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Rapid EHR Development and Implementation Using Web and Cloud-Based Architecture in a Large Home Health and Hospice Organization

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Abstract. Health care organizations have long been limited to a small number of major vendors in their selection of an electronic health record (EHR) system in the national and international marketplace. These major EHR vendors have in common base systems that are decades old, are built in antiquated programming languages, use outdated server architecture, and are based on inflexible data models [1,2]. The option to upgrade their technology to keep pace with the power of new web-based architecture, programming tools and cloud servers is not easily undertaken due to large client bases, development costs and risk [3]. This paper presents the decade-long efforts of a large national provider of home health and hospice care to select an EHR product, failing that to build their own and failing that initiative to go back into the market in 2012. The decade time delay had allowed new technologies and more nimble vendors to enter the market. Partnering with a new start-up company doing web and cloud based architecture for the home health and hospice market, made it possible to build, test and implement an operational and point of care system in 264 home health locations across 40 states and three time zones in the United States. This option of "starting over" with the new web and cloud technologies may be posing a next generation of new EHR vendors that retells the Blackberry replacement by iPhone story in healthcare.

Keywords. Nursing informatics, cloud-based architectures, Point of Care systems, EHR in Home Health and Hospice, mobile computing

Introduction

Gentiva Health Services has been a provider of home health and hospice care for over twenty-five years in the United States (US) [4]. With over 400 hospice and home health locations in 41 states and 13,000 direct care clinicians, the requirements for an EHR and point of care clinical system exceeded the capabilities of the major vendors in the US marketplace. A formal selection process was conducted with the assistance of consultants in 2004 and 2010.

In the interim between 2004 and 2010, the organization attempted to build its own clinical information system with point of care and internet connected devices. After four years of development, sixty-four locations were brought up on the

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application over a three year period before inherent limitations of the architecture design required a hold on further implementations. Millions of dollars were spent on this in-house development effort.

At the same time, the US healthcare marketplace had shifted to Accountable Care Organization (ACO) partnerships between different provider organizations targeting cost reductions and decreased hospital readmission rates [5]. Forged by legislative mandates to reduce waste, costs and improve quality outcomes and Meaningful Use incentives for EHR adoption in ambulatory and acute care, the landscape rapidly changed to require community care provider to be able to send and receive patient data electronically. Against this backdrop the Gentiva organization again went out to market in 2010 and over a 6-month process had narrowed the field but without a clear winner. Still without an EHR software partner in early 2012, it was with a sense of desperation that "out of the box options" were entertained. Through word of mouth we discovered information on a new start up, named DeVero that had developed a cloud-based Home Health and Hospice clinical documentation system, headquartered in San Jose, California. This use case describes a partnership that enabled rapid development to implementation in 14-months at price points and cost of ownership that are a fraction of the legacy vendors supplying the home health and hospice market today. Gentiva's implementation approach was to first convert its home health branches (264 sites) and follow in a phase II with its hospice programs (142 locations). This report covers the home health implementation experience.

1. Cloud Based Architecture

As more and more cloud based systems enter the marketplace, it will be important for nurse informaticists to be aware of these new tools and how they enable or limit functionality for end-users and the organization in comparison to client-server architected systems. Figure 1 illustrates the architectural design of the DeVero cloud-based platform and shows that is deployed in the Amazon Cloud. Key features to call out that make this infrastructure relevant to our Home Health and Hospice organization are those that enable scalability for high volume processing, support geographically dispersed sites in one master database and allow clinicians to be connected to the full EHR system as they work in patients' homes or facilities. Briefly these key features are: the Elastic Load Balancer distributes inbound traffic to available Application Servers that dynamically scale based on load; the ElastiCache is distributed, in-memory cache that can be scaled as needed to enable high volumes and fast response times for updates, screen views, and real-time viewing/updating same patient record by multiple clinicians at same time; and retrieving current and prior patient records in near second time is enabled by ElasticSearch built as a distributed real-time, high performing function that searches across big data sets.

