Perspective

Effect of the implementation of an enterprise-wide Electronic Health Record on productivity in the Veterans Health Administration

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Abstract: Since 1995, the Veterans Health Administration (VHA) has had an ongoing process of systems improvement that has led to dramatic improvement in the quality of care delivered. A major component of the redesign of the VHA has been the creation of a fully developed enterprise-wide Electronic Health Record (EHR). VHA's Health Information Technology was developed in a collaborative fashion between local clinical champions and central software engineers. Successful national EHR implementation was achieved by 1999, since when the VHA has been able to increase its productivity by nearly 6 per cent per year.

The US health care system is now obsolete, requiring comprehensive system redesign. Many experts have touted implementation of an Electronic Health Record (EHR) as a means to facilitate health care system redesign in order to improve quality of care and productivity. However, only a small percentage of American health care systems have a functional EHR.

A recent RAND review of existing EHR implementation found minimal evidence of improved health care productivity after extensive investment in EHR. In contrast, over the past several decades, a marked increase in productivity (in the range of 8 to 17 per cent per year) has been demonstrated in the tele-communications, security trading, retail, and wholesaling sectors, after they transformed their business models through the use of information technology (Hillestad *et al.*, 2005).

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Starting in 1995, the Veterans Health Administration (VHA) has undergone a number of transformational structural changes. The VHA was transformed from a 'hospital system' to a 'health system'. Structurally, this required the transformation of the model from a 'safety net', providing interventions after clinical catastrophes, to a model focusing on health promotion and disease prevention. This change required structural transformations including augmenting community-based ambulatory care (a 300 per cent increase in ambulatory capacity through development of 'community-based outpatient clinics'), home care, etc. Thus, the VHA's vision of providing the most efficient (improved productivity), effective (highest quality) care is based on the core idea that coordination of care between local and referral providers required massive systems improvement ('the right care at the right place and the right time'). These changes made explicit the link between information and system measurement as predicates for transformation and increased value (as measured by both improvements in productivity and quality). The VHA has undergone a process of holding regional health care system management accountable through an objective performance measurement system (a 'national contract') that highlights opportunities for improvement. Perlin *et al.* have documented the transition of the VHA from a sclerotic, bureaucratic health care system in the early 1990s to today's VHA, where quality of care has become a benchmark in health care (Perlin *et al.*, 2004, Jha *et al.*, 2003).

In late 1997, as part of a complex system redesign, the VHA began rolling out an enterprise-wide update of its existing Health Information Technology (HIT) known as 'VistA' (Veterans Health Information Systems and Technology Architecture). By 1999, all VHA facilities had fully implemented this graphical user interface (GUI)-based EHR, now known as the 'computerized patient record system' (CPRS). CPRS features include an enterprise-wide computer-based patient record, clinical decision support features, ability to communicate between providers, and ability for secondary use of data (for example, for research purposes). CPRS provides a graphical interface for a patient's entire medical record. It is flexible enough to work across the spectrum from home care, ambulatory care, inpatient, ICU, and long-term care locations, thus providing a longitudinal patient record. CPRS is a comprehensive way for clinicians to view, in a timely fashion, patient-centered information, including their problem list, allergies, medications (both provider ordered and over the counter), progress notes, laboratory and imaging results, consults, and discharge summaries. In addition, CPRS has a fully Computerized Provider Order Entry (CPOE) function. CPRS has many high-level features such as: (a) a clinical data repository; (b) privacy protection; (c) a means to facilitate clinical work flow by providing real-time data across the entire enterprise; and (d) clinical decision support with clinical reminders, a real-time clinical alert system, notification systems, and disease management features. Recent additions include VistA Imaging, which is a multimedia record of images from a multitude of sources (such

as ECGs (EKGs), imaging studies, procedures, endoscopies, and scanned documents). International observers have called VHA's EHR the 'Gold Standard in Clinical Informatics' (Morgan, 2005). An on-line demonstration of CPRS can be accessed at www.va.gov/cprsdemo (Veterans Health Administration, 2005a).

As an EHR that developed over time in a process that benefited from extensive end-user feedback with numerous suggested (and implemented) changes, CPRS has been continually refined to meet the needs of clinicians and facilitate clinical improvement programmes, resulting in 26 discrete versions that have continually enhanced the capabilities and thus the productivity of VHA's clinicians. A major feature in the development of CPRS that facilitated its acceptance across a disparate group of clinical staff was the use of a collaborative approach in its development and updates. The combination of extensive, grass roots innovations, together with feedback from the clinicians who served as the CPRS champions, has facilitated the rapid spread of this technology (Veterans Health Administration, 2004; Brown, 2003). The VHA invested significantly in the means to bring together clinicians, administrators, and programmers each year to address needed improvements, role out new features, and ensure that there was both input into the development process and acceptance by the end users. In fact, an annual national meeting known as Camp CPRS was established to promote teamwork and facilitate networking among endusers, which became an important forum for indentifying needs for future CPRS development and sharing innovative applications of the technology. Shortliffe (2005) states that the major investment in VistA 'has had a profound influence on the quality and efficiency of clinical care and data management in the nation's veterans' hospitals'.

