

IT Sophistication and Quality Measures in Nursing Homes

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ABSTRACT

This study explores relationships between current levels of information technology (IT) sophistication and seven reportable quality measures (QMs) in 210 nursing homes in Missouri. Between December 2006 and August 2007, each nursing home completed a survey providing IT sophistication levels measured within nine subscales. During this same time, nationally reported QMs were collected for each nursing home giving permission ($n = 95$). The QM data were merged with IT sophistication data, and relationships between the QM variables and IT sophistication subscales were examined. Mean IT sophistication scores were higher in resident care management and administrative processes. Significant relationships were found in nearly all IT sophistication subscales and the QM regarding residents' need for assistance with activities of daily living; another significant relationship occurred with IT sophistication in clinical support and incontinence. Correlating IT sophistication with quality is important to determine whether IT implementation provides clinical benefits to residents.

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Information systems with electronic health records are recognized nationally as a critical tool to support the needs of long-term care residents and providers. In June 2008, the American Health Information Community, a federal advisory body responsible for recommending how to accelerate the development and adoption of health information technology (IT) for the United States, recommended standards development in long-term care to address electronic exchange of assessment information between electronic health records (U.S. Department of Health and Human Services, Office of the National Coordinator for Health Information Technology, 2008). Current and future electronic exchange of resident health information in long-term care settings depends greatly on the implementation of health information technologies using interoperable standards that enable information exchange.

Implementation of electronic technology supporting information exchange has the capability to improve clinical decision making. For example, clinical decision support systems help care providers in earlier identification of resident problems, which results in earlier intervention (Alexander, 2008a). Electronic clinical information systems also allow clinicians to spend more time on direct resident care and less on administrative tasks (Banner & Olney, 2009). Using elec-

tronic technologies to provide more timely decision making and greater time with residents should result in higher quality of care. The purpose of this article is to report findings from a study that explored the relationship between IT sophistication in nursing homes and selected national quality measures (QMs) collected in these settings.

BACKGROUND

IT sophistication in nursing homes is defined as the level of diversity of technology and software used to support resident care, clinical support, and administrative processes (Jaana, Ward, Paré, & Wakefield, 2005). Three domains

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of IT sophistication have been identified to support these functions: functional, technological, and integrated sophistication (Paré & Sicotte, 2001). Functional sophistication identifies the kinds of computerization used; technological sophistication specifies the extent of use of the technology; and integrated sophistication reflects the amount of internal and external integration of technology used in each health care domain (Alexander, 2008b). Attributes for each of these domains in nursing homes have been described previously (Alexander & Wakefield, in press).

Diverse levels of IT sophistication in long-term care have been shown to be associated with facility characteristics, such as bed size, regional location (i.e., rural and



urban), and kind of ownership (i.e., for profit and not for profit). For example, the degree of functional IT sophistication adopted in a sample of Missouri nursing homes was mostly related to facility bed size and location. IT integration was mostly affected by kind of ownership (Alexander, Madsen, Herrick, & Russell, 2008).

Researchers have examined the relationship between facility characteristics and use of electronic health records for resident admissions,

discharges, and transfers (Alexander et al., 2008). They found the majority of nursing homes using computerized resident admission processes were located in medium-sized facilities (60 to 120 beds) in metropolitan and urban locations. Nursing home location also appeared to be a common variable for determining relationships in technology use during resident discharges. When comparing the use of technology during resident transfers, no substantial relationships were detected among

TABLE 1

COMPARISON OF IT SCORES FOR NURSING HOMES WITH AND WITHOUT QM DATA PROVIDED

Subscale	Mean (SD)	Minimum	Maximum
QM data provided (n = 95)			
Resident care management			
Functional	29.61 (19.13)	0	93.03
Technological	10.62 (12.65)	0	62.35
Integrated	20.29 (20.64)	0	100
Clinical support			
Functional	11.89 (19.20)	0	84.98
Technological	8.87 (14.31)	0	65.65
Integrated	6.84 (16.16)	0	83.33
Administrative processes			
Functional	14.63 (16.62)	0	70
Technological	29.96 (12.58)	3.85	63.65
Integrated	34.62 (15.22)	6.67	80.88
Total	167.33 (112.40)	25.27	658.23
QM data not provided (n = 115)			
Resident care management			
Functional	29.05 (21.40)	0	93.03
Technological	10.38 (13.80)	0	62.35
Integrated	18.34 (22.27)	0	100
Clinical support			
Functional	10.41 (17.29)	0	81.20
Technological	7.48 (14.67)	0	71.43
Integrated	6.11 (17.39)	0	88.89
Administrative processes			
Functional	13.91 (16.21)	0	90
Technological	26.75 (15.07)	0	57.08
Integrated	32.14 (18.90)	0	80.88
Total	154.57 (125.23)	0	661.07

Note. IT = information technology; QM = quality measure.

facilities stratified by ownership, bed size, and location.

