Phased implementation of electronic health records through an office of clinical transformation

Colin A Banas,1 Alistair R Erskine,1 Shumei Sun,2 Sheldon M Retchin1

ABSTRACT
Evidence suggests that when carefully implemented, health information technologies (HIT) have a positive impact on behavior, as well as operational, process, and clinical outcomes. Recent economic stimulus initiatives have prompted unprecedented federal investment in HIT. Despite strong interest from the healthcare delivery community to achieve ‘meaningful use’ of HIT within a relatively short time frame, few best-practice implementation methodologies have been described. Herein we outline HIT implementation strategies at an academic health center with an office of clinical transformation. Seven percent of the medical center’s information technology budget was dedicated to the Office of Clinical Transformation, and successful conversion of 1491 physicians to electronic-based documentation was accomplished. This paper outlines the process re-design, end-user adoption, and practice transformation strategies that resulted in a 99.7% adoption rate within 6 months of the introduction of digital documentation.

INTRODUCTION
Electronic health records (EHRs) have yielded both cost savings1–2 and improved patient outcomes.3–5 Quality improvements have been especially compelling when EHRs are appropriately applied to clinical workflows and process redesign takes place.6 7 Some institutions have established EHRs through the healthcare sector has been limited.8 Automation of paper-based processes and the standardization of clinical workflow required during EHR installation is disruptive and can lead to incomplete adoption. The lack of engagement of clinical stakeholders likely accounts for some disappointing results.10 Unintended consequences of EHR implementation can be associated with increased mortality11 and reduced efficiency.12 The term ‘iatrogenesis’13 has even been coined to refer to harm introduced as a result of conversion to electronic records. Some institutions have abandoned EHR installations altogether, even after earlier commitment.14 Still others have demonstrated that the majority of physicians will adopt EHRs if given long horizons and functionality is addressed.15

The American Recovery and Reinvestment Act mandated federal investment in health information technologies to encourage physicians and hospitals to adopt EHRs.16 17 After an initial adoption phase, Medicare and Medicaid programs will penalize providers and facilities which have not implemented EHRs. However, implementation challenges remain, including organizational barriers.18 Herein we provide a case study of the implementation of online provider documentation at a leading medical center with the establishment of an office of clinical transformation (OCT).

BACKGROUND
The Virginia Commonwealth University Health System (VCUHS) is the only comprehensive academic health center in central Virginia. The VCUHS has a rich tradition of initiatives in information technology with more than 30 years of use of computer provider order entry (CPOE) and clinical decision support systems. In 1999, the VCUHS committed to update its clinical information system to a more contemporary product which promised streamlined electronic-based clinical workflows and more intuitive graphical user interfaces.

Despite due diligence and ample research by the VCUHS leadership, the magnitude of the conversion effort from the legacy software to a new clinical information system was underestimated. While the VCUHS made significant investments to establish electronic-based clinical automation, clinicians became progressively disenfranchised. They complained the new system was fragmented, lacked intuitiveness, and required excessive effort to sift through data. Worse, the paper paradigm remained embedded in new electronic processes and some staff developed workarounds which undermined standardized workflows.

DESIGN OBJECTIVES
In order to overcome the barriers posed by traditional methods of implementing clinical applications, the VCUHS created an OCT. The OCT was established as a data-driven entity with the goal of converging clinical, educational, financial, and research activities through the application of medical informatics. The VCUHS dedicated 7% of its information technology operational budget to the OCT. It relied on the OCT to prioritize and make configuration decisions about the EHR. The OCT membership was broadly represented across multidisciplinary teams spanning the health system, drove consensus, and provided a balanced approach to electronic process redesign and practice transformation.

SYSTEM DESCRIPTION
OCT members included faculty physicians who underwent formal biomedical informatics training
and received protected time (ranging from 25% to 50%) as ‘physician informaticists.’ The Chief Medical Information Officer (CMIO) served as the physician champion, devoting 75% of his time to transformative endeavors while remaining clinically active for the remainder. He also continued to carry out his traditional CMIO activities, such as strategic planning. ‘Nurse informaticists’ provided balanced and equal leadership and were led by the Chief Nursing Information Officer. These clinician leaders played vital roles in translating clinical needs into technical specifications. Dedicated analysts provided technical subject matter expertise and valuable input regarding feasibility during software configuration discussions.

