



Do Information Systems Affect Adverse Events in Hospitals—and the Workload of Nurses?

Measuring the impact of communications technologies on nurses

SUMMARY

In the late 1990s the Veterans Administration (now called the U.S. Department of Veterans Affairs) (VA) implemented two major information systems covering electronic patient records and the administration of medications. VA administrators expected the technologies to reduce errors in patient care and improve the work environment for staff.

From November 2004 to July 2008 researchers with the School of Nursing at the University of California, San Francisco, measured the effect of the two information systems on the number of adverse events—that is, avoidable complications resulting from medical treatment—experienced by patients and the hours worked by nurses.

Key Findings

- Most VA staff and managers view the information systems as important and useful in helping ensure that the VA provides excellent care to veterans.
- There were few relationships between the implementation of the information systems over time and changes in the number of adverse events.
- Payroll data indicated that staffing hours did not change with the implementation of the new information technologies.
- Adequate training, equipment and staff resources and stable positive leadership contributed to smoother implementation and greater acceptance of the new technologies. Key factors in effective implementation included:
 - How well the hospital and implementation team plan for setbacks
 - The development of a flexible implementation approach
 - Allocating adequate resources, such as a concise set of documentation
 - Providing support staff to offer hands-on assistance during implementation

- Deploying additional patient care staff during implementation
- The strength of organizational culture and leadership
- A work environment in which staff concerns and problems are respected

Key Recommendations

The research team offered the following recommendations regarding the effective implementation of information technologies:

- Provide adequate training and support staff.
- Additional patient care staff should be deployed during a transitional period.
- Health care leaders must expect that there will be setbacks during an information technology implementation and must address these setbacks thoughtfully and deliberately.

Funding

The Robert Wood Johnson Foundation (RWJF) funded this study with a \$150,000 grant.

THE PROBLEM

In the late 1990s the Veterans Administration (VA) implemented two major information systems to enhance record keeping and quality of care in its hospital system:

- The Computerized Patient Record System—a comprehensive electronic patient medical record, covering both outpatient and inpatient services
- Bar Code Medication Administration—a computerized pharmacy ordering, distribution and administration system for use in the inpatient setting

According to University of California researchers, VA administrators expected the information systems to improve the quality of care for several reasons, including:

- Complete patient records would provide accurate information to all care providers.
- Cross-checks on the administration of medication could prevent errors.
- Computerized entry of orders would avoid errors resulting from misreading.
- Adoption of new information systems could raise staff morale, which has been linked to improved quality of care.

Although the VA differs from other hospital systems in several ways (such as its size, funding, patient base and staffing model), its experiences and successes in introducing new information technologies could inform health reform efforts elsewhere. However,

there had been no formal evaluation of the effect of these information systems on VA medical staff or patients, and there was little research on the effects of these types of systems in other hospitals and health care facilities.

RWJF STRATEGY

This grant was made by RWJF's Quality/Equality team in 2004. The team's strategies are posted on the RWJF [website](#).

THE PROJECT

Researchers with the School of Nursing at the University of California, San Francisco (UCSF), sought to determine the effects of the Veterans Administration's (VA) new information systems on patient safety and nursing staffing levels. With input from a five-member advisory committee of VA officials (see [Appendix 1](#) for a list of members), the research team conducted analyses and activities to answer four questions:

- **Did the information systems change the need for nursing staff?** The researchers used the VA's administrative payroll data to look specifically at nurse staffing levels, which they measured in three ways:
 - Registered nurse hours per patient day
 - The log of registered nurse hours
 - Registered nurse overtime hours as a percentage of total registered nurse hours
- **Did the information systems reduce adverse events—avoidable complications resulting from medical treatment—for patients in the VA?** The research team used two sets of quality and patient safety indicators established by the federal Agency for Healthcare Research and Quality (AHRQ), which can be derived from data the VA collects as part of patient records. (For details, see [Appendix 2](#).)
- **What do nursing staff believe are the strengths and weaknesses of the information systems?** The research team visited seven VA hospitals to conduct 118 in-depth interviews with nurses, pharmacists, physicians, information technology staff and managers. The seven hospitals were chosen to cover a range of implementation time lines, geography and staff characteristics, based in part on responses to a Web-based survey of VA facilities.
- **What recommendations can be made to the VA and other hospitals as they implement information systems, based on the findings from the study?**

The research team also conducted and maintained a literature review of papers related to this study, updating it approximately every 18 months.

UCSF awarded a subcontract to the Palo Alto, Calif., VA Health Care System to support the work of two co-investigators:

- Ciaran Phibbs, Ph.D., at the Palo Alto VA
- James Burgess, Ph.D., at the Boston VA

The subcontract also funded a programmer who extracted data from various VA sources.

Other Funders

The Gordon and Betty Moore Foundation provided a matching grant of \$150,000.

