Failure to Rescue in the Surgical Oncology Population: Implications for Nursing and Quality Improvement

Christopher R. Friese, RN, PhD, AOCN®, and Linda H. Aiken, RN, PhD, FAAN, FRCN

Purpose/Objectives: To analyze the frequency, type, and correlates of postoperative complications for surgical patients with cancer to illustrate practical application of the failure to rescue concept in oncology nursing practice.

Design: Secondary analysis of inpatient claims.

Setting: Data obtained from the Pennsylvania Health Care Cost Containment Council were linked with data from the Pennsylvania Cancer Registry.

Sample: 24,618 patients with solid tumors hospitalized for tumor-directed surgery in 164 acute care hospitals from 1998–1999.

Methods: Frequency distributions examined the incidence of each complication, the proportion of patients who died with the complication, and complication frequency by tumor type. Chi-square tests compared the frequency of complications for patients who were admitted routinely or via the emergency department.

Main Research Variables: 30-day mortality, postoperative complications, and tumor type.

Findings: The most frequent complication in the sample was gastrointestinal bleeding (13.2%); however, 37.1% of patients who died had respiratory compromise as a complication. Admission through the emergency department was significantly associated with experiencing a complication (71.9% versus 43.9%).

Conclusions: Treatable but serious postoperative complications are frequent and can be fatal in the surgical oncology population. Complication frequency and fatality vary significantly by cancer type.

Implications for Nursing: The complications studied are detectable by nurses and can be managed successfully with timely intervention. Recognition of complications at an early stage and evidence-based management may assist nurses in patient rescue and, ultimately, improve quality of care.

Key Points . . .

- Failure to rescue—defined as death following a postoperative complication—is increasingly studied as a quality-of-care measure.
- Because understanding and application of failure to rescue currently are limited in oncology settings, examination of the frequency and fatality of complications can aid nurses in detection and management.
- Serious postoperative complications, including gastrointestinal bleeding, fluid and electrolyte disturbances, and respiratory compromise, occurred in about 50% of the studied population and were associated with high mortality rates. Patients admitted via the emergency department had higher rates of studied complications.

Increasing interest in healthcare quality improvement has focused on the prevention or management of complications for patients undergoing surgery (Berwick, Calkins, McCannon, & Hackbarth, 2006; Leape et al., 1991). Failure to rescue, defined as a death among surgical inpatients with treatable serious complications, is one outcome measure frequently studied to examine quality of care in hospitalized patients (National Quality Forum, 2004; Silber, Williams, Krakauer, & Schwartz, 1992). Failure to rescue is strongly linked to nursing care; when nurses identify abnormal findings signifying a complication during patient assessment, they often are the first line of intervention to rescue the

Christopher R. Friese, RN, PhD, AOCN®, is an assistant research scientist in the School of Nursing at the University of Michigan in Ann Arbor; and Linda H. Aiken, RN, PhD, FAAN, FRCN, is the Claire M. Fagin Leadership Professor of Nursing and director in the Center for Health Outcomes and Policy Research at the University of Pennsylvania in Philadelphia. *While completing this research, Friese was a research fellow at the Dana-Farber Cancer Institute Center for Outcomes and Policy Research/Harvard School of Public Health, Department of Society, Human Development, and Health in Boston, MA. Original data collection was supported by a grant from the National Institute of Nursing Research R01-NR04513 (principal investigator [PI]: Linda H. Aiken). Analyses were supported by the American Cancer Society, DSCN-03-202-01-SCN (PI: Christopher R. Friese), the Oncology Nursing Society via the Pennsylvania Tobacco Settlement Funds (PIs: Julie A. Sochalski and Deborah B. McGuire), and a predoctoral training grant from the National Institute of Nursing Research, T32-NR07104 (PI: Linda H. Aiken). The funders had no role in the study design, data analysis, or manuscript preparation. Mention of specific products and opinions related to those products do not indicate or imply endorsement by the* Oncology Nursing Forum *or the Oncology Nursing Society. (Submitted October 2007. Accepted for publication April 3, 2008.)*

Digital Object Identifier: 10.1188/08.ONF.779-785

patient. Through early recognition of complications and timely interventions, additional morbidity, mortality, and costs can be spared (Aiken, Sochalski, & Lake, 1997; Clarke & Aiken, 2003).

