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Evaluation of the Use of Bedside Technology to Improve Quality of Care in Nursing Facilities

Final Report

Prepared by

Marilyn Rantz, PhD, RN, NHA, FAAN
Project Principal Investigator
Jill Scott-Cawiezell, RN, PhD
Greg Alexander, RN, PhD
Vicki Conn, RN, PhD, FAAN
University of Missouri Sinclair School of Nursing

Richard Madsen, PhD
Gregory Petroski, PhD
Lanis Hicks, PhD
University of Missouri

Mary Zwygart-Stauffacher, RN, PhD, FAAN, Clinical Nursing
and Nursing Home Expert
University of Wisconsin, Eau Claire

and

RTI International
3040 Cornwallis Road
Research Triangle Park, NC 27709-2194

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CONTENTS

Figure

List of Tables

A.   OVERVIEW

The purpose of this project is to conduct a feasibility pilot study on the use of bedside technology to collect daily measures of resident care and outcomes in a limited number of nursing facilities. To accomplish this work, research under this project evaluated

- the use of a specific bedside data collection technology with portable computer devices, automated processes, and electronic medical records technology in improving daily measures of resident care and outcomes in nursing facilities;

- the degree to which the use of technology that incorporates bedside data collection could impact resident outcomes; and

- the potential enhancement of resident outcomes by coupling the use of this technology with on-site clinical consultation by expert nurses.

Research has been done by the University of Missouri Sinclair School of Nursing to demonstrate the effectiveness of providing on-site clinical consultation and quality indicator feedback reports to nursing facilities in the Quality Improvement Program for Missouri (QIPMO). In this previous work, on-site consultation was provided by experts in gerontological nursing, education of nursing home staff, the use of quality indicator reports, and technical assistance with Minimum Data Set (MDS) for Resident Assessment and Care Screening data analysis. Through this previous project with Missouri nursing facilities, improvements were documented in several quality indicators, including pressure ulcers, range of motion or activities of daily living, dehydration, fecal impaction, residents remaining in bed, depression with no treatment, cognitive impairment, incontinence without a toileting plan, and the use anti-anxiety agents (Rantz et al., 2003a).

The application of bedside technology to collect daily measures of resident care and outcomes in nursing facilities could also be useful for improving the efficiency and effectiveness of care in these facilities. However, it is not clear whether bedside technology alone is potentially sufficient, or whether bedside technology should be coupled with other on-site interventions to achieve maximum potential effect (such as the clinical consultation described above). To understand the unique contributions of bedside technology and expert on-site consultation, the Centers for Medicare & Medicaid Services (CMS) sought to evaluate an intervention plan designed to test their unique and combined contributions toward improving the care of nursing facility residents.

In this pilot evaluation project, two groups of nursing homes located in Missouri implemented a bedside technology system developed by Optimus EMR, Inc. formerly OneTouch Technologies Corporation. One intervention group implemented the Optimus EMR only, while the other implemented the Optimus EMR coupled with an on-site clinical consultation program. Two additional groups of Missouri nursing homes did not implement the Optimus EMR (one had only on-site clinical consultation; the other had no programs) and therefore served as control sites. All sites were voluntarily recruited, and intervention sites received partial financial support to implement the Optimus EMR. The evaluation activities focused on changes over a 24-month period in patient outcomes, as measured by MDS–based quality indicators. Focus groups were

also conducted to gather feedback from nursing home clinical and administrative staff on the Optimus EMR.

Although this pilot project is important in testing the overall operational feasibility of the design—including the willingness of sites to participate, and the usability of the hardware and software—the effectiveness of bedside data collection using personal digital assistants (PDAs) can only be assessed in the larger study not funded here. This report presents findings of this pilot evaluation project.

B.   BACKGROUND

The bedside technology implemented in this evaluation is a system developed by Optimus EMR (hereafter the "OEMR") that represents a shift from the manual to digital input, and through which nursing staffs and management in long-term care facilities have instant access to more real time information. The OEMR's goal is to make clinical documentation of care efficient and accurate. The system automates several manual processes, including the preparation of MDS forms. This potentially time-saving element uses the data collected during routine care. Furthermore, accurate reporting of the services provided should result in correct reimbursement rates. Using the OEMR also potentially allows facilities to strengthen medical record compliance, thereby minimizing potential fines, penalties, and malpractice issues.

The OEMR integrates iButtons, radio frequency (RF), infrared, PDAs, and wireless technology through the company's proprietary software to bring a revolutionary approach to clinical operations. Data that are collected either at the point of care or entered on a personal computer automatically populate all appropriate sections in the electronic medical record (EMR) and the MDS. Moreover, the OEMR offers the following features:

- Bedside data collection (at the point of care [POC]) using handheld personal data assistants (PDAs or "palm devices")

- Accountability, verification of caregiver activities, and bi-directional alerts and messages using microchips (iButtons) on each resident's bracelet and on the caregiver's ID badge

- An intelligent MDS feature that uses the data collected at bedside and on terminals to immediately and accurately prepare the MDS in minutes once the reference date is selected

- Comprehensive clinical records that are date- and time-stamped for the MDS; an MDS "fly-over" feature that shows the data used in the calculated field along with the date and time of the activity

- Embedded system logic that identifies any "missing or illogical data" and any questionable MDS answers

- A total electronic charting system

- Automatic data transmission (ADT) and census tracking

- Clinical assessments and nurses' notes with clinical content drill-down, which provides all disciplines the ability to enter complete clinical notes quickly and completely

- Complete care plans that are individualized and connected to task reminders

- Comprehensive, fast, and accurate physician order entry system

- Electronic medical administration record (MAR) using touch screens at the point of care

- Complete skin and wound assessment on a PDA for use at the POC

Quality Improvement and Standardized Assessment in Nursing Homes

Nursing homes have a long history of mandates from Congress to improve quality of care (Committee on Nursing Home Regulation, 1986). The Omnibus Reconciliation Act of 1987 (OBRA, 1987) had several provisions intended to improve nursing home care. These provisions included developing the MDS, mandating routine use of the MDS and its companion care-planning process for all nursing home residents, and requiring that a quality assurance and assessment process be used in all nursing homes to improve the quality of care (McElroy & Herbelin, 1989).

This standardized resident assessment process was envisioned to improve resident care through the formulation of a resident-specific care plan; to provide nursing home management with resident-level data for monitoring case mix, staffing, and quality of care performance; and to provide regulators with data for case mix, sampling for survey processes, monitoring resident outcomes, and utilization review for Medicare or Medicaid eligibility (Committee on Nursing Home Regulation, 1986). Most recently, another Institute of Medicine (IOM) committee viewed the continued use of standardized assessment data as "essential" (Committee on Improving Quality in Long-Term Care, 2001, p.8). Unfortunately, most observers would agree that marked improvements nationally in quality of care have not been realized. This evaluation of the application of technology and on-site clinical consultation is an attempt to more fully implement these national mandates and achieve some improvement in quality of care in nursing homes.

A few studies have demonstrated the effectiveness of on-site clinical consultation by a nurse expert to help nursing home staff implement changes to improve care. The use of advanced-practice nurse consultation in a randomly assigned treatment to work with nursing home staff to implement research-based protocols resulted in improvement or less decline in incontinence, pressure ulcers, and aggressive behavior (Ryden et al., 2000). Educational programming and resident-centered consultation were found to reduce the use of physical restraints in nursing homes without subsequent increases in staffing or resident injury (Ejaz et al., 1994; Evans et al., 1997; Neufeld et al., 1999, 1995; Strumpf et al., 1992; Werner et al., 1994). Similarly, consultation was shown to reduce falls in nursing homes (Ray et al., 1997). However, some of these studies and others have demonstrated that follow-through by the nursing home staff on the recommendations made during consultation and sustained use of the recommended

interventions over time may be difficult to achieve (Ouslander et al., 1995; Schnelle et al., 1993a, 1993b).

Rantz and colleagues (2001) designed and conducted a randomized controlled trial (n=113 nursing facilities) to test the benefit of feedback in a quality improvement model and determined that simply providing nursing facilities with comparative quality performance information and education about quality improvement is not of sufficient strength to improve clinical practices and subsequently improve resident outcomes. They found that a stronger intervention of expert clinical consultation with nursing facility staff coupled with comparative feedback is needed to improve resident outcomes. Facilities need the additional intensive support of on-site clinical consultation to effect enough change in clinical practice to improve resident outcomes significantly. The expert clinical consultation was provided by a gerontological clinical nurse specialist. Comparative feedback reports were specially designed to display five quarters of MDS-based quality comparisons in tables and graphs so that trend lines over time are easy to see and interpret (Rantz et al., 1997a; 2000).

The findings of the Rantz et al. (2001) quality improvement study became the foundation for the Quality Improvement Program for Missouri (QIPMO), a cooperative program between the Missouri Department of Health and Senior Services and the Missouri University Sinclair School of Nursing. QIPMO began as a pilot project in nursing facilities in 1999 with an official start in mid-2000 (Heimericks, 2001). QIPMO is designed to provide on-site quality improvement assistance to nursing facilities using their quality indicator (QI) reports as a foundation for the consultation. The QIPMO staff consists of several gerontological nurse specialists, most with advanced degrees, providing resources and support to the staff of nursing facilities throughout the geographic regions of the state. During QIPMO's first 3 years of operation, its nurses conducted over 1,200 site visits in more than 350 different facilities in Missouri. Costs of the program are for the nurses' time and travel to facilities, coordination support staff, and data analysis and data support staff for reports; these costs total about $600,000 annually (Rantz et al., 2003a).

The success of QIPMO has been positive with facilities, as evidenced by the facilities' repeated requests for additional visits. A quality improvement evaluation instrument is completed at the conclusion of each site visit so that QIPMO staff can improve their services to facilities. Additionally, distributions of QI scores have been compared for all nursing facilities in the state for the years 1999 (prior to the official start of QIPMO) and 2001 (the end of the second year of implementation of QIPMO). Since the implementation of QIPMO, Missouri has seen an improvement in several quality indicators provided to facilities Actual improvements of several points (range of 1–15 points) have occurred in scores at the median, 90th, and 95th percentiles in such indicators as pressure ulcers for residents at high risk and low risk for developing them; range of motion or activities of daily living; dehydration; fecal impaction; residents remaining in bed; depression; depression with no treatment; problem behaviors; cognitive impairment; incontinence without a toileting plan; and anti-anxiety and hypnotic drug use (Rantz et al., 2003a). In the most recent analysis of QI scores, continued improvement have been noted for facilities who use the QIPMO services (Rantz et al, 2006).

The Centers for Medicare & Medicaid Services (CMS) (formerly the Health Care Financing Administration [HCFA]) has a basic strategy to develop a system of QIs across the

full range of services paid for by the Medicare and Medicaid programs nationwide (Gaglel, 1995; Jencks, 1995). For nursing facilities, these indicators are derived from MDS data that are routinely obtained for residents upon admission to facilities participating in Medicaid and/or Medicare, at times of significant change in condition of the resident, quarterly, and annually. As part of the HCFA Multistate Nursing Home Case-Mix and Quality Demonstration Project, Zimmerman and colleagues at the University of Wisconsin-Madison developed a series of MDS-based QIs (Ryther, Zimmerman, & Kelly-Powell, 1994, 1995; Zimmerman et al., 1995). The most current version includes 30 MDS QIs, measuring such aspects as falls, incontinence, physical function, skin care, cognitive functioning, and behavior (Karon & Zimmerman, 1996; Rantz et al., 1999). Nationally, 24 of the 30 QIs were implemented by HCFA in 1999 for use in the nursing home survey and certification process and provided to facilities in a feedback report. We have successfully used MDS-derived QIs to measure outcomes of residents in our prior research (Rantz et al., 1996, 1997b, 2000, 2001, 2003a, 2003b, 2004a, and 2004b).

The ultimate goal of quality improvement in nursing homes is to improve resident outcomes. Several quality improvement strategies have been found to be effective. We used the findings from the Rantz and colleagues intervention study (2001) and evaluation of QIPMO (Rantz et al., 2003a) in the design of this evaluation of technology. Additionally, we used MDS QIs as the major resident-outcome measures in this evaluation.

Technology in Health Care

Primary uses of clinical information systems are assisting in the delivery, support, and management of patient care; assisting in administrative and financial matters; and assisting in patient self-management (Institute of Medicine, 2003). The Institute of Medicine (2003) identified eight core functions for clinical information systems including (1) storage and retrieval of health data, (2) results management, (3) electronic order entry, (4) decision support, (5) communication and connectivity, (6) education, (7) administrative processes, and (8) population health. Within the IOM report, projections were made for each core function through the year 2010. These projections describe the expected levels of sophistication for clinical information systems in nursing homes. For example, by 2010, the IOM projects that nursing homes should have capabilities to use multimedia support for images and scanned forms such as resident consents. By the year 2007, nursing homes should be implementing rules-based alerts and preventative reminders to support resident care.

Relevant research evaluating the use and effect of sophisticated technology in nursing homes is becoming an important focal point in the literature. Changing societal demographics, increased complexity of healthcare knowledge, and increased shortages of healthcare staff have led healthcare strategists to recommend redesign options that incorporate technology into healthcare practices (Courtney et al., 2005). Courtney et al. (2005) indicated that how technology is shaped affects the acceptance levels within an organization. Recent studies have investigated the adoption of new technologies in nursing homes during periods when implementation was just beginning (Alexander et al., 2005; Alexander & Rantz, 2005). Common themes that affected implementation of advanced technology in nursing homes included (1) the perception and cognitive abilities of people interacting with the technology, (2) change management, (3) the ability of staff to work with the system, (4) competence levels, and (5) connectedness (Alexander et al., 2005; Alexander, 2005b).

Computerized nursing documentation systems help nursing professionals to provide significant, positive impacts on work practices and resident outcomes. Technology has improved computer charting, care planning, information accessibility, decision making, and perceptions of information security in acute care settings (Bates & Gawande, 2003; Wozar & Worona, 2003; Mills & Staggers, 1994; Dennis et al., 1993; Kawamoto et al., 2005; Garg et al., 2005). Nahm and Poston (Nahm & Poston, 2000) showed that computerized clinical documentation systems make a difference in quality of documentation after implementation of an integrated point of care system on hospital nursing units. The researchers indicated that there was a 13% increase in compliance with Joint Commission accreditation requirements during the study. In a similar study, Dennis, Sweeney, Macdonald, and Morse (Dennis et al., 1993) realized improvements in 11 (34%) Joint Commission accreditation requirements for nursing documentation using technology.

Few resources are available on the use and effectiveness of computerized records in nursing homes (Ferris, 2005). Abbott (Abbott & Brocht, 2001) indicated that computer use in nursing homes has generally been limited to business applications and management of the federally required minimum data set. In contrast, research on computer implementation in nursing homes identified some facilities using highly sophisticated computerized systems to manage care (Alexander et al., 2005; Alexander, 2005a; Alexander & Rantz, 2005; Courtney et al., 2005; Alexander, 2005b). However, there is a limited understanding of how widespread is the use of these sophisticated systems in nursing homes.

C.   OVERALL EVALUATION DESIGN

As a pilot study, this evaluation will rely on comparison of descriptive statistics across four groups—two intervention groups and two control groups. Specifically, the four groups were defined as follows:

- *Group 1* *(n=4)* are Missouri nursing facilities that agreed to implement OEMR and take advantage of the on-site nurse clinical consultation services of QIPMO.

- *Group 2* *(n=4)* are nursing facilities in other states that implemented OEMR and did not have access to on-site clinical consultation from a service such as QIPMO.

- *Group 3* *(n=5)* are facilities from Missouri that did not implement OEMR but did participate in the on-site nurse clinical consultation services of QIPMO.

- *Group 4* *(n=5)* are control facilities from Missouri that did not implement OEMR and did not participate in the on-site clinical consultation services of QIPMO.

The four-group design enabled us to look for preliminary evidence on whether the use of bedside data collection and technology can facilitate improved quality of care and subsequent resident outcomes, and whether adding on-site clinical consultation can further enhance improvements. This design enabled us to analyze the contribution of the bedside technology as well as the contribution of on-site clinical consultation to quality of care. Pre- and post-intervention of the OEMR intervention, as well as cross-group comparisons, are evaluated.

Research Questions: In the pilot evaluation for CMS, the study focused on the following research questions:

- Is the quality of care provided to nursing home residents improved through the use of bedside technology alone, on-site clinical consultation alone, or the combined effect of both?

- If care is improved, what specific elements of care are improved, and what are the mechanisms by which it is improved?

- How does the use of bedside technology affect the reliability and accuracy of nursing home quality measures?

- Does the use of bedside technology to collect daily measures of resident care facilitate the creation of nursing home quality measures?

- What is the impact of bedside technology to collect daily measures of resident care on the nursing personnel delivering care?

- To the extent that care is improved through this interventional study, how readily can the interventions tested in this project be adopted by other nursing facilities not participating in this project?

- Are there features about the nursing facilities participating in this study beyond the actual interventions themselves that affect the generalizability of the results?

A summary of the findings for each of these questions is provided in this report.

Nursing Home Intervention and Control Group Recruitment

A stratified purposive approach was used to recruit the Group 1 sites. Facilities from urban and rural areas were recruited. Additionally, a mix of for-profit, not-for-profit, and governmental facilities is represented in each of the groups. Table 1 displays the characteristics of facilities recruited for the evaluation. Because facilities entered the study during different time periods, they have different baseline data dates. As an incentive for participation, facilities implementing the OEMR (Groups 1 and 2) received partial financial support in purchasing the OEMR hardware, software, and ongoing technical support.

Group 1 (intervention) facilities were solicited from current QIPMO service users in Missouri. Four facilities were recruited in urban and rural communities with a mix of ownership of one governmental, one for-profit, and two not-for-profit facilities, with a total bed count of 668. *Group 2* (intervention) facilities were recruited from facilities in other states that were users of the OEMR. Facilities in other states were used to increase the sample size and to have a comparison group of facilities implementing technology without the potential additional benefit of QIPMO. This design allows analyses to determine any potential additional benefit from on-site clinical consultation when implementing technology. Four facilities were as closely matched as possible to the Group 1 facilities; two for-profit and two not-for-profit facilities were recruited, with at total bed count of 635. *Group 3* (control) facilities were recruited from current

QIPMO users in Missouri within the sampling strata. Five facilities were recruited, matching as closely as possible Groups 1 and 2 for ownership, bedside, and location; one governmental, one for-profit, and three not-for-profit facilities, with a total bed count of 543 were recruited to participate in the data collection for comparison purposes with the OEMR facilities. *Group 4* (control) facilities were randomly selected from the Missouri MDS data set by strata from those facilities not participating in QIPMO. Five facilities were matched for the analysis: two governmental, two for-profit, and one not-for-profit, with a total bed count of 890.

Table 1
Characteristics of study participant nursing homes

Group	Facility	Bed size	Ownership	Baseline quarter
1 Intervention MO	1A	240	NFP	Q4 2003
	1B	180	Gov	Q3 2003
	1C	98	FP	Q1 2004
	1D	150	NFP	Q3 2004
	668 total beds			
2 Intervention Other States	2A	105	FP	Q4 2002
	2B	218	FP	Q1 2003
	2C	162	NFP	Q1 2004
	2D	150	NFP	Q2 2004
	635 total beds			
3 Control MO -QIPMO	3A	123	Gov	Q4 2003
	3B	120	NFP	Q4 2003
	3C	120	FP	Q4 2003
	3D	90	NFP	Q4 2003
	3E	90	NFP	Q4 2003
	543 total beds			
4 Control MO -No QIPMO	4A	180	FP	Q4 2003
	4B	120	Gov	Q4 2003
	4C	154	Gov	Q4 2003
	4D	126	NFP	Q4 2003
	4E	310	FP	Q4 2003
	890 total beds			

Implementation Procedures

Group 1 nursing homes implemented the OEMR in their facilities. Implementation dates, baseline quarter for analysis of resident outcomes, and data collection dates are displayed in Figure 1. The first facility implemented in July 2003, the second in September 2003, the third in February 2004, and the fourth in June of 2004. All intervention facilities required staff to participate in educational training to operate the system. Intervention facilities appointed a project coordinator who worked closely with OEMR staff during planning and implementation. Facility staff had a track record of working with the QIPMO nurses, who helped staff focus on clinical care and improving care systems that can be facilitated by the OEMR Technology. QIPMO nurses provided on-site clinical consultation as requested by facility staff, but at least

every 2 months for the duration of the evaluation. Most facilities used the QIPMO nurses at least monthly during the evaluation and others more often.

Group 2 nursing homes also had OEMR implemented in their facilities; two were implemented in August 2002, a third in December 2003, and the fourth in April 2004. These intervention facilities had a designated facility project coordinator. Facility staff participated in the standard OEMR educational training required to operate the system. Group 2 intervention facilities did *not* have QIPMO on-site clinical consultation from expert nurses.

Group 3 control group facilities had a track record of working with the QIPMO nurses. QIPMO nurses provided on-site clinical consultation as requested by facility staff but at least every 2 months for the duration of the evaluation. They did not have the OEMR intervention.

Group 4 control group facilities had no experience working with QIPMO nurses and did not have the OEMR intervention.

Data Collection Plan

Table 2 illustrates the data collection plan used for this evaluation. The primary outcomes that are used to answer the study aims are resident outcomes as measured by MDS-derived quality indicators (QIs) and quality measures (QMs). MDS QIs were developed in the late 1980s by researchers from the Center for Health Systems Research and Analysis (CHSRA) at the University of Wisconsin-Madison and collaborators from the Multi-state Nursing Home Case Mix and Quality Demonstration Project (NHCMQ) as the national implementation of the MDS was planned. The QIs measure potentially good or poor care practices (Zimmerman et al., 1995; Zimmerman, 2003). The most recent version includes 30 different QIs, measuring a variety of domains and clinical problems (e.g., accidents, use of nine or more scheduled medications) (Karon & Zimmerman, 1996; Karon, Sainfort, & Zimmerman, 1999; CHSRA, 1999). Some QIs were risk adjusted to account for differences in residents' characteristics across facilities. QIs have been reported to nursing facilities nationwide and used in the survey process since 1999. The algorithms from the most recent Version 6.3 for the RUGSIII Quarterly Form from CHSRA were used in this evaluation (CHSRA, 1997); this includes 23 QIs that can be calculated from the Missouri MDS data set. Our research team has had extensive experience with calculation and analysis of MDS QIs since the early 1990s (Rantz et al., 1996, 1997b, 2001, 2004a).

Using MDS data to analyze quality of care and resident outcomes in nursing homes is of interest because these data, by federal mandate, are routinely obtained for all nursing home residents upon admission, at times of significant change in condition, quarterly for selected items, and annually for all facilities participating in Medicaid and Medicare. The multidimensional resident-specific aspects encompassed by MDS data items provide a way to measure quality of care more directly than using proxy measures such as facility survey citations that are commonly used in nursing home research (Harrington et al., 2000, 2001; Munroe 1990; Spector & Takada, 1991). Survey citations provide a limited view of quality because they view quality from the perspective of compliance with minimum standards instead of achievement of higher-quality standards.

