at the local, state and national levels. In addition, a series of 9 key informant interviews and 1 focus group were conducted. Finally, statewide data from three surveys (children's hospital [N=98], providers who serve children [N=1,021], and community health centers/health departments/community mental health centers [N=76]) were analyzed. Aggregation of these data sources identified a number of finding and

recommendations which will be discussed throughout the document. A more detailed description of each study can be found in Appendix 4.

Findings

"Build it for children and it will work for everyone."

While children have unique needs has described above, a separate, independent strategy is not warranted. What is needed is integrated and early attention to these needs in the design, deployment, financing and sustainability plans so that children's needs are addressed. A common theme across all of the data sources was that current EHR systems do not adequately meet the needs of child health providers. Some software developers are beginning to offer child-specific EHRs or add-on modules. However, although issues such as weight-based dosing and access of medical information by parents/guardians appear to be child-specific, there are applications for these same data elements in the adult populations as well. For example, weight-based dosing may be needed for very thin or morbidly obese adults while mentally incompetent adults have guardianship issues. Therefore supporting an underlying theme that all EHRs should be designed to be used with children will help ensure the needs of children are met as well as enhancing the functionalities available for adult populations.

Finding 1: HIT adoption by providers serving children in Florida, especially those in smaller practices, is different than for other populations.

Studies have been conducted to identify factors associated with HIT adoption as well as barriers to adoption. In 1990, Weiss et al. found that board certification, working in group rather than solo practice, conducting teaching activities, reading medically related publications, having an academic appointment, younger age, and higher patient volume were associated with greater HIT use. Additionally, having physician colleagues who were champions for the adoption of HIT incentivized adoption of innovations (Weiss et al, 1990). This suggests that economies of scale and provider scope are significant factors in the promotion of HIT adoption (Furukawa M & Ketcham J, 2006). Nearly twenty years later, some of the same associations are still being identified as issues and will be discussed further.

Adoption is Much Slower in Ambulatory Child Health Settings

Physicians caring for children are slower to adopt EHR-systems than other types of health care providers (Menachemi, Ettel, Brooks, Simpson, 2006). A major reason for this lack of adoption is that the number and significance of barriers can be much greater than for other types of providers. A total of 4,203 physicians in Florida including 1,021 (25% response rate) pediatricians, family practitioners with at least 20% of their patients being children under age 18, or pediatric specialists were surveyed regarding IT adoption and quality of care issues. General

findings indicate that pediatricians and other child health providers (CHPs) were less likely to adopt HIT than other types of physicians (Menachemi N, Ettel D, Brooks R, & Simpson L.; 2006). Furthermore, approximately 80% of CHPs who do not currently use an EHR system are either not currently considering the purchase of an EHR, or not considering an EHR within the next year. When exploring specific reasons for these responses, CHPs were more likely to report every barrier listed in the survey than other physicians with the strongest of these barriers being financial. Additionally, child health providers with more HIT quality enabling functionalities were more likely to be larger and multi-specialty practices yet the majority of children are served in smaller practices. Interestingly, African American physicians were more likely to be employed in higher quality enabled practices which is in contrast to recent studies.

When comparing CHPs with a high volume of Medicaid funded patients versus those with a low volume, CHPs generally did not differ with respect to reported barriers or self-reported levels of computer sophistication. However, high volume Medicaid providers were less likely to have a practice web site, to routinely use an EHR in their office practice, and to have many important key functions in their EHR systems. For example, CHP high volume Medicaid providers were significantly less likely to have *allergy lists*, *e-prescribing of medications*, *electronically available x-ray results*, *patient scheduling*, and *offsite access/log-in capabilities*. Conversely, high volume Medicaid CHPs were more likely to have *weight-based dosing* functions, and *growth charting* functions in their EHR systems. Finally, high volume Medicaid providers were less likely to think an EHR will *slow them down*, but more likely to suggest they *lack in-house technical knowledge* necessary for EHR system selection.

Minor Differences Were Found in Hospitals Serving Children

A survey of 98 acute care hospitals serving children throughout Florida found that hospitals caring for a large number of children were adopting both clinical and non-clinical IT applications more frequently than their counterparts. In addition, as children comprised an increasingly larger percent of a given hospital's business, the propensity to adopt IT increases. It may be that children requiring an inpatient stay at an acute care hospital are typically very ill having either have a serious chronic condition, or experiencing a severe acute episode. As such, these children seek care in advanced-care hospitals that staff pediatric sub-specialists. These, hospitals appear to be more likely to adopt IT. High volume pediatric hospitals were also more likely (than low volume pediatric hospitals) to utilize manage care contract management systems as well as cost accounting information systems.

When comparing children's hospitals having a high volume of Medicaid-funded patients versus those with a low volume, the only difference in barriers was that high volume pediatric hospitals were more likely to indicate that *"vendor's inability to effectively deliver product or service to our satisfaction"*. With respect to strategic (executive) information systems, when compared to their counterparts, hospitals with high volumes of Medicaid-funded patients and those with high volumes of pediatric patients were more likely to use managed care software. Finally, no Medicaid volume differences were found with respect to adoption of clinical and administrative information systems between hospitals..

When exploring IT priorities among all hospitals, the most common was to "implement technology to reduce medical errors/promote patient safety". However, IT priorities differed based on Medicaid and pediatric volume in hospitals. High volume Medicaid hospitals were more likely to indicate the following priorities: integrate systems in multi-vendor environment; implement technology to reduce medical errors/promote patient safety; and implement EDI to meet HIPAA requirements. Low volume Medicaid hospitals were more likely to indicate the following priorities: deploy internet technology (e.g. Web-based applications); upgrade network infrastructure (LANs, WANs); and replace/upgrade inpatient financial/administrative systems.

Community Health and Mental Health Clinics Responses Were Mixed

A survey of community health clinics[2] was conducted regarding their use of health information technology (HIT). In all, 76 of the 250 surveys sent were completed including 24 (65% response rate) CHCs, 27 (37%) HDs and 25 (22%) CMHCs. Generally speaking, most respondents indicated that they routinely used computers, and that computer functions were based more on administrative tasks such as electronic claims submission as well as scheduling and registering patients. Reports of the existence and use of other functions, including those addressing patient quality and safety issues, were less common and varied by the type of organization for which the respondent was employed. In regard to EHRs, less than five percent used an all electronic record while another 32% used a combination of paper and electronic records. When asked about EHR expansion, respondents from CHCs were the most likely to report an intention to purchase a new or upgrade an existing EHR system while CMHCs were the least likely to do so. When asked about EHR barriers, a lack of capital investment funding was the strongest issue reported. The ability to integrate with other systems and a lack of HIT staffing resources were also reported as barriers. Conversely, the highest rated incentives for promoting HIT adoption were grant monies to purchase systems and technical assistance to support the implementation of an EHR. This includes help with developing an estimate for hardware needs and choosing an EHR vendor.

Issues with the implementation of this survey included a relatively low response rate and inconsistencies across respondents with different job positions. This finding is an indication that researchers need to take greater care in capturing the true functionality of HIT within organizations such as by using a mixture of qualitative and quantitative methods to triangulate the knowledge of multiple individuals within an organization.

Policies May Have Already Spurred Adoption

In 2003, Florida's Governor, State Legislature and Agency for Health Care Administration began a program involving the use of wireless hand held personal digital assistants (PDAs) to improve clinical outcomes as well as identify issues involving over and under prescribing. Three thousand PDAs were provided to physicians with the highest number of Medicaid prescriptions written. The use of these PDAs allows Medicaid providers to view the last 100 days of prescription

[2] This includes community health centers [CHC], health departments [HD]/Children's Medical Services [CMS], and community mental health centers [CMHC].

history, has an e-prescribing function and produces drug alerts (over use, under use and drug interactions) (Richard, 2006). Early findings indicate that e-prescribing physicians are writing fewer prescriptions and it is believed that hospitalizations due to drug interactions have been avoided. Finally, according to the Physician Survey, high volume Medicaid providers were more likely to use PDAs. The use of PDAs was associated with higher levels of perceived computer sophistication, and higher levels of sophistication were associated with more EHR use.

