Relationships among patient safety climate, standard precaution adherence, healthcare worker and patient outcomes

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Disclosures

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Broad Objectives

- Review a current research study guided by structured review questions to evaluate the strength of evidence presented in the article following IMRaD format [*Introduction, Methods, Results and Discussion*];
- Develop and hone your critical appraisal skills;
- Promote implementation of evidence expected to improve patient safety and outcomes into clinical practice.

Citation:

Hessels AJ, Guo J, Johnson CT, Larson E. Impact of patient safety climate on infection prevention practices and healthcare worker and patient outcomes. *American Journal of Infection Control*. 2023 May 1;51(5):482-9.

Study Specific Learning Objectives

- Describe the importance and significance of the problem addressed;
- Identify the study framework, aims, methods and procedures;
- Identify at least two key relationships among safety climate, SP adherence and adverse healthcare worker and patient outcomes;
- Discuss strategies to translate findings into practice and policy implications.

Article Review Questions: Part I Introduction

1. What is the purpose of the article? Is it clearly described? Identify the research questions, objectives, or hypothesis(es)?

2. Is the literature review comprehensive and current? Does the content of the review relate directly to the research problem? (evaluate the research cited in the literature review and the argument developed to support the need for this study)

3. Does the research report use a theoretical or conceptual model for the study? Does the model guide the research and seem appropriate?

The Problems

Health Care Workers

- 1/25 RNs suffers an occupational blood-borne pathogen exposure annually
- 384,000 HCW/annually
- 56-88% are preventable
- Direct and indirect costs ~$747 per case ($268 million USD)

Patient HAIs

- 1/25 patients has an HAI at any time
- 2 million patients annually
- 99,000 estimated deaths
- 10-70% are preventable
- Attributable costs ~ $6.7 billion in U.S. hospitals

Underestimate of True Burden?

<50% of the time HCW report exposures

<50% of HCW interactions with patients use standard precautions (SP)

data is largely limited by self-report as there *were* no existing, standardized tools to capture observational data

What are Standard Precautions (SP)?

"Primary strategy for the prevention of healthcare-associated transmission of infectious agents among patients and healthcare personnel," (Seigel et al., 2007).

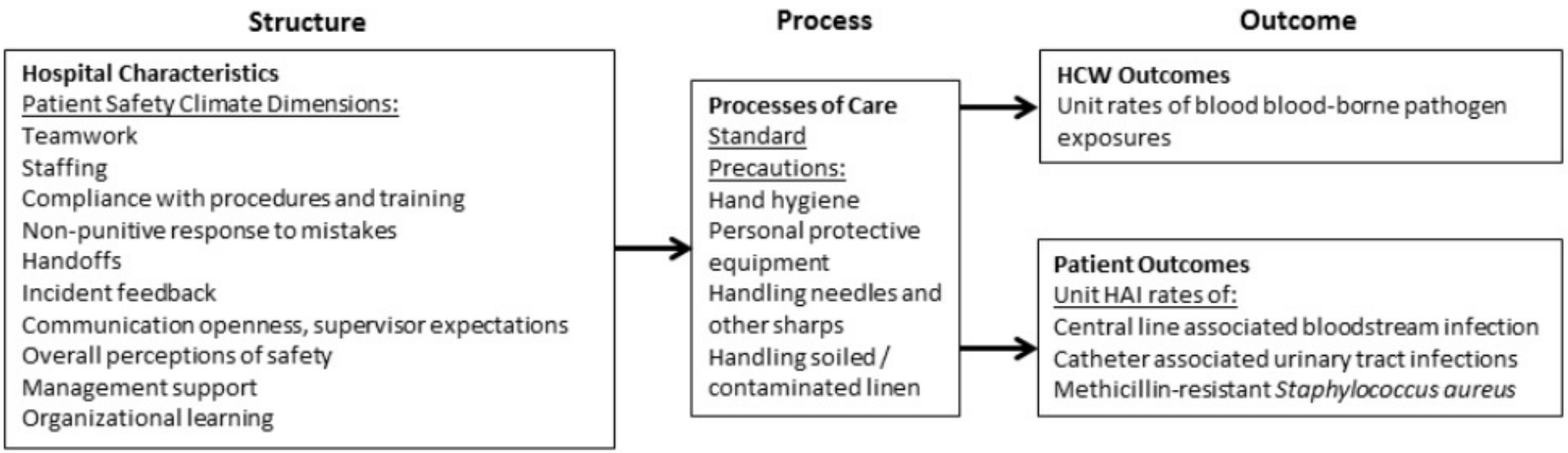
- **SP apply to:**
  - **all** patients
  - **all** healthcare settings
  - **all** the time
- **Base** of the HAI prevention pyramid