Table 2
Overall evaluation plan and data elements

Group	Intervention	Data source	Frequency of collection	Descriptive measures	Outcome measures
1	**OEMR and QIPMO: Missouri**				
		MDS	Baseline	Facility Characteristics	MDS QIs/QMs
		OEMR data (includes MDS)	Initial and quarterly	Care processes	MDS QIs/QMs
		Medicaid Cost Reports	Baseline and Project End	Direct care, staffing and total costs; staffing and staff mix	
		Payroll data classifications, date of hires	Baseline and Project End	Employee mix	Staff retention
		Competing Values Framework Interviews	Baseline and Project End	Employee view of organizational culture	Change in Organizational culture
		Focus Groups employees	6–12 and 12–18 months	Satisfaction w/ technology and care	
		Observations of use of technology	6–12 and 12–18 months	Use of staff time for technology and care	
2	**OEMR, no QIPMO: Various States**				
		OEMR data (includes MDS)	Initial and quarterly	Facility Characteristics, care processes	MDS QIs/QMs
		Medicaid Cost Reports	Baseline and Project End	Direct care, staffing and total costs; staffing and staff mix	
		Payroll data classifications, date of hires	Baseline and Project End	Employee mix	Staff retention
		Competing Values Framework Interviews	Baseline and Project End	Employee view of organizational culture	Change in Organizational culture

(continued)

Table 2 (continued)
Overall evaluation plan and data elements

Group	Intervention	Data source	Frequency of collection	Descriptive measures	Outcome measures
3	QIPMO only: Missouri				
		MDS	Baseline	Facility Characteristics	MDS QIs/QMs
		Medicaid Cost Reports	Baseline and Project End	Direct care, staffing and total costs; staffing and staff mix	
		Payroll data classifications, date of hires	Baseline and Project End	Employee mix	Staff retention
		Competing Values Framework Interviews	Baseline and Project End	Employee view of organizational culture	Change in Organizational culture
4	No OEMR, No QIPMO: Missouri				
		MDS	Baseline	Facility Characteristics	MDS QIs/QMs
		Medicaid Cost Reports	Baseline and Project End	Direct care, staffing and total costs; staffing and staff mix	

Quality measures (QMs) are variations of the MDS QIs, developed by other researchers and reviewed by a CMS-sponsored technical expert panel in 2000 (CMS, 2005). As a result of this work, a "new" set of QMs were developed for public reporting and for nursing facilities to use in quality improvement. Most of these measures have some risk adjustments to account for variations in resident acuity. Some are algorithmically the same as the QIs. The publicly reported QM scores for all facilities were downloaded from the public Web site and used in this evaluation.

Resident outcomes using QIs and QMs are calculated for all four study groups. Cost and staffing data are used to describe and compare the four study groups.

Data Collection Procedures

Data captured in the OEMR from each of the participating Groups 1 and 2 facilities were used in the evaluation. These data include assessment, intervention, care planning, medication, treatment, MDS, and other service elements. *Before data were provided to the MU evaluation team, all resident identifying information was removed by OEMR staff, and a fictitious unique resident identifier replaced each resident's name or numeric identifier.* Data were stored in a secured computer accessed only by authorized MU research staff. The study plan and data

collection procedures were reviewed and approved by the MU Health Sciences Institutional Review Board prior to the initiation of the evaluation.

Groups 3 and 4 facility comparisons were made using MDS data that are available to the MU School of Nursing for MDS QI reports for facilities, evaluation of QIPMO, and other Department of Health and Senior Services evaluation questions. We have the necessary DUA from CMS. Because all facilities in Missouri have access to QIPMO, all facilities receive quarterly feedback QI reports. The MU MDS and Quality Research Team (some of whom are responsible for this CMS evaluation of OEMR) are responsible for evaluating statewide Missouri outcomes using MDS data from all facilities; outcomes of residents are periodically evaluated to track the effectiveness of QIPMO and other programs in the state. We also used the publicly reported QMs from the Web for comparisons of Groups 3 and 4.

MDS data from the Missouri MDS data set and the OEMR were used as the primary outcome measures across the four groups to answer the study aims. Additional interview and focus group data were collected in some of the groups to address the individual research questions.

Although cost and staffing data for Missouri can be obtained from Medicaid cost reports that are available to the public upon request from the Division of Medical Services, due to time limitations for this evaluation, we requested and used the cost reports directly from each of the participating facilities in Groups 1, 2, and 3. However, we requested and obtained the Medicaid cost reports from Division of Medical services for Group 4 since funding for working directly with the control facilities was not available. The reports received from the facilities and from the Division of Medical services were all "un-audited reports" due to the time lag in state auditing of cost reports and the time limitations of the study. OEMR staff assisted with obtaining the reports from Group 2 facilities. MU staff followed up with all facilities in Groups 1, 2, and 3, as well as with the Division of Medical Services for the Group 4 facilities, to obtain the cost reports for analysis.

Baseline cost reports are those that coincide with the start date of the evaluation. Project end cost reports that are as close as possible to the final date of the evaluation for each facility were used as the post-report data source due to the time lag in preparation and submission of cost reports in each state. Driven by the participation timelines for the different study groups (shown in Figure 1), , cost reports from 2003 were used for beginning costs and 2004 for the ending costs. Data were extracted from the cost reports so that total costs, direct care costs, staffing costs, staffing hours per resident per day, and staff mix were analyzed and reported.

In Groups 1, 2, and 3, staff retention was measured using payroll data listing employee job classification and date of hire; no employee names were obtained. Staff retention was calculated at the beginning and at the end of the evaluation. In these Groups, staff perceptions of organizational culture and innovation were measured using the Competing Values Framework interviews. *No individual employee identifying information was collected for the staff retention calculation or for the Competing Values Framework interviews*. Participation in the interviews was voluntary. Facility staff assisted in finding staff willing to be interviewed.

Figure 1: Participation timelines for study groups

					BASELINE		6-12 MONTHS					12-24 MONTHS				
	Imp Date	Baseline Qtr	QMs from NH Compare	Elec Med Rec Sys	Cost Report	Staffing	Cost Report	Staffing	Org Surveys	Focus Groups	Staff Obs	Cost Report	Staffing	Org Surveys	Focus Groups	Staff Obs
Group 1																
1A 240 beds NFP	9/5/03	Q4 2003	Q2 03-Q2 05	Y	FY 02	8/1/03	FY 03	8/30/04	Sep-03	2/3/04	Feb-04	FY 04	8/31/05	Aug-05	8/25/04	Sep-05
1B 180 beds Gov	7/30/03	Q3 2003	Q2 03-Q2 05	Y	FY 02	7/1/03	FY 03	8/25/04	Dec-03	2/11/04	Feb-04	FY 04	11/15/05	Aug-05	10/1/04	Jul-05
1C 98 beds FP	2/2/04	Q1 2004	Q2 03-Q2 05	Y	FY 02	6/17/04	FY 03	2/28/05	Mar-04	8/10/04	Aug-04	FY 04	1/5/06	Sep-05	3/18/05	Mar-05
1D 150 beds NFP	6/25/04	Q3 2004	Q2 03-Q2 05	Y	FY 02	7/12/04	FY 03	8/31/05	Jun-04	12/14/04	Dec-04	FY 04	1/11/06	Aug-05	8/8/05	Aug-05
Group 2																
2A 105 beds FP	8/22/02	Q4 2002	Q2 03-Q2 05	Y	FY 02	8/16/03	FY 03	8/14/04	Jan-04			FY 04	8/13/05	Sep-05		
2B 218 beds FP	8/8/02	Q1 2003	Q2 03-Q2 05	Y	FY 02	12/10/03	FY 03	12/14/04	Feb-04			FY 04	8/18/05	Sep-05		
2C 162 beds NFP	12/23/03	Q1 2004	Q2 03-Q2 05	Y	FY 02	12/1/03	FY 03	8/1/04	Mar-04			FY 04	8/1/05	Sep-05		
2D 150 beds NFP	4/8/04	Q2 2004	Q2 03-Q2 05	Y	FY 02	7/14/04	FY 03	4/14/05	Aug-04			FY 04	1/18/06	Sep-05		
Group 3																
3A 123 beds Gov		Q4 2003	Q2 03-Q2 05	N	FY 02	8/22/03	FY 03	12/21/04	Sep-03			FY 04	11/10/05	Aug-05		
3B 120 beds NFP		Q4 2003	Q2 03-Q2 05	N	FY 02	11/5/03	FY 03	12/27/04	Sep-03			FY 04	12/31/05	Sep-05		
3C 120 beds FP		Q4 2003	Q2 03-Q2 05	N	FY 02	9/23/03	FY 03	1/5/05	Sep-03			FY 04	1/20/06	Sep-05		
3D 90 beds NFP		Q4 2003	Q2 03-Q2 05	N	FY 02	7/28/03	FY 03	12/10/04	Sep-03			FY 04	1/26/06	Oct-05		
3E 90 beds NFP		Q4 2003	Q2 03-Q2 05	N	FY 02	10/14/03	FY 03	2/11/05	Oct-03			FY 04	11/23/05	Oct-05		

Figure 1: Participation timelines for study groups (continued)

	Imp Date	Baseline Qtr	QMs from NH Compare	Elec Med Rec Sys	BASELINE		6-12 MONTHS					12-24 MONTHS				
					Cost Report	Staffing	Cost Report	Staffing	Org Surveys	Focus Groups	Staff Obs	Cost Report	Staffing	Org Surveys	Focus Groups	Staff Obs
Group 4																
4A 180 beds FP		Q4 2003	Q2 03-Q2 05		FY 02	FY 02*	FY 03	FY 03*				FY 04	FY 04*			
4B 120 beds Gov		Q4 2003	Q2 03-Q2 05		FY 02	FY 02*	FY 03	FY 03*				FY 04	FY 04*			
4C 154 beds Gov		Q4 2003	Q2 03-Q2 05		FY 02	FY 02*	FY 03	FY 03*				FY 04	FY 04*			
4D 126 beds NFP		Q4 2003	Q2 03-Q2 05		FY 02	FY 02*	FY 03	FY 03*				FY 04	FY 04*			
4E 310 beds FP		Q4 2003	Q2 03-Q2 05		FY 02	FY 02*	FY 03	FY 03*				FY 04	FY 04*			

* Imported from cost reports/quality measure (QM) reports

Qualitative data were collected from focus groups of employees in facilities in Group 1 to evaluate their satisfaction with the use of technology. Staff satisfaction with technology was measured using focus groups from 6–12 and 12–18 months post-implementation. Employee job classification was recorded and reported in aggregate); those with fewer than 6 in a classification will be combined with a similar classification to protect identity. *No individual employee identifying information was collected for the focus groups.* Participation in focus groups was voluntary; however, we made every effort to recruit employees with potentially diverse opinions of the technology to obtain a balanced view of the impact of implementing the technology.

Observational qualitative data of the process of using the bedside technology was collected at the same intervals: 6–12 months and 12–18 months for all three shifts in Group 1 facilities. These data provide insights into the use of staff time for technology and care. Observations verified the accuracy of the quantitative data of staff time spent with residents being captured in the OEMR. *No resident or employee identifying information was collected.*

Evaluation Outcome Measures

Intervention and control group resident outcomes were calculated using QIs derived from MDS data. QIs were calculated using the Version 6.3 algorithms (CHSRA, 1997). MDS-derived QIs are measures of potentially good or poor care practices (Zimmerman et al., 1995; Zimmerman, 2003). In this evaluation, we were particularly interested in the QIs found most sensitive to quality of care in prior research: falls, depression, depression without treatment, use of nine or more medications, urinary tract infection, weight loss, dehydration, bed-fast residents, decline in late-loss ADLs, and stage 1-4 pressure ulcers (Rantz et al., 2004b). However, we analyzed *all* QIs and publicly reported QMs in each facility that can be calculated using MDS data to be complete in our analysis. Outcomes were measured at the individual-resident level, calculated, and reported as a facility score; *no resident identifying information was used or reported.* For the facilities implementing OEMR, MDS data were extracted from the OEMR data from the information system installed in each of Groups 1 and 2 facilities. For the control group facilities, MDS data from the Missouri MDS data set managed by our research team (with appropriate DUA) were used to calculate QIs. As a quality check on the data, comparisons were made from the MDS data set in Group 1 facilities in Missouri with the calculated QIs from the OEMR data. Results of this analysis revealed nearly identical calculations for the QIs using the two separate data sources.

For the evaluation, a baseline was established for each quality indicator, and then changes were analyzed for each quarter for the duration of the evaluation (for 24 months post-implementation). We anticipated fluctuations in quarterly measurements and observed trends in improvement or decline. Baseline measures for Group 1 were calculated from the most complete data from OEMR following each facility's implementation (See Figure 1 for the dates of baseline), then quarterly post-implementation using data from the OEMR Technology system. Baseline dates for Group 3 were matched closely to the baseline for Group 1. For Group 2, we retrieved archival data from their OEMR data system for their initial data to calculate baseline measures; then data were trended from each quarter for each QI from baseline through 24 months. We used a descriptive approach to compare the changes in resident outcomes using MDS-derived QIs and QMs across Groups 1, 2, 3, and 4. Descriptive analysis is appropriate for this evaluation due to the small sample size.

Because cost and staffing are such critical operational issues in long-term care, cost and staffing outcomes for all groups were compared by using Medicaid cost reports. We compared total costs, total direct care costs, staffing costs, direct care staffing hours per resident per day, and staff mix in all Missouri facilities participating. These comparisons have proved insightful in our prior research (Hicks et al., 1997, 2004; Rantz et al., 2004a). In addition, we solicited cost information from facility administrative staff in their interviews that they were willing to share with research staff about cost savings or expenses experienced with implementation of the OEMR.

Staff outcomes of staff retention (Groups 1, 2, 3) were measured with payroll data, and organizational culture and innovation were measured by staff interviews (Groups 1, 2, 3). Staff satisfaction with the use of technology (Group 1) was measured using focus groups. Observational data of staff use of the technology were supplemental data for understanding staff satisfaction with technology (Group 1).

Analytic Approach

A blend of quantitative and qualitative analyses was selected for this evaluation because human technology interaction and the impact of the technology is complex. Quantitative measures were selected for resident outcomes to be precise in the impact of technology on residents. QIs and QMs are valid and reliable resident outcomes that our research team and other researchers have successfully used in other research projects. Staff retention is a quantifiable, readily obtainable measure that was evaluated across all intervention groups, as are costs and staffing as reported in Medicaid cost reports. Staff perceptions were qualitatively interpreted about organizational culture and innovation. Qualitative methods are essential so that multiple views can be solicited, and staff satisfaction with technology and the staff views of the impact of technology can be understood. Basic observations of the use of the technology are again needed to understand the impact of implementation of technology on the care delivery.

Because small intervention and control group observations were available in this pilot study, descriptive analysis was used to trend and display changes in QI scores for each facility in each group from baseline to the end of the evaluation at 6-month intervals (Groups 1, 2, 3, 4). Tables 5-15 display the actual QI and QM scores for each facility (n=18 facilities); immediately below the QI scores in Tables 5-15 are the number of residents used in the calculation of each score. Then, group means and medians are displayed for each QI or QM score at each of the six month intervals. Also on the tables are the 12 and 24 month raw and relative (%) change scores for the QIs or QMs for each facility and for the groups. Where possible, six and three month pre-baseline scores are included so that baselines could be checked for potentially unusual baseline scores to facilitate interpretation.

Cost and staffing data were descriptively summarized by facility and by group (Groups 1, 2, 3, 4). Similarly, employee retention was calculated for each facility and summarized by facility and by group, as are the results of the Competing Values Framework interviews (Groups 1, 2, 3). Focus group data, observational data of the use of technology, and process data of resident changes were analyzed for each facility for themes using qualitative methods (Krueger, 1988; Patton, 1990) and summarized by facility and by group (Group1).

Timeline for Evaluation Activities and Analyses

This pilot project had a 24-month task order. We have collected and analyzed 24 months of data from all participating facilities in Groups 1 and 2 using OEMR and for facilities in Groups 3 and 4. However, QM data for the final quarter are not available at the time of the writing for this final report for one facility in the sample.

D. RESULTS

Quantitative

The aim of this project was to evaluate the use of a specific bedside data collection method (including portable computer devices, automated processes, and electronic medical records technology) and to conduct a pilot study to determine this system's potential to improve daily measures of resident care and outcomes in nursing facilities; to evaluate the degree to which the use of technology that incorporates bedside data collection can improve resident outcomes; and to evaluate the potential enhancement of resident outcomes by coupling the use of this technology with on-site clinical consultation by expert nurses.

Demographics of Residents in Study Facilities: Demographics were summarized for residents cared for in each of the participating intervention and control group facilities. We needed to determine whether there were any large differences in the demographic characteristics of residents that would need to be taken into consideration when comparing outcome measures across these groups. All residents were counted only once and were cared for sometime during the time interval from the specific facility's baseline date through the third quarter of 2005. Over the evaluation period, there were a total of 8,166 residents cared for in the study facilities. Data were extracted from the MDS data from the OEMR and Missouri MDS data for the comparison Groups 3 and 4. Selected resident demographics are displayed in Table 3.

Recall that Group 4 facilities were randomly selected from non-QIPMO users in Missouri, then matched on facility ownership and approximate facility size. Group 4 has a larger percentage of black, a larger percentage of male, fewer married, and younger average age residents than the other facilities. Group 3 has more residents with less than an eighth-grade education, fewer with a high school education, and fewer with education beyond high school than the other groups. Comparison of the intervention facilities (Groups 1 and 2) with the control facilities (Groups 3 and 4) found that residents in intervention facilities were slightly older, more educated, and more likely to be married or widowed.

These differences may at least theoretically impact the outcomes of the residents, as other studies have found that those elders who are more highly educated and married, in general, have better health outcomes (Ross & Chia-Ling, 1996; Jaffe, Eisenbach, Neumark, Manor, 2005; Liang, Brown, Krause, Ofstedal, Bennett, 2005). However, additional characteristics of resident cognitive impairment and acuity of health conditions are more likely better indicators of resident similarities or differences across the groups that could have impacted the study results.

Cognitive Performance Scale (CPS) scores are another way to examine differences in resident populations in nursing facilities. Based on the MDS data, the scale reliably calculates a

Table 3
Resident demographics

Group	N	Age	Education less than 8th grade	High school education	Education beyond HS	Married	Widowed	White	Black	Male	Female	Average CPS score	Average RUG score
1	2066	82.9	8%	29%	19%	21%	43%	93%	7%	27%	73%	2.2	0.94
2	3643	78.7	5%	29%	15%	27%	45%	85%	12%	32%	68%	1.7	1.10
3	1040	80.8	28%	17%	10%	18%	35%	97%	3%	32%	68%	2.6	0.90
4	1417	76.7	17%	30%	13%	12%	31%	69%	30%	36%	64%	1.9	0.86
Total	8166												

functional cognitive performance score from 0 (intact) to 6 (very severe impairment) (Morris et al., 1994). As can be seen in Table 3, Missouri Groups 1 and 3 are more cognitively impaired than Groups 2 (OEMR in other states) and 4 (Missouri Control Group, No QIPMO, No Technology). The CPS scores in Table 3 are averages calculated from the MDS data at the 12-month data collection for each facility in the groups; CPS scores were calculated at 6-month intervals and were stable within each facility, varying only 0.1 or 0.2 between 6-month intervals. As can be seen in Table 3, both intervention (1 and 2) and control (3 and 4) groups each had one group with high and one group with lower average CPS scores. This could be interpreted as balancing this resident difference across both intervention and control groups.

Resource utilization groups (RUGs) are a method of resident acuity measurement and staff utilization in nursing homes developed by Fries and colleagues (Fries et al., 1994). The RUGs III version was used to compare resident populations across the four groups. As can be seen in Table 3, Group 2 had the highest resident acuity (1.10) and Group 4 the lowest (0.86). (Detailed RUGs information for each group is in A comparison of intervention (1 and 2) and control (3 and 4) groups reveals slightly higher resident acuity in intervention groups as compared with the controls. This could be interpreted as a disadvantage for the intervention groups to demonstrate improvement in quality indicators or quality measures with the help of technology.

Results of Resident Outcome Analysis: Resident outcomes were measured using the MDS data from OEMR for Groups 1 and 2 and the MDS data from the Missouri data set for Groups 3 and 4. Additionally, Group 1 outcomes were calculated using the Missouri data set to display more pre-implementation outcome scores for more accurate analysis of baseline measures.

For the quantitative analysis of QIs, algorithms for QIs prepared for MDS 2.0 were used (CHSRA, 1997). Table 4 summarizes QIs and QMs that either showed no group trend or

Table 4
QIs and QMs that showed no group trends or
remained constant in the evaluation

Quality indicators	Quality measures
Any injury	
Falls	
Depression	More depressed or anxious
Use of 9 + medications	
Onset of cognitive impairment (incidence)	
Bladder/bowel incontinence (risk adjusted)	Low risk residents who lose control of bowel/bladder
Incontinence without toileting plan	
Indwelling catheters (risk adjusted)	Catheter in their bladder
Fecal impaction	
Weight loss	Lose too much weight
Tube feeding	
Dehydration	
Bedfast residents	Spends most of their time in bed or chair
Antipsychotic w/o condition (risk adjusted)	
Antianxiety/hypnotic use	
Daily physical restraints	
Little or no activity	
Stage 1-4 pressure ulcers (risk adjusted)	Pressure sores (too much missing data)
	Pressure sores risk adjusted (too much missing data)
	Low risk residents who have pressure sores
	SS with pressure sores
	Need for help with activities of daily living has increased
	Ability to move around their room got worse
	SS residents who walk better (too much missing data)
	Residents with pain
	SS with pain
	SS with delirium risk adjusted (too much missing data)
	Residents with infection (too much missing data)

remained constant throughout the evaluation period. Then, Tables 5 to 12 present a summary of the findings for resident outcomes using data analyzed through quarter one 2006. Each table displays a specific QI. All tables display the actual QI scores for each facility (n=18 facilities); immediately below the QI scores is the number of residents used in the calculation of each score. Then group means and medians are displayed for each QI score at each of the 6-month intervals. Also in the tables are the 12- and 24-month raw and relative (%) change scores for the QIs or QMs for each facility and for the groups. Where possible, 6- and 3-month pre-baseline scores were included so that baselines could be checked for potentially unusual baseline scores to facilitate interpretation. *Note that negative values in change scores indicate improvement in QI scores and therefore improvement in resident outcomes. Also note that there are some missing measurements because three facilities have not yet reached all post-implementation*

measurement times. These will be reached in fall 2006. Recall that the aim of these analyses is to determine this bedside technology system's potential to improve daily measures of resident care and outcomes; to evaluate the degree to which the use of technology that incorporates bedside data collection can improve resident outcomes; and to evaluate the potential enhancement of resident outcomes by coupling the use of this technology with on-site clinical consultation by expert nurses.

To measure the degree of improvement in resident outcomes, changes in QI scores were determined. Several approaches to examining the data were used. First, to answer the evaluation questions of improvements in resident outcomes, relative changes and actual QI and QM scores were calculated for each facility, then means and medians were calculated for each group of facilities. These iterations were carefully examined for trends in scores, raw changes, and relative (%) changes. Results were also compared with thresholds for QIs that our research team has developed to help facilities in Missouri interpret their QI scores (Rantz 1997a, 2000). The thresholds were updated periodically to reflect the current statewide distributions of scores.

To better examine for baseline differences pre-implementation of OEMR, additional analyses were conducted using the Missouri MDS data set so that QI scores could be examined 3 and 6 months pre-implementation of OEMR. In earlier versions of the analyses, unusually high baseline scores for some QIs for some OEMR facilities were found and needed to be understood. These differences can be seen using 3- and 6-month pre-implementation data displayed in Tables 5 through 12 for Missouri Groups and are used in the descriptions of the results.

The data were also examined for potential negative impact on resident care from the technology. No negative trends were detected in the QI or in the QM scores that would indicate an adverse effect on resident care by implementing technology. There were QIs and QMs that did not show group trends of improvement or negative impact, or remained relatively constant during the evaluation; these are summarized in Table 4. QMs for short-stay residents are marked as SS in the table. Several of the QMs had missing data, so calculation of summary statistics are interpreted with caution and are not used in some cases as described below.

