Healthcare-Acquired Infections as an Indicator of Patient Safety

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Objectives

1. Discuss the patient safety movement
2. Identify sources of threats to patient safety
3. Discuss role of institutional review boards in infection control practice and research
4. Understand the relationship between staffing patterns and HAI as well as nurse turnover in ICUs

The Patient Safety Problem and the Institute of Medicine (IOM)

- To Err is Human
  - 44,000 to 98,000 deaths per year
- Crossing the Quality Chasm
  - A blueprint on how to modify our complex healthcare delivery system
- Keeping Patients Safe-Transforming the Work Environment of Nurses
  - Outlines the contribution nurses make to patient safety and recommendations on how to improve practice

The Patient Safety Movement

Initiatives designed to prevent adverse patient outcomes resulting from errors.

- Error: Failure of planned action to be completed as intended, or use of the wrong plan to achieve an aim.
- Adverse event: Injury resulting from healthcare intervention.

Not all errors result in an adverse event and not all adverse events are a result of an error!

Determining if an Adverse Event Compromises Patient Safety

Event	Adverse Event	Prevent-able	Patient Safety Problem
Patient with ruptured appendix develops sepsis.	Yes	No	No
Patient does not receive antibiotic on time.	No	Yes	Maybe
Patient experiences a device-related HAI.	Yes	Yes	Yes
Patient dies as a result of infection.	Maybe	Maybe	Maybe

Stone, P.W. & Hughes, R. (2004). Patient Safety. In J. Fitzpatrick (Ed.) Encyclopedia of Nursing Research. Springer Publishing.

Types of Errors and Failures

- Sentinel Event: Adverse event that results in death or serious injury.
- Near Miss: Process variation that did not affect outcome, but for which recurrence carries risk of serious adverse outcome.
- Active Failures (sharp end): Unsafe acts committed by individuals (nurses and doctors).
- Latent Failures (blunt end): Failures that arise from fallible decisions made by people indirectly involved (managers and leaders).

JACHO

- 2004 National Patient Safety Goals (seven goals in all)
  - Reduce the risk of health care-associated infections (HAI)
    - Comply with current CDC hand hygiene guidelines
    - Manage as sentinel events all identified cases of unanticipated death of major permanent loss of function associated with HAI

AHRQ's Patient Safety Indictors (PSI)

- Focus on adverse events following surgery, procedures and childbirth
- Developed after
  - Comprehensive literature review
  - Analysis of ICD-9-CM codes
  - Review by clinician panel
  - Implementation of risk adjustment
  - Empirical analysis
- Software available for download

http://www.qualityindicators.ahrq.gov/data/hcup/psi.htm

Patient Safety Indictors (PSI)

- Hospital-level
  - 20 PSI (e.g., accidental punctures, birth trauma, post-operative sepsis, selected infections)
    - 4 have been identified as "staffing sensitive"
      - Decubitus ulcers
      - Failure to rescue
      - Post-op DVT
      - Post-op respiratory failure

Infection Control and Patient Safety

- Strengths Brought to the Patient Safety Team
  - Surveillance techniques
  - Standardized definitions

Identify Sources of Threats to Patient Safety

- *Leadership and Management*
- *Workforce*
- *Work Process*
- *Organizational Culture*

Organizational-Safety Culture

- …an integrated pattern of individual and organizational behavior, based upon shared beliefs and values, that continuously seeks to minimize patient harm which may result from the processes of care delivery*
- Specify short- and long-term safety objectives
- Continuous review and feedback on success or failure at meeting these objectives
- Training and rewards workers for safety

* **(Kizer, KW. 1999. Large system change and a culture of safety. *Enhancing Patient Safety and Reducing Errors in Health Care*. Chicago, IL: National Patient Safety Fnd.)**

Safety Culture – Organizational Elements

- Environmental structures and processes within the organization
- Attitudes and perceptions of workers
- The safety-related behaviors of individuals