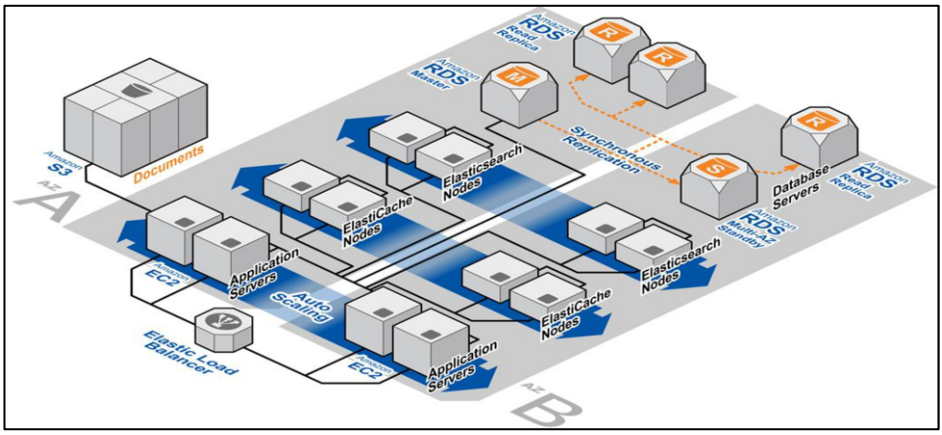

Figure 1. DeVero's Cloud Based Architectural Platform

This infrastructure is fundamental to enabling Gentiva to have one master database for our home health and hospice patients, subzero response time for our branch locations, as well as for our clinicians who basically work anywhere in a given community from patient's home, Assisted Living Facilities to Skilled Nursing Facilities. Additionally, given that DeVero's system is true web-based, clinicians only need to connect to their internet browser to access the system. This means that a clinician is connected in real-time to the full EHR system – complete clinical record access, can view other team member's updates, communication notes, scheduling updates and new patient admissions, as well as, retrieve, view new orders, lab results, imaged documents and photographs. The ability to scan and upload supporting medical information into GentivaLink provides the clinician with access to referral information for newly admitted patients, the most recent laboratory results and even photographic documentation of wound progression that can be shared with the attending provider electronically. Unlike client-server applications that require users to download software to their devices and synchronize views or work through Citrix, web and cloud based systems enable for the first time, remote deployed team clinicians in home health to access an EHR in real-time. These new empowering technologies (web tools, internet connecting devices, cloud servers and databases), allow for EHR systems that appear to be based on our experience easier to build, implement, teach, learn and use, and at cost points significantly less than the major vendor offerings in the marketplace today.

2. Rapid Development – 14 Months to Implementation

From the initial handshake agreement in early 2012, development teams from both organizations immediately started working on requirements, design and device testing prior to contract signing which in of itself is unusual but in this instance was indicative of the mutual commitment to this partnership. Within 10 months, a

robust real-time integration was complete between Gentiva's legacy billing system and our software partner's cloud electronic health record (EHR). We named our new point of care EHR system "GentivaLink". The conversion strategy adopted and DeVero's system design allowed Gentiva to leverage existing patient data, billing processes, and workflows to avoid impacting revenue and overall productivity. Included in this effort was functionality to support programmatic batch importing of data from Gentiva's existing patient record and billing system and other software applications to DeVero's cloud platform, The batch import supported upwards of 2,500 records per minute and to date Gentiva has imported over 6 million records to GentivaLink in this fashion. With these patient and operational data being preloaded, Gentiva had the ability to roll out branches on demand with a ready to use system.

Just as the Gentiva organization was charting new ground with DeVero's cloud-based architecture; it was also looking to do a rapid implementation across its 264 Home Health locations with a small team of trainers using virtual classrooms, facilitated sessions and practice environments. The wide expanse of geography, time urgency to have an EMR, and need to contain costs required a training approach that minimized dependence on face-to-face classroom style sessions as well as on-site support. Once rollout started, the plan was to bring 24 to 27 branch locations live every week, starting the first week in September and finishing mid-November, 2013. Thus, getting the training approach such that each role could learn how to do their job in the new system without impacting productivity was critical for the Project Team to deliver.

