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Nurses' Perceived Skills and Attitudes about Updated Safety Concepts: Impact on Medication Administration Errors and Practices

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Abstract

Approximately one-quarter of medication errors in the hospital occur at the administration phase, which is solely under the purview of the bedside nurse. The purpose of this study was to assess bedside nurses' perceived skills and attitudes about updated safety concepts, and examine their impact on medication administration errors (MAEs) and adherence to safe medication administration practices. Findings support the premise that MAEs result from an interplay among system-, unit- and nurse-level factors.

Keywords

Adverse drug events; Medication administration errors; Nurses; Patient safety; Safety concepts

Despite the landmark Institute of Medicine report over 15 years ago that alerted health care systems to the pervasive occurrence of errors in health care¹, adverse drug events (ADE) remain among the most frequently occurring adverse events in hospital patients.² Defined as injury resulting from medical intervention related to a drug¹, ADEs occur in approximately 2 million hospitalizations annually with resultant increase length of hospital stays, increase

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hospital costs, and increase risk of death.^{3–5} ADEs can be categorized as injury resulting from adverse drug reactions, therapeutic failures, withdrawals or medication errors. Approximately 25% of ADEs are caused by medication errors and thus considered preventable ADEs; estimates range from 380,000 to 450,000 preventable ADEs occurring in US hospitals annually.⁴

In an effort to reduce ADEs, health care leaders and organizations have updated safety principles and practices, ie, how errors are examined, understood and addressed.^{6–13} System approaches and analyses to reduce medication errors and ADEs include strategies such as electronic health records (EHR), computer physician order entry (CPOE), bar code medication administration systems (BCMA), and structured prescribing forms.^{8,11,14–17} Despite these strategies, ADEs, and more specifically medication errors, have remained a common occurrence.

One explanation for the lack of effectiveness in these system-level strategies is a lack of focus on the nursing role in medication errors. Approximately one-quarter to one-third of medication errors occur at the administration phase; medication administration is almost solely under the purview of the bedside nurse.¹⁸ Yet, little is known about nurses' attitudes about updated safety practices or their skills in implementing these updated safety practices. Understanding safety includes integration of elements from the emerging field of safety science, inclusion of system-level causes, and an appreciation for the contribution of complexity of work, and human limitations and complexity.^{19–21} Focusing on nurses' attitudes and skills with updated safety concepts may provide insight into the design and implementation of effective system- and nurse-level interventions to minimize medication administration errors (MAEs).

Thus, the purpose of this study was to assess bedside nurses' attitudes about and skills with updated safety concepts. The specific aims were to: 1) describe nurse attitudes about and perceived skills with updated safety principles and explore associations between attitudes and skills, and 2) explore the influence of nurse attitudes and perceived skills on a) unit-level MAE rates and b) unit-level adherence to safe medication administration practices.

CONCEPTUAL FRAMEWORK

Given the institutional and individual variables that impact unit-level MAE rates, this study used a conceptual framework adapted from the Outcome Production Framework (OPF)⁶ and the Shimokura model of skepticism.⁷ The OPF postulates that organizational characteristics, capital inputs, and institutional process variables interact and influence clinician behaviors that in turn have an impact on patient outcomes. Clinician behaviors also may be influenced by individual characteristics, including attitude.⁶ Skepticism is a major element in assessing attitude and, in this study, reflects the degree to which nurses believe in the efficacy of evidence-based practice.⁷ Skepticism is relevant to MAEs because the concept highlights not only an individual clinician's knowledge of evidence-based practice, but also any accompanying doubt of the guideline's effectiveness, which may affect a clinician's sustained adherence to evidence-based practice.

METHODS

Design

A cross-sectional study was conducted using 2 data sources: registered nurses (RNs) employed at hospitals participating in the Collaborative Alliance for Nursing Outcomes (CALNOC) registry and CALNOC data on medication administration practices and medication errors. CALNOC is a not-for-profit, self-sustaining, national registry that oversees nursing-sensitive measures that are collected at the unit level of a hospital.⁸ CALNOC supports hospital collection of data on nursing-sensitive structure, process, and outcomes for benchmarking and quality improvement planning⁸. Human Subjects Review Committees at relevant organizations approved the study.

Sample and recruitment

This study targeted RNs employed at hospital agencies that had participated in collection of MAE data via the CALNOC direct observation methodology within the 18 months prior to the survey data collection timeframe (November 2014 to April 2015). CALNOC provided a list of 34 agencies that met the inclusion criteria. Three waves of inquiry emails and letters were sent to the Chief Nursing Officers (CNO) in these systems. Six agency CNOs agreed to participation, 4 declined participation, and 24 did not respond. Once a CNO provided permission for agency participation, the principal investigator contacted the CALNOC Site Coordinator to explain the study, identify appropriate target units, and develop recruitment strategies for nurse participation. Target units were any inpatient adult or pediatric unit or emergency department. Emergency departments were included since many patients are kept up to 23 hours for observation, and nurses frequently administer medications during observation.