Additional Physician survey analyses conducted to explore pay for performance experiences found that purchasers are beginning to fund health care differently. Traditional forms of billing promote treatment of illnesses rather than wellness. To promote preventive health, alternative forms of compensation are beginning to be used, often in combination with a variety of incentives. These include compensation for measures of clinical care, patient surveys and experience, use of clinical information technology, and quality bonuses or incentives. According to survey resuts, explicit compensation for the use of clinical information technology was the only type of incentive listed that was associated with increased use of EHRs.

Finding 2: Barriers affecting child health providers are the same as for other providers but more pronounced

The literature of adult and child health providers as well as the results for the state-wide data collection efforts found that HIT adoption barriers are similar across populations. The advisory committee was presented a synopsis of this information regarding adoption barriers and was asked to prioritize the issues by identifying the most important CHP barriers that should be addressed first. The top three priorities identified by the committee included the cost of purchasing and maintaining EHR systems, the need for systems that better meet the needs of providers, and legal issues regarding access to information, especially among adolescents.

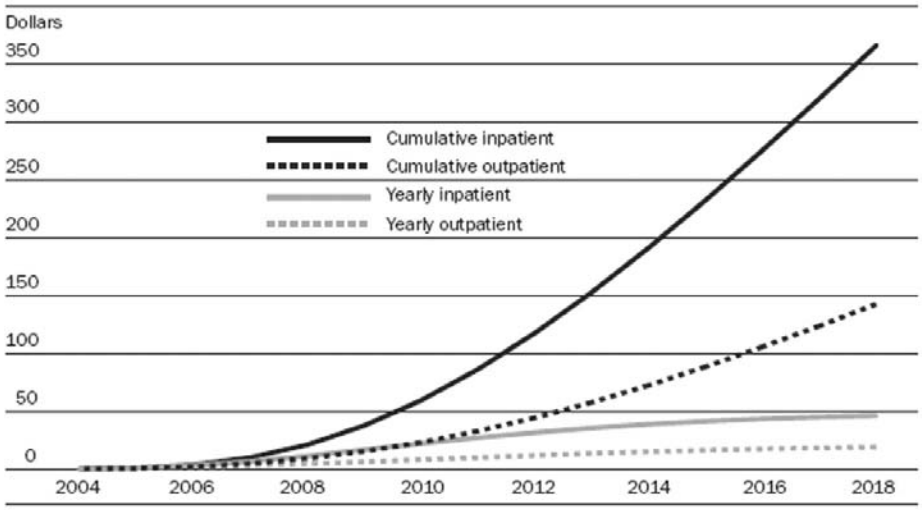
Barrier #1: EHR Purchase, Transition and Maintenance Costs are Most Common Barrier

Financial pressure has been identified nationally and through local interviews and surveys as the primary barrier for adopting HIT (AHRQ, 2006; Key Informants, 2006; Physician Survey, 2006). Miller and Sim, 2004, found that not only were there difficulties with the high initial financial costs high but that there were also initial high physician time costs while financial payoffs were slow and uncertain. In addition to these initial software and hardware costs, there is the ongoing expense of training, upgrades, and support (Benson K, 2006). Nationally, recent estimates conclude that as a whole, the nation could save up to $81 billion annually in health care costs if EHR adoption reached 90% coming from both efficiency savings, safety savings, and health savings from improved preventive and chronic care (Hillestead, 2006; see Figure 4). In another study, Miller et al examined solo or small group practices (the situation for many child health providers),and found that initial costs averaged just under $44,000 for each billing provider FTE and included primarily software training and installation, hardware, lost

revenue due to initial lost productivity. Ongoing costs were much less, averaging about $8,400 per year per physician FTE. The financial benefits to the practice averaged $33,000 annually per billing provider FTE, demonstrating a positive return on investment (ROI) after the second year. This ROI came from two main sources: increased coding levels, and efficiency-related savings or revenue gains. In fact, increased coding levels accounted for more than half of financial benefits.

Figure 4

EXHIBIT 6
Net Potential Savings (Efficiency Benefits Over Adoption Costs) For Hospital And Physician Electronic Medical Record (EMR) Systems Adoption During A Fifteen-Year Adoption Period (2004–2018)



SOURCE: F. Girosi et al., *Extrapolating Evidence of Health Information Technology Savings and Costs* (Santa Monica, Calif.: RAND, 2005), sec. 4.2.3.

The lack of resources for capital investment in EHR systems is amplified for most CHPs, in part, because of a disproportionate number of children who receive health care services funded through Medicaid. The traditionally low reimbursement rates for Medicaid as compared to private insurance limits the amount of flexible funds that can be used to purchase EHR systems. Findings from the Florida physician survey found that among CHPs, the larger the proportion of patients in a practice funded through Medicaid, the less likely the provider was to use an EHR system (Menachemi, et al, 2006). Small practices and those in rural regions have additional financing issues (AHRQ, 2006; Gans, Kralewski, Hammons & Dowd, 2005; Kemper, Uren & Clark, 2006; Menachemi, 2006; Miller & Sim, 2006). These differences are not consistent across all CHPs with pediatric specialists and family physicians adopting HIT faster than general pediatricians. Similar patterns can be seen at the hospital-level, where public hospitals are likely to require special considerations and targeted funding to keep pace with the rest of the industry in regard to HIT adoption (Moylan, Sickler, Carrier & Cromwell, 2006).

In addition to the general issue of the expense to start-up and ongoing maintenance costs, there are other economic issues that also influence the decision to adopt HIT. First, there is a misalignment of the costs and benefits of adopting HIT. The high costs of purchasing the HIT systems generally fall on the physicians and other providers when the anticipated

cost savings gained from improving efficiency is generally realized by funders of health care (Health Policy Institute of Ohio, 2005). This re-alignment of funding can be amplified when focusing on early technology adopters who independently took risks by purchasing first generation EHR systems. As the technology evolves and standards are implemented, these initial systems may need to be updated or replaced. These additional expenses essentially punish innovative providers. Second, an excessive number of companies providing EHR systems increases the risk that a vendor could go out of business or that the software would become obsolete too quickly and leave the provider to expend the funds for a new EHR system all over again (Health Policy Institute of Ohio, 2005). Third, this newness has also not allowed for adequate research regarding demonstrating the returns on investment (AHRQ, 2006).

Barrier #2: Products are not Meeting the Needs of CHPs

A recurring issue spanning the literature, surveys and key informant interviews is that the use of EHR systems is relatively new with much of the software and vendors in an immature stage of evolution and offering systems that do not adequately meeting the needs of providers, especially those serving children (Community Health Center Survey, Kemper, Uren & Clark, 2006, Key Informant Interviews, and Physician Survey). In many instances, software customization is needed for efficient use, clinical decision support is often rudimentary, and simple tasks such as populating forms may not be available without technological enhancements (Benson K, 2006). Multiple key informants reported that after the software has been purchased, a significant amount of additional resources have needed to be spent to customize the software to the individual needs of the health care provider.