As shown in figure 1, the OCT was organized across three primary domains: diffusion of innovation, impact assessment, and interoperability.

**Domain one: diffusion of innovation**

With any new technology, there are barriers to diffusion of innovation which requiring cultural metamorphosis if they are to be overcome. Thus, to aid the diffusion of the EHR, four councils were established to facilitate adoption in the clinical environment: the Clinical User Experience Council, the Online Documentation Council, the Orders Council, and the Clinical Decision Support Council. The following sections describe each of these councils.

**Clinical User Experience Council (CLX)**

The CLX council was established to focus on the intuitiveness of the graphic user interface and the visual-spatial views presented to end-users. The CLX addressed information management, processing, and usability of the clinical application. It examined the timing of mouse click-counts across electronic workflow as a surrogate measure of adoption and navigation effectiveness. Cognitive and behavioral outcome measures were estimated by the CLX via a survey instrument; clinical data repository reporting was used to identify end-users who were struggling and expert users suitable for super-user recruitment. The Council coordinated advice and recommendations with pre-existing information system training and support staff.

**Online Documentation Council (DOC)**

The DOC was tasked with eliminating the paper chart in favor of a ‘paper-light’ medical record. Under a paper-light environment, documents could still be printed from the electronic

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**Figure 1** Organization of the Office of Clinical Transformation. CDS, Clinical Decision Support Council; CLX, Clinical User Experience Council; CMIO, Chief Medical Informatics Officer; COM, Clinical Communication Council; DATA, Data Integrity and Analytics Council; DOC, Online Documentation Council; EHR, electronic health records; FTE, full-time equivalent; ORD, Orders Council.
record as workflow aids, but permanent sections of the medical record remained only electronic. Billing, regulatory, and process-based outcomes were tracked through content quality review by the compliance and Health Information Management (HIM) department.

Orders Council (ORD)
The ORD maintained responsibility for institutional CPOE and order set management. Evidence-based practice recommendations from a third party vendor were used, and merged with consensus from in-house clinical opinion leaders. The ORD tracked use of order sets and oversaw the migration to standardized CPOE practice. The efforts of the Council were tightly linked to the health system’s pharmacy and laboratory departments.

Clinical Decision Support Council (CDS)
The goals of the CDS were to promote best evidence practice and reduce variations in care. While the majority of the requests received by the CDS were generated from performance improvement initiatives, the CDS also was charged with reviewing clinical decision support initiatives.20 These included support systems embedded in order sets, documentation templates, and graphical user interface data. The CDS monitored quality and safety outcome measures through analysis of alert over-ride patterns and medical error rates. The CDS coordinated their efforts with the organization’s professional liability claims, safety, and quality committees.

Domain two: impact assessment and metrics
The accessibility of multi-source data elements is vital to the return on investment for an EHR. For example, an EHR needs to ensure that inputted data have integrity and are robust enough to support hypothesis testing. Thus, we set up a council that was dedicated to the integrity of the data to preserve the analytic potential of the system for later study.

Data Integrity and Analytics Council (DATA)
The DATA supported a clinical data repository that was designed to report on the integrity of the data flowing into the system, as well as on the validity of the data being reported. The team was tightly aligned with financial, operational, and quality data stewards from the health system to map data across the organization for aggregated reporting purposes.

Domain three: interoperability and outreach
One goal of an EHR is to provide a seamless communication tool that can transcend borders. To that end we felt a focus on interoperability issues needed to be prioritized. We sought to concentrate our efforts on physician groups in the community. We established a communication council to underscore the need to communicate with other providers and to set priorities for these efforts.

Clinical Communication Council (COM)
The COM principally focused on three issues: interoperability with other healthcare delivery organizations, outreach to community providers, and patient-centered medical home models.21 The COM worked closely with outreach committees, information technology interface teams, and the HIM department.

Although clinician engagement proved to be a successful catalyst toward implementation of a comprehensive EHR, it also generated an abundant flow of requests for modifications. To prioritize these requests, the OCT used a weighted, forced-ranked order algorithm (table 1).

