COORDINATION IN THE ICU AND THE RELATION WITH QUALITY OF CARE AND PATIENT SAFETY FROM A NURSE PERSPECTIVE

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TOPICS  
Organization, organizational design, quality of care patient

KEYWORDS  
.Work organization, coordination, quality of care, patient safety, Intensive Care Unit

1. INTRODUCTION
A large amount of health care resources are spent in Intensive Care Units (ICUs). For example, estimates show that the cost of a patient day in an ICU is three to five times that of a day of care on a medical-surgical floor. The total ICU expenditures represent approximately 1%-1.5% of the USA’s Gross Domestic Product (GDP). It is estimated that critical care units account for as much as 1/4-1/3 of total hospital budgets. With a declining number of overall acute care hospital beds over the past twenty years, the number of critical care beds has increased by over 250% and now accounts for approximately 10% of all hospital beds. With the increasing costs of health care, which will only further increase in the future because of aging populations and longevity, and the current focus on patient safety and reducing medical errors, the ICU has become a prime study object. The literature shows that medical errors occur frequently in ICUs. In our study, we examine ICUs from an organizational/human factors perspective.

During the last decades there has been a growing literature on managerial and organizational practices that are related to better patient outcomes. For example, results show that strong leadership, timely communication, and good interdepartmental coordination are important in improving performance. However, there is relatively little literature on the organization of ICUs. Apart from the studies by Shortell and colleagues, the organization of ICUs has received little attention.

There are three different organizational models of ICUs: the open model, the closed model, and the hybrid model. In the open model, the intensive care unit is open to physicians of all specialties and training to admit their patients as they deem appropriate. There are no specific regulations regarding the triage of patients and each staff physician is autonomous in his/her decision making. This is the traditional model that remains pervasive in most intensive care units throughout the country, particularly those with a non-academic or non-university affiliation. At the other extreme, in the closed model, all patients are cared for by intensivists with board certification in critical care medicine. Referrals to the intensive care unit are made by the primary attending physician and the appropriateness of the admission and triage are the responsibility of the intensivist. The intensivist is responsible for all aspects of the patient care including admission, discharge, plan of therapy and procedures. The intensivist seeks consultative assistance when appropriate. This model is more common in tertiary academic or university hospitals with full time faculty in critical care medicine. It is also more common in areas with highly penetrated managed care. Between these two extremes are multiple, hybrid models that combine various aspects of intensive care administration. Frequently, local expertise and culture dictates the relative integration of concepts from closed and open units.
In this study we examine one particular aspect of the organization in ICUs: the coordination within and between units. As suggested by Shortell et al. 4, coordination is one of the organizational factors that can improve performance in ICUs. We examine the effect of coordination on quality care in 4 ICUs. Three of the ICUs have the closed organizational model of intensive care and one of the ICUs has the open model of intensive care. We examine coordination in these ICUs and the relation with quality of care from a nurse perspective.

1.1 Backgrounds

From an organizational theory perspective, intensive care units (ICUs) can be considered as complex organizations of services. There are several causes for the complexity, including a combination of great uncertainty in the process of care, the diversity of the processes involved, and the need for quick decision making required by urgent situations 21. The team model of care and the multidisciplinary team approach have been emphasized by the Society of Critical Care Medicine 25 and the American Association of Critical Care Nurses 14. Several studies in the USA and in Europe have described the organization of ICUs 15,28. The American study demonstrates the existence of a wide range of organizational arrangements of ICUs within hospitals 14. Some of the organizational characteristics that contribute to improved patient care outcomes have been identified in the literature. However, only a very small portion of that research has examined both patient care outcomes, and working conditions and work organization.