Tables 5 through12 display the QIs with improvements in one or more groups; first the text explaining the trends is presented, followed by the table with descriptive data for all four groups for the study period. Three facilities have not yet reached the 24-month timeline, so these are marked as follows to indicate missing data: "."Each table displays a separate QI. Some QIs are risk adjusted, with high-risk or low-risk residents pooled in each separate calculation. Each table first displays the QI overall calculation for each group, then low-risk and high-risk calculations. Each facility is displayed in each group so that individual facility scores can be seen, as well as mean and median scores for each group. Scores are displayed at quarterly intervals, beginning with pre-measurements of 6 and 3 months pre-implementation of OEMR technology system in the facilities in Groups 1 and 2. The baseline implementation is noted as month 0 and subsequent measurement points of 6, 12, 18, and 24 months post-implementation are displayed. Both raw and relative change scores are calculated for changes at 12 and 24 months.

To evaluate for group differences, the mean and median scores for each group were evaluated, as well as the raw and relative group change scores. *Note that improvements in QIs*

are indicated by negative value change scores. A drop in QI scores, indicating a reduction of the problems that the QIs are potentially detecting, is an improvement. Interpretations were made by evaluating for group differences. The individual facility differences can be seen so that one can determine whether more than one facility accounted for the differences in raw and relative group change scores.

For Group 1 (OEMR and QIPMO), the trends reflected in the data through 18 months are used in the text, because there are still two facilities in Missouri that have not reached the 24-month point in the evaluation at the time this report was prepared. For Group 2 (OEMR, no QIPMO), one facility has yet to reach the 24-month point. Complete data are used for comparison Groups 3 (QIPMO and no OEMR) and 4 (no QIPMO and no OEMR). Therefore, the data are limited at the 24-month period for Groups 1 and 2. Results of the analysis of each QI with improvement trends are discussed and summarized below. It must be noted that the sample size is limited; results are to be interpreted cautiously and are discussed as trends. A larger scale study is needed for more definitive results.

Decline in Late Loss ADLs (Incidence measure; risk adjusted)—Table 5. Improvement in scores can be seen in the median QI scores and the calculated change scores for both Groups 1 and 2. Pre-implementation scores for Group 1 do not reveal an inflated median QI score at baseline as can be seen in Group 2. However, a comparison of subsequent Group 2 scores reveals, particularly at the 24-month post-implementation time frame, a lower score than at post 6 months. The same pattern for Group 2 can be seen for high-risk residents: an unexplained high QI score at baseline, followed by consistent declines to levels lower than the 6-month time frame. For Group 1, improvements were not detected for the high-risk residents. For low-risk residents, there were consistent improvements for both Groups 1 and 2.

In summary, a trend of improvement is detected in the QI data for Groups 1 and 2 as compared with Groups 3 and 4 for decline in late-loss ADLs, as measured by the QI that is both an incidence measure and risk adjusted. An interpretation, based on the observation and interview data presented later in this report, is that this effect is real and likely due to the attention that nursing assistants receive as they use the OEMR bedside documentation system. For the first time, every day, at least every shift, real time, the nursing assistants note in the chart the ADL assistance they provide. Nurses who supervise the nursing assistants are accountable for checking that nursing assistants have charted about their residents without the time-consuming task of pulling charts at the end of the shift, one of the busiest times in nursing homes. Additionally, the data are used in the record, a powerful reinforcement of the importance of the work of nursing assistants that is focused on ADLs.

Table 5
Quality indicator trends of improvement: Decline in late loss ADLs.

QI 18—Residents showing ADL decline in self-performance between previous and most recent assessment
QI 18LR—Residents showing ADL decline in self-performance between previous and most recent assessment: Low Risk
QI 18HR—Residents showing ADL decline in self-performance between previous and most recent assessment: High Risk

QI Number	Risk	Group	NH	Month 6	Month 3	Month 0	Month 6	Month 12	Month 18	Month 24	Month 12 Raw Change	Month 12 % Relative Change	Month 24 Change Raw	Month 24% Relative Change
18		1	1A	15.19	21.79	17.11	16.87	14.81	19.51	24.14	-2.30	-13.44	7.03	41.09
				79	78	76	83	81	82	87				
			1B	8.82	8.16	24.51	16.35	18.18	21.10	16.83	-6.33	-25.83	-7.68	-31.33
				102	98	102	104	110	109	101				
			1C	14.49	34.33	14.52	25.86	19.72	15.87	20.00	5.20	35.81	5.48	37.74
				69	67	62	58	71	63	55				
			1D	18.00	9.88	15.88	9.57	8.70	27.93	22.49	-7.18	-45.21	6.61	41.62
				100	162	170	188	207	179	169				
				======	======	======	======	======	======	======	======	======	======	======
			Mean	14.13	18.54	18.01	17.16	15.35	21.10	20.87	-2.65	-12.17	2.86	22.28
			Median	14.84	15.84	16.50	16.61	16.50	20.31	21.25	-4.32	-19.63	6.05	39.41
18		2	2A	--	--	14.08	13.41	12.79	25.64	5.97	-1.29	-9.16	-8.11	-57.60
						71	82	86	78	67				
			2B	--	--	18.67	10.87	13.14	14.29	14.29	-5.53	-29.62	-4.38	-23.46
						150	138	137	133	126				
			2C	--	--	12.31	11.21	10.19	8.59	8.96	-2.12	-17.22	-3.35	-27.21
						130	116	108	128	134				
			2D	--	--	24.05	46.67	20.00	11.36	8.14	-4.05	-16.84	-15.91	-66.15
						79	75	90	88	86				
				======	======	======	======	======	======	======	======	======	======	======
			Mean	--	--	17.28	20.54	14.03	14.97	9.34	-3.25	-18.21	-7.94	-43.61
			Median	--	--	16.38	12.31	12.97	12.83	8.55	-3.09	-17.03	-6.25	-42.41
18		3	3A	8.08	8.49	8.42	5.15	13.13	7.53	6.25	4.71	55.94	-2.17	-25.77
				99	106	95	97	99	93	96				

(continued)

Table 5 (continued)
Quality indicator trends of improvement: Decline in late loss ADLs

QI 18—Residents showing ADL decline in self-performance between previous and most recent assessment
QI 18LR—Residents showing ADL decline in self-performance between previous and most recent assessment: Low Risk
QI 18HR—Residents showing ADL decline in self-performance between previous and most recent assessment: High Risk

QI Number	Risk	Group	NH	Month -6	Month -3	Month 0	Month 6	Month 12	Month 18	Month 24	Month 12 Raw Change	Month 12 % Relative Change	Month 24 Change Raw	Month 24% Relative Change
			3B	20.00	20.00	13.64	18.42	7.14	11.90	13.33	-6.50	-47.65	-0.31	-2.27
				45	45	44	38	42	42	45				
			3C	8.70	17.78	9.62	13.95	25.00	25.00	28.13	15.38	159.88	18.51	192.41
				23	45	52	43	40	32	32				
			3D	10.17	8.96	20.00	17.14	14.86	17.91	9.68	-5.14	-25.70	-10.32	-51.60
				59	67	65	70	74	67	62				
			3E	9.88	12.99	14.29	15.58	18.92	24.36	14.52	4.63	32.40	0.23	1.61
				81	77	77	77	74	78	62				
				======	======	======	======	======	======	======	======	======	======	======
			Mean	11.36	13.64	13.19	14.05	15.81	17.34	14.38	2.62	34.97	1.19	22.88
			Median	9.88	12.99	13.64	15.58	14.86	17.91	13.33	4.63	32.40	-0.31	-2.27
18		4	4A	8.96	5.00	2.86	8.86	5.63	5.26	6.25	2.77	96.85	3.39	118.53
				67	80	70	79	71	76	64				
			4B	11.43	7.81	5.63	6.94	16.05	17.33	10.67	10.42	185.08	5.04	89.52
				70	64	71	72	81	75	75				
			4C	10.96	4.69	15.15	9.09	15.07	10.96	5.33	-0.08	-0.53	-9.82	-64.82
				73	64	66	66	73	73	75				
			4D	13.41	12.94	5.95	12.50	11.36	11.83	10.34	5.41	90.92	4.39	73.78
				82	85	84	72	88	93	87				
			4E	5.30	6.29	7.18	15.65	10.24	3.57	8.90	3.06	42.62	1.72	23.96
				151	175	181	147	166	168	191				
				======	======	======	======	======	======	======	======	======	======	======
			Mean	10.01	7.35	7.35	10.61	11.67	9.79	8.30	4.32	82.99	0.94	48.19
			Median	10.96	6.29	5.95	9.09	11.36	10.96	8.90	3.06	90.92	3.39	73.78

(continued)

Table 5 (continued)
Quality indicator trends of improvement: Decline in late loss ADLs

QI 18—Residents showing ADL decline in self-performance between previous and most recent assessment
QI 18LR—Residents showing ADL decline in self-performance between previous and most recent assessment: Low Risk
QI 18HR—Residents showing ADL decline in self-performance between previous and most recent assessment: High Risk

QI Number	Risk	Group	NH	Month -6	Month -3	Month 0	Month 6	Month 12	Month 18	Month 24	Month 12 Raw Change	Month 12 % Relative Change	Month 24 Change Raw	Month 24% Relative Change
18	LR	1	1A	15.22	14.29	10.81	19.64	12.96	14.58	16.36	2.15	19.89	5.55	51.34
				46	49	37	56	54	48	55				
			1B	9.09	8.97	26.51	15.29	17.02	19.28	14.29	-9.49	-35.80	-12.22	-46.10
				77	78	83	85	94	83	84				
			1C	12.24	37.25	17.78	23.33	10.53	15.00	10.00	-7.25	-40.78	-7.78	-43.76
				49	51	45	30	38	40	40				
			1D	15.29	9.09	14.47	9.32	7.69	26.21	18.60	-6.78	-46.86	4.13	28.54
				85	143	152	161	182	145	129				
				======	======	======	======	======	======	======	======	======	======	======
			Mean	12.96	17.40	17.39	16.90	12.05	18.77	14.81	-5.34	-25.89	-2.58	-2.49
			Median	13.73	11.69	16.13	17.47	11.75	17.14	15.33	-7.02	-38.29	-1.83	-7.61
18	LR	2	2A	--	--	9.26	12.33	10.96	22.39	3.70	1.70	18.36	-5.56	-60.04
						54	73	73	67	54				
			2B	--	--	14.29	9.68	12.17	14.29	14.74	-2.12	-14.84	0.45	3.15
						126	124	115	105	95				
			2C	--	--	9.47	9.20	9.59	6.86	9.09	0.12	1.27	-0.38	-4.01
						95	87	73	102	110				
			2D	--	--	24.24	43.94	19.48	11.54	6.85	-4.76	-19.64	-17.39	-71.74
						66	66	77	78	73				
				======	======	======	======	======	======	======	======	======	======	======
			Mean	--	--	14.32	18.79	13.05	13.77	8.60	-1.27	-3.71	-5.72	-33.16
			Median	--	--	11.88	11.01	11.57	12.92	7.97	-1.00	-6.78	-2.97	-32.03
18	LR	3	3A	7.06	7.61	7.79	4.60	10.98	8.54	3.53	3.19	40.95	-4.26	-54.69
				85	92	77	87	82	82	85				

Table 5 (continued)
Quality indicator trends of improvement: Decline in late loss ADLs

QI 18—Residents showing ADL decline in self-performance between previous and most recent assessment
QI 18LR—Residents showing ADL decline in self-performance between previous and most recent assessment: Low Risk
QI 18HR—Residents showing ADL decline in self-performance between previous and most recent assessment: High Risk

QI Number	Risk	Group	NH	Month -6	Month -3	Month 0	Month 6	Month 12	Month 18	Month 24	Month 12 Raw Change	Month 12 % Relative Change	Month 24 Change Raw	Month 24% Relative Change
			3B	19.44	14.29	10.81	17.65	5.56	2.94	13.33	-5.25	-48.57	2.52	23.31
				36	35	37	34	36	34	30				
			3C	0.00	16.67	7.50	15.15	21.88	22.58	21.43	14.38	191.73	13.93	185.73
				18	42	40	33	32	31	28				
			3D	11.32	7.27	16.67	15.79	10.00	11.86	7.55	-6.67	-40.01	-9.12	-54.71
				53	55	48	57	60	59	53				
			3E	7.35	8.06	12.90	10.34	12.28	23.44	14.89	-0.62	-4.81	1.99	15.43
				68	62	62	58	57	64	47				
				======	======	======	======	======	======	======	======	======	======	======
			Mean	9.04	10.78	11.13	12.71	12.14	13.87	12.15	1.01	27.86	1.01	23.02
			Median	7.35	8.06	10.81	15.15	10.98	11.86	13.33	-0.62	-4.81	1.99	15.43
18	LR	4	4A	5.17	1.47	3.13	4.55	5.97	5.80	2.17	2.84	90.73	-0.96	-30.67
				58	68	64	66	67	69	46				
			4B	9.23	6.90	3.51	3.23	13.24	13.11	8.20	9.73	277.21	4.69	133.62
				65	58	57	62	68	61	61				
			4C	10.17	1.67	13.73	7.14	11.11	9.84	4.48	-2.62	-19.08	-9.25	-67.37
				59	60	51	56	63	61	67				
			4D	9.59	11.11	5.88	12.90	8.97	8.05	9.64	3.09	52.55	3.76	63.95
				73	72	68	62	78	87	83				
			4E	3.73	5.81	7.64	14.60	8.28	3.25	7.43	0.64	8.38	-0.21	-2.75
				134	155	157	137	157	154	175				
				======	======	======	======	======	======	======	======	======	======	======
			Mean	7.58	5.39	6.78	8.48	9.51	8.01	6.38	2.74	81.96	-0.39	19.35
			Median	9.23	5.81	5.88	7.14	8.97	8.05	7.43	2.84	52.55	-0.21	-2.75
18	HR	1	1A	15.15	34.48	23.08	11.11	18.52	26.47	37.50	-4.56	-19.76	14.42	62.48
				33	29	39	27	27	34	32				

(continued)

Table 5 (continued)
Quality indicator trends of improvement: Decline in late loss ADLs

QI 18—Residents showing ADL decline in self-performance between previous and most recent assessment
QI 18LR—Residents showing ADL decline in self-performance between previous and most recent assessment: Low Risk
QI 18HR—Residents showing ADL decline in self-performance between previous and most recent assessment: High Risk

QI Number	Risk	Group	NH	Month -6	Month -3	Month 0	Month 6	Month 12	Month 18	Month 24	Month 12 Raw Change	Month 12 % Relative Change	Month 24 Change Raw	Month 24% Relative Change
18	HR	1	1B	8.00	5.00	15.79	21.05	25.00	26.92	29.41	9.21	58.33	13.62	86.26
				25	20	19	19	16	26	17				
			1C	20.00	25.00	5.88	28.57	30.30	17.39	46.67	24.42	415.31	40.79	693.71
				20	16	17	28	33	23	15				
			1D	33.33	15.79	27.78	11.11	16.00	35.29	35.00	-11.78	-42.40	7.22	25.99
				15	19	18	27	25	34	40				
				======	======	======	======	======	======	======	======	======	======	======
			Mean	19.12	20.07	18.13	17.96	22.46	26.52	37.15	4.32	102.87	19.01	217.11
			Median	17.58	20.39	19.44	16.08	21.76	26.70	36.25	2.33	19.29	14.02	74.37
18	HR	2	2A	--	--	29.41	22.22	23.08	45.45	15.38	-6.33	-21.52	-14.03	-47.70
						17	9	13	11	13				
			2B	--	--	41.67	21.43	18.18	14.29	12.90	-23.49	-56.37	-28.77	-69.04
						24	14	22	28	31				
			2C	--	--	20.00	17.24	11.43	15.38	8.33	-8.57	-42.85	-11.67	-58.35
						35	29	35	26	24				
			2D	--	--	16.67	66.67	23.08	10.00	15.38	6.41	38.45	-1.29	-7.74
						12	9	13	10	13				
				======	======	======	======	======	======	======	======	======	======	======
			Mean	--	--	26.94	31.89	18.94	21.28	13.00	-8.00	-20.57	-13.94	-45.71
			Median	--	--	24.71	21.83	20.63	14.84	14.14	-7.45	-32.19	-12.85	-53.03
18	HR	3	3A	14.29	14.29	11.11	10.00	23.53	0.00	27.27	12.42	111.79	16.16	145.45
				14	14	18	10	17	11	11				
			3B	22.22	40.00	28.57	25.00	16.67	50.00	13.33	-11.90	-41.65	-15.24	-53.34
				9	10	7	4	6	8	15				

(continued)

Table 5 (continued)
Quality indicator trends of improvement: Decline in late loss ADLs

QI 18—Residents showing ADL decline in self-performance between previous and most recent assessment
QI 18LR—Residents showing ADL decline in self-performance between previous and most recent assessment: Low Risk
QI 18HR—Residents showing ADL decline in self-performance between previous and most recent assessment: High Risk

QI Number	Risk	Group	NH	Month -6	Month -3	Month 0	Month 6	Month 12	Month 18	Month 24	Month 12 Raw Change	Month 12 % Relative Change	Month 24 Change Raw	Month 24% Relative Change
			3C	40.00 5	33.33 3	16.67 12	10.00 10	37.50 8	100.00 1	75.00 4	20.83	124.96	58.33	349.91
			3D	0.00 6	16.67 12	29.41 17	23.08 13	35.71 14	62.50 8	22.22 9	6.30	21.42	-7.19	-24.45
			3E	23.08 13	33.33 15	20.00 15	31.58 19	41.18 17	28.57 14	13.33 15	21.18	105.90	-6.67	-33.35
				======	======	======	======	======	======	======	======	======	======	======
			Mean	19.92	27.52	21.15	19.93	30.92	48.21	30.23	9.77	64.48	9.08	76.84
			Median	22.22	33.33	20.00	23.08	35.71	50.00	22.22	12.42	105.90	-6.67	-24.45
18	HR	4	4A	33.33 9	25.00 12	0.00 6	30.77 13	0.00 4	0.00 7	16.67 18	0.00	--	16.67	--
			4B	40.00 5	16.67 6	14.29 14	30.00 10	30.77 13	35.71 14	21.43 14	16.48	115.33	7.14	49.97
			4C	14.29 14	50.00 4	20.00 15	20.00 10	40.00 10	16.67 12	12.50 8	20.00	100.00	-7.50	-37.50
			4D	44.44 9	23.08 13	6.25 16	10.00 10	30.00 10	66.67 6	25.00 4	23.75	380.00	18.75	300.00
			4E	17.65 17	10.00 20	4.17 24	30.00 10	44.44 9	7.14 14	25.00 16	40.27	965.71	20.83	499.52
				======	======	======	======	======	======	======	======	======	======	======
			Mean	29.94	24.95	8.94	24.15	29.04	25.24	20.12	20.10	390.26	11.18	203.00
			Median	33.33	23.08	6.25	30.00	30.77	16.67	21.43	20.00	247.66	16.67	174.98

Decline in Range of Motion (ROM) (Incidence measure; risk adjusted)—Table 6.
Improvements in scores are revealed in the improvements of QI scores and relative change
scores for Groups 1 and 2. Again, there is an unexplained higher baseline score for Group 2, and
somewhat higher for Group1 as compared with 6 months pre-OEMR. The same pattern is seen
for both high-risk and low-risk residents. The scores for this QI are consistently higher for
Groups 1 and 2 (with OEMR) than for comparison Groups 3 and 4. An explanation for this
result, based on the observations and interviews of the staff using OEMR, is that nursing
assistants are charting about the ability of the residents as measured by this QI for decline in
range of motion. It is likely that the nursing assistants are more accurately describing the ability
of the residents, making the nurses more aware of the limitations of the residents. The charting
then results in higher initial QI scores for this QI. In other words, more accurate documentation
is resulting in more detection of this condition. After this initial detection, scores improve for
Groups 1 and 2.

Urinary Tract Infections (Prevalence measure; no risk adjustment)—Table 7. Table 7
reveals improvements in prevalence of urinary tract infections as measured by this QI. QI scores,
raw and relative changes are improving for both Groups 1 and 2. These improvements were not
detected in group differences in Groups 3 or 4. An explanation, based on the interviews with
nurses who use the OEMR, could be that signs of changes in condition and early signs of
infection or problems with nutrition or hydration are being detected more readily with the help of
the electronic medical record. Nurses indicated in interviews that they were able to use the report
and retrieval functions of the record to see changes in resident conditions more easily than in the
traditional hard-copy chart. They think they are picking up these problems more quickly and
getting treatment for residents earlier.

Behavioral Symptoms Affecting Others (Prevalence measure; risk adjusted)—Table 8.
Table 8 reveals improvement in actual QI scores, raw and relative changes for Groups 1, 2, and
3. If the influence of the QIPMO consultation is considered, it appears that larger improvements
were detected in Group 1 as compared with Group 2. If the influence of technology is considered
with QIPMO, Group 1 has larger improvements than Group 3 (QIPMO but no technology).
These similar patterns were revealed for both high- and low-risk groups. Group 4 (low risk) also
showed some improvements; these could be explained by improvements in their care systems or
a reflection of the lower resident acuity and less cognitive impairment of the residents in Group 4
as revealed in the resident demographics in prior Table 3.

An explanation for the larger improvements for Group 1 than Group 2 could be that the
QIPMO nurse is influencing the staff interventions used for those residents with behavior
problems. This clinical area is often the focus of education and role modeling with staff by the
QIPMO nurses, as tracked in the evaluation of the QIPMO program for Missouri. Coupling
QIPMO with technology appears to effectively improve this QI.

***Symptoms or Diagnosis of Depression with No Treatment (Prevalence measure; no
risk adjustment)—Table 9***. Group 1 improvements were detected in this QI (technology and
QIPMO), as revealed in Table 9, as compared with Groups 3 and 4. Group 2 (technology only)
had small improvements at 12 and 24 months. This appears to be another QI that is improved by
coupling QIPMO with technology. This clinical area is often the focus of education and role
modeling with staff by the QIPMO nurses, as tracked in the evaluation of the QIPMO program
for Missouri.

