Opening the Black Box: Understanding Organizational Influences on Clinical Judgment in Hospital Nursing Care

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My Background

• CCU nurse, trained as cardiology nurse practitioner
• PhD from McGill University in psychosocial aspects of cardiac disease
• Postdoc in nursing outcomes research at Penn 1999-2001: transitioned to research on organizational aspects of hospital safety and quality of care
• Was on nursing faculty and Associate Director of Center for Health Outcomes and Policy Research at U/Pennsylvania for 7 years
• Recruited to University of Toronto to hold cardiovascular nursing research chair and joint appointment between UHN and the Bloomberg Faculty in 2008
Outcomes Research

• The study of context (patient, providers, community, health care system) in relation to the endpoints of clinical care

• Goal is to provide data for improving care quality. Intended audiences:
  – Clinicians
  – Managers/Administrators/Executives
  – Policymakers
  – Other stakeholders
Nursing Care

• More to the work than meets the eye
• Independent clinical judgment but also implementation of interdisciplinary care plan (important dependent and interdependent domains)
• Complex organizational contexts
  – Services delivered 24/7/365 and range of activities covered is broad
    • Large teams with workers at several fundamentally different educations/outlooks
  – Interdisciplinary teamwork was always important—only becoming more so with time
• Acute care is increasingly complex, pressured and potentially dangerous—one of nurses’ major roles is to mitigate risks
Professional Practice Environments, Nurse Staffing, and Outcomes

Nurse Practice Environments
- Resource adequacy
- Support from administrators
- Nurse-physician relations

Hospital Leadership

Nurse Staffing
- RN:patient ratios
- Staffing skill mix

Nurse job outcomes

Process of care, including surveillance/early detection of complications

Patient outcomes
**Simplified Framework**

- **Leadership Decisions**
- **Human Resources and the Practice Environment**
  - **Human resources** = Staffing levels and qualifications of health care workers
  - **Practice environment** = Support from managers, availability of resources for care, interdisciplinary relations, models of care etc.
- **Frontline Care**
- **Patient Outcomes**
Center for Health Outcomes and Policy Research, University of Pennsylvania

• Multidisciplinary team—heavy representation from nursing and sociology, but also medicine, economics, etc. and extensive international collaboration
• 4 full-time standing faculty, 2.5 research track FTE faculty members, 2 programmer/analysts, 2 administrative staff, 4 funded PhD students, 3 funded postdoctoral slots
• Some “classic” workforce research—e.g. studies of supply/demand, nurse migration; other health services research work: disparities, vulnerable populations, intervention research
• Continuous U.S. federal program and infrastructure funding since early 1990s, foundation and some private sector funding
• Primary focus: Organizational determinants of acute care hospital quality—studies at the hospital level
Major Lines of Scholarship 2000-2008

• Nurse staffing in relation to adult inpatient care outcomes in broad populations
  – Data-based papers based on U.S. and international data
  – Reviews and methodological commentaries

• Influences of practice environment characteristics beyond staffing on outcomes in patients and nurses in acute care
  – Papers based on U.S. and international data
  – Methodological commentaries

• Study of a “microevent” in clinical care and its organizational correlates: Nurse needlestick injuries
Main Research Strategies

• Analysis of large administrative datasets (especially discharge abstract databases)
• Anonymous staff surveys as a window into organizational conditions
Hospital Nurse Staffing and Patient Mortality, Nurse Burnout, and Job Satisfaction

Linda H. Aiken, PhD, RN
Sean P. Clarke, PhD, RN
Douglas M. Sloane, PhD
Julie Sochalski, PhD, RN
Jeffrey H. Silber, MD, PhD

Principal funding source: NINR, NIH
Patient Selection Criteria

- between the ages of 20 and 85
- underwent general surgical, orthopedic, or vascular procedures
- hospitalized between April 1, 1998 to November 30, 1999 in Pennsylvania in an adult general hospital
168 PA Hospitals (1999): Average Patient Load Carried By Nurses on Last Shift Worked

- 4 or less: 12%
- 5: 39%
- 6: 24%
- 7: 17%
- 8 or more: 8%
Outcomes in 232,342 Surgical Patients Treated Over 18 Months at These Hospitals

