Clinical Information Systems—Developing a Systematic Planning Process

David Goldberger
Richard Kremsdorf, MD

CHW is a large and diverse hospital system that developed a systematic planning process to define, prioritize, and assess the current status of those functionalities needed by caregivers to assist them in providing optimal care. In order to develop a durable consensus, a bottom-up approach was used. The details of the process including the structure of the meetings and many of the methodologies employed are presented. Key words: CHW, clinical information systems, clinicians, strategic planning

THE ADVISORY BOARD COMPANY has identified an innovative auditing and planning process developed at Catholic Healthcare West (CHW) used to prioritize clinical systems investments across the organization’s 48 hospitals. It has numerous applications outside the hospital and in the ambulatory setting and thus is reported in this issue of The Journal of Ambulatory Care Management. The underlying premise of CHW’s program is that effective clinical systems planning must proceed from the bottom up, drawing less on corporate information systems (IS) priorities or vendor product offerings than on the diverse workflow needs of caregivers. CHW’s program is distinguished from other planning processes in three primary respects.

1. First, the process included an initial effort to develop a compendium of all potential clinical IS functionalities—ensuring that all parties involved in planning were working with the same set of assumptions and definitions.

2. Second, priorities were set through “caregiver summits” with clinical personnel from across the health system—grounding planning efforts in the

David Goldberger, The Advisory Board Company, Washington, DC
Richard Kremsdorf, MD, Five Rights Consulting, San Diego, California

The Advisory Board Company would like to express its appreciation to David Bowen, Richard Kremsdorf, MD, and Susan Perry, RN, of Catholic Healthcare West’s Corporate Information Management department. Their knowledge, guidance, and generosity were invaluable as we sought to understand their clinical systems planning process. For further information on this article, The Advisory Board Company, please contact David Goldberger, The Advisory Board Company, Washington, DC: 202/673–5983, goldberg@advisory.com

At the time of writing Richard Kremsdorf was Vice President of Clinical Information Systems, Catholic Healthcare West, San Francisco, California

J Ambulatory Care Manage 2001, 24(1), 67–83
expressed needs of each hospital’s clinical staff.

3. Finally, the process concluded with a comprehensive audit of clinical IS capabilities for each system hospital—ensuring that future investments would build on a clear understanding of each hospital’s current capabilities.

This article provides an overview and analysis of CHW’s planning process. While not all aspects of the program will be relevant to ambulatory care providers, elements of the program methodology are likely applicable to a wide variety of organizations (see box entitled “Case in Brief”).

PROBLEM IN BRIEF

In research interviews, Chief Information Officers (CIO) cited four common frustrations with clinical systems planning:

1. Many CIOs and senior executives find it increasingly difficult to understand what clinical functionalities are in place across their health systems—making it hard to identify hospitals falling behind and best practices worth replicating systemwide.

2. Even with adequate clinical systems in place, suboptimal performance often goes unnoticed; many functionalities are limited in effectiveness due to insufficient caregiver training or limited deployment among hospital staff.

3. Underlying cause of suboptimal performance is insufficient knowledge of caregiver needs and workflows; without detailed understanding of care processes, new technologies often fail to deliver on potential.

4. Problems are compounded by territoriality among individual hospitals and between hospital departments; diverse hospital constituencies driven by conflicting priorities and interests often fail to approach clinical functions as inter-dependent systems supporting facility-wide processes.

Case in Brief

Goals
- Develop clinician-driven standards for inpatient clinical IS functionalities
- Measure the relative performance of each hospital against system standards
- Provide tools to help hospital executives prioritize future clinical IS investments

Key elements
- Functionality dictionary
- Caregiver summits
- Facility audits
- Systemwide status report

Early results
- Defined and measured performance of clinical IS functionalities across the health system
- Established clear guidelines for phasing in new clinical functionalities
- Developing systemwide vendor contracts to fill common gaps in clinical systems performance

CLINicians Toolkit (CLINT)

This is a complex idea that needed a simple term to establish branding. CLINT stands for CLINicians Toolkit.