Table 6
Quality Indicator trends of improvement: Decline in range of motion

QI 19—Residents with increases in functional limitation in ROM between previous and most recent assessments
QI 19LR—Residents with increases in functional limitation in ROM between previous and most recent assessments: Low Risk
QI 19HR—Residents with increases in functional limitation in ROM between previous and most recent assessments: High Risk

QI Number	Risk	Group	NH	Month -6	Month -3	Month 0	Month 6	Month 12	Month 18	Month 24	Month 12 Raw Change	Month 12 % Relative Change	Month 24 Change Raw	Month 24% Relative Change
19		1	1A	9.41	6.98	15.66	14.12	16.67	9.41	19.10	1.01	6.45	3.44	21.97
				85	86	83	85	84	85	89				
			1B	7.48	6.93	25.47	11.01	18.02	7.02	18.27	-7.45	-29.25	-7.20	-28.27
				107	101	106	109	111	114	104				
			1C	2.78	11.43	13.64	20.00	15.07	10.61	11.48	1.43	10.48	-2.16	-15.84
				72	70	66	60	73	66	61				
			1D	2.75	1.74	1.67	1.50	1.82	5.56	5.05	0.15	8.98	3.38	202.40
				109	172	180	200	220	198	198				
				======	======	======	======	======	======	======	======	======	======	======
			Mean	5.60	6.77	14.11	11.66	12.90	8.15	13.48	-1.22	-0.83	-0.64	45.06
			Median	5.13	6.95	14.65	12.57	15.87	8.22	14.88	0.58	7.72	0.61	3.07
19		2	2A	--	--	10.13	1.12	7.53	9.20	14.47	-2.60	-25.67	4.34	42.84
						79	89	93	87	76				
			2B	--	--	25.00	16.99	18.92	15.17	19.85	-6.08	-24.32	-5.15	-20.60
						160	153	148	145	136				
			2C	--	--	7.46	15.00	6.14	11.11	4.29	-1.32	-17.69	-3.17	-42.49
						134	120	114	135	140				
			2D	--	--	12.73	7.63	16.38	19.27	4.95	3.65	28.67	-7.78	-61.12
						110	118	116	109	101				
						======	======	======	======	======	======	======	======	======
			Mean	--	--	13.83	10.19	12.24	13.69	10.89	-1.59	-9.75	-2.94	-20.34
			Median	--	--	11.43	11.32	11.96	13.14	9.71	-1.96	-21.01	-4.16	-31.55
19		3	3A	20.39	31.82	6.06	6.86	13.21	20.41	6.00	7.15	117.99	-0.06	-0.99
				103	110	99	102	106	98	100				
			3B	22.64	20.75	21.15	18.00	8.77	5.26	7.14	-12.38	-58.53	-14.01	-66.24
				53	53	52	50	57	57	56				
			3C	20.00	6.25	3.70	6.67	4.55	16.67	11.43	0.85	22.97	7.73	208.92

(continued)

Table 6 (continued)
Quality Indicator trends of improvement: Decline in range of motion

QI 19—Residents with increases in functional limitation in ROM between previous and most recent assessments
QI 19LR—Residents with increases in functional limitation in ROM between previous and most recent assessments: Low Risk
QI 19HR—Residents with increases in functional limitation in ROM between previous and most recent assessments: High Risk

QI Number	Risk	Group	NH	Month -6	Month -3	Month 0	Month 6	Month 12	Month 18	Month 24	Month 12 Raw Change	Month 12 % Relative Change	Month 24 Change Raw	Month 24% Relative Change
19		3		25	48	54	45	44	36	35				
			3D	2.50	6.02	11.39	1.27	3.66	1.33	2.99	-7.73	-67.87	-8.40	-73.75
				80	83	79	79	82	75	67				
			3E	1.18	2.47	0.00	6.02	10.98	8.75	8.96	10.98	--	8.96	--
				85	81	80	83	82	80	67				
				======	======	======	======	======	======	======	======	======	======	======
			Mean	13.34	13.46	8.46	7.76	8.23	10.48	7.30	-0.23	3.64	-1.16	16.98
			Median	20.00	6.25	6.06	6.67	8.77	8.75	7.14	0.85	-17.78	-0.06	-33.62
19		4	4A	1.47	2.47	2.82	5.00	2.82	4.05	3.23	0.00	0.00	0.41	14.54
				68	81	71	80	71	74	62				
			4B	4.05	1.49	6.67	3.85	2.38	7.59	15.19	-4.29	-64.32	8.52	127.74
				74	67	75	78	84	79	79				
			4C	10.00	4.82	4.71	3.75	4.76	5.95	5.06	0.05	1.06	0.35	7.43
				90	83	85	80	84	84	79				
			4D	2.41	1.15	0.00	0.00	4.44	2.02	1.08	4.44	--	1.08	--
				83	87	87	76	90	99	93				
			4E	8.88	3.09	3.06	1.84	10.00	8.29	7.69	6.94	226.80	4.63	151.31
				169	194	196	163	180	181	208				
				======	======	======	======	======	======	======	======	======	======	======
			Mean	5.36	2.60	3.45	2.89	4.88	5.58	6.45	1.43	40.89	3.00	75.25
			Median	4.05	2.47	3.06	3.75	4.44	5.95	5.06	0.05	0.53	1.08	71.14
19	LR	1	1A	6.25	4.69	15.71	12.33	16.67	7.89	17.07	0.96	6.11	1.36	8.66
				64	64	70	73	72	76	82				
			1B	6.90	6.25	27.06	10.42	16.83	6.80	18.28	-10.23	-37.80	-8.78	-32.45
				87	80	85	96	101	103	93				

Table 6 (continued)
Quality Indicator trends of improvement: Decline in range of motion

QI 19—Residents with increases in functional limitation in ROM between previous and most recent assessments
QI 19LR—Residents with increases in functional limitation in ROM between previous and most recent assessments: Low Risk
QI 19HR—Residents with increases in functional limitation in ROM between previous and most recent assessments: High Risk

QI Number	Risk	Group	NH	Month -6	Month -3	Month 0	Month 6	Month 12	Month 18	Month 24	Month 12 Raw Change	Month 12 % Relative Change	Month 24 Change Raw	Month 24% Relative Change
19	LR	1	1C	3.23	11.48	13.33	20.37	14.06	7.41	12.24	0.73	5.48	-1.09	-8.18
				62	61	60	54	64	54	49				
			1D	2.20	0.68	1.96	1.71	1.04	2.45	2.96	-0.92	-46.94	1.00	51.02
				91	148	153	175	192	163	135				
				======	======	======	======	======	======	======	======	======	======	======
			Mean	4.64	5.77	14.52	11.21	12.15	6.14	12.64	-2.37	-18.29	-1.88	4.76
			Median	4.74	5.47	14.52	11.38	15.37	7.11	14.66	-0.10	-16.16	-0.05	0.24
19	LR	2	2A	--	--	9.52	0.00	7.14	10.53	10.94	-2.38	-25.00	1.42	14.92
						63	74	84	76	64				
			2B	--	--	23.85	18.03	16.38	14.41	18.27	-7.47	-31.32	-5.58	-23.40
						130	122	116	118	104				
			2C	--	--	5.36	15.15	4.35	9.65	5.22	-1.01	-18.84	-0.14	-2.61
						112	99	92	114	115				
			2D	--	--	15.56	8.64	9.86	13.51	6.94	-5.70	-36.63	-8.62	-55.40
						90	81	71	74	72				
				======	======	======	======	======	======	======	======	======	======	======
			Mean	--	--	13.57	10.46	9.43	12.03	10.34	-4.14	-27.95	-3.23	-16.62
			Median	--	--	12.54	11.90	8.50	12.02	8.94	-4.04	-28.16	-2.86	-13.00
19	LR	3	3A	19.59	31.73	6.45	6.25	14.14	19.32	6.67	7.69	119.22	0.22	3.41
				97	104	93	96	99	88	90				
			3B	28.21	25.00	21.62	25.00	2.86	8.11	7.89	-18.76	-86.77	-13.73	-63.51
				39	40	37	32	35	37	38				
			3C	15.79	2.56	2.17	5.41	5.56	16.00	3.85	3.39	156.22	1.68	77.42
				19	39	46	37	36	25	26				
			3D	1.75	6.25	6.78	1.69	0.00	1.72	1.79	-6.78	-100.0	-4.99	-73.60
				57	64	59	59	64	58	56				
			3E	0.00	2.63	0.00	5.33	8.33	8.70	8.62	8.33	--	8.62	--

(continued)

Table 6 (continued)
Quality Indicator trends of improvement: Decline in range of motion

QI 19—Residents with increases in functional limitation in ROM between previous and most recent assessments
QI 19LR—Residents with increases in functional limitation in ROM between previous and most recent assessments: Low Risk
QI 19HR—Residents with increases in functional limitation in ROM between previous and most recent assessments: High Risk

QI Number	Risk	Group	NH	Month -6	Month -3	Month 0	Month 6	Month 12	Month 18	Month 24	Month 12 Raw Change	Month 12 % Relative Change	Month 24 Change Raw	Month 24% Relative Change
19	LR	3		79	76	76	75	72	69	58				
				======	======	======	======	======	======	======	======	======	======	======
			Mean	13.07	13.64	7.40	8.74	6.18	10.77	5.76	-1.23	22.17	-1.64	-14.07
			Median	15.79	6.25	6.45	5.41	5.56	8.70	6.67	3.39	16.23	0.22	-30.05
19	LR	4	4A	1.59	2.67	3.08	5.48	3.03	2.90	3.57	-0.05	-1.62	0.49	15.91
				63	75	65	73	66	69	56				
			4B	5.17	1.89	6.15	3.33	2.82	9.23	16.13	-3.33	-54.15	9.98	162.28
				58	53	65	60	71	65	62				
			4C	7.59	4.23	5.56	4.48	5.48	5.63	6.06	-0.08	-1.44	0.50	8.99
				79	71	72	67	73	71	66				
			4D	2.56	1.23	0.00	0.00	3.49	1.09	1.20	3.49	--	1.20	--
				78	81	80	71	86	92	83				
			4E	6.67	2.80	2.70	0.79	7.84	6.96	5.11	5.14	190.37	2.41	89.26
				120	143	148	126	153	158	176				
				======	======	======	======	======	======	======	======	======	======	======
			Mean	4.72	2.56	3.50	2.82	4.53	5.16	6.41	1.03	33.29	2.92	69.11
			Median	5.17	2.67	3.08	3.33	3.49	5.63	5.11	-0.05	-1.53	1.20	52.58
19	HR	1	1A	19.05	13.64	15.38	25.00	16.67	22.22	42.86	1.29	8.39	27.48	178.67
				21	22	13	12	12	9	7				
			1B	10.00	10.00	19.05	15.38	30.00	9.09	18.18	10.95	57.48	-0.87	-4.57
				20	20	21	13	10	11	11				
			1C	0.00	11.11	16.67	16.67	22.22	25.00	8.33	5.55	33.29	-8.34	-50.03
				10	9	6	6	9	12	12				
			1D	0.00	8.70	0.00	0.00	7.14	17.65	9.84	7.14	--	9.84	--
				17	23	27	25	28	34	61				
				======	======	======	======	======	======	======	======	======	======	======

Table 6 (continued)
Quality Indicator trends of improvement: Decline in range of motion

QI 19—Residents with increases in functional limitation in ROM between previous and most recent assessments
QI 19LR—Residents with increases in functional limitation in ROM between previous and most recent assessments: Low Risk
QI 19HR—Residents with increases in functional limitation in ROM between previous and most recent assessments: High Risk

QI Number	Risk	Group	NH	Month -6	Month -3	Month 0	Month 6	Month 12	Month 18	Month 24	Month 12 Raw Change	Month 12 % Relative Change	Month 24 Change Raw	Month 24% Relative Change
19	HR	1	Mean	7.26	10.86	12.78	14.26	19.01	18.49	19.80	6.23	33.05	7.03	41.36
			Median	5.00	10.56	16.03	16.03	19.45	19.94	14.01	6.35	33.29	4.49	-4.57
19	HR	2	2A	--	--	6.67	6.67	11.11	0.00	33.33	4.44	66.57	26.66	399.70
						15	15	9	11	12				
			2B	--	--	27.59	13.33	28.13	18.52	25.00	0.54	1.96	-2.59	-9.39
						29	30	32	27	32				
			2C	--	--	18.18	14.29	13.64	19.05	0.00	-4.54	-24.97	-18.18	-100.0
						22	21	22	21	25				
			2D	--	--	0.00	5.56	26.67	31.43	0.00	26.67	--	0.00	--
						20	36	45	35	29				
				======	======	======	======	======	======	======	======	======	======	======
			Mean	--	--	13.11	9.96	19.89	17.25	14.58	6.78	14.52	1.47	96.77
			Median	--	--	12.43	10.00	20.16	18.79	12.50	2.49	1.96	-1.30	-9.39
19	HR	3	3A	33.33	33.33	0.00	16.67	0.00	30.00	0.00	0.00	--	0.00	--
				6	6	6	6	7	10	10				
			3B	7.14	7.69	20.00	5.56	18.18	0.00	5.56	-1.82	-9.10	-14.44	-72.20
				14	13	15	18	22	19	18				
			3C	33.33	22.22	12.50	12.50	0.00	18.18	33.33	-12.50	-100.0	20.83	166.64
				6	9	8	8	8	11	9				
			3D	4.55	5.26	25.00	0.00	16.67	0.00	9.09	-8.33	-33.32	-15.91	-63.64
				22	19	20	20	18	17	11				
			3E	16.67	0.00	0.00	12.50	25.00	9.09	11.11	25.00	--	11.11	--
				6	5	4	8	8	11	9				
				======	======	======	======	======	======	======	======	======	======	======
			Mean	19.00	13.70	11.50	9.45	11.97	11.45	11.82	0.47	-47.47	0.32	10.27
			Median	16.67	7.69	12.50	12.50	16.67	9.09	9.09	-1.82	-33.32	0.00	-63.64

Table 6 (continued)
Quality Indicator trends of improvement: Decline in range of motion

QI 19—Residents with increases in functional limitation in ROM between previous and most recent assessments
QI 19LR—Residents with increases in functional limitation in ROM between previous and most recent assessments: Low Risk
QI 19HR—Residents with increases in functional limitation in ROM between previous and most recent assessments: High Risk

QI Number	Risk	Group	NH	Month -6	Month -3	Month 0	Month 6	Month 12	Month 18	Month 24	Month 12 Raw Change	Month 12 % Relative Change	Month 24 Change Raw	Month 24% Relative Change
19	HR	4	4A	0.00	0.00	0.00	0.00	0.00	20.00	0.00	0.00	--	0.00	--
				5	6	6	7	5	5	6				
			4B	0.00	0.00	10.00	5.56	0.00	0.00	11.76	-10.00	-100.0	1.76	17.60
				16	14	10	18	13	14	17				
			4C	27.27	8.33	0.00	0.00	0.00	7.69	0.00	0.00	--	0.00	--
				11	12	13	13	11	13	13				
			4D	0.00	0.00	0.00	0.00	25.00	14.29	0.00	25.00	--	0.00	--
				5	6	7	5	4	7	10				
			4E	14.58	3.92	4.17	5.41	24.00	17.39	22.58	19.83	475.54	18.41	441.49
				48	51	48	37	25	23	31				
				======	======	======	======	======	======	======	======	======	======	======
			Mean	8.37	2.45	2.83	2.19	9.80	11.87	6.87	6.97	187.77	4.03	229.54
			Median	0.00	0.00	0.00	0.00	0.00	14.29	0.00	0.00	187.77	0.00	229.54

Table 7
Quality Indicator trends of improvement: Urinary tract infections

QI 12—Residents with urinary tract infections on most recent assessment

QI Number	Risk	Group	NH	Month -6	Month -3	Month 0	Month 6	Month 12	Month 18	Month 24	Month 12 Raw Change	Month 12 % Relative Change	Month 24 Change Raw	Month 24% Relative Change
12		1	1A	15.22	15.22	16.47	19.15	13.33	20.65	13.33	-3.14	-19.06	-3.14	-19.06
				92	92	85	94	90	92	90				
			1B	10.43	3.92	10.00	4.39	8.77	6.96	8.49	-1.23	-12.30	-1.51	-15.10
				115	102	110	114	114	115	106				
			1C	5.48	8.57	6.06	8.33	20.55	21.21	14.75	14.49	239.11	8.69	143.40
				73	70	66	60	73	66	61				
			1D	7.46	9.09	10.81	5.34	7.17	5.03	7.50	-3.64	-33.67	-3.31	-30.62
				134	176	185	206	223	199	200				
				======	======	======	======	======	======	======	======	======	======	======
			Mean	9.65	9.20	10.84	9.30	12.46	13.46	11.02	1.62	43.52	0.18	19.65
			Median	8.95	8.83	10.41	6.84	11.05	13.81	10.91	-2.19	-15.68	-2.33	-17.08
12		2	2A	--	--	8.64	4.49	5.32	2.30	3.90	-3.32	-38.43	-4.74	-54.86
						81	89	94	87	77				
			2B	--	--	8.64	5.66	11.46	7.05	11.81	2.82	32.64	3.17	36.69
						162	159	157	156	144				
			2C	--	--	11.54	11.57	16.38	21.90	10.42	4.84	41.94	-1.12	-9.71
						130	121	116	137	144				
			2D	--	--	2.83	8.40	5.17	9.57	4.95	2.34	82.69	2.12	74.91
						106	119	116	94	101				
						======	======	======	======	======	======	======	======	======
			Mean	--	--	7.91	7.53	9.58	10.21	7.77	1.67	29.71	-0.14	11.76
			Median	--	--	8.64	7.03	8.39	8.31	7.69	2.58	37.29	0.50	13.49
12		3	3A	4.85	4.55	5.05	8.74	2.83	8.16	9.00	-2.22	-43.96	3.95	78.22
				103	110	99	103	106	98	100				

Table 7 (continued)
Quality Indicator trends of improvement: Urinary tract infections

QI 12—Residents with urinary tract infections on most recent assessment

QI Number	Risk	Group	NH	Month -6	Month -3	Month 0	Month 6	Month 12	Month 18	Month 24	Month 12 Raw Change	Month 12 % Relative Change	Month 24 Change Raw	Month 24% Relative Change
12		3	3B	11.32	15.09	3.85	2.00	5.26	8.77	5.36	1.41	36.62	1.51	39.22
				53	53	52	50	57	57	56				
			3C	7.69	14.58	9.09	15.56	9.09	10.81	17.14	0.00	0.00	8.05	88.56
				26	48	55	45	44	37	35				
			3D	8.64	8.43	7.59	5.06	6.10	10.67	5.97	-1.49	-19.63	-1.62	-21.34
				81	83	79	79	82	75	67				
			3E	5.88	8.64	5.00	7.23	13.41	8.75	10.45	8.41	168.20	5.45	109.00
				85	81	80	83	82	80	67				
				======	======	======	======	======	======	======	======	======	======	======
			Mean	7.68	10.26	6.12	7.72	7.34	9.43	9.58	1.22	28.25	3.47	58.73
			Median	7.69	8.64	5.05	7.23	6.10	8.77	9.00	0.00	0.00	3.95	78.22
12		4	4A	4.35	4.82	13.89	23.46	9.72	9.21	15.63	-4.17	-30.02	1.74	12.53
				69	83	72	81	72	76	64				
			4B	11.84	8.57	5.19	3.75	8.14	15.00	11.25	2.95	56.84	6.06	116.76
				76	70	77	80	86	80	80				
			4C	3.23	5.81	4.55	6.02	5.81	4.65	9.88	1.26	27.69	5.33	117.14
				93	86	88	83	86	86	81				
			4D	6.02	6.90	5.75	6.49	12.22	15.15	7.45	6.47	112.52	1.70	29.57
				83	87	87	77	90	99	94				
			4E	3.39	2.48	2.02	2.45	4.40	2.19	2.87	2.38	117.82	0.85	42.08
				177	202	198	163	182	183	209				
				======	======	======	======	======	======	======	======	======	======	======
			Mean	5.77	5.72	6.28	8.43	8.06	9.24	9.42	1.78	56.97	3.14	63.62
			Median	4.35	5.81	5.19	6.02	8.14	9.21	9.88	2.38	56.84	1.74	42.08

Table 8
Quality Indicator trends of improvement: Behavioral symptoms affecting others

QI 3—Residents with behavioral symptoms affecting others on most recent assessment
QI 3LR—Residents with behavioral symptoms affecting others on most recent assessment: Low Risk
QI 3HR—Residents with behavioral symptoms affecting others on most recent assessment: High Risk

QI Number	Risk	Group	NH	Month -6	Month -3	Month 0	Month 6	Month 12	Month 18	Month 24	Month 12 Raw Change	Month 12 % Relative Change	Month 24 Change Raw	Month 24% Relative Change
3		1	1A	9.78	7.61	10.59	0.00	16.67	14.13	10.00	6.08	57.41	-0.59	-5.57
				92	92	85	94	90	92	90				
			1B	16.81	15.84	17.59	12.39	11.50	11.30	8.57	-6.09	-34.62	-9.02	-51.28
				113	101	108	113	113	115	105				
			1C	20.55	20.00	9.23	8.33	6.85	10.77	13.11	-2.38	-25.79	3.88	42.04
				73	70	65	60	73	65	61				
			1D	6.72	7.95	10.81	9.71	11.66	11.06	6.50	0.85	7.86	-4.31	-39.87
				134	176	185	206	223	199	200				
				======	======	======	======	======	======	======	======	======	======	======
			Mean	13.47	12.85	12.06	7.61	11.67	11.82	9.55	-0.39	1.22	-2.51	-13.67
			Median	13.30	11.90	10.70	9.02	11.58	11.18	9.29	-0.77	-8.96	-2.45	-22.72
3		2	2A	--	--	23.75	17.05	21.51	27.91	27.63	-2.24	-9.43	3.88	16.34
						80	88	93	86	76				
			2B	--	--	21.15	27.56	24.52	15.69	12.68	3.37	15.93	-8.47	-40.05
						156	156	155	153	142				
			2C	--	--	22.31	19.01	12.07	21.17	20.83	-10.24	-45.90	-1.48	-6.63
						130	121	116	137	144				
			2D	--	--	23.58	27.73	28.45	31.91	29.70	4.87	20.65	6.12	25.95
						106	119	116	94	101				
				======	======	======	======	======	======	======	======	======	======	======
			Mean	--	--	22.70	22.84	21.64	24.17	22.71	-1.06	-4.69	0.01	-1.10
			Median	--	--	22.95	23.29	23.02	24.54	24.23	0.57	3.25	1.20	4.85

Table 8 (continued)
Quality Indicator trends of improvement: Behavioral symptoms affecting others

QI 3—Residents with behavioral symptoms affecting others on most recent assessment
QI 3LR—Residents with behavioral symptoms affecting others on most recent assessment: Low Risk
QI 3HR—Residents with behavioral symptoms affecting others on most recent assessment: High Risk

QI Number	Risk	Group	NH	Month -6	Month -3	Month 0	Month 6	Month 12	Month 18	Month 24	Month 12 Raw Change	Month 12 % Relative Change	Month 24 Change Raw	Month 24% Relative Change
3		3	3A	21.36	20.00	18.18	18.45	19.81	22.45	23.00	1.63	8.97	4.82	26.51
				103	110	99	103	106	98	100				
			3B	35.85	39.62	38.46	36.00	29.82	31.58	35.71	-8.64	-22.46	-2.75	-7.15
				53	53	52	50	57	57	56				
			3C	30.77	35.42	43.64	36.36	43.18	21.62	14.71	-0.46	-1.05	-28.93	-66.29
				26	48	55	44	44	37	34				
			3D	22.22	27.71	30.38	26.58	28.05	25.33	25.37	-2.33	-7.67	-5.01	-16.49
				81	83	79	79	82	75	67				
			3E	29.41	25.93	31.25	26.51	20.73	22.50	26.87	-10.52	-33.66	-4.38	-14.02
				85	81	80	83	82	80	67				
				======	======	======	======	======	======	======	======	======	======	======
			Mean	27.92	29.74	32.38	28.78	28.32	24.70	25.13	-4.06	-11.18	-7.25	-15.49
			Median	29.41	27.71	31.25	26.58	28.05	22.50	25.37	-2.33	-7.67	-4.38	-14.02
3		4	4A	7.25	7.32	2.78	8.64	9.72	14.47	18.75	6.94	249.64	15.97	574.46
				69	82	72	81	72	76	64				
			4B	38.16	35.71	32.47	33.75	25.58	23.75	30.00	-6.89	-21.22	-2.47	-7.61
				76	70	77	80	86	80	80				
			4C	18.28	26.74	28.41	48.19	29.07	30.23	30.86	0.66	2.32	2.45	8.62
				93	86	88	83	86	86	81				
			4D	1.20	4.60	3.45	6.49	2.22	4.04	2.13	-1.23	-35.65	-1.32	-38.26
				83	87	87	77	90	99	94				
			4E	14.77	17.91	13.20	16.05	14.92	21.31	20.67	1.72	13.03	7.47	56.59
				176	201	197	162	181	183	208				
				======	======	======	======	======	======	======	======	======	======	======

Table 8 (continued)
Quality Indicator trends of improvement: Behavioral symptoms affecting others

QI 3—Residents with behavioral symptoms affecting others on most recent assessment
QI 3LR—Residents with behavioral symptoms affecting others on most recent assessment: Low Risk
QI 3HR—Residents with behavioral symptoms affecting others on most recent assessment: High Risk

