

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/6705072>

Patient safety: a tale of two institutions.

ARTICLE *in* JOURNAL OF HEALTHCARE INFORMATION MANAGEMENT: JHIM · FEBRUARY 2006

Source: PubMed

CITATION

1

READS

54

3 AUTHORS, INCLUDING:



Marion Ball

IBM

156 PUBLICATIONS 1,358 CITATIONS

[SEE PROFILE](#)



Christoph U Lehmann

Vanderbilt University

212 PUBLICATIONS 2,240 CITATIONS

[SEE PROFILE](#)

JOURNAL OF HEALTHCARE INFORMATION MANAGEMENT

Patient Safety

Patient Safety: A Tale of Two Institutions

Driving Out Errors through Tight Integration
Between Software and Automation

Evaluation of Reported Medication Errors Before
and After Implementation of CPOE



Also in this issue...

Identification and Conceptualization of Nurse Super Users
Information Technology Strategy: Three Misconceptions

A **HIMSS**® Publication



Join us at our upcoming
healthcare IT conferences and
exhibitions and be a part of
transforming healthcare
through IT.

We invite you to attend:



For more information,
visit www.himss.org.



HIMSS
transforming healthcare through IT™
architects of change

JOURNAL OF
**HEALTHCARE
INFORMATION
MANAGEMENT**

Volume 20, Number 4 • Fall 2006

EDITOR'S INTRODUCTION

- 2 **Patient Safety and IT: A Need for Incentives**
Richard D. Lang, EdD

COLUMNS

- THE H.I.T. FUTURIST
5 **Patient Safety: Getting It Right
by Doing It Backwards**
Jeffrey C. Bauer, PhD

- TECHNOLOGY
8 **IT and Global Sourcing: Good Thing or Bad Thing?**
Rick Krohn

- PHYSICIAN'S PERSPECTIVE
11 **Harmonizing Healthcare Data Standards**
John D. Halamka, MD, MS

- LEGAL PERSPECTIVE
14 **A New Paradigm for Medical
Technology Procurement**
Sharon R. Klein and James P. Keller

- MANAGEMENT ENGINEERING
17 **Back to the Future—Process Maps Get You There!**
Brian J. Compas, FHIMSS

- NURSING INFORMATICS
20 **Progress and Challenges in Nursing
Documentation, Part II**
Brian Gugerty, DNS, MS, RN

- LEADERSHIP
23 **Transforming IT—The CIO as Clinical
Transformation Champion**
Pam Arlotto

FOCUS: PATIENT SAFETY

- 26 **Patient Safety: A Tale of Two Institutions**
Marion J. Ball, EdD, FHIMSS; Tamra Merryman, RN, MSN,
FACHE; and Christoph U. Lehmann, MD

- 35 **Driving Out Errors through Tight Integration
Between Software and Automation**

Mark Reifsteck; Thomas Swanson, MS, RPh;
and Mary Dallas, MD

- 40 **Enhancing Patient Safety through Electronic
Medical Record (EMR) Documentation
of Vital Signs**

Pauline Gearing, RN, BSN, CCRC; Christine M. Olney, MS, RN,
Doctoral Candidate; Kim Davis, MS, ARNP; Diego Lozano,
MD; Laura B. Smith, RN, MSN, CCRN; and Bruce Friedman,
D. Eng.

- 46 **Evaluation of Reported Medication Errors Before
and After Implementation of Computerized
Practitioner Order Entry (CPOE)**

Victoria M. Bradley, RN, DNP, FHIMSS; Carol L. Steltenkamp,
MD, MBA; and Kimberley B. Hite, MS, PharmD

ORIGINAL CONTRIBUTIONS

- 54 **Nursing and Knowledge Work: Issues Regarding
Workload Measurement and the Informatics
Nurse Specialist**
Jason Windsor, MS, MHA, RN, Major, U.S. Army Nurse Corps

- 60 **Identification and Conceptualization
of Nurse Super Users**
Daniel P. Boffa, RN, MS; and Lawrence M. Pawola,
PharmD, MBA

- 69 **Information Technology Strategy:
Three Misconceptions**
John P. Glaser, PhD

- 74 **Trusted and Relevant Medical Knowledge: The
Promise of Information Retrieval in Biomedicine**
Eric Z. Silfen, MD, MSHA; and Chintan O. Patel, MS

WRITER'S GUIDELINES

83

A **HIMSS** Publication

Patient Safety and IT: A Need for Incentives

Richard D. Lang, EdD

Technology to improve patient safety has been available for some time now. In fact, this issue contains several examples of applications that can dramatically improve the safety of patient care.

Automated medication administration records, vital sign data collection and dissemination applications, ubiquitous clinical data access, alert and reminder systems, and computerized practitioner order entry (CPOE) programs are just some of the technologies helping organizations that are striving to provide safe patient care. With careful and deliberate implementation processes that involve all key stakeholders in a progressive patient-care setting, organizations can use IT and take measurable steps toward reinventing quality in their organizations.

Notwithstanding these notable examples of technological progress, healthcare is still years away from widely adopting IT as a means to achieve continual improvement and refinement of critical patient care processes. Thus, before all providers can begin to realize the benefits of IT for improving all clinical processes, a system of incentives must be developed to encourage the deployment, use, and continual improvement of IT in care settings. These incentives must involve all constituents in the healthcare setting and be inextricably linked to measurable quality and performance improvement.

Incentives to Build/Procure

Even though there are many documented positive ROI examples linking IT with clinical process improvement, providers with limited and constrained resources are finding it hard to invest in IT.

*“...healthcare is still
years away from
widely adopting IT
as a means to
achieve continual
improvement and
refinement of critical
patient care processes.”*

Recently, some major employers have begun to encourage healthcare providers to use IT by providing pay-for-performance incentives. Cisco, Intel, and Oracle plan to offer rewards of as much as \$150,000 per year for healthcare firms that use systematic processes and health information technology to improve the quality of care. These companies want to help providers with razor-thin margins adopt IT platforms for improvement. The belief is that such systems ultimately will improve outcomes and provide better experiences for their

employees when they enter the healthcare system.¹

Hopefully, these types of employer-led initiatives will help spur other key players to offer similar incentives. For example, insurers have a similar reason to improve provider performance. Better quality care, especially in the provision of preventive care, ultimately will result in lower utilization, lower costs, and healthier members. Thus, it would seem to make sense for insurers to offer similar incentives, such as grants or other reimbursement bonuses, to providers who can demonstrate process and patient safety improvements through the deployment of IT.

Many non-profit insurers note that they must remain solvent and yet are required by law to set aside a substantial amount of their profits in a reserve fund to pay projected future claims, which limits their ability to fund incentives to improve provider efficiency. But every year, thousands of people either die or are injured as a result of preventable errors in our healthcare system—if that doesn’t constitute a substantial future liability for insurance claims, I don’t know what does.

If insurers want to establish true partnerships with providers and members, they need to devise more creative ways to improve patient safety by providing financial incentives for providers to invest in IT. Raiding reserve coffers may not be the

EDITOR'S INTRODUCTION

answer, but when insurers over-contribute to these funds,"² it does raise the question of whether some of these reserves can be used to help fund patient safety initiatives. New grants provided by the California Network for Electronic Health Record Adoption, a project of the Blue Shield of California Healthcare Foundation, and the Community Clinics Initiative, a joint project of the Tides Foundation and the California Endowment,³ are great steps forward. Similar insurer-based endowments need to be extended to hospitals and other providers to help fund advanced clinical system initiatives.

Incentives to Use

When organizations decide to deploy IT as a way to improve patient safety, they must obtain commitments from everyone in leadership at the organization. Unfortunately, to assuage the political tumult raised by skeptics and other recalcitrant forces, some organizations may approach patient safety-related IT initiatives with tepid requests for voluntary participation.

This type of indecisiveness forces organizations to simultaneously support both electronic and paper-based processes. As a result, nursing, ancillary, and other clinical support personnel must be especially vigilant to respond to orders, alerts, and reminders coming from two completely different sources. Although it may be necessary to support these dual processes for a short transitional period, prolonged support of two approaches will drain resources and add complexity, inevitably increasing opportunities for errors.

As a result, organizations' leaders must provide incentives to ensure a quick transition to widespread use of clinical IT application systems. These incentives could include clear and decisive mandates, and deadlines for full compliance regarding active and demonstrated competent use of core clinical applications, such as CPOE, by

all affiliated providers. Additionally, medical staff executives should consider making the active utilization of IT a credentialing requirement for admitting and other medical staff privileges.

Incentives to Analyze and Reflect

After IT systems are widely and actively used, organizations need to take full advantage of the data that is collected to analyze and reflect on the quality of past performance. A recent column in the *Philadelphia Inquirer* implied that the inability to identify, examine, and resolve problems and systemic process-related flaws in the healthcare system may have less to do with IT and more to do with apprehension. It seems that the fear of litigation drives some healthcare organizations to under-report medical errors. In metropolitan areas such as Philadelphia that have been rocked by high malpractice insurance costs, hospitals and physicians are naturally reticent to adopt an open and honest reporting policy.⁴

The United States has the most advanced medical care in the world. Advancements have come as a direct result of learning from mistakes—that's one of the reasons that autopsies are performed. But today, with all the malpractice litigation and misinformed public scrutiny, the healthcare industry is mired in the process of under-reporting and, in some cases, may even hide errors. Thus, even though the nation's healthcare system has greatly benefited from calculated risk-taking and the value of learning from mistakes, it's abandoning these virtues in a misguided attempt at self-preservation.

Stronger incentives are needed to promote full disclosure of infection rates, medical errors, near misses, and mortality data. In addition to long overdue and much-needed malpractice reform, state agencies that collect such data must provide a clear and cogent amnesty and confidentiality guarantee to all providers that are

JOURNAL OF HEALTHCARE INFORMATION MANAGEMENT

Journal of Healthcare Information Management[®] (ISSN 1099-811X) is published quarterly by the Healthcare Information and Management Systems Society (HIMSS). Subscription to this publication is a benefit of membership in HIMSS.

Statements and opinions appearing in articles and departments of the journal are those of the authors and do not necessarily reflect the position of HIMSS. Canadian Agreement #40648621.

Copyright© 2006 by the Healthcare Information and Management Systems Society.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without prior written permission. Please contact: HIMSS Publications, 230 E. Ohio St. Suite 500, Chicago, IL 60611; (312) 915-9238; nvitucci@himss.org.

"HIMSS," "Healthcare Information and Management Systems Society," "Journal of Healthcare Information Management," and the HIMSS symbol are registered trademarks.

NOTE: Starting with volume 16, number 1, each volume of *Journal of Healthcare Information Management*[®] begins with the Winter issue.

U.S. SUBSCRIPTIONS cost \$69.00 for individuals and \$104.00 for institutions, agencies, and libraries. Standing orders are accepted. There is no sales tax on U.S. subscriptions. Canadian residents, add GST and any local taxes.

INTERNATIONAL SUBSCRIPTIONS cost \$109 for individuals and \$144 for institutions.

SINGLE COPIES cost \$26.00 plus shipping (see below). Please include appropriate sales tax for your state. Canadian residents, add GST and any local taxes. Prepayment is required.

SHIPPING (Single Copies only): \$30.00 and under, add \$5.50; to \$50.00, add \$6.50; to \$75.00, add \$8.00; to \$100.00, add \$10.00; to \$150.00, add \$12.00.

TO ORDER subscriptions or single issues, please contact *Journal of Healthcare Information Management*, P.O. Box 9369, Lowell, MA 01853, 978/256-6490, 978/256-1703 (fax), cs-jhim@circ.net.

EDITORIAL QUESTIONS AND PERMISSION REQUESTS should be directed to Nancy Vitucci, Manager, Publications, HIMSS, 230 East Ohio Street, Suite 500, Chicago, IL 60611, 312/915-9238, 312/915-9511 (fax), nvitucci@himss.org.

ADVERTISING SALES AND ARTICLE REPRINTS For advertising sales, contact John Payne, VP Sales, MedTech Publishing, at john.payne@medtechpublishing.com. For article reprints, contact Pamela E. Slye, Assistant to the Publisher, MedTech Publishing, at pamela.slye@medtechpublishing.com.

ADDRESS CHANGES should be sent to Healthcare Information and Management Systems Society, 230 E. Ohio St., Suite 500, Chicago, IL 60611.

Printed in the United States of America.

EDITOR'S INTRODUCTION

required to submit error reports. The voluntary 100,000 Lives Campaign is an example of providers' willingness to freely share data when they do not fear reprisal. After providers feel reasonably secure that their reports will only be used to help improve patient safety, IT systems can be used to collect, analyze, and report on a wide variety of mishaps, missed opportunities, and process flaws to promote widespread, evidence-based patient safety improvement initiatives.

Incentives to Continue

These incentives are just a few examples of how the increased use of IT could be promoted to improve patient safety. After IT systems are in place, these and other incentives need to be maintained to ensure that processes and systems continue to improve and evolve through the integration of new developments in software and other technology advancements.

Upgrades, maintenance, and new implementations will continue to be expensive, capital-draining requirements. If we are to continue on a path of steady and measurable progress, new incentives must be developed to keep systems current, agile, and responsive for tomorrow's patient safety requirements.

The Fall 2006 issue of the *Journal of Healthcare Information Management* contains a collection of special interest columns and articles

focusing on patient safety. In this issue, there are several examples, strategies, opinions, and case studies that will be of interest to healthcare leaders who are working to make healthcare environments safer for their patients. These articles include A Tale of Two Institutions; Driving Out Errors through Tight Integration Between

"After IT systems are widely and actively used, organizations need to take full advantage of the data that is collected to analyze and reflect on the quality of past performance."

Software and Automation; Evaluation of Reported Medication Errors Before and After Implementation of Computerized Practitioner Order Entry; and Enhancing Patient Safety through Electronic Medical Record (EMR) Documentation of Vital Signs. These contributions and case studies provide useful knowledge and best-practice examples on advanced

clinical system automation for patient safety.

In addition, special interest columns and articles provide valuable information and insight on the following topics: Patient Safety: Getting It Right by Doing It Backwards; IT and Global Sourcing: Good Thing or Bad Thing?; Harmonizing Healthcare Data Standards; A New Paradigm for Medical Technology Procurement; Back to the Future—Process Maps Get You There!; Progress and Challenges in Nursing Documentation Part II; and The CIO as Clinical Transformation Champion, as well as other original contributions.

Finally, I would like to thank the professional staff at HIMSS, the peer reviewers, and the JHIM editorial review board for all the behind-the-scenes work that goes into producing each issue. JHIM continues to look for new ways to provide relevant, important and useful information for healthcare professionals, academicians and HIMSS members. If you have any comments or suggestions that could help us improve in any way, please feel free to e-mail me at rdlang@know-power.com.



Richard D. Lang, EdD, is the editor of the *Journal of Healthcare Information Management* and CIO for Doylestown (PA) Hospital.

References

1. Havenstein, H., Medical Groups Offered Rewards for IT Use, February 6, 2006, *Computerworld*.
2. <http://www.californiahealthline.org/index.cfm?Action=dsplItem&itemID=111564>
3. Grants Aim to Speed Clinics' EHR Uptake, June 2006, *Healthcare IT News*.
4. Goldstein, J., Hospital Infection Data Low; Too Low?, May 22, 2006, *Philadelphia Inquirer*.

Patient Safety: Getting It Right by Doing It Backwards

Jeffrey C. Bauer, PhD

As the son and grandson of university engineering professors, I was taught to use ideal design as a tool for solving problems. The general idea is to imagine a desired solution and then to work backwards—to “reverse engineer”—from the desired solution to the current problem. Ideal design is fundamentally creative (and fun) because its starts with the solution, not the problem; it works in the opposite direction of most approaches to solving problems.

People who do not think like engineers are more likely to start with the problem and focus on finding a way to repair what is broken. Different fixes are tried until the system again functions normally, just like it did in the past. This approach is reflected in the adage, “If you like what you have always gotten, keep doing what you have always done.” Ideal designers, on the other hand, are motivated by seeking something better than what they have always gotten.

Doing It Backwards

Ideal design strongly shaped my approach to teaching in the two decades I spent as a professor. The final examination for my course in health economics always included an essay question that asked students to create a “backwards” solution to a persistent problem of healthcare

“Ideal designers, on the other hand, are motivated by seeking something better than what they have always gotten.”

delivery. The exercise was structured to focus initial attention on a desired improvement in quality, cost, or access—a solution that purposefully met a new objective.

JOURNAL OF **HEALTHCARE INFORMATION MANAGEMENT**

Richard D. Lang, EdD, Editor in Chief

Fran Perveiler, Vice President, Communications

Nancy Vitucci, Manager, Publications

2006 HIMSS BOARD OF DIRECTORS

CHAIR George T. Hickman, CPHIMS, FHIMSS
Senior Vice President and Chief Information Officer
Albany Medical Center

VICE CHAIR Marion J. Ball, EdD, FCHIME, FHIMSS
Fellow, IBM Global Leadership Initiative
Center for Healthcare Management
Professor, Johns Hopkins School of Nursing

CHAIR ELECT John Wade, FCHIME, FHIMSS
Vice President/Chief Information Officer
Saint Luke's Health System

VICE CHAIR ELECT Victoria Bradley, RN,
CPHIMS, FHIMSS
Director of Patient Information
University of Kentucky Chandler Medical Center
University of Kentucky

Margret Amatayakul, RHIA, CHPS, FHIMSS
President
Margaret A. Consulting, LLC

Barry Chaiken, MD, MPH, FHIMSS
Associate Chief Medical Officer
BearingPoint, Inc.

Charles E. Christian, CIO, FCHIME, FHIMSS
Director, Information Systems/
Chief Information Officer
Good Samaritan Hospital

Ray Gensinger Jr., MD, CPHIMS, FHIMSS
Deputy Medical Director
Hennepin County Medical Center

John Hansmann, CPHIMS, FHIMSS
Regional Manager, Management Engineering
Intermountain Health Care

Liz Johnson, FHIMSS
Vice President, Clinical Informatics
Tenet Healthcare Corporation

Karen J. Ondo, FHIMSS
Executive Vice President, Business Solutions
KLAS Enterprises &
Principal Computer Systems Associates

Jay Srinivasan
Vice President, Emerging Technologies
University of Pittsburgh Medical Center

THE H.I.T. FUTURIST

Part of the fun of ideal design is creating a new solution from scratch, so I prepared students for the final exam question by encouraging them to approach a chosen problem without fear of existing constraints. A real problem is a challenge to be overcome by working backward—not a reason to prevent going forward—in ideal design.

I illustrated the point in classroom lectures by stating my belief that a major systemic problem of American healthcare is the lack of alignment between the economic objectives of physicians and health systems. With a few prominent exceptions, medical care in the U.S. is inefficient and ineffective because physicians and hospitals are playing a zero-sum game. One party's gain is the other's loss.

In the realm of health information technology, the adoption of computerized practitioner order entry (CPOE) illustrates this problem. Hospitals can immediately enhance patient safety and ultimately save money by replacing handwritten orders with automated systems that improve clinical decision-making and simultaneously prevent expensive medical errors. Physicians, on the other hand, lose money when CPOE is implemented because using an automated system takes more time than scribbling orders on paper. They bear real short-run costs but do not share in the long-term economic gains. The only exceptions to this occur in health maintenance organizations and academic health centers, where physicians' incomes are directly linked to the health system's financial success through employment, not voluntary affiliation.

When I envision an ideal alternative to our dysfunctional health system, hospitals and physicians work

together because their economic incentives are the same. Their fortunes literally rise or fall together based on how well they work toward a common goal. The challenge for ideal design is to reverse-engineer a system that aligns the economic interests of physicians and hospitals. No aspect of healthcare, including patient safety, will perform optimally until these two provider groups are aligned economically.

Carrots and Sticks

Other articles in this issue discuss the use of appropriate incentives to facilitate adoption of information

"Standardization to promote patient safety is all but impossible when practitioners must rely on manual information systems."

technology. Physicians' losses in time and money need to be compensated by equal or greater gains in income or other rewards sought from the practice of medicine.

However, experience also has demonstrated the importance of "sticks" to prevent abuses that can arise from unfettered pursuit of "carrots" or simple distaste for making changes. For example, we all know that a few members of any hospital's voluntary medical staff will resist or even sabotage an HIT project as a matter of principle, no matter how attractive the incentives are for them to support it.

Experiences in other industries clearly demonstrate that process

standardization is an essential "stick" for performance improvement. Incentives for change are not sufficient to produce desired outcomes if workers are still free to perform in inconsistent ways. To use a common saying that makes the point, the carrots and the sticks must get everyone "reading off the same page,"—that is, doing the same thing the same right way.

Standardization to promote patient safety is all but impossible when practitioners must rely on manual information systems. Even if all caregivers were able to read from the "same page" at every stage of a paper-based patient care process, clinical performance would still be uneven because of potential differences in their interpretation of information and deviations from standards. Standardization is a significant benefit of IT in comparison to paper. In 21st century terms, the appropriate phrase is to get everyone reading off the "same screen."

Getting It Right

For any student who would use patient safety to answer the ideal design question on my final exam, discussion of IT would be essential for getting an A.

Fixing glitches in paper-based information still leaves us with a system that is the root of most errors in healthcare. Admittedly, some errors are caused by professional incompetence, but the vast majority of safety problems in patient care are explained by a failure of information. Experience in aviation shows that good IT can counteract incompetence. Errors in the cockpit of a commercial airliner virtually have to be intentional; safe performance is enforced by built-in information technology.

Our process of ideal design should

THE H.I.T. FUTURIST

begin with the vision of a truly modern health system, one where patients do not have to worry about medical care any more than they have to worry about air travel. Looking backwards from this desired future, automation is indisputably the way to ensure patient safety in healthcare.

The paper trail will not lead us to this ultimate solution. We need standards-based IT as a "stick" to move us from where we are to where we must be.

About the Author

Jeffrey C. (Jeff) Bauer, PhD, a nationally recognized medical economist and health futurist, is a partner in the management consulting practice of ACS Healthcare Solutions (Dearborn, MI). See www.jeffbauerphd.com or contact him at jeff.bauer@acs-hcs.com.

JOURNAL OF HEALTHCARE INFORMATION MANAGEMENT

ADVISORY BOARD MEMBERS

Simon P. Cohn, MD, MPH, FACEP, FACMI
The Permanente Federation,
Kaiser Permanente Medical Care Program

Janet Dillione
Siemens Medical Solutions

JOURNAL OF HEALTHCARE INFORMATION MANAGEMENT EDITORIAL REVIEW BOARD

Mary Alice Annecharico, RN, FHIMSS
Executive Director, IS
University of Pennsylvania School of Medicine
Philadelphia, PA

Marion J. Ball, EdD, FHIMSS
Vice President, Clinical Informatics Strategies
Healthlink Incorporated
Baltimore, MD

Eta S. Berner, EdD
Professor Health Services Administration
University of Alabama at Birmingham
Birmingham, AL

William F. Bria, MD
Medical Director, Clinical Information Systems
University of Michigan Hospitals
Ann Arbor, MI

John P. Glaser, PhD, FHIMSS
Vice President and CIO
Partners HealthCare System
Boston, MA

Margaret M. Hassett MS, RN, C, FHIMSS
Consultant
Picis, Inc.
Charlestown, MA

David S. Memel, MD, MS
Roche Laboratories, Inc.
Nutley, NJ

Pierre S. Pincetl, MD
Chief Information Officer
University of Utah Hospitals and Clinics
Salt Lake City, UT

Elaine S. Remmlinger
Principal
Hamilton-HMC
New York, NY

Albert A. Sinisi
Vice President and Chief Information Officer
Children's Hospital of Philadelphia
Philadelphia, PA

Patricia Skarulis
Vice President and CIO
Memorial Sloan-Kettering Cancer Center
New York, NY

IT and Global Sourcing: Good Thing or Bad Thing?

Rick Krohn

It's often said that the challenge of healthcare IT staffing is the constant search for local talent, but this industry dynamic is in the midst of a fundamental shift. Increasingly, the healthcare IT gap is being bridged with talent found not only beyond local ZIP codes, but well beyond local time zones.

Global sourcing describes the combined strategies of outsourcing and offshoring, which enable healthcare managers to capture the collective operational and cost benefits of global supplier networks. Global sourcing is becoming a common feature of domestic healthcare operations. On the supply side, it's driven by enabling clinical, business and communications technologies; on the demand side, it's driven by cost, the scarcity of labor, and IT resource imbalances.

To answer this demand, advanced healthcare technologies and communications networks are radiating throughout developing economies, with India and China as notable examples. These technologies are releasing previously untapped reser-

"Increasingly, the U.S. healthcare and life sciences industries are tapping into these new technology supply chains to service mission-critical functions."

voirs of skilled technology workers and technology resources. Increasingly, the U.S. healthcare and life sciences industries are tapping into these new technology supply chains to service mission-critical functions.

A Growing Trend

The result is that a vast supply of cheap, available technology tools and talent are being inserted into U.S. healthcare operations, typically at the expense of local resources. That's not to suggest that healthcare's IT jobs

are taking wing, never to return. According to *Information Week's* 2006 National IT Survey of 10,425 IT professionals, only 14 percent reported offshoring IT jobs, while 20 percent outsourced within the U.S. and 16 percent of respondents reported a combination of both. Some 45 percent reported no outsourcing of any kind.¹

Nevertheless, a clear pattern is emerging. IT-assisted global sourcing is penetrating the clinical and business environments within U.S. healthcare organizations, which are using dictation, transcription, records management, finance, coding and other services. Executives site cost reduction, speed to market, business innovation, and risk mitigation as principal benefits of adopting a global sourcing strategy.

However, opinions differ on its security, reliability, regulatory compliance, and true cost. Critics suggest that outsourced and offshore IT services, particularly those that routinely handle sensitive information, may not meet HIPAA or data security standards, may threaten intellectual

TECHNOLOGY

property rights, may not be available around the clock, or may not be accessible in all economic and political climates.

Some evidence suggests that windfall savings from global sourcing may never materialize. A study conducted by TPI examining outsourcing contracts awarded between 2003 and 2005 found that savings ranged from a low of 10 percent to a high of 39 percent, with 15 percent being the average.²

Challenges of Offshoring

Offshoring is particularly challenging because it requires partnerships between organizations in different time zones, often with language and cultural variances and different communications styles. Internally, offshoring requires a wide range of management skills that blends together two wholly separate staffs and infrastructures and prevents employee dissatisfaction and defections. Change management, redeploying staff and introducing new business processes are just a few of the challenges that accompany this transition. Failing to deftly navigate this thorny path often results in a difficult relationship with the offshore company and employee resistance internally.

The same danger looms when organizations outsource IT applications. There is always the danger that attrition rates among highly skilled internal staff will increase when IT is used to transition organizations to more virtual business models. Poor management communication and a contentious working relationship with outsourced colleagues expedite this process.

Despite these difficulties, supporters of global sourcing argue that it's an issue of having access to

the right technology staff resources at the right time and in the right place.

"Leveraging technology for business value, flexible staffing, improving time to market, and the effective expansion of the 'global' work day from eight to as many as 18 hours all speak strongly in favor of IT outsourcing and offshoring," says Krish Venkat, vice president of healthcare and life sciences for Cognizant. "Global sourcing provides access to best-in-class technologies, technology and domain professionals, and other related capabilities that may be otherwise unavailable locally."

Such access propels business

***"To succeed with
global sourcing, U.S.
healthcare
organizations must
devise a change
management strategy
to accommodate the
new operating
environment."***

innovation and operational efficiencies without the constant draining of resources required by recruitment and retention. The pharmaceutical industry has been particularly active in establishing global-sourced partnerships in areas such as research and discovery and clinical trials.

"From the pharma perspective, global sourcing creates opportunities to unlock the potential of highly educated workforces outside of individual companies and outside the U.S.," says Mark Powell, PhD, senior

vice president of pharmaceutical development for Bristol Myers Squibb. "For instance, global sourcing allows us to leverage existing resources and expand our capabilities for clinical trials, as well as for select aspects of drug discovery and pharmaceutical development."

Going forward, labor arbitrage will remain a driver, but the landscape of global sourcing is in transition. Some 21 percent of companies are outsourcing today, primarily to improve quality, up from 11 percent in 2004, according to the TPI study.³

"Offshore technology companies are faced with rising salary expectations from their staffs and have been compelled to find value-adds to maintain their competitive advantage," says Harry Rhodes, director of practice leadership for the American Health Information Management Association.

"Niche services, higher orders of intellectual capital, improved infrastructures and expanded services are emerging as value propositions of these outsourcing companies," Rhodes added. These expanded capabilities eventually may include best-in-class global supply chains, global technology grids and globally distributed infrastructures.

Principles of Success

To succeed with global sourcing, U.S. healthcare organizations must devise a change management strategy to accommodate the new operating environment. Proper planning, staff education, ongoing communication, and a keen sensitivity to staff anxieties are vital to integrating remote people and processes into daily operations.

With global partnerships, it's vital to establish contractually ironclad guarantees of performance in areas such as HIPAA compliance, privacy, and data security, in addition to

TECHNOLOGY

the customary outsourcing contract features.

Finally, it pays to start small, using "modular" global sourcing to soften the impact of exporting jobs and functions by scaling IT-driven outsourcing within specific business and IT functions. The

scope of the relationship can always be expanded after the initial dust has settled and a record of success has been established.

About the Author

Rick Krohn (rkoohn@healthsen.com) is president of HealthSense Inc., a

leader in healthcare business development, marketing and communications, technology application, and business transformation.

References

1. McGee, Marianne Kolbasuk, *Information Week*, April 24, 2006. Page 46.
2. Technology Partners International Press Release, April 13, 2006.
3. ibid. Technology Partners International

Harmonizing Healthcare Data Standards

John D. Halamka, MD, MS

As an emergency physician at Beth Israel Deaconess Medical Center in Boston, I treat patients using incomplete medical information. Patients often do not know their medications, their medical history, or their latest laboratory results. Patients seek care from a heterogeneous collection of primary care providers, specialists, hospitals, clinics, laboratories, imaging centers, and pharmacies, all of which have disconnected pieces of the medical record.

Patients, providers, and payers believe that communication among caregivers is key to delivering high-quality, personalized medicine. Many believe that sharing electronic records across the entire community of clinicians can play a crucial role in coordinating care.

Currently, only 18 percent of clinicians in the U.S. have electronic health records (EHRs) in their offices. In Massachusetts, one of the most wired states in the country, 52 percent of physician offices have adopted EHRs. However, data does not flow between these systems because of the inconsistent use of data standards, the

lack of a consistent architecture for exchanging data, and the lack of community-wide agreement on privacy policies.

The Need for Standards

Standards have positively revitalized our lives in a number of areas. For example, anyone can travel

"...there has not been consistent adoption of standards for the storage and exchange of medical information among clinicians, hospitals, and insurance companies..."

worldwide, walk up to an automated teller machine, insert an ATM card, and retrieve whatever local currency is

needed. This is made possible by the worldwide adoption of electronic standards for banking and cash transfers.

However, if a traveler has a major medical problem, even if it's in the patient's hometown, medical records cannot be electronically exchanged, even among the world's best teaching hospitals that are located across the street from each other. That's because there has not been consistent adoption of standards for the storage and exchange of medical information among clinicians, hospitals, and insurance companies in the U.S.

But all of this appears to be changing in 2006. Health and Human Services Secretary Michael Leavitt has established the American Health Information Community, a group of 17 government, business, and not-for-profit organization leaders charged with fostering adoption of interoperable electronic records throughout the country. Further, the HHS-based Office of the National Coordinator for Health Information Technology has funded a coordinated effort to accelerate electronic medical

PHYSICIAN'S PERSPECTIVE

record interoperability efforts. This effort is comprised of three parts.

The first step is to harmonize all electronic standards for healthcare in the country. Currently there are more than a dozen organizations creating healthcare standards in the US. These standards are at times redundant, competitive, and non-interoperable. In addition, there are so many versions and variations of these standards that they become non-standard. To achieve the kind of universal functionality ATM cards provide worldwide, the country must agree on a common set of healthcare data standards, implemented consistently by hospitals, clinician offices, and long-term care facilities.

The second step is to ensure electronic medical records provide the basic functions needed for a physician to record and transmit patient medical information. The average patient older than 80 has 10 medications and three clinicians; rarely is there any coordination of care among caregivers. Objective criteria to certify that an electronic record system meets the basic requirements for data capture and exchange is essential.

The third step is to standardize privacy and security policies across all 50 states. In Massachusetts, physicians cannot retrieve a complete electronic medication list from insurance companies, even if they have patient consent, if a medication related to mental health, substance abuse, or HIV treatment is present. In Ohio, physicians must use a cryptographic electronic signature to prescribe medications electronically. In California, only signed paper consent forms, not electronic forms, are considered valid. The laws that created many of these regulations were appropriate 30 years ago when

electronic systems lacked the sophistication available today, but now they're an impediment to delivering safe, patient-focused care.

The Role of HITSP

The Health Information Technology Standards Panel (HITSP), which I chair, was established by HHS to convene all the stakeholders necessary

"...the resulting standards will serve the consumer and other healthcare stakeholders by addressing issues such as data accessibility, privacy, and security."

to build consensus around the most appropriate standards for clinical care, public health reporting, and consumer empowerment. More than 170 stakeholder members and 15 standards development organizations work together to identify the most appropriate standards for specific use cases involving patients, providers, and government agencies.

The panel brings together experts from across the healthcare IT community. Participants range from consumers to physicians, nurses and hospitals; from those who develop healthcare IT products to those who use them; and from the government agencies that monitor the U.S. healthcare system to organizations that are actually writing the standards.

HITSP members and experts have committed themselves to setting and implementing standards that will

ensure the integrity and interoperability of health data. A standard specifies a well-defined approach that supports a business process; has been agreed upon by a group of experts; has been publicly vetted; provides rules, guidelines, and characteristics; helps to ensure that materials, products, processes, and services are fit for their intended purpose; is available in an accessible format; and is subject to an ongoing review and revision process. Harmonization is required when a proliferation of standards prevents progress rather than enables it.

In some cases, redundant or duplicative standards will be eliminated. In other cases, new standards may be established to span information gaps. In all cases, the resulting standards will serve the consumer and other healthcare stakeholders by addressing issues such as data accessibility, privacy, and security.

The Standards Harmonization Process

HITSP's most important job will be to develop a well-defined, repeatable process to identify the most appropriate standards for each AHIC use case.

Currently, the process begins with AHIC and its working groups developing breakthroughs, and an AHIC working group or other customer preparing an HITSP harmonization request. Then, the HITSP technical committees identify candidate standards, which are harmonized into a final list of standards. They also identify overlaps and highlight gaps. Gaps are forwarded to standards development organizations for their guidance on emerging candidate standards or new standards requirements.

HITSP coordinating committees

PHYSICIAN'S PERSPECTIVE

provide technical committees with important background information to support their work, such as offering objective criteria to evaluate the appropriateness of standards for a given purpose.

The final chosen standards produced by the technical committees are discussed and ratified by the HITSP panel. These standards then are made available for public comment and feedback.

Technical committees work with standards development organizations and other groups to produce detailed specifications, an unambiguous "cookbook" for the implementation of chosen standards. HITSP provides a convening and facilitative function for this activity.

Then, HITSP work products are delivered to AHIC for their endorsement. After AHIC endorses HITSP work, the Certification Commission on Healthcare Information Technology will include HITSP specifications in its certification work. Hospitals and clinicians will be more likely to buy products that are certified as interoperable, leading to increased business for vendors that embrace standards and interoperability.

