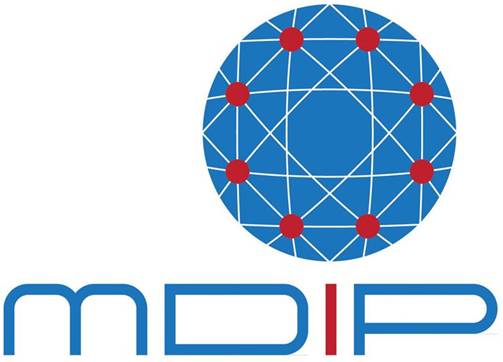
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**Veterans Health Administration (VHA)**

**Medical Device Interoperability Program (MDIP)**

**Echocardiogram Workstation Integration**

**Clinical Usability Study**

**Ralph H Johnson VAMC**



**VHA Office of Health Informatics (OHI)**

**Knowledge Based Systems (KBS)**

**April 2018**

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# Executive Summary

Diagnostic procedures and studies (e.g. Echo Lab cardiac ultrasound) are crucial to Veteran care. Third party systems such as the GE EchoPAC workstation are widely used by VA to document findings and conclusions and share them with other care team members through the VHA’s Electronic Health Record (EHR) known as VistA/CPRS. When procedure reports from third party systems are entered manually, however, there are delays and errors that can adversely affect Veteran care and increase the workload for clinical staff.

In response to concerns from local clinicians, an interdisciplinary team at the Ralph H. Johnson VA Medical Center (VAMC) in Charleston, SC reached out to VHA Office of Health Informatics (OHI) Knowledge Based Systems (KBS) Medical Device Interoperability Program (MDIP) to identify challenges within the echocardiogram reporting workflow, assess their impact on Veteran care, and propose solutions, specifically to the manual entry of procedure notes into CPRS. Medical devices and software such as the GE EchoPAC reporting workstation increased the quality of procedure reports, however, reports still required manual entry into CPRS. A focused usability and workflow analysis identified concerns from ordering providers who were not receiving timely notification of completed procedure reports. By observing the manual workflow in person, we developed simple techniques that lowered risk introduced by manual data entry, and we identified the strong need to specify automation and interoperability as key requirements of any diagnostic procedure system. The study showed that a well-designed Clinical Usability Study (CUS) can pinpoint workflow issues, help to re-engineer clinical workflows, and foster care team collaboration between local and national resources.

For FY17, the study team identified eleven (11) charting adverse events at Charleston VAMC that were impacted by the lack of interoperability of the EchoPAC system and manual entry of echocardiogram reports into CPRS. A focused usability analysis is greatly needed to pin-point breakdowns in clinical workflows, reduce short-term risk of near-misses, and identify robust solutions (e.g., software upgrades and standards-based interoperability) that can be deployed across VA sites.

# Background

The Echocardiogram Workstation Integration CUS, conducted in partnership with the Charleston VAMC, is the second study in a series conducted by MDIP. It is a follow-up to a previous study that evaluated the impact of introducing standards-based interoperability and automation into the Respiratory Therapy workflow by integrating a vendor device into VistA Vitals at the Tennessee Valley VA Healthcare System in Nashville, TN. The Nashville study quantified the benefits of device interoperability and automation and confirmed the thesis that these standards-based efforts drastically improve efficiency and patient care.

MDIP Overview

MDIP was initiated in 2010 by the VA Medical Device Interoperability Summit to “bridge the gap” in medical device interoperability requirements that were not being adequately represented across VA.

MDIP has since had a long track record of successful outcomes within VA and in the industry at large (i.e. the IHE Pulse Oximetry Integration (POI) Profile).

MDIP staff is available to provide assistance to other VAMCs in investigating and resolving similar issues as were identified in this study.

The Charleston study approached usability from a different perspective: by assessing the cost of noninteroperable and nonautomated echocardiogram reporting on overall system usability, patient safety, and patient outcomes. The results of the study proved that the lack of integration of the EchoPAC reporting workstation has a negative effect on the procedure reports recorded in CPRS and is an obstacle to the seamless management of Echo Lab orders. Radiology staff deployed manual workarounds to improve the reports entered in CPRS. Changes to the process increased the likelihood of error. While the manual workarounds improved the reports overall, they could not overcome data display barriers (e.g. representation of tables) or address notification challenges on a consistent basis.