SP Components & Actions

- hand hygiene
- personal protective equipment (PPE)
- safe use and disposal of sharps
- decontamination of environment and equipment
- patient placement
- linen and waste management

(Siegel et al., 2007)

Conceptual Framework



Aims

1. Describe	The direction and magnitude of relationships among patient safety climate (PSC) and self-reported and observed standard precaution (SP) adherence
2. Identify	The relationship between SP adherence and (a) HCW blood-borne pathogen exposure and (b) HAIs
3. Determine	The direct and indirect relationships among PSC, observed and reported SP adherence, and HCW and HAI outcomes

Article Review Questions: Part II Methods

1. How did the researchers obtain the sample for the study?
2. How were the data collected?
3. Are the data collection instruments clearly described?
4. Were the instruments appropriate for the measures of the variables under study?

Methods

Design:

Multi-site, cross-sectional study employing convenience sampling with recruitment through national professional organizations (APIC & AOHP) to reach geographically diverse populations in U.S.

Sample Aim:

50 hospitals; 1-2 adult medical-surgical units per hospital (powered at 87 units).

Hospital inclusion criteria:

1) use and availability of data following National Healthcare Safety Network (NHSN) and OSHA 300 surveillance methodology and definitions

2) organizational policies and procedures congruent with the standard precaution behaviors measured using the observational tool.

Nurse Inclusion criteria:

Works in direct care at least 16 hrs/week and on select unit at least 6 months

Article Review Questions: Part II Methods

1. Describe and evaluate the reliability of the instruments (reliability refers to the consistency of the measures). Will the same results be found with subsequent testing?

2. Describe and evaluate the validity of the instruments (validity refers to the ability of the instrument to measure what it proposes to measure).

3. How did the researchers analyze the data? Were the methods appropriate to answer the research question(s)?

Data Sources & Variables

Surveys

- Nurses in hospital units on perceptions of PSC and reported SP adherence (adapted HSOPSC- 12 dimensions 44 items- 5pt. Likert scale & 22 SP items)

Observations

- Hospital based staff were recruited and trained on observational surveillance methodology using a novel tool
- SP items represented categories of hand hygiene, PPE, sharps and soiled linen handling
- All provider types

Routine Surveillance & Outcomes Data

- One year of existing HAI (CLABSI, CAUTI and MRSA bacteremia rates) and HCW BBP exposures/splash rates/100 RN FTE encompassing six months pre and post survey and observational data collection

Hospitals:

- with and without post graduate medical residents or fellows (teaching or non-teaching)
- ownership
- bed size
- geographic category based on U.S. Rural-Urban Continuum Codes
- Magnet status
- nurse skill mix (proportion of RN to licensed practical nurses and others)
- nurse staffing (defined as occupied RN full time equivalent)

Data Collection Procedures

- Institutional Review Board approvals, all data were collected between 01/2017 and 10/2018
- Study site liaisons:
  - infection preventionists, occupational health nurses, and clinical nurses
  - incentivized to participate in the study (entered into a professional conference registration raffle)
  - trained by the research team to collect and collate outcomes and observational data.
- Units initiated in cohorts of up to 10 units every 2-4 weeks to allow for early identification of any issues and related adjustments in accordance with NORA r2P guidance

500 surveys were collected from nurses on 54 units in
from 6 states. Excluding sites that did not submit all 3 ty
yielded a total of 5,285 standard precaution observation
surveys collected across 43 units in 13 hospitals from 6 st
for analyses.

Descriptive results

Demographic distributions of hospitals and nurses are shown Tables 1 and 2. The majority of standard precaution observatic included nurses (43.1%) (Fig 1A), and the most frequent indicatic observed was hand hygiene (72.6%). Overall observed standard pre caution adherence at the individual level was 64.4%. Overall adher- ence for nurses was highest (69.1%), followed by the other provider category (62.1%), and lastly physicians (58.4%). As shown in Figure 1B, in descending order, adherence rates were: PPE (81.8%), sharps handling (80.9%), linen handing (68.3%) and hand hygiene (58.3%).