Despite the increased interest in outcome measures to study nursing quality, few empiric studies have deconstructed the clinical aspects of these outcome measures; therefore, the measures are not readily applicable to practice. Multiple studies have documented variations in outcomes for surgical patients with cancer (Bach et al., 2001; Begg, Cramer, Hoskins, & Brennan, 1998; Birkmeyer, Dimick, & Birkmeyer, 2004; Finlayson & Birkmeyer, 2003; Finlayson, Goodney, & Birkmeyer, 2003; Hillner & Smith, 1998; Hodgson et al., 2003; Hodgson, Fuchs, & Ayanian, 2001; Meyerhardt et al., 2003; Schrag et al., 2003). The research findings that document the effects of nursing and hospital characteristics on outcomes for surgical patients with cancer were reported previously (Friese, Lake, Aiken, Silber, & Sochalski, 2008). The current article's researchers conducted a secondary analysis of the data that follow to explore the type, frequency, and outcomes of serious postoperative complications. The findings highlight patient populations that experience the studied complications, which can assist managers and nurses with implementing changes in care that could prevent or ameliorate postoperative complications.

Failure to Rescue and Application to Surgical Patients With Cancer

The original research that introduced failure to rescue as an outcome measure focused on surgical patients, including patients with prostatectomy (Silber et al., 1992). Silber Rosenbaum, and Ross (1995) identified issues with the use of 30-day mortality and postoperative complications for quality assessment and empirically demonstrated that patient characteristics explained more variation than hospital characteristics in 30-day mortality and complications, whereas the effect of patient characteristics was diminished in failure to rescue. They concluded that failure to rescue is a more appropriate measure to study quality of care because hospital characteristics are more likely to influence the measure. Failure to rescue resonates for patients with cancer because of the increasing number of older adults and patients with comorbidities who are seeking active treatment. Not all complications are preventable. However, if patients navigate a postoperative complication successfully, they are more likely to commence chemotherapy or radiotherapy with less toxicity, which may enable them to complete therapy in a timely manner. A case study of the concept of failure to rescue in clinical practice is demonstrated in Figure 1.

Research findings have documented significant relationships between failure to rescue and nursing organizational characteristics. The original research conducted on failure to rescue identified a strong and significant association with nurse-to-patient ratios in a sample of surgical patients (Silber, Rosenbaum, & Ross, 1995). Failure to rescue also has been associated to the educational preparation of RNs (Aiken, Clarke, Cheung, Sloane, & Silber, 2003) and the quality of nursing practice environments (Friese et al., 2008).

Other researchers have modified the original failure to rescue measure, and those other approaches were reviewed (Manojlovich & Talsma, 2007). Needleman, Buerhaus, Mattke, Stewart, and Zelevinsky (2002) selected a sample of surgical and medical populations and studied death following pneumonia, shock or cardiac arrest, upper gastrointestinal bleeding, sepsis, or deep vein thrombosis. Boyle (2004) studied medical and surgical patients and defined failure to rescue as a death following a fall, pneumonia, urinary tract infection, pressure ulcer, or cardiac arrest. Using facility incident report data, Seago, Williamson, and Atwood (2006) reconceptualized failure to rescue rates as the proportion of patients who experienced a medication error with injury divided by the proportion of patients who experienced any medication error or the proportion of patients with moderate or severe pressure ulcers divided by the total number of patients with an ulcer.

Although nontrivial differences exist in the measures and conceptualizations, a shared theme is the recognition that patients receiving hospital care frequently develop complications; the question is whether the healthcare team is able to detect the issue in a timely manner and intervene rapidly and appropriately to rescue patients from additional harm. Because detection and intervention are tied so closely to the role of nurses, failure to rescue has been identified conceptually as a nursing-sensitive outcome measure. The Agency for Healthcare Research and Quality (2004) modified Silber et al.'s (1992) original failure to rescue measure and endorsed it as a patient safety indicator. The National Quality Forum (2004) selected the failure to rescue measure modified by Needleman et al. (2002) as a core measure for evaluating the performance of nursing care in acute care hospitals.

D.S., a 55-year-old woman, was admitted to the hospital for exploratory laparatomy for presumed ovarian cancer. Her previous medical history included stage IIB estrogen receptor-positive breast cancer seven years ago. After mastectomy, she received six cycles of doxorubicin and paclitaxel followed by five years of tamoxifen therapy. D.S.'s only other recorded comorbidity was osteoporosis.