STATUS REPORT: A THREE-PHASED IMPLEMENTATION FOR DIGITAL DOCUMENTATION
The OCT and its six councils working across three domains increased the usage and adoption of the EHR. The deployment strategy included three phases: a preparatory phase focused on training and technical application, an adaptive period designed to engage clinicians at their own pace, and a practice transformation phase for optimization of the application after implementation (figure 2).

Phase one: 6-month preparatory phase
During the preparatory phase, the DOC reviewed deployment strategies and focused on the production of documentation tools. Thus, providers were encouraged to create digital documentation according to personal preference across three available tools (blob text, structured text, and dictation). The DOC negotiated configuration decisions across specialties.

The DOC devised a clinical note nomenclature based on experience from the Veterans Administration.22 The training strategy evolved during the preparatory phase and included a combination of classroom and e-learning to manage the volume of users who required training. Training was declared mandatory by the medical center leadership. End-users had the option of completing e-learning modules (which included competency-based exams that demonstrated adequate aptitude for navigating documentation tools), classroom training, or one-on-one sessions. Completion of one of the forms of training was a prerequisite to retain access to the EHR by the end of the preparatory phase.

Phase two: 6-month adaptive period
During implementation of the electronic documentation tools in the adaptive period, providers were encouraged to convert to an electronic note writing process; however, conversion was not yet mandatory. Early adopters benefited from dedicated resources to help build specialty-specific templates and received dedicated presentations regarding EHR changes. Those choosing to implement digital documentation during the adaptive period were asked to print and insert notes into the paper chart to avoid hybrid documentation and maintain a single source record. This paper medical record was sustained until full electronic conversion.

During the adaptive period it was necessary to simplify and adjust vendor provided documentation templates. Less complicated templates were valued over more comprehensive models. The tools which automated the addition of standardized discrete data into notes were managed by the CLX and CDS and also helped to drive adoption. Concerns over copy-and-paste features were mitigated by the development of policy, education, and remote auditing of electronic notes.

The adaptive period overlapped with a widespread campaign promoting awareness of the conversion date mandated by the VCUHS. Members of the DOC held regular meetings at all levels of the organization describing progress and managing expectations. Early adopters identified flaws in the configuration of the application and adjustments were made to ease the adoption for subsequent users. In all, 94 super-users were recruited and provided additional guidance during the adaptive period. Over 80% of the providers had chosen to convert to digital documentation 2 weeks ahead of the mandatory conversion (drop-dead) date. The results indicated a successful initiative with
conversion of 1451 physicians to electronic-based documentation in a 6-month period, with a sustained adoption rate of 99.7%.

Phase three: 2-week practice transformation
Following mandatory conversion, providers who were still unfamiliar with online documentation were identified. Nurse coordinators performed concurrent review of medical records and HIM staff reviewed paper records after discharge—both reported records with evidence of provider handwriting on a daily basis. These methods were effective as the initial 10–20 providers who sustained paper documentation quickly converted.

The OCT continues to exist as the primary clinical transformative change agent in the VCUHS. Its role is continually expanding and now includes leadership roles in EHR governance and practice, as well as advisory roles for upcoming EMR implementations. The OCT is also serving as part of the bioinformatics core leadership for participation in NIH grants such as the Clinical and Translational Science Award.

DISCUSSION AND LESSONS LEARNED
We describe the results of a clinical informatics program to accelerate adoption of an EHR by physicians. Our case study illustrates the value of creating a clinician-led approach to electronic conversion through an OCT. The structure of the approach demonstrates that clinician-led adoption of an EHR can help to mitigate resistance.

Several limitations merit emphasis. First, the investment required to establish the OCT was substantial. However, there are many instances of failed implementation of EHRs due to clinician resistance because of deployment of non-intuitive software. Therefore, it was reasonable to invest a modest amount in successful implementation strategies with clinician leadership.