When aggregated for unit level analyses, overall observed adher- ence was 62.6%; adherence for nurses was highest (69.1%), followed by the other provider category (56.7%), and lastly physicians (46.1%). In descending order, adherence rates were: PPE (81.1%), sharps han- dling (63.2%), linen handing (46.3%) and hand hygiene (56.4%). A one-way ANOVA was conducted to compare the effect of provider role on observed standard precaution adherence, and significant dif- ferences were identified ($P < .001$). Differences were identified between nurses and physicians ($P < .001$) and nurses and others ($P = .01$), but not physicians and others ($P = .08$).

The average unit response rate for survey completion was 38.7%. The distribution of perceptions of patient safety climate dimensions is shown in Table 3. The majority of nurses surveyed (95.8%) reported they often or always perform the 14 precaution behaviors included in the survey and (77.3%) rated their unit environment positively, o conducive to following standard precautions.

Regarding outcomes, unit HAI mean rates in descending o d were: 0.76 CAUTIs per 1000 device days ($SD = 0.76$); 0.69 CLABS' 1000 device days ($SD = 1.22$), and 0.04 MRSA infections pe 1 patient days ($M = 0.04$, $SD = 0.08$). Unit needlestick injury rat f

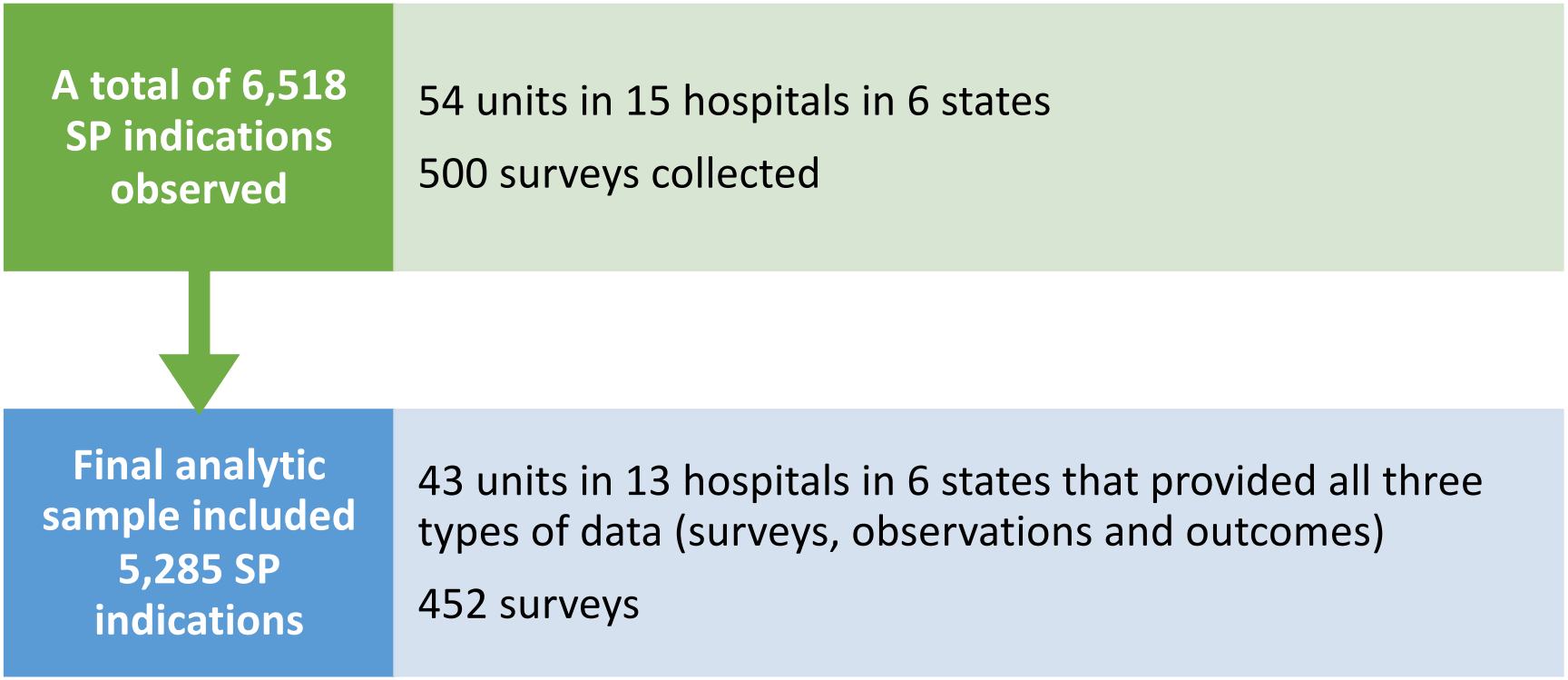
Article Review Questions: Part III Results