QI Number	Risk	Group	NH	Month -6	Month -3	Month 0	Month 6	Month 12	Month 18	Month 24	Month 12 Raw Change	Month 12 % Relative Change	Month 24 Change Raw	Month 24% Relative Change
3		4	Mean	15.93	18.46	16.06	22.62	16.30	18.76	20.48	0.24	41.62	4.42	118.76
			Median	14.77	17.91	13.20	16.05	14.92	21.31	20.67	0.66	2.32	2.45	8.62
3	LR	1	1A	10.00	0.00	10.00	0.00	0.00	13.33	0.00	-10.00	-100.00	-10.000	-100.00
				10	9	10	12	11	15	8				
			1B	5.88	7.14	0.00	4.00	6.67	0.00	14.29	6.67	--	14.29	--
				17	14	10	25	15	18	14				
			1C	0.00	0.00	12.50	0.00	5.56	0.00	0.00	-6.94	-55.52	-12.50	-100.0
				9	10	8	6	18	10	7				
			1D	7.14	0.00	0.00	9.52	0.00	3.23	0.00	0.00	--	0.00	--
				14	6	8	21	17	31	15				
				======	======	======	======	======	======	======	======	======	======	======
			Mean	5.76	1.79	5.63	3.38	3.06	4.14	3.57	-2.57	-77.76	-2.05	-100.0
			Median	6.51	0.00	5.00	2.00	2.78	1.62	0.00	-3.47	-77.76	-5.00	-100.0
3	LR	2	2A	--	--	12.50	0.00	7.89	0.00	17.39	-4.61	-36.88	4.89	39.12
						8	31	38	23	23				
			2B	--	--	23.08	9.76	15.69	10.64	6.12	-7.39	-32.02	-16.96	-73.48
						13	41	51	47	49				
			2C	--	--	13.33	7.69	4.08	7.55	8.33	-9.25	-69.39	-5.00	-37.51
						15	39	49	53	60				
			2D	--	--	0.00	9.09	0.00	22.22	0.00	0.00	--	0.00	--
						3	11	6	9	5				
				======	======	======	======	======	======	======	======	======	======	======

(continued)

Table 8 (continued)
Quality Indicator trends of improvement: Behavioral symptoms affecting others

QI 3—Residents with behavioral symptoms affecting others on most recent assessment
QI 3LR—Residents with behavioral symptoms affecting others on most recent assessment: Low Risk
QI 3HR—Residents with behavioral symptoms affecting others on most recent assessment: High Risk

QI Number	Risk	Group	NH	Month -6	Month -3	Month 0	Month 6	Month 12	Month 18	Month 24	Month 12 Raw Change	Month 12 % Relative Change	Month 24 Change Raw	Month 24% Relative Change
3	LR	2	Mean	--	--	12.23	6.64	6.92	10.10	7.96	-5.31	-46.10	-4.27	-23.96
			Median	--	--	12.92	8.39	5.99	9.10	7.23	-6.00	-36.88	-2.50	-37.51
3	LR	3	3A	23.53	7.14	10.00	11.76	9.09	11.11	25.00	-0.91	-9.10	15.00	150.00
				17	14	10	17	11	9	8				
			3B	0.00	37.50	30.00	7.69	11.11	7.69	14.29	-18.89	-62.97	-15.71	-52.37
				10	8	10	13	9	13	7				
			3C	25.00	0.00	28.57	30.00	25.00	10.00	0.00	-3.57	-12.50	-28.57	-100.00
				4	10	7	10	4	10	2				
			3D	22.22	14.29	10.00	25.00	33.33	16.67	0.00	23.33	233.30	-10.00	-100.00
				9	14	10	8	6	6	7				
			3E	25.00	0.00	14.29	0.00	0.00	0.00	0.00	-14.29	-100.00	-14.29	-100.00
				4	7	7	9	5	3	5				
				======	======	======	======	======	======	======	======	======	======	======
			Mean	19.15	11.79	18.57	14.89	15.71	9.09	7.86	-2.87	9.75	-10.71	-40.47
			Median	23.53	7.14	14.29	11.76	11.11	10.00	0.00	-3.57	-12.50	-14.29	-100.0
3	LR	4	4A	0.00	0.00	16.67	0.00	0.00	0.00	18.18	-16.67	-100.00	1.51	9.06
				7	7	6	16	4	5	11				
			4B	11.11	0.00	20.00	25.00	20.00	50.00	0.00	0.00	0.00	-20.00	-100.00
				9	7	5	8	10	2	3				
			4C	0.00	11.11	16.67	36.36	6.25	27.78	0.00	-10.42	-62.51	-16.67	-100.00
				12	9	12	11	16	18	12				
			4D	0.00	8.33	0.00	0.00	4.76	0.00	6.25	4.76	--	6.25	--

(continued)

Table 8 (continued)
Quality Indicator trends of improvement: Behavioral symptoms affecting others

QI 3—Residents with behavioral symptoms affecting others on most recent assessment
QI 3LR—Residents with behavioral symptoms affecting others on most recent assessment: Low Risk
QI 3HR—Residents with behavioral symptoms affecting others on most recent assessment: High Risk

QI Number	Risk	Group	NH	Month -6	Month -3	Month 0	Month 6	Month 12	Month 18	Month 24	Month 12 Raw Change	Month 12 % Relative Change	Month 24 Change Raw	Month 24% Relative Change
3	LR	4		17	24	23	18	21	15	16				
			4E	0.00	16.67	0.00	0.00	11.11	5.56	22.22	11.11	--	22.22	--
				9	12	21	10	9	18	9				
				======	======	======	======	======	======	======	======	======	======	======
			Mean	2.22	7.22	10.67	12.27	8.42	16.67	9.33	-2.24	-54.17	-1.34	-63.65
			Median	0.00	8.33	16.67	0.00	6.25	5.56	6.25	0.00	-62.51	1.51	-100.0
3	HR	1	1A	12.12	10.45	12.96	0.00	21.43	15.79	12.50	8.47	65.35	-0.46	-3.55
				66	67	54	66	56	57	64				
			1B	28.81	25.00	33.33	24.44	20.45	25.00	12.24	-12.88	-38.64	-21.09	-63.28
				59	52	48	45	44	44	49				
			1C	25.86	25.93	10.64	10.64	9.30	14.63	15.56	-1.34	-12.59	4.92	46.24
				58	54	47	47	43	41	45				
			1D	7.69	9.24	14.75	10.95	13.99	16.53	7.75	-0.76	-5.15	-7.00	-47.46
				91	119	122	137	143	121	129				
				======	======	======	======	======	======	======	======	======	======	======
			Mean	18.62	17.65	17.92	11.51	16.29	17.99	12.01	-1.63	2.24	-5.91	-17.01
			Median	18.99	17.72	13.86	10.80	17.22	16.16	12.37	-1.05	-8.87	-3.73	-25.50

Table 8 (continued)
Quality Indicator trends of improvement: Behavioral symptoms affecting others

QI 3—Residents with behavioral symptoms affecting others on most recent assessment
QI 3LR—Residents with behavioral symptoms affecting others on most recent assessment: Low Risk
QI 3HR—Residents with behavioral symptoms affecting others on most recent assessment: High Risk

QI Number	Risk	Group	NH	Month -6	Month -3	Month 0	Month 6	Month 12	Month 18	Month 24	Month 12 Raw Change	Month 12 % Relative Change	Month 24 Change Raw	Month 24% Relative Change
3	HR	2	2A	--	--	33.33	26.42	30.91	38.10	32.08	-2.42	-7.26	-1.25	-3.75
						51	53	55	63	53				
			2B	--	--	30.34	33.33	28.85	18.10	16.13	-1.49	-4.91	-14.21	-46.84
						89	105	104	105	93				
			2C	--	--	30.26	25.33	17.91	29.76	29.76	-12.35	-40.81	-0.50	-1.65
						76	75	67	84	84				
			2D	--	--	29.58	31.58	32.97	29.76	34.62	3.39	11.46	5.04	17.04
						71	95	91	84	78				
				======	======	======	======	======	======	======	======	======	======	======
			Mean	--	--	30.88	29.17	27.66	28.93	28.15	-3.22	-10.38	-2.73	-8.80
			Median	--	--	30.30	29.00	29.88	29.76	30.92	-1.96	-6.09	-0.88	-2.70
3	HR	3	3A	28.81	30.65	27.78	26.32	28.13	26.87	30.30	0.35	1.26	2.52	9.07
				59	62	54	57	64	67	66				
			3B	54.84	55.56	55.56	53.57	44.83	48.15	55.17	-10.73	-19.31	-0.39	-0.70
				31	27	27	28	29	27	29				
			3C	38.89	48.28	54.29	50.00	42.31	27.27	20.00	-11.98	-22.07	-34.29	-63.16
				18	29	35	24	26	22	20				
			3D	26.92	37.74	39.62	33.33	30.91	32.00	37.78	-8.71	-21.98	-1.84	-4.64
				52	53	53	51	55	50	45				
			3E	34.55	32.14	36.36	32.73	25.81	27.69	34.04	-10.55	-29.02	-2.32	-6.38
				55	56	55	55	62	65	47				
				======	======	======	======	======	======	======	======	======	======	======
			Mean	36.80	40.87	42.72	39.19	34.40	32.40	35.46	-8.32	-18.22	-7.26	-13.16
			Median	34.55	37.74	39.62	33.33	30.91	27.69	34.04	-10.55	-21.98	-1.84	-4.64

(continued)

Table 8 (continued)
Quality Indicator trends of improvement: Behavioral symptoms affecting others

QI 3—Residents with behavioral symptoms affecting others on most recent assessment
QI 3LR—Residents with behavioral symptoms affecting others on most recent assessment: Low Risk
QI 3HR—Residents with behavioral symptoms affecting others on most recent assessment: High Risk

QI Number	Risk	Group	NH	Month -6	Month -3	Month 0	Month 6	Month 12	Month 18	Month 24	Month 12 Raw Change	Month 12 % Relative Change	Month 24 Change Raw	Month 24% Relative Change
3	HR	4	4A	7.84	8.06	2.33	10.42	14.63	17.78	25.71	12.30	527.90	23.38	1003.4
				51	62	43	48	41	45	35				
			4B	54.76	47.22	43.18	43.40	30.91	31.58	35.71	-12.27	-28.42	-7.47	-17.30
				42	36	44	53	55	57	56				
			4C	23.91	32.65	34.00	57.50	36.11	42.50	43.24	2.11	6.21	9.24	27.18
				46	49	50	40	36	40	37				
			4D	2.70	5.26	8.82	11.11	2.27	9.09	2.70	-6.55	-74.26	-6.12	-69.39
				37	38	34	36	44	44	37				
			4E	18.75	19.84	19.05	22.55	20.69	28.23	26.71	1.64	8.61	7.66	40.21
				112	126	126	102	116	124	146				
			Mean	21.59	22.61	21.48	29.00	20.92	25.84	26.81	-0.55	88.01	5.34	196.83
			Median	18.75	19.84	19.05	22.55	20.69	28.23	26.71	1.64	6.21	7.66	27.18

Table 9
Quality Indicator trends of improvement: Depression with no treatment

QI 5 - Residents with symptoms or diagnosis of depression on most recent assessment and no antidepressant therapy and no psychotherapy

QI Number	Risk	Group	NH	Month -6	Month -3	Month 0	Month 6	Month 12	Month 18	Month 24	Month 12 Raw Change	Month 12 % Relative Change	Month 24 Change Raw	Month 24% Relative Change
5		1	1A	9.78	6.52	5.88	4.26	8.89	10.87	5.56	3.01	51.19	-0.32	-5.44
				92	92	85	94	90	92	90				
			1B	12.17	11.76	20.00	7.89	8.77	5.22	6.67	-11.23	-56.15	-13.33	-66.65
				115	102	110	114	114	115	105				
			1C	10.96	7.14	9.09	13.33	6.85	9.09	14.75	-2.24	-24.64	5.66	62.27
				73	70	66	60	73	66	61				
			1D	13.43	11.93	11.89	12.62	12.56	15.58	16.50	0.67	5.63	4.61	38.77
				134	176	185	206	223	199	200				
				======	======	======	======	======	======	======	======	======	======	======
			Mean	11.59	9.34	11.72	9.53	9.27	10.19	10.87	-2.45	-5.99	-0.85	7.24
			Median	11.57	9.45	10.49	10.26	8.83	9.98	10.71	-0.79	-9.50	2.15	16.66
5		2	2A	--	--	12.50	12.36	12.77	16.09	12.99	0.27	2.16	0.49	3.92
						80	89	94	87	77				
			2B	--	--	8.70	10.69	12.74	14.10	11.11	4.04	46.44	2.41	27.70
						161	159	157	156	144				
			2C	--	--	16.92	14.88	13.79	14.60	11.81	-3.13	-18.50	-5.11	-30.20
						130	121	116	137	144				
			2D	--	--	19.23	21.01	18.10	19.15	19.80	-1.13	-5.88	0.57	2.96
						104	119	116	94	101				
				======	======	======	======	======	======	======	======	======	======	======
			Mean	--	--	14.34	14.74	14.35	15.99	13.93	0.01	6.06	-0.41	1.10
			Median	--	--	14.71	13.62	13.28	15.35	12.40	-0.43	-1.86	0.53	3.44
5		3	3A	2.91	4.55	6.06	4.85	4.72	9.18	13.00	-1.34	-22.11	6.94	114.52
				103	110	99	103	106	98	100				

(continued)

Table 9 (continued)
Quality Indicator trends of improvement: Depression with no treatment

QI 5 - Residents with symptoms or diagnosis of depression on most recent assessment and no antidepressant therapy and no psychotherapy

QI Number	Risk	Group	NH	Month -6	Month -3	Month 0	Month 6	Month 12	Month 18	Month 24	Month 12 Raw Change	Month 12 % Relative Change	Month 24 Change Raw	Month 24% Relative Change
5		3	3B	1.89	5.66	3.85	10.00	12.28	10.53	10.71	8.43	218.96	6.86	178.18
				53	53	52	50	57	57	56				
			3C	7.69	14.58	21.82	22.22	25.00	24.32	17.14	3.18	14.57	-4.68	-21.45
				26	48	55	45	44	37	35				
			3D	4.94	2.41	10.13	3.80	3.66	0.00	0.00	-6.47	-63.87	-10.13	-100.00
				81	83	79	79	82	75	67				
			3E	1.18	2.47	3.75	6.02	4.88	5.00	7.46	1.13	30.13	3.71	98.93
				85	81	80	83	82	80	67				
				======	======	======	======	======	======	======	======	======	======	======
			Mean	3.72	5.93	9.12	9.38	10.11	9.81	9.66	0.99	35.54	0.54	54.04
			Median	2.91	4.55	6.06	6.02	4.88	9.18	10.71	1.13	14.57	3.71	98.93
5		4	4A	1.45	4.82	4.17	11.11	13.89	11.84	12.50	9.72	233.09	8.33	199.76
				69	83	72	81	72	76	64				
			4B	10.53	10.00	12.99	12.50	9.30	12.50	10.00	-3.69	-28.41	-2.99	-23.02
				76	70	77	80	86	80	80				
			4C	10.75	12.79	13.64	10.84	19.77	18.60	14.81	6.13	44.94	1.17	8.58
				93	86	88	83	86	86	81				
			4D	1.20	2.30	1.15	3.90	3.33	6.06	3.19	2.18	189.57	2.04	177.39
				83	87	87	77	90	99	94				
			4E	3.39	5.94	10.10	12.27	4.40	4.92	5.26	-5.70	-56.44	-4.84	-47.92
				177	202	198	163	182	183	209				
				======	======	======	======	======	======	======	======	======	======	======
			Mean	5.46	7.17	8.41	10.12	10.14	10.78	9.15	1.73	76.55	0.74	62.96
			Median	3.39	5.94	10.10	11.11	9.30	11.84	10.00	2.18	44.94	1.17	8.58

No Training/Skill Practice in Bed Mobility and no ROM (Prevalence measure; no risk adjustment)—Table 10. Improvements in Group 1 (technology and QIPMO) were detected for group differences; however, the beginning scores were higher in this group than in the other groups. This higher baseline can be explained by the higher RUG scores for Group1 as compared with Groups 3 and 4 (Table 3). Coupling technology with QIPMO appears to have a positive effect on this QI. Educating staff and helping them implement best practice information are a focus of QIPMO.

Hypnotic Use (Prevalence measure; no risk adjustment)—Table 11. There were improvements in all Missouri Groups detected for this QI, as compared with Group 2. An explanation could be the influence of statewide reporting of this QI through the Show-me reports, surveyor emphasis on the inappropriate use of hypnotics in the elderly, or statewide education of the QIPMO nurses about RAI and QI topics.

Tables 12 through 15, which follow, display the QMs with improvements. For Groups 1 and 2, the trends reflected in the data through 12 months are used in the text, because three facilities have yet to reach the 24-month point in the evaluation. Results of the analysis of each QM with improvement trends are discussed and summarized below. It must be noted that the sample size is limited; results are to be interpreted cautiously and are discussed as trends. A larger scale study is needed for more definitive results.

Quality measures (QMs) are similar to QIs; they are both calculated from Minimum Data Set (MDS) assessment data collected on admission, annually, and quarterly about all nursing home residents in Medicare- and Medicaid-licensed facilities in the United States. The problems that are the focus of QIs and QMs are also similar, but calculation of risk adjustments are different and can result in different calculations of similar problems for individual facilities. QMs are posted on the Web by CMS to help consumers make judgments about quality of care in individual facilities. Because results are posted on the Web, there are restrictions placed on displaying small numbers of observations in some QMs, as concerns for resident privacy are considered.

Both QIs and QMs were evaluated in this study for completeness of the analysis. Because there are differences in the calculation methods and restrictions on displaying some small numbers, there is much missing data for the QM tables. Again, in the analysis, group difference scores were examined for trends and used in the discussion of each of the QMs with improvements. Improvements were inferred from reductions in scores, so negative values indicate improvements.

Urinary Tract Infection (Prevalence measure; no risk adjustment)—Table 12. Improvements for this QM were detected in Group 1 only, as can be seen in Table 12. The results for Group 1 are similar to the results for the QI analysis. However, unlike the QI analysis, QM improvement was not detected for Group 2. This difference between the QI and QM detection of improvement is likely due to missing QM data for Group 2. Missing data in QM calculations is common.

Table 10
Quality Indicator trends of improvement: No training or skill practice in bed mobility

QI 20—Residents who do not receive training/skill practice in bed mobility or transferring or locomotion AND who are not receiving ROM

QI Number	Risk	Group	NH	Month -6	Month -3	Month 0	Month 6	Month 12	Month 18	Month 24	Month 12 Raw Change	Month 12 % Relative Change	Month 24 Change Raw	Month 24% Relative Change
20		1	1A	43.42	45.57	65.38	63.53	60.49	65.43	71.79	-4.89	-7.48	6.41	9.80
				76	79	78	85	81	81	78				
			1B	54.55	68.75	79.27	70.73	88.37	22.62	37.18	9.10	11.48	-42.09	-53.10
				77	64	82	82	86	84	78				
			1C	100.00	100.00	100.00	96.36	92.65	100.00	100.00	-7.35	-7.35	0.00	0.00
				62	62	60	55	68	62	56				
			1D	100.00	100.00	99.26	100.00	100.00	99.31	100.00	0.74	0.75	0.74	0.75
				101	126	135	148	153	144	159				
				======	======	======	======	======	======	======	======	======	======	======
			Mean	74.49	78.58	85.98	82.66	85.38	71.84	77.24	-0.60	-0.65	-8.74	-10.64
			Median	77.27	84.38	89.27	83.55	90.51	82.37	85.90	-2.08	-3.30	0.37	0.37
20		2	2A	--	--	20.37	17.19	33.82	32.39	47.62	13.45	66.03	27.25	133.78
						54	64	68	71	63				
			2B	--	--	20.42	38.81	72.59	57.25	39.20	52.17	255.48	18.78	91.97
						142	134	135	138	125				
			2C	--	--	34.86	27.10	30.39	30.51	34.59	-4.47	-12.82	-0.27	-0.77
						109	107	102	118	133				
			2D	--	--	79.49	87.38	60.71	55.29	41.49	-18.78	-23.63	-38.00	-47.80
						78	103	112	85	94				
				======	======	======	======	======	======	======	======	======	======	======
			Mean	--	--	38.79	42.62	49.38	43.86	40.73	10.59	71.27	1.94	44.29
			Median	--	--	27.64	32.96	47.27	43.84	40.35	4.49	26.60	9.26	45.60

(continued)

Table 10 (continued)
Quality Indicator trends of improvement: No training or skill practice in bed mobility

QI 20 - Residents who do not receive training/skill practice in bed mobility or transferring or locomotion AND who are not receiving ROM

QI Number	Risk	Group	NH	Month -6	Month -3	Month 0	Month 6	Month 12	Month 18	Month 24	Month 12 Raw Change	Month 12 % Relative Change	Month 24 Change Raw	Month 24% Relative Change
20		3	3A	6.94	6.33	6.06	12.31	9.38	16.95	9.68	3.32	54.79	3.62	59.74
				72	79	66	65	64	59	62				
			3B	13.89	11.43	14.29	19.44	22.50	15.91	23.26	8.21	57.45	8.97	62.77
				36	35	35	36	40	44	43				
			3C	66.67	61.76	63.16	93.75	94.29	75.00	70.37	31.13	49.29	7.21	11.42
				15	34	38	32	35	28	27				
			3D	58.33	40.43	31.11	26.09	32.00	38.46	30.95	0.89	2.86	-0.16	-0.51
				48	47	45	46	50	52	42				
			3E	60.38	64.15	46.43	57.63	38.89	19.30	27.66	-7.54	-16.24	-18.77	-40.43
				53	53	56	59	54	57	47				
				======	======	======	======	======	======	======	======	======	======	======
			Mean	41.24	36.82	32.21	41.84	39.41	33.12	32.38	7.20	29.63	0.17	18.60
			Median	58.33	40.43	31.11	26.09	32.00	19.30	27.66	3.32	49.29	3.62	11.42
20		4	4A	82.22	78.95	62.00	72.88	46.94	69.64	87.23	-15.06	-24.29	25.23	40.69
				45	57	50	59	49	56	47				
			4B	44.64	44.23	48.15	67.31	66.67	30.36	14.04	18.52	38.46	-34.11	-70.84
				56	52	54	52	60	56	57				
			4C	90.57	91.67	85.19	74.47	75.51	58.82	62.22	-9.68	-11.36	-22.97	-26.96
				53	48	54	47	49	51	45				
			4D	37.74	33.33	29.31	34.78	50.85	37.50	35.29	21.54	73.49	5.98	20.40
				53	54	58	46	59	56	51				
			4E	10.26	1.28	5.48	5.88	23.53	38.89	35.29	18.05	329.38	29.81	543.98
				78	78	73	68	68	54	68				
				======	======	======	======	======	======	======	======	======	======	======
			Mean	53.08	49.89	46.03	51.06	52.70	47.04	46.81	6.67	81.14	0.79	101.45
			Median	44.64	44.23	48.15	67.31	50.85	38.89	35.29	18.05	38.46	5.98	20.40

Table 11
Quality Indicator trends of improvement: Hypnotic use

QI 24—Residents who received hypnotics more than 2 times in last week on most recent assessment

QI Number	Risk	Group	NH	Month -6	Month -3	Month 0	Month 6	Month 12	Month 18	Month 24	Month 12 Raw Change	Month 12 % Relative Change	Month 24 Change Raw	Month 24% Relative Change
24		1	1A	4.35	1.09	3.53	3.19	10.00	2.17	3.33	6.47	183.29	-0.20	-5.67
				92	92	85	94	90	92	90				
			1B	6.09	9.80	10.91	6.14	7.02	5.22	0.94	-3.89	-35.66	-9.97	-91.38
				115	102	110	114	114	115	106				
			1C	5.48	1.43	0.00	0.00	1.37	1.52	8.20	1.37	--	8.20	--
				73	70	66	60	73	66	61				
			1D	2.99	6.25	5.95	3.40	5.38	10.05	12.00	-0.57	-9.58	6.05	101.68
				134	176	185	206	223	199	200				
				======	======	======	======	======	======	======	======	======	======	======
			Mean	4.72	4.64	5.10	3.18	5.94	4.74	6.12	0.85	46.02	1.02	1.54
			Median	4.91	3.84	4.74	3.30	6.20	3.70	5.77	0.40	-9.58	2.93	-5.67
24		2	2A	--	--	1.23	1.12	7.45	2.30	2.60	6.22	505.69	1.37	111.38
						81	89	94	87	77				
			2B	--	--	0.62	2.52	4.46	4.49	2.78	3.84	619.35	2.16	348.39
						162	159	157	156	144				
			2C	--	--	3.08	6.61	3.45	2.19	4.17	0.37	12.01	1.09	35.39
						130	121	116	137	144				
			2D	--	--	1.89	3.36	5.17	4.26	3.96	3.28	173.54	2.07	109.52
						106	119	116	94	101				
				======	======	======	======	======	======	======	======	======	======	======
			Mean	--	--	1.71	3.40	5.13	3.31	3.38	3.43	327.65	1.67	151.17
			Median	--	--	1.56	2.94	4.82	3.28	3.37	3.56	339.62	1.72	110.45
24		3	3A	0.97	2.73	2.02	1.94	1.89	1.02	3.00	-0.13	-6.44	0.98	48.51