The Nashville and Charleston studies are blueprints for similar VHA efforts to quantitatively measure the effects of noninteroperable and nonautomated solutions, while proposing steps to optimize workflows, usability, and outcomes.

Figure 1 illustrates other clinical areas that use third-party device and information systems that may benefit from a study using the same approach (e.g. Audiology, Orthopedics).

A screenshot of a cell phone

Description generated with very high confidence

Figure : Clinical Usability Study Context

# Acknowledgements

This document summarizes the activities of an entire team over the many phases of the project – in chronological order of their involvement. The editors would like to acknowledge the following team members and their contributions:

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# Clinical Usability Study

## Abstract

This report describes a mixed-method study to evaluate the echocardiogram procedure reporting process at a major VAMC with respect to effectiveness, efficiency, and patient safety. The purpose of the study was to quantify the costs and benefits to improving the interoperability of medical devices with the EHR. Findings strongly suggest that better interoperability can eliminate multiple patient safety risks, improve efficiency of the workflow, and improve the effectiveness of the diagnostic process. Recommendations include interventions for improving the echocardiogram process specifically, as well as techniques for evaluating and improving similar device-to-EHR subsystems.

## Introduction

An echocardiogram is an ultrasound test that produces images used by clinicians to help assess a patient’s heart function. The orders for an echocardiogram (Echo Lab Consults) originate from either a primary care doctor or cardiologist. This diagnostic procedure is performed by an ultrasound technician or cardiologist using a cardiac ultrasound device. The resulting images are interpreted by a cardiologist using specialized image analysis and reporting workstation software. The specific cardiac ultrasound workstation used to interpret Echo Lab images at the Charleston VAMC is called GE EchoPAC. At Charleston, the cardiologist’s findings are then recorded as a text-based note that is included in the procedure report as part of the patient record within the EHR system. At VA, this EHR system is VistA/CPRS. For this study, we utilize CPRS.

In an earlier effort to improve echocardiogram reporting, the cardiology department at the Charleston VAMC made changes to the reporting process. In April 2017, the department changed from a process using an outline template within CPRS, in which findings were typed exclusively within CPRS, to a process utilizing a report-generating system within the EchoPAC software. Table 1 shows a comparison of the report styles between the old and new processes.

Table 1. Comparison of style for echocardiogram reports (excerpts show left ventricle findings)

|  |  |
| --- | --- |
| **Old style (CPRS): Outline form** | **New style (EchoPAC): Clinical statements** |
| Left Ventricle:  Size is: Dilated  Wall thickness: normal  Global Function: mild LV dysfunction  Ejection Fraction: 45-50 %  Regional Function: inferior and inferioseptal hypokinesis  Thrombus: Not present  stage 1 diastolic dysfunction with normal LV filling pressures. | Left Ventricle: Left ventricular size is normal. Left ventricular wall thickness and mass are normal. There is normal global left ventricular systolic function. Left ventricular ejection fraction measured by Simpson's biplane method is 63.59%. There is paradoxical septal motion. The distal anterior LV wall is hypokinetic. The apex is hypokinetic. Pseudonormal LV filling pattern (grade II diastolic dysfunction), suggesting elevated LV filling pressures. |

As can be seen above, the earlier CPRS-only reporting template used a general outline in which cardiologists filled in study results as necessary, while leaving unused fields blank. This system allowed for short, concise, specific inputs that may have left out critical clinical information. In contrast, the newer EchoPAC system used a more verbose reporting style that reads as complete clinical statements. Charleston Cardiology Department leadership explained that this change was made to improve the clarity, consistency, and completeness of echocardiogram reports. Because of a lack of interoperability between the EchoPAC and CPRS systems, however, this improvement in report quality and clarity required additional steps for the EchoPAC content to be manually transferred into CPRS. This trade-off of additional steps for higher report quality resulted in unintended consequences that will be discussed later.

The primary goal of this study was to better understand usability issues regarding echocardiogram reporting, with an emphasis on issues stemming from a lack of system interoperability, in support of the broader goal of improving system interoperability efforts VA-wide. The main study question asked whether improved interoperability markedly improves: time efficiency, time for originating clinician to receive results, patient safety, provider satisfaction, and ultimately, patient care.