CLINT KEY ELEMENTS

Catholic Healthcare West’s program consists of four key elements, described below.

Element #1—Functionality dictionary

Comprehensive list and description of every potential IS function is used to support
Developing a Systematic Planning Process

The goal is to provide a common vocabulary on which to build clinical IS planning efforts.

- Draft of definitions created by the Medical Informatics Information Officer and reviewed by system medical directors of information management, nurse leadership, and a variety of IS department leaders.
- Final document provides listing of 54 clinical system functionalities, organized according to six subsets (see Figure 1).

Element #2—Caregiver summits

Regional meetings occurred including 15 to 40 clinical personnel from each region’s acute care facilities. The goal is to elicit feedback from a diverse group of clinical staff to prioritize clinical IS functionalities by select strategic criteria (see Figure 2).

Five steps at clinical IT summits

Step #1

Functionality Work Groups—Diverse mix of attendees convene in groups of four to six to discuss subsets of the 54 clinical IS functionalities. The goal is to enable group members to develop a broad understanding of each functionality and its role in clinical care delivery.

- Work plan: At least one group assigned to each of four functionality subsets

Figure 1. Functionality Inventory and Dictionary.
Figure 2. Caregiver Summits.

(administration, clinical documentation, medication, and radiology/lab/transcription).

- Group composition: Attendees span disciplines and hierarchical levels to ensure broad perspective.
- Agenda: Group members read the functionalities aloud, discuss, and weigh the relative value of each (see box entitled “A Broadened Perspective”).

**Step #2**

Individual Rankings—Members of each work group rank each functionality according to four equally weighted criteria. The goal is to enable attendees to quantify their perception of the relative value of each functionality, incorporating lessons learned from group discussion (see Figure 3).

**Step #3**

Group Review and Discussion—Individual results of ranking exercise presented before the larger group for review and revision. The goal is to reach group consensus on each clinical IS functionality’s relative level of importance.

Review Process:
- Individual scores projected in front of the entire group to show variations.
- Each group’s scores averaged and presented; representatives from work groups explain ranking rationale to the larger group.
- Group discussion on whether rankings accurately reflect each functionality’s value; rankings may be changed, but only by group consensus.

**A Broadened Perspective**

The physicians would say, “what we want to do is get the lab results electronically, we don’t care whether or not the lab has a system.” But the physicians needed to come to the understanding that if the lab didn’t have a system there was no way that they [the physicians] would be able to look up results on their own computers. Since we had lab technicians and nurses in the discussions with the physicians, that fact came out—clinicians came to recognize that the ancillary departments needed systems in place before the clinicians could get their wants satisfied. And from the flip side, departmental leadership came to learn that it wasn’t enough to just get a lab system cranking out results—the clinical people needed a way to look up results as well.

—Richard Kremsdorf, MD
Vice President of Clinical Information Systems
Catholic Healthcare West
### Figure 3. Functionality scoring system—clinical documentation rankings.

*Note: The examples are for illustrative purposes only. This figure is representative of one person's priorities.*
Table 1. Definitions of functionality

<table>
<thead>
<tr>
<th>Tier</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core</td>
<td>Minimum functions that should be in each and every acute care facility based on their direct link to improved patient outcomes (quality, service, and cost).</td>
</tr>
<tr>
<td>Midlevel</td>
<td>Essential functions that are more challenging technically or organizationally, have less immediate or certain payback.</td>
</tr>
<tr>
<td>Mature</td>
<td>Valuable and feasible functionalities that build on other functionalities or organizational changes and may incorporate more advanced technologies.</td>
</tr>
</tbody>
</table>

**Step #4**

Clinical IS Priority Scale—Based on individual rankings, group scores, and larger group discussion, clinical IS functionalities were assigned to one of three tiers—core, midlevel, or mature. The goal is to capture group consensus on the appropriate level of prioritization for each functionality (see Table 1).