Technology use during important events such as resident admission, discharge, and transfer has the potential to improve quality of care. In acute care settings, greater IT sophistication has been shown to enhance quality of care through improved workflow and

communications processes (Breslin, Greskovich, & Turisco, 2004). To date, the impact of greater levels of IT sophistication in nursing homes on quality has not been reported. In this article we explore the relationship of IT sophistication in Missouri nursing homes and seven nationally reported nursing home QMs related to resident skin integrity.

METHOD

IT Sophistication and Quality Measures

Between December 2006 and August 2007, we completed a survey of 210 Missouri nursing homes (representing 43% of all Missouri nursing homes) to assess their level of IT sophistication (functional, technological, integrated) in each domain (resident care, clinical support, and administrative) (Alexander, 2008b). Nine subscales were examined (Table 1). In previous research, subscales were explicated through a combination of key informant interviews and focus groups conducted to capture insights, perceptions, and opinions of experts using highly sophisticated IT systems in nursing homes (Alexander & Wakefield, in press).

Following the initial survey, each home was contacted again to obtain permission to collect data on seven reported quality measures (Table 2) collected by Missouri's federally designated Quality Improvement Organization (QIO) and the Centers for Medicare & Medicaid Services' Nursing Home Compare. QM data were requested from the local Missouri QIO for five consecutive quarters that overlapped with the survey period. The QM data were then merged with the IT sophistication data so relationships between the QM variables and the IT sophistication subscales could be examined.

Statistical Analysis

To assure there was no response bias between the nursing homes that gave consent for access to their QMs and those that did not, we performed a Wilcoxon rank-sum test on the IT sophistication subscales for both groups of nursing homes. We then used Spearman's rank correlation to examine the relationship between the QM data and each of the nine IT survey subscales. This nonparametric method was chosen because the distribution of QM

scores across homes was significantly skewed for some of the QMs. To summarize the QM scores for a home across the five quarters, we used the median in our calculations, as there were some extreme values among the quarters, and the median reflects the overall average value better than the mean.

The primary data analysis focused on comparing the IT sophistication subscales, and the QMs focused on the resident care management functional and technological subscales, as these were the ones for which researchers believed a priori the strongest relationship might be found. As a secondary (exploratory) analysis, we considered the remaining IT sophistication subscales as well as total IT sophistication score.

RESULTS

Table 1 shows that the resident care management and administrative processes variables tend to have higher mean IT sophistication scores than the clinical support variables, indicating that many more of these homes had technology available for resident care management and administrative processes versus technology used for clinical support purposes. In homes that provided QMs, mean IT sophistication scores for resident care management ranged from 10.62 to 29.61; mean IT sophistication scores were slightly higher when administrative processes were evaluated (range = 14.63 to 34.62). Conversely, nursing homes' mean scores were lower on IT sophistication being used for clinical support (range = 6.84 to 11.89); however, this still indicates that some technology is being used for these functions. More kinds of technology are being used in resident care (29.61), but there is wider integration of technology used for administrative purposes (34.62). Similar IT sophistication scores were found among the homes that did not provide

TABLE 2

SUMMARY OF NURSING HOME QM SCORES ($n = 95$)

Quality Measure	Mean (SD)	Minimum	Maximum
ADL decline	13.40 (5.83)	0	32.43
Incontinence	39.39 (14.08)	10	66.67
High risk for pressure ulcers	11.28 (6.65)	0	36
Low risk for pressure ulcers	1.39 (2.16)	0	10.53
Worsening locomotion	10.59 (4.92)	0	23.42
Use of physical restraints	4.81 (6.58)	0	34.85
Bedfast	2.00 (2.49)	0	9.76

Note. ADL = activity of daily living; QM = quality measure.

their QMs for this analysis.

More homes ($n = 115$) did not provide permission for us to use their QMs in our analysis than did. Table 1 shows the means for the nine IT sophistication subscales for homes with and without QMs

In the past, technology in nursing homes has been used primarily for administrative functions and less for resident care management and clinical support functions.

provided. None of the differences between the two groups was significant on the basis of the Wilcoxon rank-sum test.

QM data were available for 95 homes (Table 2). The most common QM was incontinence (39.39%, range = 10% to 66.67%). Slightly more than 13% of the residents experienced some decline in activities of daily living (ADLs) and worsening locomotion

(10.59%) over the five quarters analyzed. More than 11% of the residents in this sample were at high risk for and/or had developed pressures ulcers during their stay in these nursing homes. Very few of these residents were bedfast (2%) or required physical restraints (4.81%). Physical restraint use varied widely across homes, from 0% to 34.85%.

In the first analysis using the residential functional and technological sophistication subscales (Table 3), a weak but statistically significant correlation ($r = 0.26$, $p = 0.03$) was found with the ADL quality measure. Similarly, when relationships were compared between QMs and all other IT sophistication subscales and the total score, a weak correlation ($r = 0.26$, $p = 0.01$) also existed in the ADL QM scores. Thus, nearly every IT sophistication subscale had a relationship with the ADL QM, with the exception of the clinical support technological subscale, where no relationship was found. In the analyses of other subscales, a weak correlation was found for residents with incontinence and the clinical support technological ($r = -0.19$, $p = 0.05$) and integrated ($r = -0.20$, $p = 0.05$) sophistication subscales.

