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FEATURE

ARTICLE

# Clinical Information Systems in Nursing Homes

## An Evaluation of Initial Implementation Strategies

GREGORY L. ALEXANDER, PhD, RN
MARILYN RANTZ, PhD, RN, FAAN
MARCIA FLESNER, PhD, RN
MARGIE DIEKEMPER, MSN, RN, BC
CAROL SIEM, MSN, RN, BC, GNP

This article presents qualitative results collected 6 months after implementation of a clinical information system in four nursing homes in the Midwestern USA. Researchers explored initial implementation strategies, discussed employee experiences and analyzed employee satisfaction. Transcript-based analysis and axial coding were completed to illustrate recurring phenomena. Common attributes were identified by two gerontological nurse experts and a researcher with human factors expertise. Common themes emerging from 22 focus groups and direct observation of more than 120 nursing home staff were perception and cognition, change, workable systems, competence, and connectedness. Implementation strategies associated with lower satisfaction were availability of equipment, training resources, and the presence of information technology professionals. Initial clinical information system implementation strategies and employee satisfaction could be enhanced by the inclusion of a system life cycle charter plan, emphasizing change management procedures, improving start-up projections, hiring adequately trained information technology staff, and providing a system support plan. Findings will be useful to administrators and policy makers who are contemplating implementation of a clinical information system.

**KEY WORDS**

Attitude of health personnel • Human engineering • Informatics • Information systems • Nursing homes

For more than a decade, experts have stressed the importance of integrating clinical information systems (CIS) to improve healthcare practices and patient care quality while reducing medical error.[1–3] Growing evidence demonstrates CIS improve quality of care through computer-assisted diagnosis and disease treatment and management.[4] Recently, long-term care strategists have prioritized implementing interoperable CIS in long-term care settings.[5] Adopting new technologies has historically been slow in long-term care, with as many as 14% of the nation's 17,000 Medicare, Medicaid, and dually certified nursing facilities reporting having no computer system.[6] The Institute of Medicine (2001) report on long-term care indicated that nursing homes "have little experience using information either to evaluate the quality of care or to manage staff activities; they traditionally have not employed floor supervisors with training or expertise in information management. Even today, computers typically are not found at nurses' stations or otherwise accessible to direct care staff."[2(pp224,225)] Thus, health system researchers are uniquely positioned to suggest improvements for future nursing home CIS implementation by examining the link between implementation strategies and employee satisfaction and work performance.

This article presents qualitative research data evaluating the use of bedside data collection with portable computer devices, automated processes, and electronic medical records used in a nursing home CIS called

From the Sinclair School of Nursing, University of Missouri, Columbia (Dr Alexander, Dr Rantz, Dr Flesner, Ms Diekemper, and Ms Siem); and Quality Improvement Program for Missouri (QIPMO) (Dr Rantz, Dr Flesner, Ms Diekemper, Ms Siem).

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Corresponding author: Gregory L. Alexander, PhD, RN, University of Missouri, Columbia, Sinclair School of Nursing S415, Columbia, MO 65211-4380 (e-mail: alexanderg@missouri.edu).

OneTouch Technology (OTT). Research goals were to explore and analyze initial implementation strategies, employee experiences, and factors influencing employee satisfaction. Research participants were from four nursing homes in the Midwestern United States. Data were collected during focus group sessions and direct observations completed 6 months after implementation of the OTT CIS.

## BACKGROUND

### Human Factors

Human factors researchers investigate interrelationships between humans, the tools they use, the environments in which they live and work, and the tasks performed.[7,8] Human factors models have been depicted with the following subsystems: (1) operator, (2) machine (eg, technology), and (3) environment.[9–12] Properties of these subsystems guided this study.