Coordination with HHS Activities

The standards harmonization activities of HITSP are well coordinated with the efforts of other healthcare IT projects being pursued by HHS, which include the following:

National Health Information Network. Four lead contractors—Computer Sciences Corp., Northrop Grumman, IBM Corp., and Accenture—have been given contracts to develop a nationwide architecture for the secure exchange of medical records using HITSP-harmonized standards. These contractors generate requests for harmonization to HITSP, which shares its work products with NHIN contractors through group forums that ensure ongoing coordination and communication.

Health Information Security and Privacy Collaboration (HISPC). HITSP work products will be shared with the HISPC program management, and harmonized privacy use cases will undoubtedly be shared with HITSP to inform the selection of technical standards that enforce security.

Certification Commission on Health Information Technology (CCHIT). CCHIT staff attend HITSP meetings, and the commission has promised to include HITSP work products in its future certification criteria.

Current Progress, Next Steps

HITSP has established an initial process for resolving gaps and overlaps in HIT standards. In May 2006, HITSP reduced 570 candidate standards to 180 appropriate standards for the secure exchange of medication, lab, allergy, and demographic

data. By June 2006, these 180 standards were further reduced to a few dozen.

By October 30, 2006, HITSP will deliver unambiguous interoperability specifications that will enable vendors, hospitals, and the government to create software components for clinical data exchange.

Beyond 2006, HITSP will develop harmonized standards and unambiguous implementation guides that provide precise instructions for data sharing for all future requests for harmonization. Also, it will standardize the interoperability specifications for technology products, while permitting differentiation and competitive advantage in the marketplace. HITSP hopes to empower patients and care providers with EHRs that facilitate easy access to critical health data that is accurate, private, and secure.

HITSP is a key component of HHS' vision to create an interoperable healthcare system, and the panel looks forward to developing work products that empower patients, providers, and government stakeholders in 2006 and beyond.

About the Author

John D. Halamka, MD, MS, is the chair of the Health Information Technology Standards Panel and the CIO at Beth Israel Deaconess Medical Center and Harvard Medical School.

A New Paradigm for Medical Technology Procurement

Sharon R. Klein and James P. Keller

We have all heard about the rapid convergence of medical devices and information technology. What once may have been considered a simple PC now may be reading, displaying, and recording live patient data. It may even sound medical alarms. Many traditional medical devices now have built-in Windows operating systems and may be sending data back and forth across hospital networks through hard-wired or wireless connections, populating an electronic medical record, for example.

From a procurement and legal point of view, the convergence of medical technology and IT creates a new paradigm for what constitutes a medical device. This changes the roles and responsibilities for many professionals in healthcare settings.

Information technology professionals now must consider the clinical performance and patient safety characteristics of technology purchased by hospitals. Clinical engineers are expected to understand the networking, interoperability, and privacy and security issues for the

technology they support. Nursing managers, physicians, and administrators must learn to speak the language of the clinical engineers and IT

“As a result, healthcare professionals must consider several key issues as they become more involved in the procurement of IT-based medical technology.”

professionals supporting their technology, and they need to understand the basic principles of IT-related concepts like data management or wireless communications standards. As a result, healthcare professionals must consider several key issues as they become more involved in the procurement of IT-based medical technology.

It's No Longer Just a Box

Consider the ubiquitous infusion pump. Procurement of this technology traditionally has involved the box-shaped infusion pump, disposable administration sets and accessories like IV poles. These devices were typically purchased on a five- to seven-year cycle that may have included a contract for service and preventive maintenance. Frequently, clinical engineering departments handled the service and support, and a service contract was unnecessary.

As this technology has evolved to include sophisticated software, like dose error reduction systems and wireless delivery of dose-related order sets, new factors for procurement emerge. The paradigm has shifted from buying a “box” with accessories to a software- and services-related procurement, necessitating associated legal terms and conditions.

Manufacturers recognize the necessity of these additional legal terms and add them as shrinkwrap conditions to purchase and service agreements. Hospitals cannot ignore the fine print,

LEGAL PERSPECTIVE

which often sets conditions on updating and replacing defective products, restrictive warranties, mandatory purchase of consumables, and limitations on liability.

A master services and support agreement that sets best practices and service levels mutually acceptable to both parties should be negotiated to replace these one-sided, boilerplate forms. Also, master agreements can leverage pricing across an enterprise for purchases at a discounted rate or enable a dedicated service account team to respond on a priority basis to service requests.

Implementation of infusion pumps with dose error reduction systems and other new IT-related features is much more involved than with traditional infusion technology. This will typically require fee-based implementation services from infusion pump vendors and possibly outside consultants. These services may include the vendor or consultant assisting with the extensive training needed for clinical staff on the new ways they will interact with infusion pumps, developing pump-related drug formularies and verifying wireless coverage.

In these cases, it is important for the vendor or consultant to warrant their work and indemnify the hospital against patient safety issues that might result from such services. In the case of extensive modifications, the medical device may need to be retested for FDA compliance after services are performed.

Confidentiality, Security, and HIPAA

Infusion pumps and other computer-based medical technologies like physiologic monitoring systems that store patient information raise new confidentiality and security concerns. As these devices connect to

and transmit data across hospital networks, procurement planners must consider interoperability issues and software security.

These planners will need to establish responsibility, for example, by biomedical engineering or IT personnel, for implementing security upgrades; determine whether purchasing agreements cover all costs for security upgrades; and, from a patient safety standpoint, determine when it is safe to install security patches for devices that are often continuously connected to patients. As patient monitoring services go wireless, special attention should be paid to HIPAA security standards, for example, to ensure that data transmissions to and from medical devices are encrypted or otherwise secure.

Hospitals' HIPAA compliance programs must ensure that individuals such as manufacturer service personnel do not have inappropriate access to patient data whether on site or remotely. All technicians should receive training on HIPAA privacy and security and must adhere to compliance procedures.

Any access to protected health information by third-party service providers should be covered by a business associate agreement. These protective measures need to be taken with any existing equipment and should be addressed when developing language for purchasing agreements for new equipment.

Preparing for the Paradigm Shift

Preparing for any new technology can be a daunting task. However, when key players involved in procurements are asked to operate outside of normal comfort zones, the task can seem nearly impossible. This is the case with computer-based medical technology.

Most IT professionals are not used to addressing detailed clinical issues. Most clinical engineers are just beginning to learn about the intricacies of networking and interoperability. Clinicians, administrators and technical staff are still learning to speak a common information technology-oriented language, and until they do, such gaps can have a negative impact on patient safety and increase liability.

The only way that the acquisition of computer-based medical technology can work is to use a carefully thought-out technology assessment process, which involves establishing a committee of key players with clearly defined roles. This is especially important for clinical engineering and IT professionals, who may bring overlapping expertise to the table.

For any new acquisition, a technology assessment committee should clearly understand the hospital's needs related to the technology being considered. Detailed criteria should be developed based on the hospital's specific needs. Then, the committee should establish a good evidence-based argument that the technology will actually meet the hospital's needs. The argument should be further validated by verifying that other competing technologies do not do a better job of meeting the hospital's needs. This requires thoughtful collaboration among every member of the technology assessment team. Clear ground rules should be established before the process begins to avoid problems, such as instances in which one member of the team dominates the process.

Building in Safety and Standards

Many healthcare technologies have a long paper trail of information about past performance, recall histories, reported problems, and safety and

LEGAL PERSPECTIVE

use. IT professionals that are new to the medical device procurement process must learn how to find this information to ensure that devices with previously reported hazards or recalls are not allowed to be used on patients, at least until there is confirmation that reported problems have been resolved.

Also, the FDA has very specific medical device reporting requirements for product defects and failures under the Safe Medical Devices Act of 1990 and the Medical Device Reporting Rule of 1995. If these devices fall under the care of IT professionals, they will likely bear the responsibility of such reporting.

Many clinical engineering departments support medical devices with Windows-based operating systems or other built-in software applications that may be prone to viruses or other malicious software. Known viruses and malware problems should be addressed before purchasing decisions are made. Clinical engineering inventories for these devices need to track software versions and general security vulnerabilities.

The clinical engineering departments supporting these devices must have plans in place to root out relevant sources of viruses and other malware from their existing inventories and to outline how these devices will be upgraded when security upgrades are identified. These measures have serious patient safety implications. Medical devices infected with viruses have shut down hospital

networks, putting patients at risk.

As medical devices become more sophisticated, they may become more difficult for clinicians to use. ECRI, which has operated a medical device problem reporting system for more than 30 years, has reported that the

"As medical devices become more sophisticated, they may become more difficult for clinicians to use."

vast majority of its medical device reports were caused by user-related issues based on a lack of clinician understanding about the devices.

User difficulties highlight the need for technology assessment committees to plan and budget for clinician training during implementation and for ongoing refresher courses. The refresher courses also may need to include more comprehensive training for staff that comes on board after the initial implementation training. Clinicians should have a strong understanding of the complex technology they are expected to use and the legal requirements for reporting problems they may experience. Such training will not only enhance patient safety, but it will help clinicians utilize the technology's advanced features to the fullest.

Summary

Procurement of IT-based medical technology requires new thinking and understanding for a variety of health-care professionals. New technical, clinical, and legal issues must be addressed. Establishing clear roles and responsibilities among the various members of a multi-disciplinary technology assessment committee for IT-based medical technology will improve the odds that the technology will meet the true needs of an institution, and that it will be used safely once it arrives.

About the Authors

Sharon R. Klein is the partner in charge of the Orange County office of the law firm of Pepper Hamilton LLP, a multi-practice law firm with 10 offices nationwide. She handles a variety of corporate and regulatory matters and has more than 20 years of experience in healthcare information transactions including issues involving HIPAA and other privacy and security regulations. She can be reached at kleins@pepperlaw.com.

James P. Keller is vice president of health technology evaluation and safety for ECRI. He directs ECRI's medical device evaluation program, which thousands of hospitals rely on for objective advice on medical technology procurement. He can be reached at jkeller@ecri.org.

Note: This article is informational only and should not be construed as legal advice or legal opinion on specific facts.

Back to the Future— Process Maps Get You There!

Brian J. Compas, FHIMSS

In the popular 1985 movie, “Back to the Future,” the leading character, Marty McFly, befriends a slightly wacky inventor named Doc Brown. Doc is a forward thinker who has invented a time machine by installing a plutonium-powered time transportation mechanism inside a Delorean sports car.

In a strange happenstance of events, Marty accidentally drives the car and is transported back in time to 1955, which happens to be the year when Marty’s parents met and fell in love. By messing with events in the past, he inadvertently prevents his parents from meeting, jeopardizing his very future existence.

Fortunately, Marty meets the 30-years younger Doc Brown, who is in the process of developing his infamous time machine. While Marty helps him understand the design with the information he knows about the machine from his interactions with Doc in the future, the “flux capacitor” that is the heart of the time machine’s mechanism is powered by plutonium, a fuel that is nowhere to be found in 1955.

Based on some information from a newspaper clip that Marty has brought back with him from the future, Doc Brown develops a precise plan to have the time machine receive an electric charge from a storm’s lightning bolt, which will activate the capacitor and transport Marty “back to the future,” where he can return to his normal teenage life.

“Without a precise implementation plan, an organization may be doomed to live “in the past” or, at a minimum, not realize the full potential of the future.”

After Marty successfully ensures his future existence by reuniting his parents, he pilots the Delorean sports car to precisely 88 miles per hour, and

the lighting bolt hits just in time to activate the machine. Marty is successful in returning to the future, and the movie had a happy ending for all, including the producers who, based on the movie’s success, made two more sequels.

Process Maps

Why am I making this trip down memory lane about this Hollywood movie? Without the precise plan developed by Doc Brown, Marty McFly would have spent the rest of his days living in the past. Critically important steps were “mapped” in Doc’s mind that required precise timing and attention to detail.

New system implementations are, at a minimum, as complex as Doc’s time machine exploits. Without a precise implementation plan, an organization may be doomed to live “in the past” or, at a minimum, not realize the full potential of the future. The success of any new system or process change requires coordinated interaction of people, devices, and procedures.

One of the best ways to prepare

MANAGEMENT ENGINEERING

for future implementations is to document how things are currently done and to develop a schematic of how things will be done after the implementation. Process maps or workflows of the current system will help the design team understand how the work is currently being performed.

Often, the way a system was originally designed is not the way it actually functions on a day-to-day basis. Employees develop ways to circumvent system designs that limit their ability to get their work done. Usually these changes in the process are not formally documented. During the design phase of a new system installation, it is vital that implementation team members take the time to learn the reality of the current system to fully understand the issues that employees face on a daily basis. Appropriately detailed flow charts or process maps will provide a hard-copy view of the current system flow. Steps in the process that are cumbersome for employees can be identified and targeted for correction in the new design.

With this vital information in hand and the knowledge of the capabilities of the new system or procedure, it's much easier to develop a system that will improve the workflow and not simply replicate the current process, including any of its shortcomings.

The design team, which should include subject matter experts familiar with the current process, can use the current system flowchart as a backdrop for the creation of the new process. Here again, the team can develop process maps that mirror the future. Pitfalls, stumbling blocks, and lengthy queues that were identified in the current system can be given careful consideration in the design of the new system. Additionally, the

process map can document how the new system will interact with end users and who will be responsible for the inputs and outputs of the system. Highly developed process

"Process maps are an excellent way to document the current process to aid in designing a new system."

maps may include the manual steps leading to the inputs in the system as well as several steps after the output is produced.

Process Maps and Training

If Doc Brown had a process map to share with Marty, he may not have felt so nervous about the whole plan to get him back to the future, particularly when some unforeseen changes in the process almost sabotaged the plan. Process maps can serve as an invaluable training tool to help end users understand the whole process, giving them a bigger picture of the impact of their actions on the process.

Showing users the "way it was," compared with the "way it will be" can gain instant support from those front-line employees who are key components of the system's success.

It is well-documented that many systems fail to reach all design efficiencies because of poor end-user training. As new employees are added to the mix of staff over time, the efficiencies of the original design can get watered down as new users sometimes learn poor practices from their teachers, not realizing that their

"shortcuts" cause ripples downstream in the process that may lead to duplicative work or less-than-optimum output for other system users.

Using the process map as a baseline, new employees can get oriented quickly to the process and understand their role in completing the work. If process maps are kept up to date with new modifications being recorded as they are implemented, they can continue to be a valuable aid in training new employees.

Roadmap to the Future

In any complex plan, you need clear direction on where you are going and a structure to get you there. Process maps are an excellent way to document the current process to aid in designing a new system.

Documentation of the current process provides the design team with the issues and shortcomings of today. Process maps of the future provide visibility of what is to come and help the design team stay focused on the outcomes needed for success.

As was the case in "Back to the Future," well-designed processes will provide a greater chance for success. Without the detailed plan that Doc Brown concocted, Marty may never have gotten to his final destination of being back home. Without process maps to document the steps required in a new process, an organization may end up with a system that never reaches its "final destination."

With today's focus increasingly on value returned for time and money invested, it is imperative that organizations use every tool available to increase the odds for success. Those who use process maps as a roadmap to the future will be assured that they can safely leave the past behind. And don't forget to enjoy the ride!

MANAGEMENT ENGINEERING

About the Author

Brian J. Compas, FHIMSS, is a senior consultant with Healthlink, a division of IBM. He has more than 25 years of systems and process improve-

ment experience, including 15 years as director of management engineering for a major teaching hospital. Brian is also a past member of the HIMSS Board of Directors, a

Fellow of HIMSS and is currently serving as the chair of the HIMSS Foundation. He can be reached at bcompas@us.ibm.com.



Looking to share best practices?
Want to expand your professional circle?
Ready to connect with colleagues
who share your HIT issues?

Then you're ready for Member Connect—a new online tool that helps you find others who share your professional interests and expertise, and puts you in touch with colleagues from your country or region.

You can participate in online discussions and form meaningful connections with peers, share experiences and discuss best practices, while expanding your professional circle. Sign up by visiting www.himss.org.

**It's never been easier to network –
link up with Member Connect today.**

HIMSS
MEMBER CONNECT
HIMSS MEMBER CONNECT

Progress and Challenges in Nursing Documentation Part II

Brian Gugerty, DNS, MS, RN

In a previous Nursing Informatics column in this journal, I asserted that there are areas with low-hanging fruit in which healthcare IT could be applied to make immediate and substantial gains in process improvement and increased patient safety in the delivery of nursing care. Two examples that were highlighted were barcode-assisted medication administration and vital sign collection technology implemented with vital sign documentation technology.

"After improving (medication administration and) vital signs documentation in the EHR and similar processes for which nurses are responsible, opportunities for improving nursing documentation will be more difficult to accomplish, but the payoffs are greater," I wrote in that column. "Information technology is being used to improve flowsheets, assessment forms, plans of care, and other documentation approaches that nurses use.

"There are a variety of challenges facing attempts to improve these areas. They are often multidisciplinary in nature, adding complexity to the

improvement process; there is tremendous variation and proliferation of documentation approaches within and across healthcare organizations; there are few, if any, standards and models

*"...nurses perceive
that time spent
documenting takes
away from time that
should be spent with
patients; too much
documentation is
devoted to non-direct
clinical concerns; and
documentation is
often redundant."*

integrating different documentation approaches; and organizations wish to incorporate standardized terminologies and evidence-based knowledge with

these documentation approaches as they improve them."

I delayed a further exploration of these issues because in the most recent issue of this journal I wrote about a convergence of forces entitled, "The Holy Grail: Cost-Effective Healthcare Evidence Transparently and Consistently Used by Clinicians."

In that column, I asserted that increasing amounts of high-quality evidence are being produced by researchers; standardized clinical reference terminologies necessary for the application of evidence-based practice terms in EHRs are maturing; commercial clinical content providers are entering this space, rapidly pulling together large amounts of evidence-based clinical knowledge; and EHR companies are starting to pull all of this together in the form of plans of care, order sets, and other evidence-based practice manifestations, all of which are computable and interoperable on a large scale.

The convergence of these forces will enable clinicians to be guided by the evidence as they use information

NURSING INFORMATICS

systems to receive information, document care and to make and execute decisions. The convergence will facilitate the widespread use of updated evidence by making it transparent to users by having these resources embedded deep within their tools of practice.

Survey Results to Consider

In the past six months, nursing colleagues and I have been analyzing data from a survey on nursing documentation issues. The survey was conducted in late 2005 by the documentation workgroup of the workplace issues committee of the Maryland Legislature Commission on the Crisis in Nursing. Some 934 nurses, mostly registered nurses from Maryland, responded to the survey.

While this was not a random sample and findings from the survey should be cautiously applied, the survey found that nurses perceive that time spent documenting takes away from time that should be spent with patients; too much documentation is devoted to non-direct clinical concerns; and documentation is often redundant.

Other findings indicate that nurses perceive the nursing documentation process to be substantially suboptimal. Taken together, results suggest that the current state of nursing documentation of patient care is a potent work life dissatisfier.

Wow! That's a splash of cold water on the face. But have EHR modules, like barcode-assisted medication administration, clinical documentation, and plans of care, which have been increasingly implemented in the past five years, helped improve nurses' perceptions of care documentation?

About a third of the entire sample used such technology, and about a half of the hospital nurses used

electronic documentation. Somewhat alarmingly, at least at first blush, nurses who used electronic documentation reported increased redundant documentation, increased time spent on documentation, and poor integration of information across systems. Yikes! While it seems like this story is getting worse, the survey also revealed nurses perceived increased completeness and quality of documentation.

“...healthcare organizations may substantially benefit by engaging in the nursing documentation movement to bring best practices back to their organization in a timely manner.”

One conclusion that may be drawn is that increased quality of documentation appears to come at a price of increased time spent on this critical function. One question that should have been asked was how long respondents had been using electronic documentation. Perhaps there is a significant perception of increased time spent on electronic documentation when a nurse is climbing the learning curve of electronic documentation. The task force wants to partner with other groups to conduct the survey again on a national level with improved questions and methods.

So it appears that healthcare IT is making gains in process improvement

and increased patient safety in the delivery of nursing care. A variety of forces are beginning to facilitate a long-standing objective in nursing clinical practice, namely the widespread use of updated evidence-based knowledge, making the evidence transparent to the user in the information systems they use on a daily basis to plan, carry out and document care to patients. However, despite these positive developments, documentation in general and electronic documentation specifically is perceived as effectively a fractured process that takes too much time.

Time Implications of Documentation

Documentation of patient care by nurses is important because those professionals comprise 54 percent of the healthcare workforce. The survey of Maryland nurses revealed a majority of nurses spend a third of their shift documenting patient care, with a minority spending half or more of their time on documentation. Other research has demonstrated similar findings.

If 350,000 nurses, or those who report directly to nurses, are on duty at any given time in the U.S., that means that about 3 million hours per day are spent on documentation in the U.S. alone! If healthcare IT can increase the quality of nursing documentation and decrease the time spent on this process, huge gains can be made in the effectiveness and efficiency of nursing care.

There are efforts under way by knowledgeable and committed experts to tackle aspects of this issue. The HIMSS Nursing Informatics Task Force conducted a national survey to measure the impact of health information technology on the role of nurses and interdisciplinary communication

NURSING INFORMATICS

in acute care settings. Their recommendations include using existing IT applications and tools in different, more effective ways and working to overcome barriers to interdisciplinary communication impacting acute care workflows.

The International Medical Informatics Association Nursing Informatics-Special Interest Group (IMIA/NI-SIG) has several working groups that are looking at documentation issues. Nurses from Scandinavia, Europe, Asia-Pacific, and other regions have a record of scholarship in nursing documentation, and many individuals involved in this scholarship belong to IMIA. Many countries besides the US have made more progress initiating the EHR, but not necessarily in electronic nursing documentation. The issues in nursing documentation of patient care are largely the same around the world and provide a golden opportunity for international collaboration.

Clinical terminology standards have attracted increasing effort. Nursing classification systems, terminologies, and "languages" have been developed, expanded, and aligned with broader healthcare reference terminologies, thesauri, and others. This essential work will enable nursing documentation to become more standardized and interoperable.

But standardization of terms and clinical expressions that nurses use in their documentation of patient care may not be enough because there are no consistent best practices and frameworks for the nursing documentation of patient care that I am aware of. There are a plethora of nursing documentation frameworks—structured notes, unstructured notes, POMR, charting to standards, clinical pathways, care maps, and charting by exception, just to name a few. More

work needs to be done to identify best documentation practices, streamline documentation workflows and test documentation frameworks so that increasingly standardized clinical terms and expressions can appear in nursing documentation of patient care that is truly interoperable.

Getting Involved

For the most part, healthcare organizations have realized that they are not in the business of aggregating clinical content or building clinical information systems through which the content will be used by their clinicians. When choosing companies in this field—clinical content aggregators, and healthcare information system and EHR providers—healthcare organizations would be well advised to partner with companies that have depth of understanding and staying power, particularly in the area of the nursing documentation of patient care. Nursing applications are "hot." This area is attracting more interest. Organizations should look for partners that are engaged in standards-setting efforts, thought leadership, and innovative initiatives in nursing documentation of patient care.

Also, healthcare organizations may substantially benefit by engaging in the nursing documentation movement to bring best practices back to their organization in a timely manner. Be aware of the HIMSS nursing informatics task force initiatives; have nurses participate heavily in the next survey; follow the promising developments of the IMIA/NI-SIG; attend the HIMSS and AMIA day-long nursing symposia or the MEDINFO in Australia in 2007 or NI 2009 in Finland. Be open to working with researchers and companies who are seeking partners to test and study new approaches for documenting patient

care. In these and many other ways, healthcare organizations will shape the direction of this promising field.

Progress in nurse documentation of patient care in recent years has shed light on this promising area. Those who have been immersed in the field have been heartened by the interest in nursing documentation and the positive outcomes many have been able to demonstrate by applications such as barcode-assisted medication administration. This progress is only the tip of the iceberg, and nurses are substantially dissatisfied with the patient care documentation process. To extend the progress, the nursing and clinical informatics communities have their work cut out for them as healthcare organizations, vendors, and professional societies work together to overcome the challenges that exist in taking nursing documentation to new levels. It is worth the effort, as markedly improved patient care outcomes and greatly improved satisfaction by nurses are possible.

About the Author

Brian Gugerty, DNS, MS, RN, is a clinical informatician in a research and innovation group at Siemens Medical Solutions, where he models, designs, develops and prototypes advanced nursing and clinical applications. Before coming to Siemens, Dr. Gugerty was a faculty member in the nursing informatics program at the University of Maryland School of Nursing.

Transforming IT— The CIO as Clinical Transformation Champion

Pam Arlotto

The healthcare industry has discovered information technology is a strategic asset. It has moved from a tactical function within individual provider, payer, and supplier organizations to a driver of clinical care redesign, regional information sharing and collaboration, pay for performance, and research.

Most health systems, today, have strategic initiatives revolving around electronic medical records, computerized practitioner order entry, clinical decision support, and other clinical information systems. These advanced technologies offer clinicians an opportunity to change the way they work to include new information-based modal-

ties and reduce their dependence on paper.

In fact, now more than ever before, the industry has the opportunity to drive significant clinical transformation within the health system (see Table 1).

Successful transformation efforts are more than technology implementations—they are organizational change initiatives led by the most senior executives in the health system. In fact, for many health systems, these transformations are the most comprehensive, complex efforts ever undertaken. The potential for positive change is significant, yet the risks are also high.

Much has been written about the

role of executive sponsors, the participation of physician and nursing leadership, and the change management needed within clinical operations. But there also is significant change that must occur within the information technology function. The IT staff must play a role in facilitating transformation and the role of the chief information officer must be expanded so he becomes a clinical transformation champion.

Most health systems must take specific steps to prepare for clinical transformation, and that requires certain actions by the CIO to ensure the IT organization is prepared to deliver value and champion clinical

Definition of Transformation: The transformation of health care services from manual processes to technology-enabled or automated processes. For success, health care professionals in every category, from physicians and nurses to pharmacists and IS staff, must change the way they think about and do their work. Change will occur in the way information is collected, managed and stored. Each individual must seek new ways to improve patient care, operational work methods, and their own personal productivity while confronting the challenges of learning new processes and technologies.

Table 1.

LEADERSHIP

transformation. Those steps include the clinical readiness assessment; vision development; and transformation roadmap design.

Clinical Readiness Assessment

Before launching a major clinical system rollout, the CIO should work with operational and clinical leaders to evaluate the organization's readiness for systemic transformation and care delivery redesign. Key questions include:

- What other redesign projects have been completed?
- What lessons were learned?
- Are top executive, physician, nursing, and other clinical leaders ready to commit to redesigning care delivery?
- Do champions exist?
- Has the case been built for change?
- Does a culture exist for information sharing and collaboration?
- Do competing organizational initiatives exist that may dilute the effectiveness of change initiatives?
- Does the medical and clinical staff have the needed skills, tools, and resources to accomplish the redesign process?
- What role has IT played—or not played—in these efforts? Is the IT function viewed as a change agent or a barrier to change?

This detailed analysis will set the stage for casting IT as a change agent. Through the clinical readiness assessment, information can be obtained regarding the needs, wants, and values of IT customers. Best practices from the industry can be researched and shared with the organization's leadership. Commitment can be obtained, and a thorough understanding of change management requirements within the organization and within IT can be established.

Vision Development

The leadership team, in conjunction with key members of the medical staff and board, should create a comprehensive integrated understanding of what is meant by clinical transformation and identify strategic objectives with clearly defined desired outcomes for the health system. The vision then can feed a high-level roadmap for the resource, funding, revenue, and operational expectations required for achieving desired objectives and outcomes.

"Specifically the roadmap defines the critical path, resources, funding, revenue, and operational expectations required for achieving desired objectives and outcomes."

The CIO also should work internally within IT to ask the following questions:

- What value will IT bring to accomplishing this vision?
- What unique skills or capabilities does IT bring to the table today?
- What skills and capabilities does IT need to have in the future?
- How can the department increase the contribution of IT to accomplishing these clinical objectives?

Transformation Roadmap Design

The readiness assessment provides a "current state" assessment, while the vision provides a "future state" goal. The next major step for the organiza-

tion is to create a transformation roadmap that closes the gap between the two.

Specifically the roadmap defines the critical path, resources, funding, revenue, and operational expectations required for achieving desired objectives and outcomes. A cogent plan with the proper political support and champions is essential to create the foundation for success.

During this important planning phase, IT must align its strategy, organization, internal work processes, and behaviors with the overall transformation plan. Specifically, IT should:

- Develop a business case for change within IT.
- Create a value-based IT strategic plan that is consistent with the strategic plan of the enterprise.
- Augment IT steering committee functions with overall transformation governance and leadership teams.
- Coordinate risk management practices within the enterprise and within IT.
- Shift more to process owners and business/clinical sponsors.
- Become more consultative and learn to facilitate process redesign and change management into work practices.
- Develop strong customer service and relationship management processes within IT.
- Expand the IT program management offices to become enterprise transformation management offices.
- Develop metrics derived from overall business objectives.
- Create a communication plan and conduct regular meetings to ensure exposure to industry lessons learned; program management tools; the role of vendor, IT, business, and clinical teams; and transformation accomplishments.

LEADERSHIP

- Source appropriate internal and external expertise.

Systemic change requires new insight and methods at all levels. Transformation provides a unique opportunity for IT and the CIO to champion the most profound changes that most organizations will go

through. During the planning phase, IT should focus internally while simultaneously leading the enterprise.

About the Author

Pam Arlotto is the president and CEO of Maestro Strategies LLC, an Atlanta-based strategy consulting

firm. She can be reached at pwarlotto@maestrostrategies.com.



HEALTH INITIATIVE
Int. Value, Health & Life

CONNECTING COMMUNITIES REGIONAL FORUMS

Creating the Vision...Living the Reality



AseriesoffivedayconferenceswillfeatureleadersfromtheadultinitiativesCo-leadingCommunitiesprogramandHIMSSChapters

Attend this one-day Forum and:

- Turn collaboration into action. Join forces with key regional healthcare executives, government officials, clinicians and IT decision makers.
- Show breakthroughs and horrors. Promote best practices and success stories with other Regional Health Information Organization (RHO) and Health Information Exchange (HIE) initiatives.
- Learn the rules of survival and sustainability. Attend practical, technical educational sessions taught by leaders on the front lines of experienced RHIOs/HIEs.
- Transform theory into reality. Participate in solutions-driven discussions on topics of common national and local interest, including: funding; engaging stakeholder commitment; selecting the right technology tools; ensuring security and many others.

SAVE THESE DATES!

December 12, 2006
Salt Lake City, UT

December 14, 2006
Chicago, IL

April 19, 2007
Orlando, FL

May 10, 2007
Boston, MA

Fully Accredited
Earn up to 7 AIA
PCRA Category 7
certification and up
to 47 medical
hours of
authoring
content available
toward renewal of
the CPNHS
credential.

Visit www.himss.org/HIEForums for more information.

Patient Safety: A Tale of Two Institutions

*Marion J. Ball, EdD, FHMSS; Tamra Merryman, RN, MSN, FACHE;
and Christoph U. Lehmann, MD*

A B S T R A C T

The Johns Hopkins Medical Institutions and the University of Pittsburgh Medical Center are both working to improve patient safety. Johns Hopkins is focused on creating a culture of safety—frontline interventions at its Children's Center include a focus on the "Culture of Safety" and three programs that use information technology to "fix the broken medication process." Quantitative data indicate these programs are making care safer. At UPMC, efforts launched under the Robert Wood Johnson Foundation and the Institute of Health Care Improvement, a program named Transforming Care at the Bedside, are redesigning care processes to support nurses and focus on patients. Interventions include family-initiated rapid response teams and other changes designed to streamline processes and use information technology to make care patient-centered. Simulation-based training targets critical procedures and performance for physicians and nurses, and a "smart room" is slated for development.

K E Y W O R D S

- Patient safety ■ Information technology ■ Safety culture ■ Patient-centered care
- Care processes ■ Process re-design ■ Computerized decision support
- Computerized practitioner order entry ■ Simulation ■ Academic medical centers

The Institute of Medicine brought patient safety to national attention when it published *To Err Is Human* in 2000 and *Crossing the Quality Chasm* in 2001. These groundbreaking reports sparked efforts in both public and private sectors, and the goals they set forth are guiding the initiative to give most Americans electronic health records by 2014.

However, progress has been slow. In November 2004, two prominent patient safety advocates who served on the IOM committee that prepared the reports voiced their disappointment.¹ "Let's not kid ourselves about what's

happening," Lucian Leape said. "We still don't have a national effort for patient safety."² Donald Berwick stated, "We know how to protect you in the hospital. The bad news is that your hospital is having a hard time finding the will or funding to do it."³

In May 2006, *Time* magazine's cover story⁴ on patient safety described physicians as "scared" of being a patient, and it related physicians' experiences when they or their family members were hospitalized. The conclusion was far from reassuring: "Scientific knowledge improves, but the care doesn't keep up; it is easier to gather gigabytes of infor-

1. Make Health Care in America a Human Right.
2. Pay for the Care of Populations, Not Events
3. Put the Patient in the Driver's Seat
4. Computerized Medical Records, Once and for All
5. Use Modern Engineering Science to Make Health Care Safer and Smoother
6. Re-Energize Primary Care and Nursing
7. Give Up the "More Is Better" Myth

Source: "How To Fix The System," in Time Magazine, May 1, 2006

Table 1. Donald Berwick's Top Seven Reforms for Health Care

"Because pediatric dosing requires caregivers to adjust dosages for age, weight, and body surface area, the process is especially complex and prone to error."

mation than to acquire the judgment to apply it wisely." However, in the same issue, Donald Berwick, a pediatrician who is president of the Institute for Healthcare Improvement, called for action and listed his top seven reforms. Four of his reforms map directly to interventions discussed below; the remainder are beyond the scope of this article (see Table 1).

In its 2006 progress report, the Institute for Healthcare Improvement expressed optimism for patient safety.⁵ "For the first time since IHI began, we are seeing a broad-based commitment." The report stressed that this was not simply "unity in our industry around...the common cause of avoiding preventable deaths," but involved the healthcare workforce rising up to make "fundamental shifts in how healthcare organizations respond to the needs of their patients." According to the report, these responses involved "making the small and large changes that save time, resource, energy...and ultimately patients' lives."

This article describes the approaches to patient safety taken at two large academic medical centers, the Johns Hopkins Medical Institutions and the University of Pittsburgh Medical

Center. Each institution has adopted a broad goal of patient safety. Different entities at each facility have adopted different frontline interventions specific to their own needs. For example, the Johns Hopkins Children's Center has introduced process changes in the form of rounds and has implemented limited-scale computerized practitioner order entry. UPMC has redesigned processes to focus on the patient, make care smoother, re-energize nursing, and save money. The article concludes by summarizing the lessons these institutions offer to other facilities that want to improve patient safety.

Johns Hopkins' Culture of Safety

After the IOM report was published in 2000, Johns Hopkins Hospital established a Patient Safety Committee and Center for Innovations in Quality Patient Care and launched several activities. Early efforts included a systematic assessment of safety at the hospital; from this, a strategic plan was developed to improve safety.⁶

The assessment used two survey instruments to assess patient safety in different populations. A 10-item safety climate scale measured safety attitudes among staff throughout the hospital, while a second instrument measured the extent to which patient safety was a priority among senior clinical and administrative leaders. Findings suggested the need to involve senior executives with frontline staff, to educate staff about patient safety and to implement proactive planning processes.