From 1996 to 2004, VHA has been able to accomplish the following metrics:

- An increase in the number of patients treated from 2,898,631 to 4,910,882, a rise of 1,911,501 or 69.4 per cent (Veterans Health Administration, 2005b).
- A net decrease of 0.2 per cent in the cost per patient. In 1996, the VHA spent US$5,058 per patient per year, while in 2004 it spent $5,048 (nominal) per patient, a decrease of US$10 per patient per year. The VHA's cost per patient in 1996 was similar to Medicare's annual spending per enrolee (US$5,000). By 2004, the VHA's unchanged cost per patient was nearly 26 per cent lower than Medicare's cost per patient (in 2004, Medicare spent US$6,800 annually per enrolee – see Figure 1) (Veterans Health Administration, 2005b; Centers for Medicare and Medicaid, 2004)).
- A 69.4 per cent increase in the number of patients seen came at the cost of 68.7 per cent increase in the total budget (from US$14.7 billion to US$24.8 billion) (Veterans Health Administration, 2005b).

Figure 1. Medicare vs. VHA Cost per Patient by Year
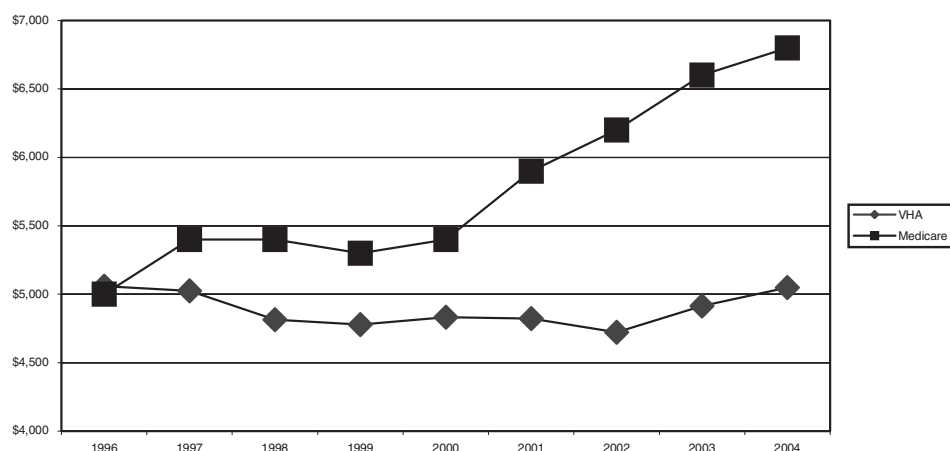
- A net decrease of 23.3 Full Time Employee Equivalents (FTEE) per 1,000 patients, a 37 per cent reduction. In 1996, the VHA had 62.7 FTEE per 1,000 patients, while in 2004 it had 39.4 employees per 1,000 patients. The VHA FTEE at the end of 1996 was 195,151 and at the end of 2004 was 192,557, a decrease of 2,594 or 1.33 per cent (Veterans Health Administration, 2005b).

On a simple cost per patient definition, the VHA's marked improvement in productivity, together with the dramatic 37 per cent drop in the employee to patient ratio, offers an indication of the magnitude of the system redesign that the VHA underwent during this time. Overall, veterans in the US fare better in terms of health and income than other Americans. However, veterans using the VHA for health care are adversely selected. On average, compared with age-matched Americans, they are older (49 per cent are over age 65), sicker (three additional physical and one additional mental health diagnosis than age-matched Americans), and poorer (70 per cent with incomes less than US$26,000 per year, and 38 per cent with incomes less than US$16,000 per year) (Perlin *et al.*, 2004). Despite this relatively high risk group, the VHA's ability to benefit from the implementation of an efficient enterprise-wide EHR over the seven-year period is indicated by the fact that, while the US medical consumer price index (CPI) went up by 48 per cent over the period, the VHA's nominal cost per patient did not substantially change, demonstrating a 6 per cent per year decrease in the cost per patient relative to the increase in the medical CPI.

The cost of implementing Health Implementation Technology (HIT) both in large systems (as well as in small provider offices) has been cited as a major barrier to the rapid spread of EHRs (Bates, 2005). The VHA's unchanged cost per patient documents the ability to redesign a health care system (through the implementation of HIT) over time in a cost-neutral fashion.

