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Relationship Between Patient Safety Climate and Adherence to Standard Precautions

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Abstract

Background—Standard Precautions (SP) are designed to limit blood-borne pathogen exposures among healthcare workers (HCW) and healthcare associated infections. SP adherence is globally suboptimal; yet reasons are underexplored. This study aim was to explore the relationships among safety climate factors and SP adherence by HCW in hospitals using newly developed survey and observational tools.

Methods—Cross-sectional data from 11 units in five hospitals were collected between March and September 2015. A patient safety and standard precaution survey was administered to nurses and pooled with data from observations of HCW-patient interactions using defined SP indications. Descriptive statistics of distributions, frequencies, and Pearson correlation coefficients were calculated using SAS to determine the unit-level relationships among dimensions of the patient safety climate and unit percentage of SP adherence ($p < .05$).

Results—540 HCW-patient encounters with 1,713 SP indications and 140 surveys and were collected. Although most nurses (94%) reported “always” or “often” adhering to SP and generally reported positive scores on unit safety climate, observed SP adherence was 62% (unit range 31–80%). Only 30% of nurses rated staffing positively, and this was inversely related to observed SP adherence.

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Conclusions—Adherence to the full complement of observed SP behaviors by HCW of all types was suboptimal. The relationship between safety climate, particularly staffing, and adherence to SP warrants further testing.

Keywords

standard precautions; compliance; infection control; safety climate; adherence; observational tool

Background

Two decades ago the Centers for Disease Control and Prevention (CDC) introduced standard precautions (SP) as a core component and primary prevention strategy for health care associated infection. This horizontal approach was deemed applicable to all health care workers (HCW) in contact with all patients in all settings, regardless of the suspected or confirmed presence of an infectious agent. Specific SP components include hand hygiene, use of appropriate personal protective equipment, safe use and disposal of sharps, decontamination of environment and equipment, patient placement and linen and waste management.¹

In contradistinction to this long standing recommendation, recent literature, based primarily on self-report surveys, documents that HCW basic preventive practices such as SP are suboptimal, adhered to less than 50% of the time.^{2,3,4,5} While surveys are relatively inexpensive and focus HCW attention to their own practices, they may also have poor reliability and validity.^{6,7,8} In fact, no psychometrically tested observation measures were found in a 2013 integrative review of instruments to measure compliance with infection control practices.⁹

There is some evidence that features of the safety climate are related to HCW safety practices, including adherence to SP,^{11–16} in a systematic review conducted to examine the relationship between patient safety climate and SP we found that despite several high quality studies this topic is underexplored and all studies used different and self-report measures.¹⁷ Because the correlation between observed and reported SP adherence using psychometrically validated tools that account for the features of the safety climate remains unknown, the specific aim of this study was to examine the relationship among these measures of SP adherence and safety climate factors in hospital settings using psychometrically tested instruments.

Material and methods

Psychometric testing of two tools, the Standard Precautions Observation Tool and the Survey on Patient Safety & Standard Precautions was conducted, followed by exploratory pilot testing of both tools in 11 adult hospital units.

Study Instruments

Standard Precautions Observation Tool—This tool was developed by nurse researchers with expertise in infection prevention and control and surveillance methodologies to measure observed SP behaviors in hospital settings. The observational tool

was adapted from the psychometrically sound World Health Organization Hand Hygiene Observation Tool and CDC guidelines.^{1, 20} A co-investigator of this project was on the international task force that developed the WHO Self-Assessment Framework. The tool is comprised of 10 observable items which include the four major categories of CDC-recommended SP behaviors: hand hygiene, personal protective equipment, disposal of needles or other sharps, and soiled linen handling,¹ items are scored dichotomously (“yes” or “no”) and adherence is expressed as a percentage per unit.

Prior to using the Standard Precautions Observation Tool for actual field testing we conducted psychometric evaluation. First, content experts, including two infection preventionists, a health services researcher with extensive expertise in tool development and testing, and a nurse researcher assessed the face validity of the tool and a panel of experts and end users confirmed the extent to which the items measured the complete range of SP and was readily understandable prior to field testing.