The interdisciplinary Comprehensive Unit-based Safety Program developed at Johns Hopkins⁷ includes many of these elements. In an ongoing eight-step process, the

1. Evaluate culture of safety
2. Educate staff on science of safety
3. Identify staff's safety concerns
4. Assign executive to adopt a unit
5. Prioritize improvement efforts
6. Implement improvements
7. Share stories and disseminate results
8. Evaluate culture

Table 2. Comprehensive Unit-based Safety Program (CUSP): An Eight-Step Process⁹

CALORIES:

AminoAcids: g/kg * 20.0 kg = 30 g Trophamine * 4 = **120 kcal protein**
(12 % of calories)
1006 kcal/day
50 kcal/kg/day

Sodium: mEq/kg * 20.0 kg = **440 mEq**

Potassium: mEq/kg * 20.0 kg = **20 mEq**

Magnesium: mEq/kg * 20.0 kg = **6 mEq**

ADDITIVES:

For other Additives (Vit K, Albumin, Carnitine) check here and press recalculate:

Calcium: Super Max Max Standard Half-Standard None **Standard Calcium**

Phosphate: Super Max Max Standard Half-Standard None **Standard Phosphate**

Anions: Balanced **Balanced Chloride/Acetate**

Multivitamins: Yes No **Standard**

Trace Elements: Yes No **Standard**

Heparin: units/ml **0.5 units/ml**

Ranitidine: mg/kg/day * 20.0 kg = **40 mg/day Ranitidine**

ADDITIVES / INSTRUCTIONS:

add 2 mg Zinc per day

Press here for Dosing Guidelines

!Alert! The Sodium exceeds 6 mEq/kg/day. This may be too high.
!WARNING! Heparin not recommended with PERIPHERAL Access.
!Alert! Please do not forget to discontinue other Ranitidine orders in the chart.
!WARNING! Total Osmolality is 1497.7

Figure 1.

program begins and ends with evaluation, provides education for staff, assigns a senior executive to the unit, and proactively involves staff in planning and implementing improvements (See Table 2). Initially implemented in intensive care units, the program has since been rolled out in other settings at Hopkins and elsewhere. According to Peter Pronovost, who led its development, the program focuses on improving communication for all staff—from senior executives to unit clerks.⁸

A 174-bed pediatric tertiary care facility, the Children's Center provides state-of-the-art pediatric services and treatments, from intensive care to transplants and trauma. The center has 7,800 inpatient visits and 24,000 outpatient visits annually. Located on the Johns Hopkins Medical Institutions campus, it shares in and draws from the Hopkins culture, while maintaining its own distinct identity. To address its challenges as a pediatric facility, the center created a new position of director of quality and safety initiatives and implemented several interventions tailored to its needs.

Patient safety efforts at the children's center are based on belief that injuries are not accidents, that near-misses precede many or all events. According to Heinrich's Ratio,¹⁰ for every 300 no-injury accidents in industry, there are 29

minor injuries and one major injury.

Accordingly, one key intervention at the center, patient safety rounds, looks to address problems before they cause harm; analysis of its results helps to identify patterns and the full range of factors that contribute to injuries. Rounds at the children's center take a systems approach: building on the staff's tribal knowledge, they focus on preventing errors, identifying system vulnerabilities, and being constructive and inclusive in nature.

Changing Processes

The center implemented general pediatric safety rounds in January 2004; 15 months later, in March 2005, separate pediatric surgical safety rounds were established.¹¹ Today, each inpatient unit and outpatient clinic at the children's center is visited monthly by a team consisting of senior leaders and frontline staff, including patient safety staff. Others—including the heads of housekeeping and of facilities management, members of the board of trustees, and parent liaisons—are invited or welcome, as are providers on the unit when rounds occur. These rounds make senior executives visible to and involved with frontline staff.

Every concern that is identified during rounds is recorded

by the safety nurse and is assigned to a member of the safety staff, who is responsible for developing a plan of action.¹² During rounds, staff members are asked, "How do you think the next patient will be harmed?" The intent is to address problems proactively before they cause harm to patients and are thus reported using Patient Safety Net, the online error reporting system developed by the University Health Consortium. At the next month's rounds, safety staff review each concern and report on progress; new action plans are developed when necessary.

"Acting on selected suggestions, UPMC implemented each change on a small scale. Innovations that did not work were ended; those that were successful were deployed by 'spread teams' working with unit directors."

To improve information dissemination, the director of quality and safety initiatives describes hospitalwide safety efforts, and nurse managers provide feedback on rounds to frontline staff who are unable to attend. The most important effect of the safety rounds is the change in culture; nurses, physicians, and ancillary staff are encouraged to think about safety, their input is appreciated and validated, and a signal is given that safety has priority over productivity. Priming an individual in that way will lead to behavioral changes with more "safe" behavior.¹³

As of January 2006, general safety rounds had resolved 148 problems, and surgical safety rounds had resolved 11. After problems were resolved, they were catalogued into a database for categorization.¹⁴ Analysis indicated that the two types of rounds did not differ appreciably. Safety rounds most often were dominated by equipment issues followed by problems in communication, which are by nature larger and more complicated. Relatively low-cost but highly visible, this intervention continues today.

Using Information Technology

In general medicine, adverse drug events account for an estimated 41 percent of hospital admissions and inpatient costs of more than \$2 billion a year.¹⁵ The medication error rates for children are nearly three times those for adults.¹⁶ Because pediatric dosing requires caregivers to adjust dosages for age, weight, and body surface area, the process is especially complex and prone to error.

To streamline and simplify the medication process, the Children's Center has leveraged information technology^{17,18} to provide solutions to some of the problems found on safety rounds. Small cross-trained development teams identified

"broken" medication processes, designed and implemented solutions, and evaluated results to determine whether those solutions should be adjusted or extended. Using a local area network that linked patient-care units with the pharmacy, three separate project teams used a commercially available rapid application development tool to address well-known and well-documented problem areas in pediatrics—calculating total parenteral nutrition, ordering continuous intravenous infusions, and managing antibiotic use.

TPNCalculator.¹⁹ A team made up of a neonatologist-programmer, pediatric nutritionist, and a neonatal pharmacist developed a Web-based total parenteral nutrition order-entry system to replace the paper-based system that was associated with a high rate of errors. Designed to resemble the paper form, thereby easing transition and reducing the risk of new types of errors, the TPNCalculator guides the prescriber through the repetitive process of ordering and automates all necessary calculations using nutritional guidelines and 62 rule-based alerts and reminders that check for age-weight ratio and dose ranges for all components and validate entered data (see Figure 1).

The TPNCalculator initially cut errors by more than half, from 10.8 errors per 100 to 4.2. Modifications based on feedback further reduced errors to 1.2 per 100 orders, for an overall reduction of 89 percent. Users report the system is easy to use, saves them time, and protects them from making errors. With total development time of only three weeks, the system was extended to the entire center within a month of rollout and is now in use at three other institutions. More than 45,000 orders have been written with it since 2000. Careful estimates place the savings through prevention of errors at the ordering step at \$60,000 to \$80,000 annually for the children's center alone.

Infusion Calculator.²⁰ A neonatologist and pediatric pharmacists collaborated to improve the accuracy of intravenous drug orders. Because overdoses of drugs for IV infusion are potentially toxic, the impact of errors is greater than for other routes. Multiple infusions and frequent weight changes in children also increase the probability of error.

This project used an approach similar to that for the TPNCalculator, simulating a paper-based form via a standard Web-based interface that guides the prescriber through data entry with default doses and dose ranges; determines flow rate based on the patient's weight, drug and dose, carrier fluid, and volume and standard concentration; and provides alerts based on rules adapted from Hopkins protocols and handbooks and validated by two pharmacists (see Figures 2 and 3).

A printed copy of the order is faxed to the pharmacy and placed in the patient's chart. Orders generated by the infusion calculator had 83 percent fewer errors ($p<0.001$) with one or more errors than handwritten orders (6 percent vs. 33 percent). Handwritten orders also resulted in more high-risk errors that required pharmacist intervention than

Harriet Lane Infusion Calculator

Weight in kg: PICU Patient

Drug	Carrier Fluid			Dose	Flow Rate
Dopamine	Dextrose D10W	Sodium Type left or select	Volume 100 ml Bag	100 mcg/kg/min	1 ml/h
Fentanyl	Dextrose D7.5W	Sodium Type left or select	Volume 50 ml Syringe	1 mcg/kg/h	1 ml/h

Figure 2.

Ordered		Order (Weight = 3.5 KG)				Noted by	Order Completed		Initials
Date	Time	Dopamine	6 * 100 mcg/KG/min * 3.5 KG 3.5 mL/hour	= 600 mg Dopamine in a 100 mL Bag of D10W	to run at 3.5 mL/hour * (100 mcg/KG/min *)		Date	Time	
Aug 29, 2006	06:13 PM								
!ALERT! The selected infusion rate of 1 mL/hour and dose 100 mcg/KG/min resulted in a solution exceeding the maximum allowed concentration (600 mg in 100 mL). The infusion rate was recalculated to 3.5 mL/hour. If this patient is in the PICU and has a central line, consider checking the PICU checkbox on the previous page, which allow for higher drug concentrations.									
!WARNING! The Dopamine dosage (100 mcg/KG/min) exceeds the recommended maximum dosage of 50 mcg/KG/min.									
Aug 29, 2006	06:13 PM	Fentanyl	50 * 1 mcg/KG/hour * 3.5 KG 1 mL/hour	= 175 mcg Fentanyl in a 50 mL Syringe of D7.5W	to run at 1 mL/hour (1 mcg/KG/hour)				
Physicians Name: <input type="text" value="Christoph Lehmann"/> Physicians ID: <input type="text" value="N1234"/>									

Figure 3.

calculator-generated orders (26 percent vs. none). Today, the children's center requires use of the system for all pediatric patients receiving continuous IV infusions.

Antibiotic Approval System.²¹ Pediatric pharmacists worked with infectious disease specialists and an informatician to streamline the approval process for antibiotics. To prevent inappropriate antibiotic use and development of resistant hospital strains, Johns Hopkins has required approval of certain antibiotics since 1980. From 2001 to 2005, as approval requests grew from 600 to more than 2,000 annually, the number of procedural errors also increased.

In addition to no written record and prolonged unapproved use of antibiotics, a survey of physicians using the system found 55 percent reported missed doses, and almost 70 percent reported delayed doses. The online system developed to replace the telephone pager-based system enables prescribers to log in and select the patient

and antibiotic; the interface then prompts them to enter the reason for the request using a check list or free text (see Figure 4).

The request is sent by pager to the pharmacist on call and to the ID fellow, who contacts the prescriber if there are questions. The ID fellow approves or rejects the request on a Web-based interface that notifies the prescriber and the pharmacists. Certain reasons are granted automatic approval, such as requests between 11 p.m. and 7 a.m. and certain patient conditions such as immunocompromise).

In addition to offering computerized decision support to determine appropriateness, the system streamlines tracking the duration of approvals and notifies the original prescriber of any expiring approvals. Using different Web-based forms in the system, ID fellows can review and manage approvals, and nurses can search for approvals on their patients.

Initial reports following implementation in June 2005 suggested the system shortened antibiotic courses and

Controlled Antibiotics Request System: Request a drug - Step 2

Test, BG-Test (MRN: 1234567)

DOB: 06/19/2006 - Unit: NICU2

Antibiotic requested: Vancomycin

Note: Please obtain assistance with renal dosing if applicable

Discouraged Use: Routine surgical prophylaxis

Discouraged Use: Empiric treatment for febrile neutropenic patients

Discouraged Use: Single positive blood culture for coagulase-negative staphylococci

Discouraged Use: Continued empiric use for presumed infection with negative cultures

Discouraged Use: Prophylaxis of lines

Discouraged Use: Selective decontamination

Please provide a reason for requesting Vancomycin

(The more information you provide, the more likely it is the request will be approved!)

AHA alternate agent for prophylaxis against endocarditis

Bacterial meningitis possibly caused by resistant S. pneumoniae (48h approval)

Bone Marrow Transplant Patient

HIV positive

Immunocompromised oncology patient

Immunosuppressed patient (non-malignancy)

Neonate

Proven infection by B-lactam resistant g+ organism (document organism, site and date)

Proven C. difficile colitis [ORAL only] (document organism, site and date)

Figure 4.

reduced delays in first dose delivery. In the first two weeks, there were 105 requests and 69 approvals (65 percent), 12 of which were automatic. The average time from request to approval was 19 minutes. The approval system resulted in an overall antibiotic costs savings of \$25,000 in six months.

University of Pittsburgh Medical Center

A 486-bed tertiary hospital with more than 600 physicians, the University of Pittsburgh Medical Center Shadyside is committed to "ensuring the right patient gets the right care at the right time in the right way every time." To this end, UPMC is re-engineering processes to eliminate inefficiencies and ensure that the right information is in the right location. These persistent efforts, both large and small, are showing

positive outcomes. A prototype "smart room" will build on these redesigned processes to interject information technology into patient care.

In 1998, UPMC developed its clinical design initiative to look at how patient care is delivered. In 2001, they began to apply principles of the Toyota Production System to a few inpatient surgical beds. Frontline staff from various disciplines worked with a core team to redesign care processes using the Toyota PDCA process (plan, do, check, act) to develop solutions that addressed root causes. From 2001 to 2003, UPMC improved intravenous dispensing of painkillers, reduced hospital-acquired bloodstream infections from intravenous catheters and improved turnaround times for services from labs to meal delivery.

These successes paved the way for UPMC to be one of the 13 hospitals participating in Transforming Care At the Bedside, a project sponsored by the Robert Wood Johnson Foundation and the Institute for Healthcare Improvement. Under the project, UPMC is redesigning processes to increase the amount of time nurses can spend caring for patients.

In early brainstorming sessions, staff generated 200 suggestions in response to two questions: If you could design a perfect patient experience, what would it be? If you could design a perfect nursing experience, what would it be? Acting on selected suggestions, UPMC implemented each change on a small scale. Innovations that did not work were ended; those that were successful were deployed by "spread teams" working with unit directors. Ongoing spot checks monitor success and ensure staff accountability.

One of the first TCAB initiatives made rapid response teams available to patients and their families when they report that, "something isn't right." Known as Condition H (help),²² this extends UPMC's success in using Condition A (cardiac arrest) and Condition C (medical crisis) to deploy rapid response teams to the bedside when healthcare professionals determine that a hospitalized patient is at increased risk of mortality. In 12 months ending November 30, 2005, there were 171 Condition A calls and 699 Condition C calls institution-wide. Although the number of codes called during this period increased, 30 percent fewer patients progressed to cardiac arrest, and unexpected mortality went down 27 percent.²³

Condition H gives patients and families an emergency telephone number and a direct inside line. Calls go to a trained operator who asks for the caller's identification and the patient's room number, name and concern. The operator can activate Condition H, bringing a team of healthcare professionals to the bedside. Of the 21 Condition H calls made during its first nine months, the majority met one of two criteria for appropriateness – either a noticeable medical change in the patient unrecognized by the healthcare team or a breakdown in or confusion about care being provided. Most were in the second category, although five Condition H calls were to request more effective pain management. Interviews with patients or families involved in Condition H calls were unanimously positive. "Having Condition H available makes me feel safer, respected, and empowered," one patient said.²⁴

To add clarity and structure to what many call "routine" discussions in healthcare, UPMC adopted a situational briefing tool, called Situation, Background, Assessment, and Recommendations, or SBAR. Now in practice with patient transfers, handoffs, and calls to physicians, the tool helps ensure that the right information is available to meet patient needs.

To improve communication, UPMC implemented a flexible password protected telephony reporting system. Known as

Voice Care, it enables nurses to use non-cellular phones throughout their shifts to file detailed reports, without intrusions and background noise. Reports can be replayed even after the nurses filing them have left the hospital.

Voice Care has been enhanced to support critical transitions in care. It eases physician handoff reports for new admissions, and a successful prototype is being spread across UPMC for its use for handoff reports when patients are transferred from acute to long-term care settings. A pilot launched in July 2006 provides the nurse's discharge instructions to the patient and family members via Voice Care, with a dedicated number and a unique identifier. This builds on the success of a post-discharge call line that enables patients to call a nurse directly; this immediate connection to a healthcare worker already has saved one patient's life.

To measure the time nurses spend in documentation and to quantify value-added and non-valued-added work, UPMC gives nurses personal digital assistants for a shift. Several times during the shift, the PDA vibrates; at those times, nurses use the PDA to identify what they are doing at the time of the vibration. Several real-time data collections are done each month and are used to track improvements.

To reduce the documentation burden for nurses, the Nurse's Note merges four pages into one, combining daily notes with fall, restraint, and skin care sheets. Nurses gave this change 4.52 points on a 5-point satisfaction scale, and the combined note saved 10 minutes per nurse per day, or a total of 11.6 hours per day. Time on paperwork was cut in half, and nurses had more time to perform more meaningful work. This single innovation returned savings of \$480,000 to the bedside.

Placing commonly used supplies in patient rooms saves nurses' time. Before the change, staff visited the supply room one to three times an hour, taking from 1.5 to 2 minutes per trip. The change saved from 650 to 750 trips to the supply room each week, or a total of 16 to 18 hours, saving more than \$19,000 per unit.

According to the Agency for Healthcare Research and Quality, handwashing is one of the top 12 challenges for patient safety. At UPMC, signs are placed above sinks in patient rooms and on floor tiles in the emergency department; patient gowns have pockets that state, "Please remember to wash your hands." Under the Hardick Handwashing Initiative, UPMC is using battery-based soap dispensers that use counters to measure soap consumption.

Under the Transforming Care at the Bedside program, UPMC has introduced innovations that put patients at the center of care. At admission, every patient is given a pen and a tablet listing "Tips to Help Us Safely Care for You." Questions entered by the patient are discussed during rounds. Staff meet with the patient in the patient's room, ask for input on safety and satisfaction, and invite suggestions. Overturning tradition to actively involve patients in their own care, UPMC gives hospitalized patients open

access to their charts and the opportunity to view their own medical records.

Under a new liberalized diet program rolled out across UPMC Shadyside in 2004, physicians still write orders specifying dietary requirements, but patients can order what they wish from a new menu that has educational symbols to guide their choices. The program has resulted in a 22 percent increase in the number of educational activities and a 58 percent increase in patient satisfaction with the dietary service. Less food is left on trays, 18 percent fewer second trays are requested, and dietitians act as educators and work closely with physicians and nurses on care plans.

As part of a bidirectional process, the patient "teaches back" what the nurse has taught about self-care. The teach-back process enables patients to clarify their understanding of instructions before discharge; as discussed earlier, discharged patients are given a direct phone number to call with any questions that arise after they get home. Patients have responded favorably to these and other small changes, such as posting the patient's goal for the day in the patient's room and providing 30 minutes of uninterrupted quiet time each day.

In all, UPMC made 15 changes during the initial implementation of process improvements under the care transformation initiative. Together, they saved 12,000 hours of nurses' time for total savings of \$670,000. The return is much more than monetary; it is more time nurses can spend on direct patient care.

The Center for Quality Improvement and Innovation at UPMC now is extending the Transforming Care at the Bedside approach to more settings across the system, reducing patient wait times in the medical procedure area, and reducing operating room turnaround time and late starts for first cases. These initiatives focus on performance excellence and make specific improvements that result in savings and better patient care.

Simulation-Based Training

The University of Pittsburgh's Peter M. Winter Institute for Simulation, Education, and Research supports patient safety activities across the system. The institute provides simulation-based training for interdisciplinary crisis teams that respond to medical emergencies, for all physicians in the departments of anesthesia and emergency medicine in difficult airway training; and for more than 400 first-year house staff in the best practices for central line insertion. Continued growth in simulation-based training will support the provision of evidence-based care and the development of critical skills, without increasing patient risk. Current research projects are studying the longitudinal effects of skills decay as well as the reliability of education and assessment methodology.

UPMC plans to build a "smart room" at the institute that integrates radio frequency identification device technology

with the electronic patient record to test how technology should interface with patient care. The prototype will announce caregivers as they enter the room, and it will display patient information relevant to the caregiver on the wall behind the patient, including the patient's allergies. For example, a nurse entering the room will see a schedule for the patient that shows what needs to be done for that patient at that time; a nursing assistant will see the schedule for vitals, input-output charting, baths and other tasks; and critical lab values and recent medication administrations will be displayed for the arriving physician.

The smart room will do much more, from tracking dentures and turning on the bathroom light, to supporting pharmacists during clinical rounds and making images available to physicians at the bedside. It also will capture information that can be used in adjusting and evaluating care, such as determining how much time a nurse or physician spends with patients and the frequency of patient contact, and to support root-cause analysis when problems occur.

Lessons Learned

Like all politics, patient safety is local. Approaches can vary, and they should. In the efforts described here, Johns Hopkins and UPMC each focused on problems specific to their institutions and worked to solve those as best they could. The Johns Hopkins Children's Center focused on improving the safety of prescribing because dosing is so critical in pediatric care, where the error rate is triple that in adult care. At UPMC, the focus was on nursing, because of the growing body of evidence that a better work environment for nurses means safer care for patients.²⁵

Looking toward the broad vision for care outlines by the Institute of Medicine, they each have targeted specific needs to make patients safer by redesigned processes one at a time. Both are continuing in their efforts, in the knowledge that patient safety is a journey, not a destination.

Acknowledgments

Many others have contributed to the understanding of patient safety and to the specific interventions described in this article. At Hopkins, we would like to thank Peter Pronovost, MD, PhD; Lori Paine, RN; George R. Kim, MD; Marlene R Miller, MD; and Michael Rinke, the Johns Hopkins Center for Innovation in Quality Patient Care. At UPMC, we would like to thank Pamela Greenhouse, MBA; Beth Kuzminsky, RN, MSN; Susan Christie Martin, RN, MSN; and Dave Sharbaugh, the UPMC Center for Quality Improvement and Innovation.

About the Authors

Marion J. Ball, EdD, FHMSS, is a professor in the Johns Hopkins University School of Nursing and a fellow in the IBM Center for Healthcare Management, Business Consulting Services.

Tamra Merryman, RN, MSN, FACHE, is vice president at the Center for Quality Improvement and Innovation for the University of Pittsburgh Medical Center System.

Christoph U. Lehmann, MD, is assistant professor at the

Johns Hopkins University and director for Clinical Information Technology for the Children's Medical and Surgical Center. He is board-certified in pediatrics and neonatology.

References

1. Nursing Executive Center. Second-Generation Patient Safety Systems: Nursing Technology Scan. The Advisory Board Company: Washington, DC. 2005.
2. Landro, L. (2004, November 17). The Informed Patient: Hospitals Make Fewer Errors, but Fall Short of Safety Goals. *The Wall Street Journal*.
3. Zwillich, T. (2004). Little Progress Seen in Patient Safety Measures. Medscape website, available at www.medscape.com. Accessed November 12, 2004.
4. Gibbs, N., Bower, A. (2006, May 1). Q: What Scares Doctors? A: Being the Patient. What Insiders Know about our Healthcare System that the Rest of Us Need to Learn. *Time Magazine* cover story. www.time.com/archive. Accessed May 15, 2006.
5. Institute for Healthcare Improvement. (2006). Saving Accounts: Stories of how health care organizations are saving time, resources, energy and patients' lives. *Annual Progress Report 2006*. www.ihi.org. Accessed May 18, 2006.
6. Pronovost, P.J., Weast, B., Holzmueller, C.G., Rosenstein, B.J., Kidwell, R.P., Haller, K.B., Feroli, E.R., Sexton, J.B., Rubin, H.R. (2003). Evaluation of the Culture of Safety: Survey of Clinicians and Managers in an Academic Medical Center. *Quality and Safety in Health Care*, 12, 405-410.
7. Ball, M.J. (2005). Culture of Safety: Johns Hopkins Initiative Improves Interdisciplinary Communication to Better Protect Patients. *Advance for Nurses*, 7, 23, 31.
8. Johns Hopkins University. (2002.) Comprehensive Unit-based Safety Program (CUSP). www.icusrs.org. Accessed August 2, 2005.
9. Pronovost, P. (2003.) Improving Patient Safety: From Rhetoric to Reality. A presentation to the Georgia Patient Safety Summit, November 12, 2003. Available at www.icusrs.org/PDFs/MakingSafetyaReality.pdf
10. Heinreich, H.W. (1941). *Industrial Accident Prevention*. New York and London.
11. Rinke, M.L., Zimmer, K.P., Lehmann, C.U., Colombani, P., Dover, G., Garger, C., Miller, M.R. Patient Safety Rounds in a Pediatric Tertiary Care Center. Unpublished data.
12. Rinke, M.L., Zimmer, K.P., Lehmann, C.U., Colombani, P., Dover, G., Garger, C., Miller, M.R. Patient Safety Rounds in a Pediatric Tertiary Care Center. Unpublished data.
13. Darley, J.M., Batson, C.D. (1973). From Jerusalem to Jericho: a Study of Situational and Dispositional Variables in Helping Behavior. *Journal of Personality and Social Psychology*, 27, 1, 100-108.
14. Rinke, M.L., Zimmer, K.P., Lehmann, C.U., Colombani, P., Dover, G., Garger, C., Miller, M.R. Patient Safety Rounds in a Pediatric Tertiary Care Center. Unpublished data.
15. Moore, N., Lecointre, D., Noblet, C., Mabille, M. (1998). Frequency and Cost of Serious Adverse Drug Reactions in a Department of General Medicine. *British Journal of Clinical Pharmacology*. 45:301-308.
16. American Academy of Pediatrics Committee on Drugs and Committee on Hospital Care. (2003). Prevention of Medication Errors in the Pediatric Inpatient Setting. *Pediatrics*, 112, 2, 431-436.
17. Lehmann, C.U., Kim, G.R. (2005, March). Prevention of Medication Errors. *Clinical Perinatology*, 32, 1, 107-123, vii.
18. Lehmann, C.U., Kim, G.R. (2006). Computerized Provider Order Entry and Patient Safety. Accepted for publication. *Pediatric Clinics of North America*.
19. Lehmann, C.U., Conner, K.G., Cox, J.M. (2004, April). Preventing Provider Errors: Online Total Parenteral Nutrition calculator. *Pediatrics*, 113, 4, 748-753.
20. Lehmann, C.U., Kim, G.R., Gujral, R., Veltri, M.A., Clark, J.S., Miller, M.R. (2006, May). Decreasing Errors in Pediatric Continuous Intravenous Infusions. *Pediatric Critical Care Medicine*, 7,3, 225-230.
21. Lee, C., Agwu, A., Jain, S., Murray, K., Topolski, J., Miller, R.E., Townsend, T., Kim, K.D., Lehmann, C.U. Web-based System Improves a Restricted Antibiotic Approval Program. Unpublished data.
22. Kuzminsky, B., Martin, S.C., Greenhouse, P., Merryman, A. (2006). Condition H (Help): a Family Initiated Rapid Response Team. *American Journal of Nursing*, in press.
23. Scholle, C.C., Mininni, N.C. (2006). Best-practice Interventions: How a Rapid Response Team Saves Lives. *Nursing*, 36, 1, 36-40.
24. Scholle, C.C., Mininni, N.C. (2006). Best-practice Interventions: How a Rapid Response Team Saves Lives. *Nursing*, 36, 1, 36-40.
25. Spence Laschinger, H.K., Leiter, M.P. (2006, May). The Impact of Nursing Work Environments on Patient Safety Outcomes: the Mediating Role of Burnout Engagement. *Journal of Nurs Adm*, 36, 5, 259-267.

Driving Out Errors through Tight Integration Between Software and Automation

Mark Reifsteck; Thomas Swanson, MS, RPh; and Mary Dallas, MD

A B S T R A C T

A clear case has been made for using clinical IT to improve medication safety, particularly bar-code point-of-care medication administration and computerized practitioner order entry (CPOE) with clinical decision support. The equally important role of automation has been overlooked. When the two are tightly integrated, with pharmacy information serving as a hub, the distinctions between software and automation become blurred.

A true end-to-end medication management system drives out errors from the dockside to the bedside. Presbyterian Healthcare Services in Albuquerque has been building such a system since 1999, beginning by automating pharmacy operations to support bar-coded medication administration. Encouraged by those results, it then began layering on software to further support clinician workflow and improve communication, culminating with the deployment of CPOE and clinical decision support. This combination, plus a hard-wired culture of safety, has resulted in a dramatically lower mortality and harm rate that could not have been achieved with a partial solution.

K E Y W O R D S

- Medication safety ■ Closed loop ■ Pharmacy automation ■ Robotics ■ Bar coding
- CPOE with clinical decision support ■ Integration

Many healthcare providers were deep in denial in 1999 when the Institute of Medicine's seminal report, *To Err Is Human*,¹ made patient safety a household phrase. Because executives at Presbyterian Healthcare Services in Albuquerque already had begun developing a new medication safety vision in the late 1990s, they were able to act quickly.

The IOM report and a similar one from the Agency for Healthcare Research and Quality captured the interest of the senior leadership team and served as an impetus for change. Two statistics in particular caught their attention—that

preventable adverse drug events cause one out of five injuries or deaths per year to hospital patients, and that preventable healthcare errors cost the economy from \$17 billion to \$19 billion annually.²

PHS consistently ranks among the top 10 integrated healthcare delivery networks in the country, according to rankings by *Modern Healthcare* magazine. The network comprises Presbyterian Hospital, the state's largest tertiary medical care center, and Presbyterian Kaseman Hospital, both in Albuquerque, plus six other acute care hospitals, with a combined total of 900 beds. It also includes a

long-term-care facility, a physician group which has 350 physicians practicing at 30 rural clinics and community-based family healthcare centers, home health services, and an affiliated managed care health plan.

To mobilize efforts around patient safety, the hospital formed a multidisciplinary task force with representatives from pharmacy, nursing, administration, and information technology. The task force studied the hospital's entire medication use process, focusing on eliminating manual, highly repetitive tasks that can lead to medication errors. It pinpointed stress points such as handoffs, process variations, and potential bottlenecks caused by workload and staffing levels. Above all, the team wanted to ensure that the healthcare system did not simply automate bad processes.

The Leapfrog Group and other industry organizations have made a clear case for using clinical IT to improve medication safety. But the task force knew that software alone would not be enough to help caregivers eliminate errors and ensure safe clinical practice. The core components of a closed-loop medication management system are a computerized practitioner order entry (CPOE) system with clinical decision support, a bedside point-of-care medication administration system, and a pharmacy information system that serves as the hub for these and other feeder systems, such as laboratory.

A true end-to-end medication management system that drives out errors at every stage where they can occur—ordering, transcribing, dispensing, and administering—is even more complex. It requires automating pharmacy operations to achieve 100 percent unit-dose bar-coding. It requires integrating the medication administration record, or MAR, with the patient's complete electronic chart and making that information instantly available to the entire care team. Ideally, it also requires using another rules-based clinical decision support engine that monitors patient data and notifies clinicians of abnormal lab values and other critical data so they can react quickly.

A combined software-automation strategy for medication management can begin at any number of places, depending on organizational priorities and resources. Results of its analysis led the task force to recommend automating pharmacy operations first to support a bedside administration system, then measuring results before layering on additional clinical software, with CPOE and CDS serving as the capstones. The task force also determined that equal effort should go into creating a culture that encourages transparency, with senior management leading by example.

Pharmacy Automation

The pharmacy at Presbyterian Hospital and Presbyterian Kaseman Hospital provides centralized unit-dose drug distribution services with decentralized pharmacists located in patient-care areas. Altogether, the pharmacy staff, which employs 93 full-time equivalents, dispenses approximately

2.5 million doses annually across the network. More than 1,700 nursing FTEs work at the two Albuquerque hospitals. Each of these individuals was about to be significantly affected when their manual approach to work was automated. Even positive change in the name of patient safety would have to be managed carefully.

Specifically, the task force recommended a bar code-driven, centralized robotic drug distribution system supplemented by unit-based medication cabinets on patient floors, which together would support automated medication administration at the bedside. Because implementation of CPOE was a few years off, the team also worked with medical staff to close gaps between prescribing and transcribing activities, such as standardizing dosing schedules and rebuilding order entry pathways. It also recommended redeploying pharmacists to clinical roles as soon as automation began to relieve them of administrative tasks. The timeframe for this phase of redesign was less than 30 months.

Fully operational since 2001, the primary workhorse in the pharmacy is the robot, which automates the storage, dispensing, returning, and restocking of bar-coded unit-dose inpatient medications. The robot dispenses 95 percent of all robot-eligible medications at an accuracy level of 99.9 percent. At Presbyterian Hospital, it dispenses approximately 6,500 inpatient doses daily for both Albuquerque facilities via patient-specific envelopes, an approach that has shaved 12 FTE hours a day from 24-hour cart fill and first-dose operations. An additional 59 automated cabinets are used on patient floors for the secure storage, dispensing, and tracking of as-needed, floorstock, narcotics, and some first doses.

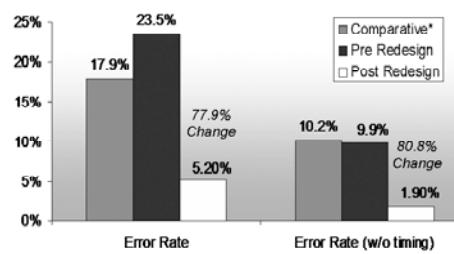
As expected, these efficiencies have freed up valuable time for pharmacists, who can spend more time consulting with physicians and other clinicians, another key recommendation from the task force.

But increasing the use of technology involves additional challenges. A bedside point-of-care (BPOC) medication administration system is designed to ensure that the right patient receives the right drug in the right dose at the right time via the right route. But effective bedside scanning requires 100 percent barcoding.

After two years of anticipation, in April 2006 the FDA began requiring that drug makers and marketers barcode patient-level doses of drugs, biological products, and blood components. The regulation is designed to increase adoption of medication administration technology by shifting some of the unit-dose packaging burden to drug makers. However, the industry still lacks bar-coding standards, and not all scanners can read all labels. Even with such uniformity, pharmacies will never completely eliminate the need to package and label patient-specific doses and some bulk items in-house.

In light of the state of the industry, Presbyterian Healthcare Services opted to contract for a professionally managed service that provides packaging technology and

Medication Error Category	Pre-System Redesign		Post-System Redesign	
	Percent	Number	Percent	Number
Total Errors	23.5%	216	5.2%	32
Unauthorized Drug	0.5%	1	0	0
Omission	12.9%	28	6.3%	2
Wrong Route	1.9%	4	3.1%	1
Improper Dose	8.8%	19	0	0
Wrong Dosage Form	0.9%	2	0	0
Wrong Administration Technique	0.5%	1	21.9%	7
Wrong Time	74.5%	161	68.8%	22
Total Error Rate	23.5%	--	9.9%	
Total Errors Excluding Wrong Time	9.9%	55	1.9%	10
Percent Change	77.9%		80.8%	

Table 1: Medication Errors by Category**Figure 1: Comparative Error Rates**

onsite staff to bar-code packages of all medications for both hospitals. The service ensures consistency and readability by keeping dedicated resources focused completely on packaging. It also reduces labor costs and frees technicians to perform other tasks.

Quantifying Error Reduction

To measure how much BPOC backed by pharmacy automation reduces medication errors at the point of care, PHS did something that many facilities forego. From March 2000 to November 2003, it hired consultants to help develop a study to evaluate the impact of the medication system redesign.

Medication error rates were measured at baseline and then after the redesign of the system under direct observation. During the study, trained individuals observed and recorded more than 500 medication doses being administered by nurses to approximately 110 patients.

A medication error was defined as "a deviation from the

physician's medication order as written in the patient's chart." Errors were further categorized into seven types, according to American Society of Health System Pharmacists standards—unauthorized drug, improper dose, wrong dosage form, wrong route, wrong time, wrong administrative technique, and omission.

The wrong time was defined as medication administration more than 60 minutes before or after the scheduled time. When implementing BPOC, an organization must define this window based on when it wants to alert the nurse that a dose is early or overdue. A two-hour window is

fairly typical, because it takes into account the realities of both pharmacy and nursing workloads.