#### OPERATORS

Humans, as operators, are at the core of human factors models.[13] Factors that contribute to or hinder success include usability, human physiologic and psychological readiness to act, standardization, and intuitiveness of design.[14,15] Evaluations strive to improve working environments, reduce fatigue and stress, and increase user acceptance.[13]

#### MACHINE

Current technology issues result from the expanded use of automation, technological controls, visual displays, and workstation structures.[16,17] Objectives of human factors evaluations are to increase reliability, improve maintainability, and reduce training requirements in machine systems.[13]

#### ENVIRONMENT

Pertinent environmental issues are organizational climate, workflow, and system performance. Attitudes toward technology contribute to implementation success or failure. For example, innovations may reduce proceduralized tasks, causing task uncertainty and requiring greater administrative coordination and feedback to prevent system failure.[18,19] Additionally, workflow may be positively or negatively affected by new technologies.[20,21] A study of the adoption of clinical technology in an ambulatory healthcare setting found some users perceived an increased workload. As a result, users either rejected the system after a few attempts or adapted their routines to the system.[22] Systems with a high degree of IT sophistication allow humans and technology to jointly execute tasks, monitor operations, and provide system safety.[23] Technology implementation is complex. Administrators who execute a thoroughly planned implementation strategy are more likely to have a smoother process that is on time, on budget, and supported by employees.[24,25]

### Nursing Home Technology: OneTouch

CIS are absent in most nursing homes. Reasons cited include significant cost of infrastructure, lack of on-site technological expertise, variable competency levels of staff, and high turnover, increasing training costs.[26,27] However, policy makers' recent emphasis on the need to integrate computerized systems in all healthcare settings has advanced the development of IT in nursing homes.[4]

The OneTouch Technology Corporation (now Optimus EMR, Irvine, CA) has developed a CIS for nursing homes that provides real time, automated healthcare records. The technology integrates magnetic iButtons, radio frequency, infrared, personal digital assistants (PDA), and wireless technology through the corporation's proprietary software. Clinical data are collected at the bedside (point of care) on PDAs or personal computers and the software automatically populates all appropriate sections in the electronic health record. The iButton technology located on the resident's identification (ID) bracelet and the caregiver's ID badge makes caregivers more accountable for resident care and documentation. Furthermore, PDA modules provide a template for complete, verifiable documentation and can provide care delivery direction in real time using specific data points in the clinical record. Each touch of the PDA to the iButton creates a bidirectional exchange of information. Information currently provided at the point of care includes vital signs, clinical alerts, nurse messaging, certified nurse assistant (CNA) task lists for care planning, active physician orders, medications, and treatments. Evidence shows that electronic inventions such as these have improved employee satisfaction and quality of care in acute care settings.[28–30] However, few descriptions of its use and effects on quality in long-term care settings exist.[31]

## METHODS

Facilities were recruited to voluntarily participate in an evaluation study by advertising in nursing home association newsletters. Both urban and rural facilities with a mix of ownership types and bed size were sought.

Selected facilities were given an opportunity to receive partial funding for the CIS implementation through a federal grant. However, no funds were provided by the vendor to support this research. Vendor staff met with nursing home leaders who had inquired about the project to evaluate each facility's current technological expertise, environmental needs, and infrastructure. Participating facilities selected implementation strategies appropriate for their facility.

Staff participation in the focus group meetings and observations was voluntary, and incentives were provided to maximize staff participation. Multiple meetings on each shift were scheduled to increase attendance. All employees were invited to attend, regardless of experience using technology, length of employment, or job description.

## Sample

Table 1 displays facility characteristics and total numbers of staff in each classification that participated in focus groups. Facilities ranged in bed size from 98 to 240 and were a diverse mix of location and ownership types. Staff from all three shifts and each of the following working classifications were included: certified nursing assistant (CNA), medical technicians, licensed practical nurses (LPN), registered nurses (RN), supervisors, and administrators. Twenty-two focus groups included 120 employees, with group sizes ranging from four to 12 participants. Administrators were interviewed separately from the RN/LPN and CNA groups to encourage forthright communication without fear of reprisal. The majority of focus groups for RN/LPNs were separate from those of CNAs; however, staffing issues sometimes limited this arrangement.

Observational data were collected on the same day as focus groups, during the same shift, and in the same locations where participants worked, allowing for verifying the accuracy and validity of issues discussed. Researchers conducting the focus groups also completed the staff observations. While efforts were made to include observations with as many of the focus group participants as possible, not all focus group participants were observed. The total number of observations was not calculated.

