Using Electronic Health Records and Data Warehouse Collaboratively in Community Health Centers

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EXECUTIVE SUMMARY

The organization Community Partners HealthNet (CPH), Inc. is a so-called Health-Center-Controlled Networks (HCCNs) that provide health information technologies, in particular Electronic Health Records and Data Warehouse, to participating community health centers (CHC) and rural health clinics (RHC). All 16 member organizations (CHCs and RHCs) in CPH are non-profit health care organizations providing primary health care to individuals in medically underserved areas. To provide quality and accessible health care to those medically needed, CPH and member organization rely heavily on funding from federal and state governments as well as charitable foundations. The investment in system-wide Health Information Technologies has been financially limited given the nature of the organizations. CPH and member organizations, through visionary leadership and cost-effective execution, have been able to adopt and implement advanced information technologies like EHR and data warehouse since early 1990s. There has been software updates and EHR upgrades, but the original design of the system still serve the information needs of the organization. This case study describes CPH in the health care environment, discusses the collaboration of six original individual CHCs to create CPH, the EHR and Data Warehouse projects at CPH, and then explains CPH’s on-going operations and new challenges in the context of meaningful use and big data movement.

Keywords: Business Intelligence, Community Health Center (CHC), Data Warehouse, Economy of Scale, Electronic Health Record, Health-Center-Controlled Network (HCNN), Scalable, Succession Planning, Transformational Leadership

DOI: 10.4018/jcit.2013100104
ORGANIZATION BACKGROUND

Community Partners HealthNet, Inc. (CPH) is a non-profit, federally-funded, health-center-controlled network (HCCN) headquartered in Snow Hill, NC, United States. The federal Health Resources and Services Administration (HRSA) defines an HCCN as: “A group of safety-net providers (a minimum of three collaborators/members) collaborating horizontally or vertically to improve access to care, enhance quality of care, and achieve cost efficiencies through the redesign of practices to integrate services, optimize patient outcomes, or negotiate managed care contracts on behalf of the participating members...HCCNs ... exchange information and establish collaborative mechanisms to meet administrative, IT [information technology], and clinical quality objectives” (HRSA, n.d., n.p.). Benefits of being an HCCN include federal financial incentives and favorable status in the awarding of federal grants (HRSA, What are the benefits, n.d.). CPH’s member organizations began with six community health centers (CHCs) in North Carolina. By 2011, it had expanded to include 8 multi-site CHCs (including three of the original members), one FQHC LookAlike, and 7 rural health clinics (RHCs) in Connecticut, Missouri, North Carolina, and Texas (Community Partners HealthNet, n.d.). Together, CPH members provide primary health care services at 41 sites to 118,833 patients each year.

Health Care Environment

CPH’s member organizations are ambulatory “core safety net providers” [also known as “essential community providers” and “providers of last resort” (Lewin & Altman, 2000, p. 54)]. The Institute of Medicine (IOM) has defined “core safety net provider” as a set of

providers that organize and deliver a significant level of health care and other health-related services,... These providers have two distinguishing characteristics: (1) by legal mandate or explicitly adopted mission they maintain an “open door,” offering services to patients regardless of their ability to pay; and (2) a substantial share of their patient mix is uninsured, Medicaid, and other vulnerable patients. (Lewin & Altman, 2000, p. 21)

Examples of core ambulatory safety-net providers are CHCs, RHCs, migrant clinics, free clinics, public health department clinics, and emergency rooms of public and teaching hospitals. They are mostly funded by governments and charitable foundations and are critical to provide needed care to medically uninsured, underinsured, and underserved population.

CHCs and RHCs have a 50-year history in the U.S health care system. Early roots of CHCs were in the Migrant Health Act of 1962 and the Economic Opportunity Act of 1964 (Bureau of Primary Health Care, 2008; Lefkowitz, 2005). These acts provided federal support for medical care delivered in migrant health centers and neighborhood health centers. In the mid-1970s neighborhood health centers became known as CHCs (Bureau of Primary Health Care). RHCs were established under the Rural Health Services Act of 1977 (Office of Rural Health Policy, 2006). In the 1980s and 1990s, Congress expanded the concept of CHCs to cover care provided to homeless people and residents of public housing under the McKinney Homeless Assistance Act of 1987 and the Disadvantaged Minority Health Improvement Act of 1990, respectively (Bureau of Primary Health Care). The Federally Qualified Health Center (FQHC) program is an extension of the migrant and CHC programs. The FQHC program was established under the Omnibus Budget Reconciliation Act (OBRA) of 1989 and expanded under the OBRA of 1990. Under these acts, FQHCs receive specially enhanced Medicare and Medicaid reimbursements (Office of Rural Health Policy). The Health Centers Consolidation Act of 1996 consolidated four federal primary care programs (community, migrant, homeless, and public housing) under section 330 of the Public Health Service Act (Bureau of Primary Health Care).
CHCs are non-profit, patient-governed, and community-directed organizations (North Carolina Community Health Center Association [NCCHCA], 2011). Strategic direction and community oversight are provided by boards of directors in which the majority of the board members receive medical care at the CHC (HRSA, 2011). The purpose of CHCs is to increase access to comprehensive basic health care. They have provided high-quality, affordable primary and preventive care, as well as dental, mental health and substance abuse, and pharmacy services. Currently CHCs provide care to 22 million people at more than 9,000 sites. They are the largest network of primary care providers in the United States (National Association of Community Health Centers [NACHC], 2013).