Work Process

- Work processes and workspaces need to be designed to make them
  - More efficient
  - Less conducive to the commission of errors
  - More amenable to detecting and remedying errors
- Effects of fatigue
  - Slow reaction time
  - Lapses of attention to detail
  - Errors of omission
  - Compromised problem solving
  - Reduced motivation and energy

Work Process

- Design work area and processes to reduce errors associated with:
  - Surveillance of patient health status
  - Transfers and hand-offs
  - Complex care processes
  - Non-value added activities…locating and obtaining supplies, looking for others (MDs, etc.), redundant documentation, poor communication systems
- First areas to address: Medication administration and HAND HYGIENE

Design of Work Area

- Should reflect an understanding of human factors – memory, fatigue, ergonomics
- Should be standardized
- Should facilitate immediate access to information
- Should be created with the most vulnerable patients (and staff) in mind
- Must have the capability for change

* Adapted from St Joseph's Community Hospital of West Bend, WI 2003

Leadership and Management

- Provide ongoing vigilance in balancing efficiency and patient safety
- Demonstrate and promote trust in and by staff
- Engage staff in non-heirarchical decision making and work design
- Establish the organization as a "learning organization"

Workforce - Job Redesign

JOB REDESIGN AND PERFORMANCE – POSSIBLE PATHWAYS

- Job redesign leads to improved job perceptions and job satisfaction, which in turn many positively influence intrinsic motivation.
- Job redesign may lead to increased extrinsic motivation because of pay rises or improved promotion prospects. Workers who are extrinsically motivated are more likely to perform more and better.
- Performance may improve if workers perceive closer links between effort, performance and valued rewards [expectancy theory].
- Job redesign may be accompanied by goal setting: employees either set themselves new performance targets or management sets new performance targets. There is lots of evidence that goal setting is a powerful motivator, in particular under specific conditions (e.g., difficult goals).
- Redesigning a job one discovers structural inefficiencies such as inadequate access to equipment. These inefficiencies may be overcome by work methods improvements that are part of the job redesign.

Institutional Review Boards

Protecting Patient Safety?

Extent of Human Research

- In 2000, there were an estimated 12 million persons participating in federally-funded research alone, with millions more participating in other studies
- Office of Human Research Protection is responsible for monitoring compliance of >30,000 NIH-funded studies

When is QA Research?

- Whenever you plan to publish or disseminate results beyond your setting
- When patients are in any way identifiable
- When results are generalizable beyond your setting

Three Basic Ethical Principles of Research

- Beneficence
  - Do no harm
  - Risk/benefit ratio in favor or research
- Respect for persons
  - Maintain confidentiality
  - Voluntary participation
  - Informed consent
- Justice
  - Equal opportunity

Role of Institutional Review Board (IRB)

- Protect patient safety
- Assure that benefits (to individual and/or society) outweigh risks
- Prevent coercion to participate
- Assure voluntary and informed consent

When Does the ICP Need the IRB?

- Fine line between quality monitoring, ongoing surveillance, and research
- If you are planning to publish your findings
- If the data collection is not solely for patient care

Levels of Approval

- Exempt
  - Projects related to educational tests, using data already collected which is deidentified, observations of public behavior, consumer acceptance studies, survey and interview procedures
  - Decision is made by IRB—still must submit

Levels of Approval

- Expedited
  - E.g. Collecting data by non-invasive means, focus groups, minor changes in previously approved studies

Levels of Approval

- Full Board review
  - Any study with a therapeutic or pharmaceutical intervention

Comparison of IRB Procedures

- 68 U.S. hospitals
- Multi-center project to examine the relationship between organizational climate, staffing and healthcare-associated infections
- IRB application submitted to each hospital

Hospital Characteristics

- About 60% from East Coast
- Mean bed size=465 (77 2112)
- 13% associated with academic health centers