## Data Collection

Researchers with experience leading focus groups conducted interviews addressing personal experiences with the technology, difficulties encountered, perceived job changes, how technology improved or did not improve employees' jobs, and satisfaction with technology. Participants were informed they could leave voluntarily at any time. Additionally, they were advised of the study's purpose, that all information received would remain confidential, and participation would not affect employment. Participants were allowed to discuss their experiences until saturation of the topic was achieved, usually about 60 minutes for each focus group. Pause and probe methods were used to prompt for and request additional viewpoints from group participants.[32] Focus groups were audiotaped and the results transcribed at a later date.

Unstructured observations were recorded immediately after watching unfolding behaviors without observer/participant interaction. Observations were recorded as field notes, were not restricted in any way, and included information about the physical surroundings, users, activities or interactions, precipitating factors, organization, and other intangible factors.[33] Observation times were short, usually less than 5 minutes, and were made when staff was using the bedside technology in a variety of settings (eg, resident rooms, activity rooms, nursing station, supply rooms, and administrative offices) and while performing a variety of tasks (eg, medication delivery, treatments, resident assessments). Not all observations included resident interaction, although insights were noted into how staff used technology in resident care. Data were

**Table 1**

**Focus Group and Facility Characteristics**

| | Facilities | | | |
|---|---|---|---|---|
| | A | B | C | D |
| Total focus groups | 5 | 6 | 5 | 6 |
| Administrator | 5 | 8 | 4 | 6 |
| RN/LPN | 6 | 14 | 7 | 8 |
| CNA | 12 | 19 | 19 | 12 |
| Total staff participating | 23 | 41 | 30 | 26 |
| Facility bed size | 180 | 240 | 98 | 150 |
| Facility location | Rural | Urban | Urban | Urban |
| Ownership | Government | Nonprofit | For profit | Nonprofit |

immediately recorded following each clinical observation using handheld recorders; tapes were transcribed at a later time.

## Data Analysis

A transcript-based analysis approach identified common themes from the focus groups and observation data collection. A process of axial coding was used, consisting of placing labels in the margins of the transcript when ideas or phenomenon appeared. This allowed the data to be fractured and reassembled in new ways, and researchers prepared a statement of findings. Emerging themes were identified and verified by two gerontological nurse experts and a researcher with human factors expertise. Finally, a matrix of attributes using common themes as one axis and human factors subsystems as the other axis was created. No resident or employee identifying information was collected to protect the privacy of individuals participating in the study. All research procedures were approved through the university's institutional review board.

# RESULTS

## Initial Implementation Strategies

The most notable issues surrounding initial implementation strategies raised in focus groups were site preparation, system testing and conversion, start-up, equipment projections, and availability of on-site technical expertise. Some implementation strategies are shown in Table 2. Actual implementation preparation began after facilities were selected and agreements formalized.

### SITE PREPARATION

Site preparation began by assessing facilities for any needed special accommodations. (eg, equipment space, network wiring, and end user space requirements[34]). The majority of differences between facilities during site preparation were related to dedicated training space. Three of the four facilities dedicated space for equipment and training, which included restructuring small spaces previously used for lounges or offices. In another case, a large training room was designated for technology training and included extra computers for hands-on experience. One facility provided initial training in a designated space and then moved follow-up training to nursing units using mentors, releasing the room for other activities.

### SYSTEM TESTING AND CONVERSION

System testing and conversion includes serial steps in implementation ranging from unit testing to integrated testing.[34] Because conversion processes are critical to capturing new and retraining old information, all facilities developed and used backup documentation systems when converting paper records to computer-based records (Table 2). Each facility duplicated documentation in paper and computer form until the systems were fully functional. Syncing process problems were recognized during the transfer of information from the PDA to the main system in each home. This was corrected with the installation of a new server.

### SYSTEM START-UP

System start-up phases occur by (1) abruptly changing over to the new system across all units, (2) gradual