Finally, the medication error rate was defined as the combined number of errors divided by observed doses plus omissions.

The pre- and post-studies were similar with respect to the number of observed sessions, charts reviewed, and opportunities for error. As shown in Table 1, overall medication administration errors were reduced by 77.9 percent, with wrong administration time and omission errors declining dramatically, by 86.3 percent and 93 percent, respectively, primarily because of system warnings that nurses received on their handheld scanners.

Improper doses were reduced from 8.8 percent to zero, and undocumented medications declined from 10 percent to less than 0.5 percent because the electronic medication administration record is automatically updated upon administration. Errors increased in wrong administration technique after the system was redesigned, but because these types of errors were not found to be a problem at baseline, no specific risk reduction initiatives were implemented.

Because this was an observational study and little comparable data was available, PHS was surprised by the high pre-automation error rate of 23.5 percent, which included timing errors; that rate was 9.9 percent when timing errors were excluded. However, the data is comparable to a similar study that examined 2,556 doses given at 36 hospitals and skilled nursing facilities in Colorado and Georgia.³ That study reported a 17.9 percent rate for all errors using manual systems and a 10.2 percent rate when timing errors were excluded (see Figure 1).

Aside from the patient safety benefits, BPOC also captures charges for medication when they are administered. Previously, nurses had to go back to the nurses' station and

electronically chart in a separate information system which medications they had given the patient. As a result, roughly 10 percent of scheduled medications went uncharted and patients were not charged for them. After system implementation, less than 0.5 percent of all medications were undocumented. The unit-based cabinets also capture patient charges where appropriate. Between the two systems, PHS has realized from \$200,000 to \$350,000 in incremental revenue each year.

Software Integration Closes Gaps

With solid results in hand, PHS moved ahead with its closed-loop strategy. In 2004, the enterprise implemented a next-generation pharmacy information system to serve as the communication hub.

Integration with the BPOC system enhanced communication between nursing and pharmacy on patient allergies, schedule changes, missing dose requests, and STAT or verbal orders that require pharmacy verification. Because the pharmacist sees the actual administration time, pharmacokinetics is more precise.

That same year, nurses adopted an integrated electronic documentation system that incorporates the updated medication administration record in the patient's chart after every round of medications. Because patient information is displayed on a single flowsheet, nurses can view important clinical information, like vital signs and inputs and outputs, before each administration.

PHS also introduced a new laboratory information system that improved communication between the laboratory and pharmacy. As soon as lab results are available, rules-based alerts appear in the pharmacist's work queue based on laboratory values. For example, the pharmacist is notified of abnormal values signaling toxicity, or when a lab finding affects a drug dose or requires a lab measure for titration. This improves patient monitoring and eliminates misinterpreted results.

On the dispensing side, the pharmacy information system shares two-way communication with the robot and cabinets, which enables advanced dispensing logic. The pharmacy information system intelligently sends dispensing requests to the appropriate filling device and inventory location, based on the type of medication ordered and inventory on hand. Physical and virtual inventories are synchronized after every order, so staff know the exact quantities available in each location.

Phasing in Other Applications

When it comes to reducing care variability and improving patient safety, computerized practitioner order entry (CPOE) and clinical decision support is the gold standard, especially when integrated with the pharmacy information system. Two-way communication simplifies the verification process, eliminates transcription errors, and enables physicians and

pharmacists to share a common drug knowledge base, formulary, and allergy information. Orders modified in the pharmacy that require a physician's co-signature before they can be dispensed can be automatically flagged for that physician in the CPOE-CDS system, reducing phone calls and turnaround time.

Even for an organization with five years of clinical transformation under its belt, implementing CPOE-CDS has been a major undertaking. Like any user, physicians will resist any system that they perceive will slow them down and does not work the way they think. Gaining their trust can mean having to overcome memories of bad experiences with earlier technology.

A good approach to jumpstart adoption is to give physicians and other clinicians access to patient information anytime and anywhere. In 2004, PHS launched a secure portal that clinicians can use to review results, sign off on patient charts, and access multiple clinical applications. As with any good technology, adoption was almost immediate. At PHS, more than 1,000 employed and affiliated physicians were relying on the portal for more than a year before the organization began a carefully phased approach to CPOE-CDS.

Best practices for CPOE-CDS adoption still are emerging, but many organizations start with hospitalists, who place the most orders and are most likely to become system champions. In December 2005 and January 2006, 26 hospitalists at Presbyterian began using the system on two medical-surgical units. ICU intensivists were scheduled for July, with cardiologists and other specialty groups expected to follow.

As hoped, a physician champion emerged early on among the hospitalists. She has been instrumental in adapting multiple sources of experience-based content to meet the medical staff's needs and simplifying how clinical decision support is incorporated into routine order sets.

The process of building such order sets already is helping to eliminate care variability. For example, even though cardiologists are not yet live on the system, they are busy automating protocols, first by deciding as a group on the best way to take care of an average cardiac patient in the ICU, then building order sets with embedded clinical decision support that reflects the standards on which they have agreed. Another common issue with CPOE-CDS is determining the amount of "noise" to allow, because many believe that too many pop-up alerts and reminders will stop the average user from heeding them. Physician groups also are spending considerable time setting individual levels for each order set.

Establishing Metrics

Based on the results of its earlier medication error study, PHS knew the importance of linking performance improvements to technology investments. For CPOE-CDS, the organi-

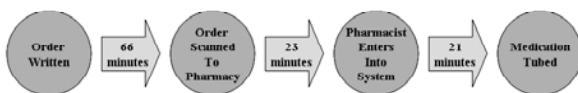


Figure 2: Pharmacy Turnaround Time Baseline Study

zation has similarly established metrics based on data that can be gathered from reports, observation, and surveys.

Those metrics fall into three categories: adoption, operational effectiveness, and patient safety.

For example, an adoption metric measures the percentage of orders placed via CPOE by physicians trained in its use, and another measures clinician satisfaction with CPOE.

Operational metrics look at order turnaround times from the pharmacy, lab, and radiology, as well as the accuracy of orders that clinicians enter via CPOE.

Measures of patient safety include the scores on CMS' 20 hospital quality measures for patients who have primarily had their orders placed via CPOE. Baseline studies for these and other metrics are in process.

The baseline study for pharmacy turnaround time was completed in April, measuring the time elapsed from when a handwritten order was faxed to and scanned in the pharmacy, entered in the order entry system, and delivered by tube to the floor. During three days, delivery of 99 antibiotic orders was tracked. The data in Figure 2 shows averaged elapsed times between each stage, after removing outliers. The data indicates the potential to cut turnaround time by more than 75 percent through integration between CPOE-CDS and the pharmacy information system, which eliminates transcription and simplifies verification.

Conclusion

At Presbyterian Healthcare Services, executives have balanced the push to implement the most advanced software and automation with the need to remain sensitive to clinicians' ability to absorb change. They also have led the effort

to create a culture of safety.

With a combined solution almost fully deployed, the best indicator of clinical transformation cannot be tied to any one thing. Between 2002 and 2005 the mortality index at Presbyterian Hospital dropped from 1.2 to 0.9. The harm rate—the number of adverse drug events per 1,000 doses—also has continued to decline to a current low of 0.48, which is within the top tenth of a percentile for the harm rate nationally. These and the many other results could not have been achieved with a partial solution.

What will it take to replicate this experience across the country? A woefully small percentage of providers have implemented close-loop technology, much less a combined software and automation solution. On the automation side, unit-based cabinets are way out in front, used by 72 percent of hospitals, but pharmacy robotics is used by only 15 percent of facilities. On the software side, only 9.4 percent of providers use BPOC,⁴ and only 5.7 percent of nongovernmental hospitals have implemented CPOE-CDS. Of the latter, only 13 percent also use bar-code scanning at the point of care, and a quarter still re-enter medication orders in the pharmacy.⁵

It is obvious that adoption rates are well below what is needed to deliver the nationwide quality and efficiency outcomes demanded by payers, regulators, and consumers. And despite available technology, closed-loop medication management that combines software and automation is still virtually nonexistent where it matters most—in clinicians' hands.

About the Authors

Mark Reifsteck is senior vice president and COO of Presbyterian Healthcare Services.

Thomas Swanson, MS, RPh, is the pharmacy quality and patient safety manager for Presbyterian Healthcare Services.

Mary Dallas, MD, is the medical information officer for Presbyterian Healthcare Services. She practices with Presbyterian's Adult Hospitalist Physician Group.

References

1. Kohn, Linda T., Corrigan, Janet M., Donaldson, Molla S., eds.; Committee on Quality of Health Care in America, Institute of Medicine. *To Err Is Human: Building a Safer Health System*. National Academies Press, 2000.
2. Medical Errors: The Scope of the Problem. Fact sheet, Publication No. AHRQ 00-P037. 2000. Agency for Healthcare Research and Quality, Rockville, MD. <http://www.ahrq.gov/qual/errback.htm>.
3. Flynn, E.A., Barker, K.N., Pepper, G.A., Bates, D.W., Mikael, R.L. *American Journal of Health System Pharmacists*. 2002 Mar;59(5):436-446.
4. Pedersen, Craig A., Schneider, Philip J., Scheckelhoff, Douglas J. ASHP 2005 National Survey of Pharmacy Practice in Hospital Settings: Dispensing and Administration. *American Journal of Health Systems Pharmacists*. 2006 Feb; 63(4):327-345.
5. KLAS Enterprises. "Closed-Loop Medication Management Solutions Report 2005," January 2, 2006. http://www.healthcomputing.com/site/v2/reports/view_report_detail.asp?catalogid=436

Enhancing Patient Safety through Electronic Medical Record Documentation of Vital Signs

Pauline Gearing, RN, BSN, CCRC; Christine M. Olney, MS, RN, Doctoral Candidate; Kim Davis, MS, ARNP; Diego Lozano, MD; Laura B. Smith, RN, MSN, CCRN; and Bruce Friedman, D. Eng.

A B S T R A C T

As technology becomes more sophisticated in healthcare, there is increasing need to measure its impact on key quality indicators, such as error reduction, patient safety, and cost-benefit ratios. When a product is designed to decrease medical errors, the baseline error rate must be determined before implementation to accurately measure the impact. Given the opportunity to adopt a technology that would eliminate the need to manually document vital signs, a large Florida hospital decided to measure the current process and error rate of vital signs documentation. University Community Hospital in Tampa, Fla., designed a two-phase study to evaluate this process. Phase I of the study evaluated errors in the electronic medical record and traditional manual documentation. The results demonstrate that use of an EMR can reduce vital sign documentation errors by more than half, compared with traditional manual documentation in paper charts. Researchers found the error rate for electronic vital signs documentation to be less than 5 percent, compared with the paper chart error rate of 10 percent.

K E Y W O R D S

- Vital signs monitoring
- Medical error reduction
- Patient safety
- Barcodes
- Electronic medical record

In the wake of the Institute of Medicine report in 1999,¹ the issue of medical errors has become front-page news. Subsequent IOM reports, the emergence of the Leapfrog Group, together with a well-publicized focus on patient safety by JCAHO² and national quality organizations have made the issue of medical errors in general—and medication errors, in particular³—a highly visible and favored target of hospital patient-safety programs.⁴

However, errors associated with the documentation of patient vital signs, perhaps the most fundamental of patient information, have received scant attention.⁵ A search of the literature failed to identify any studies dealing with vital signs documentation error rates, although numerous studies have compared data entered in paper-based systems with those entered in electronic medical record (EMR) systems.^{6,7,8,9} Therefore, it is not known if vital signs documentation has

been studied or if hospitals are aware of their errors in this area of patient monitoring.

The reluctance to report vital signs errors may in part be a result of the inherent reluctance of institutions to publicize their medical errors; the difficulty in tracking the accuracy of vital signs documentation; and the complexity of determining the significance of errors associated with vital signs.

While no studies have been published evaluating the documentation of vital signs data, previous studies comparing paper-based and electronic records showed a wide range of error rates. A study in a pediatric outpatient clinic found that only 44 percent of patient information was documented identically in the paper and electronic records, while 25 percent was documented only in the paper record, and 31 percent only in the electronic record.⁸

Another evaluation conducted in a hospital neurology department studied errors in documents entered in a paper record and in an EMR.⁹ A total of 17 documents (6.6 percent) recorded in both the paper record and the EMR were considered inconsistent with respect to the information communicated, and 13.8 percent of the documents were missing from either the paper or electronic record. They did not evaluate the individual number of errors.

Nurses spend a significant portion of their time obtaining information necessary for patient care. Paper documentation often requires repeated transfer of data from the point of initial documentation to forms such as flow sheets and, ultimately, to the patient's chart. Vital signs documentation is a case in point. From initial documentation on the source document to final documentation, the same vital signs may be re-transcribed as many as three times in three separate locations. It is not uncommon for nurse technicians collecting vital signs to write the data initially on individual sheets of paper they have created to organize the patient's daily information. The data then is transferred to a nursing flow sheet and ultimately into the patient's chart. This replicated documentation may generate errors in transcription, omission, or a delay in readily available information, as well as lost time because of inefficient clinical workflow.

A recent study at University Community Hospital in Tampa, Fla., evaluated the overall accuracy of vital signs documentation from the initial values on the handwritten source document to the final values entered into the paper patient chart or the EMR. In light of the lack of existing data regarding the accuracy of vital signs documentation, the study was conducted to establish a baseline of vital signs documentation accuracy within a system that is either partially or completely paper-based.

Because of the lack of reference data, there is no objective way to determine if the error rates reported in this study are higher, lower, or the same as that of other hospitals. Phase II of the study will involve a paperless solution in which vital signs are electronically transferred to the EMR, utilizing a personal digital assistant with bar-coding

technology, eliminating all paper transcription of vital signs by the healthcare staff.

Background

University Community Hospital is a 475-bed tertiary care hospital serving the north Tampa area. Known widely for its cardiac services, UCH is a teaching hospital affiliated with the University of South Florida and is part of University Community Health, a five-hospital integrated delivery system operating a total of 963 beds.

University Community Health recently opened Pepin Heart Hospital and the Dr. Kiran C. Patel Research Institute, which was designed to incorporate an all-GE line of medical technology and IT. In the process of planning for the new hospital's state-of-the-art equipment, UCH evaluated numerous technologies, many of which were new to the market.

UCH has a long history of focusing on patient safety, being one of the country's first hospitals to create the position of patient safety officer in each patient care unit of the hospital. The hospital communicates the patient safety message from top management down to individual floors through a management "communication relay," involving the performance improvement coordinating council headed by the chief medical officer and the chief nursing officer as co-safety officers. Safety data is shared with the nursing roundtable and unit-level patient safety officers. A corporate focus on patient safety was a major impetus behind UCH's implementation of the Centricity Clinical Information System, which enables nurses to chart without leaving patients' rooms.

The decision to conduct this study was based on a desire to know the error rate associated with the current documentation system. Better understanding of the frequency and nature of these errors will help UCH design and implement safer processes and technology. A logical question to ask after the error rate is measured is how do errors in vital signs documentation affect patient treatment? The study was not designed to answer this question. However, it is likely that vital signs errors, missing data, or data on the wrong chart could result in inappropriate, delayed, or omitted treatment.

There is a notable lack of evidence regarding the accuracy of vital signs documentation. Numerous literature searches yielded no studies reporting a baseline of accuracy involving multiple documentation points to the final patient chart. Further, studies comparing the accuracy of vital signs documentation from paper-based transcription with totally electronic documentation of vital signs—from the vital signs monitor directly to the EMR—apparently have not been published.

Nurse technicians may write the original set of vital signs on pieces of paper that they carry from room to room, eventually recording them in the patient's chart—either in a

paper chart or electronic medical record—later in the shift. This increases the risk of various mistakes, such as transposition of digits, missing digits, an inability to read what was written on the paper prior to final transcription, omission of documentation, documentation in the wrong chart, and delayed information for clinicians who are making treatment decisions for the patient.

Purpose of the Study

The purpose of the Phase I study was to evaluate the accuracy of vital signs documentation in a paper-based or partially paper-based system. Two hypotheses were tested in Phase I—that patient vital signs documentation via paper sources results in documentation errors or omissions in the paper-based patient medical record, and that patient vital signs documentation via paper sources also results in documentation errors or omissions in an EMR.

A published analysis of 19 studies on the accuracy of computerized patient records found that differences in the classification of errors made meta-analysis of accuracy unfeasible.⁶

During the protocol design phase of the study, the research team invested a great deal of time defining terms, specifically detailing what constituted a documentation error. Emphasis was placed on establishing strict definition of error for consistency throughout data collection and analysis. The study did not assess the delay in available information nor the initial accuracy in documentation from the monitor to the paper record because both assessments would demand direct observation of the nurse technician or nurse, thereby introducing bias into the study.

For the purposes of the study, the following five vital signs were defined—blood pressure, temperature, heart rate, oxygen saturation (SpO₂), and respiration rate. The research team noted that opportunities for documentation error exist for every digit recorded for these vital signs. There are a maximum 18 total digits in a single set of readings on one patient: systolic (three), diastolic (three), heart rate (three), SpO₂ (three), respiration (two), and temperature (four).

For the purposes of this study, the research team determined that if an individual digit error were made, the treatment error would be related to the specific parameter. The maximum potential for error in one set of vital signs is six. The percentage of errors reported in this study relate to the percentage of error per set of vital signs, based on one parameter being counted as one error, even though that parameter may have three digits.

The large volume of vital signs documented in a typical medical-surgical unit can lead to a high likelihood of error. For example, based on the number of sets of vital signs taken per day, as many as six parameters may be transcribed in one set of vital signs, with each parameter providing an opportunity for an error. Because each patient on a hospital unit may have vital signs taken every four hours, and that

each unit may have as many as 30 patients on any given day, the total opportunity for error is 972 opportunities per day on that one unit.

Errors can arise from transposition of digits, missing digits, an inability to read what was written on the paper prior to final transcription, and vital signs being documented on the wrong patient's chart. Further, error opportunities also arise from data that, for some reason, were never documented in the patient's medical record. Omission is a source of errors that occurs when a set of vital signs is not taken or not documented on the patient's record and therefore considered not taken. Finally, errors can result from entering the wrong data on the wrong chart, a situation easily overlooked if the values recorded are similar to the correct patient's values.

The Phase I vital signs documentation accuracy study, sponsored by GE Healthcare, was approved through expedited review from the IRB at UCH in March 2006.

Research Design and Implementation

After establishing definitions, researchers developed and implemented the research design. The study was conducted on two floors: a 20-bed cardiac step-down unit that treats patients recovering from vascular and cardiovascular surgery and a 27-bed medical-surgical unit.

During a three-week period, vital signs were collected from all three shifts. Nurse managers were given a script about the collection procedure of source documentation to read to nurse technicians. Participating nurse technicians on the designated units placed their original source document—with room number, date, time, bed number, and patient vital signs values—into a closed envelope at the end of each shift for comparison to the one entered into the patient record. Nurse technicians who documented the vital signs were de-identified, ensuring their anonymity and eliminating any punitive implications.

To be included in the study, vital signs documentation had to meet these criteria—it had to be initially documented on paper; be within a limited, pre-selected area of the hospital; be documented by the caregiver responsible for documenting vital signs for the medical record (such as a registered nurse or nurse technician); and be identified by the date, room, and bed number.

A total of 1,463 vital sign sets from the medical-surgical unit were evaluated for inclusion in the study. Of those, 613 were eligible based on the inclusion criteria. On the cardiac step-down unit, a total of 680 vital sign sets were evaluated, and 623 were eligible for inclusion based on the criteria. The large number of sets found ineligible on the medical-surgical unit resulted in large part from the inability to verify data from the paper medical record. This problem did not exist on the cardiac step-down unit, which uses an EMR.

Following careful analysis of the workflow involved in vital signs documentation at UCH, researchers outlined the

Description	Paper Chart Entry	EMR Entry	EMR vs. Paper Chart
Unit	Medical/Surgical	Cardiac Surgery Step Down Unit	
Bed Capacity ¹	27	20	
Sets of Vital Signs Reviewed ²	613	623	
Sets of Vital Signs With One or More Errors ³	157	93	
Percent of Vital Sign Sets With One or More Errors ⁴	25.6%	14.9%	
Percent Reduction in Vital Sign Sets with Errors Using EMR Entry vs. Paper Chart Entry ⁵			41.8%

¹ Number of beds available on this floor

² Vital signs recorded at each measurement (systolic, diastolic, HR, SpO₂, temperature, RR)

³ Sets with errors in one or more of the measured vital signs

⁴ Calculated as: (Sets with errors/Total Sets) x 100%

⁵ Calculated as: ((25.6 – 14.9)/25.6) x 100%

Figure 1. Demographics and Results of Vital Sign Error Data Collection at University Community Hospital for Patients Admitted Between 3/13/2006–3/31/2006.

following methodology for data collection. After the source records were obtained, the data collector compared the source vital signs with the patient's vital signs in the medical record, either paper or electronic. Any differences between the original vital signs on the source document and the patient's medical record were documented by means of either printing out the values from the EMR or making a copy of the paper chart. Researchers documented all discrepancies in a spreadsheet.

The research team reviewed all discrepancies between the original source document and the patient chart and determined errors, as defined in the study protocol. The team then reviewed all discrepancies and errors and agreed on the error classification. A second data collector compared all of the errors to the patient chart for inter-rater reliability and to validate the original findings, resolving any disagreements between the two data collectors. The inter-rater reliability for the vital sign data were 99.8 percent for both paper and electronic charts combined. The bed number, date, and time resulted in a 97.9 percent agreement for electronic and 98.3 percent for paper.

A second study is planned to be completed later this year to evaluate the impact of eliminating the paper record. In Phase II, a PDA will be used to electronically collect data from the vital signs monitor and transmit it directly to the electronic medical record using wireless

communication links. The PDA uses a barcode reader for patient identification.

After the staff is trained and efficient in the use of the PDA vital signs documentation system, the second phase of the study will begin to evaluate the occurrence of errors in an environment where no one has to write down or type the vital signs into the patient record. The second phase of this study will involve hospital units that are using an EMR.

Early Research Finds Errors

Study findings supported both hypotheses. Vital signs documentation via paper sources resulted in documentation errors and omissions in the paper-based patient medical record. Further, patient vital signs documentation via paper sources combined with the EMR resulted in documentation errors and omissions in the EMR.

In the Phase I study, researchers reviewed 613 sets of vital signs on the 27-bed medical-surgical unit that used a paper medical record. Findings revealed that 157, or 25.6 percent, of those sets had at least one error related to omission or transcription (see Figure 1).

While the average error rate of each vital sign parameter was about 10 percent, when individual averages by parameter are considered, the numbers are much higher in some cases (see Figure 2). In particular, the number of transcription errors tended to be higher for the temperature and

	Data Patients Reviewed	Omission Errors		Transcription Errors		Total Errors	
		No.	%	No.	%	No.	%
Systolic	613	32	5.2%	24	3.9%	56	9.1%
Diastolic	613	33	5.4%	28	4.6%	61	10.0%
Heart Rate	613	31	5.1%	25	4.1%	56	9.1%
Temperature	613	31	5.1%	43	7.0%	74	12.1%
Respiration	613	32	5.2%	41	6.7%	73	11.9%
SpO ₂	613	32	5.2%	16	2.6%	48	7.8%
Total	3678	191	5.2%	177	4.8%	368	10.0%

Figure 2. Parameter and Type Vital Sign Documentation Errors

	Data Patients Reviewed	Omission Errors		Transcription Errors		Total Errors	
		No.	%	No.	%	No.	%
Systolic	623	12	1.9%	10	1.6%	22	3.5%
Diastolic	623	14	2.3%	13	2.1%	27	4.3%
Heart Rate	623	8	1.3%	10	1.6%	18	2.9%
Temp	623	9	1.4%	31	5.0%	40	6.4%
Respiration	623	15	2.4%	19	3.1%	34	5.5%
SpO ₂	623	7	1.1%	18	2.9%	25	4.0%
Total	3738	65	1.7%	101	2.7%	166	4.4%

Figure 3. Summary of Vital Sign Documentation Errors

respiration parameters (counts were 43 and 41, respectively, with roughly a 7 percent error rate for each), compared with other parameters. When the omission and transcription errors for temperature and respiration are combined, the total error rate is about 12 percent.

Researchers reviewed 623 sets of vital signs from the 20-bed cardiac step-down unit that used an EMR. The results show that 93, or 14.9 percent, of those sets had errors related to omission or transcription. The number of omission errors vs. the number of transcription errors is comparable for all parameters except temperature and SpO₂, where transcription error counts are double and triple, respectively, the number of omission errors. The temperature parameter recorded the highest percentage of total errors (6.4 percent) using the EMR (see Figure 3), while heart rate recorded the lowest total error rate (2.9 percent).

A comparison of error rates for entering vital signs in the paper medical record and the EMR provided other relevant findings.

Frequency. The overall total vital signs entry error rate in the EMR of 4.4 percent was 56 percent less than the 10 percent rate of errors in the paper record. Also, there were

41.8 percent fewer vital signs sets with one or more errors when using the EMR (14.9 percent), compared with the paper medical record (25.6 percent).

Type. The types of errors identified were either errors of omission or transcription. While the combined percent of both omission and transcription errors was about the same for EMR and paper record combined (6.9 percent were omission errors and 7.5 percent were transcription errors), the percent of both types of errors was higher in the paper record. The omission errors for the paper-record entries were substantially higher than the EMR for all parameters, generally by a factor of two to three times, depending on the parameter.

Vital signs parameters. The most frequently reported error rates by parameter for both EMR and paper records were temperature and respiration. However, the error rate in the EMR for these parameters was about half that reported in the paper record, which recorded a 12.1 percent error rate for temperature and 11.9 percent for respiration. The larger number of errors in the temperature parameter can be attributed primarily to errors in recording and transcribing the “tenths” digit, which is often written in smaller print on

the original source document. No specific indicator was identified for the respiration parameter.

Multiple errors within a single set of vital signs.

Some 85.1 percent of all EMR vital signs were error-free, compared with 74.4 percent of all paper record vitals. Single sets of vital signs containing multiple errors were more likely to occur in paper records (6.5 percent) than in an EMR (1.4 percent).

EMR vs. Paper. Overall, the percent of EMR documentation errors was lower, regardless of error type, for every parameter except SpO₂ transcription errors, where the EMR recorded a 2.9 percent error rate, compared with 2.6 percent for the paper chart.

Limitations

This study does have its limitations. Findings related to error documentation are from two different units, staffed by different personnel. It is possible that error rates were influenced by variances among the units, such as training of the nurses and nurse technicians as well as patient load and severity of patient illness. Therefore, care should be used in interpreting discrepancies in documentation errors between units.

Conclusions

Patient vital signs are a fundamental component of clinical information and therefore integral to achieving excellence in patient care and safety. The process of vital signs documentation by nursing personnel has changed little in decades, typically consisting of manual documentation on paper and repeated manual re-entries of the information at multiple sites before final entry in the patient record. University Community Hospital undertook the study outlined in this article in order to establish a baseline to compare error rates of vital signs documentation for the paper chart and the EMR.

References

1. Kohn L, Corrigan J, Donaldson: Committee on Quality of Health Care in America, Institute of Medicine. *To Err is Human: Building a Safer Health System*. Washington, DC: National Academy Press, 2000.
2. Joint Commission on Accreditation of Healthcare Organizations, national patient safety goals. Available at <http://www.jcaho.org>.
3. Rosen R: Medication Errors: a 21st Century Perspective. *Health Care Research and Improvement*, Baylor University Medical Center Proceedings 2004 Vol. 17 pgs. 464-467.
4. Gillespie G.: I.T. Helps Steer Caregivers from Danger of Medical Errors. *Health Data Management*. May 2002. Available at: <http://www.healthdatamanagement.com?HDMSearchResultsDetails.cfm?DID=11760>.
5. Agency for Health Research and Quality, Medical Errors: the Scope of the Problem (fact sheet). Publication No. AHRQ 00-P037. Rockville, Md.: Available at <http://www.ahrq.gov/qual/errback.htm>.
6. Hogan W, Wagner M: Accuracy of Data in Computer-based Patient Records, *J Am Med Inform Assoc.*, 1997;5:342-35.
7. Mikkelsen G, Aasly J: Concordance of Information in Parallel Electronic and Paper-based Patient Records, *International Journal of Medical Informatics*, 63 (2001) 123-131.
8. Roukema J, Los R, Bleeker S, van Ginneken A van der Lei J, Moll H: Paper Versus Computer: Feasibility of an Electronic Medical Record in General Pediatrics, *Pediatrics*, 2006;117;15-21.
9. Johannes CB, Woods J, Crawford S, Cochran H, Tran D, Schuth B : Electronic Versus Paper Instruments For Daily Data Collection, *Ann Epidemiol.*, 2000; 10, 7: 449-483.

This study found that entry of vital signs into an EMR cut the documentation error rate by more than half (56 percent). The error rate for entering vital signs documentation on electronic records was 4.4 percent, compared with the paper chart error rate of 10 percent. Further research is necessary to determine if these rates are below, consistent with, or above the average for hospitals across the country.

UCH will conduct a Phase II study later in 2006 to determine the statistical significance of eliminating manual transcription altogether by implementing automatic electronic downloading of patient vital signs data directly into the EMR. Additional research is needed to better understand the impact of vital signs documentation on the delivery of quality care and patient safety.

About the Authors

Pauline Gearing, RN, BSN, CCRC, is a manager of clinical trials at the Dr. Kiran C. Patel Research Institute located in the Pepin Heart Hospital on the campus of University Community Hospital in Tampa, Fla.

Christine M. Olney, MS, RN, is a doctoral student and research assistant at the College of Nursing at the University of South Florida.

Kim Davis, MS, ARNP, is the manager of clinical services at GE Healthcare, Monitoring Solutions.

Diego Lozano, MD, is the clinical project leader at GE Healthcare, Monitoring Solutions.

Laura B. Smith, RN, MSN, CCRN, is a cardiovascular clinical nurse specialist at the University Community Hospital in Tampa, Fla.

Bruce Friedman, D. Eng., is the manager, Technology Development at GE Healthcare, Monitoring Solutions.

Evaluation of Reported Medication Errors Before and After Implementation of Computerized Practitioner Order Entry

*Victoria M. Bradley, RN, DNP, FHMSS; Carol L. Steltenkamp, MD, MBA;
and Kimberley B. Hite, MS, PharmD*

A B S T R A C T

While a major objective of CPOE is to reduce medication errors, its introduction is a major system change that may result in unintended outcomes. Monitoring voluntarily-reported medication errors in a university setting was used to identify the impact of initial CPOE implementation on medical-surgical and intensive care units. A retrospective trend analysis was used to compare errors one year before and six months after implementation. Total error reports increased post-CPOE but the level of patient harm related to those errors decreased. Numerous modifications were made to the system and the implementation process. The study supports the notion that CPOE configuration and implementation influences the risk of medication errors. Implementation teams should incorporate monitoring medication errors into project plans and expect to make ongoing changes to continually support the design of a safer care delivery environment.

K E Y W O R D S

- Medication error ■ Computerized practitioner order entry (CPOE) ■ Implementation
- Reporting ■ Medication cycle ■ Trend analysis

Implementing a computerized practitioner order entry (CPOE) system with clinical decision support has been proposed as an important way to foster the development of a new care delivery process for hospitals to decrease harmful medication errors. Information technology is viewed as a critical component in the development of a healthcare

delivery system that prevents errors and incorporates the lessons learned from errors that do occur.¹

The Institute of Medicine also recommends that information on adverse events and near misses be captured to design safer care delivery systems. However, the Institute of Medicine also cautions that while technology may solve

some problems, it may generate new forms of error and failure.

Through CPOE, clinicians who have order-writing authority directly enter orders via the computer.² It replaces the use of making handwritten orders in a patient chart and the physical delivery of the order to the receiving department or clinician. Clinical decision support refers broadly to giving clinicians clinical knowledge and patient-related information, intelligently filtered or presented at appropriate times, to enhance patient care.³ CPOE is intended to primarily decrease ordering and transcription errors, while clinical decision support provides additional information to prevent ordering errors related to lack of drug knowledge, rules violations, lack of standardization, lack of patient information, and inadequate monitoring.

An increasing number of studies caution those implementing systems that CPOE can inject new errors into the healthcare delivery system.

Inpatients face risks of medication errors throughout their hospital stays. In various studies, the risk varies based on how medication errors, adverse drug events, or adverse drug reactions are defined; how data was retrieved; and the populations studied. The studies have illustrated that medication errors are a significant problem in hospitals.

For example, the rate of medication error was reported as 1.4,⁴ 5.07%⁵ or 0.19⁶ per admission. Risk of serious harm is less, variable, and unacceptable. Examples of rates are 6.5 per 100 non-obstetrical admissions,⁷ 0.25% of admissions,⁸ or 14.97 per 100 patient-days in critical care.⁹ Numerous studies conclude that many medication errors are preventable.^{4,7,9-18}

Most of the studies demonstrating the benefits of CPOE-CDS in reducing medication errors have been conducted at a few sites with home-grown systems.¹⁹ Because there have been few studies of commercially available CPOE applications, the ability to replicate benefits of CPOE across most of the hospitals in the United States is still an unmet challenge. Because implementation of CPOE is recommended as a way to help hospitals decrease medication errors, it is imperative that medication errors be used as a measurement outcome.

An increasing number of studies caution those implementing systems that CPOE can inject new errors into the healthcare delivery system.^{20,21,22,23,24} Different CPOE-CDS systems have different areas of risk for medication errors based on application design, workflow integration, and deployment strategy.

Weiner et al²⁴ emphasized the need to monitor ordering errors and institute processes to prevent errors resulting from

CPOE implementation. Ash, Berg, and Coiera²⁰ recommended qualitative research to identify why and how the kinds of unintended consequences occur. George and Austin-Bishop²⁵ identified the need for CPOE optimization, and Hicks et al²⁶ suggest that design flaws, poor or insufficient decision support rules, inadequate training, and user resistance undermine the promised benefits of CPOE. They encourage enhanced vigilance in error detection and careful pilot testing to ensure that errors are prevented and not perpetuated.

Koppel et al²¹ recommend emphasizing workflow, aggressive examination and resolution of technology problems, and diligent investigation of error causes to support resolution. They also suggest the continual evaluation of new risks and support ongoing revisions.²¹ Nebeker et al¹⁸ suggest that adverse drug events become more visible as more of the record is computerized, and they theorize that the system does not necessarily induce more of them. They recommend that clinical decision support will be needed to resolve many types of adverse drug events.

Kim et al²⁷ also recommend ongoing medication error surveillance and guidance by domain and IT experts when CPOE is deployed. Battles and Keys²⁸ warn that, "While automation holds substantial promise for improved safety, error experts caution that all technology introduces the potential for new and different errors. It is critical that any new automated system be tested in actual operational settings to determine what, if any, unanticipated failures exist. Field-based research is essential in the emerging field of patient safety to create the evidence as to which technologies actually improve patient safety and those that may well increase the potential for harm."²⁸

These studies and the advice from safety experts reinforce the need to incorporate the evaluation of the impact of CPOE-CDS on medication errors as part of the implementation process. The outcome of a CPOE-CDS implementation is not to just successfully install the system from a technical viewpoint, but to reduce harmful medication errors.

While not the most effective method of error identification,^{5,29-32} using reports of medication errors is a timely, cost-effective way to provide data on the impact of implementing CPOE. Dixon³³ reports that the benefits of electronic reporting via the Web include increased standardized reporting, along with immediate notification and investigation. Rapid communication of errors via e-mail also supports earlier analysis and prevention efforts.^{33,34} Rudman et al³⁵ found that internet reporting increased the volume and completeness over a paper-based system.