1. What were the findings of the research?

2. Are the results presented in a clear and understandable way?

3. Are the findings, discussion, and conclusions of the study supported by the data presented in the article?

Data Collected & Results



Characteristics of Hospitals

Table 1. Characteristic of Hospitals (n = 43)		
Characteristic	n	%
Magnet Designated		
Yes	28	65.1
No	15	34.9
Teaching Status		
Teaching	28	65.1
Non-teaching	15	34.9
Hospital Ownership		
Private	36	83.7
Public	7	16.3
Hospital Bed Size		
Large (>400)	29	67.4
Medium (216-400)	7	16.3
Small (1-215)	7	16.3

Characteristics of Nurses

Table 2. Characteristics of Nurses (n = 452)		
	n*	%
Years in current profession		
0-5	224	49.6
6-10	81	17.9
≥11	138	30.5
Years worked in current hospital		
0-5	242	53.5
6-10	68	15.0
≥11	131	29.0
Primary work unit		
Combined Medical/Surgical	279	61.7
Medicine	48	10.6
Surgery	15	3.3
Pediatrics	17	3.8
Other	72	15.9
Many different units/No specific unit	13	2.9
Years worked on current unit		
0-5	313	69.2
6-10	43	9.5
≥11	86	19.0
Hours worked per week		
≥40 (Full-time)	417	92.3
16-39 (Part-time)	25	5.5
* Numbers may not total 452 due to missing data		

Outcomes

HCWs

Needlestick injury rates

All staff (*M* = 12.54, S*D* = 24.95)

RNs (*M* = 5.35, *SD* = 5.34)

Mucotaneous exposure rates

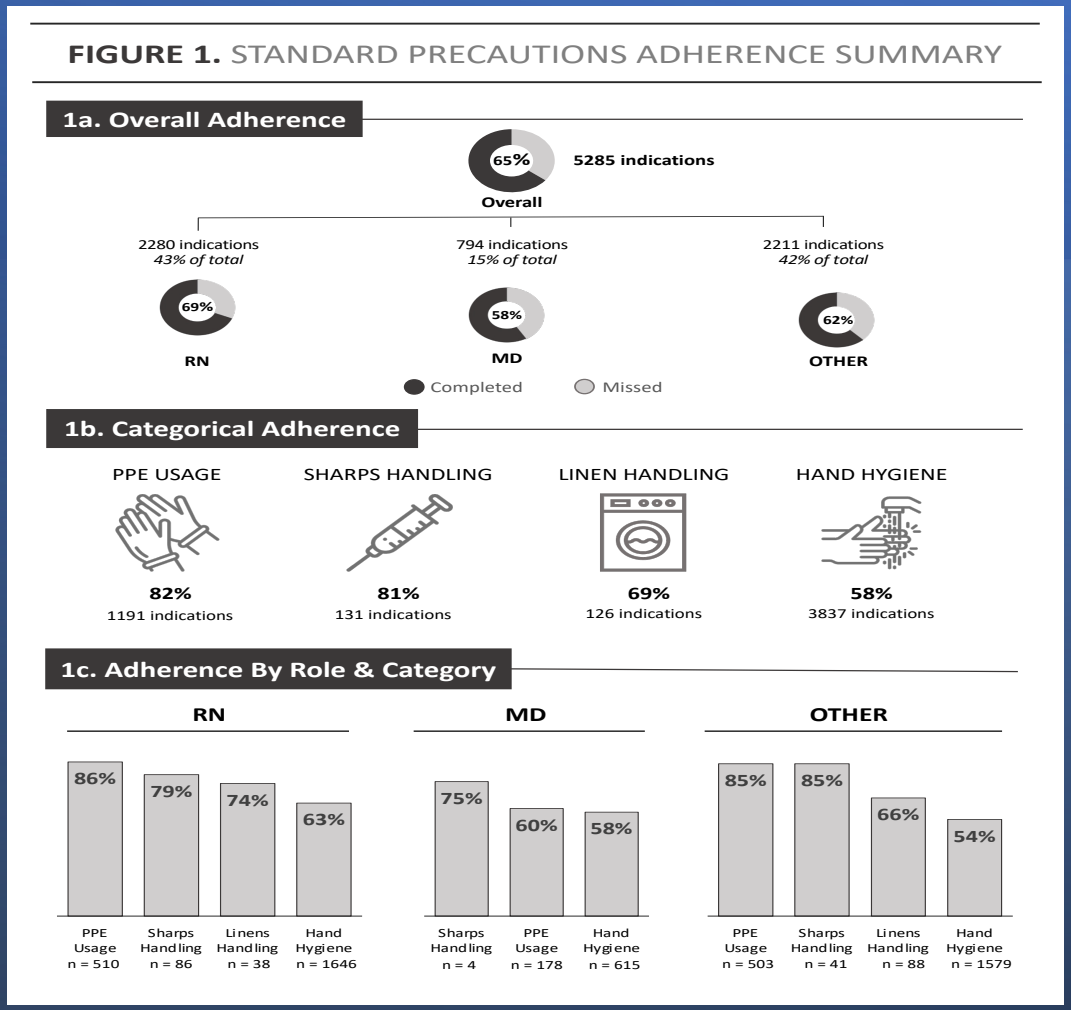
All staff (*M* = 2.30, *SD* = 5.18)