**Step #5**

Regional Benchmarking—Group views running average of prioritization rankings compiled from all previous CHW regional summits. The goal is to highlight deviations from (evolving) system standard, and adjust group rankings when appropriate (see box entitled “Pressure Testing the Group’s Thinking”).

**Element #3—Facility audits**

Audit team visits system hospitals to determine the operational status of all clinical IS functionalities. The goal is to grade clinical IS capabilities at each system hospital.

**Pressure Testing the Group’s Thinking**

I would then say to the group “well you ranked this functionality at core, but these other regions ranked it at midlevel. Here is their rationale as to why they did this. What do you think about it?” Sometimes they would decide that the other regions’ rationale made more sense and they would change their ranking. Other times they would say “well, we’re different,” and they would leave the ranking as is.

—Richard Kremsdorf, MD
Vice President of Clinical Information Systems
Catholic Healthcare West

- Audit team: Vice President for Clinical Information Systems and CHW Information Officer for Clinical Enterprise Applications and RN recruited from system hospital.
- Audit process: Audit team converses with physicians, nurses, and unit clerks, observes as hospital staff uses clinical information systems.
- Scoring methodology: Team members independently assign grades to each functionality based on three criteria: functional richness, ease of use, and level of deployment. Three grades were entered into a simple formula to calculate final score for each functionality.
- Data validation: Scores of each audit team member presented and discussed; team settles on single score for each functionality, averages individual scores in the absence of consensus (see Figure 4).

**Element #4—Systemwide status report**

Comprehensive report listing assessment scores for each clinical IS functionality at each system hospital. The goal is to
benchmark the operational status of each functionality across the system.

- Clinical IS functionalities at each hospital assigned to one of three status levels (red, yellow, or green); calibration determined by comparing individual functionality assessment scores across the system;

- Final report reveals assessment scores (numeric) and status level (shading) of 54 functionalities at each system hospital (see Table 2 and Figure 5).

RESULTS

The program at CHW has yielded two comprehensive data sets for corporate IS planners. The first set documents the relative level of importance that clinicians place on each of 54 clinical IS functionalities. The second set records the performance level of each functionality at each system hospital. Analyses of these data sets enable corporate IS planners to help hospitals prioritize IS investments, taking into account caregiver
Table 2. Shading criteria

<table>
<thead>
<tr>
<th>Score range</th>
<th>Shade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;10</td>
<td>Red</td>
<td>Hospital does not have functionality in place or the functionality is not being used</td>
</tr>
<tr>
<td>10–19.9</td>
<td>Yellow</td>
<td>Hospital has functionality in place, but system is lacking in functional richness, ease of use, or deployment</td>
</tr>
<tr>
<td>20–50</td>
<td>Green</td>
<td>Hospital has functionality in place; functionality is in full use by clinical staff</td>
</tr>
</tbody>
</table>

Note: Score ranges may be adjusted based on median scores and best demonstrated practices established within each functionality (e.g., see “discharge planning screens” in Figure 5).

Facility scorecard

- Audit team members visit key information management staff and executive leadership from each hospital to review customized clinical IS functionality “scorecard;” scorecard lists the performance level of each functionality compared with clinical IS road map, to identify deficiencies on which hospitals should focus future IS planning efforts (see Figure 6 and box “Focusing Future Investment”).

Add-on product set [In development]

- Corporate IS working to develop systemwide IS contracts with select group of vendors to address common gaps in IS performance across the system. The contracts enable CHW to bring all hospitals up to standard “Phase I” levels of functionality at reduced cost.

Figure 5. Assessment results: clinical documentation.

Note: Assessment scores are hypothetical and for illustrative purposes only. The shadings on the table are defined as follows: white = green; gray = yellow; black = red.
Developing a Systematic Planning Process

Focusing Future Investments

The fundamental problem is that at the hospital level, the executives are hearing all kinds of different stories as to what to prioritize, but they don’t really know what to work on first. What we can now do is sit down with executives at an individual hospital and say, “well, here is the deal. We started out with 54 functionalities, and we looked at each hospital. Within Phase IA, there are only 12 functionalities. Within your hospital, within Phase IA, nine are green and three are red. So, focus on turning your red boxes to green.”