Communications

The research team produced a comprehensive report, *The Effect of Information Technology on Nurses and Patients in the Veterans Health Administration*, for the funders and the VA in 2008. The team also made nine presentations to professional groups and wrote two unpublished articles:

- "What Determines Successful Implementation of Inpatient Information Technology Systems?"
- "The Effect of Inpatient Information Technology Systems on Patient Safety"

FINDINGS

The research team reported the following findings in a report, *The Effect of Information Technology on Nurses and Patients in the Veterans Health Administration*, and the two unpublished articles:

- **Most Veterans Administration (VA) staff and managers view the Computerized Patient Record System and Bar Code Medication Administration as important, useful information technology systems that help ensure that the VA provides excellent care to veterans.**
- **The study demonstrated few relationships between the implementation of the information technology systems over time and changes in the number of adverse events.** However, the researchers acknowledged that the outcomes they measured were influenced by many factors and may not have been sensitive enough to these types of technologies to find an effect with these sample sizes.
- **Both the analysis of payroll data and statements from nurses and managers supported the conclusion that staffing hours did not change with the implementation of the new information technologies.**
- **Adequate training, equipment and staff resources and stable positive leadership contributed to smoother implementation and greater acceptance of the new**

technologies. Problems that developed in the early stages of implementation tended to become persistent, particularly if staff developed work-arounds as a way to avoid addressing problems. Key factors in effective implementation included:

- How well the hospital and implementation team plan for inevitable setbacks.
- The development of a flexible implementation approach.
- Allocating adequate resources for the equipment and infrastructure.
- Providing support staff to offer hands-on assistance during implementation.
- Deploying additional patient-care staff during implementation. Because learning how to work with the new systems requires a substantial amount of time, nurses have less time for direct patient care. Hospital administrators must make up for the shortage by putting more staff on the floor.
- The strength of organizational culture and leadership.
- A work environment in which staff concerns and problems are respected by hospital administrators.

RECOMMENDATIONS

In its report to RWJF, the research team offered the following recommendations for the effective implementation of information technologies:

- **Provide adequate training and support staff, both in the classroom and on the units when the system is launched.** Interviewees identified failure to provide 24-hour support as a near-fatal flaw during implementation.
- **Deploy additional patient care staff during the transitional period after the technology is introduced.**
- **Expect that there will be setbacks during an information technology implementation, and address these setbacks thoughtfully and deliberately.** The concerns of the care providers who use the systems must be respected and considered throughout the transitional period. Although the first months of implementation are crucial, effective adoption of these technologies is not a one-time effort, but an ongoing process.

LESSONS LEARNED

1. **Include qualitative data when studying the implementation process for information technology systems.** The principal investigator credits the interviews with key informants for helping understand how the systems affected staff workflow, morale and perceptions of quality of care. (Project Director/Spetz)

2. **Carefully consider the benefits and trade-offs of decisions relating to prospective and retrospective study designs.** Prospective research, in which the events or subjects are identified and then followed forward in time, can be time-consuming and expensive; however, such studies are rewarded with the ability to measure changes accurately. Retrospective research of previously collected data is less expensive and thus attractive to research teams that cannot afford a large research budget. There is, however, a trade-off with respect to the quality and reliability of the quantitative results. Sometimes, the situation determines the study design. In this study, because the VA had not collected data beforehand, the research team had to conduct a retrospective study. (Project Director/Spetz)

AFTERWARD

With the study completed, the research team is writing, revising and submitting articles to professional journals.

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APPENDIX 1

Advisory Committee Members

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APPENDIX 2

Measuring Adverse Events

The research team used two sets of quality and patient safety indicators established by the Agency for Healthcare Research and Quality (AHRQ), which can be derived from data the Veterans Administration (VA) collects as part of patient records. The sets of indicators include the following measures:

- The Inpatient Quality Indicators measure patient volume and inpatient mortality for specific medical conditions and surgical procedures, including the mortality rates for:
 - Coronary artery bypass graft
 - Heart attack
 - Congestive heart failure
 - Stroke
 - Gastrointestinal hemorrhage
 - Pneumonia
 - Percutaneous transluminal coronary angioplasty (i.e., use of a balloon-tipped catheter to enlarge a narrowed artery)

In this study, the researchers focused on the mortality outcomes.

- The Patient Safety Indicators focus on avoidable complications such as:
 - Death in diagnoses typically associated with low mortality
 - Failure to rescue after complication
 - Selected infections resulting from medical care
 - Postoperative hemorrhage or hematoma
 - Postoperative respiratory failure
 - Postoperative sepsis
 - Accidental puncture or laceration
 - Obstetric trauma

The research team did not analyze all these indicators for this study, because some, such as birth and obstetric trauma, had low volumes of patients at risk at the VA, and others did not have a close theoretical relationship to the likely effects of the information systems, especially those that may be sensitive to nursing activities.

BIBLIOGRAPHY

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Articles

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