Primary care is defined as the “provision of integrated, accessible health care services by clinicians who are accountable for addressing a large majority of personal health care needs, developing a sustained partnership with patients, and practicing in the context of family and community”. (Donaldson, Yordy, Lohr, & Vanselow, 1996, p. 1). Primary care services are general medical services provided to ambulatory patients. These services include family practice, pediatrics, obstetrics and gynecology, and preventive services. Primary care services include well-baby checks, immunizations, and prenatal and post-natal care. Also included are treatments for childhood diseases and common chronic conditions, such as hypertension, angina, back pain, arthritis, depression, and diabetes mellitus. Primary care providers include physicians, nurse practitioners, and physician assistants.

The majority of the patients of CHCs have limited access to health care services. Factors limiting access include financial, geographic, language, cultural, and other barriers (NCCHCA, 2011). Therefore, most of the patients have low incomes, are uninsured or have Medicaid, and are members of racial or ethnic minorities (NACHC, 2010). They may live in urban or rural areas. In our case, most patients live in rural areas. Patients facing these types of barriers are known as medically underserved or vulnerable patients. HRSA designates medically underserved areas/populations (MUAs) as areas or populations with one or some combination of the following statuses:

- Health professional shortage areas (HP-SAs) defined by HRSA as having shortages of primary medical care, dental or mental health providers,
- Residents with shortages of personal health services,
- High infant mortality,
- High poverty, or
- High elderly population

MUAs may be whole counties, groups of contiguous counties or other civil divisions, or groups of urban census tracts. MUPs may include groups of persons who face economic, cultural or linguistic barriers to health care. They are sometimes called vulnerable patients or populations. Included in medically underserved populations are migratory and seasonal agricultural workers, the homeless, and residents of public housing.

FQHCs receive federal grant funding under section 330. FQHCs provide services using a sliding fee scale (fee adjusted to ability to pay). Benefits of the FQHC designation include:

- Start-up grant funding up to $650,000 from 330 grant.
- Enhanced Medicare and Medicaid reimbursement.
- Medical malpractice coverage through the Federal Tort Claims Act
- Eligibility to purchase prescription and non-prescription medications for outpatients at reduced cost through the 340B Drug Pricing Program
- Access to National Health Service Corps
- Access to the Vaccine for Children Program
- Eligibility for various other federal grants and programs

Two additional types of FQHCs exist (although not among CPH’s member
organizations). Look-Alikes are health care organizations that are similar to FQHCs in terms of eligibility requirements and benefits, except that they do not receive the section 330 grant funding (Office of Rural Health Policy, 2006). Outpatient health programs/facilities operated by tribal organizations or urban Indian organizations under the Indian Self-Determination Act and Indian Health Care Improvement Act, respectively (Office of Rural Health Policy).

One notable upcoming change to the reimbursement mechanism is that Section 10501 of the Patient Protection and Affordable Care Act of 2010 modified how payment is made for Medicare services furnished at FQHCs. Beginning on October 1, 2014, FQHCs will transition to a prospective payment system (PPS) in which Medicare payment is made based on a predetermined, fixed amount. CMS is working on collecting data and feedbacks on these changes (CMS, 2013).

RHCs increase access to primary and preventive health care in rural areas. RHCs must be located in non-urbanized areas with health professional shortages (HPSA or Governor-designated; Office of Rural Health Policy, 2006). Generally, similarities exist between FQHCs and RHCs in terms of eligibility requirements and benefits. Key differences are that RHCs:

- Must be in non-urbanized areas (unlike FQHCs which may be in urban areas)
- Are ineligible for 340B Drug Pricing Program
- Have narrower scopes of services
- Must have mid-level practitioners (nurse practitioner, physician assistant, or nurse midwife) on site and available to see patients 50% of the time

**Community Partners HealthNet (CPH), Inc. Environment**

The organization’s mission statement is “Community Partners HealthNet, through shared resources, serves the participating community health centers in their commitment to provide quality, accessible health care to the populations in underserved areas” (Community Partners HealthNet, n.d.).

Plans and actions taken follow the organization’s values of service and the providing of quality, accessible care for the specific constituency. As the Chief Executive Officer/Chief Information Officer of CPH, Doug Smith explained the genesis of CPH, “CPH was needed. I knew it was the right thing to do.” CPH allows for small health centers to centralize information that can, in turn, be used not only to improve patient quality, but also allows for the health centers to have access to such information at a more affordable cost. Instead of each facility having its own staff to train staff, implement information technology, write reports, and manage data activities, CPH provides the information services. Smith noted, “It was obvious that this [CPH] would serve all of us to work together.”

In this model, CPH is an application service provider (ASP) providing information management as services to its clients. For its member organizations in North Carolina, Connecticut, Missouri, and Texas, CPH

- Supports and delivers information technology and administrative services. These services include Electronic Health Records (EHR), Electronic Dental Records (EDR) and Practice Management Software.
- Manages a data warehouse, and
- Tracks clinical outcomes (Community Partners HealthNet, n.d.).