Next we conducted inter-rater reliability testing among the principal investigator and two or more observers per site using a series of vignettes and live on-site observations; 100% reliability was established at each site and communication among liaisons was encouraged to further develop any decision rules.

Survey on Patient Safety & Standard Precautions—This tool was designed to measure HCW perceptions of safety climate in the hospital unit on which they work, reported SP adherence, and factors that influence that adherence. For that purpose, we combined items from the Agency for Healthcare Research and Quality (AHRQ) Hospital Survey on Patient Safety Culture and the Gershon Standard Precaution and Safety Climate Surveys.^{13, 18, 19}

The unmodified AHRQ survey is extensively used to measure 12 dimensions of safety climate: supervisor expectations and actions promoting safety, organizational learning, teamwork, communication openness, feedback and communication about errors, non-punitive responses to incidents, staffing, hospital management support for patient safety, handoffs and transitions, and overall perceptions of safety. Forty-four items are measured using a 5-point Likert scales so that a “1” represents a low score, “5” a high score and a composite score per dimension is obtained. The AHRQ tool is reliable (Cronbach’s alpha 0.63–0.84) and there is an extensive and explicit Survey User’s Guide, including guidance for modifying and administering the tool.¹⁸ The 22 items we added rate perception of SP adherence, barriers and facilitators using a 5-point Likert scale from “strongly disagree” to “strongly agree,” or “never” to “always.”

We conducted psychometric testing to assess the reliability and validity of the combined instrument prior to use in the field test. A test-retest survey from 21 nurses demonstrated moderate test stability at the item level by weighted Cohen’s Kappa statistic and the dimension level by intra-class correlation coefficient. Internal consistency reliability was demonstrated by Cronbach’s alpha per dimension ($\alpha = .52-.89$).

Field Test and Training of Liaison Observers

We tested the two tools in a convenience sample of five hospitals from two healthcare systems in two northeastern U.S. states, including community, acute-care, trauma, teaching and non-teaching hospitals with licensed bed size ranging between 211–692. Initially, usability and feasibility testing were completed on two medical-surgical units, followed by the pilot study on the remaining nine medical- surgical units. Our aim was to survey 50% of the eligible full-time equivalent nurses and collect 100–200 events using the SP Observation Tool on each of the nine units.¹⁸ Following IRB approvals, all data were collected between March and September 2015.

Direct Observation of Standard Precautions

Observations were conducted with English-speaking adult patients on medical, surgical, intensive care or emergency department units who provided permission for the observer to be in the patient room. Patients in isolation precautions (contact, droplet, or airborne) or in acute crisis (undergoing a rapid response, code or cardio-pulmonary resuscitation) are not observed. The observer unobtrusively records up to nine HCW-patient encounters with 10 SP indications per encounter.

Observers on each study unit who met the following criteria collected observational data: 1) at least six months of experience in nursing or conducting HCW infection prevention observations or equivalent training, and 2) availability to be trained on the use of the observational tool. These site liaisons ($n=11$) were staff nurses, nurse educators, advanced practice nurse and epidemiologists. Training on the study procedures and tool background, design and definitions was provided and followed by interactive demonstrations using a series of case scenarios. Scripted procedure guides were developed and used by the site observers, who were instructed to limit each observation session in a patient room to no more than 60 minutes to limit observer fatigue bias. Though data were primarily collected on weekdays, observations were also collected on weekends and evenings.

Healthcare workers with direct patient contact or contact with the patient's immediate surroundings such as nurses, nursing assistant/aide, medical doctor, or other HCW (e.g. physical therapist, technician, dietician, social worker) were observed. Students or volunteers were excluded from observations. Details to numerically code the HCW type were provided on the tool to aid the observer.

Survey on Patient Safety & Standard Precautions

Nurses were surveyed because they are the largest direct care work force routinely available and representative of the unit climate appropriate for this study purpose. Nurses surveyed met three criteria: 1) licensed registered nurse 2) currently having direct patient contact at least 16 hours per week, and 3) had worked on that unit for a minimum of six months.