Carlson et al. 8 argue that the use of an ICU team, admission and discharge criteria, protocols and guidelines that are the result of available data, and the principles of evidence-based medicine can improve ICU outcome, performance and cost-effectiveness. Lustbader and Fein 22 reviewed studies that demonstrate reduced ICU length of stay, improved overall mortality rates, and greater team satisfaction with the closed model of intensive care. They argue for an organized multidisciplinary team approach to critical care delivery. Studies of the effects of change from an open to a closed ICU have shown improved clinical outcomes 18,25. However, most of these studies do not evaluate the impact of the ICU organization on healthcare providers. The study by Carson et al. 9 collected data on staff perceptions and found that the closed unit format had both positive and negative aspects. The staff felt more comfortable in teaching sessions and less time to learn and to teach. This study demonstrates the need to build up positive aspects in the work organization of ICUs, without creating any additional negative aspects, in designing and implementing intervention strategies. A large observational study with patient data collected retrospectively and ICU data collected prospectively was conducted to examine ICU organizational characteristics that were related to improved outcomes of abdominal aortic surgery 29. Not having daily rounds by an ICU physician was associated with a 3-fold increase in in-hospital mortality, and with a range of complications (i.e. cardiac arrest, sepsis, acute renal failure, and reintubation). Not having daily rounds by an ICU physician, having an ICU nurse-patient ratio of less than 1:2, not having monthly review of mortality and morbidity, and extubating patients in the operating room were associated with increased resource use. This result is confirmed in a study by Rapoport et al. 29 on the relationship between ICU organizational factors and pulmonary artery catheter use. Using data from a retrospective study of 10,217 non-operative patients, they found that a full-time ICU physician was associated with a two-thirds reduction in the probability of catheter use. Other studies have confirmed the benefits with regard to patient care outcomes of daily rounds by an ICU physician 17, the presence of full-time critical care specialists 3,16,27, the presence of physicians trained in critical care medicine 30 and intermediate care units 12. Knaus, Rousseau, Shortell, Zimmerman, and colleagues 28 have extensively studied organizational characteristics and performance of ICUs. In a study of ICUs in 13 tertiary care hospitals, Knaus et al. 71 used a severity of disease classification system (Apache II) to identify organizational characteristics associated with better care. Coordination of care and involvement and interactions of nurses and physicians were associated with improved patient care. The methodology used in the National ICU study is described in detail in several articles 14,22,25. The conceptual framework (see Figure 1) is based on the structure-process-outcome approach.

Figure 1 Managerial and organizational factors affecting ICU performance

The performance of an ICU is hypothesized to be determined by the structural characteristics of the ICU (e.g., technical capacity, qualifications of the medical and nursing staff) and the process characteristics of the ICU (e.g., coordination, communication, satisfaction) 34. An optimal performing unit is defined as one that provides superior patient outcomes at less cost with high levels of patient, family, and staff satisfaction 34. Analyses of data collected from 17,400 patients across 42 ICUs examined the factors associated with risk-adjusted mortality, risk-adjusted average length of stay, nurse turnover, technical quality of care, and ability to meet family member needs 34. The Apache III method was used to compute risk-adjusted patient care outcomes. Results show that (1) technological availability is significantly associated with lower risk-adjusted mortality; (2) diagnostic diversity is significantly associated with greater risk-adjusted mortality, and (3) caregiver interaction. Caregiver interaction was conceptualized as a composite concept that includes dimensions of unit culture, leadership, communication, coordination, and problem-solving/conflict management. The study by Shortell et al. 34 underlines how important managerial and organizational factors are. Shortell et al. concluded: “The findings suggest that ICUs that have a team-oriented culture with supportive nursing leadership, timely communication, effective coordination, and
with collaborative open problem solving approaches are significantly more efficient in terms of moving patients in and out of the unit. The units also have lower nurse turnover that can result in further cost savings through reduced expenses for recruitment and selection” [9,5,21].

Apart from the studies by Shortell and colleagues, there are very few studies that have examined coordination within and between units and their relation with quality of care. Minvielle et al. [3] found a relation between cultural factors and coordination (see Figure 1) in ICUs but did not examine the relation between coordination and quality of care. Pollack et al. [27] in a study in 16 pediatric ICUs failed to find a relation between unit coordination and a patient’s chance of survival. Coordination was defined as “the medical director or his or her representative being involved in the vast majority (>90%) of patient’s care, and/or there was a 24-hour-a-day, 7-days-per-week physician staff dedicated solely to the pediatric ICU” [27].