—Richard Kremsdorf, MD
Vice President of Clinical Information Systems
Catholic Healthcare West

THE CLINicians Toolkit PROCESS CONTINUES*

A key element of the planning process is to validate and share the results of the process to date with a broad audience within CHW. To that end, three distinct groups were identified: Information Systems staff, executives, and the clinician community. CLINT stands for Clinicians Toolkit.

Information Systems staff

The prioritization process had focused on the needs and behaviors of the clinicians. For that reason, only a few Information Systems professionals had been involved in the earlier...
phases. Indeed, the process identified a gap between what capabilities were technically available on computers and how work was actually being done—which had not been broadly understood. Thus, in some cases, Information Systems staff were learning that the systems they had worked so hard to implement were not being used.

Consequently the first meetings in each region to share the results were held with the Information Systems staff. At these meetings, the extensive prioritization process was only briefly reviewed, with focus instead on how the assessments were performed and scored. Then one functionality at a time, one hospital at a time, the results were reviewed in detail, to show how the scores were calculated. Each participant got a book that contained the detailed scores for every functionality at every hospital in one’s region. Thus, it was clear that the scoring was objective and fact-based. It was not a casual opinion, but rather the result of focused scrutiny applied relentlessly.

The key in these sessions was to focus on the validity of the assessment in a nonjudgmental way and to avoid explanations as to why things were the way they were. Even more important, the ground rules were to not have any discussion about how to solve the identified gaps, though the desire to do that was strong. In this way, the consensus about the needs going forward could be solidified before the disagreements about different potential solutions set in.

The validation of the scores was strong. In some cases, there had been improvements after the evaluation had occurred. In over 99% of the assessments, the results were accepted as accurate.

**Executives**

The top management team in the regions had until this time received only high-level information about the process. Most knew some type of clinical information systems planning was happening, but not the details. A few were very involved, but that was the exception.

A key success factor was to have validated the assessments results with the Information Systems staff before presenting to the executives. That way, the opportunity for summary rejection of the assessment results was minimized.

The executive leadership team for each region, including the CEO, COO, CFO, CMO, and CIO was gathered for the discussion. The presentation was distinctly different from that presented to the IS staff. It started with a reminder of the aspects of the strategic plan of the region that could be accomplished using clinical information systems. Some examples of clinical work processes were described with and without the use of supporting systems. Then, the extensiveness of the prioritization process was emphasized, so that it would be accepted as valid. In particular, the criteria used to prioritize was described as well as the origin of those criteria, namely, from COOs and CFOs. The assessment scoring method was only briefly mentioned, with reliance instead on the validation of the results by the local staff.

The most important part was the display of the summary findings for the region. Since the results for each functionality had been summarized as a color, red (missing), yellow (present, but incomplete), and green (present), a single graphic could be used to summarize hundreds of results. The results for each hospital are presented in a column. At the top of the column are the highest priority functionalities. Thus, red boxes near the top of the graphic identified important functionalities that were not available to clinicians. The metaphor “we need to turn red boxes into green boxes” quickly became common parlance, underscoring the effectiveness of the display.

The final section of the discussion focused on specific applications with financial and strategic impact. An example of Physician Rounds Report was displayed and had
particular impact. This report is created by the physician and contains all the information available on the computer system that the physician needs to do inpatient rounds. It helps the physician to save 5–10 minutes per patient visit per day and so is a great efficiency tool. This application is immediately compelling to physicians and executives.

Another example, Casefinders, was also explained. Casefinders are reports that identify patients who have special needs that warrant intervention. For example, a respiratory Casefinder identifies all patients in the facility who are having problems with their breathing, based on aberrant measurements of respiratory rate, oxygen saturation, use of supplemental oxygenation, and blood gas results. A respiratory therapist can then look in on these patients and facilitate optimization of their care. Since such interventions can prevent costly catastrophic events, the financial as well as the clinical impact is immediately apparent.