Variations in IRB Review

- Mean number of pages for the application was 5.24 (1-31)
- 1-8 copies were requested
- About one-third required PI on site
- About one-fourth required human subjects research training
- Only 10% requested conflict of interest information
- Two hospitals had no IRB

Approval Process

- Mean time to approval: 45.4 days (range: 1-303 days)
- About 20% were considered exempt, 60% expedited and 17% full review
- Expedited review took significantly longer than full review (55 vs 47 days, p=0.03)

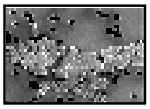
Discussion

- There is little standardization of the review process
- One must question whether the goal of protecting research participants can be met in an effective and efficient manner under these circumstances
- We could find no data demonstrating that increased surveillance by IRBs has had any impact on patient safety or on the risk of adverse events

Implications for ICPs

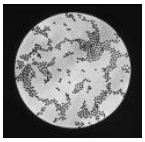
- There will be increased scrutiny of 'routine' surveillance and data collection activities
- You need to know the IRB process in your facility
- Consider how you can add to the body of generalizable infection control knowledge with your own work

Nurse Staffing and Healthcare-Associated Infections


Literature

- Bloodstream infection (BSI)
- Pneumonia
- Urinary tract infection (UTI)
- Gastrointestinal infection
- Outbreaks
  - MRSA
  - *E. cloacae*
  - *S. marcescens*



"Float" Nurses and BSI

Detailed ICU Surveillance (DISC) Study:

- 8 ICUs in 6 hospitals
- December 1997 – November 1998
- ICPs and NNIS definition

Results:

- Increased risk of BSI with CVC care by a float nurse (p=.0019)

Alonso-Eschanove J, et al. Effect of nurse staffing and antimicrobial-impregnated central venous catheters on the risk for bloodstream infections in intensive care units. Infection Control and Hospital Epidemiology. 2003; 24: 916-925.

"Pooled" Nurses and BSI

Case control study:

- 20 bed SICU in a 1000 bed hospital
- June 1994 – June 1995
- 28 patients and 99 controls
- ICPs and NNIS definition

Results:

- BSIs increased with care by pooled nurses (p=.004)

Robert J et al. The influence of the composition of the nursing staff on primary bloodstream infection rates in a surgical intensive care unit. Infection Control and Hospital Epidemiology. 2000; 21:12-17.

"Patient-to-Nurse Ratio" and BSI

Case control and cohort studies:

- SICU and non-SICU
- January 1992 – September 1993
- NNIS definition

Results:

- Patient-to-nurse ratio higher during outbreak (p<.01)
- SICU CVC-BSI correlated with patient-to-nurse ratio (p<.01)

Fridkin SK et al. The role of understaffing in central venous cather-associated bloodstream infections. Infection Control and Hospital Epidemiology. 1996; 17: 150-158.

"RN Hours" and Pneumonia

Cross sectional study:

- National Inpatient Sample (NIS) 1990 1996
- Staffing data AHA survey 1990 1996
- ICD 9codes

Results:

- Inverse relationship between RN hours per adjusted patient day and pneumonia (p<.05)

Kovner C. et al. Nurse staffing and postsurgical adverse events: an analysis of administrative data from a sample of U.S. hospitals, 1990-1996. Health Services Research; 37: 611-629.

"Nurse-to-Patient Ratio" and Pneumonia

Statewide cohort study:

- Maryland Health Service Cost Review Commission data 1994 1998
- Primary diagnosis esophageal resection
- ICD 9codes

Results:

- Patients with NPR <1:2 had increased risk of pneumonia (OR 2.4; p=.012)

Amaravadi RK et al. ICU nurse-to-patient ratio associated with complications and resource use after esophagectomy. Intensive Care Medicine. 2000; 26:1857-1862.