**Table 2**
**Initial Implementation Strategies**

| Implementation Strategies | Facility A | B | C | D |
|---|---|---|---|---|
| Site preparation | | | | |
| Dedicated space for training | No | Yes | Yes | Yes |
| System testing/conversion | | | | |
| Duplicated backup systems | Yes | Yes | Yes | Yes |
| System start-up | | | | |
| Partial start-up | Yes | | Yes | |
| Whole system start-up | | Yes | | Yes |
| Equipment projections | | | | |
| Number of CNAs per shift | 28 | 35 | 10 | 35 |
| Total PDAs | 28 | 65 | 16–20 | 96 |
| Technology professional | | | | |
| On-site | No | Yes | No | No |
| Off-site | Contract | | Corporate | Corporate |

phasing in of applications on selected units, or (3) phasing in of applications across the organization.[34] Each implementation team had a unique testing and conversion process. Three of four facilities elected to start up a select group of nursing units (partial system start-up), then roll out the technology to the remainder of the nursing units at a later time. One facility deployed the technology across all units (whole system start-up) but then had to back out of parts of the system when the conversion became overwhelming. Three of the nursing homes elected to start up parts of the technology at certain times on designated units, then add another usage once the first part was mastered.

### EQUIPMENT PROJECTIONS

Table 2 gives details about the number of needed PDAs projected by administration for each facility. Administrators tried to maintain at least one to three working PDAs per CNA. However, the availability of properly functioning PDAs fluctuated widely, depending on breakage and repair.

### ON-SITE TECHNOLOGY PROFESSIONAL

Only one facility employed an on-site technology expert; another contracted with an outside consultant who could be paged for questions. The two remaining homes were assisted by a corporate CIS expert. Nursing leaders within each organization were assigned IT roles, which as implementation progressed, included education, repairing broken equipment (eg, PDAs), assisting with technology updates, and troubleshooting system problems. These tasks were in addition to their management duties. In most cases, the only training provided was on-the-job through remote access networks linking staff with OTT technology professionals.

## Human Factors and Common Themes From Initial Implementation

Five common themes emerged from the focus groups and observations: (1) perception and cognition, (2) change, (3) workable system, (4) competence, and (5) connectedness. Attributes for each theme were associated with human factors subsystems and placed in a matrix to demonstrate how staff was reacting to initial implementation strategies (see Table 3).

### PERCEPTION AND COGNITION

Perception allows humans to detect, identify, and recognize sensory input, whereas cognition refers to higher level mental phenomena, such as memory, information processing, use of rules or strategies, problem solving, learning, and judgment.[15,35] Greater than 90% of administrators were optimistic that this technology could improve management oversight, quality management, and documentation of resident care. However, they also expressed, rather negatively, that technology was an inevitable and essential next step. In a sense it was being forced on them.

First impressions, always critical, shaped staff attitudes based on the technology's functionality and support staff's responsiveness. Frustration set in when expectations were not met, problems not resolved in a timely manner, or support staff appeared dismissive. This increased staff suspicion and decreased their desire to work with the system. Administrators in facility A realized *"their staff spent 3–4 hours daily in the beginning dealing with PDA issues and problems, which affected their staffing levels."* In their words, *"nursing homes that implement [technology] need to be warned about the increased need for manpower during the initial months."* It is important to note that facility A did not have on-site IT resources available to them (Table 1). Their contractual arrangement with an IT professional often led to slow response times and increased downtime.

Staff perceptions regarding usability are found under machine subsystem (Table 3). Equipment availability strongly affected staff perceptions, including both the number of PDAs and frequency of breakage. Furthermore, when part of the system did not readily interface with other technology already in place, OTT was viewed as a detriment to the end users. Finally, ease of use, accuracy in information processing needs, and flexibility of data entry choices were identified as important themes among participants.

### CHANGE

Employees lamented the change process. RN/LPNs and CNAs were frustrated because of slow implementation, increased tasks, and poor understanding about parts of the CIS. All levels of staff indicated it was difficult to maintain a positive attitude about the system and move forward when the implementation wasn't going smoothly.

Slowness of PDA screens and syncing processes was attributed to system design by the employees; they distrusted the response of the system and worried about lost data they thought had been entered. During initial implementation, data entry was slow because of difficulty in selecting the correct charting place because of multiple screens; terminology was not understandable or was different from that previously used in the hard copy medical record; and available terminology did not match what they intended to chart.