Clinician community

The entire initiative is about providing the tools that clinicians need in order to provide optimal care. Though they have been involved all along, there is an ongoing need for further engagement, enlarging the circle of involvement. All of those who participated in the earlier portions of the process expressed interest in learning what we concluded. Finally, the broader and deeper the groundswell of support, the more likely that funds could be secured for such projects in the next budget cycle.

The Regional CLINT discussions are still unfolding. These discussions emphasize only the high level findings of the assessment, focusing instead on confirming the consensus about the implementation sequence.

The initial prioritization separated functionalities into three tiers: core, mid-level, and mature. However, there were still too many functionalities in the core tier to be implemented in one fell swoop. Indeed, even within the core tier, some are much easier to implement than others. Thus, all of the core functionalities became Phase I implementation targets, but Phase I was broken down further into Phases IA, IB, and IC (see Appendixes 1 and 2). The idea is that Phase IA serves as the building block for Phase IB. Once Phase IA is done, the technology and the culture to be successful on Phase IB would be in place.

A key distinction was made early on: clinical documentation of a patient’s status was separated into distinct components:

- Bedside Numbers: Quantitative measures of patient status that are routinely obtained will be entered into the computer in a timely fashion and available in a variety of display formats wherever computer access is available
- Medication charting: documentation of medication administration
- Nursing physical assessment
- Patient care plans/pathways
- Documentation of patient care activities and interventions by nursing
- Documentation of all ancillary caregiver interventions

During the initial prioritization, bedside numbers and medication charting rose into the core tier, while the other clinical documentation functionalities remained in the mid-level tier. This occurred because of the more pervasive use of the information gathered in the core functionalities and its operational and economic impacts. Once these issues are articulated, there is broad agreement with it, though it does not reflect the way clinical documentation has been historically implemented within CHW and elsewhere.

Often, capturing the bedside numbers electronically makes it more difficult for the physicians to do rounds, while creating a Physician Rounds Report holds the opportunity to expedite rounds. Similarly, unless
Casefinders or alerting is used, the potential value of having clinical data in electronic form is not realized. Instead, a pile of numbers on paper only becomes a comparable pile on a screen and not really a tool to facilitate optimal care.

One additional leap has been the addition of the use of a handheld computer to capture the bedside numbers. While the applications to do this are not yet commercially available, in a setting where the right database infrastructure is in place, the development should be straightforward.

Happily, when all of these concepts are brought forward, the opportunity for improvement has been viewed as compelling.
## Appendix 1