The information technology and administrative services include Electronic Health Records (EHRs), electronic dental records (EDRs), and practice management software CPH has 7.0 full-time equivalents (FTEs) exclusive of Smith. Smith also serves as the director/CEO of Greene County Health Care, Inc. (GCHC), a CHC-member of CPH. His position at CPH is donated by GCHC. Moreover, in addition to the 7.0 FTE assigned exclusively to CPH, GCHC provides personnel support whose contribution to CPH is co-mingled with the clinic’s mission. The positions at CPH include
a report writer whose primary responsibility is to generate the reports requested by CPH members. Smith explained, "We can track clinical outcomes and process measures and offer feedback to the Medical Director." (See Table 1 for a sample report.)

Also working at CPH are hardware technical support staff that back-up data and work with other sites if there are connectivity issues. For CPH’s electronically-stored patient data, support staff members also ensure compliance with the Health Insurance Portability and Accountability Act (HIPAA) of 1996. Moreover, they work with the other CPH members to assure the data’s safety during inclement weather (e.g., checking on the site during a recent hurricane). In addition, there are three training and support staffers for the member sites. Key to CPH’s success in EHR implementation, data warehousing, and data reporting is the member centers’ follow through in staff training. CPH staff train the staff members at each member site so they can use the health information technology (e.g., properly add a provider or specialist to EHR or a pharmacy to EHR’s contract manager) and stay updated regarding meaningful use requirements and ICD-10 readiness as well as EHR user preferences on CPH’s purchased certified ambulatory practice management and EHR system.

The organization chart of CPH is shown in Figure 1. The staff number is small (6), but each staff member was hired with the understanding and desire for continued learning. Smith stated, “We ‘grew our own.’” Smith originally hired local personnel who (a) had extensive IT experience, (b) endorsed the mission of CPH, and (c) possessed the desire to learn more about health information technology and the administrative responsibilities that accompany it. More recently hired staff members have already had some training and experience in the field. For example, two recent hires included a director of a health center’s management information systems (MIS) and an individual with 20-years’ experience in second-level support at a large, multinational technology and consulting corporation. Nonetheless, all staff members endorse the service mission of community and rural health centers -- to provide quality, accessible health care to the populations in underserved areas.

**SETTING THE STAGE**

CPH evolved from discussions among directors of North Carolina CHCs in the late 1990s. These leaders were discussing the mutual creation of a health maintenance organization. As part of this discussion, leaders established functional task forces, such as MIS and finance. Doug Smith, one of the CHC directors, was a member of the MIS task force.

Political forces terminated the discussion of the mutual health maintenance organization. However, Doug and other directors continued to consider a shared information network. Concomitantly, HRSA, through grant funding, was supporting the establishment of health-center-controlled networks (HCCNs). Deciding to go forward on the shared information network,

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Doug and five other directors applied for the federal funding to start he HCCNs.

Smith served as the driving force, identifying the need for health information technology for the CHCs. He gained support among his colleagues for the notion that economies of scale could be realized if all the health centers used CPH as an HIT and data warehousing service provider. Cost savings could accrue to the health centers because, in economies of scale, cost per unit decreases as the scale increases. Along with the CEOs’ support, Smith also had physician champions from CHCs. Patient care could be improved via physicians making decisions informed by data. Finally, Smith took the lead role in gaining support from North Carolina Senators and Congressmen. Smith served as the lead champion and entrepreneur for CPH.

Two additional interviews of the directors of member organizations revealed similar findings. Dr. Thomas Maynor, Chief Operating Officer of Robeson Health Care Corporation (one of the original member centers), provided insight into the impetus for forming this shared information network. Original members of CPH shared a vision for improving the quality of health care delivered, establishing best practices, reducing costs, and making decisions informed by the aggregation of information in a data warehouse. The data warehouse would be made possible by the adoption and implementation of an integrated HIT system that included a PMS, an EHR, and an electronic dental record across the shared information network. Members of CPH participate in shared governance. The CEOs of each of the participating CHCs serve on the governing board which routinely meets quarterly, but which has met as often as monthly. Active participation by the CEOs enhances buy-in into the network; further strengthening this support is the CEOs’ practice of bringing staff members to the board meetings to discuss initiatives and concerns within their functional areas of expertise. Work groups are also hosted by CPH (T. Maynor, personal communication, October 27, 2011).

Ms. Lucy Ramirez, CEO of Nuestra Clinica del Valle, acknowledged dedication and leadership as factors in her clinic’s decision to join CPH approximately three years ago. Her clinic had been participating in a network seeking to implement an EHR. Delays in implementation and her discovery that the new EHR would not interface with a legacy practice management system, despite previous assurances from the vendor that it would both contributed to the termination of the contract with the vendor and search for a new shared
information network. As a positive deciding factor to transition to CPH, Ms. Ramirez cited her familiarity, through working together at national CHC meetings, with Mr. Doug Smith and the successes achieved at CPH. In the brave new digital world, geographic boundaries pose few problems. Although her clinic is located in Texas, Ms. Ramirez participates in board meetings via telephone conference, and her staff members are active participants in working groups addressing clinical operations, billing and revenue cycle management, compliance, and performance improvement (L. Ramirez, personal communication, October 27, 2011).