RNs (*M* = 0.77, *SD* = 1.60)

HAIs rates

CAUTI (*M* = 0.76, *SD* = 0.76)
CLABSI (*M* = 0.69, *SD* = 1.22)
MRSA (*M* = 0.04, *SD* = 0.08)

FIGURE 1. STANDARD PRECAUTIONS ADHERENCE SUMMARY



Aim 1: Relationships between PSC and SP Adherence

Table 3. Associations among Patient Safety Climate Dimensions and Reported Standard Precaution Adherence (N = 43)			
Dimension	Mean (*SD*)	r^2	*p* value
Reported Standard Precaution Practice	.96 (.04)		
Teamwork Within Units	.85 (.12)	.113	.47
Organizational Learning – Continuous Improvement	.79 (.15)	.522	<.001*
Supervisor/Manager Expectations & Actions Promoting Patient Safety	.78 (.17)	.386	.01*
Standard Precaution Environment	.77 (.12)	.435	<.001*
Feedback & Communication About Error	.74 (.18)	.504	<.001*
Frequency of Events Reported	.73 (.17)	.513	<.001*
Communication Openness	.67 (.18)	.321	.04*
Management Support for Patient Safety	.63 (.18)	.402	.01*
Teamwork Across Units	.57 (.17)	.364	.02*
Overall Perceptions of Patient Safety	.56 (.18)	.333	.03*
Nonpunitive Response to Errors	.48 (.22)	.070	.66
Handoffs & Transitions	.46 (.16)	.334	.03*
Staffing	.43 (.18)	.261	.09
Composite Safety Score	.64 (.14)	.442	<.001*
Notes: Patient safety climate measured as composite frequency scores of positive responses (rated 4 or 5). Composite safety score excludes reported adherence. * = statistically significant at *p* <.05			

Aim 2: Relationship between SP adherence and HCW or HAI outcomes

HCW Outcomes

- Observed ***sharps*** adherence was significantly correlated with all staff mucotaneous exposures (r (41) = .325, p = .03)
- Examinations of other SP categories and HCW outcomes were non-significant

HAIs

- Observed SP adherence examined by ***quartiles*** of ("bad", "poor", "good" and "excellent") was associated with MRSA (r (41) = .326, p = .03).
- ***HH*** adherence was significantly correlated with MRSA (r (41) = .306, p = .04).
- OLS regression models were non-significant

Aim 3: Relationships among PSC, SP adherence and HCW outcomes

Table 4. Multivariable Regression Models of Predictors of Unit HAIs and Occupational Exposures (N = 43)

Occupational Exposures			
Nurse needlestick/sharps injury	**Omnibus *P* = .345, R^2 = .082**		
Predictors	β Coefficient	SE	P value
Observed SP Adherence	-.103	.048	.541
Patient Safety Climate	.211	5.56	.133
Teaching Status	.240	1.83	.154
Nurse Staffing	-.000	.069	.999
Nurse mucotaneous exposures	**Omnibus *P* = .004*, R^2 = .362**		
Observed SP Adherence	-.167	.017	.401
Patient Safety Climate	-.084	1.22	.406
Magnet Designated Status	-.441	.692	.041*
Licensed Hospital Bed Size	.371	.001	.055
Teaching Status	.258	.333	.014*
All needlestick/sharps injuries	**Omnibus *P* = .001*, R^2 = .378**		
Observed SP Adherence	.266	.198	.074
Patient Safety Climate	.262	28.6	.091
Hospital Ownership	-.577	15.25	.016*
Average Daily Census	-.041	.593	.813
All mucotaneous exposures	**Omnibus *P* = .007*, R^2 = .431**		
Observed SP Adherence	.098	.032	.394
Patient Safety Climate	.217	6.31	.184
Average Daily Census	-.050	.105	.733
Hospital Ownership	-.440	2.82	.037*
Magnet Designated Hospital	-.414	1.43	.004*