The findings from the exploratory laparatomy were consistent with stage IIIC ovarian cancer, and a total abdominal hysterectomy and bilateral salpingo-oopherectomy were performed. D.S. received IV fluids and patient-controlled analgesia for two days after surgery. On day three, D.S. called the nurse to complain of shortness of breath. Vital signs revealed tachycardia, tachypnea, and hypoxia. D.S.'s nurse mobilized additional nurses, the surgical resident, and respiratory therapist to assist D.S. She was given supplemental oxygen therapy, and a STAT ventilation/perfusion scan suggested high probability for pulmonary embolus. D.S. was started on heparin therapy and was transferred to the medical intensive care unit for closer monitoring. Following a slow recovery, D.S. was discharged home eight days later with a referral for outpatient physical therapy. Her adjuvant chemotherapy was delayed eight weeks to enable recovery, and her first dose of paclitaxel was held as a precaution.

Although D.S. experienced an undesirable complication, she was rescued successfully from the complication. Had D.S. died either during the inpatient stay or as many as 30 days following the surgical admission, the case would have been considered failure to rescue. No obvious mistakes were made in medical management that contributed to the complication, but D.S.'s preexisting medical history and use of tamoxifen therapy increased the likelihood for pulmonary embolism. In terms of quality of care, the question is whether the nurse and hospital mounted the resources necessary to prevent the complication.

Figure 1. Case Study of Failure to Rescue as a Concept

Similar to the Centers for Medicare and Medicaid Services ([CMS], 2008) "hospital compare" metrics, failure to rescue is a potential quality measure to report publicly and reimburse differentially in various "pay-for-performance" proposals. The policy approaches provide enhanced reimbursement rates to hospitals for achieving selected outcomes targets. CMS has announced it will no longer reimburse hospitals when significant medical errors have occurred during the stay (Neergaard, 2008). As reimbursement becomes increasingly tied to quality measures, clinicians should understand the basis of the measures. However, the clinical community often is unfamiliar with the determinants of failure to rescue. Few studies, if any, have identified specific nursing interventions associated with failure to rescue. One of the aims of this article is to use a patient outcomes data set to describe the frequency and severity of complications that patients with cancer face after surgery. Armed with that information, nurses are better positioned to perform more frequent or thorough assessments for specific complications, identify resources to remedy certain complications, or alter care delivery models so patients at risk for fatal complications are identified early. Such analyses stimulate a dialogue about how to deliver safer care and avoid adverse patient outcomes.

Methods

The data were obtained from a larger study of nursing care and hospital outcomes conducted from 1998–1999 in Pennsylvania (Aiken, Clarke, Sloane, Sochalski, & Silber, 2002; Aiken et al., 2001, 2003). The analytic sample was modified to study surgical patients with cancer using added tumor information available on each patient from the Pennsylvania Cancer Registry. All identities in the data were removed and exempt institutional review board approval was granted.

Sample and Data Sources

The analytic sample consisted of 24,618 adults with a confirmed cancer registry diagnosis, and International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) diagnosis and procedure codes for surgical resection for cancer. Since 1986, the Pennsylvania Health Care Cost Containment Council ([PHC4], 2003) has collected uniform claim and billing forms on all adults admitted to acute care hospitals in Pennsylvania. The data were made available to researchers following the execution of a data use agreement; identifiable patient information was stripped from the data and replaced with a pseudoidentifier that can be used to link patients to prior claims, death, or cancer registry data. Data routinely collected by PHC4 on the forms include admission and discharge information, an array of demographic findings, and principal and secondary diagnoses and procedures during the inpatient stay.

For the analyses reported in this article, complete staging and diagnostic information was required to verify tumor-related resection; patients with breast malignancies were excluded because of their relatively short lengths of stay in hospitals. When patients experienced multiple tumor-related surgeries during the study period, a decision rule was applied to select only one random admission for analysis. Therefore, studied patients are present in the data set only once. The study patients were admitted to 164 acute care hospitals in Pennsylvania from 1998–1999.

Measures

To measure complications, a set of ICD-9-CM diagnosis and procedure codes reflect the occurrence of complications during the inpatient stay (available from the primary author on request). The diagnosis and procedure codes were derived from expert review and empirical validation in prior surgical outcomes studies (Silber et al., 2002; Silber, Rosenbaum, Schwartz, Ross, & Williams, 1995). The range of complications varies from cardiac events to psychosis, and patients could experience more than one complication. Several of the complications were conditional based on the absence of similar diagnosis and procedure codes in the preceding 90 days, reducing the likelihood that the complication was a preexisting condition. An aggregate variable, any complication, identified patients who suffered any one of the complications specified. Thirty-day mortality was measured by linking hospital admissions data with state vital health statistics and reflected a death date occurring within 30 days of the hospital admission date. Previous studies have suggested that 30-day mortality, when available, is preferable to inpatient mortality for quality assessment (Chassin, Park, Lohr, Keesey, & Brook, 1989; Jencks, Williams, & Kay, 1988). Length of cancer diagnosis was measured by calculating the days between confirmed cancer registry diagnosis date and the date of hospital admission. Emergent admission status was identified as the admission source (i.e., admitted via the emergency department or not) from the PHC4 hospital claim.