Pneumonia & UTI

Cross-sectional study:

- 589 hospitals in 10 States
- Discharge data 1993
- Staffing data AHA

Results:

- Inverse relationship between fulltime RNs and pneumonia (p<.001) and UTI (p<.0001)

Kover C, Gergen PJ. Nurse staffing levels and adverse events following surgery in U.S. hospitals. Image: Journal of Nursing Scholarship. 1998; 30:315-321.

"Proportion of RN Hours" Pneumonia and UTI

Cross sectional study:

- 799 hospitals in 11 States
- Administrative discharge data 1997
- Estimated nurse staffing data 1997

Results:

- Higher proportion RN hours lower rates UTI (p<.001) and pneumonia (p=.001) (medical)
- Higher proportion RN hours lower rates UTI (p<.04) (surgical)

Needleman J et al. Nurse-staffing levels and the quality of care in hospitals. The New England Journal of Medicine. 2002;346:1715-1722.

"RN Skill Mix" Pneumonia & UTI

ANA Report Card:
- CA and NY- 502 hospitals
- Administrative discharge data
- Nurse staffing data

Results:
- Low RN skill mix associated with pneumonia and UTI (p<.05)

Knauf RA. et al. Implementing Nursing's Report Card: A Study of RN staffing, Length of Stay and Patient Outcomes. 1997. Washington, DC: American Nurses Association.

"RN Skill Mix" Pneumonia & UTI

ANA Report Card II:
- 1575 hospitals
- Administrative discharge data
- Nurse staffing data

Results:
- Low RN skill mix associated with pneumonia and UTI (p<.005)

Lichtig LK. et al. Nurse Staffing and Patient Outcomes in the Inpatient Hospital Setting. 2000. Washington, DC: American Nurses Association.

"Patient-to-Nurse Ratio" and Gastrointestinal Infections

Retrospective study:
- 44 bed general pediatric unit
- December 1997 - March 1999

Results:
- Correlation between rate of infection and patient to nurse ratio day (p<.05), night (p<.05) and census (p<.05)

Stegenga J. et al. The role of nurse staffing in nosocomial viral gastrointestinal infections on a general pediatrics ward. Infection Control and Hospital Epidemiology. 2002; 23:133-136.

"Nurse-to-Patient Ratio"and Outbreak of *S. marcescens*

Retrospective study:
- Pediatric cardiac ICU
- December 1994-December 1995
- NNIS definition

Results:
- Inverse correlation between infection rate and ratio of nursing hrs/patient day (p=.003)

Archibald LK. et al. Patient density, nurse-to-patient ratio and nosocomial infection risk in a pediatric cardiac intensive care unit. Pediatric Infectious Disease Journal. 1997;16:1045-1048.

"Understaffing" and Outbreak of *Enterobacter cloacae*

Retrospective cohort study:
- Neonatal ICU
- 60 infants
- December 1996 – January 1997

Results:
- Hand hygiene noncompliance (37% pt contact) and (75% IV contact)
- Census exceeded by 15 infants
- Only 20 staff worked; 35 required (RR 5.97)

Harbarth S. et al. Outbreak of Enterbacter cloacae related to understaffing, overcrowding, and poor hand hygiene practices. Infection Control and Hospital Epidemiology. 1999;20:598-603.

"Extra" Staff and Outbreak of MRSA

Retrospective cohort study:
- 36 bed neonatal ICU
- May – June 1999

Results:
- Before/during outbreak only 50% fulltime RNs
- 42% RNs relatively untrained
- 6 - 8mo prior "extras"- 26% day, 40% evening, 34% night and 62% weekends.

Anderson BM. et al. Spread of methicillin-resistant *Staphylococcus aureus* in a neonatal intensive care unit associated with understaffing, overcrowding, and mixing of patients. Journal of Hospital Infection. 2002;50:18-24

"Nurse:Patient Ratios" and MRSA

Retrospective study:

- Adult intensive therapy unit – 50 cases
- 19 month data collection
  - Nurse:patient, staff:patient, staffing level, peak and trough levels, staffing surplus

Results:

- Correlation between MRSA and ratios of staff:patient, peak staff:patient, trough staff:patient, nurse:patient (p<.001)

Vicca AF. Nursing staff workload as a determinant of methicillin-resistant *Staphylococcus aureus* spread in an adult intensive therapy unit. Journal of Hospital infection. 1999;43:109-113.