(continued)

Table 11 (continued)
Quality Indicator trends of improvement: Hypnotic use

QI 24—Residents who received hypnotics more than 2 times in last week on most recent assessment

QI Number	Risk	Group	NH	Month -6	Month -3	Month 0	Month 6	Month 12	Month 18	Month 24	Month 12 Raw Change	Month 12 % Relative Change	Month 24 Change Raw	Month 24% Relative Change
24		3		103	110	99	103	106	98	100				
			3B	1.89	5.66	7.69	4.00	3.51	5.26	5.36	-4.18	-54.36	-2.33	-30.30
				53	53	52	50	57	57	56				
			3C	3.85	4.17	0.00	2.22	6.82	0.00	2.86	6.82	--	2.86	--
				26	48	55	45	44	37	35				
			3D	0.00	0.00	3.80	3.80	7.32	1.33	1.49	3.52	92.63	-2.31	-60.79
				81	83	79	79	82	75	67				
			3E	0.00	0.00	0.00	0.00	1.22	0.00	0.00	1.22	--	0.00	--
				85	81	80	83	82	80	67				
				======	======	======	======	======	======	======	======	======	======	======
			Mean	1.34	2.51	2.70	2.39	4.15	1.52	2.54	1.45	10.61	-0.16	-14.19
			Median	0.97	2.73	2.02	2.22	3.51	1.02	2.86	1.22	-6.44	0.00	-30.30
24		4	4A	2.90	3.61	5.56	8.64	2.78	0.00	1.56	-2.78	-50.00	-4.00	-71.94
				69	83	72	81	72	76	64				
			4B	0.00	0.00	0.00	2.50	3.49	0.00	3.75	3.49	--	3.75	--
				76	70	77	80	86	80	80				
			4C	2.15	2.33	4.55	4.82	3.49	1.16	2.47	-1.06	-23.30	-2.08	-45.71
				93	86	88	83	86	86	81				
			4D	1.20	5.75	2.30	0.00	0.00	0.00	1.06	-2.30	-100.0	-1.24	-53.91
				83	87	87	77	90	99	94				
			4E	1.13	1.98	1.01	0.61	4.95	2.19	2.39	3.94	390.10	1.38	136.63
				177	202	198	163	182	183	209				
				======	======	======	======	======	======	======	======	======	======	======
			Mean	1.48	2.73	2.68	3.31	2.94	0.67	2.25	0.26	54.20	-0.44	-8.73
			Median	1.20	2.33	2.30	2.50	3.49	0.00	2.39	-1.06	-36.65	-1.24	-49.81

Table 12
Quality Measure trends of improvement: Urinary tract infection

Percent of Residents with a Urinary Tract Infection

QM	Group	NH	Month -6	Month -3	Month 0	Month 6	Month 12	Month 18	Month 24	Month 12 Raw Change	Month 12 % Relative Change	Month 24 Change Raw	Month 24% Relative Change
UTI	1	1A	--	15	18	19	14	21	13	-4	-22.2	-5	-27.8
		1B	--	.	10	4	9	7	9	-1	-10	-1	-10
		1C	--	--	--	5	10	4	20	--	--	--	--
		1D	8	9	11	6	7	--	.	-4	-36.4	--	--
		Mean	8	12	13	8.5	10	10.7	14	-3	-22.9	-3	-18.9
		Median	8	12	11	5.5	9.5	7	13	-4	-22.2	-3	-18.9
UTI	2	2A	--	--	--	--	5	1	4	--	--	--	--
		2B	--	--	--	6	11	7	12	--	--	--	--
		2C	13	9	12	12	16	22	--	4	33.3	--	--
		2D	15	7	7	8	5	--	--	-2	-28.6	--	--
		Mean	14	8	9.5	8.7	9.3	10	8	1	2.4	--	--
		Median	14	8	9.5	8	8	7	8	1	2.4	--	--
UTI	3	3A	--	5	6	9	3	8	9	-3	-50	3	50
		3B	--	15	4	2	5	9	5	1	25	1	25
		3C	--	15	9	15	9	11	16	0	0	7	77.8
		3D	--	8	8	5	6	11	6	-2	-25	-2	-25
		3E	--	9	5	7	13	8	10	8	160	5	100
		Mean	--	10.4	6.4	7.6	7.2	9.4	9.2	0.8	22	2.8	45.6
		Median	--	9	6	7	6	9	9	0	0	3	50
UTI	4	4A	--	4.8	13.6	24.1	8.7	--	15	-4.9	-35.9	1.4	10.5
		4B	--	7.9	5	4.6	8.9	--	11	3.9	77.8	6	120
		4C	--	5.8	4.6	5.9	5.7	--	10	1.1	24.8	5.5	119.8
		4D	--	6.9	5.8	6.1	11.6	--	7	5.9	102.3	1.3	21.7
		4E	--	2.5	2	2.4	4.3	--	3	2.3	114.9	1	49.3
		Mean	--	5.6	6.2	8.6	7.8	--	9.2	1.7	56.8	3	64.2
		Median	--	5.8	5	5.9	8.7	--	10	2.3	77.8	1.4	49.3

High-risk Pressure Sores (Prevalence; risk adjusted)—Table 13. Groups 1, 2, and 3 had improvements at 12 months, as displayed in Table 13. Larger raw and relative change was seen in Group 1 scores (OEMR and QIPMO). An explanation for this QM result could be that the influence of QIPMO coupled with technology had a larger effect than technology alone (Group 2) or QIPMO alone (Group 3). Helping staff to implement best practice information about pressure ulcer treatment and prevention is a common educational focus of the QIPMO nurses, as tracked in the evaluation of the QIPMO program for Missouri.

Short-stay Residents with Delirium (Prevalence measure; risk adjusted)—Table 14. Group 1 and 3 improvements can be seen in Table 14, as compared with Groups 2 and 4. An explanation for this QM result could be the influence of QIPMO, because the on-site services of QIPMO were provided in these two groups but not in the others. Helping staff to implement best practice information about early detection and treatment of delirium is a common educational focus of the QIPMO nurses, as tracked in the evaluation of the QIPMO program for Missouri. Larger improvements were noted for Group 1 as compared with Group 3, indicating that combining QIPMO with technology could have a larger effect on improvement of this QI.

Residents Who Were Physically Restrained (Prevalence measure; no risk adjustment)—Table 15. All groups had improvements in this QM from baseline to 12 months; for those facilities in Groups 1 and 2 with QM data, the trend appears to be continuing to 24 months; for those facilities in Groups 3 and 4, the trend did not continue. Overall, lower restraint use was seen in Groups 1 and 2 than in Groups 3 and 4. An explanation could be that restraint use is reduced in facilities using OEMR, because it is easier for nursing leaders to track the usage with technology.

Summary of Results of Resident Outcome Analysis: Resident outcomes were measured using QIs and QMs, which are calculated from MDS data collected about individual nursing home residents. They are similar in the clinical problems they measure and calculate from the MDS data; they have different risk calculation methods applied. QIs were calculated from the MDS data from OEMR for Groups 1 and 2 and the MDS data from the Missouri data set for Groups 3 and 4. Group 1 outcomes were also calculated using the Missouri data set to display more pre-implementation outcome scores. QMs were downloaded from the Nursing Home Compare Web site for the duration of the study.

Analysis of the QI and QM scores (25 QIs and 20 QMs) for each facility has been completed for 24 months for all of Groups 3 and 4; Groups 1 and 2 have all reached the 24-month timeline so they have complete QI data. QI scores were descriptively analyzed for trends in scores, examining for group differences at 12 and 24 months post-implementation of bedside technology in Groups 1 and 2 as compared with control Groups 3 and 4. QM scores were complete for all but one facility in Group 1 and two facilities in Group 2, so descriptive analysis was based on data available for each facility. (QM data were not complete due to the timeline of the study and lag time posting QM results for facilities on the web.)

No negative trends were detected in any QI or QM scores that would indicate an adverse effect of technology on resident care. There were 18 QIs and 16 QMs that did not reveal group trends of improvement or remained relatively constant during the evaluation.

Trends in improvement were detected in seven QIs and four QMs. Improvement in three QIs–decline in late-loss ADLs, decline in range of motion (ROM), and urinary tract infections–

Table 13
Quality Measure trends of improvement: High-risk pressure sores
Percent of high-risk residents who have pressure sores

QM	Group	NH	Month -6	Month -3	Month 0	Month 6	Month 12	Month 18	Month 24	Month 12 Raw Change	Month 12 % Relative Change	Month 24 Change Raw	Month 24% Relative Change
HR_PU	1	1A		14	9	7	6	4	7	-3	-33.3	-2	-22.2
		1B			13	15	5	15	15	-8	-61.5	2	15.4
		1C	--	--	--	20	12	9	13	--	--	--	-
		1D	15	10	17	8	6			-11	-64.7	-	-
		Mean	15	12	13	12.5	7.3	9.3	11.7	-7.3	-53.2	0	-3.4
		Median	15	12	13	11.5	6	9	13	-8	-61.5	0	-3.4
HR_PU	2	2A					10	2	4	.-		.	-
		2B				20	25	20	26	.-		.	-
		2C	12	10	10	13	13	9		3	30	-	-
		2D	30	14	20	12	9			-11	-55	-	-
		Mean	21	12	15	15	14.3	10.3	15	-4	-12.5	-	-
		Median	21	12	15	13	11.5	9	15	-4	-12.5	-	-
HR_PU	3	3A		2	11	3	8	3	14	-3	-27.3	3	27.3
		3B				0	7	9		.-		.	-
		3C								.-		.	-
		3D		11	24	19	3	3	6	-21	-87.5	-18	-75
		3E		2	4	7	8	15	13	4	100	9	225
		Mean	--	5	13	7.3	6.5	7.5	11	-6.7	-4.9	-2	59.1
		Median		2	11	5	7.5	6	13	-3	-27.3	3	27.3
HR_PU	4	4A		16.1	10	20	199			189	1890	-	--
		4B		3.1	5.4	7.3	22		15	16.5	305.7	9.6	177.3
		4C		12.5	16.7	8.8	2.7			-14	-83.8	-	-
		4D		6.1	199	199	199			0	0	-	-
		4E		20.4	18	17.4	30		24	12	66.7	6	33.3
		Mean		11.6	49.8	50.5	90.5		19.5	40.7	435.7	7.8	105.3
		Median		12.5	16.7	17.4	30		19.5	12	66.7	7.8	105.3

Table 14
Quality measure trends of improvement: Residents with delirium

Percent of short-stay residents with delirium

QM	Group	NH	Month 6	Month 3	Month 0	Month 6	Month 12	Month 18	Month 24	Month 12 Raw Change	Month 12 % Relative Change	Month 24 Change Raw	Month 24% Relative Change
SS_Del	1	1A	1	5	8	1	0	0	3	-8	-100	-5	-62.5
		1B	--	4	4	0	2	4	2	-2	-50	-2	-50
		1C	--	--	--	1	3	3	2	--	--	--	--
		1D	0	3	7	5	2	.	--	-5	-71.4	--	--
		Mean	0.5	4	6.3	1.8	1.8	2.3	2.3	-5	-73.8	-3.5	-56.3
		Median	0.5	4	7	1	2	3	2	-5	-71.4	-3.5	-56.3
SS_Del	2	2A	--	--	--	0	2	2	0	--	--	--	--
		2B	--	--	--	2	0	0	1	--	--	--	--
		2C	8	3	1	1	3	2	--	2	200	--	--
		2D	6	5	0	1	2	--	--	2	--	--	--
		Mean	7	4	0.5	1	1.8	1.3	0.5	2	200	--	--
		Median	7	4	0.5	1	2	2	0.5	2	200	--	--
SS_Del	3	3A	--	--	--	--	--	--	--	--	--	--	--
		3B	--	--	--	--	--	--	--	--	--	--	--
		3C	--	11	8	2	0	0	3	-8	-100	-5	-62.5
		3D	3	10	7	3	10	11	7	3	42.9	0	0
		3E	4	--	--	8	0	2	0	--	--	--	--
		Mean	3.5	10.5	7.5	4.3	3.3	4.3	3.3	-2.5	-28.6	-2.5	-31.3
		Median	3.5	10.5	7.5	3	0	2	3	-2.5	-28.6	-2.5	-31.3
SS_Del	4	4A	--	--	3.3	5.8	15.7	.	6	12.4	381.3	2.7	84
		4B	--	--	--	--	--	--	--	--	--	--	--
		4C	0	0	0	4.1	0	--	0	0	--	0	--
		4D	--	--	--	--	2.1	--	7	--	--	--	--
		4E	--	0	0	--	0	--	--	0	--	--	--
		Mean	0	0	1.1	4.9	4.4	--	4.3	4.1	381.3	1.4	84
		Median	0	0	0	4.9	1	--	6	0	381.3	1.4	84

Table 15
Quality measure trends of improvement: Restraint use

Percent of residents who were physically restrained

QM	Group	NH	Month -6	Month -3	Month 0	Month 6	Month 12	Month 18	Month 24	Month 12 Raw Change	Month 12 % Relative Change	Month 24 Change Raw	Month 24% Relative Change
Restraint	1	1A	15	12	13	10	6	4	0	-7	-53.8	-13	-100
		1B		17	12	11	12	9	9	0	0	-3	-25
		1C				1	1	0	2				
		1D	0	1	1	0	0			-1	-100		
		Mean	7.5	10	8.7	5.5	4.8	4.3	3.7	-2.7	-51.3	-8	-62.5
		Median	7.5	12	12	5.5	3.5	4	2	-1	-53.8	-8	-62.5
Restraint	2	2A				1	1	0	0				
		2B				5	7	8	6				
		2C	8	7	11	9	7	4		-4	-36.4		
		2D	9	6	8	16	9			1	12.5		
		Mean	8.5	6.5	9.5	7.8	6	4	3	-1.5	-11.9		
		Median	8.5	6.5	9.5	7	7	4	3	-1.5	-11.9		
Restraint	3	3A	15	8	13	11	11	9	7	-2	-15.4	-6	-46.2
		3B	11	6	10	14	5	12	27	-5	-50	17	170
		3C		4	6	7	5	5	8	-1	-16.7	2	33.3
		3D	5	11	13	8	11	14	19	-2	-15.4	6	46.2
		3E	5	6	6	6	5	8	12	-1	-16.7	6	100
		Mean	9	7	9.6	9.2	7.4	9.6	14.6	-2.2	-22.8	5	60.7
		Median	8	6	10	8	5	9	12	-2	-16.7	6	46.2
Restraint	4	4A	10.8	6	3.7	6.9	0		2	-3.7	-100	-1.7	-45.9
		4B	18.4	15.8	13.8	12.5	18.9		23	5.1	37.4	9.3	67.3
		4C	0	0	2.3	1.2	0		1	-2.3	-100	-1.3	-55.9
		4D	7.2	4.6	5.8	6.1	7		3	1.2	21.4	-2.8	-47.8
		4E	0	0	0.5	0	0		0	-0.5	-100	-0.5	-100
		Mean	7.3	5.3	5.2	5.3	5.2		5.8	0	-48.2	0.6	-36.5
		Median	7.2	4.6	3.7	6.1	0		2	-0.5	-100	-1.3	-47.8

was detected in both Groups 1 and 2 and not in comparison Groups 3 and 4. These trends are an indication of a positive impact of technology on these particular resident outcomes.

Improvement in the QI behavioral symptoms affecting others was identified in Groups 1, 2, and 3, with the largest improvement detected in Group 1, indicating that coupling technology with the clinical consultation of QIPMO was apparently most effective for this QI. Improvements were detected only in Group 1 in two other QIs, symptoms or diagnosis of depression with no treatment as well as no training/skill practice in bed mobility and no ROM, again suggesting that coupling the on-site clinical consultation of QIPMO with technology appears to be effective to improve other resident outcomes.

Improvement in the QI, hypnotics more than twice a week, was detected in all Missouri Groups 1, 3, and 4, but not in Group 2 (technology only in other states). There appeared to be a state improvement effect on this QI.

Trends in improvement in QMs include urinary tract infection in Group 1 only. This is likely due to missing data in Group 2 that is apparent in the tables that display the QM data. The QI for urinary tract infection did detect improvement but did not have missing data. No improvements were detected in Groups 2, 3, or 4.

Groups 1, 2, and 3 had improvement in the QM, high risk pressure sores, with the largest improvement in Group 1, suggesting that coupling technology and QIPMO is most effective for this QM.

The impact of QIPMO appears to have affected the QM for short stay residents with delirium as improvement was detected in Groups 1 and 3, not Groups 2 and 4.

Improvement in the QM for residents who were physically restrained was detected in all groups in the first 12 months of the evaluation. Overall, less restraint use was seen in Groups 1 and 2 than in Groups 3 and 4, perhaps because the technology helps nursing and administrative staff to more readily track the use of physical restraint use.

Table 16 summarizes the resident outcomes results of the QI and QM analysis for the four groups. Note that the "XX" in two boxes illustrates the larger trend effect in Group 1 as compared with other groups.

Cost and Staffing Analysis

Tables 17 through 22, which follow, reflect both individual nursing facilities within each group and an aggregate sum for all nursing facilities within each group. Group 1 has facilities receiving both technology and on-site clinical consultations, Group 2 has facilities receiving technology only, Group 3 has facilities receiving on-site clinical consultations only, and Group 4 has the control facilities receiving neither technology nor on-site clinical consultations. In this first table, Table 17, Total Costs indicates all staffing costs experienced by the nursing facilities. The costs are presented as cost per resident day to take into account varying sizes of facilities within the study over the 3 years of the study. Percentage changes in total costs per resident are also presented between Years 1 and 2, Years 2 and 3, and then over the study period of Years 1 and 3.

Table 16
Summary of QIs and QMs that improved

	Quality Indicator or Quality Measure	Group 1 Technology & QIPMO–MO	Group 2 Technology only–other states	Group 3 QIPMO only–MO	Group 4 MO--No tech/no QIPMO
Quality Indicators	Decline in late-loss ADLs	X	X	-	-
	Decline in range of motion	X	X	-	-
	Urinary tract infections	X	X	-	-
	Behavioral symptoms	XX	X	X	-
	Symptoms of depression no treatment	X	-	-	-
	No training in bed mobility no ROM	X	-	-	-
	Hypnotic use	X	-	X	X
Quality Measures	Urinary tract infection	X	-	-	-
	High-risk pressure sores	XX	X	X	-
	Short-stay delirium	X	-	X	-
	Physically restrained	X	X	X	X

Group 1, those facilities receiving both technology and on-site clinical consultations, experienced the largest growth in total costs over the study period; Group 2 facilities, those facilities receiving technology only, experienced the next-largest growth in total costs over the study period. Facilities in Group 3, which received on-site clinical consultations only, remained relatively constant, and Group 4, the control group, experienced a slight decrease in total costs over the study period.

In Table 18, "direct costs" refers to facility costs associated with providing care to residents in the facility. As shown by the data, there are wide fluctuations in the changes in the direct costs per resident day among the groups and among facilities within groups. Group 1 experienced a smaller increase in direct care costs between Years 2 and 3 than it did between Years 1 and 2. Group 2 experienced a substantially larger increase in costs between Years 2 and 3 than it did between Years 1 and 2. Group 3 experienced a large increase in direct care costs between Years 1 and 2 and then experienced a decrease in direct care costs between Years 2 and 3, resulting in a large net increase in direct care costs over the period of the study. Group 4 experienced a very small net decrease in direct care costs per patient day over the period of the

Table 17
Total costs per resident per day

Costs per resident	Total costs					
	Year 1	Year 2	Year 3	Chg Y1 - Y2	Chg Y2 - Y3	Chg Y1 - Y3
1A	$144.33	$153.23	$158.34	6.17%	3.34%	9.71%
1B	105.98	112.85	106.75	6.48	-5.41	0.72
1C	118.24	130.28	134.61	10.18	3.33	13.84
1D	128.56	143.44	151.77	11.58	5.81	18.05
Group 1	128.29	140.12	144.40	9.22	3.06	12.56
2A	150.56	147.73	154.08	-1.88	4.30	2.34
2B	176.60	181.94	191.66	3.03	5.34	8.53
2C	213.60	225.64	236.98	5.64	5.02	10.95
2D	148.78	155.43	173.02	4.46	11.32	16.29
Group 2	175.31	181.28	192.20	3.41	6.02	9.63
3A	105.98	96.83	94.51	-8.64	-2.39	-10.83
3B	94.16	101.87	95.83	8.19	-5.93	1.78
3C	113.93	127.99	135.38	12.34	5.78	18.82
3D	86.47	89.88	97.85	3.94	8.87	13.16
3E	108.45	106.41	101.31	-1.88	-4.79	-6.58
Group 3	103.95	105.38	103.98	1.38	-1.33	0.03
4A	105.37	99.65	99.56	-5.43	-0.10	-5.52
4B	86.17	92.33	91.23	7.16	-1.19	5.88
4C	97.12	86.83	81.50	-10.59	-6.14	-16.08
4D	105.37	99.65	99.56	-5.43	-0.10	-5.52
4E	98.74	101.41	106.72	2.70	5.23	8.07
Group 4	97.50	96.43	97.29	-1.09	0.89	-0.21

study. In Group 4, three facilities experienced increased costs during the study period, and two facilities experienced decreased costs during the period.

Table 19 shows staffing costs per resident day and includes only nursing staff—RNs, LPNs, and Aides and Orderlies. As indicated, facilities in Groups 1, 2, and 3 experienced increases in the costs for nursing staff over the period of the study; Group 4 experienced a slight decline in nursing staff costs per resident day. Group 1 experienced the largest rate of increase in nursing staff costs per resident day, and Group 2 experienced the second-highest rate. Even with the increases, Group 1 is still substantially below the average staffing cost per patient day in the facilities in Group 2. Group 1 is higher than facilities in Groups 3 and 4.

In Year 3 of the study, nurse staffing as a percentage of total costs per resident day was 33.5% in Group 3; 34.9% in Group 4; 35.0% in Group 1; and 38.6% in Group 2. In terms of nurse staffing as a percentage of direct patient-care costs per resident day, the percentages were as follows: Group 3 = 48.4%; Group 1 = 51.3%; Group 4 = 51.4%; and Group 2 = 60.0%.

Among the individual facilities in each of the groups, there were wide variations in changes in the costs of nurse staffing costs per resident day. Within each group, at least one facility experienced a decrease in nurse staffing costs per resident day during the period of the study.