CALNOC Site Coordinators sent out 3 waves of invitations to nurses, 2 weeks apart. The identified best date to launch the nurse-level survey was determined by unit managers or CALNOC Site Coordinators, as several targeted units were managing other quality and safety work with nurses (eg, preparation for The Joint Commission visits or Ebola training and validations). One agency was lost to follow-up. The initial nurse sample consisted of 293 nurses from 6 agencies on 40 units. Employing a minimum 25% participation rate for unit inclusion criteria decreased the final sample to 15 units at 4 agencies, for a sample size of 159 nurses.

Characteristics of the 4 agencies included: 75% presence of BCMA (n=3), 100% use of CPOE (n=4), 0% Magnet Status, 25% University Hospital Consortium (n=1), and 25% identification as an academic research center that partners with a local university (n=1). Size of the 4 participating agencies were 48, 193, 198, and 336 beds. The types of units engaged in the study included: medical, surgical, obstetrics, emergency department, telemetry, neuroscience, rehabilitation, orthopedics, and ICU

Variables

Nurses' Attitudes and Skills with Updated Safety Concepts—The Nurses' Attitudes and Skills with Updated Safety Concepts (NASUS) Scale adapted 2 existing scales

(Schnall's Patient-Safety Attitudes, Skills and Knowledge Survey)¹⁴ and Chenot and Daniel's Health Professions Patient Safety Assessment Curriculum Survey.¹⁵ The NASUS scale consists of 2 subscales: an attitude subscale and a perceived skill subscale. The attitudes subscale has 17 questions (eg, if there is no harm to the patient, there is no need to address an error), and the perceived skill subscale consists of 7 questions (eg, ability to analyze a case to find the cause of an error). Each item of the NASUS employs a continuous visual analogue scale, ranging from 0 to 100. Cronbach's alpha reliability for the entire NASUS Scale, attitudes subscale, and skills subscale are: $\alpha = .73$, $\alpha = .67$ and $\alpha = .71$, respectively. The development and pilot testing of the scale with 293 clinical RNs and psychometrics of the scale are described elsewhere.¹⁶

Medication Administration Errors—Unit-level MAEs are one of the primary outcomes of this study. CALNOC tracks MAEs using a standardized approach, the Medication Administration Accuracy Assessment¹⁷. This approach involves naïve observation whereby the trained observers do not know the actual medication order, but observe the entire preparation and administration process. The observers conduct a comparative record review to determine number, type of errors and frequency of each type of medication error.¹⁷ Medication administration error types include the following 9 error categories: unauthorized drug error, wrong dose error, wrong form error, wrong route error, wrong technique error, extra dose error, omission error, wrong time error, and drug not available error.¹⁷ For each of these errors, observers document “yes” or “no.” Rates of medications administered free of errors are tracked at the unit level, and data are reported as a monthly rate of error per 100 doses.¹⁷ For this study, categories were combined for an overall MAE rate per unit.

Adherence to Safe Medication Administration Practices—The second outcome variable in this study is nurses' adherence to safe medication administration practices. This variable employs a direct observation methodology in CALNOC agencies. For each administered medication, observers compare the congruency of the nurse's practice to medication administration safe practices. These practices are: 1) compares medication with electronic Medication Administration Record (eMAR), 2) labels medication throughout the process from preparation to administration, 3) checks 2 forms of patient identification, 4) explains medication to patient, and 5) charts medication immediately after the administration. Adherence is defined as the practices that met the behavioral criteria divided by the total number of observed behaviors, times 100. Adherence to safe medication practices are tracked at the unit level.¹⁷

Data analysis

IBM SPSS Version 23 (IBM Corp, Armonk, NY) was used for all analyses. NASUS data (nurse-level data) were collected and managed through a secure, web-based survey tool designed to support data capture for research. CALNOC data were reported at the unit-level.

Collected data were examined for missing values, of which there was a minimum (less than 1%). Descriptive statistics included frequencies for nominal data, and median, minimum and maximum values for continuous data due to skewed distributions and some very small sample sizes (eg, < 10 nurses within some units). Spearman's rho coefficients were used for

assessing correlations of attitude scores with skill scores, as well as for assessing correlations of unit-level aggregated nurse attitudes and skills with outcome variables. Unit-level attitude and skill scores were correlated with outcome variables, adjusting the standard errors for lack of independence. Those analyses resulted in essentially identical findings to those observed using the unit-level scores, therefore only the results from the Spearman's rho approach are reported.