Nurse Staffing Research

Strengths:

- Replication of findings
- Body of knowledge

Nurse Staffing Research

Weaknesses:

- Study design
  - Few prospective
- Large data sets
  - Potential for error
- Definitions of nurse staffing
  - Vary across studies

Nurse staffing & healthcare-associated infections: NICU

- All nursing staff providing patient care
  - RNs, care technicians, floats and temporary staff
- All neonates admitted to NICU

Outcome Variables

- Time to first infection…
  - Any healthcare associated infection
  - Bloodstream infection
  - Conjunctivitis
- Length of stay…
  - Day of admission to day of discharge (+1day)

Predictor Variables

- Birthweight
  - four categories
- Major surgery
  - yes or no
- Hand hygiene product
  - alcohol or CHG
- Site
  - NICU A or NICU B

Nurse Staffing Variables

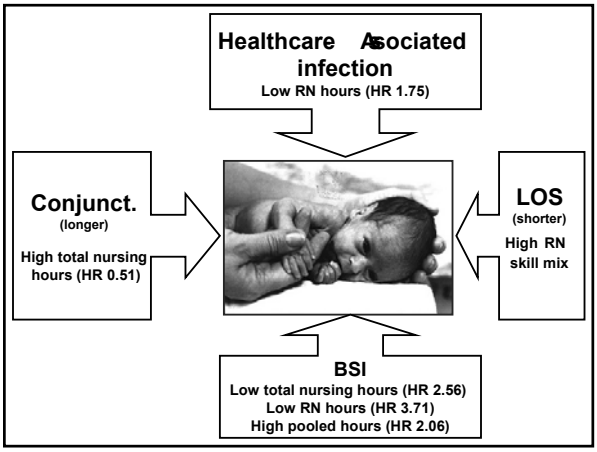
- Total nursing hours
  - all staff provide direct nursing care
- RN hours
  - Registered nurse hours
- Pooled hours
  - Float and agency nurses
- RN skill mix
  - Proportion of RNs

Case Mix Adjustment

- All-Patient DRGs
- New York grouper
  - 3M DRG Finder software
- Nursing Intensity Weights (NIW)
  - allocation statistic
  - NYS
  - Nursing hours/daily NIW

Nurse Staffing

- 3,155 neonates admitted
- Final sample 2,675 (< 48 hrs excluded)
- 374 neonates with infection
- 114 with more than one infection



Outcomes of ICU Working Conditions: Turnover of Critical Care Nurses

Investigators: Pat Stone, Andy Dick
Teresa Horan, Elaine Larson, Cathy Mooney-Kane
Jack Zwanziger
Graduate Research Assistants: Diane Pastor, Jeannie Cimiotti

Funded by AHRQ (RO1 HS 133114-0)
Supported by the CDC

Working Conditions and Patient Safety

- Growing concern that poor working conditions in the health care sector is contributing to decreasing patient safety (IOM, 2004).
- An acute nursing shortage that will not be as cyclic as past shortages due to
  - Aging workforce
  - Aging population and increased demand for nursing services
  - Poor working conditions resulting in difficulty recruiting and retaining qualified nursing personnel

Purpose

Examine the factors related to behavioral intention to leave of critical care RNs:

- Nurse characteristics
- Hospital characteristics
- Perceptions of organizational climate

Design

- Cross sectional analysis
- RNs employed in the ICU participating in larger study were surveyed
  - Anonymous survey identifiable to ICU where distributed
- Survey results linked with AHA data

Survey Measures

- Organizational climate
  - Based on Nursing Work Index-Revised (Aiken)
    - 42 items
    - 1-4 Likert scale
    - Strongly agree to strongly disagree
- Demographic questions
  - 8 items including gender, age, education and experience
- Behavioral intention to leave
  - 1 item, "Do you intend to leave your position in the coming year?"
  - If yes, why?