2.1. Two pilots over nine months

To help us thoroughly test the software, networks, devices and our training methodology, we completed two pilots prior to beginning rapid implementation in September 2013. The first pilot started in January 2013 using six home health branches that represented large and small censuses, urban and rural settings, and some with multiple specialty programs. Based on lessons learned we continued to refine and develop nuance levels of functionality for an additional four months, revamped training materials, classes and pre-implementation readiness preparation, and changed from Android devices to the iPad. Starting in July 2013, the second pilot phase included another 8 home health branches and served to further test functionality, response time, internet connectivity, security requirements and device management. Most importantly, we used this second pilot to validate the effectiveness of the virtual training methodology and training materials.

Much to our surprise, we learned that our clinicians needed hands-on training in how to use the iPad devices. We had assumed that the pervasiveness of the iPhone and iPad made teaching navigation of the iPad unnecessary. However, what we saw happen was that the majority of clinicians in the second pilot group spent four to eight hours on their first day of go-live on the phone to the Help Desk with set up, password, and iPad navigation issues. At the clinicians' recommendation, we added a structured a "clinician workshop" session the day before go-live. We used fellow expert clinicians and a virtual facilitator to tutor the clinicians on set up, iPad navigation, and password reset. While this approach allowed clinicians to immediately be able to do close to a normal day's work on day 1, we found with

the rollout that managing passwords was problematic. September through October, Help Desk call volumes ran between 500 and 800 calls per week Passwords in all their permutations accounted for 50% of Help Desk calls with the other major category being "how to" questions. In addition, our office staff and clinicians needed the ability to view the virtual training classes multiple times after their branch's go-live date. To address this need we made recorded sessions of the classes available in our learning management system as well as posted on YouTube for our iPad users.

3. Rapid Implementation and Rollout

As of 11 November 2013, rollout was 100% completed with 264 branches up on the GentivaLink system. The training approach has been adjusted to require the regional operations teams to hold daily question and answer sessions with those branches going through conversion in a given week in their region. These calls are open to any Branch and we are finding that sites in their 2nd to 4th week live on the system continue to have one or two staff on the daily calls. Evaluation metrics are tracked weekly and reviewed by the Project Steering Committee (Chief Clinical Officer, Chief Information Officer, Chief Operations Officer, Chief Compliance Officer, HR VP, VP Clinical Ops, and Director Business Application/Training). These metrics focus on time to complete key tasks by clinicians as well as by staff within the Branch office and give a picture if staff are adopting the new work processes and competent in use of the system.

Given this organization's prior painful experiences with electronic health record systems and clinical point of care documentation, this initial phase of the GentivaLink implementation minimized workflow redesign and targeted basics of being able to do all the tasks around admitting, documenting, discharging, bill and generate correct paychecks. Even with this minimalist approach, we are seeing branches reduce time required to complete the admission start of care process and some clinicians are reporting 20-30% time savings in their documentation. Table 1 presents the productivity metrics for clinicians and office processes for the two months pre-implementation, during implementation and 1-month post implementation.

Table 1. Impact of system implementation on productivity metrics for clinicians and key office processes

Month 2013	# Documents Created	Clinician Accuracy (percentage)	Days to Send to Office	Days to Lock (QA)	Days to RAP (Bill)
June	Pre-implementation	na	3.5	7.2	10.2
July	18,959	86.4	3.1	6.6	12.4
August	38,170	90.8	4.2	7.6	12.2
September	88,656	85.5	3.1	7.6	12.67
October	247,805	87.5	2.9	9.2	13.3
November	384,067	90.4	2.7	9.4	14.28
December	466,150	93.0	2.3	10.5	16.63

The two clinician metrics are ***Clinician Accuracy*** and ***Days to Send*** documentation to the office. These Table 1 metrics show that our 12,000 field clinicians were able to admit patients and complete their documentation at the same rate pre-implementation as during implementation. ***Clinician Accuracy*** and ***Days to Send*** documentation to the office actually steadily improved throughout the implementation period and continues to gain in the post implementation period. Over the two pilots and two-month rollout, clinicians' use of the decision support functionality to check for missed fields or inconsistent functional assessments improved from 86.4% at start to 93% one month after rollout completion. Clinicians became strong supporters of this point of care documentation system in part because it took away repetitive work, eliminated the rework with correcting their documentation errors, and minimally changed the look and feel of their documentation forms. Anecdotally, clinicians widely related the qualitative difference of being able to complete all their documentation within their workday, enabling them to save their nights and weekends for their families.