RESULTS

Aim 1 – Nurse Attitude and Skill Subscales

Descriptions of the agency-level nurse attitude and skills scores are presented in Table 1. A more expanded version of this Table, including unit-level data, is available as Supplemental Digital Content, Table 1. At the agency-level, the median of nurses' attitude subscale scores clustered around 67–68; unit median values ranged from 61 to 76. Within units, individual nurses' attitudes scores ranged from a minimal value of 30 to a maximum value of 86.

At the agency-level, the median nurses' perceived skill subscale scores ranged from 55 to 63; unit-level median scores ranged from 52 to 65. Within units, individual nurse means ranged from a minimal value of 33 to a maximum value of 92.

The strength of the association of the perceived skills subscale to the attitudes subscale was assessed. In addition to statistical significance ($p < .05$), Spearman's Rho correlation coefficients .40 explained 16% shared variability of the scores, indicating a level of association worthy of exploring clinically significant association between the 2 variables.²² In general, the pattern of the associations indicated that higher attitude scores were associated with higher skill levels. As nurses scored higher in the attitudes associated with updated safety (eg, sharing information about errors, believing improving systems is part of nursing practice, near misses need to be analyzed), they scored higher in the skills subscale (eg, analyzing a case to find the cause of an error, disclosing an error to a manager, interpreting aggregate error data), which would impact nurse safety practice (eg, medication administration). At the unit level, strength of correlations ranged from .03 to .61 with 7 of the 15 units with correlation coefficients .40. Two of those associations were statistically significant with $r_x = 0.56$ and 0.59 . Two small units ($n=4$ and $n=5$) indicated inverse relationships ($r_x = -0.80$ and -0.40) between nurses' attitudes and skills. Neither were statistically significant.

Aim 2 – Nurses' Attitudes and Perceived Skills on MAE and Adherence Rates

Supplemental Digital Content, Table 2, displays the unit-level MAE-rates and adherence to safe medication practice rates reported to CALNOC. Nine units reported MAE rates of 100%, and the remaining 6 units were observed with MAE rates ranging from 97% to 99%. Practice adherence rates were slightly more varied; three units were observed with 100% adherence rates and the other 12 units ranged between 84% to 99% practice adherence rates. The overall lack of variability in the outcome measures indicates strong nursing practice related to medication administration, but makes analysis difficult.

Associations of unit-level aggregated nurses' attitudes and perceived skills with their respective unit's MAE rates and practice adherence rates are summarized in Table 2. A clinically significant level of association was observed between nurses' perceived skills and MAE rates but it was not statistically significant ($r_s=.47$, $p=.077$).

DISCUSSION

Our study found that nurses' attitudes ranged appreciably at the individual level, but less so at the unit and agency level. There is a dearth of literature exploring nurses' attitudes about safety practices that affect their care delivery in the hospital setting. Much of the research about nurses' attitudes has focused on job satisfaction^{23,24} or work environment.²⁵ Although updated safety models, such as, human factors and safety science, are becoming increasingly common for examining adverse health care outcomes,^{26,27} research has yet to examine nurses' safety practices in terms of the competency framework of knowledge, skills and attitudes. Attitudes impact nurses' clinical decision making; nurses continuously prioritize work importance based on their attitudes.²⁸ This study's finding of notable variability in nurse-level attitude scores, combined with the lack of research examining nurse attitudes about safety practices, invites further exploration.

At the agency-level, there was less variability in the attitude subscale median values, as well as a smaller unit-level range span, averaging 30 points between minimum and maximum values. The 3 small units in the sample ($n=3, 4, 5$) reported the smallest attitude subscale range span of 14 points. The fact that unit-level attitudes subscale values were not correlated with MAEs or adherence rates may be a reflection of the homogeneity of the sample.

Our study found that nurses had low perceived skills needed for implementing updated safety practices. The only item in the NASUS skill subscale in existing literature is nurses' willingness or reluctance to report errors or near misses.²⁹ Although tracking error data is paramount to improving systems, an updated understanding of safety in complex working environments identifies other skills that contribute to reduction of adverse outcomes.³⁰ The NASUS skills subscale explores other skills such as identifying the cause of an error, discussing an error with a colleague, examining error trend data with aggregate data, and participating in a root cause analysis, which reflect a more complete approach to updated safety and the breadth of nurses' potential impact on safety outcomes. The NASUS scale is important because there is a lack of literature exploring nurses' skills in these areas.