- 4,535 (2.0%) died within 30 days of admission
- 53,813 (23.2 %) were observed to experience a major complication
- the death rate among complicated patients (failure to rescue rate) was 8.4%
Effect of Nurse Staffing on Mortality

- For every one patient-per-nurse increase in average nursing workload in a Pennsylvania hospital: 14% increase in risk of death within 30 days for individual patients
- After controlling all hospital and patient variables: 7% increase in risk of death
Education Levels of Hospital Nurses and Patient Mortality

• Aiken, Clarke, Cheung, Sloane, & Silber (September 24, 2003, Journal of the American Medical Association)

• The proportion of hospital RNs holding baccalaureate degrees as their highest credentials in nursing ranged from 0 to 77% across the hospitals
### Odds Ratios for Patient Mortality (Fully-Adjusted Model)

<table>
<thead>
<tr>
<th>Factor</th>
<th>Odds Ratio (95% CI)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nurse education (10% increase in BSN+)</td>
<td>0.95 (0.91-0.99)</td>
<td>0.008</td>
</tr>
<tr>
<td>Nurse workload/staffing (1 pt per nurse increase)</td>
<td>1.06 (1.01-1.10)</td>
<td>0.02</td>
</tr>
<tr>
<td>Nurse experience (per 1 year increase)</td>
<td>1.00 (0.98-1.02)</td>
<td>0.86</td>
</tr>
<tr>
<td>Board-certified surgeon</td>
<td>0.85 (0.73-0.99)</td>
<td>0.03</td>
</tr>
</tbody>
</table>
Some Early Steps in Breaking Into the “Black Box” of Process of Care as Affected by Organizational Issues

Needlesticks
Failure to rescue
The volume-outcomes relationship
Process of care measures
Why study percutaneous injuries with used sharps (needlesticks)?

• Epidemiological significance as an occupational health issue in health care
• Indicative of “cut corners” (injured worker and others), safety climate, resources
• Less prone to certain some problems in measuring adverse outcomes (sensitive events, reporting issues)
  – involve the nurse herself/himself
  – readily identified, memorable
• A proxy for a wider range of safety issues in hospitals?
Needlestick Papers


The Findings

- Steep decline in sharps injury risk in medical-surgical nurses from 1991 (0.8 injuries/FTE/year) to 1999 (0.15 injuries/FTE/year) and beyond (coincident with U.S. state and federal regulations mandating use of safety engineered equipment)
- Staffing and work environment conditions (such as support from frontline managers) very strongly related to sharps injury risk in initial studies, less dramatic in later work (environment still important)
- Experience, clinical specialty important determinants of risk
Clarke, PI. Risk factors and incidence of sharps injuries to nurses. National Institute of Occupational Safety and Health, Centers for Disease Prevention and Control, R01-OH008996, 2007-2010. $669,000

- Incidence rates of sharps injuries and use of engineered devices in acute care hospital nurses replicated in a 3 state survey and expanded from prior work to include:
  - Specialty, children’s hospitals
  - Nursing homes
  - Home health care
  - Practical nurses in NJ
  - Advanced practice nurses

  Anonymous surveys as a complement to other databases

- Organizational correlates of hospital nurse injury rates (practice environment, staffing, safety climate) in ~600 hospitals in CA, PA, NJ
Failure to Rescue

• Adverse patient outcomes related to
  – an inability to recognize reversible problems and/or
  – mount effective responses to clinical issues early enough to prevent harm
Failure to Rescue

• Mortality in patients with complications
  – With proper risk adjustment, hypothesized to reflect human and material resources for rescue
  – One of the concepts driving the Rapid Response Team/Medical Emergency Team movement
  – Tends to be lower in teaching hospitals, hospitals with higher RN staffing levels, higher RN education profiles
  – Mechanisms remain a matter of conjecture
**Assessment**
Patient condition and potential for complications (frequency and risk)

**Plan**
Assessment parameters and frequency of assessments

**Implementation**
Surveillance and interpretation of cues

**Intervention**

- Yes
- No

**Abnormalities: Correction needed?**

- Regular review
  - With passage of time
  - Change of settings
  - Handover, etc.
Abnormal assessment findings needing correction

Establish immediate priorities

Immediate actions

Inform other clinicians

Collaborative actions

Problem resolved?