## Method

### Study design

A mixed-method approach was taken (that is, combining multiple human factors study methods), driven principally by ethnographic techniques. Ethnography is the study of human groups and the individual beliefs, actions, and interactions that contribute to collective team behavior and work product. The main ethnographic techniques used were: (1) observation, and (2) informal interviews punctuated with probing questions to understand tacit (unspoken) information, usability and patient safety issues, and to reconcile apparent inconsistencies. In this case, these techniques were used to study how well we are meeting the clinical goal of providing effective, efficient, and safe patient care specific to assessing patient heart function.

Other human factors techniques used include: (1) workflow analysis, and (2) hierarchical task analysis to provide structure and context to the knowledge gleaned from the ethnographic study. A patient safety analysis (based on Healthcare Failure Modes and Effects Analysis – HFMEA) and a high-level review of completed echocardiogram notes were used to identify and understand specific patient safety issues. Additionally, timing data was collected on a portion of the cardiology reporting task to gain a baseline understanding of efficiency impediments.

### Workflow

The overall workflow for an echocardiogram procedure is fairly straightforward. Figure 2 illustrates a simplified sequence diagram for a common echocardiogram scenario.



Figure 2. Normative sequence of events in a simplified echocardiogram procedure process

The workflow begins at the top-left of the diagram and follows the arrows down and to the right before moving back to the left side for the final step in the sequence. The first step is a patient visit that results in the order from a Primary Care Physician (PCP) for an echocardiogram. The patient is subsequently scheduled for the procedure where the echocardiography technician (Echo Tech) performs the ordered echocardiogram and makes the resulting imagery available to the cardiology fellow (Cardio Fellow) via the EchoPAC workstation. The images resulting from the echocardiogram are then interpreted by the Cardio Fellow, who creates a draft report of the findings. The cardiology attending physician (Cardio Attending) reviews and approves the draft report on the EchoPAC workstation, with the approved report then manually pasted into a CPRS patient note. When the final patient note is signed by the Cardio Attending, it is returned to the PCP for follow-up with the patient. There are many variations on this basic sequence that occur in the real world, but this example is sufficient to illustrate the basic steps, timing, and interactions. The study focused primarily on the interactions between the Cardio Fellow and Cardio Attending (steps circled in red in Figure 2) because these interactions involve multiple manual actions as a result of limited system interoperability. These interactions are further examined below in the Taskflow Results section.

### Test environment

Observations and interviews in the study were conducted on site at the Ralph H Johnson VAMC in Charleston, SC. Most observations were conducted in the echocardiogram “reading room” where Cardio Fellows read and analyze echocardiogram images and report their findings on patient heart function. The reading room is a small office approximately 10’ x 12’ in size and contains three workstations and other ancillary equipment with space for 2-3 people. Figure 3 (at right) shows two of the workstations used for echocardiogram readings.

On the left side of Figure 3, the dual monitor workstation runs the GE EchoPAC software. This allows images to be viewed on the left screen while findings can be added to the echocardiogram report on the right screen. The second, single-monitor workstation on the far right of Figure 3 runs CPRS and is used to review the patient record to better inform the echocardiogram report. It also allows the transfer of text files between the workstations via shared drive. The reading room environment is quiet and typically kept dark to facilitate better viewing of the echocardiogram images. Paper artifacts can be seen on the table top, which augment task execution by allowing Cardio Fellows to make handwritten notes. The walls are adorned with various job aids and teaching aids. A reminder note, taped to the top of the far right monitor, states “Change encounter first,” to ensure that when creating a CPRS note, the Fellows complete the echocardiogram procedure request properly. During the course of observation, there was sometimes a second person at this table, seated in front of the left workstation.

Figure 3. Cardio Fellow working in the echocardiogram reading room

### Participants

Multiple medical professionals in the echocardiogram process were observed and interviewed. Principal among these were Cardio Fellows who are second- and third-year physicians in a postdoctoral cardiology training program. Fellows rotate into the VA echocardiogram reading role monthly; second-year Fellows begin their roles in January and third-year Fellows take over in July. Four Fellows participated in this study: two male and two female, two second-year and two third-year.