Notes: * = statistically significant $p < .05$., Robust regression approach with robust standard errors (SE). standardized Beta coefficients reported. SP = standard precautions. CAUTI = Catheter-associated urinary tract infection. CLABSI = Central line-associated bloodstream infection. MRSA = Methicillin-resistant *Staphylococcus aureus.* Nurse staffing defined as occupied RN full time equivalent.

Aim 3: Relationships among PSC, SP adherence and HAI outcomes

Table 4. Multivariable Regression Models of Predictors of Unit HAIs and Occupational Exposures (N = 43)

HAI Outcomes			
CAUTI	**Omnibus *P* = .023*, R^2 = .233**		
Predictors	β Coefficient	SE	P value
Observed SP Adherence	-.120	.014	.641
Patient Safety Climate	.009	1.19	.952
Magnet Designated Hospital	.082	.336	.607
Teaching Status	.282	.314	.067
Nurse Staffing	.356	.008	.003*
CLABSI	**Omnibus *P* = .357, R^2 = .278**		
Observed SP Adherence	.097	.007	.406
Patient Safety Climate	.194	1.48	.235
Magnet Designated Hospital	-.277	.442	.121
Hospital Ownership	-.419	.812	.101
MRSA	**Omnibus *P* = .034*, R^2 = .412**		
Observed SP Adherence	.042	.000	.727
Patient Safety Climate	.077	.070	.498
Teaching Status	.201	.017	.058
Nurse Staffing	.555	.001	.030*

Notes: * = statistically significant $p < .05$., Robust regression approach with robust standard errors (SE). standardized Beta coefficients reported. SP = standard precautions. CAUTI = Catheter-associated urinary tract infection. CLABSI = Central line-associated bloodstream infection. MRSA = Methicillin-resistant *Staphylococcus aureus.* Nurse staffing defined as occupied RN full time equivalent.

Article Review Questions: Part IV Discussion

and enhanced communication skills will be essential to coalesce our care for patients and fellow HCWs, and developers of these training modalities would be well served to take into consideration role-based hierarchies and needs of educationally disadvantaged HCWs.

Third, the multivariable models identified for the first time that in combination a stronger patient safety climate, better standard precaution adherence (as measured by observation), and key hospital characteristics (such as nurse staffing, daily census, teaching status) predict key HAI and occupational health outcomes. These models explain 41% of the variance in MRSA, 23% of the variance in CAUTI, 43% of the variance in all staff mucotaneous exposures, and 38% of the variance in all staff needlestick and sharps injuries. Finally, potentially modifiable variables of nurse staffing and hospital Magnet designation explained substantial variance in the multivariable models for outcomes of MRSA, CAUTI, nurse, and all staff mucotaneous exposures

Emerging evidence has identified a relationship between nurse staffing and HAIs, including bloodstream infections, pneumonia, and urinary tract infections (with and without a catheter).[42,43] Our study confirms these findings and extends our knowledge by identifying that unit level nurse staffing predicts unit level CAUTI and MRSA rates, independent of patient safety climate and other organizational factors. Literature has also documented that Magnet facilities have better patient outcomes, including lower incidence of HAIs (CLABSI, CAUTI, and MRSA), length of stay, and mortality and reported benefits of increased nurse satisfaction and retention and decreased staff turnover.[38,44–46]

Magnet status characterizes and includes nurse participation in hospital affairs, nursing foundations for quality care; nurse manager ability; leadership; support of nurses, staffing and resource adequacy; and collegial nurse-physician relations and is measured in part through the nurse practice environment.[46] Thus, the nurse practice environment captures distinct, but similar, constructs to the dimensions of the safety climate.[46] In this study, hospital Magnet status may be considered a proxy measure for nursing practice environment.

needle stick exposures, and this was a business case assessment for small hospitals.[45]

This is the first study to our knowledge to document the impact of Magnet designation status on unit level nurse and staff mucotaneous exposure rates. While our study did not identify Magnet status as an independent predictor of HAIs, we generated new evidence of the relationship of Magnet designation and important occupational health outcomes. When these results are considered in context of extant literature, it appears both patients and HCWs benefit in terms of outcomes when seeking care or working in a Magnet designated organization.