Analysis

Data were aggregated and analyses were conducted at the hospital unit level using SAS statistical software, version 9.3 (SAS Institute, Inc., Cary, North Carolina). Data were assessed to examine for normalcy and bivariate analyses conducted to describe relationships

among the key variables. Analysis of survey items, in accordance with the direction of the AHRQ Survey User Guide, were grouped into safety climate dimensions, and the two lowest response categories (e.g. strongly disagree/disagree) and two highest response categories (e.g. strongly agree/agree) were combined to create a negative or positive frequency score. The midpoints of the scale (e.g. neither or sometimes) are reported as a separate category. Additionally we calculated the mean score per item and dimension to better understand the distribution of responses. Missing data was excluded from the denominators.

Pearson correlation coefficients were calculated to determine associations among dimensions of safety climate and reported and observed SP adherence. Test-retest reliabilities were used to compare scores of the same participants tested two weeks apart by χ^2 coefficient of stability (reliability coefficient) and intra-class correlation coefficients. Cronbach α statistic was calculated to test the internal consistency of the survey tool. The level of significance for all testing was set at $p < .05$.

Results

Sample Characteristics

A total of 540 HCW-patient encounters associated with 1,713 SP indications were observed, and 140 surveys were obtained from nurses. The final analytic sample included observational data ($n=1,474$) from units that also had survey data. Fewer than 2% of responses were missing from any single item. Characteristics of the hospitals and nurses are shown in Table 1.

Observation Results

Unit level observed SP adherence ranged between 31–80% across all indications. At the provider level, mean adherence was 62% with little difference between nurses (64%), physicians (56%) or other HCW (62%). Data were predominantly comprised of hand hygiene indications (75%), and hand hygiene was missed the most frequently, up to 58% of the time indicated. Nearly every time hand hygiene was indicated and performed an alcohol based hand rub (95%) was used. HCW wore gloves 26% of the time when hand hygiene was indicated and missed. In descending order, remaining indications missed included using a mask (50%), donning a gown (43%), handling linens appropriately (22%), disposing of sharps immediately (16%), donning (13%) and doffing (11%) gloves (Table 2).

Survey Results

The vast majority of nurses surveyed reported positive scores (i.e., agree/strongly agree) for SP practices (*mean proportion with agree/strongly agree responses* = 0.94, *SD* = .02), teamwork within units (*mean proportion with agree/strongly agree responses* = 0.82, *SD* = .09), and organizational learning (*mean proportion with agree/strongly agree responses* = 0.81, *SD* = .09). In contrast, a lower proportion of nurses reported positive scores for unit staffing (*mean proportion with agree/strongly agree responses* = 0.30, *SD* = .11), non-punitive response to errors (*mean proportion with agree/strongly agree responses* = 0.35, *SD* = .16), and unit handoffs and transitions (*mean proportion with agree/strongly agree responses* = 0.41, *SD* = .09) (Table 3). Analysis of variance across units demonstrated

statistically significant ($p < .05$) differences in seven of the 14 safety climate dimensions by mean composite frequency scores.

Relationship between SP Adherence and Safety Climate

The distribution of observed composite SP adherence and all-item safety climate scores (categorized as negative, neutral, or positive) by site is shown in Table 4. Statistically significant relationships between both staffing ($r^2 = -.85$, $p = .03$) and teamwork within units ($r^2 = -.60$, $p = .09$) and the composite SP adherence score were identified. Significant relationships between safety climate dimensions and specific SP items include: teamwork within units and sharps adherence ($r^2 = -.75$, $p = .03$), management support for patient safety and hand hygiene ($r^2 = -.70$, $p < .01$), and staffing and hand hygiene ($r^2 = -.84$, $p < .01$). Linen adherence was correlated with four dimensions: staffing ($r^2 = -.85$, $p < .01$); non-punitive response to errors ($r^2 = -.84$, $p < .01$), organizational learning/continuous improvement ($r^2 = -.95$, $p < .01$); and management support for patient safety ($r^2 = -.94$, $p < .01$).