### Clinical IS Road Map: Catholic Healthcare West’s Functionality Listing by Phase

<table>
<thead>
<tr>
<th>Phase/Description</th>
<th>Subphase</th>
<th>Description</th>
<th>Functionalities</th>
</tr>
</thead>
</table>
| **Phase I**       | IA       | Basic administrative and clinical transactions required before complex workflows can be affected; effective establishment of these functionalities provides the foundation on which to build more complex functionalities | Results Retrieval  
- Lab results review by encounter  
- Radiology transcribed results  
- Pathology results review  
- Blood gas results review  
Clinical Care Delivery and Documentation  
- Printed medication administration records  
- Transcription  
- Discharge planning screens  
- Physician patient list  
Departmental Operations  
- Laboratory department functions  
- Pharmacy departmental functions  
- Radiology departmental functions  | Administrative Procedures  
- Drug utilization evaluation studies  
- Case review reports  |
|                   | IB       | Functionalities focused more deeply into caregivers’ workflows. | Results Retrieval  
- Physician rounds report  
- Longitudinal lab results review  
- Longitudinal radiology results review  
- Clinical care delivery and documentation  
- Bedside orders (iv, med, lab, weights, therapy, etc.)  
- Medication allergies  
- Medication profile  
- Medication vending machines  
Inpatient Care Management  
- Drug utilization evaluation studies  | Administrative Procedures  
- Electronic and printed order sets for common clinical pathways/standard orders |
|                   | IC       | Functionalities requiring and supporting interdepartmental collaboration, which create new ways of providing care. | Clinical Care Delivery and Documentation  
- Medication charting  
- Clinical management workflows  
- Inpatient Care Management  
- Discharge planning screens  
Administrative Procedures  
- Electronic communication among all clinical caregivers |
| **Phase II**       | IIA      | Electronically enabled caregiver no longer can accept paper-based methods; range of clinical IS functionalities expanded to eliminate more complex paper-based and manual functions. | Results Retrieval  
- Lab order status available on HIS  
- Blood bank product status  
Inpatient Care Management  
- Microbiology/Antimicrobial Therapy Alerts  | Departmental Operations  
- Electronic report distributor  
- Alerts to Pharmacist  |
|                   | IIB      | Clinical IS functionalities that support processes that are more technically challenging, involve multiple organizational groups and technologies, and build upon existing knowledge and caregiver trust in existing systems. | Results Retrieval  
- Images of digital modalities (CT, MRI, US, NM)  
Clinical Care Delivery and Documentation  
- ICU/PICU monitor to computer download  
- Nursing physical assessment  
- Remote access from ED, home, office  
Inpatient Care Management  
- One-to-one alerts  
Administrative Procedures  
- Electronic filing cabinet for protocols and schedules  
- Review of OR, Cath Lab, PT schedules  | Administrative Procedures  
- Electronic filing cabinet for protocols and schedules  
- Cross-contaminates patient registration systems  
- MPR across all site of care  
- Housestaff sign-out card/problem list |
|                   | IIC      | Remainder of bedside and paper workflow is captured and integrated, tying in new pieces with those already established. | Results Retrieval  
- Pathology transcribed results  
- Patient careplan/patient flowsheet  
- Documentation of nursing interventions  
- Documentation of all ancillary caregiver interventions  | Inpatient Care Management  
- Critical status alerts  |
| **Phase III**      |         | Addresses the most challenging work process in more specialized environments. | Clinical Care Delivery and Documentation  
- Anesthesia record  
- Telemedicine CME  
- Telemedicine Remote diagnostics  
- Departmental Operations  
- Digital radiography  | Departmental Operations  
- Electronic signature  
- Alerts to EMOs and PHS  
- Physician order entry |
Appendix 2
Functionalities by Work Processes and Phases

**FUNCTIONALITIES BY WORK PROCESSES**

**Results retrieval**
Clinical decisions commonly depend on the results of diagnostic testing. Such information needs to be pervasively available so that caregivers can make the most appropriate and expeditious decisions wherever they are physically located, unencumbered by competition for the physical asset (the chart), and with data presented in the way that optimize understanding of the clinical problem. Data from prior encounters enhance understanding of the patient’s clinical trajectory, highlight potentially significant issues, and reduce duplicative evaluations.

**Clinical care delivery and documentation**
Patient care is a team activity. Consequently, sharing information among, and coordinating the activities of, the caregiver team are essential for clinical effectiveness. The information with the greatest impact is that which is used by the most people, unambiguous in its significance, and directly needed for the most important clinical decisions. Gathering all the data needed for a clinical judgment and presenting it optimally result in greater clinical effectiveness.

**Inpatient care management**
While primary caregivers focus on the patient in front of them, others look at a larger population, ensuring that the resources and needed attention are applied where most needed. Identifying those patients where there is likely to be a need for more help, more expertise, or there is an opportunity to improve the effectiveness of care is a key way to leverage data that have been gathered in the course of Clinical Care Delivery. Fundamentally, it is a way to make sure no one “falls through the cracks” and that resources are focused on those in greatest need.

**Departmental operations**
Bedside patient care depends on the support of many people and systems outside the patient’s room. These departments are “high transaction volume” environments where high service levels are essential for the rest of patient care to be efficient. Happily, extensive automation has already occurred in these areas, though gaps remain.