Table 18
Direct care costs per resident per day

Costs per resident	Direct costs					
	Year 1	Year 2	Year 3	Chg Y1-- Y2	Chg Y2 -- Y3	Chg Y1- - Y3
1A	$105.04	$111.79	$115.51	6.43%	3.33%	9.98%
1B	84.42	88.40	82.24	4.71	-6.97	-2.59
1C	82.20	88.63	90.07	7.81	1.63	9.57
1D	87.71	88.33	95.25	0.70	7.84	8.60
Group 1	91.42	95.22	98.55	4.16	3.49	7.79
2A	105.81	102.18	102.59	-3.44	0.41	-3.04
2B	114.20	116.66	121.19	2.15	3.89	6.12
2C	136.26	142.31	155.54	4.44	9.30	14.16
2D	100.84	101.99	109.06	1.14	6.93	8.15
Group 2	115.33	117.39	123.78	1.79	5.45	7.33
3A	71.54	66.48	63.24	-7.07	-4.87	-11.60
3B	76.29	73.84	67.73	-3.21	-8.28	-11.22
3C	52.71	81.28	83.11	54.20	2.26	57.69
3D	63.19	66.96	72.65	5.97	8.50	14.97
3E	75.48	78.55	78.36	4.07	-0.24	3.82
Group 3	67.99	73.63	71.95	8.30	-2.29	5.82
4A	61.22	55.93	52.34	-8.65	-6.41	-14.51
4B	68.10	73.15	72.83	7.42	-0.44	6.94
4C	75.13	67.65	61.73	-9.96	-8.75	-17.84
4D	74.54	75.15	84.25	0.81	12.11	13.02
4E	67.55	67.32	71.26	-0.34	5.85	5.48
Group 4	67.99	66.32	66.05	-2.46	-0.41	-2.86

The use of contract staffing (Table 20) to provide services within a nursing facility has been viewed, historically, as being very expensive and as having a negative impact on quality. Because numbers were small in terms of cost per resident day, percentage change over the course of the study may not be very meaningful. Also impacting the use of the aggregate change per group is the fact that some facilities did not use contract nurses during the study period. One facility in Group 1 did see a substantial decrease in the cost of contract services per resident day, from $10.79 in Year 1 to $6.39 in Year 3. The other facility in Group 1 that had contract costs, however, had an increase from $0.03 to $0.34 per resident day during the study. All except one facility in Group 2 used contract staffing; one facility discontinued contract services during the study; a second experienced a decrease; and the third a substantial increase, from $5.70 to $11.92.

Another way of analyzing changes in the nursing facilities participating in the study is to examine changes in the number of staff hours per resident (Table 21.) As indicated in the following table, the total number of staff hours per resident day increased substantially more in Group 1 than in the other groups. Groups 2 and 3 experienced decreases in the total staff hours per resident day, while Group 4 experienced an increase during the study. The substantial increase in staff hours per patient day in Group 1, however, can be attributed to major changes in one facility, rather than in an overall increase in the group. One home in Group 2 did not report total staff hours, making it difficult to interpret the results in that group. It does appear that the

Table 19
Staffing costs per resident per day

Costs per resident	Staffing costs					
	Year 1	Year 2	Year 3	ChgY1--Y2	ChgY2--Y3	ChgY1--Y3
1A	$59.64	$61.75	$63.76	3.55%	3.25%	6.91%
1B	40.21	41.31	37.67	2.75	-8.83	-6.32
1C	43.07	43.88	45.61	1.88	3.93	5.88
1D	40.35	43.84	47.60	8.66	8.57	17.97
Group 1	46.02	48.69	50.55	5.80	3.81	9.83
2A	58.21	60.62	61.33	4.15	1.17	5.36
2B	68.17	65.60	65.75	-3.77	0.23	-3.55
2C	76.99	79.98	86.70	3.89	8.41	12.62
2D	76.63	77.34	81.51	0.92	5.40	6.37
Group 2	71.00	71.34	74.21	0.48	4.03	4.53
3A	32.01	30.19	27.18	-5.69	-9.95	-15.08
3B	33.03	34.31	32.49	3.88	-5.30	-1.62
3C	29.30	35.77	37.14	22.08	3.81	26.74
3D	26.12	28.45	29.88	8.93	5.05	14.42
3E	39.43	43.66	44.23	10.72	1.33	12.19
Group 3	34.55	35.71	34.83	3.33	-2.46	0.79
4A	30.66	28.32	26.57	-7.61	-6.18	-13.32
4B	34.42	36.98	36.85	7.46	-0.36	7.07
4C	38.51	34.01	31.40	-11.66	-7.70	-18.46
4D	39.97	41.80	46.48	4.57	11.21	16.29
4E	34.59	34.61	37.19	0.07	7.45	7.53
Group 4	34.62	33.75	33.96	-2.51	0.61	-1.92

hours per patient day were remarkably similar for most of the facilities in Groups 1 and 2 with technology implementation. Similarly, most facilities in comparison Groups 3 and 4 appeared to have stable staff hours per resident per day over the duration of the study.

The numbers of direct care staff hours per resident day were also analyzed. In some cases, facilities reported the same direct care staffing hours (Table 22) as were reported as total staff hours. Therefore, the results were very similar to the total staff hours per resident day. However, in this instance, no facility in Group 2 reported direct care staff hours, making it impossible to conduct comparisons with that group. On average, direct care staff hours per resident per day were similar in Missouri for Group 1 as compared with Group 3; Group 4 (facilities with no technology and no QIPMO) had consistently lower staffing than the others in Missouri. Hours per resident per day of total staff and direct care staff were remarkably stable for each facility in the study, except for one Group 1 facility that increased total staff and direct care staff hours from 2.71 to 3.75 hours per resident per day, accounting for a 38.5% increase in staffing. One facility in Group 3 reduced direct care hours from 3.28 to 2.41 from the beginning to the end of the study, a 26.4% decrease. All other facilities did not experience such increases and staffed direct care on average from 3.08 to 3.77 hours per resident per day at the end of the study.

Table 20
Contract staffing costs per resident per day

Costs per resident	Contract costs					
	Year 1	Year 2	Year 3	Chg Y1 - Y2	Chg Y2 - Y3	Chg Y1 - Y3
1A	$0.00	$0.00	$0.00			
1B	0.00	0.00	0.00			
1C	0.03	0.14	0.34	459.89	140.16	1244.65
1D	10.79	6.81	6.39	-36.85	-6.15	-40.74
Group 1	4.89	3.02	2.76	-38.23	-8.66	-43.58
2A	0.91	0.00	0.00	-100.00		-100.00
2B	5.70	8.41	11.92	47.46	41.69	108.93
2C	5.39	3.23	4.87	-40.00	50.65	-9.61
2D	0.00	0.00	0.00			
Group 2	3.48	3.70	5.15	6.19	39.42	48.05
3A	0.00	0.00	0.00			
3B	4.54	1.01	0.00	-77.79	-100.00	-100.00
3C	0.00	0.00	0.00			
3D	0.00	0.00	0.00			
3E	0.00	0.00	0.00			
Group 3	1.12	0.19	0.00	-83.14	-100.00	-100.00
4A	0.00	0.00	0.00			
4B	0.00	0.00	0.00			
4C	0.00	0.01	0.04		257.46	
4D	0.00	0.20	0.27		35.09	
4E	0.00	0.00	0.24			
Group 4	0.00	0.00	0.11		4185.89	

Table 21
Total staff hours per resident per day

Hours per resident	Total staff hours					
	Year 1	Year 2	Year 3	Chg Y1 - Y2	Chg Y2 - Y3	Chg Y1 - Y3
1A	4.05	4.09	4.06	0.99%	-0.57%	0.41%
1B	4.33	4.35	4.17	0.49	-4.11	-3.64
1C	3.08	3.09	3.04	0.27	-1.38	-1.11
1D	2.71	3.40	3.75	25.61	10.25	38.49
Group 1	3.38	3.71	3.83	9.89	3.24	13.45
2A	3.95	4.13	3.98	4.52	-3.60	0.76
2B	4.66	4.47	4.25	-4.04	-4.89	-8.73
2C	4.49	4.59	4.78	2.20	4.16	6.46
2D	0.00	0.00	0.00			
Group 2	3.36	3.36	3.29	0.15	-2.11	-1.96
3A	3.88	3.81	3.37	-1.73	-11.60	-13.13
3B	3.34	3.35	2.47	0.17	-26.35	-26.23
3C	2.63	3.28	3.33	24.79	1.56	26.74
3D	2.95	3.06	3.09	3.60	1.15	4.78
3E	4.58	4.62	4.75	0.89	2.77	3.69
Group 3	3.74	3.71	3.53	-1.78	-3.51	-5.23
4A	3.04	2.95	2.86	-2.94	-3.09	-5.94
4B	3.57	4.06	4.01	13.89	-1.43	12.26
4C	3.50	3.50	3.24	-0.01	-7.45	-7.46
4D	3.63	2.80	3.90	-22.73	39.24	7.60
4E	2.86	2.93	3.20	2.65	9.10	11.99
Group 4	3.13	3.24	3.29	3.53	1.33	4.91

Table 22
Direct care staff hours per resident per day

Hours per resident	Direct care staff hours					
	Year 1	Year 2	Year 3	Chg Y1 - Y2	Chg Y2 - Y3	Chg Y1 - Y3
1A	4.05	4.09	4.06	0.99%	-0.57%	0.41%
1B	4.00	3.98	3.81	-0.45	-4.17	-4.60
1C	3.08	3.09	3.04	0.27	-1.38	-1.11
1D	2.71	3.40	3.75	25.61	10.25	38.49
Group 1	3.33	3.65	3.77	9.90	3.24	13.46
2A	0.00	0.00	0.00			
2B	0.00	0.00	0.00			
2C	0.00	0.00	0.00			
2D	0.00	0.00	0.00			
Group 2	0.00	0.00	0.00			
3A	3.10	3.04	2.59	-2.00	-14.89	-16.59
3B	3.28	3.32	2.41	1.25	-27.35	-26.44
3C	2.63	3.28	3.33	24.79	1.56	26.74
3D	2.94	3.06	3.09	3.99	1.15	5.18
3E	3.60	3.72	3.84	3.42	3.07	6.60
Group 3	3.22	3.27	3.08	0.61	-4.77	-4.18
4A	3.03	2.94	2.85	-2.78	-3.18	-5.87
4B	3.57	4.06	4.01	13.89	-1.43	12.26
4C	3.50	3.50	3.24	-0.01	-7.45	-7.46
4D	3.62	2.79	3.87	-22.87	38.61	6.91
4E	2.86	2.93	3.20	2.65	8.99	11.87
Group 4	3.13	3.24	3.28	3.57	1.27	4.88

Contract staffing hours per resident per day were analyzed, but only two facilities reported contract hours, so the analysis could not be calculated in a meaningful way.

Discussion: In conclusion, facilities in Groups 1 and 2 (implementing technology) experienced an increase in total costs per resident per day of $16.11 and $16.89 (12.6% and 9.6%), respectively over the duration of the study. The comparison groups did not experience these increases in total costs. Facilities in Groups 1 and 2 experienced an increase in direct care costs of $7.13 and $8.45 (7.8% and 7.3%), respectively, as compared to an increase of $3.96 (5.8%) for Group 3 and a decline of $1.94 (-2.9%) in Group 4. Additionally, staffing costs per resident per day increased in Groups 1 and 2 by $4.53 and $3.12 (9.8% and 4.5%), respectively, while the staffing costs of comparison Group3 increased slightly $.28 (0.8%) and declined in Group 4 $.66 (-1.9%).

It must be noted that the Group 1 and 2 total costs per resident per day were higher ($128.29 and $175.31, respectively) at the beginning of the study than in Groups 3 and 4 ($103.95 and $97.50). The group costs for Groups 1 and 2 did increase throughout the duration of the study to $144.40 and $192.20, respectively; group costs for 3 and 4 remained constant. One facility in Group 1 was able to increase total costs in Year 2 but return to nearly baseline in Year 3. Apparently that facility was able to implement technology without large increases in total costs.

While the sample sizes were small, there appeared to be a self-selection effect of facilities with higher costs being willing to embark on the technology challenge. Another explanation is that facilities in Groups 1 and 2 may be serving a more acutely ill population, as suggested by their higher RUG score (0.94 and 1.10, respectively, as displayed in Table 3) as compared to the RUG scores for Groups 3 and 4 (0.90 and 0.86). A post hoc analysis of cost report data recording the percentage of Medicare residents revealed an increase in serving Medicare residents in Groups 1, 2 and 3 (6.25%, 9.5% and 7.8% in year 1 then 8.5%, 14.5% and 9.4% in year 3) while Group 4 reduced the number of Medicare served from 4.6% to 1.8%. A larger percentage of Medicare residents does influence the RUG scores and confirms that resident acuity analysis displayed in Table 3. Acuity differences and lower Medicare residents may provide some explanation for the lower total and direct care costs in Group 4 as compared to other groups.

Hours per resident per day of total staff and direct care staff were stable for each facility in the study, except for one Group 1 facility that increased total staff and direct care staff hours from 2.71 to 3.75 hours per resident per day, accounting for a 38.5% increase in staffing. One facility in Group 3 reduced direct care hours from 3.28 to 2.41 from the beginning to the end of the study. All other facilities did not experience such increases and staffed direct care on average from 3.08 to 3.77 hours per resident per day at the end of the study.

It does appear that the hours per patient day were remarkably similar and stable for most of the facilities in Groups 1 and 2 with technology implementation; on average all staffed more than 3 hours and some more than 4 hours per resident per day. Similarly, most facilities in comparison Groups 3 and 4 appeared to have stable staff hours per resident per day over the duration of the study; on average all staffed more than 3 but not as high as 4 hours per resident per day.

It appears that the increased costs for staffing were not from facilities increasing the direct care staff hours per resident. Increased staffing costs were likely due to wage adjustments or additional staff not reported in direct or total staff hours worked. Increased total costs were likely due to the increased staffing costs as well as other expenses such as the addition of technology and inflation of other business expenses.

Staff Turnover

A turnover rate (TOR) was estimated for each facility, each job code, full-time/part-time, and for each of the collection dates. There were 13 facilities, four job codes (RN, LPN, Aides and Orderlies, Other), and three collection dates. The estimates of TOR are not highly reliable for situations where there are a relatively small number of employees in a category. A minimum of 20 employees was required in a category before including the calculated TOR in the analysis. Separate comparisons were done for each job code and full-time/part-time combination. For example, full-time LPN's were examined separately from part-time LPN's and separately from full-time Aides and Orderlies. This method of estimating TOR from date of hire information and job classification of employees is one that has been developed at the University of Missouri (Madsen, 2005), and is being used in other research at this time (Rantz, PI, NINR funded, 2005–2010).

To see if the TOR might be increasing or decreasing over time, a regression line was fitted to the data from each facility for each combination. A positive slope would indicate an increasing TOR. A sign test was used to address the question of whether the slopes across different facilities were equally positive and negative. The alternative would be that slopes tend to have more positive (or negative) slopes. The results did not show statistical evidence to reject the null hypothesis that the slopes had equal probability of being positive or negative. The p-values for the sign test were all higher than 0.54; that is, there was no evidence of an increasing or decreasing trend in the TOR over time for any of the groups in this evaluation.

The staffing data were descriptively analyzed as well, examining for trends in particular facilities or particular groups that would indicate improved staff retention for nurses, nursing assistants, or other staff. These analyses revealed no trends of higher staff retention for particular groups. There were some facilities that had better retention than others, but all groups contained these higher retention facilities so that potential links to technology or clinical consultation could not be identified.

Culture Analysis

The Competing Values Framework (CVF), a quantitative survey instrument designed to measure organizational culture (Quinn, 1988) was adapted by Scott-Cawiezell and colleagues (2005) for use in the nursing home setting as a quantitative measure of nursing home culture within four domains: Group, Risk-taking, Hierarchy, and Market. The adapted CVF was used in this study as a qualitative interview guide for select nursing home staff to identify the predominant culture type within the study homes in Groups 1, 2, and 3. A sample of 10 staff members per facility were individually interviewed either in person or by phone at the beginning of the study (n=130) and near the end of the study (n=130) to identify the predominant culture viewed by each staff member as a representation of their nursing home. The results of these interviews were summarized across each of the facilities, then further summarized across each of the three groups.

In summary, the tendency across Groups 1, 2, and 3 at both points in time was toward the Group orientation. Group orientation is a culture which reflects that nursing homes have shared values and goals, are cohesive, and have a sense of team. This finding is consistent with findings in another study exploring nursing home culture (Scott-Cawiezell, Jones, Moore, & Vojir, 2005). This study found that 84 of the nursing homes surveyed were consistent with a dominant Group culture type (Scott-Cawiezell, Jones, Moore, & Vojir, 2005). The findings using the adapted CVF as a qualitative interview guide suggest that the nursing homes in Groups 1, 2, and 3 are culturally similar to other nursing homes, which further suggests generalizability among the homes. Additionally, the stability of culture toward the Group orientation is a positive finding particularly for study homes in Groups 1 and 2, as these homes appeared to maintain a stable culture as they underwent the change of technology implementation.

E.   QUALITATIVE DATA ANALYSIS

Qualitative data analysis for study homes in Group 1 included an extensive review of focus group transcripts and audio tapes, field notes from on-site observations, and individual staff interviews. These were done at 6–12 months and 12–18 months post-implementation. Two of the four Group 1 facilities have now passed the 24 months of implementation, allowing some

data to be analyzed on their staff perceptions 2 years post-implementation. (This was an additional step added to the initial plan and has added important insight into the findings.) These perceptions and experiences are valuable in the analysis to examine for improvements or declines with additional time. These data sources were reviewed to identify emerging themes specific to staff perceptions of the impact of technology on resident care as well as indicators of staff satisfaction and dissatisfaction with the implementation of technology.

Table 23 summarizes the focus group participants and some facility characteristics.

Table 23
Focus group and selected 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 size	180	240	98	150
Ownership	Government	Nonprofit	For profit	Non profit

Initially, focus group transcripts were reviewed multiple times with actual audiotapes reviewed as needed to clarify content within the written transcripts. Field notes for the on-site observations and staff interviews were also reviewed for additional inclusion in the emerging themes. These emerging themes were formatted into a table that delineated content specific to categories of staff perceptions including administrative staff, licensed nurse staff, and non-licensed staff with a cross link to specific domains related to technology implementation including resident care, technology systems, implementation, documentation, and equipment. Krueger's (1994) process for data analysis using focus groups was utilized for this portion of the evaluation.

Criteria to identify emerging themes were extrapolated from the research questions: Resident quality of care, specific elements improved and mechanisms by which it is improved (Q1 and Q2); reliability and accuracy of quality measures (Q3) (as impacted by documentation of daily care measures); the impact of bedside technology to collect daily measures of resident care on the nursing personnel delivering care (Q5).

A summary of emerging themes follows with details of the changes in resident care, technology, implementation, documentation, equipment, and evaluation questions 1, 2, 3, and 5 using qualitative data.

Resident Care

Stakeholder feedback regarding resident care included the following:

- Administrative staff and licensed staff across the four homes noted general improvements at 12 months:

  – Communication about resident care was better between staff.

  – Clinical information about the resident was easier to access and was considered more comprehensive since the clinical assessments were more thorough.

  – Trending of problems was beneficial in managing each resident's condition.

- *All direct care staff in each of the four study homes* felt that limited time with the resident was still a concern and that time spent documenting and managing technology limited the amount of time actually spent with the resident. However, *administrative staff* in one of the study homes felt that direct care staff could spend more time with the resident because documentation at the bedside was their standard.

- *Certified staff in one home* wanted more communication from the nurses about resident care, and they felt technology could facilitate that communication.

- *Certified staff in one home* felt they were able to think more about what they were to do for the resident through the use of technology.

- *At 24 months,* two of the study homes noted overall improvements in resident care. (The other two homes had not yet reached the 24-month post-implementation point.)

- *Licensed staff and certified staff* felt that care was safer through the use of eMAR systems, improved staff communication, as well as the ability to trend clinical problems with improved follow-up.

- *Administrative staff and licensed staff* recognized that a clearer picture of the resident's clinical condition was evident as well as the fact that clinical assessments continued to be more thorough with the use of standardized, comprehensive documentation.

- *Licensed staff* recognized that better communication and follow-up of care was occurring, including communication with the physician because staff were able to retrieve information more readily through the electronic record.

Technology

Stakeholder feedback regarding technology included the following:

- *All stakeholders in all four homes* noted an improved satisfaction with technology between 6 and 12 months.

- Overall, *all stakeholders in each of the four homes* agreed that technology was getting better and improving over time, and that technology was great when it worked but very frustrating when it did not work.

- *Administrative staff* discussed concerns about the need for IT support either in-house or by contract. After-hours support, both nights and weekends, was of particular concern for staff.

- *Administrative staff in three of the four study homes* voiced concerns and frustrations about the software vendor. Issues such as timely response, belief of concerns, and follow-up were lacking.

- At 24 months, *all stakeholders in both study homes* were excited about technology and felt their jobs were now becoming easier with the use of technology.

Implementation

Stakeholder feedback regarding implementation included the following:

- Overall, *all stakeholders across the four homes* agreed that training was still a concern. Issues such as ongoing training, refresher training, and training specific to individual learning needs were consistently identified. One facility used mentors, which was felt to be of benefit as an ongoing resource for staff.

- *Two of the study homes* recommended that several systems be reviewed prior to selection. Another study home recommended that facility staff recognize that any product will have limitations, be aware of those limitations, and not expect major changes to be made in the system at their request.

Documentation

Stakeholder feedback regarding documentation included the following:

- *All stakeholders in each of the four homes* demonstrated improved satisfaction about documentation systems between 6 months and 12 months

- *All stakeholders in each of the four study homes* had general concerns about documentation errors: *All stakeholders in all homes* noted they would enter data into the system only to check later and find it was missing. Reasons for missing documentation were linked to inabilities to "hot sync" information, staff forgetting to document, and the continued use of paper systems, which was specifically necessary when the computer system went down. Additional errors were noted to be related to staff documenting at the end of the shift instead of ongoing as care was provided. This was felt to lead to staff entering erroneous information in order to fill in the blanks.

- *Administrative and licensed staff responsible for the MDS proces*s were concerned about accuracy of the MDS simply because *certified staff* did not understand certain terms such as "extensive assistance, toileting, and so forth." Documentation had to be reviewed to assure accuracy--this was seen as a time concern.

- *Licensed staff and certified staff* voiced concern that "big brother" was able to watch what they were doing simply by monitoring what was documented. However, other *certified staff in two of the study homes* found comfort in knowing that the nurses were monitoring what needed to be documented so that documentation was not being missed.

- *Licensed staff and certified staff* across the four homes perceived documentation as too time-consuming**.**

- On a few occasions, *certified staff* commented that previously (pre-technology) their documentation was minimal and was only completed at the end of the shift. However, with the implementation of technology and bedside charting, there were expectations with daily documentation. *Certified staff* perceived this as too time-consuming and created an additional burden, taking time away from resident care.

- *Certified staff in one study home* recognized daily documentation as a positive, seeing their work being accurately recorded and recognized.

- *One CNA in one study home* commented that she actually spends more time with the resident since she is in the residents' rooms documenting as she provides care.

- *Certified staff* viewed daily documentation such as care needs of the resident (i.e., ADLs) as a "waste of time" since, in their opinion, residents do not change every day. This added to their sense of too much documentation and too much time spent documenting.

- *Licensed staff in three of the four homes* discussed using shortcuts with documentation. Rather than documenting based on the assessments, staff found it easier to use "quick notes." This is a quicker system to access and allows greater freedom when documenting because it is narrative text. A concern identified by *administrative staff* with the use of "quick notes" was that documentation was not consistent or standardized. Additionally, documentation found in "quick notes" did not transfer to the clinical reports; therefore, the information could not be accessed when needing to trend clinical information for the resident.

- *Licensed staff across the study homes* commented that the assessments were often too limited or too lengthy to use; therefore, they preferred a quicker method.

- *Licensed staff and certified staff across all four homes* mentioned that paper-based systems were still being utilized.

- *Licensed staff and certified staff* discussed double documentation with paper, reporting what is already recorded on daily logs, communication sheets, and even handwritten physician's orders. This information would then have to be transferred into the electronic record, however that did not always occur.