Additionally, Spencer et al³³ used voluntarily reported medication errors to identify CPOE-related errors. Zhan et al³⁶ reported that a national voluntary medication error-reporting database can be used to identify specific types of errors related to CPOE systems. Miller et al³⁷ reviewed reports from a voluntary online error-reporting system and

Figure 1 NCC MERP index for categorizing medication errors

Error Category	Result of Error
No Error	
Category A	Circumstances or events that have the capacity to cause error
Error, No Harm	
Category B	An error occurred but the error did not reach the patient
Category C	An error occurred that reached the patient but did not cause patient harm
Category D	An error occurred that reached the patient and required monitoring to confirm that it resulted in no harm to the patient and/or required intervention to preclude harm
Error, Harm	
Category E	An error occurred that may resulted in temporary harm to the patient and required intervention
Category F	An error occurred that may have contributed to or resulted in temporary harm to the patient and required initial or prolonged hospitalization
Category G	An error occurred that resulted in permanent patient harm
Category H	An error occurred that required intervention necessary to sustain life
Error, Death	
Category I	An error occurred that may have contributed to or resulted in the patient's death

found most reports to be accurate and reflect true errors.

While reported medication errors cannot be used to determine error rates^{31,32} they are valuable for providing information that can be used to improve CPOE-CDS systems and the work processes surrounding their use. This paper reviews changes in reported medication errors before and after CPOE implementation in a university hospital and describes changes made as a result of monitoring errors.

Methods

A descriptive study of reported medication errors before and after implementation of CPOE within two groups was conducted at the University of Kentucky Hospital, a 473-bed facility. The study was approved by the University of Kentucky's institutional review board. The system was the Sunrise Clinical Manager from Eclipsys, version 3.04, and included patient lists, CPOE to 22 departments, and basic CDS, including allergy checking, drug-food, and drug-drug interactions. Interfaces included incoming patient demographics and bidirectional interfaces with laboratory, pathology, and radiology for textual results. A unidirectional orders interface to the pharmacy system (Mediware WORx) was activated four months after the beginning of this study.

The CPOE-CDS system was implemented via an incremental rollout strategy. This represented the first major step toward an electronic medical record at the hospital. Two clusters of units and services were implemented approxi-

mately one month apart in September and October of 2004. Six acute care and three intensive care units were included, incorporating the services of neurosurgery, neurology, urology, nephrology, solid organ transplant, cardiology, and cardiothoracic surgery.

Data for the study was obtained from the hospital's voluntary Web-based reporting system for medication errors. The system is a combination of incident reports via the Web and solicited reports as pharmacists interact with direct patient care providers. The report includes incident date and time, report date, location, medical service, gender, type of error, medication(s) involved, severity (level of harm), who was notified of the error, reporting person, and a free-text field for a description of the incident.

Clinicians are encouraged to report medication errors in a non-punitive environment. The hospital uses the following definition for a

medication error and harm by the National Coordinating Council for Medication Error Reporting and Prevention: "A medication error is any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the healthcare professional, patient, or consumer. Such events may be related to professional practice, healthcare products, procedures, and systems, including prescribing; order communication; product labeling, packaging, and nomenclature; compounding; dispensing; distribution; administration; education; monitoring; and use."³⁸

"By detecting errors or potential errors, prevention strategies can be developed."

Harm is a term used to describe the impact of the medication error on the patient. Harm is defined as, "Impairment of the physical, emotional, or psychological function or structure of the body or pain resulting there from."³⁸ The Medication Error Category Index³⁸ that categorizes errors based on severity of patient outcome is part of the error report form. It contains nine categories, A through I, ranging from identification of medication errors that had the potential for harm, to errors that may have resulted in

Figure 2. Level of harm pre and post CPOE for reported medication errors per 100 patients

NCC MERP Index		Pre CPOE Reported errors/100 patients	Post CPOE Reported errors/100 patients
A	No error	1.06	2.75
B – D	Error, no harm	4.04	7.93
E – H	Error, harm	.41	.07
I	Error, Death	0	0

the patient's death (see Figure 1).

At the University of Kentucky Hospital, after a clinician submitted an error, an Access database received the error and automatically routed an e-mail of the information to the pharmacy director, associate director of pharmacy, nurse manager of the unit where the event occurred, and nursing services quality care coordinator. After implementation of CPOE, the project leader was added to the recipient list to participate in this concurrent review.

The project leader and pharmacy directors closely reviewed each error to confirm severity coding and to identify errors that could potentially be related to CPOE implementation. Virtual e-mail discussions were used between pharmacy, nursing, physicians, and project team members to discuss, recommend, and confirm actions taken.

In addition to the concurrent review, a retrospective review was conducted to identify changes and trends. Pre-activation data was collected for twelve months preceding each area's activation date. Post-activation medication error data was collected for six months from those units and services, beginning in October and November 2004. Because of the comparison of twelve months pre-data to six months post-data, percentages are reported. Data on the number of patients and doses was obtained from the pharmacy system.

The project director removed any data from the database that fell outside of the study parameters. For medication errors occurring after implementation of CPOE, additional fields were added to the database—CPOE-related error, potential cause of error associated with CPOE, and actions taken. For example, if an error was related to a nurse selecting the wrong drug from the medication administration cabinet or a nurse giving a medication to the wrong patient, it was not coded as a CPOE-related error. If the error was, for example, the physician selecting the wrong patient in the computer or pharmacists entering wrong frequency into the pharmacy system, it was coded as CPOE-related. All coding was confirmed by the associate director of pharmacy.

Results

For the twelve months prior to CPOE implementation, 135 errors were reported in the sample population and 164 for the six months post-CPOE. To account for variations in patient volume and the number of prescribed medication doses, rates were determined for both study phases. The reported error rate per patient pre-CPOE was 5 percent

(.0551) and per prescribed dose 0.12 percent (.0012). For the six months immediately after CPOE implementation, the reported error rate per patient was 10.75 percent (.1075) and 0.25 percent (.0025) per dose.

The NCC MERP index was used to determine any change in levels of harm. For the one year pre-CPOE implementation, 19.3 percent were "no error" reports, 73.3 percent

were "error, no harm" reports, and 7.4 percent were "error, harm" reports. For the first six months post-CPOE, "no errors" were 25.6 percent, "error, no harm" represented 73.8 percent and "error, harm" was 0.6 percent. Figure 2 shows the rates based on patient volume, errors per 100 patients. Thus, data indicated that reporting of errors increased post-CPOE and the level of patient harm decreased.

CPOE-related errors. During the post-activation period, 164 errors were reported from the study areas. Of these, 117, or 71 percent, were considered CPOE-related. By level of harm, the percentage of CPOE-related errors to the total reported post-activation errors were 62 percent of the "no error," 74 percent of the "error, no harm," and 100 percent of the "error, harm."

The majority (79 percent) of the errors related to CPOE did not reach the patient (categories A and B). Less than one-fourth (21 percent) reached the patient (category C, D and E). There was only one reported error in category E and it was CPOE-related.

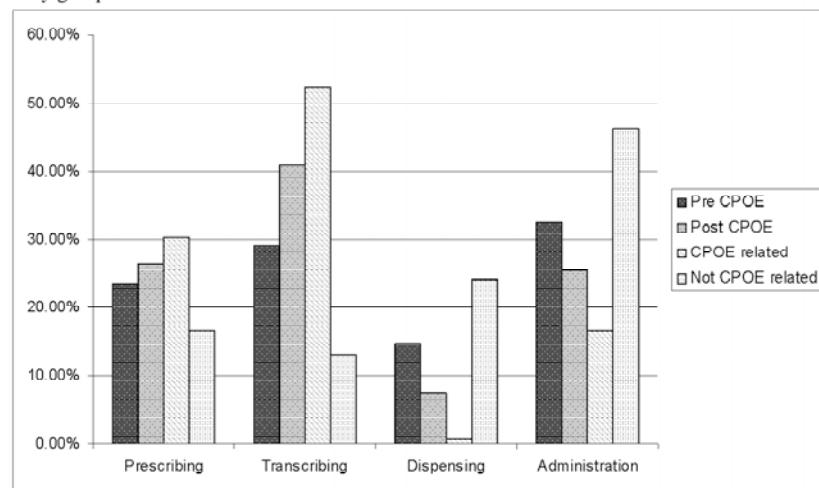
Within the medication administration cycle, there were more transcribing mistakes and fewer errors related to dispensing and administration (see Figure 3). The most common CPOE-related errors were related to transcribing, followed by prescribing and administration. In prescribing, the most common error was inappropriate medication, followed by duplicate orders, wrong patient, and wrong dose. Errors of illegibility were eliminated. For transcription, the most common error was order not entered by pharmacy, followed by entry of wrong dose, wrong medication, and wrong patient into the pharmacy system.

In administration, unauthorized dose (for example, order discontinued but medication still given) and omissions were the most common errors. The most prevalent non-CPOE related error was in the administration process. Frequently, errors reflect multiple slips within the medication cycle.

Contributing causes. To assist in the development of safety interventions, contributing causes were identified for reported errors. The most common contributing cause was noncompliance to policy and procedure, identified in 40 percent of errors. For example, a previous order may not have been discontinued when a new dose change was entered, resulting in two active orders for the same medication with different dosages.

The next most common contributing cause was computer entry errors, seen in 25 percent of mistakes. One example

Figure 3. The percentage of reported errors by medication administration cycle for each study group



was if a medication order was placed on the wrong patient. The next most common error was initial load errors (19 percent). During entry of all current medications on the day of activation, multiple category B errors were made. An example was a written order for sliding scale calcium gluconate "PRN," which was entered into the CPOE system as "scheduled."

There were also computer design issues that contributed to 10 percent of errors. An example was when the pharmacist received two printouts for methylprednisolone 500 mg

IV. He assumed it was a duplicate order, but when he reviewed the CPOE system, he saw that one order was for today and the other was for tomorrow. The dates for these orders were not visible on the order printout from the CPOE system.

Concurrent and retrospective review of reported errors post-CPOE provided input into system changes and alterations to CPOE-CDS deployment plans. The most significant was the decision to implement the interface between the CPOE system and the pharmacy system before CPOE was deployed to any additional areas.

System safety interventions were classified into the following seven categories:

Force—eliminate options or force required actions.

Simplify—reduce steps and the number of options.

Differentiate—enhance the differences between items.

Standardize—set up systems to guide practitioners for consistent communication and decision-making.

Redundancy—provide check systems and backups.

Educate—provide information to the practitioner at the point of decision-making.

Notify—tell the practitioner of an event when certain conditions are met.

Figure 4 contains examples of system safety interventions that have been implemented between go live and the present. Other common actions initiated in the initial six months related to changes and clarification in workflow, such as what should be done when a patient is transferred from a unit running on CPOE to a non-CPOE unit or visa versa. Many hours were spent re-educating through 24-hour clinician support, and educational materials were provided in newsletters, unit notebooks, and on the Web. Monitoring reported medication errors continues, along with system revisions and development of future recommendations.

Comments

In this review, the number of reported medication errors increased

Limit user security privileges	Prescribing privileges	Chemotherapy medications are restricted oncology attendings.	Restrict
Medical logic module	Dose Range checking	Dose range checking alerts fire when limit is exceeded for selected high risk medications.	Notify
	Review of Active Orders at Transfer	Transfer MLM triggers a prompt that forces practitioners to review all active orders at the point of transfer order. MLM allows for active orders to automatically be acted upon.	Force
	Allergy prompt	Allergy entry form displays when allergies have not been entered during order process prompting practitioner to enter the allergy.	Force
Order sets	Evidence based orders sets are created to include medication, nursing, diet, lab orders related to specific disease state. Orders within order sets are defaulted to standardize dose, frequency, etc.	Order sets are developed by each service for common diagnosis and procedures.	Standardize
		Created pediatric insulin order set to handle different workflow of dispensed vial vs. floor stock	Standardize
		Admission order sets include a nursing order for vaccine evaluation.	Standardize
Report Generation	Identify patients requiring clinical intervention	Heparin drip order sets include order for q6h monitoring of pTT.	Standardize
		Reports are generated to identify patients with specific disease states that require intervention (e.g., incomplete vaccine evaluation and pneumonia diagnosis)	Notify
TallMAN lettering	TallMAN lettering -Use upper case lettering to highlight portions of name	Tallman lettering added for Tiagabine, Tizanidine, Hydrochlorothiazide, Hydroxychloroquine, Quinine, Quinidine	Differentiate

Figure 4.

in the first six months following CPOE implementation. Battles and Lilford³¹ state that one of the goals of a patient safety program is to increase reporting rates to decrease the risk of harm. By detecting errors or potential errors, prevention strategies can be developed.

While we would like to think that education efforts contributed to the increased number of error reports, there are several reasons that may have influenced this change. For example clinicians may be more likely to report an error that they believe is aimed at a computer system vs. an individual practitioner. Clinicians are increasingly using the computer and may have easier access to the online reporting form. The increased reports did provide valuable feedback to the implementation team.

As cautioned by others,²⁰⁻²⁴ when CPOE is implemented, new errors were uncovered in the review of the reported medication errors. As reported by Spencer et al,²³ a separate pharmacy system requiring pharmacists to re-enter the order into the pharmacy system resulted in transcription errors. Errors resulted from some fields not being visible on the printout or typing errors. Most of these errors were resolved when orders were interfaced between the two systems. Another transcription error occurred between CPOE and the paper medication administration record. Because CPOE does not generate the administration record, nurses must transcribe the order onto it. If this does not occur, delays in implementation of the order result. An electronic medication administration record is planned to eliminate the need for this manual process.

Many error reports were related to duplicate order entries. In the paper world, if duplicate therapy was ordered, the pharmacist clarified the duplication and entered the appropriate order into the pharmacy system. The current CPOE design does not prevent duplicate therapy, resulting in errors of duplication. Training prescribers to remember to discontinue orders when a new dose was entered was not effective. An exact match drug-dose duplicate alert was implemented. In the next upgrade, additional duplicate checking functionality will be added.

Selection errors also were identified. Wrong chart selection in the paper process translated into wrong patient selection in CPOE. Illegible writing was eliminated but was replaced with selection errors from drop down lists. The use of a mouse with a scroll wheel can inadvertently change the item selected in CPOE. A replacement mouse was distributed to all clinical areas. Application changes and recommendations to the vendor have been made to minimize user-selection errors.

Another contributor to errors was the incremental rollout of CPOE. Patients were transferred from active CPOE areas to areas not using CPOE and visa versa. Errors arose over the confusion about which process to use when a patient's destination was unknown. Nursing leadership strongly recommended increasing the pace of CPOE deployment.

Additional activation support resources were obtained so more units could be activated simultaneously. The procedure for how to handle orders upon patient transfer were revised and widely communicated. There was much less confusion with patient transfers after all inpatient units were live with CPOE.

As the types of errors have changed, there is a need to update the medication error report form to keep the process user-friendly and reflective of the CPOE process. Converting choices to reflect "wrong chart" to "wrong chart-patient" and adding a mechanism to enable the reporter to indicate CPOE contributed to the error are some examples. Efforts will continue to promote reporting of errors, unsafe situations, and potential solutions.

Ongoing monitoring of medication errors requires significant resources. Having a pharmacist as part of the implementation team is critical. Adding time for medication error evaluation and implementation of recommended changes needs to be included in project resource planning. There are more opportunities for medication error prevention with implementation of CPOE and CDS. Additional studies are planned to include all activated inpatient CPOE areas and lengthen the review period to one year post-activation.

This study had several limitations. First, this study was not designed to measure the effectiveness of CPOE in decreasing medication errors. A basic assumption is that the universe of medication errors is currently unknown. Any conclusion that medication errors have been reduced is an error in and of itself. The trending of data is meant to be only informational. Also, six months is too short of an interval to determine the long-term effects of this major change. There was no attempt to control for any variables such as incremental deployment of units and services, various levels of staff CPOE competency, the influence of frequent policy-procedure and system changes, the impact of 80-hour resident work weeks, staffing levels-workload or seasonal fluctuations. Because of numerous differences in the site, system, and implementation strategy, these results are not generalizable.

In conclusion, implementation of CPOE is a major institutional change fraught with variability. Monitoring reported medication errors is a strategy that can be successfully employed to provide constructive feedback for the never-ending evolution of a safer care-delivery system for hospitalized patients.

Acknowledgment

Special thanks to Gary Coutts, RPh, clinical systems coordinator, for his persistence and creativity in system design changes.

About the Authors

Victoria M. Bradley, RN, DNP, FHMSS, is director of patient information at University of Kentucky HealthCare

and leads the implementation of an enterprise clinical information system. She is a current HIMSS board member and vice chair elect for 2007.

Carol L. Steltenkamp, MD, MBA, is the chief medical informatics officer for University of Kentucky HealthCare.

Dr. Steltenkamp is an active clinician and is co-chair of the Kentucky eHealth Board.

Kimberley B. Hite, MS, PharmD, is associate director of medication safety and decentral pharmacy services at University of Kentucky HealthCare.

References

1. Institute of Medicine, *Patient Safety: Achieving a New Standard of Care*. 2004, The National Academies Press: Washington D.C.
2. Ash, J.S., P.Z. Stavri and G.J. Kuperman, A Consensus Statement on Considerations for a Successful CPOE Implementation. *Journal of the American Medical Informatics Association*, 2003.
3. Osheroff, J.A., et al., *Improving Outcomes with Clinical Decision Support: An Implementer's Guide*. 2005, Chicago: Health Information and Management Systems Society.
4. Bates, D.W., et al., Relationship Between Medication Errors and Adverse Drug Events. *Journal of General Internal Medicine*, 1995. 10(4): p. 199-205.
5. Bond, C.A., C.L. Raehl, and T. Franke, Medication Errors in United States Hospitals. *Pharmacotherapy*, 2001. 21(9): p. 1023-36.
6. LaPointe, N.M.A. and J.G. Jollis, Medication Errors in Hospitalized Cardiovascular Patients. *Archives of Internal Medicine*, 2003. 163(12): p. 1461-1466.
7. Bates, D.W., et al., Incidence of Adverse Drug Events and Potential Adverse Drug Events. Implications for Prevention. ADE Prevention Study Group. *Journal of American Medical Association*, 1995. 274(1): p. 29-34.
8. Rothschild, J., et al., The Critical Care Safety Study: The Incidence and Nature of Adverse Events and Serious Medical Errors in Intensive Care. *Critical Care Medicine*, 2005. 33(8): p. 1694-1700.
9. Lisby, M., L.P. Nielsen, and J. Mainz, Errors in the Medication Process: Frequency, Type and Potential Clinical Consequences. *International Journal for Quality in Health Care*, 2005. 17(1): p. 15-22.
10. Lesar, T.S., L. Briceland, and D.S. Stein, Factors Related to Errors in Medication Prescribing. *Journal of American Medical Association*, 1997. 277(4): p. 312-317.
11. Leape, L.L., et al., Pharmacist Participation on Physician Rounds and Adverse Drug Events in the Intensive Care Unit. *Journal of American Medical Association*, 1999. 282(3): p. 267-270.
12. Kelly, W., Potential Risks and Prevention, Part 1: Fatal Adverse Drug Events. *American Journal of Health System Pharmacists*, 2001. 58(14): p. 1317-1324.
13. Rothschild, J.M., et al., Analysis of Medication-Related Malpractice Claims: Causes, Preventability and Costs. *Archive of Internal Medicine*, 2002. 162(21): p. 2414-2420.
14. Winterstein, A., et al., Identifying Clinically Significant Preventable Adverse Drug Events through a Hospital's Database of Adverse Drug Reaction Reports. *American Journal of Health System Pharmacists*, 2002. 59(18): p. 1742-1749.
15. Kucukarslan, S.N., et al., Pharmacists on Rounding Teams Reduce Preventable Adverse Drug Events in Hospital General Medicine Units. *Archive of Internal Medicine*, 2003. 163(17): p. 2014-2018.
16. Bobb, A., et al., The Epidemiology of Prescribing Errors: The Potential Impact of Computerized Prescriber Order Entry. *Archives of Internal Medicine*, 2004. 164(7): p. 785-792.
17. Forster, A.J., R.B. Halil, and M.G. Tierney, Pharmacist Surveillance of Adverse Drug Events. *American Journal of Health System Pharmacists*, 2004. 61(14): p. 1466-1472.
18. Nebeker, J.R., et al., High Rates of Adverse Drug Events in a Highly Computerized Hospital. *Archive of Internal Medicine*, 2005. 165(10): p. 1111-1116.
19. Chaudhry, B., et al., Systematic Review: Impact of Health Information Technology on Quality, Efficiency and Costs of Medical Care. *Annals of Internal Medicine*, 2006. 144(10): p. 742-752.
20. Ash, J.S., M. Berg, and E. Coiera, Some Unintended Consequences of Information Technology in Health Care: The Nature of Patient Care Information System-related Errors. *Journal of the American Medical Informatics Association*, 2004. 11(2): p. 104-12.
21. Koppel, R., et al., Role of Computerized Physician Order Entry Systems in Facilitating Medication Errors. *Journal of American Medical Association*, 2005. 293(10): p. 1197-1203.
22. Han, Y.Y., et al., Unexpected Increased Mortality After Implementation of a Commercially Sold Computerized Physician Order Entry System. *Pediatrics*, 2005. 116(6): p. 1506-1512.
23. Spencer, D., et al., Effect of a Computerized Prescriber Order Entry System on Reported Medication Errors. *American Journal of Health-System Pharmacy*, 2005. 62: p. 416-419.
24. Weiner, M., et al., Contrasting Views of Physicians and Nurses about an Inpatient Computer-based Provider Order Entry System. *Journal of American Medical Informatics Association*, 1999. 6(234-244).
25. George, D. and N. Austin-Bishop, Error Rates for Computerized Order Entry by Physicians vs. Non-physicians. *American Journal of Health System Pharmacists*, 2003. 60(21): p. 2250-2252.

FOCUS: Patient Safety

26. Hicks, R.W., et al., MEDMARXSM 5th Anniversary Data Report: A Chartbook of 2003 Findings and Trends 1999-2003. 2004, USP Center for the Advancement of Patient Safety: Rockville, MD. p. 1-123.
27. Kim, G.R., et al., Error Reduction in Pediatric Chemotherapy: Computerized Order Entry and Failure Modes and Effects Analysis. *Archives of Pediatrics & Adolescent Medicine*, 2006. 160(5): p. 495-498.
28. Battles, J.B. and M.A. Keyes, Technology and Patient Safety: A Two-edged Sword. *Biomedical Instrumentation and Technology*, 2002. 36(2): p. 84-8.
29. VanGeest, J.B. and D.S. Cummins, *Educational Needs Assessment for Improving Patient Safety: Results of a National Study of Physicians and Nurses*. 2003, National Patient Safety Foundation: MacLean, Virginia. p. 1-28.
30. Murff, H., et al., Detecting Adverse Events for Patient Safety Research: A Review of Current Methodologies. *Journal of Biomedical Informatics*, 2003. 36: p. 131-143.
31. Battles, J.B. and R.J. Lilford, Organizing Patient Safety Research to Identify Risks and Hazards. *Quality and Safety in Health Care*, 2003. 12(90002): p. 2ii-7.
32. National Coordinating Council for Medication Error Reporting and Prevention. Use of Medication Error Rates to Compare Health Care Organizations is of no Value. 2002 [cited 2005 May 27]; June 11:[Available from: <http://www.nccmerp.org/council/council2002-06-11.html>.
33. Dixon, J.F., *Going Paperless with Custom-built Web-based Patient Occurrence Reporting*. Joint Commission Journal on Quality Improvement, 2002. 28(7): p. 387-395.
34. Hatfield, E., et al., Real-time Reporting Drives the Race toward Zero. *Nursing Administration Quarterly*, 2005. 29(1): p. 24-31.
35. Rudman, W.J., et al. The Impact of a Web-based Reporting System on the Collection of Medication Error Occurrence Data. 2005 Feb (cited 2006 AHRQ Publication Nos. 050021 (1-4).); 3:[Available from: <http://www.ahrq.gov/qual/advances/>.
36. Zhan, C., et al., Potential Benefits and Problems with Computerized Prescriber Order Entry: Analysis of a Voluntary Medication Error-reporting Database. *American Journal of Health-System Pharmacy*, 2006. 63(4): p. 353-358.
37. Miller, M.R., J.S. Clark and C.U. Lehmann, Computer Based Medication Error Reporting: Insights and Implications. *Quality and Safety in Health Care*, 2006. 15(3): p. 208-213.
38. National Coordinating Council for Medication Error Reporting and Prevention. National Coordinating Council for Medication Error Reporting and Prevention. 2004 [cited 2004 December 10]; Available from: <http://www.nccmerp.org/>.

Nursing and Knowledge Work: Issues Regarding Workload Measurement and the Informatics Nurse Specialist

Jason Windsor, MS, MHA, RN, Major, U.S. Army Nurse Corps

A B S T R A C T

The profession of nursing has been faced with questions concerning workload measurement for decades, and those concerns continue to be relevant today. Traditionally, nursing has turned to time-motion studies to study this, but there is a debate about how relevant time-motion studies are to the profession of nursing when it is viewed as knowledge work. Healthcare workers, including the nursing profession, may be the single biggest group of knowledge workers. Knowledge workers today represent a significantly different workforce than are the workers of the past. Informatics, as a specialty, is relatively new to the nursing profession and continually evolving. As more nurses enter informatics and function as informatics nurse specialists, they will continue to be in the group of knowledge workers whose observable input and output is difficult to measure. Today's healthcare leaders, managers, and administrators need to identify an appropriate method of workload measurement for knowledge workers.

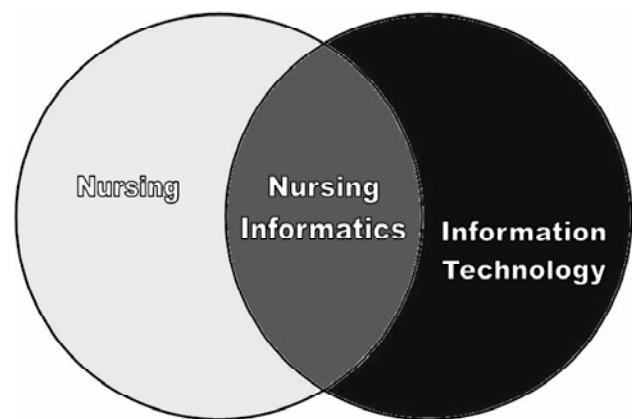
K E Y W O R D S

- Nursing ■ Knowledge work ■ Informatics ■ Workload management

The profession of nursing has been faced with questions concerning workload measurement for decades. The need to measure nursing care systematically in terms of patient care activities has been identified internationally.¹

In the profession of nursing, the specialty of informatics is continually evolving. The American Nurses Association

officially recognized this field as a nursing specialty in 1992 and defines nursing informatics as "a specialty that integrates nursing science, computer science, and information science to manage and communicate data, information, and knowledge in nursing practice".² Few differences exist in the goals of nursing and nursing informatics. The core service of

**Figure 1.**

nursing is patient care, and nursing informatics exists to support the highest possible quality of care.³

Nurse informaticians practice in a variety of settings: traditional healthcare organizations, vendor communities, educational or private businesses, and consulting firms.^{4,5} In fact, executives increasingly value clinically-driven technology as a way to improve patient care, while cutting costs.⁶

As more nurses enter the field of nursing informatics and function as an informatics nurse specialist, or INS, they will find changes in reporting structures. The hierarchical leadership may range from nursing to information technology to

corporate and financial executives. With the likelihood that an INS will work for someone who does not have broad knowledge of the nursing process, concerns may arise that the manager does not understand nursing practice and how it applies to the continuum of quality patient care. In addition, other questions can surface regarding the INS role and responsibilities while working in a position within or outside of traditional nursing.

The primary issue is determining how management measures the workload of an INS. While considering this question, it is necessary to identify where and how nursing coexists in the information technology field (see Figure 1). When searching for pertinent and relevant references to answer this question, it became apparent that this topic has not been approached from an informatics viewpoint. Therefore, it was necessary to expand on the relationship of how nursing informatics coexists

with nursing and IT. Examination revealed the need to further define IT and how it relates to an INS. Through this, the term "knowledge work" became the common theme that encompassed both IT and the nursing profession (see Figure 2).

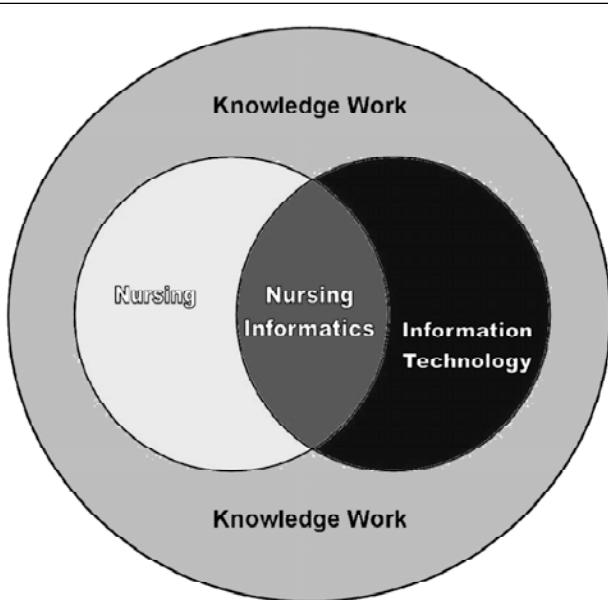
Beginning the Search

A comprehensive search of the relevant literature was performed using electronic databases, such as those of the Association for Computing Machinery, Academic Search Premier, Business Source Premier, CINAHL, Cochrane, EBSCO host, INSPEC, Lexis Nexis Academic, MEDLINE, and Science Direct; Internet search engines, such as Google and Yahoo!; as well as personal and professional contacts.

Keywords used in the literature search focused on the profession of nursing, such as nursing, time and motion study; IT, for example, engineering, system analyst, and operation research; nursing informatics, such as informatics, clinical analyst, role, and competencies; and a combination of all fields, such as workload, staffing, administration, management, productivity, manpower, personnel, and knowledge work. The results are presented as an overview covering the areas of nursing, information technology, and knowledge work.

Nursing

The profession of nursing has been faced with questions concerning workload measurement for decades, and it continues to be relevant today.⁷ The tremendous focus from media and government on safety in nursing highlights the need for accurate and objective data to assess nursing workload resources.⁸

**Figure 2.**

Traditionally, nursing has turned to time-motion studies to answer questions regarding the measurement of job performance. However, many question how relevant time-motion studies are to the profession of nursing when it is viewed as knowledge work. In effect, much of the literature from time-motion studies lacks evidence linking measures of nursing workload to improved patient outcomes.⁹

Developed by Frederick Taylor at the turn of the 20th century, the observational time study was used to increase the efficiency of industrial production. During the same time period, Frank Gilbreth and his wife were conducting similar experiments that focused on motion. In conjunction, time-motion studies seek to determine the average time for a job by using observers to record exactly how much time is being devoted to a particular task, taking into consideration the process and actions needed to complete the task.¹⁰

"The primary issue is determining how management measures the workload of an INS."

Personnel can be an essential issue to any business, especially nursing, in the face of staffing shortages, which have been experienced in the past and which are being predicted for the future. Assuming that one healthcare management goal is to improve the level of service and, ultimately, patient outcomes, qualitative, and quantitative workload metrics derived from such studies provide a good indication of the amount and kind of service rendered. Therefore, the measurement of workload also can provide information to justify personnel and resource levels required to improve the delivery of patient care.

In addition to time-motion studies, techniques such as self-reporting (in the form of self-administered timesheets), worker sampling, worker recall involving provider interviews, and patient-flow analysis are used within the healthcare setting to measure and analyze clinicians' use of time.⁷ However, many of these techniques have not been validated. The literature supports this claim and further indicates that few studies have compared time-motion studies with other methods. One study comparing time-motion with different workload measurement techniques indicates that high costs and observer-induced bias are limitations that influence administrators away from time-motion studies and toward some of the other approaches.¹¹ Conversely, accuracy and consistency of all other methods were lower when compared with time-motion studies.

Some contend that the traditional methods of time-motion studies are no longer appropriate in healthcare settings.^{7,8,12} More than a century of time-motion study use has indicated that although the limitations may be

minimized, they can never be eliminated when dealing with human resources.¹¹ Management must face these issues when considering workload measurement options of the INS.

Information Technology

More intense searching was required in finding resources related to workload measurement in the IT field. Although an abundant amount of information was available regarding companies and their issues with specific job descriptions, such as engineers and system analysts, very little was found on how IT administrators measure workload.

Resources that were available focused on fuzzy logic and long mathematic algorithms designed around prediction models.¹³ Other resources focused on issues such as functional job analysis, performance monitoring, performance forecasting, and reliability assessment, but they failed to offer a consistent measurement model.¹⁴ Two studies discussed methodologies of population ratios and constant comparison, both claiming to have a grounded theory framework.¹⁵ Many of the issues regarding workload measurement and the various methods were dealt with by falling back on the same time-motion techniques that have been the staple.

However, it also was acknowledged that managers in these fields tend to reach their level in administration based on their skill and knowledge.¹⁶ Therefore, many managers simply used intuitive reasoning and the situational theory of management to determine the appropriate leadership style to use in a given situation—for example, relating the task at hand to the skill capabilities of the workers.^{9,17} In essence, intuition dictated staff allocations, and adjustments were made as needed in specific instances.

Knowledge Work

Peter Drucker coined the phrase "knowledge worker" more than 30 years ago to describe someone who relies on knowledge rather than skills to perform a job.¹⁸

Drucker proposed that a large number of knowledge workers do both knowledge work and manual work. Terming these workers "technologists," Drucker indicates that they may be the single biggest group of knowledge workers. Healthcare workers, including those in the nursing profession, are covered in this definition.

For example, a nurse preparing for a cardiac output measurement via a cardiac catheter spends significant time in training and patient assessment before performing the procedure, which requires a great deal of specialized knowledge. In addition, complications may occur during the procedure that demand a great deal of advanced theoretical knowledge and judgment. However, the procedure itself is manual work.

In the past, manual laborers—frequently called blue-collar workers—comprised most of the workforce. Taylor's

time-motion study was modeled for these workers to improve productivity. But today's workforce has changed. In the U.S., only about 20 percent of workers do manual labor, while as many as 80 percent of the total workforce, depending on the job classification, are considered knowledge workers.^{19,20}

According to Drucker, managing workers and measuring workload is no longer covered by the same standards. Today's knowledge workers are part of a workforce that is significantly different than those of the past, when manual work was clear and well-defined.²¹ Scientific management dramatically improved the productivity of manual workers, in part by measuring work and then reorganizing the work. In managing knowledge workers and attempting to apply an approach that is similar to that which was so markedly successful in managing the blue-collar workforce, Drucker²² noted that you cannot manage what you cannot measure.

Productivity remains a concept most easily applied to industrial work vs. the nursing profession and healthcare. Business is ruled by concrete assets, such as physical resources and labor measured by product output. Industry continues to count physical products (production) and time spent (labor) as the basis of business value. However, this is not as relevant in healthcare. Often, information or knowledge itself is the output generating improved patient outcome. In the nursing profession and in nursing informatics in particular, there is limited means of recording and measuring outputs, so knowledge productivity is poorly defined at best.