**Administrative procedures**
Many work processes must occur to enable and implement direct patient care. They are closely related to patient satisfaction and efficiency of operation of the clinical staff.

**FUNCTIONALITIES BY PHASES**
The CLINT functionalities were defined and prioritized by broad-based discussions throughout CHW among more than 250 caregivers, technicians, administrative staff, managers, and executives. Then, extensive assessments of these functionalities were done throughout CHW through contacts with over 200 CHW caregivers. The tiers from the discussions and learnings from the assessments have been combined into the phases which are described in this appendix. The CLINT phases form a logical sequence that describes how an organization can implement the CLINT functionalities—getting the most value and least disruption up front and building on the foundation of the earlier phases.
Table 1. Phases IA through IC functionalities

<table>
<thead>
<tr>
<th>Phases</th>
<th>Work process</th>
<th>Functionality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase IA</td>
<td>Results retrieval</td>
<td>Lab results review by encounter</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Radiology transcribed results</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Microbiology results review</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Blood gas results review</td>
</tr>
<tr>
<td></td>
<td>Clinical care delivery</td>
<td>Printed medication administration records</td>
</tr>
<tr>
<td></td>
<td>and documentation</td>
<td>Transcription</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Physician patient list</td>
</tr>
<tr>
<td></td>
<td>Departmental operations</td>
<td>Laboratory departmental functions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pharmacy departmental functions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Radiology departmental functions</td>
</tr>
<tr>
<td></td>
<td>Administrative procedures</td>
<td>ADT (Admissions, Discharge, and Transfer) system</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Order entry to all departments</td>
</tr>
<tr>
<td>Phase IB</td>
<td>Results retrieval</td>
<td>Physician rounds report</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Longitudinal lab results review</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Longitudinal radiology results</td>
</tr>
<tr>
<td></td>
<td>Clinical care delivery</td>
<td>Bedside numbers (vitals, I&amp;O, weights, oximetry)</td>
</tr>
<tr>
<td></td>
<td>and documentation</td>
<td>Medication allergies</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Medication profile</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Medication vending machines</td>
</tr>
<tr>
<td></td>
<td>Inpatient care</td>
<td>Drug utilization evaluation studies</td>
</tr>
<tr>
<td></td>
<td>management</td>
<td>Casefinder reports</td>
</tr>
<tr>
<td></td>
<td>Administrative procedures</td>
<td>Electronic and printed order sets for common clinical</td>
</tr>
<tr>
<td></td>
<td></td>
<td>pathway/standard orders</td>
</tr>
<tr>
<td>Phase IC</td>
<td>Clinical care delivery</td>
<td>Medication charting</td>
</tr>
<tr>
<td></td>
<td>and documentation</td>
<td>Clinical management flowsheets</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Discharge planning screens</td>
</tr>
<tr>
<td></td>
<td>Inpatient care</td>
<td></td>
</tr>
<tr>
<td></td>
<td>management</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Administrative procedures</td>
<td>Electronic communication among all clinical caregivers</td>
</tr>
</tbody>
</table>

Phase I

Phase I establishes infrastructure and incorporates workflow improvements for the high volume and high value clinical transactions (see Appendix 2, Table 1).

Phase IA

The most basic administrative and clinical transactions have to work before more complex workflows can be affected. These are high volume and high value clinical transactions, which must be done, so that if there are inefficiencies the impact will be felt in delayed or ineffective clinical decisions, staffing to offset the inefficiencies, or poor service levels.

The effective accomplishment of these functionalities also establishes the basis for doing more complicated functionalities, by getting devices in place where caregivers can get to them, deploying passwords and familiarity with the system, and creating the habit that “the computer is where you look for information.”