Barriers #3: Legal Issues Regarding Assess to Information Especially Adolescent Rights to Privacy

Addressing the legal aspects of personal health information exchange is very complicated, especially since many laws, regulations, and requirements have been developed in a piecemeal fashion across a multitude of states and venues with some addressing all citizens while others target specific populations (i.e., HIV infected, developmentally delayed or mentally ill) (Benson K, 2006; Health Policy Institute of Ohio, 2005). Of particular importance to information sharing are the Health Insurance and Portability and Accountability Act of 1996 (HIPAA) and the Medicare Quality Assurance Program. However, there are also constitutional amendments, federal and state statutes, as well as Board certification, licensure, and accreditation restrictions to information sharing. Some of these laws can take precedent over federal laws while others cannot. These restrictions span across all dimensions of healthcare such as hospitals, physicians, nursing homes, pharmacists and other providers. There are separate laws regarding electronic signatures, record authentication and retention, telemedicine, antitrust pricing protections, fraud and abuse, Starke laws and malpractice ramifications (Health Policy Institute of Ohio, 2005).

Efforts are currently being made to address some of these privacy and security issues. For example, to increase the adoption of electronic prescribing and EHR systems, the federal government has recently broadened exemptions to the physician self-referral law and established two new safe harbors in the federal anti-kickback statues. By removing barriers, these exemptions will allow providers to accept donated e-prescribing and EHR software, information technology and training from entities. Additionally, hospitals and other entities may donate hardware for the sole purposes of electronic prescribing. However, there is a 15% cost share requirement involving donated electronic health record technology (United States Department of Health and Human Services, 2006b; American College of Medical Quality, 2006).

From another viewpoint, paralleling the development of RHIOs has been a shift from a provider-centric focus with restricted access to health information to one of patient-centered empowerment where individuals control access to their own personal data. This shift has created a subsequent need for legislative and policy support for the rights of consumers including affordable, easy, and timely access to their health information (California Health Care Foundation, 2006).

One poorly addressed issue that needs to be resolved during the development of health information networks is that of *contextual access to health information*. Not everyone who is given permission to access an individual's health information needs to view the entire record. Currently, potential employers, life insurers, automobile insurance personal injury claims and a number of other situations can prompt the compelled release of health information. Because most health information is dispersed across a multitude of paper files, it is nearly impossible to develop a comprehensive medical history. However, in the near future, electronic interoperable systems may threaten this protection, because sensitive information such as the occurrence of sexually transmitted diseases, mental illness and HIV infection are intermingled with other, less sensitive information needed by the third party. This concern for release of information has led an estimated one in eight Americans to engage in evasive actions to protect their health privacy, such as seeing other physicians or not seeking care at all, even when those actions may threaten their health status (California Health Care Foundation, 2006; Rothstein & Talbott, 2006).

In regard to children, these release of information issues become even more complex. There are a variety of legal principles and statutes that alter the rights of parents and youth to have access or to restrict access to health care information. For example, personal health information can be release to the state under the doctrine of parens patriae which focuses on the duty of the state to protect public health and welfare (Rosenbaum et al, 2008). This authority is often used to monitor immunization levels in communities and to control communicable diseases. Additionally, the mature minor principle permits courts to allow youth, usually age 16 or over, to choose their own treatment under special circumstances such as for reproductive health matters. Similarly, depending on local laws, emancipated minors such as those who are married, on active military duty, self-supporting, pregnant or a parent or declared judicially emancipated can be recognized as having the right to make independent health care decisions (Maradiegue, 2003 in Rosenbaum, 2006). In addition to minors having autonomous rights to make health care

decisions under specific circumstances, there are also issues involving guardianship, adoption, foster care, as well as abuse and neglect that also prompt the need to share and yet safeguard information.

Although laws currently exist to protect sensitive health information, the systems have not been put in place to protect against accidental disclosure in this new electronic environment. In an effort to address these contextual access issues, the NHIN has recently posed this issue to contractors to incorporate initial system design proposals for the NHIN architecture. The concern is that if it is not incorporated into the initial architecture, it will be too difficult and cost-prohibitive to be incorporated at a later time. Similar efforts should be taking place at the state and local levels as well.

In addition to contextual access issues, there are also provider perceptions regarding the interpretation of privacy and security laws, such as HIPAA, that forbid or disfavor information sharing (Agency for Health Care Administration, 2006e). Provider perception of increased medical malpractice risk such as incorrect information on the record driving a medical error (authentication issues) and the perceived increase in exposure due to easier record access are two examples of provider concerns (Agency for Health Care Administration, 2006).

There are a variety of other privacy and security issues identified through this needs assessment that often have nothing to do with the architecture of the system but rather focus on human involvement with that system. For example, the most noted security issue identified through key informant interviews was the widely reported occurrences of people losing laptops with sensitive data (Key Informant Interviews; RedOrbit, 2006). Additionally, malicious software (spyware, spam, hackers) have increased costs for some large providers by 10-15% in recent years. Concerns were also expressed over the possibility of provider staff releasing personal information out of vengeance or for money. There were concerns regarding the ability to steal servers out of provider offices allowing individuals to access healthcare under another person's identity with the physician potentially being left with the bill. Finally, there are concerns regarding how to address individuals who wish to "opt out" (Pruitt D., 2006).

Other Barriers Identified

In addition to the three barriers rated as the highest priority, there were a number of other issues identified as being barriers to adoption.

Uniform Technology and Data Standards: Although there is an array of technologies available, HIT system development is fragmented and lacks the ability to exchange information in a multi-directional fashion across different software applications (Health Policy Institute of Ohio, 2005; Kemper, Uren & Clark, 2006; Sujansky & Chang). Not only can this lack of interoperability be disruptive for a small practice, it can be very costly for large systems such as regional trauma centers. Three hospital representatives indicated their respective systems included hundreds of software applications, many of whom have been very difficult to integrate so data can be shared from emergency

responders through the labs and radiology services ending in the patients' EHR systems. It was also reported that over one hundred staff per system were designated to maintaining their HIT and telecommunication systems. When probed further, informants indicated resistance by vendors and other stakeholders to provide interoperability functions in the software applications (AHCA, 2006; Key Informant Interviews). One respondent indicated that some of these software applications already have the ability to be interoperable but that users would have to pay extra for that feature to be activated.

From a longitudinal perspective, not all functionalities can be realized simultaneously. Rather, there is a hierarchical structure to HIT development. For example, CPOE cannot occur until labs and service providers are linked. Similarly, PHRs cannot be successful until provider-level EHRs can exchange data. The primary focus of this report is on promoting EHR use and health information exchange which becomes the foundation for the other functionalities. One key informant indicated that national and state mandates to implement specific functionalities out of this hierarchical order had previously created problems within an agency's long-term HIT planning. This caused projects needing attention to be postponed.

Physician Resistance: For many physicians, there is resistance to implementing an EHR system (Health Policy Institute of Ohio, 2005; Kemper, Uren & Clark, 2006). Some of this resistance is due to real or perceived legal (privacy and security) issues, the high cost, concern regarding decreased workflow and disruption in the office, a lack of technical skills, and some is based on philosophical opposition. There was also the concern that introducing HIT into the examination room would decrease the level of interaction between the patient and the provider (Huchinson & DeLorimier, 2006; Key Informant Interviews, 2006). Many of these concerns are valid and need to be acknowledged and/or addressed. Otherwise, physician resistance ("Rebellion") could derail the process (AHRQ, 2006). This variety of issues may be better addressed using an individualized approach to HIT promotion rather than a one-size-fits-all approach (McAlearney AS & Chisolm D, 2006).

Return on Investment Versus the Cost of Not Doing Investing in HIT

Given the relative newness of the HIT field, there is limited knowledge regarding the real and perceived cost/benefit balance and its subsequent impact (Agency for Health Care Administration, 2006). As mentioned earlier, the expense of purchasing and maintaining and EHR is prohibitive for many provider offices. Additionally, the initial and ongoing training of staff is costly both for attending the training and the loss of staff time from office duties. There are also indirect costs that place a burden on the provider office and should be considered when planning to implement an EHR system. For example, transition requires workflow changes which, in the short-term, decreases productivity and reducing revenue for the provider (Hackbarth G and Milgate K, 2005). Due to the burdensome costs and limited resources currently available for purchasing technologies such as EHR systems, attention should also be focused on the non-financial incentives such as patient satisfaction and cost savings that can be realized by providers from adopting HIT. For example, HIT can help reduce the number of rejected insurance claims, increase billable services per child because of improved documentation, and

decrease time needed for specific tasks (i.e., email versus calling nurse, transcriptionist time).