In our study we use the coordination concepts developed by Shortell et al. [9] (within unit coordination, between unit coordination and shift/hand off coordination. We adapted those scales to study the various dimensions of coordination from the perspective of different care providers (i.e., nurses, physicians and pharmacists). In this paper, we examine these aspects of coordination from nurses’ perspective.

Although the coordination concepts developed by Shortell et al. [9,24,17] have proven to be valid and reliable [22,23,27], relatively little is known about how the different aspects of coordination relate to quality of care and patient safety in ICUs. Furthermore, we know little about the relation between coordination and quality of care in the different organizational models of ICUs (open, closed and hybrid ICUs). In our study we use three outcome measures for nurses’ perception of patient care and safety: satisfaction with care provided (SCP), enough time for patient safety (ETPS) and overall perception of patient safety (OPPS). OPPS is a measure that indicates patient safety problems. We hypothesize that:

1) Within unit coordination, between unit coordination and shift/hand off coordination are positively related to satisfaction with care provided (SCP) and enough time for patient safety (ETPS) and negatively related to overall perception of patient safety (OPPS).

2) Within unit coordination, between unit coordination and shift/hand off coordination are rated better by nurses working in the closed model than in the open model.

3) Therefore, SCP and ETPS are perceived higher and OPPS is perceived lower in closed model ICUs than in the open model ICU.

2. METHODOLOGY

2.1 Sample

One-hundred-seventy-nine nurses in four ICUs of a medical center returned the survey questionnaire (response rate 93%). Most of the respondents are female (88%). Average age is 36 years. Forty percent of the nurses have had some college or technical training; 47% graduated from college; 10% have had some graduate school; and 3% have a graduate degree. Most of them (98%) are Caucasian. Average tenure is nearly 12 years. On an average, the nurses work 41.5 hours a week, mostly in 12-hour shifts (74%); in 8 hour shifts (9%) or in a combination of both (17%). Nineteen percent of the nurses work during weekdays; 9% on weekends and 72% in a combination of both. Thirty-six percent of the nurses work day shifts; 4% evening shifts; 33% night shifts; and 27% in a combination of shifts. Twenty-nine percent of the nurses work in the Adult ICU; 27% in the Cardiac ICU; 14% in the Pediatric ICU; and 36% in the Neonatal ICU. The Adult, Pediatric and Neonatal ICUs have a closed model of intensive care organization and the Cardiac ICU has an open model of intensive care organization.

2.2 Questionnaire

2.2.1 Coordination in the ICU

We used three scales to measure coordination in the ICU: within (α=0.72) and between (α=0.83) unit coordination and shift/hand off coordination (α=0.63). To measure within and between unit coordination, we used four items from a set of 10 items on within-unit and between coordination mechanisms [13]. We changed response categories from [1-8] to [1-5] and removed the response category ‘Not applicable-not used here’. We used the two modified scales in previous research [30]. To measure shift/hand-off coordination we added two questions adapted from Akk et al. [1] on nurses’ shift changes and physicians’ sign-outs. All scales consist of two items. Results of a second order confirmatory factor analysis (CFA) showed adequate fit for the coordination construct (χ²=27.2, df=6, p=0.001, GFI=0.95, CFI=0.93, SRMR=0.05 and RMSEA=0.14). One of the causes of the less than optimal fit is the fact that most scales only consist of two items, causing Heywood cases.