For the home health branch office staff, the implementation experience has proven to carry a learning curve with an impact on processing throughput. This productivity impact can be seen through the two metrics of ***Days to Lock*** and ***Days to Rap***. As the number of documents created in the system grows with each month of implementation rollout, the branch office staffs have to increase the extent to which they are doing these basic business processes (Quality Assurance and Billing) in the new GentivaLink system. In contrast to the clinicians' metrics, branch office staff metrics show a steady increase in the amount of time required to complete processes that continues into the post implementation period. In evaluating this competency lag by our office staff, we have made changes to the training methodology to include a longer pre- and post- go-live practice of key workflows married up with managerial involvement and oversight. As we look at individual branches, the trend observed is that where strong branch leadership with solid operational practices were in place prior to implementation there is negligible change in processing time; in those branches that had uneven processes and/or leadership, we see a doubling of days to complete processes that is extending months after implementation completion.

4. Phase II Process Redesign

Prior to the GentivaLink implementation, clinical records and documentation were entirely manual and paper. Staffing in the home health offices included dedicated data entry and medical records personnel. As explained above, we deliberately took a minimalist approach in our Phase I implementation. We identified Phase II as where we had reached a steady state and could do the reengineering work to streamline processes and redefine job roles and functions. The Phase II process redesign changes will be done in conjunction with GentivaLink upgrades and process changes to accommodate ICD-10CM diagnosis coding conversion. In addition to the usual return-on-investment (ROI) metrics of productivity increases, improved documentation accuracy and completeness, savings on paper, storage, and staff, there will also be a focus on quality of clinicians' documentation, team coordination and communication, and the degree to which patient and family members are included in their care decisions. The process redesign implementation

and data tracking on results will happen with our organizations' migration to ICD-10CM. While we had initially planned to convert our 150 hospice programs to GentivaLink in early 2014 as part of Phase II, the magnitude of the ICD-10CM migration is requiring us to slow down our timeframe. Regardless if we complete Phase II in 2014 or have to have a Phase III in 2015, our vision is to have a common EHR platform across our home health and hospice practices, with a common shared patient record, using standard terminology and interoperable standards for exchanging data with our healthcare partners across the United States.

5. Discussion

Prior to Gentiva finding its web-based EHR partner, the system vendor options facing them actually would have put them at considerable business risk. Gentiva's organizational size and geographic spread presented major technical challenges to most of the major system vendors who would have had to build regional server centers to accommodate volume and geography – an approach that would be expensive, untried and based on old technologies. In addition, the requirement to have a connected mobile device to support care delivery in the home called for automatic internet connectivity built into the device. Most software vendors still use laptops with internet connection dependency. Again, the laptop represents an expensive and inefficient approach to a mobile workforce [6,7]. The new technologies that have come together in time and place to make the GentivaLink solution possible are: cloud-server technologies, web-based tools and programming and mobile, internet connected devices, such as iPads. Speed to develop, ease to implement, cost of ownership all make these new generation systems more user friendly for the healthcare organization and for the end user. The question posed in this paper and the significance of this use case is that as new entrepreneurs enter the EHR marketplace with the flexibility of the web technologies, cloud servers and the latest mobile devices, will this free up healthcare organizations to move off of old legacy EHR systems that carry the overhead of being built on 20th century technologies with usability, flexibility and interoperable standards and high costs of ownership challenges? As recently as three years ago, Blackberry dominated the marketplace for mobile phone devices. Today Blackberry's sales have dropped to less the 30% of their former high and the iPhone has taken the number one ranking in market share [8]. Could we be on the same threshold for a revolutionary technology change in the EHR market?

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