Workflow Issues

There is physician concern regarding the drop in workflow during implementation of an EHR system (AHRQ, 2006). This transition period can dramatically decrease productivity because of the doubling of efforts by having paper and electronic records to maintain during the conversion to electronic records (Agency for Health Care Administration, 2006). For example, one key informant with a multi-office practice indicated that only one office at a time was converted because workflow dropped to approximately 30% of normal capacity during the transition. It was also reported that it took three to four months to build the service levels back up. The other clinics were able to absorb the additional patient load during this time. This drop in workflow not only reduces income, but can cause patients and their parents to develop negative feelings about the provider for not being able to see them in a timely manner either by not being able to get appointments or having to wait for long periods of time beyond scheduled appointments. Office staff can also become frustrated from the slow-down and can lead to staff resignations (Hackbarth G and Milgate K, 2005; Key Informant Interview, 2006). This loss of staff then creates addition costs from recruiting and training new staff.

Some of the concern over workflow issues is directly related to the transition from paper to electronic records. However, some concerns are related more to the inter-relationships between human roles, workflow, and technology infrastructure create a type of eco-system. Imbalances in this system can increase the likelihood for medical errors. As a result, changing one of the factors elicits the need to make corresponding adjustments in other factors. Integrating changes slowly and in an iterative fashion will help maintain a balance in the system during the implementation of new technologies (Stead, 2006). To address the organizational and clinical process change is required among provider offices. The Eighth Scope of work provides funding to quality improvement organizations through the Centers for Medicare and Medical Service (CMS) to provide technical assistance for provider practices (Health Policy Institute of Ohio, 2005).

Another issue that concerns providers is that HIT workflow changes often shift more on to the doctors, at least in the short-term. This shift in workflow is especially significant to those providers that are less computer literate. Over time, this issue should dissipate as the next generation of health care providers enters the workforce. New providers are being trained in more technologically progressive and diverse environments, increasing the expectation for the technology will come too.

Technical/Computer Skills

The adoption of HIT has strong associations with human factors which are impacted by product usability, process complexity, and user engagement methods (Doebbeling et al, 2006). There is a lack of computer literacy among all types of staff in the health care field including insufficient numbers of well trained clinical informatics personnel in the workforce. (AHRQ, 2006). Additionally, many providers (doctors, nurses, office staff), especially ones that have been practicing for a number of years may not have developed a

strong conceptual understanding of how computers function (i.e., if you hit the wrong button will all the data disappear forever?) and have limited proficiency in their use. Similar literacy issues are faced by patients.

Compounding these literacy issues is the power of the EHR systems to provide a wide variety of functionalities. Key informants reported that when software vendors demonstrated their products, the variety of functions was overwhelming to some staff, creating anxiety and a desire to "shut down". However, when functionalities were introduced a few at a time it gave staff time to develop skills in those functions before more were introduced. Staggered implementation approaches usually began with administrative functions that could offer identifiable time savings to users (California Health Care Foundation, 2006c). Once these systems were mastered, additional patient safety and quality functions were introduced. This transitional process lowered staff's anxiety and increased their receptiveness to the technology because they could see the benefits to electronic media (Key Informant Interviews). One report indicated it can take years for a provider to fully integrate all the EHR system functionalities into the daily office work.

Not only does the amount of information presented at any one time impact user perceptions and skills development, so too does the instructional approach taken. If users are taught computer skills at a basic level where they learn to "hit button one then two and three" rather than why they are making those entries, software updates such as moving a button from the top of a page to the bottom can disorient users. Additionally, staff may move from one provider to another and many providers having privileges in multiple hospitals, each using different software adds an additional level of complexity for the provider to successfully utilize an EHR.

Pilot testing, such as observation of users' interactions with the application, is a way to help ensure that the products meet the needs of the intended users. Unfortunately, this process of validating the technology is often left out of the equation leading to applications that are less efficient, difficult to use and do not meet the specific needs of users.

Consumer Trust and Acceptance

To stimulate efforts to improve care, there is a need to promote use of health information by consumers. In general, patients are accepting of HIT for use with their health care providers to improve care (California Health Care Foundation, 2006; Neville, Green & Lewis, 2006). However, there are still concerns over the lack of control consumers have over the privacy and security of their data in such an open system. Some of these concerns result from a lack of involvement by consumers in the planning and discussion phases of project development. In the current paper systems, patients can find it difficult to even access their own medical records. This limited access is due in part because of concern expressed by some providers that patients cannot interpret data without the physician to explain results (Physician Survey, 2006). Other providers felt the data provided opportunity for discussion (Key Informant Interview, 2006).

It has long been recognized that including patients in the design is a critical component to designing a system that meets their needs. This consumer involvement in the development of the HIT infrastructure is outlined in the ONCHIT goals (Office of National Coordinator for Health Information Technology, 2006). These needs can be explicit, identified through surveying and interviewing people. Consumer needs can also be understood by observation. Furthermore, latent needs can be identified by making something for people to test and finding out what does or does not work (Salter C, 2006). Consumers should be provided with education, transparency and usability (Office of Disease Prevention and Health Promotion, 2006). Finally, broad acceptance by consumers requires attention to the diversity of intended users.

Finding 3: The use of HIT, especially EHR, will benefit children and CHPs as much *or more* as any other populations or provider.

Patient Quality and Safety

In the exploration of approaches to improving quality of care, studies are beginning to show that the use of information technology in the healthcare arena can improve patient safety and quality by allowing for a more comprehensive medical record to drive informed decisions, reducing medical errors and reducing duplication of services due to inaccessibility issues (Adams, Mann & Bauchner, 2003; California Health Care Foundation, 2006; Jha, et al, 2006; Leape and Berwick, 2005).

Children present unique challenges when studying quality and safety (Forrest et al, 1997) which often leads to their exclusion from studies. Indeed, the landmark IOM report on patient safety noted above contained fewer than a half dozen citations that were specific to children. What we do know about the quality and safety of care, including hospital care, for children is concerning (Leatherman & McCarthy, 2004; Perrin & Bloom, 2004). When errors do occur their impact may be greater due to the different physiologic capability of the child, particular infants, to buffer the insult (Kaushal et al 2001). Recently, five review articles based on a conference in 2003 brought together what we know about pediatric patient safety across sectors (including ambulatory, emergency department and inpatient settings) and articulated a comprehensive research agenda for the future (Miller et al, 2004; Chamberlain et al, 2004; Johnson & Davison, 2004; Kaushal et al, 2004). One conclusion from this set of articles is that we know far too little about the likely impact of information technology adoption on pediatric patient safety. Because of numerous differences between adult and pediatric services themselves as well as specific issues with pediatric IT applications, one cannot assume that a high degree of hospital IT investments will naturally translate into similar levels of benefit for adult and pediatric patients.

More recently, studies are beginning to show not only the beneficial impact of HIT on quality and safety of care for children, but also its potential for eliminating disparities in care.

Practice Efficiency and Profitability

It is believed that health information technology (HIT) improves the efficiency and effectiveness of health care by reducing the duplication of services and providing clinical decision support. Based on this assumption, the administrative simplification provisions of the 1996 Health Insurance Portability and Accountability Act (HIPAA**)** require the establishment by DHHS of *national standards* for electronic health care transactions and provider, health plan, and employer *national identifiers* (Centers for Medicare and Medicaid Services, 2006).