Attending cardiologists oversee the echocardiogram process, train the fellows, and are responsible for approving the reports. Three attending cardiologists participated in the study, both for interviews and observations.

Although any physician can order an echocardiogram, the procedure is most often ordered by a Primary Care Physician (PCP). One PCP was interviewed to help us understand the echocardiogram procedure workflow from beginning to end.

One biomedical engineer was interviewed to help understand the interaction between the sonogram equipment, the EchoPAC software, and the VistA-based CPRS patient record system.

A Clinical Application Coordinator (CAC) was interviewed to understand how the CPRS consult was constructed, how the consult process was executed, and the principal task for each role in the workflow. The CAC was also instrumental in understanding the context of some observations, in running CPRS reports to quantify suspected anomalies, and in identifying adverse events regarding cardiology notes within the patient record.

### Procedure

*Ethnography*: Interview and observation sessions were conducted during site visits to the Charleston VAMC between July 2017 and February 2018. These sessions were scheduled somewhat ad hoc depending on the availability of clinical staff. The intent during the initial July 2017 visit was to develop an initial understanding of the echocardiogram workflow and to identify key roles and responsibilities in the process. Subsequent visits sought to refine that workflow, identify individual task flows, and identify issues that affected each individual’s performance and goals. When issues were uncovered, additional questioning was used to understand the full context of the issue, its relationship to task performance, and its impact on patient safety. Typically, participants were allowed to complete their task uninterrupted by questions, with task performance issues and study team questions being addressed after task completion. Because videotaping was not used in the study, much of the follow-up questioning was used to clarify specific actions that were performed too quickly to capture adequate notes. Some of the most important questions, however, involved understanding the motivation for specific actions used in task performance, so the study team could better understand the decision-making process and how well the technical system supported clinical goals.

*Hierarchical task analysis*: Hierarchical task analysis (HTA) was used to record and organize the actions of participants when completing specific task goals. High-level tasks, identified through questions related to echocardiogram reporting, were broken up into constituent steps for each of the roles using Natural GOMS Language (NGOMSL) notation. This task breakdown was conducted to help develop a normative baseline to quantify task performance drivers and constraints regarding interoperability. By listing each of the steps required, this technique showed which steps were necessary to complete clinical goals while differentiating them from those steps required solely to overcome interoperability gaps. It also formed a basis for identifying error-prone action patterns within participant taskflows. The HTA provided a basis for measuring the time necessary to complete the subgoals specific to device interoperability.

*Patient Safety Analysis*: Patient safety analysis includes a collection of techniques used to identify and quantify patient safety risk in terms of severity, frequency, and detectability, as well as technical and operational factors that contribute to those risks. From participant observation and subsequent HTA, the analysis team focused on specific action patterns that appeared error-prone and created subsequent interview questions to further assess the risk from the perspective of the participant. When a suspected risk was confirmed by participants, the team enlisted support from the CAC to identify related adverse events by running reports in CPRS to find any correction of error in the patient record. The analysis team also reviewed communication procedures and artifacts used by the clinical team in the execution of the workflow to better understand how improved interoperability could improve team communication.

## Results

Key results described here include a more detailed explanation of the task flow surrounding the echocardiogram process, issues regarding the progress note creation process, and an issue regarding overall workflow.

### Echocardiogram Reporting Task Flow

The echocardiogram reporting tasks were a key focus of this study because they illustrate the limited interoperability within the current system. Figure 4 examines the human-system interaction for the reporting tasks highlighted previously in Figure 2. As with the sequence diagram, there was some variation in observed actions. This simplified view illustrates the task steps required because of poor interoperability, and helps explain resulting usability issues.



Figure 4. Detailed taskflow for echocardiogram reading and reporting that must be completed using multiple workstations.