Dr. Maynor and Ms. Ramirez shared a common perspective about the advantages of being a member of CPH -- access to an EHR and a PMS, on-site training, help desk and technical support requested via electronic ticket, access to the data stored in the data warehouse for reports required by the state and federal government, technical upgrades to software, support for vendor negotiations, and shared challenges to meet the emerging federal requirements related to meaningful use and patient-centered medical home certification. All these are amazingly done with small number of staff.

CASE DESCRIPTION

Technology Concerns

The planning of CPH’s EHR and data warehouse projects started in the 1990s when its initial six member CHCs faced the challenges of legacy systems that were not Y2K [year 2000] compliant and of new encounter and performance reporting from HRSA’s Bureau of Primary Health Care. The initial members also had a vision of outcome and quality-related data being used for quality improvement activities. Quality assurance organizations such as the National Committee for Quality Assurance (NCQA) now demand reporting of quality data. In the late 1990s, little reporting function existed in any of nearly 60 EHR systems reviewed by the MIS team led by Doug Smith. Most vendors were charging for custom reports any time a new report was needed. The decision then was to merge the data from the backend databases of the EHRs into one large data warehouse so reporting could be centralized and become a service to the member health centers. Both EHRs and data warehouse went online at the same time and CPH is the sole service provider for both systems. CPH also provides services to generate reports from the data in the data warehouse for individual member centers. The reports are used to submit data to organizations like HRSA or NCQA as well as for quality assurance at the individual member centers. The number of member centers has grown from the initial 6 to the current 16 while both the EHRs and the data warehouse are scaled up for the growth of the consortium. The initial cost of building the data warehouse, including hardware, reporting software, upload scripts, and a catalog for the reporting software was about $100,000. Having received many awards, CPH is widely regarded and recognized as a pioneering model for HIT projects because of its centralized and integrated EHR hosting, data warehousing, just-in-time reporting, and the operation and quality of its member centers.

Challenges exist for the implementation of an integrated HIT project. One challenge involves consistency. “Providers need to be consistent on what they do,” Doug Smith said during the interview for this case study. Providers capture initial data during the encounters with the patients. The consistency, comprehensiveness, and accuracy of their data capture will subsequently influence the quality of their data in the EHR and the data warehouse. Providers at health centers are under tremendous pressure to provide services to large numbers of patients. Consequently, the quality of captured data is not always consistent. New providers need to be trained thoroughly in order to record all needed data for quality reporting.

The second challenge that the data warehouse project often faces is the system changes required by major EHR software updates. Because CPH does not develop the EHR software in-house, it relies on the vendor to provide periodic updates. When an update
involves changes of the data model in the EHR, the data model of the data warehouse must be modified accordingly. Occasionally, but not usually, an update will require that the scripts in the reporting software be correspondingly modified. Happening once or twice a year, system updates have been and always will be a challenge because of the nature of the entire system. CPH has been working closely with the EHR vendor; the process of the system update has been made much smoother since these meetings.

As previously mentioned, CPH generates routine reports to send to federal agencies, such as HRSA, and to quality assurance entities, such as NCQA. Additionally, though, other reports on clinical quality are sent back to medical directors for quality assurance and improvement at the individual health centers. The EHR templates could then be modified based on the quality reporting in order to enhance a quality improvement (QI) process. Some of the CHCs (e.g., the Greene County Health Care) have shown improvements in delivering quality health care and in reducing disparities after implementing the data warehouse project. For example, the results of one study showed that “in comparison with national data...Greene County Health Care [GCHC] is doing a comparable job meeting diabetes goals for HbA1c, blood pressure, and lipid levels and in some instances is achieving better outcomes despite predominately low-income clients” (Kirk, Berton, Grzywacz, Smith, & Arcury, 2008, p. 281). Moreover, in one of its latest reports to HRSA, GCHC reported that disparities in terms of diabetic care do not exist within its patient population. The complete process of quality assurance with the integration of EHR and data warehouse is shown in Figure 2.
Technology Components

Data Warehouse

In computer technology, a data warehouse is a "collection of integrated subject-oriented databases designed to support the DSS [decision support system] function, where each unit of data is relevant to some moment in time. The data warehouse contains atomic data and lightly summarized data. A data warehouse is a subject oriented, integrated, non-volatile, time variant collection of data designed to support management DSS needs" (Inmon, n.d.). As a specialized database, its primary purpose is to store, report and analyze data. The data stored in the data warehouse are uploaded from multiple operational database systems. Often these operational database systems are heterogeneous; therefore, certain types of data transformation and calculation (e.g., summation) are performed before the data are merged into the data warehouse under a common data structure. The term for the steps involved in uploading data from operational databases to a data warehouse is called ETL (extraction, transformation and loading). Many major database vendors (Oracle, Microsoft SQL server) have integrated into their products the functionalities for implementing a data warehouse. Because the data in a data warehouse are cleaned, transformed, pre-calculated, and cataloged; they are readily used for analytic operations such as data mining, online analytic processing (OLAP), statistical analysis, or other business intelligence techniques. Data Warehouse and OLAP technologies have been used in health care to support clinical outcomes and population health (Parmananto, 2005; Studnicki, 2010 & 2013; Triola & Pusic, 2012).