**Table 3**

**Emerging Themes in Nursing Home Initial Implementations of a Clinical Information System**

| | Human Factors Subsystems | | | |
|---|---|---|---|---|
| **Common Themes** | **Environment** | **Operator** | **Machine** | **Implementation Strategies** |
| Perception and cognition | Inevitable | Ensuing frustration | Availability | Site preparation |
| | Optimistic/Potential | Timeliness | Ease | System life cycle charter plan |
| | Essential | Anticipation | Accessibility | Mission/Vision |
| | Expectations | Desire | Detriment | Necessary organization features |
| | Dismissive | Suspicious | Choice | Resources |
| | Ability to Question | | Accuracy | Skill sets |
| | Impression | | | Overall time estimates |
| | | | | Money needed |
| Change | Changing attitudes | Job duties/ workload | Design | System testing and conversion |
| | Uncertainty/trust | Real time | | Change management procedures |
| | Progress | Physical changes | | Current tools, printouts |
| | Forward/backward | Eye strain | | Current processes |
| | | | | What are you doing today? |
| | | | | What will you be doing tomorrow? |
| Workable system | Technology support | Timing | Quantity of equipment | Start-up and technology resources |
| | Responsiveness | Control | Terminology | Operational policies/procedures |
| | Opposition | Staffing | Fragility | Equipment projections |
| | Staff/Residents | | Accessories | User feedback reviews |
| | Protocols | | Speed | |
| | Problem resolution | | Specificity | |
| | Options | | Availability of information | |
| | Errors | | Consistency | |
| | | | Automaticity | |
| Competence | Adequate orientation | | | Available IT professionals |
| | Problem resolution | | | Training (materials, space, people) |
| | Ongoing training | | | |
| | Designated trainers | | | |
| Connectedness | Ties to other users | Communications | Location | System support plan |
| | Monitoring | | Staff/equipment | Command center |
| | | | Flow | Post implementation reviews |
| | | | Duplication | Change request documentation |

These issues hindered job performance, causing some to dislike the system from the start, created uncertainty about how to enter data correctly, and led to poor clinical documentation.

CNA staff were both positive and negative about their changing roles. In all facilities, unlicensed staff viewed the technology as increasing their accountability and workload, while reducing their time with residents. The newly automated documentation and messaging systems increased frustrations among both licensed and unlicensed staff, with the latter documenting more information than they had in the active record. Conversely, some unlicensed staff preferred the new electronic messaging system, although its use was not standardized in any of the facilities. This inconsistency created confusion among unlicensed care providers about resident care needs. In some facilities, the lack of standardization created situations in which residents did not receive necessary care, such as not having the appropriate assistive aids for ambulation.

Overall, licensed nurses viewed technology as helpful. Licensed staff and administrators liked being able to view many things about resident care at once, something not possible with hard copy medical records. They were able to know what was done for their residents in real time and could pinpoint care left undone by individual CNAs for specific residents. Administrative and licensed staff across all facilities saw this as a system benefit.

### WORKABLE SYSTEM

The facilities' various implementation strategies confirmed it was critical to have technology support available (Table 1). One of four facilities employed a full-time IT expert. The others relied heavily on OTT staff to assist in problem resolution and system development. Consultants assisted the nursing homes to build libraries for care plans and standing orders. Administrators who had little IT support had some difficulty in the initial stages building these important library data sets because other staff were busy with their full-time jobs. In every facility at least one member of the nursing staff was assigned added responsibilities for IT support, sometimes creating opposition and frustration, whereas other staff viewed the new responsibilities as a job enhancement and thrived.

Problem resolution was a significant concern discussed in every facility, correlating to the lack of technology support. When the documentation system wasn't working properly, staff stated they didn't chart. Others indicated that backup systems for documentation were created to capture data if the system experienced downtime. Concerns surfaced about increased potential for errors resulting from service duplication.

Equipment availability was an issue. Administrators had not projected the need for extra equipment accurately, at times causing severe shortages. In one facility, as many as 60% of the PDA units were broken, damaged, or the batteries were too low to operate during research interviews. Staff began to creatively accessorize their work environment with simple solutions such as sturdy clips attached to their PDAs to curb the frequency of breakage. Administrators established controls about PDAs distribution during each shift. The lack of IT support, equipment failures, and PDA unavailability were viewed as contributing to overtime work, which the staff felt management closely monitored.

### COMPETENCE

Initial and ongoing training was a prominent theme in group interviews. Facilities differed in their resources allocated for orientation and training, with three of four facilities dedicating space for ongoing training. A thorough initial orientation was provided on-site by the vendor; thereafter, each facility was responsible for follow-up training and new employee orientation.