The reporting task begins when the Echo Tech delivers the paper procedure sheet from the completed echocardiogram to the Cardio Fellow in the echocardiogram reading room (the solid green circle in the top-left of the diagram). The procedure sheet includes patient identifiers and the procedure order, which the Cardio Fellow uses to take notes and as a task management aid when working through multiple patients. The Cardio Fellow finds the patient in the EchoPAC task list, reviews the echocardiogram images, interprets the images and performs measurements, and drafts a text-based report using the EchoPAC report generation tool. The Cardio Attending on duty will join the Fellow for “Readout” (verbal explanation of the draft report, review of the findings, teaching feedback, and final report edits). During Readout, the Cardio Fellow moves from the EchoPAC workstation to the CPRS workstation and the Cardio Attending conducts the review from the EchoPAC workstation. When Readout is complete, the Cardio Attending electronically signs the report and exports the text file to a shared network drive on the EchoPAC workstation. While the Attending is reviewing the EchoPAC report, the Fellow is working through an ordered stack of paper patient procedure sheets. After verbal confirmation that both individuals are looking at the same patient, the Cardio Fellow opens the patient record within CPRS, creates a new progress note, edits the note template, and completes template attestations in preparation for importing the EchoPAC report text. The Cardio Fellow then identifies the necessary text document on the shared drive of the CPRS workstation, opens the document, copies its contents (CTRL-C), and pastes the text into the prepared CPRS progress note (CTRL-V). The Cardio Fellow then adds cosigners to the note and signs it which completes the reporting workflow for one patient, after which the Cardio Fellow begins note preparation for the next patient.

Because the Cardio Attending and Cardio Fellow are able to work concurrently at different workstations, the note preparation steps are not on the critical path for the task (the fastest sequence of correct steps through the task) and thus do not add time to overall task completion. The time observed for the Cardio Fellow to import the text report and sign the note was approximately 15 seconds (averaged over two Readout sessions with approximately 15 cases per session). The Cardio Attending then reviews the final progress notes and co-signs them, which completes the echocardiogram reporting procedure.

### Progress Note Issues

Two key issues were observed that affect report quality and patient safety, stemming from the new process instituted in 2017 (as described in the Introduction and Results sections): unwanted visual artifacts in the report and risk of wrong patient record edits.

*Visual Artifacts*: The copy-paste import process results in the insertion of visual artifacts in CPRS notes as non-printing characters from the EchoPAC report that cannot be properly processed by CPRS. CPRS replaces these characters with question marks, which are interspersed throughout the notes. In some cases, these question marks can create confusion for the reader because they occur at the end of a section header (e.g. “Thrombus:?”). A reader who is not familiar with the problem may misunderstand portions of the report as questions rather than statements. Variability in correcting these visual artifacts was observed depending on the Cardio Fellow and their current workload. Prior to the final observation session, one of the Cardio Fellows developed a workaround to fix the visual artifact problem by first pasting the text into Notepad, then copying and pasting the report contents from NotePad into CPRS. Although this corrects the problem, it adds a few steps, several seconds, and potential errors to the process.

*Wrong Patient Record Risk*: A more serious, insidious risk occurs as a result of poor interoperability between EchoPAC and CPRS. As with most human error, the root cause is due to multiple system factors; in this case, the predominant causal factor is poor interoperability. By default, the EchoPAC software exports report files with a random numeric title, which does not include any patient identifiers. Figure 5 shows an example of a default filename as seen in the shared drive browser window. If multiple such files exist in the shared drive browser, it can be difficult for the user to select the report corresponding to the current patient under discussion. If a patient-report mismatch occurs, a report may be placed in the wrong patient’s medical record.