Yes

Reestablish surveillance with new data

No
Questions to Consider: Organization of Care Factors that Facilitate Rescue?

- Basic staff competencies (surveillance, management of emergencies)
- Staffing levels (capacity to titrate surveillance up)
- Experience
- Communication issues
- Physical layout
- “Off-service” patients [off the beaten path for a particular unit or facility]
- Culture of practice
- Policies and procedures providing guidance for monitoring, especially for new staff/uncommon clinical problems
- Resources for rescue (RRT/CCOT?)
Volume-Outcomes Relationship

• Much research shows that at least in some places/times, outcomes for patients tend to be better with providers seeing higher volumes of surgeries, procedures and diagnoses
• Mechanisms unclear—common wisdom holds that “practice makes perfect”
• Major health policy implications
• Nursing factors almost absent from this research and these discussions
- Are there low-volume high-quality providers for some/all conditions? What do nursing services look like in these facilities?
How Nursing Affects the Volume-Outcomes Relationship (R01 NR04513)

• Beginning with 30-some procedures/conditions for which the literature suggested a volume-outcomes relationship we selected those that could be analyzed in 1998-1999 in PA:
  – Enough cases (and deaths)
  – Enough hospitals (and variability among hospitals)
  – Enough variability accounted for by risk adjustment (ability to control for major clinical risk factors with variables on hand to allow fair comparisons about hospitals)
## Effects of Nursing Factors and Volume (Physician and Hospital) on Mortality in the Tracers

* (Models Controlling for Patient and Hospital Characteristics)

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Staffing</th>
<th>Education</th>
<th>Env’t</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>AA surgery</td>
<td>X</td>
<td></td>
<td></td>
<td>X (P,H)</td>
</tr>
<tr>
<td>CEA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cholecystectomy</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X (H)</td>
</tr>
<tr>
<td>Colorectal resection</td>
<td>(X)</td>
<td>X</td>
<td>(X)</td>
<td>X (H)</td>
</tr>
<tr>
<td>Hip fracture repair</td>
<td></td>
<td>X</td>
<td></td>
<td>X (P)</td>
</tr>
<tr>
<td>Hip replacement</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Lower extremity bypass</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PTCA</td>
<td></td>
<td>X</td>
<td></td>
<td>X (P,H)</td>
</tr>
<tr>
<td>AMI</td>
<td></td>
<td></td>
<td>X</td>
<td>X (P,H)</td>
</tr>
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</table>

(X) Effect disappears after control for volume
Some Thoughts on These Findings

• Methodological artifacts?
• Volume explains the effect of staffing and environment (but not education) on mortality in colorectal resection—the only tracer where this seems to be the case
• No volume effect for CEA, cholecystectomy, THR, LE bypass (effect of volume formerly observed now diminished—diffusion of best practices?)
• Cholecystectomy, hip replacement, and lower extremity bypass show interesting effects of nursing factors (prevention/management of complications?)
• Otherwise, nursing factors and volume appear to have additive/independent effects in accounting for mortality in various tracers (i.e. in a perfect world would want high levels of all)
Aims—RWJF INQRI Grant

- Approximately 600 non-federal, acute care general hospitals in PA, CA, and NJ
- Linkages between HospitalCompare (CMS), nurse survey and patient outcomes (discharge abstract) datasets
- Analyses of 2005 and 2006 data
- Question 1: Do nursing factors (staffing and organization) account for performance on process measures?
- Question 2: Do process measures account for impacts of nurse staffing and organization on clinical outcomes?
Practice Environments, Staffing, and Hospital Outcomes

**Leadership decisions**
- Practice Environments
  - Resource adequacy
  - Unit-level environment
  - Hospital-wide environment
  - Professional practice foundations (education, QA, etc.)
  - Nurse-physician relations
  - Safety culture

**Staffing**
- Ratios
- Skill mix
- Educational composition of staff

**Process of care**
- Implementation of protocols and evidence-based practices

**Patient outcomes**
- Failure to rescue (FTR)
- Falls, pressure ulcers, nosocomial infections
- Condition-specific mortality and FTR