Discussion

To our knowledge, this constitutes the largest observational study of SP behaviors. Most nurses reported “always” or “often” adhering to SP whereas observed adherence was low, 62% overall. Similar to other studies, we found hand hygiene was performed around half of the time when indicated, and was more often missed prior to patient contact than after patient contact.^{2–4,9,23} Notably, one-quarter of the time when hand hygiene was missed, the HCW was wearing gloves, even when gloves were not indicated. We also found on the other hand that donning gloves or gowns when indicated did not occur during 13% and 43% of observed encounters, respectively.

Appropriate donning of masks as well as sharps and linen handling were also suboptimal. These findings are concerning given the high burden of HCW sharps injury and blood-borne pathogen exposures, transmission risks of epidemic concern such as influenza, and in context of accruing evidence of the importance of environmental cleanliness to prevent the spread of HAI.^{24, 27, 28}

Factors that may be associated with this adherence were identified using the Survey on Patient Safety & Standard Precautions. Specifically, the dimensions of staffing and teamwork within units were correlated with overall SP adherence. Unexpectedly, these were negative relationships (i.e., better self-reported staffing and teamwork were associated with lower SP adherence). This finding is puzzling. One possible explanation may be the presence of an unmeasured factor mediating or moderating these relationships such as psychosocial and individual factors that may be important including gender, training, or self-efficacy.^{11, 14, 15} Clearly more research is needed to better elucidate the relationships between staffing, teamwork, and adherence to infection prevention practices.

This study is an important step towards addressing the knowledge gap regarding SP adherence and associated factors by testing two instruments that capture a range of important SP behaviors, tools that until now were lacking.⁹ Considerable deficits were

observed in SP adherence to hand hygiene, use of personal protective equipment, sharps and linen handling. Measuring SP adherence and associated factors using reliable and valid observation and survey tools may allow health care administrators and infection preventionists to target local interventions, measure and benchmark progress internally and externally to improve SP adherence.

Limitations

Sites that had lower rates of observed adherence also had fewer observations collected. It is possible that observer drift towards positive responses occurred over time in the better performing sites, or alternatively that observing fewer than 150 indications is not representative of unit behavior. The potential of a differential Hawthorne effect across sites existed, because observers in one healthcare system were internal employees and in the other system they were external. The limitation of oversampling weekdays is also noted; however the density of SP indications is likely similar.²⁹

Regarding the Survey on Patient Safety & Standard Precautions, it is possible that we did not account for organizational or other confounding factors. The hospitals belonged to two healthcare systems and overarching system level influences may have been a factor, such as the post-hoc discovery of nursing union negotiations at several hospitals during the study period. Though our stability statistics of the tool indicate moderate stability, further testing with a larger sample may yield better stability. We also purposely only surveyed nurses as representative of the unit behavior. Future studies may also include other providers.

Conclusions

Adherence to the full complement of observed SP behaviors by HCW of all types was suboptimal. The relationship between safety climate and adherence to SP warrants further testing.

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Highlights

- Observed standard precaution adherence was suboptimal.
- Sizeable discrepancy between reported and observed adherence exists.
- Features of safety climate were correlated with standard precaution adherence.

Table 1

Characteristics of hospitals and nurses by hospital.

Characteristic	Total Number (%)	Hospital A	Hospital B	Hospital C	Hospital D	Hospital E
Hospital Bed Size	2215	692	211	574	275	463
Number of units surveyed	9	4	1	1	1	2
Number of RNs surveyed	140	66	17	17	9	31
Years in current profession*						
0 to 5 years	58 (42%)	25	9	10	7	7
6 to 10 years	31 (23%)	20	3	3	2	3
11 or more years	48 (35%)	21	4	3	0	20
How long have you worked in this hospital*						
0 to 5 years	63 (46%)	37	7	9	5	5
6 to 10 years	36 (26%)	16	5	5	3	7
11 or more years	39 (28%)	13	5	2	1	18
How long have you worked in this unit*						
0 to 5 years	76 (13%)	37	9	16	8	6
6 to 10 years	28 (21%)	17	3	0	1	7
11 or more years	32 (24%)	11	4	0	0	17
Hours worked per week*						
16-39 hours	81 (59%)	37	10	9	3	22
40 or more hours	56 (41%)	28	6	7	6	9

Note: May not total 140 due to missing data.