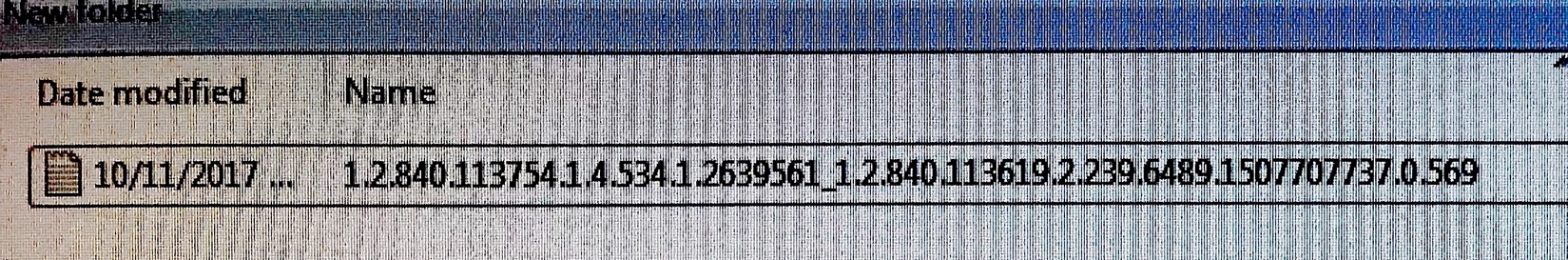


Figure 5. Default export filename from EchoPAC

The same type of adverse event can also occur if the user mistypes the copy or paste hotkey combinations during the import task. If, for example, the user does not fully press CTRL-C, the intended report text will not be copied into the workstation’s copy buffer. Then, when the user presses CTRL-V, a report from the previous patient will be incorrectly pasted into the current patient’s progress note. Detecting such errors can be very difficult because EchoPAC reports list patient identifiers only at the beginning (top) of the report, while the CPRS workstation automatically scrolls to the end (bottom) of the pasted text, hiding the patient identifiers from immediate view. Unless the user specifically scrolls up to verify the patient identifiers, the error may go undetected. Misplaced confidence, fatigue, and high workload may cause even expert users to skip such verifications.

To assess the prevalence of wrong patient record edits, a CPRS report was run to search for patient record corrections since the beginning of the new process. Each correction found was visually inspected to determine whether it was due to the wrong patient record problem identified above. Estimating a start date of April 1, 2017, the report found all incidences of patient record corrections of Echocardiogram Outpatient and Inpatient reports during the time period (4/1/17 – 12/11/17, approximately 8 months). In that 8-month timeframe:

* 2202 echocardiogram notes were created
* 5 corrections were made
* 4 corrections were due to an echocardiogram report being copied into the wrong patient’s record
* 1 correction was due to a wrong patient selection (the two patients had the same name and last 4 SSN)

For comparison, the same search was run on the prior 8-month interval (8/1/16 – 3/31/17). In that 8-month timeframe:

* 1927 echo notes were created
* 0 corrections were made

When a report is copied into the wrong patient’s record, the patients are potentially affected in three ways:

* False positive – Patient with no cardiology issues is told they need treatment and are scheduled for a follow-up appointment. This not only produces undue stress and unnecessary treatment for the patient, but it uses a time slot and resources that could be used treating other patients.
* False negative – Patient with cardiology issues is not provided timely treatment.
* Incorrect diagnosis – Patient with cardiology issues is provided wrong diagnosis (and potentially incorrect treatment).

It is important to remember that because the systems changed between these two timeframes, the patient reports during the 8 months when the 5 corrections were logged were more robust and contained greater data for clinical staff. Pasting errors cannot be tolerated and an integrated system is needed; however, many patients benefited from having a superior patient record during that time.

### Workflow Issue

While interviewing the PCP to assess report quality from the perspective of the intended recipient, another serious issue was identified. Because of the way the echocardiogram procedure is set up within CPRS, the progress note created by the cardiology team does not automatically notify the ordering physician that the procedure was completed. Charleston Cardiology staff will directly notify ordering providers of significant echocardiogram findings on a discretionary basis. This means that patients in need of follow-up treatment may or may not be scheduled in a timely manner because the PCP is not aware of the test results. The interviewed PCP indicated that the procedure notes *may* be seen during the next regularly scheduled patient visit, but the report could be missed if subsequent unrelated tests and notes push it down the list. The main mitigating factor for this risk is that the protocol for cardiology patients needing immediate treatment should require cardiology staff to communicate directly via phone or in person with the ordering physician to ensure the patient receives immediate care. Thus, this risk pertains to those patients with heart problems who require follow-up treatment but whose condition is not immediately life-threatening.

## Discussion

The results of this study illustrate usability issues due to limited interoperability within the echocardiogram procedure process along at least three key dimensions: efficiency, effectiveness, and patient safety. Almost all of the steps and subtasks performed by Cardio Fellows to complete their portion of the reporting task are either the manual transfer of information from the EchoPAC software to CPRS (the export/import and copy/paste steps) or workarounds to correct for quality issues with the manual process (such as eliminating visual artifacts with NotePad). Although the time cost for these steps is fairly minimal, participants find the additional steps frustrating, unnecessary, and often error-prone. Eliminating unnecessary actions not only improves efficiency, but also improves employee satisfaction and eliminates certain opportunities for user error.