2.2.2 Quality of care and patient safety

We used several outcome measures based on the literature and earlier work. The first concept, satisfaction with care provided (SCP) is measured with a single item, adapted from Bertram et al. [5]. The second concept, enough time for patient safety (ETPS), is measured with two items adapted from Singer et al. [33] and Carayon et al. [1]. The third concept, overall perception of patient safety (OPPS), is also measured with two items, adapted from Sorra & Nieva [40]. OPPS is a measure which indicates safety problems. All quality of care and patient safety items have been used in previous studies by Carayon et al. [33]. Results of a CFA showed a good fit for the Satisfaction with Quality of Care and Patient Safety construct (χ²=6.29, df=4, p=0.18, GFI=0.99, CFI=0.99, SRMR=0.04 and RMSEA=0.06). All scales are recoded to a score between 0 and 100. The whole questionnaire was tested in a pilot study with 10 volunteers before questionnaire distribution.

3. RESULTS

Table 1, 2 and 3 summarize the descriptive statistics of the items in the questionnaire.

Table 1 Descriptive statistics coordination in the ICU

| NE | SE | ME | E | VE |
To what extent does one-to-one communication between staff contribute to the coordination of staff activities within your ICU?

| 9% | 2.8% | 17.9% | 60.2% | 19.9% |

To what extent do daily staff rounds contribute to the coordination of staff activities within your ICU?

| 0% | 8.7% | 20.9% | 52.3% | 18.0% |

To what extent does one-to-one communication between ICU staff and members of other units effectively contribute to the coordination of your unit’s activities with other hospital units?

| 8.3% | 18.9% | 35.5% | 33.1% | 4.1% |

To what extent do daily staff rounds contribute to the coordination of your unit’s activities with other hospital units?

| 12.7% | 21.8% | 41.8% | 20.6% | 3.0% |

In your ICU, how effective are nurses’ shift changes in passing on the adequate information about patients’ cases and management plans?

| 0% | 3.4% | 13.5% | 65.7% | 17.4% |

In your ICU, how effective are physicians/PAs/NPs’ sign-outs in passing on the adequate information about patients’ cases and management plans?

| 0% | 4.7% | 30.0% | 46.6% | 4.7% |

Patient safety and standards of care.

| 5.1% | 42.6% | 27.8% | 19.9% | 4.5% |

We have patient safety problems in our unit.

| 16.2% | 39.1% | 24.0% | 15.6% | 5.8% |

I feel that it is just pure luck that more serious mistakes don’t happen around here.

SD=Strongly Disagree, D=Disagree, NA/ND=Neither Agree Nor Disagree, A=Agree, SA =Strongly Agree

Table 3 Comparison between open and closed units

<table>
<thead>
<tr>
<th>Closed Units (N=130)</th>
<th>Open Unit (N=47)</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coordination within unit</td>
<td>73.4</td>
<td>69.7</td>
</tr>
<tr>
<td>Coordination Between units</td>
<td>47.2</td>
<td>50.8</td>
</tr>
<tr>
<td>Shift/Hand-off coordination</td>
<td>70.5</td>
<td>70.7</td>
</tr>
<tr>
<td>Satisfaction with care provided</td>
<td>82.9</td>
<td>81.6</td>
</tr>
<tr>
<td>Enough Time for Patient Safety</td>
<td>71.3</td>
<td>66.8</td>
</tr>
<tr>
<td>Overall Perception of Patient Safety</td>
<td>42.1</td>
<td>39.0</td>
</tr>
</tbody>
</table>

None of the differences between the closed and open units are statistically significant

We used correlation and linear regression analyses to examine the relationship between the different aspects of coordination and the three measures of quality of care and patient safety. Since the three different aspects of coordination are relatively highly correlated, we used method forward in linear regression analysis to determine which aspects of coordination are most strongly associated with the measures of quality of care provided and patient safety. Tables 4, 5 and 6 show the results of these analyses.