Table 2

Observed SP Adherence (N= 1,474)

SP Indication	Number indicated (percent)	Number done (percent adherence)
HH before patient contact	423 (29%)	177 (42%)
HH after patient contact	375 (25%)	236 (63%)
HH after contact with patient surroundings	313 (21%)	191 (61%)
Gloves On	146 (10%)	127 (87%)
Gloves Off	129 (9%)	115 (89%)
Gown On	7 (<1%)	4 (57%)
Gown Off	2 (<1%)	2 (100%)
Mask on	2 (<1%)	1 (50%)
Sharps handling and disposal	50 (3%)	42 (84%)
Linen handling and disposal	27 (2%)	21 (78%)

Note: HH = hand hygiene. *= HH indication missed and HCW wearing gloves

Table 3Positive responses (rated 4 or 5) by dimension across all hospitals units ($N=9$ units)

Dimension	Mean proportion of respondents who rated dimension positively* (SD)	Range	<i>p</i> value	95% Confidence Intervals around the mean
Teamwork Within Units ¹	0.82 (0.09)	0.71 – 0.95	0.11	0.68–0.96
Supervisor/Manager Expectations & Actions Promoting Patient Safety ¹	0.72 (0.11)	0.57 – 0.88	0.04	0.56–0.89
Organizational Learning - Continuous Improvement ¹	0.81 (0.09)	0.70 – 0.98	0.05	0.68–0.94
Management Support for Patient Safety ¹	0.55 (0.14)	0.40 – 0.82	0.03	0.35–0.74
Overall Perceptions of Patient Safety ¹	0.44 (0.09)	0.31 – 0.57	0.16	0.30–0.58
Feedback & Communication About Error ²	0.66 (0.13)	0.52 – 0.91	0.03	0.48–0.84
Communication Openness ²	0.62 (0.14)	0.43 – 0.81	0.02	0.44–0.78
Frequency of Events Reported ²	0.65 (0.08)	0.50 – 0.75	0.81	0.44–0.86
Teamwork Across Units ¹	0.53 (0.11)	0.36 – 0.67	0.11	0.36–0.70
Staffing ¹	0.30 (0.11)	0.15 – 0.49	<0.01	0.17–0.43
Handoffs & Transitions ¹	0.41 (0.09)	0.32 – 0.57	0.42	0.23–0.59
Nonpunitive Response to Errors ¹	0.35 (0.16)	0.14 – 0.67	0.01	0.16–0.54
Standard Precaution Practices ³	0.94 (0.02)	0.90 – 0.97	0.92	0.88–1.00
Standard Precaution Environment ¹	0.70 (0.09)	0.58 – 0.81	0.06	0.58–0.83

* Positively defined as score of 4 or 5 defined as “agree” or “strongly agree,”¹ “most of the time” or “always”², or “often” or “always”

Table 4

Distribution of SP Adherence and Patient Safety Climate Ratings and by Unit

Tool and score	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8	Unit 9
Observation: total number indications observed, % adherence	121 (54.5%)	83 (34.9%)	206 (71.4%)	198 (70.2%)	253 (75.5%)	223 (80.3%)	135 (43.7%)	110 (31.0%)	145 (49.7%)
Survey: Number of items scored	1086	1066	1445	892	640	1215	575	1009	958
Low rating (1 or 2)	161 (14.8%)	134 (12.6%)	335 (23.2%)	204 (22.9%)	140 (21.9%)	205 (16.9%)	109 (19.0%)	177 (17.5%)	147 (15.3%)
Neutral rating (3)	177 (16.3%)	135 (12.7%)	221 (15.3%)	166 (18.6%)	119 (18.6%)	168 (13.8%)	86 (15.0%)	151 (15.0%)	135 (14.1%)
High rating (4 or 5)	748 (68.9%)	797 (74.8%)	889 (61.5%)	522 (58.5%)	381 (59.5%)	842 (69.3%)	380 (66.1%)	681 (67.5%)	676 (70.6%)

Note: Survey rating calculated as total number of responses per category/ total number of responses to items excluding missing responses. Survey uses a 5 point Likert scale where "1" indicates a negative response and "5" a positive response.