Data Analysis

SAS® version 9.1 was used for all data analyses. The number of patients who experienced each of the specified complications was calculated, along with the corresponding proportion of patients with the complications who died within 30 days (i.e., failure to rescue). Complication and death rates then were compared by cancer type. The proportion of complications experienced was examined by their admission source (via the emergency department or not). For the final analyses, chi-square test statistics were used to compare outcomes by emergent admission, and p values less than 0.05 were considered statistically significant.

Results

Table 1 shows the characteristics of the patient sample. Roughly a third of patients were younger than age 65. Eighty percent of patients were reported as Caucasian, 6% as African American, and 14% as other or unknown race. More than 30% of patients had new cancer diagnoses, and a significant proportion of patients had metastatic disease. The majority of patients had colorectal or prostate cancer with a related surgical procedure.

Complications and Death

From the analytic sample, 11,940 (48.5%) patients experienced at least one complication, and 836 (3.4%) patients died within 30 days of hospital admission. Out of the group of patients who died, 739 (88.4%) also had a complication recorded in their hospitalization record obtained from PHC4. Table 2 shows the most frequent complications for the study population and the percent of deceased patients with each complication. Gastrointestinal bleeding and fluid and

Table 1. Sample Characteristics

Characteristic	$\bar{X}$	SD	Range
Age (years)	68.25	12.28	20–103
Length of stay (days)	8.06	7.67	1–254
Number of hospital admissions (1998–1999)	1.43	1.17	1–21
Length of cancer diagnosis (days)	231.74	667.32	0–5
Characteristic	**n**		**%**
Gender			
Male	14,655		56.40
Female	11,302		43.60
Cancer stage			
Localized	13,243		51.00
Regionalized	8,168		31.50
Systemic	3,417		13.20
Unknown	1,129		4.30
Admission type			
Elective	21,544		83.00
Emergency	4,183		16.10
Transfer	145		0.56
Transfer and emergency	77		0.31
Unknown	8		0.03
Tumor type			
Colorectal	11,722		45.20
Prostate	7,602		29.30
Endometrium	2,859		11.00
Head and neck	1,860		7.20
Ovary	717		2.70
Lung	564		2.20
Esophagus	385		1.50
Pancreas	248		0.90

N = 25,957

electrolyte imbalances were the most common complications in the entire sample. Of the patients who died, a large proportion experienced respiratory compromise (37.1%) and fluid and electrolyte disorders (24%).

Complications, Tumor Type, and Emergent Admission Status

Patients experienced complications differently by tumor type (see Table 3). Patients with esophageal, pancreatic, and lung cancers had overall complication rates that exceeded 60%. However, complication rates varied by tumor type. For example, roughly a quarter of patients with esophageal cancer experienced pneumonia or respiratory compromise. Patients with pancreatic cancer frequently experienced respiratory compromise and pneumothorax (14.7% and 10.9%, respectively). Respiratory compromise was particularly fatal for patients with pancreatic cancer; 57.9% of the patients who died experienced this complication. Patients with ovarian and colorectal cancers had relatively high rates of gastrointestinal bleeding.

Table 4 compares the most prevalent complication rates by emergency department as the source of admission. Patients admitted through the emergency department had a significantly higher complication rate (71.9% versus 43.9%, $\chi^2 = 1{,}055.49$, $p < 0.001$). For the selected complications, the rates were significantly higher in the subgroup of patients admitted through the emergency department.

Discussion

The principal motivation to study failure to rescue in surgical patients with cancer was to inform the oncology nursing community about the frequency and severity of postoperative complications for patients with cancer. The authors also sought to study complications that precede failure to rescue in this population. The findings suggest that postoperative complications occur frequently in surgical patients with cancer and these complications, in many cases, result in death (considered a failure to rescue). Patients with esophageal, pancreatic, and lung cancers experienced very high rates of postoperative complications. Although reason may suggest those patients are more likely to die because of the aggressiveness of their cancer, the patients who died did so within 30 days of their operative procedure, and not necessarily after a course of chemotherapy or radiotherapy. All of the patients studied were cleared by anesthesiologists and surgeons prior to undergoing tumor-related resection.