The most significant finding in this study relates to patient safety risks. Although no evidence of patient harm was found, wrong patient record edits always bring the risk of incorrect or delayed diagnosis and treatment for two separate patients. Because of their serious and insidious nature, wrong patient record edits are notoriously difficult to detect and can remain a latent risk for years, especially when patient conditions or identifiers have enough similarity for clinicians to miss the discrepancies. In addition to the risk to patients, such adverse events also bring with them the cost of correcting or mitigating the errors: resources spent correcting the record, notifying and rescheduling patients, and ensuring no patient harm occurred in the interim. Collectively, such corrective actions are an unnecessary burden on staff, which reduces overall efficiency. A subtler consequence is the tendency to blame the clinicians who are responsible for patient care, even when adverse events are due to fundamental system design flaws. Such improper blame not only has a negative effect on the individual, but reduces trust in the system itself. It should be noted that the patient safety findings in this study were significant enough that Cardiology Department leadership was briefed immediately and provided a set of recommendations to mitigate the risk – many of these recommendations have already been instituted.

The findings related to workflow point to the need for a more holistic consideration of workflow processes when addressing any kind of process improvement activity. As seen in the 2017 process changes, altering one part of the process can improve one quality measure (such as report quality) while resulting in unintended consequences in other areas (such as efficiency and patient safety). More fundamentally, by considering the echocardiogram process as a whole, a latent system design flaw (i.e. the ordering physician not being automatically notified of results) that lingered for years was uncovered. This type of design flaw results in another serious, insidious error, misperceived communication, in which the cardiologist assumes a message has been successfully communicated when in fact it has not. Such was the case here, where cardiology participants all assumed the ordering physician was properly notified of all completed echocardiogram results. This design flaw had a negative impact on both process effectiveness and patient safety because echocardiogram results for some patients could not be acted on immediately, which can constitute a delay of care.

This study utilized a mixed-method approach that addressed teamwork, individual workflow, technical aspects of the workflow, information quality, and usability. In addition to the specific results reported here, the study demonstrated the effectiveness of a relatively inexpensive method for evaluating system efficiency and effectiveness, uncovering patient safety issues, and understanding the implications of fundamental design choices, even when the process is relatively straightforward and apparently well-understood.

# Recommendations

Several recommendations have emerged from this study and were discussed directly with the Charleston Cardiology staff:

1. Update the EchoPAC system to the latest, supported software version and add report interoperability by allowing progress notes to be automatically created or populated in CPRS via HL7 messaging.
   1. In the interim, update existing CPRS templates to reduce the amount of editing required for new notes.
   2. In the interim, export the EchoPAC filename using patient identifiers to reduce confusion and reliance on human memory.
   3. In the interim, change the EchoPAC report template to add patient identifiers to the end of the report as well as the beginning to improve patient identification.
2. Change the CPRS consult object used for echocardiogram orders to ensure the ordering provider is automatically notified of cardiology results.
   1. In the interim, ensure that the ordering provider is added as a co-signer to the CPRS note containing the echocardiogram report to necessitate their viewing of the note.
3. Utilize a user-centric or work-centric analysis approach to more rigorously evaluate clinical processes that are in need of change. Such approaches are well-studied in the literature and are demonstrated to be cost-effective for process improvement efforts, especially in safety-critical and mission-critical domains such as Veteran health care.

A lesson learned from the practice is that the automation mechanisms built into VistA/CPRS can provide this kind of notification back to the ordering provider. This feature is not utilized to its full benefit within the VA system, resulting in incomplete data within VistA/CPRS and an incomplete record that will be transferred over to the EHR system of the future. Contracting products and services to automate these procedures and workflows is the primary barrier to making these improvements. The importance of upgrading systems to have new and desired capabilities that support interoperability is not well understood or supported. There is also a significant lack of awareness on the risks that can be mitigated with increased interoperability and the relationship between efficiency, safety, and interoperability.

These interoperability and automation features should be replicated in the EHRM environment with all the other ancillary systems, with the hopes that best practices such as the ones developed in the Nashville and Charleston studies are taken into account and more complete, standardized records will be a hallmark of VA’s new EHR Modernization efforts.