The benefits of a data warehouse are multifold:

- Has the capability of cleaning, transforming, cleaning, and cataloging data for subsequent operations. It enhances the efficiency and quality of the analysis.
- Contains, often, operational data with time stamps and location information. Thus, it will facilitate temporal and geological data analysis.
- Uses a common data structure so consistency of data is enforced, even though data may come from different sources.

A data warehouse is a specialized database different from a relational database that is often used for transactions. Most relational databases conform to relational model theory and are designed based on a data modeling technique called Entity Relationship Diagram. Tables and attributes of tables are normalized for efficient capture of transactional data. However, it is often too time consuming to run queries involving multiple relational databases along several dimensions. The schema for a data warehouse follows a dimensional template (time, location, outcome, etc.). On the other hand, the relational database follows the entity relationship diagram. The purpose of the data warehouse is for storage, reporting and analysis. Usually, the data warehouse is not a real time system; it should not be used for ad hoc query because it will not reflect the real data distribution at the moment. Commonly, hierarchical and redundant data are stored in a data warehouse in order to improve the performance for data access and analysis. Students may consult standard texts on data warehouses, such as Building the Data Warehouse (Inmon, 2005), The DataWarehouse ETL Toolkit (Kimball & Caserta, 2004), and Data Warehouse Fundamentals for IT Professionals (Ponniiah, 2010), for details on their implementation.

CPH is an application service provider (ASP) hosting both EHRs for individual member centers and the data warehouse (see Figure 3). An EHR is a "longitudinal electronic record of patient health information generated by one or more encounters in any care delivery setting. Included in this information are...
Figure 3. Architecture of the data warehouse project

patient demographics, progress notes, problems, medications, vital signs, past medical history, immunizations, laboratory data and radiology reports” (Healthcare Information and Management Systems Society, 2011).

CPH uses a vendor’s certified ambulatory system to store both clinical and practice management data. The current system was selected 10 years ago by a committee of several EHR experts including one of the authors following a standard EHR selection process. In standard EHR selection processes, common criteria for vendor comparisons are: (a) technology and scalability, (b) standards and compliance, (c) user interface, (d) integration, (e) reporting and data, (f) implementation, (g) training, (h) support, (i) references, (j) leadership and response, and (k) CHC experience (Smith & Rachman, 2008). On these criteria, a vendor is rated as above average (meets most or all the criteria), average (meets some criteria), or below average (meets few or no criteria). After reviewing more than 50 different vendors, the committee invited four vendors of PMS/EHR systems to demonstrate their systems. The committee used score cards for PMS and EHR to rate and rank the vendors after their demonstrations.

The system is certified, as a complete EHR supporting meaningful use, by the Office of the National Coordinator - Authorized Testing and Certification Body (ONC-ATCB). All the backend databases are running on an enterprise database management server. Using an ASP model, CPH provides services to individual member centers with charged fees. Each CHC has a dedicated database running on the server to support the transactions at the center. Each day, providers and staff at the member centers work through transparent log-ins to metaframe servers at CPH. Nothing is uploaded from the centers to CPH. The metaframe servers are connected to the main database server which houses the clinical and the PMS. Once each evening, data are extracted, transformed, and loaded into the data warehouse using the capabilities of the reporting software and the associated scripts. Selected tables from the EHR and PMS databases are used in this process; and then, time and date-stamped, as well as stamped to the originating database and server (i.e., for each CHC or RHC). The data warehouse follows a similar data schema to the relational database for the individual EHRs for the tables selected (which include all demographic and clinical

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data). The benefit of such similarity is simplified data transfer. Data tables are comparable between the databases and the data warehouse.

Conventionally, a data warehouse usually uses the data model called star schema in a dimensional format. Sometimes, it could be combined with a normalized relational data model to produce a snowflake data model to support both transaction and query of the data in the warehouse. However, the design of the data warehouse also needs to take into consideration the efficiency of data transfer and scalability. The model used at CPH does meet its members’ needs to have a data warehouse and, to date, has been scalable to additional member health centers. Given limited human and financial resources, a normalized design may not have been a top priority at this stage. More interesting, though, is that the original design, with 10 years of data in some databases, still meets the needs of CPH, its members, and can often run reports in seconds. It is always important to benchmark the data warehouse’s performance to assess its continued ability to meet the needs for increased reporting and of quality improvement requirements.

In order to track patients with different conditions (e.g., diabetes) in a data warehouse, flag fields are available and can be implemented in the EHR database, or, more commonly, the report can be based on diagnostic codes. For example, if the data warehouse needs to be used to report diabetic patient outcomes, a flag field called “diabetic” can be set on individual patients with diabetes. That information will then be uploaded and stored in data warehouse for future access and analysis. The flag can be checked manually or automatically if certain criteria can be written as scripts running within the database. Some outcome data are pre-calculated as needed for reporting purposes. After the member centers are closed for business, the data warehouse is updated each night to prevent the uploading from impacting the performance of the centers’ EHRs.