Table 4 Correlations between coordination and quality of care and patient safety (all units)

<table>
<thead>
<tr>
<th>SCP</th>
<th>ETPS</th>
<th>OPPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Within unit coordination (COORDW)</td>
<td>.20**</td>
<td>.16*</td>
</tr>
<tr>
<td>Between unit coordination (COORDB)</td>
<td>.02</td>
<td>.21**</td>
</tr>
<tr>
<td>Coordination Shift Change/Hand Offs (COORDCHSH)</td>
<td>.25**</td>
<td>.19*</td>
</tr>
</tbody>
</table>

** Correlation is significant at the 0.01 level, * Correlation is significant at the 0.05 level
Table 5 Linear regression analysis coordination on quality of care and patient safety (all units)

<table>
<thead>
<tr>
<th>SCP</th>
<th>ETPS</th>
<th>OPPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Significant predictors (Beta-coefficients)</td>
<td>COORSICH (-20)</td>
<td>COORB (-21)</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>.06</td>
<td>.04</td>
</tr>
</tbody>
</table>

Table 6 Linear regression analysis coordination on quality of care and patient safety (open vs. closed units)

<table>
<thead>
<tr>
<th>SCP</th>
<th>ETPS</th>
<th>OPPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Significant predictors closed units (Beta-coefficients) and [Adjusted R²]</td>
<td>COORSICH (-20) [0.04]</td>
<td>No significant predictors</td>
</tr>
<tr>
<td>Significant predictors open unit (Beta-coefficients) and [Adjusted R²]</td>
<td>COORSICH (-42) [0.16]</td>
<td>COORB (-41) [0.15]</td>
</tr>
</tbody>
</table>

4. DISCUSSION

Results of our study show that nurses perceive relatively few problems with regard to coordination within units and shift/hand-off coordination. However, they do perceive problems with regard to coordination between units (Table 1). Overall, nurses are satisfied with the quality of care provided and they have enough time to complete patient care tasks safely. However, they do express problems with regard to the overall perception of patient safety. Nearly a quarter of the nurses expresses concerns with regard to patient safety (Table 2). Results did not show any significant differences between coordination in open and closed units. Nor did they show statistically significant differences in self-reported quality of care and safety (Table 3). Results of our study show that coordination is related to self-reported quality of care and patient safety. However, the correlations are weak and only a small proportion of the variance in quality of care and safety is explained by the coordination mechanisms. Results of linear regression analysis show that of the different aspects of coordination, nurses’ shift changes and physicians’ sign-outs (COORSICHII) show the strongest relation with satisfaction of care provided (SCP). Coordination between units (COORB) is related to Enough Time for Patients Safety (ETPS) and Overall Perception of Patient Safety (OPPS). Interestingly, the relations between the coordination mechanisms and quality of care and patient safety are stronger in open units than in closed units (Table 6). Our results confirm the study conducted by Shortell et al. Coordination is related to quality of care and patient safety. Results of the study by Shortell et al. showed that caregiver interaction (conceptualized as a composite concept that includes dimensions of unit culture, leadership, communication, coordination, and problem-solving/conflict management) was strongly associated with lower risk-adjusted length of stay, lower nurse turnover, higher technical quality of care, and greater ability to meet family member needs. Results of our study show that coordination is a small, but significant part of the organizational factors that are related to quality of care and patient safety. Furthermore, coordination shows stronger relations with quality of care and patient safety in open units than it is in closed units.

A limitation of this study is that the relation between coordination and quality of care and safety was only examined from a nurse perspective. We will also examine this relation from a physician perspective. Another limitation is that we rely on self-reported data. The next step will be to link the self-reported data to more objective outcomes, such as length of hospital stay, and medical errors and adverse drug events.

This study is part of a larger study, evaluating Computerized Provider Order Entry (CPOE) in a large hospital. We assume that communication and coordination in ICUs will change as a result of CPOE implementation. The results presented in this paper are based on the pre-implementation round of data collection. We have nearly finished collecting our 3 months post-implementation data. We will present the results of a comparison of pre- and post-implementation in the next paper.

5. ACKNOWLEDGEMENTS

This research has been made possible with a grant from AHRQ. Grant Number: R01 HS15274, Pascale Carayon, PI.

6. REFERENCES