As noted earlier, the high proportions of children who receive health care through Medicaid and the relatively low reimbursement rates paid by Medicaid are a barrier. As a result of these narrow profit margins most pediatricians, practices need to see a high number of patients to maintain profitability making efficiency key to the survival of a practice. Therefore, any changes to the workflow of the office that reduces efficiency can have detrimental and even catastrophic financial consequences, at least in the short term.

Finding 4: Children's health care offers some opportunities for future efforts to promote HIT

Parents are Younger and More Computer Literate

Another non-financial incentive may be the patients and their families. The parents of pediatric patients tend to be younger and more computer literate than other medical practices. Key informants reported that parents were interested in the use of technology for their child's health care. This interest can be leveraged as an incentive to providers such as through the use of a website to disseminate the required forms parents must complete, scheduling appointments, and providing resources for frequently asked questions.

The Ambulatory Setting is the Next Software Market

The market of hospitals and other large health care providers is nearly saturated with most having an EHR or planning to implement one in the near future. Therefore, software vendors are beginning to recognize that smaller providers are the next market segment to be targeted. This increased focus opens up opportunities to request enhancements to the software so that it better meets the needs of providers.

Finding 5: The State of Florida, as a major payer of care for children in Florida, has the opportunity to accelerate the adoption of HIT to promote the safety, quality and efficiency of care for children in the State.

The state of Florida, similarly to most other states, has a major stake in children's health care. As a funder of health care through its Medicaid, SCHIP and state employee programs, the state of Florida has the opportunity to leverage its resources in such as way that promotes HIT adoption. In 2005, nearly one half million (441,190) emergency department visits were made by Medicaid-funded children. There were also 212,603 newborn hospitalizations as well as 175,558 child and youth hospitalizations, half being

funded by Medicaid, with a combined cost of more than 4 billion dollars. Additionally, 5,960 more children were served through the military's CHAMPUS health care programs costing an additional 61 million dollars during the same year. Given these expenses, even small improvements in health care (i.e., decreases in hospitalizations) or increases in efficiencies can result in significant savings to the state.

Recommendations

Overall, a concerted effort should be made on the part of public and private entities to spur the adoption of EHRs by child health providers, particularly pediatricians

Recommendation 1: Public and Private Sectors Should Explore Innovative Financing Strategies to Spur Adoption.

One thing is clear from our, and others' research on adoption among child health providers: financial barriers are significant. Thus financial incentives, or at least efforts to mitigate the financial risks of purchasing an EHR system, should be explored. These incentives need to help providers cover especially the costs of initial adoption (Health Policy Institute of Ohio, 2005).

One possible avenue is the growing attention to pay for performance programs in general and the extent to which their varied types could be applied fruitfully to the promoting HIT. Pay-for-performance programs are one way to improve quality, control costs, and provide value for dollars spent (Centers for Medicare and Medicaid Services, 2006). In general, PFP programs have used at least four types of performance requirements: pay for participation, pay for process, pay for improvement, and pay for outcomes. A recent survey found that, as of July 1, 2006, more than half of all state Medicaid programs were operating one or more pay-for-performance programs, and that in five years nearly 85 percent of state Medicaid programs plan to have such programs (Kurkmeyer & Hartman, 2007). Further impetus for this approach comes from Secretary Leavitt's initiative to promote value-driven health care. The four cornerstones of this initiative are health information standards, quality standards, price standards, and incentives. To date, 12 states have signed the statement of support for this initiative and "commit to support the following actions and will encourage the health insurance plans, third-party administrators, providers, and others with which we contract to take consistent actions to achieve these goals."

Evidence on the effectiveness and impact of pay-for-performance (P4P) programs is only now beginning to emerge, and is conflicting at best. Most published evaluations have not focused specifically on care for children, let alone publicly insured children (Freed & Uren, 2006). In addition, incentive programs for hospital care for Medicaid-enrolled children pose special challenges, given that regional pediatric inpatient centers often serve children under multiple state Medicaid programs and Medicaid reimbursement for hospital care in most states is substantially below cost. Despite the lack of evidence, pay-for-performance is now emerging in Medicaid programs, including in Michigan and New York, at the health plan level, individual provider level, and even at the beneficiary level.

Past efforts have focused on incentives to health plans; however, there is growing interest in physician incentives, and increasingly on HIT. In theory, PFP programs contingent on quality performance can promote HIT adoption because they can increase the use of electronic clinical data, point of care technology, as well as generation of more actionable reports for quality improvement (Williams TR, Raube K, Damberg CL, and Mardon RE, YEAR).

This growth may be happening too fast, not allowing a sufficient iterative process of letting research guide best practices. For example, some incentives are directly tied to purchasing and using HIT. However, many of these programs focus on outcome measures with the assumption that HIT would need to be used to track outcomes. A study of physicians in Florida found that although these programs may help to promote standards of care, only explicit incentives for the use of HIT were associated with increased rates of adoption (Shellhorn, Menachemi, Brooks & Simpson, 2006). Furthermore, a recent IOM report indicates that without a universal set of performance measures, tools and procedures, pay for performance programs are not going to have broad success (DoBias M, 2005). Additionally, many pay for performance programs offer insufficient incentive (1%-10% of income) to drive behavioral change.

Malpractice benefit (FL 1990 Worker's Compensation Law – Jay): The use of HIT such as an EHR can reduce the number of malpractice claims by preventing some medical errors from occurring. It can also offering legible, easily transferable documentation that can be used by doctors during malpractice investigations. This reduces administrative costs for copying records, staff time to read casenotes, and provides clear case notes from which clinical review can occur. Because of the great potential cost savings in this arena, it is recommended that malpractice insurance could be lowered for providers using an EHR.

Subsidized Loans: Providing opportunities for providers to receive subsidized loans that are either interest-free or have low interest rates can help to overcome the large financial barriers they face.

Per Member Per Month Funds: The provision by payers in the public or private sectors of at least a temporary per member per month stipend could help to offset the costs of the transition to an EHR.

Transition Grants: A variety of grants could be made available to cover training costs, health plan or M/A pool of trainers. For example, grant opportunities or other one time funding sources targeted specifically at early adopters for EHR system upgrades would reward innovators. Alternatively, provider subsidies during the three to six month transition period may be an effective tool to help to offset the loss in productivity inherent in adoption.

Recommendation 2: A number of non monetary incentives could accelerate adoption

Two areas are particularly worthy of attention: the role of public programs such as Medicaid, SCHIP and the Department of Defense; and the role of professional regulatory and licensing requirements.

Like other insurers, Medicaid and SCHIP's management information technology systems have historically focused more on claims management rather than on facilitating the sharing and use of health information to promote better quality of care and improved patient health. SCHIP and Medicaid could play a much stronger role in promoting the diffusion and adoption of child health information systems. The SCHIP reauthorization which has been twice vetoed by the President contains important provisions for demonstrations in EHRs for children and the role of HIT application in promoting care for chronic illnesses. However, there is much more that currently could be done under existing regulation at both the Federal and State levels that would advance HIT applications for promoting children's health and development. The Centers for Medicare & Medicaid Services (CMS) and states have developed the Medicaid Information Technology Architecture (MITA) framework, an initiative to provide a technological framework to facilitate and guide investments in new, interoperable and more integrated and sophisticated approaches to Medicaid information technology. CMS's authority to provide enhanced matching funds within Medicaid for HIT investments (90/10 for development and 75/25 for maintenance) applies to a full range of HIT approaches, including electronic health records, personal health records, health information exchange, and patient registries.