Table 1  Clinical informatics prioritization algorithm (100-point scale)

<table>
<thead>
<tr>
<th>Description</th>
<th>Options</th>
<th>Points</th>
<th>Weight</th>
<th>References</th>
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<td>2013 Criteria</td>
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<tr>
<td></td>
<td>2015 Criteria</td>
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<td></td>
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<tr>
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<td>No impact on meaningful use</td>
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<tr>
<td>Safety/risk</td>
<td>Critical event/liability claim</td>
<td>15</td>
<td>(×5)</td>
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<td>Documented near-miss</td>
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<td></td>
<td>Liability Claims Committee</td>
</tr>
<tr>
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<td>Risk/suspected safety first issue</td>
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<td></td>
<td>Patient Safety Officer</td>
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<tr>
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<td>No safety issues</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Regulatory</td>
<td>Known TJC, CMS, VDH criteria</td>
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<td></td>
<td>VCUHS policy</td>
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<td></td>
<td>See <a href="http://www.cms.gov/">http://www.cms.gov/</a></td>
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<tr>
<td></td>
<td>Suspected risk</td>
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<td></td>
<td>See <a href="http://www.vdh.state.va.us/OJC/Laws">http://www.vdh.state.va.us/OJC/Laws</a></td>
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<td>No regulatory issues</td>
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<td>Evidence-based care</td>
<td>Establish guideline evidence</td>
<td>10</td>
<td>(×3.3)</td>
<td>See <a href="http://www.ncqa.org/">http://www.ncqa.org/</a></td>
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<tr>
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<td>Literature or best-practice</td>
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<td>Quality officer</td>
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<td></td>
<td>Anecdotial or common practice</td>
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<tr>
<td></td>
<td>No evidence-based impact</td>
<td>0</td>
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<td>Strategic goals</td>
<td>CEO and corporate executives</td>
<td>10</td>
<td>(×3.3)</td>
<td>See <a href="http://www.vcuhealth.org/upload/docs/VCUHS_orgStructure09_10.pdf">http://www.vcuhealth.org/upload/docs/VCUHS_orgStructure09_10.pdf</a></td>
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<td>Directors</td>
<td>3</td>
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<td>Patient-centered</td>
<td>Patient-initiative</td>
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<td>(×3.3)</td>
<td>See <a href="http://www.ncqa.org/tabid/1302/Default.aspx">http://www.ncqa.org/tabid/1302/Default.aspx</a></td>
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<td>Opinion</td>
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<td>Do not affect patients</td>
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<tr>
<td>Impact/# affected</td>
<td>&gt;250 Users and/or daily issue</td>
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<td>(×3.3)</td>
<td>Use ad-hoc database query</td>
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<td>&gt;100 Users and/or weekly issue</td>
<td>7</td>
<td></td>
<td>Usage database overview</td>
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<td></td>
<td>&gt;10 Users and/or monthly issue</td>
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<td>Other objective measure as possible</td>
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<td>Between 0–10 users and rare</td>
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<tr>
<td>Efficiency improvement</td>
<td>Yes with expected goals</td>
<td>10</td>
<td>(×3.3)</td>
<td>Use existing measures (already baselined) as possible</td>
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<tr>
<td></td>
<td>Yes with metric identified</td>
<td>7</td>
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<tr>
<td></td>
<td>Suspected</td>
<td>3</td>
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<td></td>
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<tr>
<td></td>
<td>No efficiency expected</td>
<td>0</td>
<td></td>
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<tr>
<td>External relations/</td>
<td>Support research/education</td>
<td>5</td>
<td>(×1.7)</td>
<td>Clinical Trials Office, School of Medicine Dean’s Office</td>
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<td>regional partnership</td>
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</tr>
<tr>
<td></td>
<td>No partnership opportunities</td>
<td>0</td>
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</table>

CEO, Chief Executive Officer; CMIO, Chief Medical Information Officer; CMS, Centers for Medicare & Medicaid Services; CNIO, Chief Nursing Information Officer; NCQA, The National Committee for Quality Assurance; TJC, The Joint Commission; VCUHS, Virginia Commonwealth University Health System; VDH, Virginia Department of Health; VPs, Vice Presidents of Health System.
empowerment. The alternative was to concentrate on post-deployment strategies; however, EHR transformation is far more successful when approached prospectively.

Another potential limitation is the generalizability of this approach to other settings, especially those with voluntary medical staff. However, health systems are increasingly pursuing integrated models of care. Moreover, with voluntary medical staff, the role of an OCT may even be more critical and designation of physician champions particularly vital. A CMIO is a necessary ingredient to ensure that implementation initiatives succeed.

Our experience with EHR adoption is that an OCT was a vital component that helped to ensure provider input and engagement. When faced with the challenge of EHR adoption, other institutions may wish to consider similar initiatives to avert implementation failures.

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