An interesting finding of this study is the clinical significance between participating nurses' perceived skills in updated safety concepts and MAE rates. This clinical association suggests that possibly the higher the perceived skills, the higher the accuracy in medication administration. The 7 questions within the skills subscale reflect 4 dimensions of safety practice: a) reporting an error (items 1, 4); b) analyzing an individual error (item 2); c) discussing an error (items 3, 5); and d) analyzing error phenomena in the microsystem (items 23, 24). Within these 4 dimensions are both nurse- and system-level variables. This study suggests that MAEs are an interplay between system- and nurse-level factors. Further research may add further validation to this interplay. In understanding the interaction among

differing levels of influence, leaders and educators can design more effective improvements to impact MAEs.

The study found no consistently clear association between nurses' attitudes and perceived skills. Five units demonstrated clinically significant positive associations between the attitudes and skills subscales. One unit reported 1 of the sample's strongest positive association between attitudes and skills ($r_s=.59$) and was also statistically significant ($p = .021$). But there were no results that suggested a clear pattern of these associations. Within the conceptual model of competence that employs the core components of knowledge, skills and attitudes, there is the understanding that an interdependence exists among these components in contributing to competence.³¹ Studies suggest that the widespread inclusion of Quality and Safety Education for Nurses competencies in nursing programs has an impact on students' sense of readiness to perform skills related to quality and safety and their awareness of systems-level variables in their practice.³²³³³⁴ Yet minimum evidence examines this multifaceted approach to understanding quality and safety competencies with nurse clinicians. There is the possibility that with a larger sample of units, an associative pattern may emerge. Future health systems research should reflect the emerging understanding that clinician adherence to updated evidence stems from knowledge, skills and attitudes, and the interplay between agency-, unit- and nurse-level variables.³⁵

The lack of variability and high values in the outcome data (MAE and adherence to safe medication administration practices rates) are encouraging data for the safety of our health care system. In CALNOC hospitals, reported data suggest nurses are systematic and attentive to unit standards in administering medications. One limit to these data is the unknown element of how many nurses are observed per 100 doses. Given the ubiquitous nature of medications in the hospital setting, 100 doses may be observed within a relatively short time period, with a limited number of nurses, and with a limited number of patients.

Limitations

This study relied on a voluntary survey design. In today's health care environment, nurses are both required and invited to participate in multiple surveys. Recent research confirms decreasing rates of nurse participation in surveys.³⁶ Nevertheless, in a sample of 4 agencies, 15 units had adequate participation to represent the scale data. The focus of the NASUS scale may lend itself to bias as both the attitudes and skills subscales relied on nurses' self-reports. Self-reported attitudes and skills can be subject to bias if the content is considered sensitive or intrusive.³⁷ For nurses, reporting self-perceived attitudes and skills in patient safety may invite bias, as few nurses want to admit to unsafe attitudes or skills in their practice. Nevertheless, the reported data from the described study included healthy variability in its descriptive statistics. Nurses have much control over medication administration; however the MAE and adherence rates had limited variability, possibly reflecting a homogenous sample. However, a significant strength of the study was the collaboration with CALNOC, and access to data that is consistently and objectively measured in participating hospital settings and represents actual safety practices.

CONCLUSION

Prior to the IOM report, safety was traditionally defined as an individual clinician phenomenon. More recently, the pendulum has swung to safety lapses being understood as including system gaps. The described research is the first pilot study to examine nurses' attitudes and skills in updated safety concepts and their impact on MAEs and adherence rates. An expanded assessment of nurses' attitudes and perceived skills in safety practices is important in identifying strategies to impact sustainable improvement with MAEs and other safety events.

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Table 1

Nurses' Attitude and Skill Subscale Scores Aggregated at Agency Levels

Agency	Attitude Median ^a	Attitude Min/Max	Skills Median	Skills Min/Max	r _s ^b
A (n=22)	68	53/85	59	40/85	.40 ^c (p=.068)
B (n = 59)	67	30/85	63	34/86	.25 (p=.060)
C (n=36)	68	36/86	63	35/92	.30 (p=.072)
D (n=31)	68	49/80	55	33/84	.29 (p=.113)

^aMedian values were based on nurses' mean scores.

^br_s = Spearman's Rho.

^cClinically significant at r_s > = 0.40 (16% shared variance)

Table 2

Correlation Statistics^a for Nurses' Attitudes and Perceived Skills Subscales with MAE and Safe Medication Practice Adherence Rates

Subscales	MAE Rates	Adherence
Attitudes	$r_s = 0.10$ ($p = .714$)	$r_s = 0.11$ ($p = .687$)
Skills	$r_s = 0.47$ ($p = .077$)	$r_s = 0.32$ ($p = .241$)

n=15 units.

^a
 r_s = Spearman's Rho