There were noteworthy characteristics of facilities with advanced training programs versus those without. More advanced training programs, in facilities B, C, and D, had a designated clinical staff person to do ongoing training, updates, orientation, and monitoring of new employees through a mentorship program. They also provided designated space with computers and projection screens so employees could see and interact with each other and the trainer. Additionally, their nurses had assigned mentors who were able to produce orientation program materials during observations and assist with troubleshooting. On the other hand, facility A did not have designated resources, mentorship programs were not as organized, and staff appeared less comfortable with implementation.

### CONNECTEDNESS

Facility administrators were proactive in forming user groups with other administrators implementing the same technology. One administrator stated, *"ideas have sprung from these think tanks into real change. For example, one facility completely remodeled a nursing area to accommodate the PDA syncing processes in order to avoid congestion and increase accessibility."* They brainstormed about future uses of the technology, for example, hypothesizing how a future nursing environment would appear in their facility. Projections included removing nursing stations and relying solely on the use of cell phones and wireless infrastructures for mobile communication.

## DISCUSSION

Implementation strategies must address the five common themes emerging from focus groups and observations: perception and cognition, change, workable systems, competence, and connectedness. Nursing homes can best prepare for successful CIS implementation by assessing whether their strategies will increase staff satisfaction with technology (Table 3).

Developing a system life cycle charter plan to shape perception and cognition may be one component of a successful strategy. This is a core document defining the goals and scope of CIS implementation and can communicate administration's mission and vision to staff. Additionally, the charter outlines necessary organizational features: (1) structure of CIS steering committee, (2) resources required, (3) skill sets and training, (4) a proposed timetable to guide and inform the system, and (5) an estimation of costs and benefits, including full-time equivalent requirements to manage implementation and ongoing support. None of the nursing homes in this study had a charter plan, which may have contributed to decreased staff satisfaction.

Strategies to manage change could be developed during system testing and conversion. There must be a close match between existing work practices and post-CIS implementation workflow to ensure a smooth transition. Any mismatch may lead to uncertainty and distrust, misuse of the technology, and negative attitudes. The design of the CIS must also be thoroughly evaluated. This includes output/input design relating to

format, content, and frequency of forms, screens, and reports. Additional considerations are types of data manipulations performed, specifications for file and database capabilities, and security issues such as data access and backup procedures.

Building a sustainable working system must include developing operational policies and procedures, inventorying the need for equipment, ensuring there is enough equipment available at all times, and creating ways to keep it functioning. Policies and procedures require updating to transition staff members, foster adaptation, and avoid incorrect or inappropriate use of the system.[36] Equipment projections are usually identified in the project business plan, included in the system charter. In this study, it was critical that project teams accurately anticipated the number of PDAs needed in clinical areas. Too few PDAs led to greater dissatisfaction with CIS. Finally, user feedback is critical. Project managers must be aware of the staff's information and communications needs and must detail procedures for how information gets collected, distributed, acted on, and analyzed. Poor communication exponentially increases the possibility for error.[36]

Adequate user training can be accomplished only with on-site skilled technology professionals who understand the CIS being implemented. Coordinated training programs will promote creativity, provide direction, and influence users' desire to move the implementation forward. Employees designated as expert users can spearhead training initiatives and may become system champions. Ongoing training is a necessity if system integrity is to be maintained.

Leadership should build on the power of CIS to connect people no matter their location. A system support plan can be created by the CIS oversight committee and would include (1) the development of a command center providing technical and operational support for affected nursing units, (2) a means to complete post-implementation reviews, and (3) assistance in change management procedures.

## CONCLUSION

CIS integration is a crucial step toward improving healthcare practices in nursing homes. Administrators face challenges such as matching an information system to their particular needs and developing transition implementation strategies. Experiences from this study are consistent with published literature discussing technology implementation in long-term care settings.[31] Limitations of this study are differences between staff across facilities that could be attributable to employee satisfaction were not assessed; the small sample size of four nursing homes; and the evaluation of only one type of CIS affects generalizability. Although more studies are needed to evaluate and disseminate best implementation practices in long-term care settings, this pioneering study provides significant guidance to nursing home administrators preparing for their own CIS implementation.


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