2020 marked the 20th anniversary of the Needlestick Safety and Prevention Act. Unfortunately, our findings reveal there has been little progress in improvement, and dishearteningly, this issue has garnered little attention in occupational and health services research. Moreover, the focus of published work is largely percutaneous, not mucotaneous exposures, which is concerning as estimates suggest only 12% of mucotaneous exposures are reported.[48] Findings from this study amplify the recently published *Moving the Sharps Safety in Health care Agenda Forward in the United States: 2020 Consensus Statement and Call to Action*, which declares the risk of occupational exposure is greater today than at the time of the initial report and calls to redouble our efforts.[48]

Limitations

This is a cross-sectional study and as such, though it was possible to show significant relationships among several key variables, causality cannot be established. While our models identified important predictors and explained substantial variance in outcomes, we were limited by sample size on the number of predictors we could include, and by design did not include all possible important factors for each outcome. Despite the post-hoc power analyses findings for the multivariable models, it is possible this study was underpowered with 43 units (rather than the aim of 87) to detect additional meaningful relationships if they existed.

1. Are the interpretations consistent with the results?
2. Were the conclusions accurate and relevant to the problem the authors identified?
3. Were the authors' recommendations appropriate?
4. Are study limitations addressed?

Major Findings

Observed adherence to all categories of SP by all provider types was 65%.

Identified key and modifiable features of the *PSC* that may facilitate SP behaviors that are associated with better healthcare worker and patient outcomes.

Potentially modifiable *organizational factors* of nurse staffing and Magnet hospital status are also important explanatory variables.

A combination of a positive PSC, better SP adherence, and key hospital characteristics, predict HAI and occupational health outcomes- explaining a sizeable variance in MRSA (41%), CAUTI (23%), mucotaneous exposures (43%) and needlestick and sharps injuries (38%).

Summary

In combination, these results indicate that a stronger patient safety climate, better standard precaution adherence, and key organizational characteristics, predict key HAI and occupational health outcomes.

Limitations

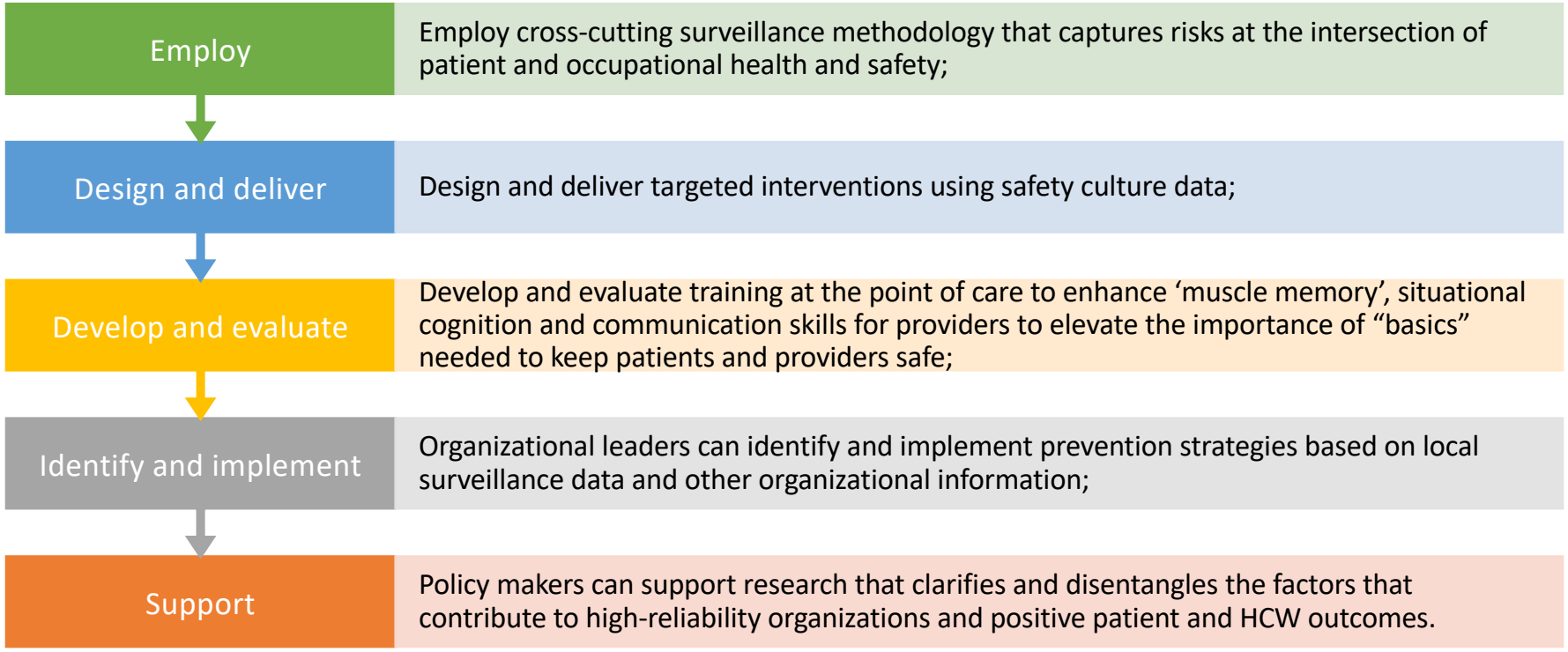
- Cross-sectional study- causality cannot be established;
- The sample size was smaller than planned and may have been too small to detect meaningful relationships if they existed;
- Because Magnet status is a journey that takes several years for organizations to attain, it may be that the longer-term, *entrenched culture* and upstream factors are more predictive of outcomes than the proximate measures of climate, such as that captured in this study;
- Survey data were only collected from nurses;
- The possibility of a Hawthorne effect exists, therefore actual adherence may be *even lower* than we report;
- Reliance on secondary data.