Simply stated, the measurement of productivity is the ratio of output to input consumed to generate that output. While it is relatively easy to identify outputs (or patient outcomes in healthcare), it is considerably more difficult to combine and appropriately weigh the various inputs used by knowledge workers.²³

Executives in technically-based companies continually find management of manpower resources a primary challenge.²⁴ Workload measurement difficulties exist because such companies rely on the unquantifiable output of knowledge and capabilities of their professional personnel.²⁵ Even 20 years ago, the knowledge worker was the highest labor cost component in the petroleum, chemical, aerospace, and healthcare industries.²⁶

While workload measurement, in the form of productivity, has been studied for more than a century, knowledge work now dominates the workforce, and researchers have only recently tried to measure the productivity of knowledge workers.²⁷ Many current "knowledge" managers dislike older, traditional, measurement techniques based on time-motion study principles.²⁸ Earlier applications of productivity measurement addressed simple, repetitive jobs of short duration, such as those performed on assembly lines. However, time-motion study techniques are not well-suited for knowledge work because such work is not repetitive,

but discretionary, transparent and difficult to identify or control.^{29,30}

According to some research, the effect time-motion methods have on knowledge work is virtually the opposite of what is desired—rather than improving performance, these methods often hinder it.²⁰ It appears that productivity, for the majority of today's workforce, cannot be measured by traditional methods, and alternatives must be considered.

Considerations

On Feb. 2, 2004, a Microsoft-guided Information Work Productivity Council convened to discuss what is known about the contributions of information technologies to productivity.³¹ The council consists of leaders in the IT industry such as Microsoft, Xerox, Cisco Systems, Hewlett Packard, and Intel.³² The goal of the coalition, which is based at MIT's Sloan School of Management, is to develop data sets and methodologies for new ways to measure productivity.³³

Drucker proposes six factors when considering workload measurement for knowledge workers—identifying the task, assigning responsibility for productivity to the individual knowledge worker, expecting continuing innovation by the knowledge worker, allowing for continuous learning and teaching, focusing on the matter of quality versus quantity, and realizing the knowledge worker is an asset rather than a cost.¹⁹

"...evidence supports the idea that knowledge worker productivity is important, but few have a good definition of what exactly knowledge work is."

Another approach is what Pepitone²⁰ terms "humaneering," which is drawn from many disciplines of science to deal with the complexities of human nature as they affect work performance and productivity. The humaneering approach relies on four principles—aligning work design to enterprise objectives, designing work at the role or job level, improving work designs through joint optimization, which means considering job roles as well as the inherent needs of the people performing them, and aligning human resource practices to support work design.

Throughout the literature, evidence supports the idea that knowledge worker productivity is important, but few have a good definition of what exactly knowledge work is.^{18,21,26,27,30} Today's healthcare leaders, managers, and administration executives need to identify an appropriate method of workload measurement for knowledge workers.

For the INS, Drucker's or Pepitone's processes may be applied through proper identification of the core competencies for informatics roles as indicated by the ANA. Then, the next step is to map out each role with its competencies to better enable effective management techniques in workload measurement.³⁴

Informatics Nurse Specialists, with the knowledge of nursing theory and information technology, can be essential in forging the relationship between nursing and healthcare and IT when lay terminology and colloquialisms differ between professions or specialties. However, the INS will continue to be in the group of knowledge workers whose observable input and output is difficult to measure.

Notes

Special acknowledgment and consideration is expressed to Dr. Kathleen Charters and Dr. Brian Gugerty for their assistance and guidance with the compilation of this manuscript. The views expressed in this article are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.

About the Author

Major Jason Windsor, MS, MHA, RN, is currently on active duty in the Army Nurse Corps serving as the Chief of Outpatient Clinical Systems and Training at Tripler Army Medical Center in Honolulu, Hawaii.

References

1. Goossen WT, Epping PJ, Van den Heuvel WJ, Feuth T, Frederiks CM, Hasman A. Development of the nursing minimum data set for the Netherlands: identification of categories and items. *Journal of Advanced Nursing*. 2000;31:536-547.
2. American Nurses Association. *Scope and Standards of Nursing Informatics Practice*. Washington, DC: ANA; 2002.
3. Turner D. Defining Nurses' Role in Health Informatics. *Canadian Nurse*. 2002;98(7):8-10.
4. Gibson IJ. Crossing the Great Divide: The Role of the Nurse Informaticist. Healthcare Information and Management Systems Society Web Site. 2002. Available at: <http://www.himss.org/content/files/proceedings/2002/sessions/slides/sess1070.pdf>. Accessed March 24, 2004.
5. Meadows G. Nursing Informatics: An Evolving Specialty. *Nursing Economics*. 2002;20:300-301.
6. Simpson RL. Mapping an IT Career: The Future of Nursing. *Nursing Administration Quarterly*. Winter 2001:80-85.
7. Bratt JH, Foreit J, Chen P, West C, Janowitz B, De Vargas T. A Comparison of Four Approaches for Measuring Clinician Time Use. *Health Policy and Planning*. 1999;14:374-381.
8. Adams-Wendling L. Clocking Care Hours with Workload Measurement Tools. *Nursing Management*. 2003:35-39.
9. O'Brien A, Abas M, Christensen J, et al. Nursing Workload Measurement in Acute Mental Health Inpatient Units. Health Research Council of New Zealand Web Site. 2002. Available at: <http://www.hrc.govt.nz/assets/pdfs/publications/mhqp-nursing.pdf>. Accessed March 23, 2004.
10. Stevens S. Time Study Prompts New HR Efficiencies. *Personnel Journal*. 1994;73(4):109-113.
11. Burke TA, McKee JR, Wilson HC, Donahue RM, Batenhorst AS, Pathak DS. A Comparison of Time and Motion and Self-reporting Methods of Work Measurement. *Journal of Nursing Administration*. 2000;30(3):118-125.
12. Walsh E. Get Results with Workload Measurement. *IT Solutions*. 2003:16-17.
13. Kolarik WJ, Woldstad JC, Lu S, Lu H. Human Performance Reliability: On-line Assessment Using Fuzzy Logic. *IIE Transactions*. 2004;36:457-467.
14. Green KC. The Continuing Challenge of Instructional Integration and User Support. The Campus Computing Project Web Site. 1999. Available at: <http://www.campuscomputing.net>. Accessed March 23, 2004.
15. King KL. Staffing Strategies for Higher Education Information Technology: a Study of Four Approaches. University of Oregon Web Site. 2000. Available at: <http://aim.uoregon.edu/pdfs/king2000.pdf>. Accessed March 23, 2004.
16. Moore FI. Guidelines for Task Analysis and Job Design: Functional Job Analysis. World Health Organization Web Site. 1999. Available at: http://hrhtoolkit.forumone.com/mstr_job_analysis/fja-00.html. Accessed March 23, 2004.
17. Mockler RJ. Situational Theory of Management. *Harvard Business Review*. 1971;49(3):146-155.
18. Drucker PF. Knowledge Worker Productivity: The Biggest Challenge. *California Management Review*. 1999;41(2):79-94.
19. Brigham A. Drucker on Managing Today's Employee, the Knowledge Worker. *The New Corporate University Review*. 2000;8(4):4-7.
20. Pepitone JE. A Case for Humaneering. *IIE Solutions*. 2002;34(5):39-44.
21. Covey SR. Knowledge Workers in the Dark. *Chief Learning Officer*. 2003;2(6):13.
22. Drucker PF. The New Productivity Challenge. *Harvard Business Review*. 1991;69(6):69-79.
23. Gregerman IB. Knowledge Worker Productivity Measurement through the Nominal Group Technique. *Industrial Management*. 1981;21(1):5-8.
24. Phelps ED, Gallagher W. Integrated Approach to Technical Staffing. *Harvard Business Review*. 1993;41(4):122-129.
25. Anderson EG. Managing the Impact of High Market Growth and Learning on Knowledge Worker Productivity and Service Quality. *European Journal of Operational Research*. 2000;134:508-524.
26. Helton BR. The "Best Work" Method of Knowledge Worker Assessment. *Information Management*. 1988;29:19-21.
27. Thomas BE, Baron JP. *Evaluating Knowledge Worker Productivity: Literature Review*. Champaign, IL: The Construction Engineering Research Laboratory; 1994.

28. McGee J. McGee's Musings. McGee's Musings Web Site. 2003. Available at: <http://www.mcgeesmusings.net>. Accessed March 18, 2004.
29. Honan TM, Ciotti VG. Information Technology: Doing More, Spending Less. *Healthcare Financial Management*. 2000;54(5):44-48.
30. Efimova L. The Knowledge Board. The European KM Community Web Site. 2003. Available at: <http://www.knowledgeboard.com>. Accessed March 24, 2004.
31. Strassmann PA. Measuring Information Work Productivity. *Computer World* [serial online]. 2004;issue 3. Available at: <http://www.computerworld.com/printhis/2004/0,4814,90543,00.html>. Accessed March 24, 2004.
32. Business Wire. Xerox Sponsors Information Work Productivity Center with Microsoft. Business Wire Web Site. 2003. Available at: <http://www.businesswire.com/webbox.bw.042203/231125800.htm>. Accessed March 23, 2004.
33. Greenemeier L. Productivity Yardstick. *Information Week*. 2003;937:24.
34. Jenkins S. Nurses' Responsibilities in the Implementation of Information Systems. In: Hannah KJ, Ball MJ, eds. *Nursing Informatics: Where Caring and Technology Meet*. New York: Springer-Verlag; 2002:207-223.

Congratulations CPHIMS Recipients!

Congratulations to the following individuals who have recently achieved the Certified Professional in Healthcare Information and Management Systems (CPHIMS) credential from April 1 through August 15, 2006. The CPHIMS designation is recognized throughout the industry as a national standard of industry knowledge. The designation is an indication that an individual has met the eligibility requirements and passed the CPHIMS examination, demonstrating to superiors, colleagues and potential employers their dedication to the industry, to high standards, and pride in their own professionalism.

Cheryl Almonrode—Columbus, OH
Melissa C. Ashmore—Arlington, TX
Pamela M. Austin—Johnson City, TN
Russell J. Bourke—Alexandria, VA
Margaret Broderick—Stamford, CT
Richard T. Broyer—Fredericksburg, VA
Nancy P. Bucceri—West Chester, PA
Brian Bullock—Belle Plaine, MN
Christopher S. Clark—Cincinnati, OH
Fritza P. Ewens—Manvel, TX
Rebecca L. Hood—Everett, WA
Peter Huang—Collegeville, PA
Christine A. Hudak—University Heights, OH
Leanne C. Huges-Mickel—Issaquah, WA

Mark A. Jahn—Minneapolis, MN
Eric J. Johannesson—Hampton, NH
Justin E. Klaus—Plymouth Meeting, PA
Glenn G. Kotlan—Warrenville, IL
Donald J. Lyons—Pearland, TX
Barney Regen—Nashville, Tenn.
Joseph L. Ronzio—Fort Bragg, NC
Terri Lee Rosas-Nichols—Sacramento, CA
Carol Shade—Dayton, OH
Gene Shaw—Yuma, AZ
Shelley M. Smiser—Chicago, IL
Steven Smith—Voorheesville, NY
Kendall R. Stanley, Sr.—Saugerties, NY
Daniel M. Thelen—Yuma, AZ
Robert Young—Seaford, VA



CPHIMS Certification

JOIN THIS ELITE GROUP. Visit www.himss.org/getcertified to find out more about the CPHIMS certification program. To see a full listing of certificants visit http://www.himss.org/content/files/cphims_certificants.pdf.

Identification and Conceptualization of Nurse Super Users

Daniel P. Boffa, RN, MS; and Lawrence M. Pawola, PharmD, MBA

A B S T R A C T

The purpose of this study is to identify super users from the general nursing population of clinical information systems users. Q-methodology was employed to identify and categorize the viewpoints of the nurses toward the use of these systems. Four factors that represented different views regarding the use of clinical information systems were extracted.

This study identifies super users' perception and attitude toward the use of clinical information systems in the workplace. The current literature reflects a weak semantic structure for the term. Thus, the study assists with defining the term "super user." Healthcare organizations can use this information to identify individuals who have the ability and attitude to function as a super user. These individuals can be more accurately and efficiently extracted from a general registered nurse population to give them more extensive training and to strategically position them within clinical operations.

K E Y W O R D S

- Clinical information systems
- Super user
- Human behavior
- Education resources
- Help desk
- Information systems support
- Q-methodology

During the past several years, the healthcare industry has extensively increased efforts to implement and use clinical information systems. This was emphasized by the Institute of Medicine report in 2000, *To Err is Human*, that estimated that 98,000 Americans may be killed each year from medical errors they experience during hospitalizations.¹ There are more deaths in hospitals each year from medical errors than there are from vehicle accidents, breast cancer, and AIDS. As a result, most healthcare organizations have strategic

initiatives to increase the utilization of clinical information technologies.

While the industry is focused on clinical information systems, and current nursing computer users have developed a variety of skills to assist them in performing their work, there are still many users who lack experience with computers. Current nursing personnel who use clinical information systems have developed a larger technical skill set, but the casual or non-technically inclined user may not be

adapting well for anxiety-related reasons because of computer illiteracy or a lack of understanding or appreciation of how modern computer systems and technology may help with delivering patient care.²

This research study will focus on two groups of nursing users. One group will be clinical information systems users selected at random from a general nursing staff. The second group will be a comparison group of nursing super users identified by a clinical information system training team.

In the general population, adult workers have a variety of experiences in other related technical areas such as data entry, previous business experience, education or certificates in software applications that identify these computer users as being more technically skilled employees with particular value to the organization.³

Super users are typically identified as workers who have acquired sufficient skills to utilize modern day information systems applications. At times, these workers appear to know more about computer usage than the trainers themselves.⁴ These experienced users have the potential to advance into positions that facilitate the use of technical skills among their peers. With clinical information technology applications, experienced nursing users also can serve as resources and clinical technology mentors, extending their knowledge to inexperienced nursing computer users.

Super users have the ability to act as healthcare informatics resources that may reduce dependence on IT resources. If technically experienced nursing users have the ability to support and teach their skills, they can serve as clinical health informatics mentors, either directly on the patient care unit or within the IT support department. An identified super user who possesses the ability to mentor peers is an efficient and effective way to provide support in a provider's clinical environment.

An organization's IT support department frequently does not have the resources to provide adequate or timely support, and, as a result, it is often not effective in helping users. Nurses who are technically inexperienced often are informally and inefficiently paired with a peer mentor with the intent of helping them to become proficient with a particular computer application in a clinical working environment.⁵ This may work in the short-term to help the less experienced user, but it usually results in wide variations of computer use over time.

In the past, managers have been educated to perform advanced information system functions. "Health administrators were found to have a significantly higher training in computers, a higher frequency of use, and a higher level of skill for both applications in word processing and database use."⁶ The first clinical applications implemented in the healthcare industry were focused on communications and administration. Thus, most of the professional nursing staff did not need to be technologically competent other than for

only casual computer use. However, as the industry demands more clinically oriented information technologies, a greater emphasis is being placed on the technical skill set in recruiting and retaining nursing personnel.

Nursing leadership must evaluate the idea of having experienced users as super users or clinical information technology mentors. The industry has realized significant skill set shortages within information technology support departments for clinical information systems and has identified the need for more advanced computer users among clinicians. If a healthcare organization decides to implement a clinical system, nursing staff users must adapt, thus supporting the need to identify more technically experienced super users to mentor and facilitate the clinical information systems working environment.

"Super users have the ability to act as healthcare informatics resources that may reduce dependence on IT resources."

Super users can be used as an extension of training. After computer training is complete, super users are the local resources for regular users to go to with questions after the trainers have finished and are no longer available.⁷

There are a variety of ideas and attitudes that are involved in identifying nursing super users who can facilitate the adaptation of a clinical information system. The nursing user may or may not have adequate information systems experience. The experienced nursing user may or may not care about supporting the clinical information system to enhance the overall clinical working environment. The technically-experienced nursing user should but does not always enjoy mentoring and helping peers better use clinical applications.

Early identification of both the technically-experienced nursing users as well as the technically-inexperienced computer nursing users could facilitate a more thoroughly and effectively automated clinical working environment and alleviate the need for comprehensive technology support from outside the clinical work setting.⁸

The nursing super user may have several individual traits, including different technical skill sets and a predisposition to mentorship. If a particular user is experienced and believes that supporting the clinical working environment is beneficial to the organization, then they may have greater potential to be a qualified super user. By contrast, users who may be experienced but do not believe that supporting their peers is beneficial may not be appropriate choices for mentors or nursing super users. In fact, they may be detrimental to the employee, peers, and ultimately, to the organization.

Defining the Terms

A review of literature found that super user and the characteristics of the super user are poorly defined terms. There have been attempts to vaguely define the characteristics of super users, but tools to identify them have not been widely utilized.

Nilsen and Sein (2002) stated there is a technical subculture of users in the clinical environment known as super users, who take on the responsibility of tasks previously held by IT staff.⁹ Also, super users have emerged as small informal help desks on designated clinical units. These users are viewed as resource persons after IT training as well as for ongoing user support in their individual work environments.

If super users can be identified in the hiring process or at the initial phases of implementation, they can be groomed to support existing clinical information systems..."

Obviously, these informal super users emerge over time, but often they do not have adequate educational training or direction. As a result, the use of information systems becomes inconsistent throughout an organization because of the availability and level of utility or understanding of the informal super users. If these individuals could be identified early in their employment, they could receive supplemental training and direction to maximize the use of clinical information systems at a consistent level throughout the organization.

This research was conducted to show various clinical organizations that their own clinical personnel may or may not be appropriate super users of information systems among their peers. The methodology employed in the study is Q-methodology that utilizes a sort of statements (Q-sort). The result of the Q-sort can help identify ideal candidates as potential super users.

A recent study released by the Software Human Resource Council at The Education and The Innovation Symposium found that IT companies that embrace literacy skills training are the most effective ... companies with literacy strategies are more productive, agile, and are better equipped to move with the shifts in the marketplace."¹⁰ Knowledgeable and literate clinician computer users are becoming critical components to the success of every healthcare organization as the delivery of patient care evolves toward greater dependence on information technology.

Obviously, in light of the need to collect and manage critical data in the clinical arena as well as the complexity of modern software, it is crucial to identify experienced

computer users who possess the desire to become super users. They can take on the daily tasks that often have to be raised to management levels or communicated to technically-staffed departments, such as IT help desks.

If super users can be identified in the hiring process or at the initial phases of implementation, they can be groomed to support existing clinical information systems, and they may be able to transition into technical liaison capacities that will bridge the gap between clinical and technical departments.⁸ Super users can mentor peers and associates that are technically inexperienced and need real-time assistance. Also, they may drastically reduce the need for outside technical support departments.¹¹

The purpose of this research is to uncover the ideas held by registered nurses regarding the use of clinical information systems in their work settings. It also aims to identify clinical information system users who have the ability to accept increased responsibilities and become super users in the clinical operating environment. The researchers anticipate that the super users the project identifies will share one or more common ideas, characteristics, or factor arrays that will help identify future super users.

Research Method

Q-methodology is the statistical technique chosen for this study. This technique is a powerful tool used to analyze ideas, perceptions, and attitudes in an objective way. The major concern of Q-methodology is not to quantify how many people believe certain ideas, but to identify why and how they believe the way they do.

Psychologist-physicist William Stephenson first introduced Q-methodology in the 1930s. This technique combines qualitative and quantitative research to permit the systematic study of subjectivity. Q-methodology determines and identifies the range of ideas regarding a specific question under investigation while it segregates groups of individuals with similar subjective viewpoints.¹²

Q-methodology is an appropriate analysis tool because of the small sample size and the need to extract the most common ideas shared by a population. The qualitative analysis incorporated in the Q-methodology accommodates the extraction of the subjects' expressed attitudes, ideas, and characteristics. The use of the method enables factor analysis of the most commonly formulated opinions identified after data collection.¹³

Data analysis includes Pearson's correlation coefficient, factor analysis, and factor rotation. The correlation coefficient between two sorters indicates the extent to which their viewpoints are similarly expressed by their Q-sorts. The inter-correlation matrix of Q-sorts then is subjected to individual person factor analysis. The factor analysis procedure identifies groups of individuals with similar viewpoints.¹⁴ Factor rotation enables researchers to look at other possibilities for developing groups.

Four-Factor Matrix with an X Indicating a Defining Sort Loadings				
QSort	Super User	Computer Resistive	Reluctant User	Independent Clinician
	1	2	3	4
1 Regsort1	0.0022	0.0521	0.6304X	0.4947
2 Regsort2	0.7521X	0.0460	0.2942	-0.0298
3 Regsort3	0.7040X	0.0795	0.1341	0.2952
4 Regsort4	0.6276X	0.2298	0.2002	-0.4726
5 Regsort5	0.1024	0.1477	0.4365	0.6922X
6 Regsort6	0.7320X	0.0305	0.0208	0.2374
7 Regsort7	0.8344X	-0.0962	0.1894	-0.0309
8 Regsort8	0.7474X	0.0025	-0.1575	0.1426
9 Regsort9	0.9013X	0.1905	-0.0223	-0.0316
10 Rgsort10	0.6837X	0.2675	-0.0827	0.3923
11 Rgsort11	0.3145	0.6511X	0.0366	0.2011
12 Rgsort12	0.3774	0.5639X	0.3932	0.0437
13 Rgsort13	0.8595X	0.1035	-0.0954	0.1178
14 Rgsort14	0.8176X	0.2287	0.0551	-0.1798
15 Rgsort15	0.9348X	0.1011	0.1270	0.0785
16 Rgsort16	-0.1753	0.8508X	-0.2197	-0.1128
17 Rgsort17	0.0531	-0.0209	-0.1019	0.6836X
18 Rgsort18	0.5319	0.4400	0.2563	-0.2215
19 Rgsort19	-0.0438	-0.2380	0.8289X	-0.0610
20 Rgsort20	0.4882	0.4390	0.3011	0.3299
21 Rgsort21	0.2506	0.2760	0.7046X	-0.0411
22 SU22	0.7368X	0.1843	0.4416	0.0283
23 SU23	0.8980X	0.2814	0.0164	-0.0576
24 SU24	0.7898X	0.2306	0.2837	0.1163
25 SU25	0.7954X	0.3429	0.2438	-0.0847
26 SU26	0.6217X	0.5104	0.3387	0.1042
27 SU27	0.8098X	0.2063	0.3551	-0.0181
% expl.Var.	42	11	11	8

Table 1A. Correlation Matrix of the Twenty Seven (27) Surveys

The first twenty one (21) surveys are regular nursing users. The surveys numbered twenty two (22) through twenty seven (27) are pre-identified nursing information system trainers. An "X" next to the survey number indicates a high correlation amongst all the surveys. Column number one (1) The "Super User" column has the largest number of correlated surveys or half (11/24) regular nursing users. Remarkably the nurse trainers which are surveys twenty two (22) through twenty seven (27) all have an "X" under the "Super User" column which places their surveys in the most appropriate column for a nurse information system trainer.

The remaining surveys have high correlations (marked with an "X") along the last three (3) columns. Therefore these users are either computer resistive, reluctant user and or an Independent clinician. What the remaining users have not correlated strongly with is the "Super User" column.

For this study, a list of subjective statements expressing common ideas about the use of automation in the workplace was created based on a literature review and input from hospital and academic professionals familiar with the use and development of super users. From this list

of common opinions, 24 statements were selected as the Q-sample (see Appendix).

A survey was distributed in a large urban academic medical center to registered nurses on staff who had at least one year of experience with clinical information systems implemented at the medical center. A total of 27 registered nurses responded, including six previously identified as super users. Participants rank-ordered the 24 statements of the Q-sample after receiving the following instruction: "Which statements would you consider important or not so important when you think about how you use the clinical information system while working at the hospital?" They then completed the grid on an answer sheet (see Appendix). Each sort was encoded to identify the subject completing the Q-sort as either a staff user or a super user.

For this study, the two statements that were determined to be the most important received a score of +3; the next three scores received a score of +2; and so forth, down to the two statements that were determined to be the least important, which received scores of -3. Statements placed in the middle of the bell-shaped curve by subjects received scores of 0, meaning participants were neutral in their feelings about the statements.

Results of Responses

Q-sorts were collected from 21 staff registered nurses and 6 super users in December 2004. All participants were from a single, large, urban, academic medical center.

Following the guidelines for Q-factor analysis,¹⁴ Varimax rotation calculated by the PQMethod software¹⁵ extracted four factor arrays, or opinion types, that represented four different views regarding perceptions and attitudes on the use of clinical information systems in the clinical work setting. A manual rotation of the data using the QRotate procedure was not used to minimize variation because

the PQMethod software optimally flagged the data into four factors that explained 72 percent of the total variance among participants (see Table 1A).

The table shows that 25 of the 27 persons who participated in the study had their opinions represented within

Factor Arrays

No.Statement	No.	1	2	3	4	Variance
1) There is always a problem with the clinical info syst.		0	1	2	0	>3
2) I feel the clinical info syst slows down my workflow.		-1	3	1	2	>3
3) I feel I learn information syst applications smoothly.		2	0	-1	1	>3
4) My peers feel comfort coming for assist on use info syst.		2	3	0	2	>3
5) I feel the clinical info sits at work is beneficial.		3	-1	1	-2	>3
6) I enjoy helping others use the clinical info syst.		1	-1	0	1	>3
7) When I figure out a fn I share the info with mgmt and peers.		2	-1	2	1	>3
8) I have minimal questions when I use the clin info syst.		1	0	0	1	<3
9) It makes no diff whether I use systems at work.		-1	0	-1	-3	>3
10) I would be irritated if I had to answer computer quest.		-2	1	0	3	>3
11) I need assistance with the clin info syst at work.		0	0	2	-1	>3
12) I don't need help I can use the computer sys at work fine.		0	-3	-2	3	>3
13) I'm an RN b/c I care for sick people & not use a computer.		0	2	0	2	>3
14) I'm not tech and find it hard to use a clin info syst.		-2	0	1	0	>3
15) I dislike computers & would prefer not using them.		-3	-3	3	-1	>3
16) I prefer to figure how to use the clin applic on my own.		0	-2	-1	-1	>3
17) I want to go back using pen and paper instead of comp.		-3	2	-2	-3	>3
18) I should not help w/ clin info b/c they should know.		-2	-2	0	0	>3
19) I prefer to work alone & handle my caseload w/o assist.		-1	0	-1	0	<3
20) I don't answer simple redundant questions from peers.		-1	1	-2	-1	>3
21) I like to assist peers when have prob using computer.		1	-1	0	0	<3
22) I feel the clin info syst at wrk is import w/ doing work.		3	1	3	0	>3
23) I am exposed to persons in comput & feel comfort w/ them.		1	2	-3	-2	>3
24) I have taken informatics courses while obtaining my RN.		0	-2	-3	-2	>3

Factor Characteristics

Factors	1	2	3	4
No. of Defining Variables	17	3	3	2
Average Rel. Coef.	0.800	0.800	0.800	0.800
Composite Reliability	0.986	0.923	0.923	0.889
	98.6%	92.3%	92.3%	88.9%
S.E. of Factor Scores	0.120	0.277	0.277	0.333

Table 1B. Factor Q-Sort Values for Statements sorted by Consensus vs. Disagreement (Variance across normalized Factor Scores)

the four defined factors. This is a significantly high definition for the four-factor rotation and illustrates that the Q-sample in this study defined the vast majority of

possible opinions in the general nursing population regarding this topic.

There were 17 defining variables for Factor One, three

each for Factors Two and Three, and two for Factor Four. The composite reliability for Factor One is 0.986, meaning that if the test was conducted again, there would be a 1.4 percent chance that Factor One would be different. Factors Two and Three have composite reliabilities of 0.923, and Factor Four has a composite reliability of 0.889. These are generally considered very high composite reliabilities and add significant credibility to the factors (See Table 1B).

Factor One identified the most flagged sorts. Because the researcher knew which sorts were completed by the super users and which were done by regular users, the super user group unanimously fits into Factor One and shares common ideas. Additionally, 11 out of 21 regular users also were flagged in Factor One and share a common opinion set with the super user group.

There are three strongly correlated flagged sorts in both Factors Two and Three. Although two sorts were flagged for Factor Four, a distinct difference exists when it is compared with the other factors (see Table 1A).

The PQMethod software analysis identifies those statements that differentiate one factor from another. Factor One, which includes all of the identified super users, demonstrates that subjects believe that the clinical information system is a beneficial tool (see Table 1B, statement 5, Q-sort value +3) and important to their work (statement 22, +3). The subjects generally believe that they learn the clinical application smoothly (statement 3, +2) and expressed positive feelings about sharing newly-learned functions with peers and management (statement 7, +2).

Distinguishing characteristics of Factor One are that subjects generally do not mind answering computer questions (statement 10, -2), do not find it difficult to use the clinical information systems (statement 14, -2) and do not believe that information systems slow down their work (statement 2, -1). These are significant traits that correlate with the expected attitudes of the super user group. As a result, the researchers labeled Factor One as super users (see Table 1B, Factor Array 1).

Factor Two showed resistance in that subjects believe that the system actually slowed work (statement 2, +3) and prefer to revert back to using pen and paper (statement 17, +2). The latter point demonstrating a preference for pen and paper is a distinguishing characteristic of this factor. For this reason, the researchers labeled Factor Two as computer-resistant users (see Table 1B, Factor Array 2).

Factor Three showed that subjects dislike the computer system. They believe that there were problems with the clinical information systems (statement 1, +2) and were neutral about their comfort level when asked for assistance with the systems by their peers (statement 4, 0). Distinguishing characteristics for this factor are that subjects believe strongly that they need assistance with clinical information systems (statement 11, +2), and they have a dislike for computers and would prefer to not use them (statement

15, +3). In fact, Factor Three subjects, unlike those in the other factors, were the only ones that believed these two distinguishing characteristics were most important. For this reason, the researchers labeled Factor Three as reluctant users (see Table 1B, Factor Array 3).

Factor Four showed an overall independence from the clinical information system with high opinion of a nursing identity. The subjects in this factor felt bothered if they had to answer computer-related questions (statement 10, +3) and had a strong preference to work as a nurse and not as a computer person (see statement 13, +2). There was a clear preference of working independently (statement 12, +3) as a distinguishing characteristic for this factor. The researchers labeled Factor Four as independent nurses (see Table 1B, Factor Array 4).

Discussion of Results

As the healthcare industry now emphasizes the use of clinical information systems, the return on investment for these systems is critical to the viability of most healthcare organizations. With reimbursements being diminished, capital becoming scarce, and skilled resources in demand, the availability of knowledgeable resources that are immediately available for advice is critical to the successful use of these systems.

“...many believe that peer resources, working side-by-side with other less-experienced personnel, can be more comfortably approached with questions.”

Because clinical activity occurs around the clock, limited availability of help desk personnel can make it difficult to provide the support required to ensure maximum utilization of clinical information systems. As a result, having resources available for immediate problem solving is essential to ensure that these systems are used to their full potential.

Further, many believe that peer resources, working side-by-side with other less-experienced personnel, can be more comfortably approached with questions. They are also on the floor and quicker to respond, compared with asking the information systems department's help desk and then potentially waiting for an answer.

Strategically positioning super users in a healthcare organization could significantly increase nurses' overall satisfaction with clinical information systems and maximize these systems' ability to deliver efficient and effective patient care. Further, identifying these super users soon after they are hired and giving them the extra training and attention to make them the best users possible will help

ensure that their shift assignments and responsibilities optimally take advantage of their unique skill sets.

The researchers noted distinct differences across the four factors. Factor One is the most significant and defines a clear picture of the ideas and characteristics a super user should possess. These users need to demonstrate a mentoring personality and feel comfortable with assisting others with their computer-related difficulties. They need an inherent enthusiasm in using clinical information systems and a desire to learn as much as possible about how these systems can be used as tools in delivering patient care. They see technology as beneficial and do not see technology as a threat to their careers. They see their careers advancing through the use of technology and are willing to share their positive technology experiences with management and peers.

A nurse super user believes that a clinical information system is not only beneficial to delivering patient care but also is important in performing nursing work tasks. These super users not only believe that they learned the clinical application easily but also share the functionality that they have learned with management and peers, and they enjoy helping others use clinical computer applications. Other staff nurses are comfortable asking super users for assistance.

Super user nurses are not necessarily exposed to nursing informatics coursework. The researchers conclude the nurse super user possesses a dual skill set that includes the personality and the ability to act as a clinical information technology specialist as well as a caregiver to patients.

As clinicians, super users desire immediate responses from their actions, the researchers found. The nature of clinicians' work is to make quick but well-educated and well-intended decisions, and to document their activities with as little additional effort as possible. Clinicians need to believe that they are in control. When they have a question, they go to a respected source and often get an immediate answer. When they have questions about clinical information systems, their experiences should not be any different.

User frustrations with installed computer systems run counter to the personalities of most clinicians and often contribute to poor utilization and negative attitudes about the systems. Even the best systems that have been successfully installed in a number of customer sites will fail because of poor post-installation user support and resulting user frustration. The healthcare industry has experienced too many IT failures and must take steps to enhance the return on its IT investments. A formal super users program, along with an emphasis on utilizing these individuals at a higher level to enhance the use of the implemented technology, will go a long way toward increasing returns on technology investments.

The next two factors, Computer-Resistant Users and Reluctant Users, are distinctly different than Factor One and

each other. Neither of these factors have the personality to be good super users. While computer-resistant users would prefer to use pencil and paper and often express frustration with clinical information systems, they are willing to share knowledge under the right conditions. These individuals are likely to be the first to complain when problems occur and would not demonstrate the enthusiasm, patience, and compassion needed to accommodate systems-related difficulties.

On the other hand, reluctant users would prefer to practice nursing the traditional way and not bother with technology. They need assistance using clinical information systems and most likely will learn just enough about the system to achieve minimal competency. They may believe there is a benefit to clinical information systems but would prefer to have someone else use them. Obviously, Factor Two and Factor Three individuals are not good super user candidates.

Factor Four, independent nurses, is quite different than the other factors. These individuals tend to focus more on nursing as a profession and may believe that patient care is the most important activity for a nurse. They prefer not to be bothered with computer-related questions and desire to work by themselves. Although they may be good clinical information systems users, they are generally not good super user candidates.

Generally speaking, nursing personnel believe that a clinical information system is an important tool in delivering patient care (statement 22, Table 1B). This could be explained by the fact that they were exposed to clinical information systems for at least one year as a requirement of the study and have learned to work with the technology in a patient care environment. Further, they may have realized and accepted the fact that the future delivery of patient care will involve information technology. Their attitude toward such systems is a crucial differentiator, and it affects their ability to be a valuable support resource for others.

The success of super users depends on their ability and willingness to offer assistance to peers in the work environment. Statements such as, "I am not going to help them because they never learned how to utilize the system properly," or "How can I help others around me?" have been verbalized by nursing experienced users expressing frustrations with inexperienced computer users who need additional computer assistance. Therefore, the early identification of willing and able computer users who can assist peers in the clinical environment potentially may help the healthcare organization.

Individuals who have the ability to become super users can be identified at the beginning of employment and subsequently exposed to more advanced systems training so they can maximize their abilities to master IT systems.

Conclusion

Results of the study identify the ideas and personality characteristics that a candidate must possess to be considered a potential super user and, conversely, they also identify the attitudes and personality characteristics of individuals who may not be good candidates for a role as a super user. As a result of this project, researchers documented a more formal understanding of the often-vague and misused term super user.

Although this study focused on the general nursing population in an urban academic hospital environment, the study and its methodology may be applied to all clinical environments in a variety of settings. This adds to the body of knowledge regarding identification and usage of clinical and non-clinical super users. An important characteristic of Q-methodology is that different people with different backgrounds can be surveyed using the same Q-sample; for example, this tool can be utilized for other clinical disciplines. Additionally, the Q-sample can be reworded to fit the needs of other industries to assess computer skills and the ability or personality traits needed by super users.