CPH staff members use enterprise-level business analytics and business intelligence software to query and analyze data from the data warehouse and to generate reports for various purposes. Business analytics tools can continuously explore and investigate business data to gain understanding and insights of the organization’s performance. In contrast, business intelligence tools focus more on using a consistent set of metrics both to measure past performance and to guide future planning. Both business analytics and business intelligence applications are based on data and statistical methods. These tools have the capabilities of fetching data cataloged in the data warehouse and of producing high quality ad hoc reports for decision makers. Figure 4 is a sample report that tabulates numbers of diabetes patients by average [hemoglobin] A1c range and rate. CPH staff can routinely generate such reports to support the centers’ quality improvement, evaluation of health disparities, and research.

**Hardware**

Two servers run concurrently to support the EHRs and data warehouse. The servers are mirrored in real time so if one server is down the other could be online immediately. Both servers use the latest data storage technologies, allowing data to be stored and retrieved quickly. Both use two 640 GB I/O adapter cards from Fusion IO as the primary storage media. I/O adapter card is one of the latest memory storage technologies based on solid state NAND Flash Memory (same category as flash drive) technology. This storage technology improves application response time; minimizes application latency; and reduces hardware infrastructure, maintenance, and energy costs. Both servers are backed up daily to another on-site server and to a remote server in a secured data center. If both servers are down, the remote server can serve as the main server for both the EHR and the data warehouse. All users access the EHR systems through the Citrix secure remote access.

**Management and Organizational Concerns**

Smith symbolizes transformational leadership. CPH and Green County Health Care, Inc.
(GCHC) are his vocation. With Smith serving as both CEO/CIO for CPH and CEO for GCHC, the building site for CPH is adjacent to the community health center. In minutes, Smith can walk from GCHC to CPH. Thus, his presence as the leader of both facilities is apparent. This multi-leadership position is both a benefit and a concern. In order for the creation of a site such as CPH, Smith as the champion and entrepreneur was a benefit. He rallied the support from other CEOs and physicians; he spoke to the NC Senators and Congressmen; he wrote the grants for funding opportunities. Once established, he hired, trained, and guided the staff members who worked at CPH. Throughout the process, he was aware of the goodness of fit of CPH for the health centers precisely because he served as CEO of a CHC. He understood the vision for CPH—the need for data sharing, the need to organize patient information better, and the need for efficiencies in a not-for-profit environment. He also could communicate the vision with authority; he was a CEO. Nonetheless, a concern is the succession planning required to replace such a dynamic, dedicated and transformational leader. The time and effort expended as a CEO of the CHC and the time and effort as the transformational leader for CPH takes its toll on (but also motivates) any one person. As Smith wryly admitted, he had not had a vacation since the start of CPH; by choice, he notes and no longer true as he began a 10-day vacation following the interview for this case.

In addition to leadership, factors pursuant to CPH success included the creation of a sustainable governance structure, good reporting and training endeavors by effective staff, growth of reputation in community and rural health center leaders, and the continued securing of funding to cover CPH costs.

The governance structure is comprised of Board members from each health center site. The Board meets quarterly, monthly if needed. The meetings provide the opportunity for oversight.
of CPH activities as well as serve as avenues to maintain member collaborative relationships.

Ms. Beverley Stroud, CFO at Greene County Health Care, Inc. (GCHC), provides an estimated 0.20 to 0.25 FTE in support of CPH. Monthly, members of CPH pay dues and support fees. Budgeting for CPH is supported out of the CFO's office, as is the preparation of monthly invoices, and the inclusion of CPH in GCHC's financial statements (B. Stroud, personal communication, September 14, 2011). CPH charges its members quarterly dues. Benefits of membership are (a) inclusion in grant applications and any subsequent grant awards and (b) access to computer support and the data warehouse reporting functions. Support revenue is the amount paid by members quarterly and/or monthly for the specific programs used (i.e., the EHR, PMS, etc.). Grant funds are also used to cover staff costs and other expenses (travel, data conversions, etc.) related to bringing new CHCs and RHCs onto the EHR. Basically, membership dues and support revenue fund ongoing operating costs. Grants pay for bringing in new centers and investments in plant, property, and equipment, if stipulated in the grant request.

CPH generated a total of $684,125 in 2010 revenue – Support Revenue ($172,234), Grants ($408,991), and Membership Revenues ($102,900). Expenses totaled $790,716. Therefore, HealthNet incurred losses of $106,591, although $231,288 was depreciation, a noncash expense (Sitterson & Barker, P.A., 2010).

As a member of CPH, GCHC and the other members derive benefits that support both the financial and clinical operations. The interface between the EHR and the PMS reduces data entry when new patients come in because common fields in the records are automatically populated. Some of the support responsibilities such as system maintenance and backup are performed by CPH rather than billing and other center personnel. Updates to CPT codes are performed annually. A weekly report of procedures documented in the EHR has improved billing for laboratory and x-ray procedures on a fee-for-services basis. Normally, many of these charges would have been lost. Finally, routine and ad hoc reporting of data collected by the data warehouse facilitates state and federal reporting such as annual cost reports and the Uniform Data System (UDS) reports required of community health centers. (B. Stroud, personal communication, September 14, 2011).