Article Review Questions: Part V Application

1. Should the findings and conclusions be applied in your setting? If not, what work needs to be done?

2. What resources and processes are needed to implement any proposed changes in your setting?

Translation of Findings: Implications for Practice and Policy



Next Steps….

***S**imulation to **I**mprove Infection **P**revention and **P**atient **S**afety: The SIPPS Trial*

AWARD: AGENCY FOR HEALTHCARE RESEARCH AND QUALITY (1R18HS026418)

Funding Acknowledgment: Agency for Healthcare Research and Quality (AHRQ) 1R18HS026418

Study Aims

1. Determine the effect of simulation training on RN knowledge, observed standard precaution (SP) adherence, and healthcare associated infections (HAIs) and RN blood-borne pathogen exposure rates.
2. Determine whether patient safety culture modifies the effect of training on observed SP adherence and SP knowledge.
3. Determine maximal duration (sustainability) of simulation intervention on clinical performance of SP adherence.

Approach

Design	5-year group-randomized, group-intervention trial
Survey	336 hospital unit-based RNs about patient safety culture and SP adherence on their units
Implement	SP simulation training modules over two years in “real world” clinical settings
Determine	impact of training on unit level SP adherence using observational data quarterly for four years
Evaluate	impact and sustainability of training on SP over time
Examine	relationships among safety culture, SP training, SP adherence and HAI and HCW outcomes

Discussion, Questions & Gratitude

Article review questions:

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17. Are study limitations addressed?
18. Should the findings and conclusions be applied in your setting? If not, what work needs to be done?
19. What resources and processes are needed to implement any proposed changes in your setting?

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October 17, 2024	**LONGITUDINAL GENOMIC SURVEILLANCE TO TRACK PATHWAYS LEADING TO *CLOSTRIDIODES DIFFICILE* COLONIZATION AND INFECTION IN AN ICU** Speaker: **Prof. Evan Snitkin**, University of Michigan Medical School
October 18, 2024	**CLEAN HOSPITALS DAY 2024: THE 6 TECHNICAL DOMAINS OF HEALTHCARE ENVIRONMENTAL HYGIENE** Speaker: **Prof. Didier Pittet**, University of Geneva, Switzerland
October 23, 2024	*(Australasian Teleclass)* ***CLOSTRIDIUM DIFFICILE* INFECTION – ONE HEALTH AND THE RISE IN COMMUNITY-ASSOCIATED INFECTION** Speaker: **Prof. Tom Riley**, The University of Western Australia
October 24, 2024	*(FREE Teleclass)* **WHY CERTIFY? THE VALUE OF CERTIFICATIONIN INFECTION PREVENTION AND CONTROL** Speaker: **Shazia Irum**, CBIC Ambassador, Saudi Arabia
November 7, 2024	**AN ETHICAL FRAMEWORK FOR SMART SANITATION TECHNOLOGY AS A PUBLIC HEALTH TOOL**

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