This study helps define the personality characteristics for a super user because the current literature reflects a weak semantic structure for the term. A better conceptualization of the applicable practices and personality traits that a super user must possess may refine job descriptions and potentially reduce the need for help desk personnel to be available and conversant in complex clinical applications.

Using these tools, nurse administrators can identify staff members who have the willingness and ability to be part of the front-line activities that support present and future clinical application implementations. These activities may include involvement in evaluating and assessing new software, incorporating new functionality into user workflow, providing input to the design of a new system, and planning and conducting training programs, among other activities.

A nurse identified as a super user can function as a

resource person on the floor who can reduce the load on the information system department's help desk. Ultimately, nurses identified as super users may act as clinical informatics liaisons between clinical operations and the information systems department.

The current literature on the subject and utility of super users is limited and does not include an adequate formal definition to develop a thorough understanding of the term as it is applied in operational use. This study was designed to not only identify specific individuals from a nursing population who have the mentality and characteristic set of a super user, but also to build a working definition of the term.

Q-methodology is different from ordinary surveys, which require a large sample size to derive valid results. Using Q-methodology, sample sizes are defined statistically in terms of the number of statements to be sorted rather than the number of respondents making the sort.¹⁶ In this study of 27 registered nurse personnel from a large urban academic medical center, varying viewpoints were extracted. If researchers determined there is a need to understand the distribution of these viewpoints, or if there was merit in expanding the results to additional healthcare organizations, more participants should be surveyed.

In the near term, nursing administrators should consider the potential opportunity for assigning personnel with adequate skill sets and backgrounds to super user roles and responsibilities as the organization strives to maximize the utilization of clinical information systems.

About the Authors

Daniel P. Boffa, RN, MS, is currently a student in the master of science in health informatics program at the University of Illinois at Chicago.

Lawrence M. Pawola, PharmD, MBA, is a clinical associate professor of biomedical and health information sciences in the College of Applied Health Sciences at the University of Illinois at Chicago.

References

1. Scott JS. *To Err is Human: To Forgive, Un-American*. Healthcare Financial Management. 2000; 54(2): 26-27.
2. Martinson M, Chong P. The Influence of Human Factors and Special Involvement on Information Systems Success. *Human Relations*. 1999; 52(1):123-152.
3. Connolly PJ, Yager T. *Do Certificates matter?* Info World Media Group Incorporated. 2000; 22(12): 33-44.
4. Burnelli M. Bethlehem Steel Views people Assets. *Purchasing*. 1999; 127(5): 94.
5. Association of Records Managers & Administrators. Thinking Outside the Training Box. *Information Management Journal*. 2002; 36(1): 12.
6. Rohan J. Determinants of Microcomputer Technology Use: Implications for Education and Training of Health Staff. *International Journal of Medical Informatics*. 1998; 50(3): 187-194.
7. VNU eMedia. The Bold Look of Training. *Training*. 2004; 41(11): 16-17.
8. Cohen S. Beam Up Staff with Technology Savvy Leadership. *Nursing Management*. 2004; 35(2): 12-13.
9. Nilsen H, Sein M. *End User Support: Where Best Practices Can Go Wrong*. Department of Information Systems. Agder University College. 2002; 1-7.
10. Training Today. Delivering IT programs. *Training*. September 16th 2003.

Original Contributions

11. Setzekorn K, Sugumaran V. A Comparison of Implementation Resistance Factors for DMSS vs. Other Information Systems. *Information Resource Management Journal*. 2002; 15(4): 48-63.
12. Valenta A, Wigger U. Q-Methodology: Definition and Application in Health Care Informatics. *Journal of the American Medical Informatics Association*. 1997; 4(6): 501-510.
13. Valenta A, Therriault D, Dieter M, Mrtek R. Identifying Students' Attitudes and Learning Styles In Distance Education. *Journal of Asynchronous Learning Networks*. 2001; 5(2): 111-127.
14. Donner JC. Using Q-Sorts in Participatory Processes: An Introduction to the Methodology. *Social Development Series: Social Analysis; Selected Tools and Techniques*. Washington, D.C., World Bank; 2001.
15. PQMethod Software. Current release version 2.11 (Nov-28-2002).
16. Mrtek RG, Tafesse E, Wigger U. Q-methodology and Subjective Research. *Journal of Social and Administrative Pharmacy*. 1996; 13(2): 54-64.

Appendix: Q-Sample statements and Sorting Grid.

Look over all the statements to familiarize yourself with the range of user feelings to be evaluated.

1. There is always a problem with the clinical application system.
2. I feel the clinical application slows my workflow down.
3. I feel I learn information systems applications smoothly.
4. My peers feel comfortable coming to me for assistance on how to use the clinical information systems at work.
5. I feel the clinical information system at work is beneficial.
6. I enjoy helping others use the clinical information system.
7. When I figure out a new function with the clinical application, I always share the information with my management and peers.
8. I have minimal questions when I use the clinical information system at work.
9. It makes no difference to me whether I use or don't use a clinical information system at work.
10. I would be irritated if I had to regularly answer computer questions at work.
11. I need more assistance with the clinical information system at work.
12. I don't need anyone to tell me how to use the computer system at work; I can use it by myself just fine.
13. I became a nurse because I like caring for sick persons and not necessarily to use a computer system in order to do so.
14. I am not very technical and find it difficult to use the clinical information system at work.
15. I dislike computers (anxiety, fear, complexity) and would prefer not using them at all.
16. I would prefer to figure out how to use the clinical application at work when I am unsure rather than ask others how to use it.
17. I would like to go back to using pen and paper at work instead of using a computer.
18. I don't feel I should help other workers with the clinical information system because they should know how to use the system by now.
19. I prefer to work alone and handle my caseload without assistance from other peers.
20. I don't like answering simple redundant questions from my peers.
21. I like to assist my peers when they are having problems using the computer system at work
22. I feel my present clinical information system at work is important in performing my working duties.
23. I am exposed to people in the computer industry (Spouse, Child, Friends, etc.) and feel comfortable with computer systems.
24. I have taken informatics courses while obtaining my Nursing Degree.

Which statements would you consider important or not so important when you think about how you use the clinical information system while working at the hospital.

Participants will sort statements in order based on which are Most Important and which are Most Unimportant and place the number in the sorting grid below.

Most Unimportant		Most Important				
-3 -2 -1 0 +1 +2 +3						

Information Technology Strategy: Three Misconceptions

John P. Glaser, PhD

A B S T R A C T

The core intent in developing an IT strategy is to ensure that there is a strong and clear relationship between IT investment decisions and the organization's overall strategies, goals, and objectives. In the course of developing an IT strategy, an organization may fall victim to three major misconceptions about IT strategy. Those misconceptions are:

- *The IT strategy should be solely derived from a thorough review of organizational strategies and plans.*
- *The IT strategy should be dominated by a focus on defining needed application systems.*
- *The IT strategy is better if it is developed by using a rigorous methodology.*

These misconceptions are dangerous. While they are right, they are not completely right. Hence, a dogmatic approach embracing these misconceptions risks an incomplete IT strategy or a strategy that is not as aligned with the organization as it should be.

K E Y W O R D S

- IT strategy ■ IT management ■ IT value ■ Emerging technologies
- IT effectiveness ■ Planning methodologies

The core purpose in developing an IT strategy is to ensure that there is a strong and clear relationship between IT investment decisions and the organization's overall strategies, goals, and objectives.

Developing a sound IT strategy can be very important for one simple reason—an organization defines the IT agenda incorrectly or partially correctly, it runs the risk that signifi-

cant organizational resources will be misdirected. Some, and perhaps most, resources may not be devoted to furthering strategically important areas. This risk has nothing to do with how well an organization executes the chosen IT direction. Being on time, on budget, and on specification is of diminished utility if the wrong thing is being done.

In the course of developing an IT strategy, an organiza-

tion may fall victim to three major misconceptions about IT strategy. Those misconceptions are:

- The IT strategy should be solely derived from a thorough review of organizational strategies and plans.
- The IT strategy should be dominated by a focus on defining needed application systems.
- The IT strategy is better if it is developed by using a rigorous methodology.

These misconceptions are dangerous. They are right but they are not completely right. Hence a dogmatic approach embracing these misconceptions risks an incomplete IT strategy or a strategy that is not as aligned with the organization as it should be.

Deriving the IT Strategy

The IT strategy often is derived directly from the organization's strategy. For example, if the organization is interested in improving patient safety, then the IT strategy will focus on applications such as computerized practitioner order entry (CPOE), electronic medication administration records, and error reporting. If the organization intends to improve patient service, then the IT strategy will focus on applications such as patient portals and new clinic scheduling systems.

“...if an organization defines the IT agenda incorrectly or partially correctly, it runs the risk that significant organizational resources will be misdirected.”

This strategy development approach depends on a fundamental assumption—once we know the organization's strategy, we can deduce the IT strategy. This view of strategy formation can be limited by its failure to understand three other lines of thinking that can contribute to the definition of IT strategy. A strategy for IT can be based on continuous improvement of core processes and information management; determined by examining the role of new information technologies; and derived by assessing strategic trajectories.

IT strategies based on continuous improvement of core operations and information management needs.

There are a small number of core operational processes and information management tasks that are essential for the effective and efficient functioning of the organization. For a hospital, these processes might include patient access to care, ordering tests and procedures, and managing

the revenue cycle. For a restaurant, these processes might include menu design, food preparation, and dining room service.

This line of thinking requires the organization to define its core operational processes and information management needs. The organization assesses the performance of these processes and develops plans to improve performance of these processes. The organization defines core information needs, identifies the gap between the current status and its needs, and develops plans to close those gaps. These plans often will point to an IT agenda.

These plans may be derived from the organization's strategy, but not always. There can be ongoing efforts to improve processes, regardless of the specifics of the organization's strategic plan. For example, every year an organization may undertake initiatives designed to reduce costs or improve service.

As a result, the IT strategy is partly driven by a relentless year-in, year-out focus on improving core operational processes and addressing critical information management needs.

IT strategies determined by examining the role of new information technologies. This approach involves determining whether new IT capabilities enable the organization to consider new approaches or significantly alter current approaches to its strategies. For example, wireless technologies may enable the organization to consider applications that previously were not effective because there was no good way to address the needs of the mobile worker. For example, medication administration systems now can be used at the bedside rather than forcing the nurse to return to a central work area to document administration.

In this vector, the organization examines new applications and new technologies and tries to answer the question, “Does this application or technology enable us to advance our strategies or improve our core processes in new ways?” For example, applications that support the communication between a physician and his or her patient through the Internet might enable the organization to think of new approaches to providing care to the chronically ill patient. Holding up new technologies in the spotlight of organizational interest can lead to decisions to invest in the new technology.

IT strategies derived by assessment of strategic trajectories. Organizational and IT strategies invariably have a fixed time horizon and fixed scope. These strategies might extend two to three years into the future, outlining a bounded set of initiatives to be undertaken in that time period.

Assessment of strategic trajectories asks the question, “What do we think we will be doing after that time horizon and scope? Do we think that we will be doing very different kinds of things, or will we be carrying out initiatives similar to the ones that we are doing now?”

There may be a plan to introduce decision support into a computerized practitioner order entry application. The decision support could point out drug-drug interactions and drug-lab test interactions. Answering the question about trajectories for decision support might indicate that patients' genetic information eventually will be part of the decision support approach, because genetic makeup can have a very significant effect on patients' drug tolerance.

The trajectory discussion may be grounded on IT applications such as the example above. The trajectory also may be grounded on today's organization with an effort being made to envision the organization as it would like to be in the future. That vision of an organization may point to IT strategy directions and needs. For example, a vision of an organization with exceptional patient service might point to the need to move to applications that enable patients to book their own appointments.

The strategic trajectory discussion often is quite forward-looking and can be very speculative about the future. The discussion might be so forward-looking and speculative that the organization may not act today on the discussion. On the other hand, such discussions can point to initiatives that can be undertaken within the next year to better understand the future and to prepare information systems for it.

The Focus on Applications

Most IT strategy efforts focus on the development of an application agenda as the outcome. In other words, the completion of the IT strategy discussion is an inventory of systems such as the electronic medical record, customer relationship management systems, and clinical laboratory systems that are needed to further overall organizational strategies. However, the application inventory is a component of the larger set of IT strategy outcomes.

The application discussion does not stop when an inventory is completed. There are additional strategic discussions that must be held. These discussions focus on the following key areas.

Sourcing. What are the sources for our applications? What criteria determine the source to be used for an application? In other words, should we buy or build applications? If we buy, should we get all applications from the same vendor or will we get them from a small number of approved vendors?

Application uniformity. If we are a large organization with many subsidiaries or locations, to what degree should our applications be the same at all locations? If some have to be the same but some can be different, how do we decide where we allow autonomy? This discussion is often a tradeoff between local autonomy and central desires for efficiency and consistency.

Application acquisition. What processes and steps should we utilize when we acquire applications? Should we subject all acquisitions to very rigorous analyses?

Should we use a request for proposal for all application acquisitions? This discussion is generally an assessment of the way in which IT acquisitions should follow whatever degree of rigor is applied to non-IT acquisitions, such as diagnostic equipment.

Infrastructure Concerns

Infrastructure is composed of the organization's information technology foundation, such as operating systems and networks, and the architecture in place to ensure that the foundation achieves desired objectives.

Infrastructure needs may arise from the strategic planning process. An organization desiring to extend its systems to community physicians will need to ensure that it can deliver low cost and secure network connections. Organizations placing significant emphasis on clinical information systems must ensure very high reliability of their infrastructure; computerized practitioner order entry systems cannot go down.

The IT strategy discussion must focus on the addition or enhancement of broad infrastructure capabilities and characteristics. Capabilities are defined by completing the sentence "We want our applications to be able to..." Those sentences could be completed with phrases such as "be accessible from home," "have logic that guides clinical decision making" or "share a pool of consistently defined data."

"Most IT strategy efforts focus on the development of an application agenda as the outcome."

Characteristics refer to broad properties of the infrastructure, such as reliability, agility, supportability, integrability, and potency. An organization may be starting to implement more mission-critical systems and must ensure high degrees of reliability for its applications and infrastructure. The organization may believe that it is in the middle of significant environmental uncertainty and thus places a premium on agility. The strategy discussion intends to answer questions such as, "What steps do we need to take to significantly improve the reliability of our systems?" or "If we need to change course quickly, how do we ensure an agile IT response?"

Data Strategies

Strategies surrounding data can involve the degree of data standardization across the organization, accountability for data quality, and stewardship and determination of database management and analyses technologies.

Data strategy conversations may originate with questions such as, "We need to better understand the costs of our care. How do we improve the linkage of our clinical data

and our financial data?" or "We have to develop a much quicker response to the outbreaks of epidemics. How do we link into the city's emergency rooms and quickly get data on chief complaints?"

In general, strategies surrounding data focus on acquiring new types of data, defining the meaning of data, determining the organizational function responsible for maintaining that meaning and quality, integrating existing sets of data, and identifying technologies used to manage, analyze, and report data.

IT Staff Issues

IT staff are the analysts, programmers, and computer operators who daily manage and advance information systems in an organization. The IT strategy discussions can highlight the need to add skills to the IT staff, such as Web developers and clinical information systems implementation staff.

"IT planning involved shared decision-making and shared learning between IT and the organization."

Organizations may decide that they need to explore outsourcing the IT function in an effort to improve IT performance or obtain difficult-to-find skills. The service orientation of the IT group may need to be improved.

In general, IT staff strategies focus on acquiring new skills, organizing the IT staff, sourcing the IT staff and solidifying the characteristics of the IT group, such as innovative, service-oriented, and efficient.

IT Governance

IT governance is composed of the processes, reporting relationships, roles, and committees that an organization develops to make decisions and manage the execution of those decisions, regarding IT resources and activities. These decisions include setting priorities, determining budgets, defining project management approaches, and addressing IT problems.

The IT strategy surrounding governance focuses on issues such as:

- Determining the distribution of the responsibility for making decisions, the scope of the decisions that can be made by different organizational functions, and the processes to be used for making decisions.
- Defining the roles that various organizational members and organizational committees have for IT, for example, which committee should monitor progress in clinical information systems, and what the role of a department

head is during the implementation of a new system for the department.

- Developing IT-centric organizational processes for making decisions in several key areas, including IT strategy development, prioritization and budgeting, project management, and IT architecture and infrastructure management.
- Defining policies and procedures that govern organizational use of IT. For example, if a user wants to buy a new network for use in a department, what policies and procedures govern that decision?

Governing Concepts

Governing concepts refer to the views or concepts that guide how an organization thinks about IT. These views can cover a wide range of an organization's IT resources. For example:

- Do we believe that IT is fundamentally a tool to accomplish our real objective—process re-engineering, or is IT a competitive weapon in its own right? Is possessing a technology of value, even if re-engineering does not occur?
- Should we view electronic prescribing as a competitive advantage or should we view it as a regional utility? If we view it as the former, we should proceed unilaterally. If we view it as the latter, we should put together a regional collaborative to develop it.
- When we say that we want to integrate our systems, what does integration mean to us? Common data? Common interfaces? Common application logic?
- Should IT be a tightly controlled resource, or should we encourage multiple instances of IT innovation? What would cause us to choose one approach over another?

All of these views or concepts are correct, because they all can be effective. However, after an organization chooses a concept or concepts, it tends to think about the technology that way, often to the exclusion of other ways of thinking about it.

There is no one formula or cookbook for arriving at governing concepts. Concepts emerge from complex and poorly understood phenomena involving insight, discussions between members of the organization's leadership, examination of the strategic efforts of others, an organization's successes and failures (and the reasons it assigns for success and failure), and the organizational values and history that form the basis for judging views.

IT Strategy Methodologies

Methodologies can be helpful in developing an IT strategy. These approaches can make the process more rigorous, politically inclusive, comprehensive, and more likely to produce a set of desired outcomes.

However, organizations that have a history of IT excellence would appear to evolve to a state where their align-

ment process is “methodology-less.” A study by Earl¹ of organizations in the UK that had a history of IT excellence found that their IT planning processes had several characteristics.

IT planning was not a separate process. IT planning, and the strategic discussion of IT, occurred as an integral part of organizational strategic planning processes and management discussions. In these organizations, management did not think of having an isolated IT discussion during the course of strategy development, any more than they would run separate finance or human resources planning processes. IT planning was an unseverable, intertwined component of the normal management conversation.

IT planning has neither a beginning nor an end. Often, the IT planning process starts in one month every year and is done a couple of months later. In the studied organizations, the IT planning and strategy conversation went on all of the time. This does not mean that an organization does not have to have a temporally de-marked process designed to form a budget every year. Rather, it means that IT planning is a continuous process reflecting the continuous change in the environment, and in organizational plans and strategies.

IT planning involved shared decision-making and shared learning between IT and the organization. IT leadership informed organizational leadership of the potential contribution of new technologies and constraints of current technologies. Organizational leadership ensured that IT leadership understood the business plans and strategies and constraints. The IT budget and annual tactical plan resulted from sharing analyses of IT opportunities and setting IT priorities.

These results imply that there is no method per se for developing IT strategy. Rather, the development of IT strategy is a never-ending series of discussions and debates that include mutual learning; it occurs across a range of settings, including senior management meetings and brief conversations in the hallway.

The limitations of IT strategy methods also are illustrated in surveys, across industries, of top management challenges. Invariably, these surveys find senior executive concern with the linkage of the IT agenda to the organization’s strategy. This linkage is difficult for many reasons—business strategies often are not clear or are volatile; IT opportunities are poorly understood; or the organization is unable to resolve the different priorities of different parts of the organization.

These reasons are often not correctable through a

methodology. No methodology, for example, can answer the question “What is the value of a RHIO?”—there is not enough experience in the country for anyone to answer that question. An unclear business strategy can be a reflection of environmental uncertainty. Methodologies may not be able to bring certainty.

These sources of difficulty always will challenge the development of IT strategy, and there is unlikely to be any approach that can remove them.

Summary

Developing an IT strategy is a critical organizational process. This process will become more important as the strategic necessity of IT increases.

IT strategy should be based on a derivation of needs from the organization’s strategy. After all, IT is a tool of which the value is based on its ability to support organizational plans and activities. However, this derivation is not the only approach for identifying important IT investments. The IT agenda can be significantly influenced by efforts to improve core organizational processes and information needs, the opportunities created by new technologies, and a discussion of strategic trajectories.

The centerpiece of any IT strategy is an inventory of applications that need to be acquired and implemented. Applications are where the IT rubber meets the organizational road. However, the IT strategy needs to go well beyond the definition of applications. Application sourcing approaches, infrastructure characteristics, data standardization, governance, and the way an organization views IT are all essential elements of the IT strategy.

Strategy planning methods can enhance the planning process. They can add a discipline, comprehensiveness, and transparency to the process. However, real strategy is crafted in many conversations, in many settings, that go on all the time. No methodology can capture this dynamic. Moreover, IT strategy must occur in the middle of imperfection that can include unclear organizational strategy, poor understanding of IT opportunities, and political behavior. No method can fully compensate for these imperfections.

The development of IT strategy is a critical and complicated process. While this process will never be easy, it should not be unnecessarily impeded by misconceptions.

About the Author

John P. Glaser, PhD, is vice president and CIO of Partners HealthCare, Boston.

References

1. Earl, M. (1993). Experiences in Strategic Information Systems Planning. *MIS Quarterly*, 17(1), 1–24.

Note:

Some of the content of this article has been adapted with permission from *Managing Health Care Information Systems: A Practical Approach for Health Care Executives*, by Karen A. Wager, Frances Wickham Lee and John P. Glaser, Jossey-Bass, May 2005.

Trusted and Relevant Medical Knowledge: The Promise of Information Retrieval in Biomedicine

Eric Z. Silfen MD, MSHA; and Chintan O. Patel, MS

A B S T R A C T

As the world of medicine becomes increasingly digitized, the Web has become a de facto resource for physicians to quickly glean pertinent clinical information to carry out diagnostic and therapeutic decisions. At present, physicians face the dual challenge of judging the relevance of the information and trusting its Web source. This paper proposes a trust-relevance framework for conceptualizing computer-accessed medical information resources, a set of criteria for evaluating these information resources, and descriptions of a sample of available online resources. It also presents a usable framework for evaluating information retrieval innovations and explains the different capabilities of representative information retrieval tools and applications. By demystifying the concepts associated with information resources, search engines, and retrieval tools, and presenting a reasonable view of current opportunities as well as future possibilities, the authors hope to provide guidance so physicians can more rapidly adopt innovative computer-assisted search tools for acquiring information that facilitate patient care decision-making.

K E Y W O R D S

- Information retrieval ■ Information extraction ■ Knowledge discovery ■ Search engine
- Relevance ■ Trust

A recent letter to the editor in the *New England Journal of Medicine*¹ ran the headline: "... And a Diagnostic Test Was Performed." The clinicopathological case under discussion described an infant with diarrhea; an unusual rash (alligator skin); multiple immunologic abnormalities, including low T-cell function; tissue eosinophilia (of the gastric mucosa) as well as peripheral eosinophilia; and an apparent X-linked

genetic pattern (several male relatives died in infancy). The Fellow diagnosed a rare syndrome known as IPEX (immunoodeficiency, polyendocrinopathy, enteropathy, X-linked). Genetic testing on the baby revealed a mutation in the FOXP3 gene, confirming the diagnosis.

When the visiting professor inquired of the Fellow how the diagnosis was made, the following dialogue ensued:

Visiting Professor: "How did you make that diagnosis?"
Fellow: "I had the skin biopsy report and a chart of the immunologic tests. So I entered the salient features into Google, and it popped right up."

As the world of medicine becomes increasingly digitized, accessing medical information is merely a matter of making a few mouse clicks on a computer screen and initiating a search. As evident from this conversation, the Web has become a *de facto* resource for physicians to quickly glean pertinent clinical information to carry out diagnostic and therapeutic decisions for patients.

The irony and gravity of the situation is that anyone can publish any information on the Web, which raises an important issue when clinicians use the Web to assist with medical practice—how can a physician judge the relevance of the information and trust its source?

Four Challenges

The richness of the clinicopathological conference dialogue emphasizes the numerous challenges associated with weaving new technology into the fabric of medicine. Besides highlighting the issues associated with changing medical practice in general, the myths associated with medical computing emerge as well. To begin, it is worth exploring four challenges posed by a combination of the medical information explosion^{2,3} and the role of computers in making this information usable in clinical practice.

The first challenge is diffusing computer innovations into the methods of medicine. Diffusion of innovation among individuals within a social system occurs asynchronously—that is, all individuals do not adopt an innovation at the same pace, but in a well-defined sequence.⁴

However, theory notwithstanding, empirical evidence is most instructive. For example, regarding the diffusion of thrombolytic therapy for the treatment of acute myocardial infarction into mainstream medical practice, the British experience has been extensively reviewed.^{5,6} Clearly, and unfortunately, the authors point out that after the initial six-year period of enthusiasm for thrombolytic therapy as a beneficial intervention, an additional eight-year climb was required to reach an acceptable plateau of only 65 percent utilization. After the initial excitement, factors associated with this slowdown in therapeutic acceptance included converting individuals to the new clinical paradigm, concern over possible adverse side-effects, patient-management systems being slow to adapt to the technology, and the threat of negative affects on hospital budgets. For physicians, it is not hard to draw parallels with the diffusion of computer technology into clinical practice.^{7,8,9,10,11}

The second challenge concerns assimilating computer technology into the physician's diagnostic and therapeutic armamentarium to catalyze a positive transformation within the art of medicine. Regardless of the power of bits and bytes, the humanness of clinical decision-making must

remain tantamount. In addition, physicians must believe that these new computer applications improve the inherently human care of patients. Conversely, if physicians do not shoulder this responsibility, they will fall victim to their worst fear—a degeneration of medical practice into technology in search of patients.

The third and fourth challenges acknowledge the humanness of physicians. For a discipline that prides itself on the rigorous application of the scientific method, admitting that arriving at the correct diagnosis sometimes depends on luck recognizes physician fallibility.¹² Although all physicians strive to know everything that is humanly possible regarding their area of professional expertise, only by recognizing their knowledge gap can physicians appreciate the potential of new computer applications and train themselves to use these tools wisely.

"For a discipline that prides itself on the rigorous application of the scientific method, admitting that arriving at the correct diagnosis sometimes depends on luck recognizes physician fallibility."

Beyond humility, there is the issue of age itself. The adaptability and flexibility of youth to avidly embrace the change associated with computers must be combined with the technological skepticism and wisdom gained through time and experience. Otherwise, all physicians will falter in their quest to rapidly uncover new knowledge, and patients will not benefit from the timely use of the best evidence for medical care.

Given these challenges, what follows is a trust-relevance framework for conceptualizing computer-accessed medical information resources, a set of criteria for evaluating these information resources and descriptions of a sample of available online resources. By reconciling the medical information needs faced by physicians and presenting a reasonable view of current opportunities as well as future possibilities, this paper aims to provide guidance that enables physicians to more rapidly adopt innovative, computerized search tools to retrieve information that facilitates best-evidence medical decision-making for care.

Trust and Relevance are Essential

Trust and relevance are essential characteristics for all medical information that is used for clinical decision-making. The Merriam-Webster online dictionary defines trust as: "Assured reliance on the character, ability, strength, or truth of someone or something; one in which confidence is

placed.¹³ For the computing world, trust implies a systematic assessment of the physician's confidence in the information retrieval system to display reliable medical information over the Web. Because trusted medical information is essential to the delivery of high-quality medical care, several trustworthy computing efforts deserve mention.

Founded in 1995, The Health On the Net Foundation is a not-for-profit organization with a mission of helping both laypersons and medical practitioners find useful, credible and reliable medical and health information online. As part of this mission, it has established ethical standards for Web site developers and has issued a code of conduct for medical and health Web sites.¹⁴

“...the physician faces the daunting challenge of not only searching for trustworthy and relevant medical information and applying that information appropriately for meaningful patient care.”

The core of Trustworthy Computing has been the requirement that computing systems be inherently secure, available, and reliable. The National Academies' Committee on Information Systems publication, entitled Trust in Cyberspace,¹⁵ defines a Trustworthy Computing system as one that “does what people expect it to do—and not something else—despite environmental disruption, human user and operator errors, and attacks by hostile parties.”

Recently, the National Center for Complementary and Alternative Medicine published 10 criteria to help clinicians evaluate medical Web resources.¹⁶ These criteria reflect a spectrum of issues, ranging from the incentives of the Web service provider for posting the information—in other words, who runs and pays for the site—through the value of the medical information (such as what is the basis of the information, where does it originate, how current is the information, and how is the information chosen) to peer activity, or how the site collects and displays user statistics.

Finally, because Web search engines play a major role in locating and accessing medical information, several online resources can help physicians evaluate Web-enabled information retrieval sources. BIOME is a collection of gateways that provide access to evaluated high-quality Internet resources in the health and life sciences.¹⁷ The Special Advisory Group on Evaluation has published a differentiated six-step guide, “How to Evaluate Internet-based Information Source,” that includes documentation regarding each step, such as how to analyze a URL, and how to efficiently answer a medical question of interest.¹⁸

In addition, the National Library of Medicine, via MedlinePlus, offers a 16-minute tutorial for evaluating health information on the Web that reflects a broader description of the criteria published by the NCCAM.¹⁹ Finally, the Health Summit Working Group of the Health Information Technology Institute of Mitritek Systems published a policy paper that describes seven criteria—credibility, content, disclosure, links, design, interactivity, and caveats—for evaluating the quality of health information provided on the Internet.²⁰

Although, these resources are helpful for screening Internet-acquired medical information, they do not provide the necessary scope to help physicians use Web-accessible information retrieval and extraction tools as well as associated clinical decision support applications for best-evidence clinical decision-making.

The Role of Relevance

In computer and library sciences, relevance has a specific meaning when applied to information retrieval. The term is comprised of two complementary metrics. One is recall, or the coverage of the system, such as the number of relevant publications a system returns from the number of relevant publications in the database. The other metric is the precision or the accuracy of the system, which measures the number of relevant publications returned, compared with all publications in the database.

These metrics describe the performance of a search engine in returning the information that users request. In addition, when searching for information, a relevance score is assigned to a search result that represents how accurately the retrieval matches the query. In many cases, that relevance score determines the order in which the information is presented to the user.

For physicians, the term relevance carries a broader meaning. Physicians are not just concerned with the inherent performance of an information search engine. In an epistemological sense, physicians are interested in relevance from a real-world, practical, patient-care perspective. To physicians, the material implications of medical information, as well as the contingency relationships that balance the truthfulness of the information against its contradictions, are most germane. In many ways, the physician's perception of relevance is more akin to that of an economist—that is, relevance as a calculation of the risk associated with use of the information for decision-making for medical purposes.²¹

To reconcile these themes, cognitive scientists have posited that relevance is central to both decision reasoning and communication.²² By expressing relevance in propositional and goal-directed terms that are applicable to real-world problem solving,²³ physicians can define relevant information as information that supports best-evidence decision-making based on what will work as a matter of

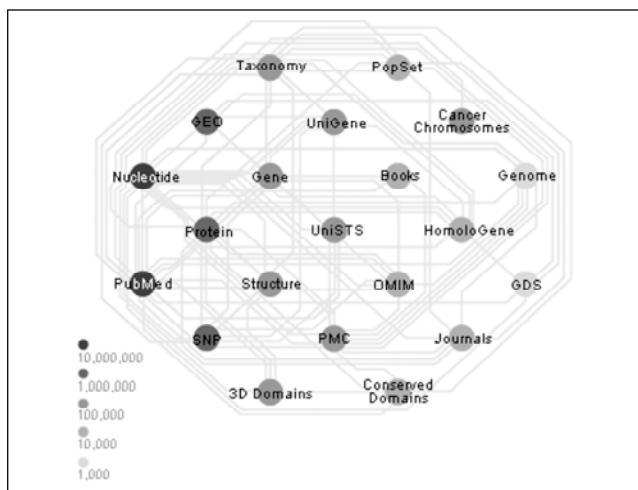
empirical fact, rather than as a state of the clinician's personal beliefs or intuition.²⁴

Features of Trusted, Relevant Resources

General themes tend to recur among Web-enabled medical information resources. These themes can be organized into a trust-relevance feature set for evaluating medical resource engines.

Domain adherence describes how well the resource provides requested information when compared with what it proposes to achieve. For example, if the information resource states it retrieves only publications on cardiology, does it fetch some publications on cardiology as well as some publications on endocrinology, while not retrieving additional publications on cardiology?

Domain coverage describes the breadth of the information resource. For example, if the information resource states it retrieves only publications on cardiology, does it fetch only general cardiology publications, or does it also get subspecialty cardiology publications as well, such as pediatric cardiology?



Comprehensibility reflects the physician's ability to understand the information that is retrieved for the purposes of clinical decision-making. Quite simply, how easily can a practicing physician relate the facts presented by the resource to patient care? Do "statistical jugglery" and "techno-jargon" obfuscate information and impede the articulation of a clear plan of care?

Autoritativeness reflects the influence of the medical information. Although an elusive concept, certain questions should be answered when assessing the potential influence of an information resource on medical care. What is the origin of the information? Is the information derived from a primary or secondary source? Does the information resource provide annotated references or citations that will enable physicians to validate the source and facts as presented?

Conciseness of results reflects efficiency by comparing information resources that retrieve an ordered or concise set

of articles or summaries with those resources that "dump" a disorganized group of documents or hyperlinks into the physician's lap.

Linkages to related resources enable physicians to expand their medical information horizons. Specifically, ease of connectivity between resources provides complementary or enriching information that could benefit physician inquiry. For example, fueled by discoveries in basic clinical and biological research, the biomedical domain is witnessing an inordinate inflow of information that is constantly updating knowledge with new findings and therapies. Information resources that contend that they are complete should have links to other biomedical knowledge sources that publish new findings (see Figure 1). This connectivity enables physicians to uncover unrecognized previously existing relationships for personal growth and the advancement of medical care.

Cost encompasses direct cash outlays, such as fees, for services; the time-value of money, which assesses how quickly a physician is able to access information during busy office hours; and the opportunity cost of the information search, which measures whether another search method, such as consulting a peer down the hallway, provides the information in a more efficacious manner.