At the state level, successful experiences with patient registries and improved Medicaid Management Information Systems (MMIS) could be replicated and expanded to most or all states. Existing payment rules could be modified to make clinical HIT investments an allowable cost in capital investment for certain providers, enabling providers to receive enhanced payments in proportion to their Medicaid patient mix (Alfreds et al, 2006). States could sponsor the development of electronic health records that meet the needs of Medicaid children , an approach that Tennessee has adopted in partnership with the state's Blue Cross Blue Shield plan (Shared Health, 2007). In addition, states could share clinically relevant information from claims data for Medicaid patients at the point of care (Alfreds et al, 2006). Additionally, financial preference for state funding for HIT could be given to rural, low-income providers and other providers who serve vulnerable populations. Finally, states could use managed care contracts to require further efforts to encourage the use of HIT. CMS could support all of these state efforts by providing explicit guidance about allowable and preferred strategies.

For Medicaid, SCHIP, other state programs and private purchasers, it will also be important to validate the costs and ultimate ROI (return on investment) from HIT in child populations.

Another Federal program with significant presence in the Florida community is the various military bases and installations and the large number of military dependent children served in the state. Thus, a concrete collaboration with the Department of Defense to enhance the use and capabilities of the AHLTA system, especially for the children and families of

dependents who may be receiving health care services outside of the military health care system (i.e., school nurses).

Another strategy to be considered would be to provide clear guidance to existing RHIOs in the state of Florida as to the need to include child health providers in their efforts. This guidance could be linked to some incentive or preference in the nature and level of state support.

Finally, the other non-financial worthy of consideration is the degree to which state licensing requirement and/or professional board certifications can help spur adoption. For example, specific content CME requirements for licensing in Florida could extend beyond patient safety, domestic violence and HIV to include didactic content around the role of HIT in improving quality and safety. Perhaps more likely to have an impact (given the limited impact of CME overall) is the move of professional boards toward including demonstrated quality improvement activity as part of re-certification. The American Board of Pediatrics now requires this, called Part IV, and the ability to measure performance and report on practice data will be increasingly important to practitioners.

Recommendation 3: A concerted effort at both the State and national levels is needed to promote the development and adoption of standards which are child sensitive.

Significant activity is underway nationally to move toward this goal, however states like Florida are also moving and developing minimum data standards for the health information exchange activities, such as those developed by the FHIN. Continued involvement of child health experts in broader HIT initiatives will continue to be important. In addition, coordination of efforts with the Florida Department of Health's many programs serving children would be critical. These include the Title V programs, the newborn screening programs, the immunization programs, and many others.

Recommendation 4: Substantial provider and practice education, training and technical assistance is needed.

Through the Medicare program, the Department of Health and Human Services has made a major investment in promoting the use of HIT in doctors' offices. The Doctors Office Quality – HIT (DOQ-IT) is a program implemented through state quality improvement organizations to promote the greater availability of high quality affordable health information technology by providing assistance to physician offices in adopting and using such technology. This is a multi-million dollar investment in Florida alone. No such comparable investment in provider technical assistance, education or training exists for child health providers. Yet, it would seem reasonable to propose that this type of activity, targeted to licensed health professionals in the state to improve the quality of services provided to Medicaid beneficiaries, would be eligible for Federal match at the enhanced rate of 75% for this type of training and education.

FMQAI, the Florida Medical Quality Improvement Organization has the led the way in Florida in these activities and now offers a "DOQ-IT University" which is a "compilation

of interactive, web-based learning modules designed to guide quality improvement organizations (QIOs) and physician practices through the phases of IT adoption (assessment, planning, implementation, evaluation/improvement and care management) (FMQAI, 2007).

Florida could also leverage the activities of the American Academy of Pediatrics (AAP) in showcasing HIT at their annual meetings. In an effort to improve the applicability of EHR systems to the pediatric population issues, the AAP's Council on Clinical Information Technology (COCIT) and the Medical Records Institute sponsor competitions for software developers to participate including the Pediatric Documentation Challenge and the Pediatric EHR Award Program (Schneider JH & Marcus, E, 2006). This competition provides scenarios of complex medical cases and the software developers must illustrate how their product would handle the case. This competition helps to raise awareness among software developers of the unique issues facing children, especially those having complex medical and social conditions (Schneider & Marcus, 2006). In May, 2006, nine pediatric EHR systems participated in the second Documentation Challenge and third Pediatric EHR Award process. EClinicalWorks was the 2006 winner with Office Practicum placing in second (and was first in 2005). A similar forum could be sponsored in Florida. In addition, online information and technical assistance could be provided. This should be linked to the availability of CME/CEU and other professional development opportunities for providers to build their technology knowledge and skills and increase the likelihood of participation.

Additional ideas include:

- Help providers select EHR systems that suit their needs by providing a checklist of functionalities that should be included in an EHR system under consideration for purchase. Establish a list of recommended software applications based on a defined set of functionalities or at least disseminate out to physicians a list of functionalities they should look for when shopping for an EHR system
- Sponsor unbiased vendor fairs to demonstrate functionalities/software available;
- Core curriculum for practice staff at community colleges, with the award of certificates in medical office HIT;
- Information and programs for physicians on the actual costs and benefits, the eventual savings and sources of savings

Recommendation 5: Consumers can and should help drive the adoption of HER, PHR and other HIT applications

In many other areas of health care, we expect consumers to drive improvements through more active involvement in decisions about their health care. Conducting broad based consumer – and in this case, parent education – about the benefits of HIT including the benefits of electronic health information to their health and the quality and safety of their

care, to their ability to manage their, and their child's healthcare, and to their decision-making skills. To do this well would require an initial investment in research to better understand Florida consumers' current understanding of HIT and their hopes and fears. Several national survey exist that could serve as models for such an effort. .

Recommendation 6: Remaining gaps in our knowledge of the impact of EHR must be addressed.

Despite the impressive growth in research on HIT in health care, many questions remain unanswered, especially for child health providers. Here are several identified by the committee and in the research leading up to this report.

- Understanding the benefits to the health and health care for children. This should include robust evaluations in demonstrations of particular applications, e.g.:
    - What would be the impact in 5 years of providing every newborn in the state with a personal health record (PHR)?
    - What if every chronically ill child served by Medicaid or Title V were provided a PHR to assist their parents in self-management?
    - Could all the pediatric hospitals in Florida collaborate to develop a shared HER platform and make it available to practicing physicians?
- Focus on the return on investment (ROI) and the business case for adoption among child health providers. In particular, identify the nature, scope and magnitude of savings, including
    - Identify what savings represent "low-hanging fruit"
    - Due to the limited resources currently available for purchasing technologies such as EHR systems, attention should also be focused on the non-financial incentives such as patient satisfaction and cost savings that can be realized by providers from adopting HIT. For example, HIT can help reduce the number of rejected insurance claims, increase billable services per child because of improved documentation, and decrease time needed for specific tasks (i.e., email versus calling nurse, transcriptionist time).
- Research on the adoption process itself and strategies to minimize workflow disruptions and practice income reductions.
- The impact of HIT on physician liability and malpractice risk, e.g. whether more research on the impact of HIT on safety could lead to physician malpractice rebates.

"Embrace the change. View it as a challenge"

Glossary of Selected Health Information Technology Terms

Prepared with the assistance of the Pinellas County Health Department

ANSI – American National Standards Institute - The U.S. standards organization that establishes procedures for the development and coordination of voluntary American National Standards.