**Structure/Context**
**Process**
**Outcomes**
Design Features

• 2005-2006 data linkages
  – Staff surveys—aggregated to the hospital level
  – HospitalCompare (CMS) process measures
  – State hospital discharge abstracts
  – AHA Annual Survey and State DOH databases

• 552 hospitals total
  – 323 in CA
  – 73 in NJ
  – 156 in PA
  – Patient discharge samples from ~200K (AMI) to ~2M (surgery groups)
NWI-PES: Nursing Foundations for Quality of Care

• An active quality assurance program.
• A preceptor program for newly hired RNs.
• Nursing care is based on a nursing, rather than a medical, model.
• Patient care assignments that foster continuity of care
• A clear philosophy of nursing that pervades the patient care environment.
• High standards of nursing care are expected by the administration.
• Active inservice/continuing education programs for nurses.
• Working with nurses who are clinically competent.

Here: Hospital mean 2.9 (SD 0.3), range 1.4-3.7, upper quartile cut 3.1
Nursing Participation in Hospital Affairs Items

- Staff nurses are involved in the internal governance of the hospital.
- Opportunity for staff nurses to participate in policy decisions.
- Many opportunities for advancement of nursing personnel.
- An administration who listens to and responds to employee concerns.
- A chief nursing officer highly visible and accessible to staff.
- Career development/clinical ladder opportunity.
- Nursing administrators consult with staff on daily problems and procedures.
- Staff nurses have the opportunity to serve on hospital and nursing department committees.
- A chief nursing executive equal in power and authority to other top level hospital executives.

Here: Hospital mean 2.5 (SD 0.3), range 1.0-3.7, upper quartile cut: 2.7
Licensed Practical Nurses

• 0.16 LPNs/RN is mean mix
• Upper quartile cut off: 0.21
  – i.e. approximately 1 LPN for every 5 RNs
Performance on Individual MI Quality Measures: Lowest Quartile of Foundation Scores (Red) vs. All Others (Blue)
Performance on Individual MI Quality Measures: Highest Quartile of LPN Use (Red)
Score comparisons

• Disease specific process measures “rolled up” (averaged together)
  – Quartile cut-offs for AMI grades: under 76, 76-82, 83-89, 89-100

• High tech (open heart and/or solid organ transplant) vs. low tech hospitals: 83 vs. 81%

• Number of Beds: 6-105, 106-183, 184-300, 301+: 80 vs. 83%
Overall AMI Performance—By Levels of NWI-PES Foundations
Overall Performance—By Levels of NWI-PES Hospital Affairs
Overall Performance—By Levels of LPN Use

- LOW: 83%
- AMI: 84%
- HIGH: 79%
Overall ...

• Associations of Foundations, Affairs, and LPN staffing with overall disease-specific performance
  – robust to controls for size, high-tech status, teaching status, and state

• No associations observed between RN staffing, RN certification, BSN education of RNs, and the other practice environment subscales and specific quality indicators or summary performance scores
Organizational Variables and Mortality

• AMI Mortality
  – Foundations—unadjusted mortality: a 1-point increase (range: 2.3, SD 0.3) associated with 19% decrease in inpatient AMI mortality (p=.02)
  – Affairs—a 1-point increase (range: 2.7, SD 0.3) associated with a 16% decrease in AMI mortality (p=.01)
  – Both associations robust to controls for patient and hospital characteristics and for clustering of observations at the hospital level
Unadjusted MI Mortality Rates by AMI Process Measure Compliance

Mean Hospital-Level Compliance Scores on AMI Process Measures

<table>
<thead>
<tr>
<th>Compliance Score</th>
<th>Mortality Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>up to 59%</td>
<td>8.9%</td>
</tr>
<tr>
<td>60-69</td>
<td>7.9%</td>
</tr>
<tr>
<td>70-79</td>
<td>7.4%</td>
</tr>
<tr>
<td>80-89</td>
<td>6.7%</td>
</tr>
<tr>
<td>90% +</td>
<td>6.5%</td>
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</tbody>
</table>
Odds Ratios for Inpatient Mortality Associated with a 10% Increase in AMI Protocol “Grade”

- Raw: .92 (95% CIs: .87, .97) (p=.003)
- Adjusted for pt. chars: .95 (.82, .99) (p=.01)
- Adjusted for pt. chars., hospital chars., state: .95 (.92, .99) (p=.01)
Do organization measures explain the impact of process measures on outcomes?