Curation reflects how well the information resource's database is constructed and maintained. Information resources need to perform curation, refinement, or rephrasing of their content to make documents and publications easily accessible to a wider interdisciplinary audience. It is important to know if standards are available that attest to the reliability and validity of the database entries, and if there is published documentation that the information resource is not only useful but has a track record of retrieving appropriate medical information. Finally, it is important to know whether the information resource uses manual or automated curation. With manual curation, knowledgeable experts generate the database content after sifting through existing publications and research. For example, an article in UpToDate is a compilation of reviews by medical domain experts. The automated curation approach employs computer algorithms to sift through millions of knowledge sources to generate database content automatically. Intuitively, the manual approach would tend to produce more trustworthy content. However, sophisticated computer algorithms sometimes produce better results on a larger scale. For example, an article found using Google Scholar²⁶ is based on the "goodness" of a document, according to the number of other "good" documents that link to it.²⁷ An ideal approach is to combine the efforts of expert curators and computerized methods, resulting in more reliable and comprehensive as well as speedier database generation. The Entrez/PubMed system applies just such a methodology.²⁸

Usability reflects the ease of information retrieval of an

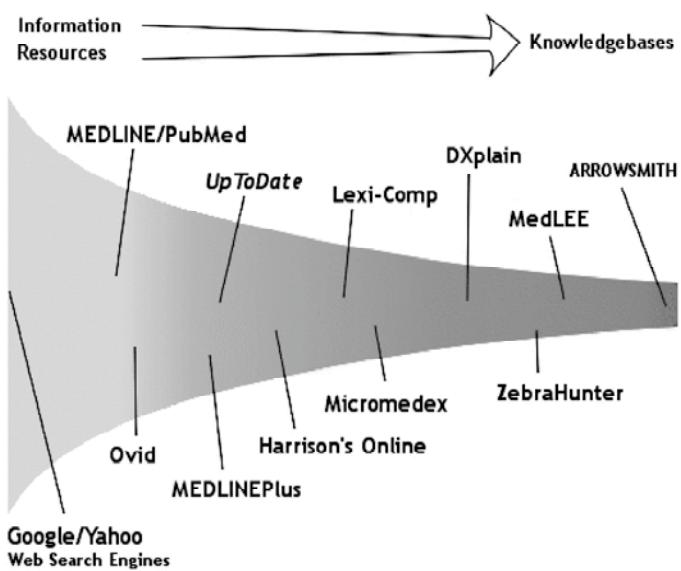


Figure 2. The Spectrum of Information Retrieval Resources in Biomedicine

information resource. Are instructions for use clear and associated with easily accessible help functions that expedite individual learning curves? Do advanced search techniques enable more efficient use of the system? Additionally, from a physician's perspective, an information resource must offer specific, biomedicine search features that are readily accessible. The sociotechnical factors that gauge the feature-accessibility balance are expert-novice configurability and visual noise. Expert-novice configurability implies that a physician should be able to open a Web browser and begin using the information resource without training. In this regard, individuals possess mental models for information searching where they expect to use an empty text box and a search button.²⁹ Unfortunately, the lack of flexibility and the complex queries preferred by physicians require input wizards that disrupt workflow and take significant time before producing the final results. Visual noise represents the amount of irrelevant information presented on the screen along with the actual result. The 79

Web's mass media model enables the display of targeted advertising, pop-ups and malicious programs that degrade users' experiences. For physicians, being bombarded by irrelevant information is a distraction and a deterrent to using the resource.

The Spectrum of Information Retrieval

Based on the trust-relevance feature set, various medical information resources can be described through a spectrum of comparison based on the resource's structure and its information retrieval focus (see Figure 2). At one end of the spectrum, general information resources use text documents

or publications to satisfy an information query—for example, if one queries Google or PubMed for information on sodium, documents containing the term Sodium or Na are retrieved. However, at the other end of the spectrum, resources use computer-interpretable knowledgebases. If someone queries for Sodium, the knowledge links in the resource can infer that sodium is related to hypo- or hypernatremia and return information that could be considered more intelligent.

Here are descriptions of and inherent trade-offs between various medical information resources and some examples of how the trust-relevance feature set can be useful for selecting a resource to assist with clinical decision-making.

Search engines (Google and Yahoo).

Currently, the World Wide Web has more than 11.5 billion Web pages and is growing each year.³⁰ Based on the Pew Internet and American Life Project study,³¹ 93 million Americans have used the Internet to search for health-related information. The most preferred access points to the Web are search engines³² such as Google, Yahoo, and MSN, which index much of the content on the Web and provide ranked results for a keyword-based query.

For example, Google³³ is a hypertextual Web search engine designed to crawl the Web for information retrieval. The software employs a proprietary PageRank system³⁴ that determines an individual page or document's value or ranking,³⁵ according to the number of other "good" documents to which it is associated or linked. Similarly, most search engines measure authoritativeness by the total number of incoming hyperlinks from other pages, and relevance by the number of keyword matches for the given query.

Unfortunately, the ranking of retrieval results across the different search engines is extremely inconsistent. Therefore, a physician viewing a query result must take additional steps to both verify the relevance and decide whether or not to trust the information displayed on the Web page.

Reference Databases (MEDLINE, Entrez/PubMed,

Ovid Medline and MedlinePlus). MEDLINE (Medical Literature Analysis and Retrieval System Online) is the National Library of Medicine's bibliographic database that contains approximately 13 million references to journal articles in the life sciences, with a concentration on biomedicine.³⁶ MEDLINE indexes journal articles and books using

the Medical Subject Headings of the Unified Medical Language System controlled terminology to create its hierarchy for information retrieval. MEDLINE may be searched via the Entrez Gateway using PubMed, one of a series of databases provided by the National Center for Biotechnology Information, a première Web site for biomedical and bioinformatics research.

Ovid Medline³⁷ is a proprietary information retrieval application that searches MEDLINE as well as other bibliographic databases (Cochrane EBM Reviews) to provide medical information. Finally, MedlinePlus³⁸ is a medical information resource that draws from the National Institutes of Health and functions as a medical encyclopedia, a medical dictionary, and a consumer-centric information resource for prescription and nonprescription drugs, consumer health news, and clinical trials information.

"In an epistemological sense, physicians are interested in relevance from a real-world, practical, patient-care perspective."

Reviews and Meta-information (UpToDate and Harrison's Online). The UpToDate³⁹ information retrieval system gives physicians current, topical medical reviews written by expert physicians. The comprehensive database is fully annotated and undergoes an extensive, peer review process of more than 330 journals per month to ensure that the information and recommendations are accurate and reliable. The system makes available current answers to clinical questions, identifies the clinical manifestations of a wide variety of diseases and disorders, and describes the current options for diagnosis, therapy, and management.

Harrison's Online, the electronic version of Harrison's Principles of Internal Medicine, serves as the flagship for McGraw-Hill's AccessMedicine educational resource for physicians and patients.⁴⁰ Via the AccessMedicine home page, users can search Harrison's Principles of Internal Medicine; review current and important updates in medicine through Harrison's Online Updates; scan drug reviews; and explore "Diagnosaurus,"⁴¹ a differential diagnosis decision support tool based on patient symptoms, possible diseases, or organ system involvement.

Medication information (Lexi-Comp and Micromedex). The Lexi-Comp Knowledge Solution and Lexi-Comp Online⁴² offer a real-time platform for integrating hospital information systems with specific formularies while enabling unlimited access to the entire site by physicians. Lexi-Comp Online focuses on medication management by providing the most current, clinically relevant content to help physicians make safe point-of-care patient therapeutic

decisions. Lexi-Comp offers a comprehensive suite of medication management information resources via managed drug databases, special search functions for therapeutic changes and drug alerts, unique modules such as drug images, and specialized applications that combine the worldwide literature and scientific understanding of drug and natural product interactions to protect against adverse drug events.

Thomson Micromedex⁴³ provides a broad spectrum of medication management information including the DRUGDEX comprehensive drug reference, the Martindale drug information from Royal Pharmaceutical Society, summarized drug information, the Physician's Desk Reference Online, and the IV INDEX for intravenous medication compatibility.

Decision support (DXplain). Developed at the Laboratory of Computer Science at the Massachusetts General Hospital, the DXplain decision support system serves as both an electronic medical textbook and a medical reference system.⁴⁴ In its reference or case analysis mode, DXplain accepts a set of clinical findings (signs, symptoms, and laboratory data) to produce a ranked list of diagnoses that might explain or be associated with the patient's clinical findings. In addition, each finding is assigned an associated disease-independent term importance from 1 to 5 indicating how important it is in explaining the presence of the disease. DXplain provides justification for each differential diagnostic choice, suggests additional clinical information that would help clarify each diagnosis, and lists those clinical manifestations, if any, that would be unusual or atypical for each disease.

As a medical textbook, DXplain can describe more than 2,200 different diseases, emphasizing the etiology, signs and symptoms, pathology, and prognosis of each disease. In addition, DXplain provides a list of diseases that should be considered for more than 4,900 different clinical manifestations as well as many as 10 references for each disease, selected to emphasize clinical reviews when available.

Information extraction and knowledge discovery (MedLEE, ZebraHunter and Arrowsmith). Although the present status of information retrieval is helpful for physicians, it is worthwhile to take a glimpse at what the future holds for retrieving medical information for patient care. Developed at Columbia University, the Medical Language Extraction and Encoding System⁴⁵ (MedLEE) is a clinical natural language processing system that uses a combination of linguistic and heuristic domain knowledge to extract, structure, and encode clinical information in textual patient reports so data can be used by physicians for clinical decision-making. Structurally, MedLEE consists of a preprocessor that delineates the sentences of the report; a parser that utilizes the grammar and categories assigned to the sentence phrases to recognize well-formed syntactic and semantic patterns; a phrase regularizer that replaces the

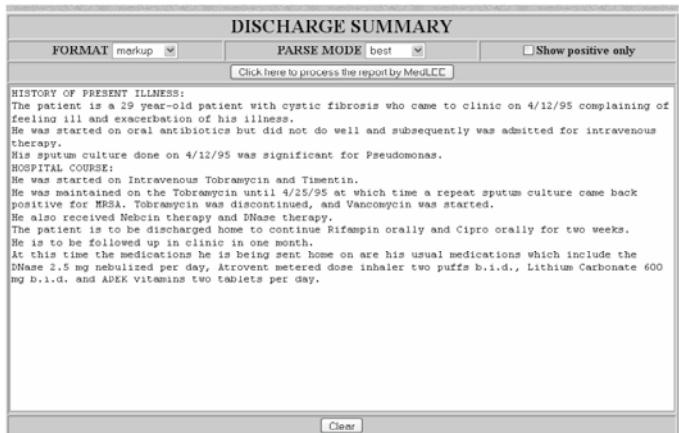


Figure 3. Dictated Textual Discharge Summary as Prepared by a Typist for Entry into the Medical Records System

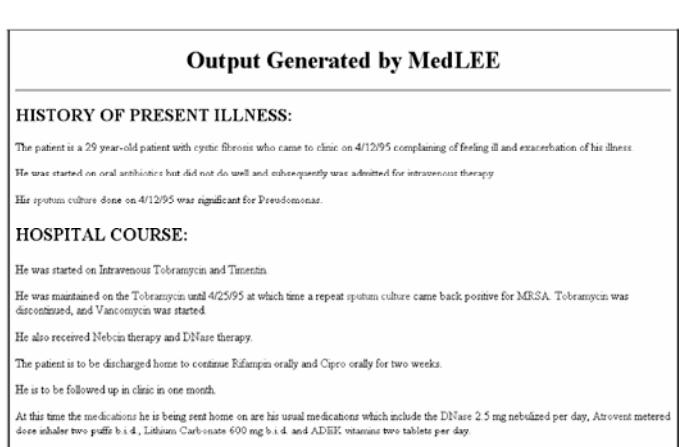


Figure 4. A MedLEE Processed Discharge Summary that Marks-up the Diagnoses (red), the Diagnostic Procedures (green), and the Medications (brown), so Physician's Can Expediently Evaluate Different Aspects of the Patient's Care

canonic output specified in the lexical definition of the phrase with its associated position in the report; and an encoder that maps the canonic forms into controlled vocabulary terms. The system generates structured output that consists of tagged text in either indented MedLEE, XML, HL7, or clinical markup format that can be used by physicians for categorizing various aspects of patient care (see Figures 3 and 4).^{46,47}

Also developed at Columbia University, ZebraHunter⁴⁸ is a Web-enabled medical literature information retrieval and extraction application that employs a complex series of wrappers, algorithms, and natural language processing tools linked to a curated database of case reports, clinicopathological conferences, and clinical images. Based on the

physician's query, the application retrieves a set of citations and references that are associated with a differential of complex and rare clinical diagnoses based on the patient's particular set of clinical signs, symptoms, and findings.⁴⁹

Finally, supported by the National Library of Medicine and the National Institute of Mental Health's Human Brain-Neuroinformatics Research Project through the University of Illinois at Chicago, Arrowsmith⁵⁰ is a medical information retrieval system that queries MEDLINE through the Entrez/PubMed Gateway to identify common items or concepts that are present in two distinct sets of documents or publications for the purpose of knowledge discovery. In addition, the system can identify information that is present in one medical domain that may be relevant to another domain of inquiry. By using the Author-ity tool, the system accepts as input an author's name associated with a specific article in MEDLINE and returns as output a list of all articles with that name ranked by decreasing probability that they are authored by the same individual.⁵¹

Four Clinical Scenarios

The following scenarios depict four common situations for which information retrieval is essential for patient care. Each section describes the applicable trust and relevance features, the information resources that would satisfy those conditions, and how the resource would be helpful to the physicians under those circumstances.

For biosurveillance, physicians need clinical reports and notifications about new rapidly evolving infectious illnesses. The Center for Disease Control's Morbidity and Mortality Weekly Report⁵² used in conjunction with UpToDate are an effective combination of resources that rely on strong domain adherence and coverage as well as authoritativeness for retrieving the most useful information.

In a busy private practice, a physician who is caring for a patient with a rare genetic disorder might wish to look up associated clinical findings. Because work process compatibility, conciseness of results, and usability are important, The Office of Rare Diseases' Term Definitions⁵³ or Harrison's Online are resources that can quickly retrieve the necessary facts with minimal disruption to the physician's work pattern.

In a high-volume emergency department, when patients come in with various signs and symptoms, the physician is concerned with rapidly retrieving a differential diagnosis to use as a springboard for further evaluation. Under these circumstances, the domain coverage, comprehensibility, and usability of DXplain would be most useful.

When requesting a consultation, a physician might feel fairly certain that a patient is suffering from a rare condition. Because citing corroborating literature is important for supporting this impression, the ZebraHunter bibliographic retrieval is an authoritative and well-curated resource that can increase the physician's diagnostic level of confidence when conferring with a colleague.

Conclusion and Future Directions

In the current medical practice environment, the physician faces the daunting challenge of not only searching for trustworthy and relevant medical information and applying that information appropriately for meaningful patient care. However, in the face of overwhelming odds, current and developing innovations in medical information retrieval will help them.

This paper gives physicians reasonable discussion points regarding these concerns, a usable framework for evaluating information retrieval innovations and explanations of the different capabilities of representative information retrieval tools and applications. By demystifying the concepts associated with information resources, search engines, and retrieval tools, and giving physicians a reasonable view of current opportunities as well as future possibilities, physicians can more rapidly adopt innovative computer-assisted search tools for acquiring information that facilitate patient care decision-making.⁵⁴

To harken back to the start of this article and the use of

Google, although serendipity is defined by a combination of sagacity and good fortune,⁵⁵ an even mixture of the former and the latter is not tolerable when it comes to the practice of medicine. The Fellow's serendipitous googling of a set of findings to retrieve a correct diagnosis might be very much consistent with Google's exhortation of "I'm Feeling Lucky."⁵⁶ However, in medical practice, physicians need the Web to present reliable, consistent, and reproducible "best expert" evidence when they are providing day-to-day care for patients, and Google alone is just not good enough.

Acknowledgment

The authors would like to thank Randolph C. Barrows, Jr., MD; James J. Cimino, MD; Stephen B. Johnson, PhD; John L. Zimmerman, DDS; and Eneida A. Mendonça, MD, PhD, faculty in the Department of Biomedical Informatics at Columbia University, for their critical reading and commentary on this manuscript. This work was supported in part by the National Library of Medicine, Training Grant Number: T-15-NLM007079.

About the Authors

Eric Z. Silfen, MD, MSHA, is a post-doctoral fellow in the Department of Biomedical Informatics and director of the executive education programs.

Chintan O. Patel, MS, is a PhD candidate in the department of biomedical informatics.

References

1. Correspondence. "...And a Diagnostic Test Was Performed". *NEJM*. 2005;353(19):2089-2090.
2. Johnson CM, Johnson TR, Zhang JJ. A User-centered Framework for Redesigning Health Care Interfaces. *Journal of Biomedical Informatics*. 2005;38(1):75-87.
3. Swanson DR. *Medical Literature as a Potential Source of New Knowledge*. Bull Med Libr Assoc. 1990;78(1):29-37.
4. Rogers EM. *Diffusion of Innovation*, 5th ed. New York:FreePress;2003.
5. Cook A, Packer C, Stevens A. Diffusion of Thrombolysis for Acute Myocardial Infarction from 1981 to 2000 in England: Trend Analysis and Comparison with Need. *International Journal of Technology Assessment in Health Care*. 2004;20(4):531-536.
6. Cook A, Packer C, Stevens A. Influences upon the Diffusion of Thrombolysis for Acute Myocardial Infarction in England: Case Study. *International Journal of Technology Assessment in Health Care*. 2004;20(4):537-544.
7. Morrissey J. Harmonic Divergence. Cedars-Sinai Joins Others in Holding off on CPOE. *Modern Healthcare*. 2004;34(8):16.
8. Kaushal R, Kaveh S, Bates DW. Effects of Computerized Physician Order Entry and Clinical Decision Support Systems on Medication Safety: A Systematic Review. *Arch Intern Med*. 2003;163:1409-1416.
9. Koppel R, et al. Role of Computerized Physician Order Entry Systems in Facilitating Medication Errors. *JAMA*. 2005;293(10):1197-1203.
10. Han YY, et al. Unexpected Increased Mortality after Implementation of a Commercially Sold Computerized Physician Order Entry System. *Pediatrics*. 2005;116(6):1506-12.
11. Audet AM, et al. Information technologies: When Will They Make it into Physicians' Black Bags? *Medscape General Medicine*. 2004;6(4):2.
12. Google: "I'm Feeling Lucky", <http://www.google.com/ig?hl=en>, accessed on 9/6/2006.
13. Merriam-Webster Online Dictionary, <http://www.m-w.com/dictionary/trust>, accessed on 9/6/2006.
14. Health on the Net Foundation, <http://www.hon.ch/HONcode/Conduct.html>, accessed on 9/6/2006.
15. Trust in Cyberspace, <http://books.nap.edu/books/0309065585/html/index.html>, accessed on 9/6/2006.
16. 10 Things to Know About Evaluating Medical Resources on the Web, <http://nccam.nih.gov/health/webresources/>, accessed 8/21/2006.
17. BIOME, <http://biome.ac.uk/about/>, accessed on 8/21/2006.

Original Contributions

18. How to Evaluate an Internet-based Information Resource, <http://biome.ac.uk/guidelines/eval/howto.html>, accessed on 8/21/2006.
19. Evaluating Internet Health Information, <http://nlm.nih.gov/medlineplus/webeval/webeval.html>, accessed on 8/21/2006.
20. Criteria for Evaluating the Quality of Health Information on the Internet—Policy Paper, <http://hiitweb.mitretek.org/docs/policy.html#top>, accessed on 8/21/2006.
21. Keynes JM. *Treatise on Probability*. London: MacMillan;1921.
22. Sperber D, Wilson D. Précis of Relevance: Communication and Cognition. *Behavioral and Brain Science*. 1987;10:697-754.
23. Gorayska B, Lindsay RO. The Roots of Relevance. *Journal of Pragmatics*. 1993;19:301-323.
24. Lindsay R, Gorayska B. Relevance, Goals and Cognitive Technology. *International Journal of Cognitive Technology*. 2002;1(2):187-232
25. National Center for Biotechnology Information, <http://www.ncbi.nlm.nih.gov/Database/datamodel/index.html>, accessed on 9/6/2006.
26. Google, <http://scholar.google.com/>, accessed on 9/6/2006.
27. Ridings C, Shishigin M. Page Rank Uncovered. 2002. www.voelspriet2.nl/PageRank.pdf, accessed on 9/6/2006.
28. Aronson AR, et al. The NLM Indexing Initiative. Proc AMIA Ann Symp. 2000:17-21.
29. Calongne, CM. Designing for Web Site Usability. Proceedings of the seventh Annual Consortium for Computing in Small Colleges. 2001:39-45. <http://portal.acm.org/citation.cfm>, accessed on 9/6/2006.
30. Gulli A, Signorini A. The Indexable Web is More Than 11.5 Billion Pages. In Special interest Tracks and Posters of the 14th International Conference on World Wide Web. ACM Press, New York, NY. 2005:902-903.
31. Pew Internet and American Life Project, http://207.21.232.103/PPF/r/95/report_display.asp, accessed on 9/6/2006.
32. Search Engine Watch, <http://searchenginewatch.com/reports/article.php/2156451>, accessed on 9/6/2006.
33. Google Technology, <http://www.google.com/technology/>, accessed on 9/6/2006.
34. Page L. The PageRank Citation: Bringing Order to the Web. January 29, 1998. <http://dbpubs.stanford.edu:8090/pub/showDoc.Fulltext?lang=en&doc=1999-66&format=pdf&compression=&name=1999-66.pdf>, accessed on 9/6/2006.
35. Henzinger M and Lawrence S. Extracting Knowledge from the World Wide Web. PNAS. 2004;101(Suppl.1):5186-5191 www.pnas.org/cgi/doi/10.1073/pnas.0307528100, accessed on 9/6/2006.
36. MEDLINE, <http://medline.cos.com/>, accessed on 9/6/2006.
37. Ovid, <http://gateway.ut.ovid.com/>, accessed on 9/6/2006.
38. MedlinePlus, <http://medlineplus.gov/>, accessed on 9/6/2006.
39. UpToDate, <http://www.uptodate.com/physicians/index.asp>, accessed on 9/6/2006.
40. Harrison's Online, <http://www.accessmedicine.com/resourceToc.aspx?resourceID=4>, accessed on 9/6/2006.
41. Diagnosaurus, <http://www.accessmedicine.com/diag.aspx>, accessed on 9/6/2006.
42. Lexi-Comp, <http://www.lexi.com/web/index.jsp>, accessed on 9/6/2006.
43. Micromedex, <http://www.micromedex.com/index.html>, accessed on 9/6/2006.
44. DXplain, <http://www.lcs.mgh.harvard.edu/>, accessed on 9/6/2006.
45. MedLEE, <http://lucid.cpmc.columbia.edu/medlee/>, accessed on 9/6/2006.
46. Friedman C, et al. Automated Encoding of Clinical Documents Based on Natural Language Processing. *J Am Med Inform Assoc*. 2004;11:392-402
47. Friedman C, et al. Representing Information in Patient Reports Using Natural Language Processing and the Extensible Markup Language. *J Am Med Inform Assoc*. 1999;6:76-87
48. ZebraHunter, www.zebrahunter.org, accessed on 9/6/2006.
49. Silfen E, Patel CO, Mendonça E, Friedman, C. ZEBRAHUNTER: Mining Case Reports in MEDLINE to Find Rare Medical Diagnoses and the Relevant Citations. Department of Biomedical Informatics, Columbia University, submitted for publication.
50. Smalheiser NR, Torvik VI, Weeber M, Swanson DR. The Arrowsmith Project: New Tools to assist Biomedical Discovery and Collaboration, presented at the Beckman Institute, University of Illinois at Urbana-Champaign, October 1, 2002. http://arrowsmith.psych.uic.edu/arrowsmith_uic/index.html, accessed on 9/6/2006.
51. Smalheiser, NR. The Arrowsmith Project: 2005 Status Report. Invited address at the 8th International Conference on Discovery Science and the 16th International Conference on Algorithmic Learning Theory, October 8-11, 2005, Singapore. To appear in Lecture Notes in Artificial Intelligence (A. Hoffman, H. Motoda, and T. Scheffer, Editors) 3735:26-43. Lecture Notes in Computer Science Series. Copyright Springer-Verlag, accessed on 9/6/2006.
52. Morbidity and Mortality Weekly Report, <http://www.cdc.gov/mmwr/weekcvol.html>, accessed on 9/6/2006.
53. Office of Rare Diseases, <http://rarediseases.info.nih.gov/>, accessed on 9/6/2006.
54. Chen H, Fuller SS, Friedman C, Hersh W. Knowledge Management, Data Mining and Text Mining in Medical Informatics. In: Chen H, Fuller SS, Friedman C, Hersh W, eds. *Medical Informatics - Knowledge Management and Data Mining in Biomedicine*. 2005
55. Coined by Horace Walpole (1754) after The Three Princes of Serendib (i.e. Ceylon), a Persian fairy tale in which the princes always make discoveries of things they were not in quest of either by accident or sagacity.
56. Google: "I'm Feeling Lucky", <http://www.google.com/>, accessed on 9/6/2006.

Journal of Healthcare Information Management Writer's Guidelines

The *Journal of Healthcare Information Management* (JHIM) is a quarterly peer-reviewed journal devoted to healthcare information and management systems. It is published by the Healthcare Information and Management Systems Society (HIMSS), a not-for-profit membership organization dedicated to promoting a better understanding of healthcare information and management systems, and to the professional growth of its members.

Readership and Circulation

JHIM's circulation is approximately 14,000. The primary audience includes healthcare professionals in hospitals, corporate healthcare systems, clinical practice groups, vendor organizations, healthcare consulting firms, and government settings in professional levels ranging from senior staff to CIOs and CEOs. JHIM is indexed by the American Hospital Association's Hospital Literature Index and the National Library of Medicine's on-line bibliographic database, Health.

Abstract Submission

Authors should submit a one-page proposal including the following:

- 150 – 200 word abstract
- Complete name, title, address, telephone number, fax number, and e-mail address of all potential authors

Sent to Nancy Vitucci, Senior Editor, HIMSS, 230 E. Ohio Street, Suite 500, Chicago, IL 60611; nvitucci@himss.org.

Manuscript Submission

JHIM seeks articles in the following formats:

- **Market Analysis:** Articles defining the state of the field, or its various components, and identifying information and management system needs.
- **Technology Overview:** Articles surveying and defining the key enabling technologies and/or business methodologies for the industry or its components (mobile computing, relational databases, handwriting/voice recognition, etc.), formulas for budgeting and/or needs assessment.
- **Case Studies:** Articles explaining the who, what, when, how, and why of a particular problem or challenge, and how it was solved or solution proposal. These include consumer-focused case studies. We discourage any type of marketing article, but allow for the name of the product to be mentioned once in the article. Generally, the product should be described in generic terms. The study should include some testimonial from the provider describing the provider's experience with the product. We strongly suggest that these articles be co-authored by the provider and vendor.
- **Data-driven Research, Pilot Studies, and Studies in Conjunction with Universities:** These articles should follow the general format for a scientific article: Introduction, Methods, Results, and Comments.
- **Book/Literature/Resource Review:** In-depth articles reviewing a book or resource (including online products and services); articles surveying a variety of resources to further readers' understanding of the field.

Sent to Nancy Vitucci, Senior Editor, HIMSS, 230 E. Ohio Street, Suite 500, Chicago, IL 60611; nvitucci@himss.org.

Manuscript Preparation

Length

- 3,000 – 5,000 words, single-spaced, excluding figures, tables, and appendices
- Author biographies are limited to 30 words and should appear at the end of text.

Abstract

- Maximum of 150 words
- Keywords
- 6 – 10 keywords

Layout

- Use standard-sized 8" x 11" white paper with one-inch margins on all sides.
- Use single column format, single spaced, ragged right.

Font

- Use 10 point or 12 point type for body copy. Serif fonts such as Palatino or Times Roman are preferred.
- Use plain text. Do not bold, underline, or italicize any words, headings, and/or titles.

- Text included in charts, graphs, and figures should be as large as possible to maximize readability.

Headings

- Include an abstract at the beginning of the paper.
- DO NOT leave blank pages or columns within the document.
- DO NOT start each new section on a new page.
- Major headings should be in CAPITAL LETTERS, flush left within the column. Please DO NOT bold.
- Subheadings should be in upper and lowercase 10 or 12 point, flush left within the column on a separate line following paragraph. Please DO NOT bold.
- Sub-subheadings should be in upper and lowercase, 10 or 12 point, flush left within the column at the beginning of the paragraph. Please DO NOT bold or italicize.

Figures/Graphs/Charts

- Limit the number of figures, graphs, and charts to three.
- Assign a title and figure number to each. In text, refer to all figures, graphs, and charts by title and figure number.
- Label x and y axis of every graph.
- Distinguish bars or pie chart sections by pattern, not color.
- DO NOT embed graphics in the manuscript/word processing file. Save all graphics in a separate graphics file. Use the figure title and number for file name.
- Graphic files must be a minimum resolution of 300 dpi.
- Two high-resolution hard copies of each graphic will be required for scanning if graphics are not retrievable.

Column Preparation

Length

- 1,000 – 1,500 words, single-spaced

Layout

- Use standard-sized 8" x 11" white paper with one-inch margins on all sides.
- Use single column format, single-spaced, ragged right.
- Bulleted lists should not be used excessively. Periodic use is acceptable; however, manuscript should not be formatted as a series of bulleted lists. Manuscripts submitted in this format may be sent back to the author for revision prior to review by our editor.

Font

- Use 10 point type for body copy. Serif fonts such as Palatino or Times Roman are preferred.
- Use plain text. Do not bold, underline, or italicize any words, headings, and/or titles.

File Format

Required Media: CD ROM

Provide text as straight text, following the minimal formatting guidelines previously stated. Save each figure and graphic in a separate graphic file. Page breaks, bolding underlining, italicizing, etc., are strongly discouraged. The original hard copy layout of the document will be used as a reference.

Acceptable word-processing software:

Word
WordPerfect
Note: If using Windows, please save in Word 97 or below.

Graphics:

Do not create graphics (tables, figures, charts, graphs, illustrations) in a word processing program.

Graphic file formats:

JPEG • TIFF • EPS
PDF (Important: When sending PDF files of graphics, save them as "press optimized." To do this, when printing to the PDF Distiller, click on "Properties." Then, click on a tab called "Adobe PDF Settings." The first section of this tab is "Conversion Settings" with a drop-down menu. Chances are it will be set to "E-book." Select "Press" from the drop-down menu. This produces the highest resolution PDF suitable for offset printing.)

Electronic Submission

Manuscripts that do not contain figures or graphs may be submitted via e-mail. Send to nvitucci@himss.org.

Style and Presentation

- Use standard spelling, style, reference, and grammar guides such as Webster's New Collegiate Dictionary, the American Medical Association Manual of Style, and The Elements of Style.
- Use active sentences and be specific. Back up generalities with examples. Avoid jargon.
- All articles will be copy edited and, where necessary, rewritten. The process by which authors may review and approve changes is defined in the letter of agreement.

References

Submit only complete references.

- In the text body, numbers should appear in square brackets [1]. In reference list, numbers should be in bullet format.
- Use AMA style for references. Please refer to the following examples:

Books

- 1. Foreman, J.F. & Fulkerson, W.F. (1997). *HIMSS Writer's Guidelines*. Chicago, IL: Healthcare Information and Management Systems Society.

Periodicals

- 2. Gabriel, D. (1996). New team, new look. *HIMSS News*, 6, 12, 10–12.
 - Reference list should begin on a separate page following the document.
 - References should be numbered and listed in the text body in order of appearance.

Submission Checklist

1. Manuscript on CD ROM following formatting guidelines.
2. One hard copy, with art and figures saved separately. Hard copy should indicate where within the text to place the art and figures.
3. Two (2) separate copies of each piece of art.
4. Signed letter of agreement. Each author must sign and submit a letter of agreement.
5. Keywords. **Must be included in manuscript.**
6. Abstract. **Must be included in manuscript.**
7. Author's bio information. **Must be included in manuscript.**
8. Send to: Journal of Healthcare Information Management, Attention: Nancy Vitucci, Staff Editor, 230 E. Ohio Street, Suite 500, Chicago, IL 60611–3269. Files may also be sent electronically to nvitucci@himss.org.

Journal of Healthcare Information Management 2007 Editorial Calendar

WINTER 2007—Process Improvement/project management

Abstracts due: July 17, 2006
Manuscript due: September 7, 2006

SPRING 2007—Clinical decision support/business decision support

Abstracts due: October 16, 2006
Manuscripts due: December 6, 2006

SUMMER 2007—RHIOS and the NHIN

Abstracts due: January 10, 2007
Manuscripts due: March 2, 2007

FALL 2007—Economics of HIT (ROI, pay-for-performance, etc.)

Abstracts due: April 16, 2007
Manuscripts due: June 6, 2007

HIMSS Toolkit

Helps You Keep Information Under Wraps

The newly enhanced Privacy & Security Toolkit from HIMSS provides principles you can use to improve the way you handle information—and it's a free resource that's available to everyone!

Vital Implementation Tips

Each Toolkit section contains key activities to help you implement information management processes, including how to:

- Keep up with changing laws and regulations
- Help patients understand your privacy and security measures
- Institutionalize responsibility for information privacy and security

Plus, you get the most up-to-date privacy and security guidelines and literature, case studies with sample policies, procedures, forms, and references for more information.

No-Risk, No-Cost Investment

It's easy to get your free Toolkit. Just go online to www.himss.org/cpri_toolkit. The Toolkit is there to help you design the information management processes you need for your organization!

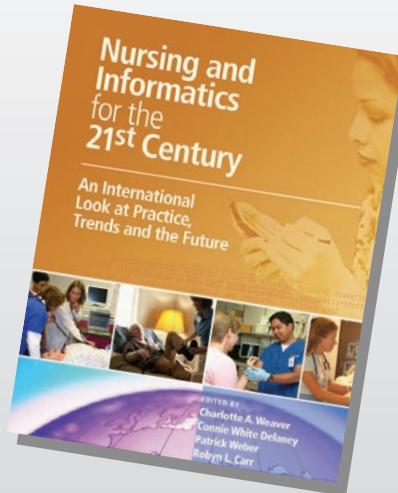
HIMSS®

New from HIMSS...

A thorough exploration of the revolution taking place in nursing today and the major role of information technology in the transformation!

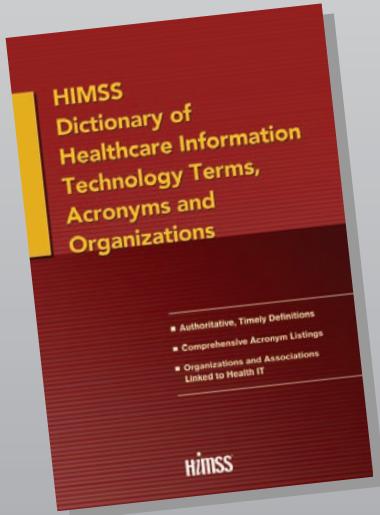
Nursing and Informatics for the 21st Century: An International Look at Practice, Trends and the Future

Written and edited by recognized experts and innovators who make IT projects happen across the globe, this comprehensive overview of nursing and informatics belongs on your bookshelf!



Member Price: \$75.00 Regular Price: \$90.00

A true industry resource that compiles terms from informatics, IT, providers, payors, government, standards groups and organizations.



HIMSS Dictionary of Healthcare Information Technology Terms, Acronyms and Organizations

The ultimate resource for definitions, cross references and more for terms used in clinical, medical and nursing informatics fields.

Member Price: \$25.00 Regular Price: \$35.00

Add these vital resources to your healthcare IT bookshelf.

Order yours today!

To learn more about all the publications and educational tools HIMSS has to offer, visit www.himss.org/bookstore.

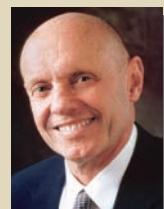
HIMSS[®].org

SAVE THE DATE: HIMSS07 in New Orleans

February 25 - March 1, 2007



Steve Ballmer
Chief Executive Officer
Microsoft



Dr. Stephen R. Covey
Co-Founder and
Vice-Chairman
Franklin Covey Company



General Colin L. Powell
US Army (Ret.)
Former US Secretary of State

transforming healthcare through IT™

- When you attend any of the 300+ educational sessions presented by leaders in the field;
- When you experience the future of healthcare IT products in the Interoperability Showcase;
- When you interact with the leading healthcare IT companies to learn the right solutions for your organization;
- When you have the opportunity to network with thousands of other healthcare IT professionals and learn about the latest technical, commercial and policy developments;
- When you customize your conference to navigate the many educational and networking opportunities;

innovation will happen.

Come experience the New Orleans renaissance and take advantage of the many hotels and restaurants now open and better than ever—and within walking distance of the Ernest N. Morial Convention Center.

Registration is Now Open - Register and save!
www.HIMSS07.org

HIMSS®07
Annual Conference & Exhibition
FEBRUARY 25 - MARCH 1, 2007 / NEW ORLEANS