Phase IB

These functionalities get more deeply into caregivers’ workflows, focusing on those tasks that can be cumbersome to do manually and whose workflow can be relatively straightforwardly improved. For example, data which is sought by many different...
Table 2. Phases IIA through III functionalities

<table>
<thead>
<tr>
<th>Phases</th>
<th>Work process</th>
<th>Functionality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase IIA</td>
<td>Results retrieval</td>
<td>Lab order status available on HIS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Blood bank product status</td>
</tr>
<tr>
<td></td>
<td>Inpatient care management</td>
<td>Microbiology/antimicrobial therapy alerts</td>
</tr>
<tr>
<td></td>
<td>Departmental operations</td>
<td>Electronic report distribution</td>
</tr>
<tr>
<td></td>
<td>Administrative procedures</td>
<td>Alerts to Pharmacists</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Physician phone directory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Web access for caregivers (including MedLine)</td>
</tr>
<tr>
<td>Phase IIB</td>
<td>Results retrieval</td>
<td>Images of digital modalities (CT, MR, US, NM)</td>
</tr>
<tr>
<td></td>
<td>Clinical care delivery and</td>
<td>ICU/OR/OB monitor to computer download</td>
</tr>
<tr>
<td></td>
<td>documentation</td>
<td>Nursing physical assessment</td>
</tr>
<tr>
<td></td>
<td>Inpatient care management</td>
<td>Remote access from MD home, office</td>
</tr>
<tr>
<td></td>
<td>Administrative procedures</td>
<td>Drug lab alerts</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Electronic file cabinet for protocols, schedules</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Review of OR, Cath. lab, PT schedules</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cross-continuum patient registration system</td>
</tr>
<tr>
<td></td>
<td>MPI across &gt;1 site of care</td>
<td>Housestaff signout cards/Problem list</td>
</tr>
<tr>
<td>Phase IIC</td>
<td>Results retrieval</td>
<td>Pathology transcribed results</td>
</tr>
<tr>
<td></td>
<td>Clinical care delivery and</td>
<td>Patient careplans/pathways</td>
</tr>
<tr>
<td></td>
<td>documentation</td>
<td>Documentation of nursing interventions</td>
</tr>
<tr>
<td></td>
<td>Inpatient care management</td>
<td>Documentation of all ancillary caregiver interventions</td>
</tr>
<tr>
<td></td>
<td>Departmental operations</td>
<td>Critical lab alerts</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Electronic signature</td>
</tr>
<tr>
<td>Phase III</td>
<td>Clinical care delivery and</td>
<td>Anesthesia record</td>
</tr>
<tr>
<td></td>
<td>documentation</td>
<td>Telemedicine: CME</td>
</tr>
<tr>
<td></td>
<td>Inpatient care management</td>
<td>Telemedicine: Remote diagnostics</td>
</tr>
<tr>
<td></td>
<td>Departmental operations</td>
<td>Alerts to RNs and MDs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Physician order entry</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Digital radiography</td>
</tr>
</tbody>
</table>

personnel in the hospital, and which therefore can have a huge impact on clinical decision-making, are put into electronic form so they can be made available in different ways, each optimized to serve a different purpose. Calculations are done automatically, improving availability, accuracy, and efficiency.

**Phase IC**

Functionalities requiring and supporting interdepartmental collaboration are added here, building new ways to do work. Paper Medication Administration Records go away, leading to much more flexibility in displaying the effects of medication therapy using Clinical Management Flowsheets and enabling even better medication monitoring.

**Phase II**

Phase II broadens the range of caregiver activities included and builds more sophistication and complexity into the tools (see Appendix 2, Table 2).
Developing a Systematic Planning Process

Phase IIA

The electronically enabled caregiver at this point can no longer accept paper-based methods, so the range of tasks is broadened, with the easier extensions of the electronic capabilities established in Phase I.

Phase IIB

More complex and more technically challenging work processes are tackled here. Many more decisions about clinical processes, such as the degree of detail required for documentation, are made. Multiple organizational groups and technologies interact, which is harder to make work than in earlier phases, but builds on existing knowledge and trust.

Phase IIC

The remainder of the bedside and paper workflow is captured and integrated, tying in the new pieces with all that has already been done.

Phase III

Phase III tackles the more challenging work processes in more specialized environments.