As previously noted in “Environment,” the staff members of CPH are from the local area. They possess degrees in Information Technology from local institutes of higher learning, have at least five years of prior work experience in IT, and endorse the mission of community health centers. In Smith’s words, “They had to learn the application software as it was developed and as we added new capabilities.”

The commitment of staff to the CPH vision was important to the success of early endeavors. For instance, understanding that any reports that were generated may or may not be accurate, based upon how the parameters were defined. To elaborate refer to Table 1, Sample Report. In this scenario, a report was requested regarding patients with hypertension. Yet, how this variable (patients with hypertension) was elucidated affects the resulting report. For example, is the requester inquiring about the number of patients who have hypertension and who have had an encounter at the health care center? OR, is the requester inquiring about the number of patients who have hypertension and who are currently being treated in the health care center? Particulars, such as the definition of the variable in question, matter and the staff members must always be aware of such distinctions to help bring about accurate data reporting and in clarifying the question being asked by health center staff. CPH staff work with members of the CPH Quality Improvement (QI) Committee and individual health centers to design templates that capture the data consistently to meet meaningful use, patient-centered medical home, Bureau of Primary Care, or individual center QI initiatives.

Efforts placed in training the staff members of member sites were also vital to CPH success. If staff members at member sites had not been adequately trained on how to use the EHR, any information summoned for reports
would be suspect and would, therefore, negate the mission of CPH. Staff members at all sites who have access to the EHR and PMS had to know how to use the systems effectively. Training was essential; Smith knew this. To this end, he hired trainers who he thought:

- Had sufficient IT experience
- Were prepared to learn relevant health information technology, including the application software
- Would test out new IT teaching services
- Possessed patience to serve as a trainer
- Had communication skills to listen to the trainees and to accommodate their teaching style to individual needs.

Crystal Beaman, currently serving as Director of Implementation and Training, was from the local area and had studied as a nursing assistant and transcriptionist. She then worked in software product engineering as she completed her college degree. With her past work experiences and her interest in CPH, Smith determined that she would be a good fit as a trainer. Beaman reported that training for a new member site is tailored to the needs of the organization. To minimize costs, remote (Web-based) training can be accomplished from the home base of CPH. Nonetheless, she does travel to each site to see that the trainees have learned the information portrayed in the remote training sessions and [to allow them] to gain further knowledge of using the EHR. This on-site encounter also presents an opportunity for face-to-face interaction with her—a CPH representative. Beaman explained, “Sometimes, if they [the trainees] are negative and frustrated in a session, it is because they missed something. We will stop, go back to where they had success, and then identify what they missed. It is important to communicate at the level they are at” (C. Beaman, personal communication, September 2, 2011).

Beaman also explained the importance of leader support at trainings. “How involved senior leadership is in supporting IT training is critical.” If the center’s CEO is present and engaged in the training, the rest of the trainees know the importance given to their mastering the subject matter. The CEO as IT trainer role model is not to be understated; they are leader champions.

Informal leaders may serve as HIT training champions, as well. To elaborate, Beamer has asked for pairings at trainee sites. In such cases, the pairings are with a faster learner and a slower learner. These pairings can be made across normal [usual] occupations [jobs]. For instance, if a member site had a fast learner at the front desk and a slower learner in the lab, these two staff members could be paired up, resulting in enhanced experiences for all involved.

Beaman directs training in steps, which include

- Initial assessment to identify what is needed, equipment to be purchased, Internet upgrades if necessary, and to begin involving the staff early in the process
- Web-based trainings to introduce staff to the basics of the EHR (clinical) and PMS (billing, scheduling appointments) packages
- On-site trainings prior to the “go live” date to ensure staff are prepared
- Web-based “how-to” documents and training videos

Her final comment regarding training was that she found the presence of the “decision makers” in the training room changes the whole process. Champions of change were key to success.

Finally, key to success of CPH was funding. Smith again serves as the leader in the procurement of grants. However, Smith notes that grant funding is subject to political and competitive events and processes. As previously stated, membership fees ($15,000 per center) and support revenues do not yet cover all of CPH’s operating costs. Sustainability is a potential issue regarding funding. However, based on having the infrastructure in place and a new joint marketing arrangement with the software vendor, CPH expects that, with the addition of two or three new member health centers, it will reach a break-even point.
CURRENT CHALLENGES FACING THE ORGANIZATION

CPH faces current challenges that center on sustainability issues of maintaining relationships, meeting diverse IT demand, keeping current with latest Health IT trend, high quality training, and succession planning.

The first issue is that of maintaining relationships, which includes relationships with current members and growing the membership. The Board meetings are one avenue to continue collaborative environment among members. Regarding membership recruitment, there is little direct marketing activity to encourage other CHCs and RHCs to join CPH. Rather, new members generally come from those who have heard about CPH’s reputation and/or Smith’s reputation, or have been chosen by the NC Office of Rural Health to participate. The reputation of CPH and Smith has allowed for the growth of CPH’s membership from 6 to 16. However, for increased financial support as well as QI efforts, more members are desired. To date, the funding has been directed towards building the hardware and software infrastructure, paying its staff members, providing training and IT support to members, and generating reports. There is not enough funding to budget for in-house marketing at this time. Health Information Technology has been touted as a critical factor for the quality of care at Community Health Centers, but more funding sources are still needed for wider adoption (Fiscella & Geiger, 2006).