ASTM International – American Society for Testing and Materials – was formed over a century ago, when a forward-thinking group of engineers and scientists got together to address frequent rail breaks in the burgeoning railroad industry. Total, standards developed at ASTM are the work of over 30,000 ASTM members. These technical experts represent producers, users, consumers, government and academia from over 100 countries. Participation in ASTM International is open to all with a material interest, anywhere in the world. http://www.astm.org/

CCR – Continuity of Care Record. A standard specification being developed jointly by ASTM International, the Massachusetts Medical Society (MMS), the Health Information Management and Systems Society (HIMSS), the American Academy of Family Physicians (AAFP), and the American Academy of Pediatrics. It is intended to foster and improve continuity of patient care, to reduce medical errors, and to assure at least a minimum standard of health information transportability when a patient is referred or transferred to, or is otherwise seen by, another provider. The origins of the CCR stem from a Massachusetts Department of Public Health, three-page, NCR paper-based Patient Care Referral Form that has been in widespread use for many years in Massachusetts, and from other minimal data sets both electronic and paper-based. The CCR is being developed and enhanced in response to the need to organize a set of basic patient information consisting of the most relevant and timely facts about a patient's condition. Briefly, these include diagnoses, recent procedures, allergies, medications, recent care provided, as well as recommendations for future care (care plan) and the reason for referral or transfer. The CCR will be created by a healthcare provider/clinician at the end of an encounter, or at the end of an episode of care, such as a hospital or rehabilitation stay. http://www.massmed.org/pages/ccrfaq.asp

CHI -- Consolidated Health Informatics Initiative – One of the 24 Presidential eGovernment initiatives with the goal of adopting vocabulary and messaging standards to facilitate communication of clinical information across the federal health enterprise. CHI now falls under FHA.

CPOE -- Computerized Provider Order Entry– A computer application that allows a physician's orders for diagnostic and treatment services (such as medications, laboratory, and other tests) to be entered electronically instead of being recorded on order sheets or prescription pads. The computer compares the order against standards for dosing, checks for allergies or interactions with other medications, and warns the physician about potential problems.

Document Consumer – the vendor who receives information, views the document; imports and stores the document for later viewing; and imports specific patient information, such as test results or medication lists. (Senders are dubbed "Document Sources.")

DSS – Decision Support System -- Computer tools or applications to assist physicians in clinical decisions by providing evidence-based knowledge in the context of patient specific data. Examples include drug interaction alerts at the time medication is prescribed and reminders for specific guideline-based interventions during the care of patients with chronic disease. Information is presented in a patient-centric view of individual care and also in a population or aggregate view to support population management and quality improvement.

DXG – Data eXchange Gateway (a web service). A PinRHIO adopted term to used for the web service, software and hardware infastructure required to support the exchange of data between and among the PinRHIO HIE participants.

EHCR – 5 levels of an Electronic HealthCare Record (EHCR):

- The Automated Medical Record (AMR) is a paper-based record with some computer-generated documents.
- The Computerized Medical Record (CMR) makes the documents of level 1 electronically available.
- The Electronic Medical Record (EMR) restructures and optimizes the documents of the previous levels ensuring inter-operability of all documentation systems.
- The Electronic Patient Record (EPR) is a patient-centered record with information from multiple institutions.
- The Electronic Health Record (EHR) adds general health-related information to the EPR that is not necessarily related to a disease.

[New Definition]EHR – Electronic Health Record – A real time patient health record with access to evidence-based decision support tools that can be used to aid clinicians in decision making. An EHR is a medical record or any other information relating to the past, present or future physical and mental health, or condition of a patient which resides in computers which capture, transmit, receive, store, retrieve, link, and manipulate multimedia data for the primary purpose of providing health care and health-related services. The EHR can also support the collection of data for uses other than clinical care, such as billing, quality management, outcome reporting, and public health disease surveillance and reporting. EHR records include patient demographics, progress notes, SOAP notes, problems, medications, and vital signs, past medical history, immunizations, laboratory data and radiology reports.

EMR – Electronic Medical Record -- A computer-based patient medical record. An EMR facilitates access of patient data by clinical staff at any given location; accurate and complete claims processing by insurance companies; building automated checks for drug and allergy interactions; clinical notes; prescriptions; scheduling; sending to and viewing

by labs; The term has become expanded to include systems which keep track of other relevant medical information. The practice management system is the medical office functions, which support and surround the electronic medical record.

eRx -- Electronic Prescribing – A type of computer technology whereby physicians use handheld or personal computer devices to review drug and formulary coverage and to transmit prescriptions to a printer or to a local pharmacy. E-prescribing software can be integrated into existing clinical information systems to allow physician access to patient specific information to screen for drug interactions and allergies.

FHA -- Federal Health Architecture – A collaborative body composed of several Federal departments and agencies, including the Department of Health and Human Services (HHS), the Department of Homeland Security (DHS), the Department of Veterans Affairs (VA), the Environmental Protection Agency (EPA), the United States Department of Agriculture (USDA), the Department of Defense (DOD), and the Department of Energy (DOE). FHA provides a framework for linking health business processes to technology solutions and standards, and for demonstrating how these solutions achieve improved health performance outcomes.

FHIN -- The Florida Health Information Network -- An integrated information system that will connect Florida's healthcare stakeholders. This secure network will make available to authorized parties the medical information they need to make sound decisions about healthcare, regardless of where that information is stored, and where or when it is needed. Computerized "decision support" programs will automatically analyze all available health information and complement the data available through FHIN with clinical logic and practice guidelines. Decision support will assist both consumers and providers in making personal and clinical decisions based on sound medical science. Providers will be liberated from a practice model based on their capacity to memorize a multitude of potentially relevant facts and recall them all during the encounter; rather, they will focus more on the patient and the science and art of healing. The healthcare system supported by FHIN will be centered on the consumer, empowering the public to direct their healthcare using readily available comprehensive information about their health, and transparent information about the advisability of competing healthcare choices that they face. Public health officials will be empowered to detect, monitor and deal with emerging health threats more efficiently. The time it takes to bring medical discoveries from the laboratory bench to the hospital bedside will be slashed.

GHIIAB -- Governor's Health Information Infrastructure Advisory Board. On May 4, 2004, Florida Governor Jeb Bush created this Board to advise the Agency for Health Care Administration (AHCA) as it develops and implements a strategy for the adoption and use of EHRs. Since the appointment of Board members in June, the Board has actively sought to educate itself and the Agency through workshops and public forums. The Board has facilitated an intensive planning process and provided an opportunity for physicians, nurses, pharmacists, dentists, hospital administrators, health insurers, community groups, and many others to contribute their expertise. The First Report to the Governor describes the Board's initial findings and recommendations. The Advisory

Board (see table below) consists of 12 members including representatives of the provider community, IT experts and health care policy experts.

W. Michael Heekin Michael.Heekin@myflorida.com	
GHIMembers	
Carmen Aceves-Blumenthal	Pharmacist with McKesson Medication Management
Robert G. Brooks, MD	FSU College of Medicine
Ronald R. Burns, DO	Florida Osteopathic Medical Association
Raymond F. Caron, MD	Pediatrician
Brian O. Coleman, DMD	Omega Dental Group
Jeannette W. Ekh	Blue Cross Blue Shield of Florida
Peter D. Greaves	HCA, Inc.
Kevin S. Kearns	Health Choice Network
Rhonda M. Medows, MD	Physician
Linda E. Moody, PhD	University of South Florida
James S. "Sandy" Phillips	Jackson Health System
Robert G. Reese	South Broward Hospital District

HIE – Health Information Exchange is a term commonly used to describe a RHIO. The notion of HIE is the precursor to RHIO and is used interchangeably when discussing RHIOs.

HIT -- Health Information Technology – The application of information processing involving both computer hardware and software that deals with the storage, retrieval, sharing, and use of health care information, data, and knowledge for communication and decision-making.

HTTP – HyperText Transfer Protocol. The Hypertext Transfer Protocol (HTTP) is the set of rules for exchanging files (text, graphic images, sound, video, and other multimedia files) on the World Wide Web. Relative to the TCP/IP suite of protocols (which are the basis for information exchange on the Internet), HTTP is an application protocol.