TABLE 3

SPEARMAN'S RANK CORRELATION COEFFICIENTS FOR IT SOPHISTICATION AND QMs

Quality Measure	Total	Resident Care Management		
		Functional	Technological	Integrated
ADL decline	0.26**	0.22**	0.18*	0.24***
Incontinence	0.05	0.08	-0.05	0.07
High risk for pressure ulcers	-0.04	-0.17	-0.07	0.08
Low risk for pressure ulcers	0.10	-0.03	0.08	0.14
Worsening locomotion	0.13	0.07	0.05	0.17
Use of physical restraints	0.01	0.00	0.03	0.03
Bedfast	-0.03	0.03	-0.01	0.00

Note. ADL = activities of daily living; IT = information technology; QM = quality measure.

* $p < 0.08$; ** $p < 0.05$; *** $p < 0.01$.

DISCUSSION

The percentage of residents in the study nursing homes with complex problems such as incontinence, ADL decline, and worsening locomotion are consistent with other studies using nationally reported QMs. Residents with these kinds of complex issues are at greater risk for skin integrity problems and the development of pressure ulcers. Advocates for greater IT implementation in nursing home settings have indicated that improvements in quality, and thus QMs, could be realized with more highly sophisticated technologies that use clinical decision support, integrate portable computing devices, and maintain connections between internal and external stakeholders.

In the past, technology in nursing homes has been used primarily for administrative functions and less for resident care management and clinical support functions (Abbott & Brocht, 2001). In this sample of nursing homes, more sophisticated technologies are being used in resident care management. These include technologies for reporting laboratory results, pharmaceutical management, and physician order entry. Furthermore, these kinds of technologies are

not only being implemented more often; they are also being integrated more often across other external and internal entities, as reflected in the score for the resident care management integrated subscale.

Future studies need to prospectively assess the relationship between IT implementation and sophistication and resident outcomes to evaluate the value added to quality care.

Technologies used in clinical support functions, such as information systems incorporating physical therapy or occupational therapy notes, increased use of wireless communication devices, and technologies for incident reporting, are less common in these facilities. However, our research indicates there is evidence that clinical support technologies are beginning to be used to a greater extent to support resident care.

Attempting to correlate IT sophistication with improved quality is important, to determine whether IT implementation provides clinical benefits to residents. In this study's homes, greater IT sophistication was related to improved detection of ADL decline in residents across all but one of the IT sophistication subscales. The strongest relationships between IT sophistication score and ADL QMs existed when technologies were used for resident care management and clinical support.

Additionally, greater IT sophistication in the clinical support domain appears to be negatively related to the detection of residents with incontinence. Both of these relationships make intuitive sense. Sophisticated technologies that enable more complete documentation by all disciplines involved in resident care also provide better communication across disciplines so that ADL decline is detected and documented more frequently, potentially raising awareness of ADL decline in facilities. Similarly, as more staff, including certified nursing assistants, are integrated into documentation systems, findings of incontinence will more than likely negatively affect the QM because of increased

	Clinical Support			Administrative Processes		
	Functional	Technological	Integrated	Functional	Technological	Integrated
	0.27***	0.16	0.19*	0.18*	0.18*	0.18*
	-0.77	-0.19*	-0.20*	0.09	0.16	0.15
	0.05	0.13	0.01	-0.06	-0.04	-0.15
	0.07	0.06	-0.03	0.12	0.12	0.10
	0.12	-0.02	0.11	0.14	0.14	0.07
	-0.02	0.05	-0.12	0.03	0.09	-0.02
	-0.05	-0.02	-0.08	-0.02	0.00	-0.06

recordings of residents experiencing incontinence. However, better documentation should lead to earlier interventions and decreased risk of altered skin integrity for residents.

LIMITATIONS

This is a small study representing less than half of the nursing homes across the state of Missouri, which limits generalizability of the findings. However, in terms of frequency of IT sophistication use, the homes included in this study appear to be representative of other homes across the state. In future studies, a greater percentage of homes in Missouri and other states should be included where IT sophistication profiles could be used to compare nationally reported QMs.

CONCLUSION AND RECOMMENDATIONS FOR FUTURE RESEARCH

The use of sophisticated information technologies in nursing homes is beginning to be realized to support resident care management, clinical support, and administrative processes of health care. Greater IT functionality is being integrated into all domains of health care in these

settings. Nursing homes are beginning to shift away from IT used primarily for administrative functions and more toward resident care management and clinical support functions. Greater IT sophistication also appears to have a relationship with nationally reported nursing home QMs. Larger studies are needed to determine how and why greater IT sophistication affects quality of resident care in these settings. Future studies need to prospectively assess the relationship between IT implementation and sophistication and resident outcomes to evaluate the value added to quality care.

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