Related to the issue of maintaining relationships with members, the variety of demand on IT services from the member organizations to CPH also presents as a challenge to CPH to satisfy the customers. One current large undertaking is the meaning use preparation and attestation. Meaningful use is one of the latest initiative from the federal government to use “carrot and stick” strategy to incentivize health care providers to adopt health information technologies, in particular, EHR and use them in a meaningful way. Meaningful use is divided into three consecutive stages from simply just adopting EHR to use advanced components in EHR to achieve better outcomes (Marcott et al., 2012). CPH does not provide health care so they are not qualified for meaningful use. They have been working closely with different member organizations to achieve the meaningful use criteria and attest for reimbursement. This presented as a challenge to CPH – not all centers are at the same stage of implementation and not all centers have the same capacity for achieving different stages meaningful use. It becomes even more challenging with a small staff at CPH. Proactively, CPH was able to secure a federal HRSA grant to standardize Quality Improvement (QI) measures among all centers. Many of these QI measures are defined in the meaningful use regulations so CPH is proactively to assist the member organizations for the later stages of meaningful use. With the support of the grant, they will be able to recruit one register nurse and one data specialist dedicated to this initiative. Notably CPH will be able to retrieve data from EHR directly for 7 out of the 9 quality measures and use data warehouse for the other two. Apparently, the technology infrastructure has positioned CPH for successfully receiving the grant.

Emerging technologies challenge CPH, as a HCCN on small staff and budget, to be current with latest development in the field. Thorough consideration and deliberation are undoubtedly needed to decide whether to embrace these technologies. One new buzzword “Big Data” has gain popularity in all fields that generate humongous size of data and need innovative computational capability to convert these data into useful information for decision-making. Big data has three characteristics that often symbolized as three “Vs” – volume, velocity, and variety. Volume refers to the rapid rate at which the data is growing. It is estimated by 2020, human being will have 35 zettabytes of data to process. Velocity refers to the increasing frequency with which data is delivered. Many data are generated without human interventions (e.g., cell phones, sensors). Variety refers to the many forms of data – text, numbers, videos, audios et al. Health care, with the incremental use of EHR in collecting routine data in...
all formats, is one of such fields (Fernades, O’Connor, & Weaver, 2012). Data in health care are heterogeneous and come from many different sources – clinical notes, lab testing machines, patient portal, genetic testing et al. One term associated with “Big Data” is predictive analytics. It goes beyond just using data warehouse to analyze existing data. It will use data from all sources to predict the outcome of care at all levels from individual to the community. Although it is enticing to deploy such capabilities on top of EHR and Data Warehouse, it is also equally important for CPH to review their internal resources and debate on the value of such technology before fully commit to it.

High quality training is also important for the organization to maintain. Beamans focuses on the training initiatives and continuously looks for efficient and effective ways to train CPH members. For the last eight years, CPH has hosted a web community that is linked to the CPH web page. Recently, social media (information posted, sent, received and/or exchanged via on-line) has been employed to expand training resources and capabilities. Social media may represent a change in how people send, receive and exchange information because participants, engaging in dialog (creating two-way content exchange), become both active publishers and passive recipients (Thielst, 2010). For health care organizations, social media are a means to build relationships with stakeholders. CPH’s social media strategies allow for (a) continuous up-to-date tweets (via twitter), (b) notifications and links supplied on Facebook (see http://www.cphealthnet.org/foraccess to these sites), (c) web-site design, and (d) e-mail accounts for communications via the centers and CPH. Members can click on a training link and start a training lesson at their chosen time.

The co-mingling of executive responsibilities between GCHC and CPH represents a continuing challenge. For the present, stakeholders at GCHC seem to accept the diversion of leadership resources in exchange for the benefits provided by CPH. Acceptance of the status quo in the short term is probably acceptable, although difficulties are anticipated if the current leader should retire or change positions.

Succession planning is an issue that may be a challenge for any organization that has a transformational leader such as Smith. Succession planning is a strategy to transition from one leader to the next with minimal disruptions to work processes and employees. Dye (2010) proposes that succession planning should be a priority as strong and dependable leadership serves the needs of employees. Transformational leaders effectively communicate the organization’s vision to its stakeholders, inspire their employees to strive for excellence, and provide individual attention to help employees excel. Robbins and Judge (2011) define transformational leaders as those who inspire their employees to “transcend their own self-interests” (p. 391). Necessarily, finding a successor to Smith, a transformational leader will challenge CPH.

At CPH, Smith is transformational leader, entrepreneur, and champion. Smith’s leadership with its positive attributes is CPH’s success. He has convincingly communicated CPH’s vision, hired and trained effective and loyal staff members, and procured grants and CPH members to fund the organization. But also as with single leadership, there is little to no succession planning for CPH. Smith responded that succession planning had not been a dominant thought, but GCHC could bring in a Deputy Director at some point, but not now. Of course, this issue relates to funding and the allocation of resources. Strategically, the issue addresses the need or not for a Deputy Director when the monies available are already directed toward keeping CPH’s serving as the ASP and data warehouse.

REFERENCES