Full implementation of an EHR may mean different things to different observers. In the VHA's CPRS, full EHR implementation features Computerized Provider Order Entry (CPOE) capability (inpatient, outpatient, medications, laboratory, imaging requests, etc.) that promotes communication (e.g. through legibility and no lost or ambiguous orders). By the end of 2004, 94 per cent of all pharmacy orders across the VHA were entered via CPOE. CPRS is an electronic medical record that proactively facilitates document creation and is not a HIT system that only scans in written notes or simply facilities results retrieval.

Significantly, while the VHA generated significant improvements in its staffing levels by redesigning its HIT, these changes were associated with measured improvements in quality. Jha *et al*. (2003) documented that by all quality measures for which comparable metrics are available, across multiple health care systems, VHA is consistently at the top. Particularly impressive are the results in preventive services and managing chronic disease processes and outcomes, such as cancer screening, acute coronary syndrome, heart failure, diabetes, depression and smoking cessation. In fact, a recent study by RAND investigators found that VHA outperforms other American health systems on 294 evidence-based, quality measures in disease prevention and treatment (Asch *et al*., 2004).

As the largest integrated health care system in the US, the VHA had several advantages to ensure complete adoption of an enterprise-wide EHR (CPRS). The VHA is a vertically integrated system responsible for both the delivery and financing of health care in that it: (a) owns its own clinic and hospital system; (b) employs its own physicians; and (c) has a minimal flow of patients in and out of the system (Kleinke, 2005). However, only one in five of VHA's physicians work solely for the VHA (approximately 15,000); there are 25,000 additional faculty physicians who come to VHA through its relationships with 107 of the 126 US medical schools. In addition there are 35,000 resident physicians that annually rotate through the VHA hospitals. This suggests that, since only 20 per cent of VHA's physicians are direct line employees, the VHA's implementation of an EHR and performance measurement are more important in making improvements than line employee relationships. The VHA has also benefited from the adoption of an EHR with enterprise-wide interoperability (same standard definitions) that functions nationwide (Shortliffe, 2005). The VHA is known as a leader in the development of national EHR standards, and VHA's next generation HIT system will be increasingly externally interoperable. While the VHA has been able to centrally mandate the adoption of new information technology, system wide adoption of an EHR has been successful because of a partnership with local clinicians and innovators. A willingness on the part of developers to adjust to clinical feedback resulted in CPRS optimization. Since the VHA's strategy has been to promote CPRS as a means to improve quality of care, a favorable consequence has been to deliver

high-quality care at an overall cost per patient that is 26 per cent lower (Figure 1) than Medicare's cost per patient. The VHA's process of continuing the development of the CPRS by an iterative partnership between local champions and central programmers differs from the development of other EHRs, which tend to be built to specifications without ongoing input from front-line users.

Middleton (2005) states that health 'IT adoption is 5 per cent technology related issues and 95 per cent sociocultural issues such as change management, political process, leadership, commitment, risk tolerance and finances'. The VHA's remarkable systems redesign demonstrates a marked cultural change that has resulted in striking improvements in both quality and productivity. Bower (2005) states that the only other large US health care system with an emerging sophisticated EHR (Kaiser) has not yet been able to demonstrate higher performance due to its EHR. The VHA's success was often dependent on strategies such as central mandates, an organized measurement system and a willingness for risk taking.

As VHA facility-based clinicians began implementing CPRS they noted that throughput increased as they began the dynamic process of clinical process redesign. If VHA clinicians had simply computerized existing workflow processes, the significant efficiency improvements that the VHA has demonstrated over the past seven years would not have occurred.

While HIT implementation is a significant and innovative systems improvement, it would be difficult to attribute all of VHA's successful redesign to the adoption of the CPRS. However, it is clear that the EHR provided the basis for large-scale databases, conferring, in turn, the foundation for evidence-based management and system accountability through the tracking of processes and outcomes. This would not have been possible with a paper-based patient record system. The current use of the CPRS is not limited to the VHA. CPRS software is in the 'public domain', and can be acquired for a minimal administrative cost. In addition, the Centers for Medicare and Medicaid Services are developing an open source Electronic Health Record, based upon VHA's VistA.

Perhaps the most significant advantage that the VHA had in EHR development was the decision to create an 'in-house' product rather than outsourcing the product. Thus, the VHA clinicians did not have to align their clinical processes to 'off the shelf' EHR software; a perverse alignment of workflow adaptation to a support system, rather than the more rational tailoring of such systems to support optimized work flow. The collaborative processes between front-line clinician champions, supportive local management teams and a talented cadre of programmers resulted in the largest scale implementation of any EHR in the world. The remarkable productivity and quality achievements of the VHA have been facilitated by the adoption of an enterprise-wide EHR, which provided the underpinning for clinical decision support,

performance measurement and management, and has measurably improved patient records management, patient safety and the quality of care.

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