No evidence of this. Models predicting AMI mortality with Foundations, Affairs scores not significantly changed by addition of AMI process performance or vice versa
Summarizing

• Three basic sources of data:
  – Observation
  – Byproducts of care delivery
  – Questionnaires

• Secondary data can be put to many interesting uses—but we come up against some big limitations

• We have a huge mass of correlational findings that are consistent with our leanings, but little information about mechanisms that would give extra heft to the findings, help us manage working conditions or set policy

• ... time for some new approaches ...
Research Plans

• Organization and processes of care: Interest in the mechanisms linking organization to the “black box” of process of care at the level of the clinician/care team (prioritization, judgment etc.)
  – Practical importance
  – Theoretical importance
  – Data source problems to be resolved

• Interdisciplinary contexts of care
  – Studying clinical practice “in vivo”

• ... One approach is using specific clinical populations ...
  ... in my case medical and surgical cardiovascular populations ...
Figure 1. Relative Risk of In-Hospital Death with Each Additional 15-Minute Interval and Number of Deaths Associated with Increases in Door-to-Balloon Time as Compared with Treatment within 90 Minutes.

From McNamara et al. JACC 2006;47:2180-6.
Other Directions

• Emerging information technologies in healthcare (process and outcome data sources)
  – Measure development
  – Collaborations between service agencies and industry

• Organizational issues in settings beyond acute care and the study of patient outcomes through longer-term health/illness/wellness trajectories
Initial Plans For the Future

• Continued study of quality, safety, workforce and occupational health questions in acute care
• Cardiac-specific safety and quality questions
  – Interdisciplinary team functioning and impacts on process and outcomes of care
  – Exercise of nursing clinical judgment under different conditions
  – Opportunities in many different populations and clinics
• Organization of care questions
  – Outcomes of advanced practice nursing (collaborative care models involving nurse practitioners)
  – Rescue and rapid response teams
New Nursing Graduate Competencies in Identifying Patient Clinical Deterioration

• Ontario MOHLTC, Nursing Research Fund 2009-2011

• Clarke, PI
The Team

• Coinvestigators:

Dr. Claire Mallette, Director of Nursing Education, Placement and Development, University Health Network

Dr. Louise Rose, Adjunct Scientist, Li Ka Shing Institute, St. Michaels' Hospital, Research Scientist, Mt. Sinai Hospital, Assistant Professor and Term Chair in Critical Care Nursing, Lawrence Bloomberg Faculty of Nursing, University of Toronto

Dr. Stuart Reynolds, Physician Lead, MOHLTC, Ontario Critical Care Strategy, Critical Care Response Teams

Dr. Ruth Childs, Associate Professor, Ontario Institute for Studies in Education, University of Toronto

• Province-wide advisory group from practice and education settings including UHN
Background

• Nurses are bombarded with volumes of information, interruptions, tasks and must nonetheless identify critical information indicative of serious decline in a patient’s status ...

• Monitoring patients is challenging for all nurses, and more so for the new graduate nurse in the first year of practice ...

• Beginning with “core” “medical-surgical” practice
Project Goals

1) Thoroughly describe the domain of practice relating to the use of clinical cues by new nurse graduates and experienced clinicians to identify patients at risk of deterioration

2) Develop a workable assessment tool to assist hospitals / clinical educators in the develop of new clinicians

Deliverable: an easily administered practice-ready tool to assess the decision making process

[MY GOAL: TO TAKE FIRST STEPS IN PUSHING ABILITY TO STUDY PROCESS OF CARE ]
Project Phases

Phase 1:
Cognitive Task Analysis--surveillance and early detection of clinical deterioration in the medical-surgical patient

Phase 2:
Development of a test format of the tool

Phase 3:
Pilot Test, Preliminary Analysis
Examples of Other Current Projects

– Benchmarking and studying interdisciplinary working climate in the cardiac program, hopefully moving towards study of outcomes

– Postoperative delirium in cardiac surgery patients – cracking into the outcome as a window into understanding surveillance, management, quality of care
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