Informatics or Information Science -- the study of information. It is often, though not exclusively, studied as a branch of Computer Science and Information Technology (IT) and is related to database, ontology and software engineering. Informatics is primarily concerned with the structure, creation, management, storage, retrieval, dissemination and transfer of information. Informatics also includes studying the application of information in organizations, on its usage and the interaction between people, organizations and information systems.

Interoperability – is the ability of a system or a product to work with other systems or products without special effort on the part of the customer.

Kerberos - a computer network authentication protocol, which allows individuals communicating over an insecure network to prove their identity to one another in a secure manner.

LHII – Local Health Information Infrastructure is a term used synonymously with RHIO. LHII was originally termed by the Office of the National Coordinator of Health Information Technology (ONCHIT) to describe the regional efforts that will eventually be linked together to form NHII (National Health Information Infrastructure).

NHII – National Health Information Infrastructure is often used synonymously with NHIN. NHII came before NHIN and is an acronym that encompasses all of the necessary components needed to make EHRs interoperable. NHIN, as the name suggests, refers to both the physical and national network needed for interoperability to occur.

NHIN – National Health Information Network -- describes the technologies, standards, laws, policies, programs and practices that enable health information to be shared among health decision makers, including consumers and patients, to promote improvements in health and healthcare. The development of a vision for the NHIN began more than a decade ago with publication of an Institute of Medicine report, "The Computer-Based Patient Record." The path to a national network of healthcare information is through the successful establishment of RHIO.

PHIT – Personal Health Information Technology -- PHIT enables the documentation of an individual's complete, lifelong health and medical history into a private, secure and standardized format that he or she owns and controls, but yet is accessible to legitimate providers day or night from any location.

PHR -- Personal Health Record -- a collection of important information about your health or the health of someone you're caring for, such as a parent or a child that you actively maintain and update. This may include:

- Personal identification, including name, birth date, and social security number
- People to contact in case of emergency
- Names, addresses, and phone numbers of your physician, dentist, and other specialists
- Health insurance information
- Living wills and advance directives
- Organ donor authorization
- A list and dates of significant illnesses and surgeries
- Current medications and dosages
- Immunizations and their dates
- Allergies
- Important events, dates, and hereditary conditions in your family history
- A recent physical examination

- Opinions of specialists
- Important tests results
- Eye and dental records
- Correspondence between you and your provider(s)
- Permission forms for release of information, operations, and other medical procedures

PinCHD – Pinellas County Health Department.

RHIO – A Regional Health Information Organization is a multi-stakeholder organization that enables the exchange and use of health information, in a secure manner, for the purpose of promoting the improvement of health quality, safety and efficiency. Officials from the U.S. Department of Health and Human Services (HHS) see RHIOs as the building blocks for the National Health Information Network (NHIN). When complete the NHIN will provide universal access to electronic health records.

RLS – Record Locator Service. The RLS holds information authorized by the patient about where authorized information can be found, but not the actual information the records may contain. It thus enables a separation, for reasons of security, privacy, and the preservation of the autonomy of the participating entities, of the function of locating authorized records from the function of transferring them to authorized users.

SAML – Security Assertion Markup Language is an XML standard for exchanging authentication and authorization data between security domains.

SASL – Simple Authentication and Security Layer, a method for adding authentication support to connection-based protocols.

SOA – Service Oriented Architecture - A service-oriented architecture is essentially a collection of services. These services communicate with each other. The communication can involve either simple data passing or it could involve two or more services coordinating some activity. Some means of connecting services to each other is needed, usually a network such as the Internet.

SOAP – Simple Object Access Protocol - a lightweight XML-based messaging protocol used to encode the information in Web service request and response messages before sending them over a network. SOAP messages are independent of any operating system or protocol and may be transported using a variety of Internet protocols, such as HTTP.

SSL – Secure Socket Layer. SSL protects transmissions over the World Wide Web from spectators by encrypting the data while it gets transmitted over the Internet. SSL works through a certificate that authenticates a certain domain. With this certificate, secure transmissions on the server are "certified" and valid.

Standards -- Though there are few standards for modern day EMR systems as a whole, there are many standards relating to specific aspects of EHRs/EMRs. These include:

- ASTM CCR -- American Society for Testing and Materials (Non profit), Continuity of Care Record - a patient health summary standard based upon XML, the CCR can be created, read and interpreted by various EHR or EMR systems, allowing easy interoperability between otherwise disparate entities.

- ANSI X12 (also known as EDI – Electronic Data Interchange) – This is a standard format used for transmitting business data, developed by the Data Interchange Standards Association. The parties who exchange EDI transmissions are referred to as trading partners. Data that is transmitted often includes what would usually be contained in a typical business document or form.

- CEN – The European Committee for Standardization, founded in 1961 by the national standard bodies in the European Economic Community. It develops technical standards for many different business domains, including health care.

- CEN EN13606 - A standard being developed by the CEN workgroup TC 251 on EHR Communications. The workgroup is focused on developing standard that include requirements on health information structure to support clinical and administrative procedures, technical methods to support interoperable systems as well as requirements regarding safety, security and quality.

- DICOM (Digital Imaging and Communications in Medicine) - a heavily used standard for representing and communicating radiology images and reporting.

- HL7 -- Health Level 7 – An ANSI standard for healthcare specific data exchange between computer applications. HL7 messages are used for interchange between hospital and physician record systems and between EMR systems and practice management systems; HL7 Clinical Document Architecture (CDA) documents are used to communicate documents such as physician notes and other material.

- ISO TC215 -- The International Organization for Standardization (ISO) is an international standard-setting body composed of representatives from national standards bodies. Founded on February 23, 1947, the organization produces worldwide industrial and commercial standards, including standardization in the field of health information and Health Information and Communications Technology (HICT) to achieve compatibility and interoperability between independent systems. Also, to ensure compatibility of data for comparative statistical purposes (e.g. classifications), and to reduce duplication of effort and redundancies. ISO is not an acronym; it comes from the Greek word isos, meaning "equal".

- Canada Health Infoway -- mandated to accelerate the development and adoption of electronic health information systems in Canada.

- openEHR - public specifications and implementations for EHR systems and communication, based on a complete separation of software and clinical models.

- openEHR Foundation -- a not for profit foundation supporting the open research, development, and implementation of EHRs. Its specifications are based on a combination of 15 years of research into EHRs and new paradigms designed to be the basis of a medico-legally sound, distributed, versioned EHR infrastructure. OpenEHR also develops and publishes EHR specifications and open source EHR implementations, which are currently being used in Australia and parts of Europe.4

- HIMSS -- Healthcare Information and Management Systems Society -- is the healthcare industry's membership organization exclusively focused on providing leadership for the optimal use of healthcare information technology and management systems for the betterment of human health. Founded as a non-profit in 1961 with offices in Chicago, Washington D.C., and other locations across the country, HIMSS represents approximately 17,000 individual members and some 275-member corporations that employ more than 1 million people. HIMSS frames and leads healthcare public policy and industry practices through its advocacy, educational and professional development initiatives designed to promote information and management systems' contributions to ensuring quality patient care.

- XML -- Extensible Markup Language is a general-purpose markup language for creating special-purpose markup languages, capable of describing many different kinds of data. Its primary purpose is to facilitate the sharing of data across different systems, particularly systems connected via the Internet. Languages based on XML (for example, Geography Markup Language (GML), Physical Markup Language (PML) are defined in a formal way, allowing programs to modify and validate documents in these languages without prior knowledge of their form.

UDDI – Universal Description, Discovery and Integration. UDDI is an XML-based registry for businesses worldwide, which enables businesses to list themselves and their services on the Internet.

WSDL – Web Service Description Language. The Web Services Description Language (WSDL) is an XML -based language used to describe the services a business offers and to provide a way for individuals and other businesses to access those services electronically.

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