- Paper-based systems were also utilized as a backup when the computer system went down. Unless this information was then manually entered into the computer when the system went back up, the information would not be available. The *licensed staff responsible for the MDS* were particularly concerned since this required additional time on their part to review both paper and computer when pulling the MDS/RAI together.

- *Administrative staff and licensed staff in one study home* discussed using a paper system for care planning because they felt that computerized care plans were too cumbersome to use.

- *All stakeholders across the four homes* reported that documentation time frames were inconsistently followed.

- *Licensed staff and certified staff* discussed documenting at the end of the shift while *one certified staff member* in one home discussed documenting as care was provided (the recommended method).

- Observations indicated that some *certified staff* documented care before it was provided, with staff commenting to the observer that the resident had not changed. This could also support the concern that documentation errors were occurring.

- *All groups across all four study homes* discussed underutilization of alerts and messages. Although *certified staff recognized* the value in relation to directing care, specifically when used by new staff, there was an *inconsistency across all groups in all four homes* as to how the alerts and messages were utilized and if the information was accurate.

- *Certified staff* saw the i-Buttons as inconvenient and bothersome to the residents. There were multiple places that i-Buttons were placed to facilitate documentation.

- *All stakeholders in all study homes* generally concluded that documentation had improved in legibility and was more easily accessible.

- *Certified staff* in some homes felt that documentation was more accurate, while other *licensed staff* in those same homes felt accuracy was still a concern.

- *Administrative staff in one study home* felt that the clinical reports were not all helpful, while another study home found benefit in the clinical reports through trending clinical patterns.

- *Licensed staff in three of the four study homes* recognized that standardized assessments and documentation when utilized were beneficial. Some *licensed staff* commented that the assessments caused them to think about what to assess and that it helped them identify problems that they might not have otherwise found.

- *Administrative staff in one study home* recognized the concern of illiterate staff not being able to navigate the computer system and handheld devices, when they were able to navigate paper-based systems because there was less to document and corrections could more easily be made. This could be particularly problematic with non-English-speaking staff using technology systems.

- *At 24 months, administrative staff and licensed staff* across both homes felt that accuracy of documentation had improved and that documentation time had decreased.

- *Licensed staff* in one study home felt eMAR facilitated a faster and safer medication pass.

- *Certified staff in one study home* were positive about documenting at the point of care and noted that documentation accuracy had improved.

Equipment

Stakeholder feedback regarding equipment included the following:

- *All stakeholders in all groups across all study homes* identified concerns related to equipment, which appeared to be the greatest consistent concern with implementing technology. Concerns specific to slow servers, hardware not working, and equipment breakage as well as access were voiced by all four homes. Only one of the four facilities discussed positive changes that had occurred in relation to equipment. The PDAs had gone through an update and were much easier to use.

- Observation validated concerns that the system was often slow, such as for time to change screens, or that staff had to change multiple screens to document; yet staff, especially the *certified staff* using the PDAs, appeared proficient in the use of the equipment.

- Some problems encountered with the equipment were related to *licensed staff and certified staff* attempting to troubleshoot on their own, dropping the PDAs, not charging the PDAs, and not reporting equipment problems in a timely manner.

- *Certified staff in one study home* reported improvements, such as the system being faster and having newer versions of the PDA.

- *At 24 months, all stakeholders across both homes* continued to report concerns and dissatisfaction about equipment, such as slow servers, breakage, the whole system going down, and equipment access and availability

In reviewing the qualitative data about equipment, an issue that needs consideration as technology is implemented in other nursing facilities is for facility staff to have a clear understanding of what they will be accountable for in the implementation (such as hardware purchases, server capabilities, contracts with the vendor for staff education, ongoing IT support, equipment breakage, equipment access). It is important to suggest to other potential facilities as they implement technology that they ask many questions of the vendor(s) to be clearly aware of

the vendor's accountability and clear about their own responsibilities to follow through with details as they implement technology.

Additionally, nursing home staff as well as policy makers need to be aware of ongoing hardware and software costs as well as ongoing staff support and constant orientation of new staff to the system. It appears that nursing home staff have not realized the ongoing need for staffing to support technology and budgeting for updates to keep the technology up-to-date and efficient. These are not insurmountable issues, but they must be considered by CMS, technology vendors, and nursing home owners and staff.

Evaluation Questions Addressed by the Qualitative Analysis

Question 1: Is quality of care provided to nursing home residents improved through the use of bedside technology alone, on-site clinical consultation alone, or the combined effect of both?

Question 2: If care is improved, what specific elements of care are improved, and what are the mechanisms for improvement?

Stakeholder feedback to Questions 1 and 2 included the following:

- *Administrative staff and licensed staff*

    - perceived there to be a clearer picture of the resident's clinical condition.

    - perceived that clinical assessments with technology are more thorough through the use of standardized, comprehensive documentation.

    - recognized that better communication and follow-up of care was occurring, including communication with physicians since staff were able to retrieve information more readily through the electronic record.

    - perceived that communication about resident care was better between staff.

    - recognized that clinical information about the resident was easier to access and was considered more comprehensive since the clinical assessments were more thorough.

    - viewed trending of problems as beneficial to managing the residents' condition.

    - recognized that a clearer picture of the resident's clinical condition as well as more thorough clinical assessments were evident with the use of standardized, comprehensive documentation.

- *At 24 months, administrative staff and licensed staff* in both homes and *certified staff* in one home perceived that overall care was improved through the use of technology.

- *Licensed staff and certified staff* recognized that resident care was seen as safer through the use of eMAR systems, improved staff communication, and the ability to trend clinical problems with improved follow-up.

- *Licensed staff* recognized that better communication and follow-up of care were occurring, including communication with the physician, since staff were able to retrieve information more readily through the electronic record.

Question 3: How does the use of bedside technology affect the reliability and accuracy of nursing home quality measures?

Stakeholder feedback to Question 3 included the following:

- *Three of the four study homes* perceived that accuracy of documentation had improved, yet documentation errors were discussed as a general concern by *all stakeholders in all four study homes.*

- *All stakeholders in each of the four study homes* discussed the concern of missing data; they noted that staff would enter information into the system only to check later and find it was missing. Reasons for missing documentation were linked to the inability to hot sync, staff forgetting to document, and the continued use of paper systems, which was specifically necessary when the computer system went down. Additional errors were noted to be related to staff documenting at the end of the shift instead of ongoing as care was provided. This was believed to lead to staff entering erroneous information in order to fill in the blanks.

- *Administrative and licensed staff responsible for the MDS process in each of the four study homes* were concerned about accuracy of the MDS simply because *certified staff* did not understand certain terms such as "extensive assistance, toileting, and so forth." A particular concern related to the MDS process was a lack of understanding of MDS definitions and terminology. Documentation had to be reviewed to assure accuracy--this was seen as a time concern.

- Observations indicated that some *certified staff* documented care before it was provided, with staff commenting to the observer that the resident had not changed. This could also support the concern that documentation errors were occurring.

- *Certified staff* perceived that documentation was more accurate, while *administrative and licensed staff* in those same homes felt that accuracy was still a concern.

- *At 24 months, administrative staff and licensed staff* across both homes believed that accuracy of documentation had improved and that documentation time had decreased.

Question 5: What is the impact of bedside technology to collect daily measures of resident care on the nursing personnel delivering care?

Stakeholder feedback to Question 5 included the following:

- *Certified staff in each of the four study homes* perceived that bedside charting and the expectations of daily documentation were too time-consuming and created an additional burden that they felt took time away from resident care. Yet *certified staff across each of the four homes* were positive that increased documentation was a reflection of the care they gave and the work they had accomplished.

- *Licensed staff* believed that documentation was also too time-consuming, particularly the assessments that were required; therefore they used systems that were "shortcuts," which could ultimately result in missing documentation. This was recognized as a problem by *administrative staff*.

- *At 24 months, administrative and licensed staff* across both homes perceived that documentation time had decreased and that accuracy was improving at 24 months.

- *Certified staff* in one of the two study homes were much more positive about documenting at the point of care. They commented about improvements in documentation being reflective of bedside documentation at the time the care was provided.

F.   CONCLUSION EVALUATION OF THE USE OF BEDSIDE TECHNOLOGY

The aim of this project was to evaluate the use of a specific bedside data collection method (including portable computer devices, automated processes, and electronic medical records technology), and conduct a preliminary pilot study to determine this system's potential to improve daily measures of resident care and outcomes in nursing facilities; to evaluate the degree to which the use of technology that incorporates bedside data collection can improve resident outcomes; and to evaluate the potential enhancement of resident outcomes by coupling the use of this technology with on-site clinical consultation by expert nurses. The bedside technology system evaluated in this pilot study was developed by OEMR Technology Corporation.

This evaluation was conducted in four groups of nursing facilities. Two groups of facilities implemented OEMR Technology electronic medical record systems, Group 1 (n=4 facilities; 668 total beds) in Missouri also using the services of QIPMO nurses for on-site clinical consultation; and Group 2 (n=4 facilities; 635 total beds) in other states not using QIPMO services. Two comparison groups were matched as closely as possible from facilities in Missouri, Group 3 (n=5 facilities; 543 total beds) using QIPMO services but not electronic medical record systems; and Group 4 (n=5 facilities, 890 total beds) not using QIPMO or electronic medical record systems.

These findings showed some potentially promising results, though findings should be interpreted with caution. It must be emphasized that these are results of a small sample pilot study and therefore, we see results that have a tendency to fluctuate within and between groups. Although every effort was made to ensure that sound research principles of design, implementation, data collection, and analysis were used, the small convenience samples of Groups 1, 2, and 3 cannot be overlooked (Group 4 was randomly selected and matched for ownership and approximate facility size from non-QIPMO users in Missouri).

Resident Outcome Results

Resident outcomes were analyzed to evaluate the effect of technology on outcomes of care using the QI and QM scores (25 QIs and 20 QMs) for each facility at quarterly and 6-month intervals for the duration of the study. At this point in the evaluation, analysis is complete for 24 months for all of Groups 3 and 4; Groups 1 and 2 have all reached 18 months with 5 of the 8 facilities in these groups past the 24-month timeline. Given the small sample sizes, QI and QM scores were analyzed for descriptive trends in group difference scores.

Trends in improvements in several resident outcomes using MDS-derived QIs and QMs were noted in OEMR technology intervention groups relative to control groups. Specifically, *improvements were seen in three QIs: decline in late-loss ADLs, decline in range of motion, and in urinary tract infection.* These improvements were measured in Groups 1 and 2 and not in comparison Groups 3 or 4. Improvements in other QIs and QMs were detected in different combinations of Groups 1, 2, and 3, indicating potential effects of QIPMO or the combination of technology with QIPMO.

Additional benefit can be expected from coupling with on-site clinical consultation of expert nurses such as those in the QIPMO program. In this pilot evaluation, *additional benefits were detected in improvements in three other QIs: behavior problems, symptoms of depression with no treatment, no training in bed mobility and no range of motion dependent residents,* for Group 1 with OEMR bedside technology and QIPMO. Groups 1, 2, and 3 had *improvements in the QM, high risk pressure sores,* with the largest improvement in Group 1, suggesting that coupling technology and QIPMO may have additional benefit for this QM. The impact of QIPMO appears to have affected the QM for short-stay residents with delirium because improvements were detected in Groups 1 and 3, not Groups 2 and 4.

Improvements in the QM for residents who were physically restrained were detected in all groups in the first 12 months of the evaluation. *Overall, less restraint use was seen in Groups 1 and 2 than in Groups 3 and 4,* perhaps, as explained by staff in Groups 1 and 2, because the technology helps nursing and administrative staff to more readily track physical restraint use.

The QI and QM data were also examined for potential negative impact on resident care from the technology. *No negative trends were detected in the QI or in the QM scores that would indicate an adverse effect on resident care by implementing technology.*

It is important to note that, in addition to these findings, there was a large number of elements (18 QIs and 16 QMs) that did not show group trends of improvement or negative impact, or that remained relatively constant during the evaluation. This group of indicators with no change was larger than the groups (noted in detail) with changes.

Qualitative Results

Qualitative interviews, observations, and focus groups were conducted in all Group 1 facilities after 6 months of implementation of technology and repeated 12 to 18 months after implementation. Additional interviews were conducted for the facilities that have reached 24 months post-implementation.

Several things have been learned from the qualitative data collected, particularly after 12 months post-implementation, when much of the change impact has been experienced by staff. Administrative and licensed staff perceive that documentation time has decreased, accuracy is better, accessing resident information is faster, trending resident condition information is helpful, and overall assessment and communication about residents and their condition have improved. Although some nursing assistant staff perceive that documentation has improved and better reflects the care that is provided, others continue to be concerned that they spend too much time documenting.

The qualitative data were also reviewed in an effort to understand why some resident outcomes improve when using the OEMR bedside technology, while others do not. Some ideas seem to be basic reinforcement of the work that is expected from a knowledgeable nurse or nursing assistant in long-term care. Watching nursing staff use the system, one can speculate about how staff interactions with residents are influenced by charting prompts that outline and reinforce correct care actions. Both nursing assistants and nurses are confronted with charting screens that display practice information. These screens prompt and set expectations for such elements as activities of daily living and many other clinical practices that are outlined in the nursing assessment tools in the system. Assessment tools outline important clinical problems such as cardiovascular or respiratory symptoms as well as appropriate interventions to consider. The clinical information that is collected by staff electronically populates the items in the MDS assessment instrument so that the items reflect the care and outcomes of care. Such reinforcement of clinical practices in the bedside technology software appears to have resulted in improvement in some of the QIs and QMs that are based on resident-assessment information.

The results of improved quantitative resident outcomes (QIs and QMs) also appear to be linked to nursing assistants and nurses being more aware of what needs to be done for individual residents, nurses holding nursing assistants more accountable for the care they deliver, better ongoing assessment information, and the ability to trend information and detect changes in resident conditions. These conclusions can be drawn from combining the qualitative observation, interview, and focus group data with the topics of the QIs and QMs that improved in intervention Groups 1 and 2.

At the same time, the staff using the technology were not fully supportive of its wholesale improvement of care. Some raise concerns about time spent in documentation, intermittent problems with equipment, and the need to disturb residents to touch their iButtons. However, when asked if they would like to go back to paper charting, the overwhelming response of direct care and administrative staff using the system was, "No!" They explained that they would keep the technology, but they would like it to work consistently and that nearly everyone has an idea for improvement.

Costs, Staffing, and Culture Results

Costs and staffing are extremely relevant issues to understand as they relate to facilities implementing bedside technology. In this limited pilot study, costs and staffing were analyzed using Medicaid cost reports. Total costs for the 3-year evaluation for the groups of facilities implementing technology increased $16.11(12.5%) for Group 1 and $16.89 (9.6%) for Group 2,

while those for the comparison groups did not. Additionally, it should be noted that Groups 1 and 2 had higher baseline total costs than comparison Groups 3 and 4.

Direct care costs increased for nearly all facilities in the study, but as a group, only Group 4 (no technology, no QIPMO) had reduced direct care costs of nearly 3% for the 3 years. The two groups implementing technology had 7.8% and 7.3% increases in direct care costs while Group 3 had a 5.8% increase. However, hours per resident per day (hprpd) of total staff and direct care staff were remarkably similar and stable for all but two facilities (one facility in Group 1 increased hprpd 38.5% and one in Group 3 reduced hprpd 26.4%).

From an acuity perspective, Groups 1 and 2 had higher RUG scores and Group 4 had the lowest RUG score. A post hoc analysis of cost report data recording the percentage of Medicare residents revealed an increase in serving Medicare residents in Groups 1, 2 and 3 (6.25%, 9.5% and 7.8% in year 1 then 8.5%, 14.5% and 9.4% in year 3) while Group 4 reduced the number of Medicare served from 4.6% to 1.8%. Acuity differences and lower Medicare resident may provide some explanation for the lower total and direct care costs in Group 4 as compared to other groups.

It appears that implementing technology is *not cost neutral*--there was an increase in total costs for all facilities in Groups 1 and 2. Although there were increased costs, it does not appear to be caused by increasing direct care staffing. This is a key concern as facilities face health care worker shortages. Implementation of bedside technology does not appear to require marked increases in direct care staff hours of care per resident. There are increases in costs for the technology and likely other staff to support the technology as it is implemented and maintained.

Nursing home staff, as well as policy makers, need to be aware of ongoing hardware and software costs as well as ongoing staff support and constant orientation of new staff to the system. Based on the qualitative data collected in this evaluation, it appears that some nursing home administrative staff are struggling with the ongoing need for staff to support technology and budgeting for software and hardware updates to keep the technology up-to-date and efficient. These issues must be considered by CMS, technology vendors, and nursing home owners and staff.

Culture and direct care staff turnover were also estimated in this pilot study. The facilities implementing the technology appear to have a stable organizational culture with a tendency toward "group" orientation. Group culture seems dominant in nursing homes, as found in other research. The stability of the group culture is important, as the organization undergoes the major change of implementation of technology. Turnover of direct care staff did not appear to increase or decrease over the duration of the evaluation. This turnover is another key concern of facilities as they approach implementation; they do not want to increase their staff turnover as they embark on technology implementation.

Research Questions

In this pilot evaluation for CMS, the study focused on the following research questions; summary conclusions for each are presented, based on the quantitative and qualitative analyses.

- **Is quality of care provided to nursing home residents improved through the use of bedside technology alone, on-site clinical consultation alone, or the combined effect of both?**

  The trends in the data indicated there were some improvements in quality of care through the use of bedside technology (such as the system we tested in this project) and that additional improvements might be made by coupling technology with on-site clinical consultation with a gerontological expert nurse. However, facilities without technology also showed improvement trends with on-site clinical consultation in some areas. These improvements were not observed in facilities that had neither bedside technology nor on-site clinical consultation.

- **If care is improved, what specific elements of care are improved, and what are the mechanisms by which it is improved?**

  It appeared that the bedside technology tested in this evaluation provided reinforcement to direct care staff in those care activities needed for individual resident care. Nursing assistants provided much of the direct care, and in this bedside technology system, they charted the actions they took as care providers for each resident, particularly the activities of daily living assistance. This charting was required by the bedside technology system for each activity done by the staff as they provided care. Nurses who were responsible for overseeing the care viewed what was or was not charted by the nursing assistants. The technology system required the nurse to follow up on missing information, so nurses readily knew if required activities had been done (or not). This basic reinforcement of required care appeared to have a positive effect on improving resident outcomes of care.

  Another important reinforcement of the technology were the clinical practice assessment guides and other cues that directed nurses and nursing assistants to assess for details of conditions, thus reinforcing current best clinical practices. A final feature that appeared to affect improvement of care was the speed by which trend data about individual residents or groups of residents became available. This speed of data enabled problems with care to be more readily detected by electronically connecting data that in traditional paper charting was difficult and time consuming to compile.

- **How does the use of bedside** technology affect the reliability and accuracy of nursing home quality measures?

  It appeared that accuracy was enhanced by including the information collected at the bedside by direct care providers (both nursing assistants and nurses). Multiple data sources were used as the MDS items are finalized by the MDS coordinator or responsible registered nurse.

- **Does the use of bedside technology to collect daily measures of resident care facilitate the creation of nursing home quality measures?**

The technology system was designed so that information collected by multiple direct care providers was used in compiling the data for completion of the MDS. This appeared to improve the accuracy of the MDS and may therefore facilitate the creation of the quality measures.

- **What is the impact of bedside technology to collect daily measures of resident care on the nursing personnel delivering care?**

  Staff experienced major changes as the bedside technology system was implemented. This appeared to frustrate staff as the implementation process progressed, then resolved after a period of about a year. Staff turnover remained the same throughout the study, so facilities did not appear to experience increased staff turnover related to the implementation of technology. As the staff became comfortable with the technology, particularly after fully implementing physician orders and medication records, nurses and administrators were quite satisfied with the positive impacts they could see. Nursing assistants continued to have mixed views, with some continuing to perceive they had more work to do with documentation but most perceiving they are now getting credit for the work they do for residents.

- **To the extent that care is improved through this interventional study, how readily can the interventions tested in this project be adopted by other nursing facilities not participating in this project?**

  As facilities embark on implementation of technology, they can learn from those who participated in this pilot evaluation. In undertaking this major change, facilities need to think about setting up support systems for staff to learn how to use the system correctly, ongoing training for new staff as they join the facility staff, and ongoing financial planning for upgrades and ongoing replacement of the technology. The value of expert gerontological nurse on-site clinical consultation was validated in this pilot study (as in other studies) and can be viewed as a potential quality improvement intervention to help facilities and can be readily adopted.

- **Are there features about the nursing facilities participating in this study beyond the actual interventions themselves that affect the generalizability of the results?**

  It appears that higher baseline costs per resident per day in this small sample of facilities may be related to these participating facilities willingness to undertake technology based changes. The facilities in both Group 1 (in Missouri) and Group 2 (in other states) who implemented the technology had considerably higher average total and direct care costs per resident per day than facilities in Groups 3 and 4. These total and direct care costs may reflect higher acuity as the Group 1 and 2 facilities did have somewhat higher average RUG scores (0.94 and 1.10, respectively, as displayed in Table 3) as compared to the average RUG scores for Groups 3 and 4 (0.90 and 0.86). However, total staff hours across the four groups were very similar (3.83, 3.29, 3.53, and 3.29 on average for the respective groups in year 3, as can be seen in Table 21). There may be an economic feature of facilities willing to undertake implementing a bedside computing system.

Summary

Based on this limited pilot study of 18 nursing facilities, it appears that there is benefit for residents and their outcomes of care from the implementation and use of bedside computing technology in nursing homes. There are trends in improvements in three QIs that are important to resident care: *decline in late loss ADLs, decline in range of motion, and decline in urinary tract infection*. There are improvements in other QIs and QMs when coupling technology with on-site clinical consultation such as QIPMO in Missouri; these include *behavior problems, symptoms of depression with no treatment, no training in bed mobility and no range of motion for dependent residents, and high risk pressure sores.* Overall, *less restraint use* is detected in facilities implementing bedside technology than in the comparison group facilities. From our observation in this small group, the technology may help nursing and administrative staff to more readily track physical restraint use.

However, we also noted no changes in a large number of indicators, suggesting that improvements possibly attributable to these interventions may be specific to certain areas of potential resident improvement. Speculation about why some indicators improved while others did not suggests that those that did improve are ones for which the nursing assistants are continuously recording the care they are giving to residents. The QIs and QMs with improvements are sensitive to nurse and nursing assistant direct care actions. Charting about the actions taken by the nursing assistant is taking place while caring for each resident, every shift. Follow-up by the nurse responsible for the care delivered by nursing assistants is facilitated by the electronic record, so that questions can be asked in a timely way (same shift) about care that was done or not done.

There are cost implications for implementing and maintaining bedside computing technology. This evaluation found an increase in total costs over three years of $16.11 (12.6%) for facilities in Missouri implementing the technology and $16.89 (9.6%) for those in other states that implemented technology; comparison groups did not have these increases in total costs. The increase in total cost is not due to increasing hours of direct care staffing, as direct care hours per resident per day were remarkably stable throughout the evaluation. Staff turnover did not increase during the implementation of the technology, an important consideration in the current nursing staffing shortage in this country. Organizational culture of the facilities that implemented the technology was predominantly a group orientation, similar to other nursing facilities in the country. The dominant culture remained stable throughout the evaluation, indicating that the implementation of technology did not disturb this important organizational feature.

Qualitatively, many details were learned in this evaluation that can be important to other nursing homes as they consider implementing bedside computing technology. Administrators need to be prepared to undertake a major change that will take many months of planning to successfully implement. Direct care staff will need support as they learn to use the equipment, especially for the first 6 to 12 months post-implementation. There needs to be a careful plan for continuing learning opportunities so that staff learn to properly use the software and can benefit (and, therefore, residents can as well) from the technology. There appears to be one very telling conclusion: although most staff have ideas for improvement of the technology after 12 to 24 months, almost no one wants to return to the era of paper charting.

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