Results

- 2,330 respondents (41% response rate)
- 68 hospitals
- 109 ICUs

Nurse Demographics

	n	percent*
Gender		
Female	2086	89.5
Male	234	10.0
Education		
ASN/Diploma	963	41.3
BSN or higher	1341	57.6
Employment Status		
Full-time	1797	77.1
Part-time	339	14.5
Float	173	7.4

* Percents do not equal 100 due to missing data

Nurse Demographics

	Mean (yrs)	Standard Deviation
Age	39.5	9.8
Healthcare Exp	15.7	9.3
ICU Experience	10.3	8.4
Tenure on unit	8.0	7.5

Hospitals Characteristics

	N	Percent
Region		
Atlantic	872	37.5
Central	727	31.3
Pacific	514	22.1
Bed size		
≤ 299	444	19.1
300-399	541	23.3
≥ 400	1128	48.5

Intention to Leave

- Positive intention: 17% (n=391)
  - 72% (n=202) reported due to negative working conditions

Intention to Leave Due To Negative Working Conditions

- No difference in intention related to
  - nursing demographics or
  - hospital characteristics

Organizational Climate Factors
and Intention to Leave
Due to Negative Working Conditions

Factor	Odds Ratio	(95% CI)
Participatory governance	0.54*	(.41, .72)
Supervisor	0.74*	(.55, .98)
Adequate staffing/resources	1.10	(.83, 1.5)
Professional practice	0.80	(.53, 1.2)
Collaboration	1.23	(.91, 1.7)
Training	0.63*	(.46, .85)
Scheduling	4.71	(.65, 1.1)

*ratios statistically significant with p<0.05

Summary

- Behavioral intention to leave of critical care RNs across the nation is great
- Negative perceptions of organizational climate impact this phenomenon
- Perception of participation in governance, positive leadership skills of supervisors, and support for RN training are independent factors

Discussion

- Turnover of 1 RN is estimated to cost $30,000 to $50,000
  - Critical care RN turnover is among the highest cost

Implications

Investing in

RN training
Nurse supervisor training
Increasing RN participation in governance

may decrease turnover, improve patient safety and reduce health care costs

Limitations

- Intention to leave as measure of turnover
- Variation in nurse labor markets
  - Nursing shortage
  - Mobility of nurses
- No information on non-responders

Infection Control Implications

- Demonstrates the importance of surveillance data to inform not only infection control policies, but also other important hospital and nursing issues!

Predictors of HAIs

Variable	Coefficient	p value
Gender	0.15	0.005
Age (75 to 79 vs. to 65-74)	0.14	0.003
Hx Cancer	-0.29	0.005
Hx GI	0.46	<0.001
Hx Cardiac Arrest	0.31	0.001
Hx CV	0.25	0.010
Hx Paralysis	0.62	0.010
Hx Transplant	0.51	0.013
ICU type (CV vs Med/Surg)	-035	<0.001
SES1	0.0002	0.008
SES 2	9.06	<0.0001
Proportion of RN overtime	**2.34**	**0.033**
Mean organizational climate	**-0.72**	**0.012**

Summary

- The more positive the organizational climate, the less likely the patient will acquire a HAI
- The higher the proportion of overtime, the more likely the patient will acquire a HAI

Final Thoughts

- HAIs are a major patient safety problem
- More can be done at the organizational and unit level to help prevent HAIs
  - Assure appropriate staffing
  - Provide opportunity for staff input into governance
  - Good surveillance of outcomes
- Infection control staff MUST work with other components of the organization