Although several complications were not observed routinely, they frequently were present in patients who died. The complications, which included atelectasis, hypokalemia, and dehydration, are conditions frequently identified by nurses and can be remedied with rapid response. Nurses can directly intervene in promoting aggressive pulmonary toilet procedures to minimize atelectasis. Monitoring of serum electrolyte levels and intake and output on a regular basis can identify patients at risk for fluid and electrolyte disorders. Corrective action can prevent clinical deterioration, such as renal dysfunction and dysrhythmias. Hypotension or hypovolemia was observed in only 4% of the entire sample but was observed in more than

Table 2. Complications and Death Rates

			Patients Who Died With Complication Recorded (N = 836)	
Complication[a]	n	%	n	%
Any complication	11,940	48.5	739	88.4
Gastrointestinal bleeding or blood loss	3,246	13.2	154	18.4
Electrolyte or fluid abnormality	2,194	8.9	201	24.0
Respiratory compromise	1,699	6.9	310	37.1
Renal dysfunction	1,516	6.2	144	17.2
Congestive heart failure	1,347	5.4	127	15.2
Pneumothorax	1,321	5.3	72	8.6
Urinary tract infection or cystitis	1,226	5.0	70	8.4
Aspiration pneumonia	1,157	4.7	132	15.8
Hypotension or hypovolemia	1,002	4.1	164	19.6
Internal organ damage	970	3.9	80	9.6
Intestinal obstruction	934	3.8	39	4.7
Deep wound infection	646	2.6	43	5.1
Cardiac emergencies	644	2.6	163	19.5
Perforation	633	2.5	46	5.5
Pneumonia, other	545	2.2	91	10.9
Peritonitis	528	2.1	82	9.8
Cardiac events	422	1.7	35	4.2
Sepsis	267	1.1	84	10.0

[a] Patients may have suffered from more than one complication.

Note. Because of incomplete or missing data, N = 24,618.

Table 3. Most Common Complications and Death Rates by Tumor Type

Tumor Type and Complication	n	%	Patients Who Died With Complication n	Patients Who Died With Complication %
Colorectal (N = 11,253; deaths = 543)				
Gastrointestinal bleeding or blood loss	1,700	15.1	117	21.5
Electrolyte or fluid abnormality	1,411	12.5	130	23.9
Respiratory compromise	998	8.9	218	40.1
Renal dysfunction	915	8.1	96	17.7
Any complication	6,474	57.5	490	90.2
Prostate (N = 7,313; deaths = 102)				
Gastrointestinal bleeding or blood loss	970	13.3	14	13.7
Urinary tract infection or cystitis	391	5.3	14	13.7
Renal dysfunction	333	4.6	24	23.5
Electrolyte or fluid abnormality	316	4.3	20	19.6
Any complication	2,630	36.0	82	80.4
Endometrium (N = 2,765; deaths = 17)				
Gastrointestinal bleeding or blood loss	210	7.6	3	17.6
Intestinal obstruction	192	6.9	1	5.9
Pneumothorax	185	6.7	2	11.8
Respiratory compromise	154	5.6	6	35.3
Any complication	982	35.5	14	82.4
Ovarian (N = 1,779; deaths = 67)				
Gastrointestinal bleeding or blood loss	234	13.2	8	11.9
Intestinal obstruction	222	12.4	9	13.4
Pneumothorax	172	9.7	4	6.0
Electrolyte or fluid abnormality	159	8.9	21	31.3
Any complication	957	53.8	60	89.6
Lung (N = 539; deaths = 56)				
Pneumothorax	164	30.4	22	39.3
Respiratory compromise	103	19.1	24	42.9
Aspiration pneumonia	70	13.0	13	23.2
Pneumonia, other	58	10.8	10	17.9
Any complication	358	66.4	51	91.1
Esophagus (N = 367; death = 22)				
Pneumonia, other	92	25.1	3	13.6
Respiratory compromise	88	24.0	10	45.5
Electrolyte or fluid abnormality	52	14.2	7	31.8
Aspiration pneumonia	49	13.4	2	9.1
Any complication	254	69.2	18	81.8
Head and neck (N = 364; deaths = 10)				
Respiratory compromise	32	8.8	4	40.0
Electrolyte or fluid abnormality	25	6.9	1	10.0
Congestive heart failure	20	5.5	1	10.0
Aspiration pneumonia	18	4.9	1	10.0
Any complication	125	34.3	7	70.0
Pancreatic (N = 238; deaths = 19)				
Gastrointestinal bleeding or blood loss	47	19.7	3	15.8
Electrolyte or fluid abnormality	37	15.5	7	36.8
Respiratory compromise	35	14.7	11	57.9
Pneumothorax	26	10.9	4	21.1
Any complication	160	67.2	17	89.5

Note. Because of incomplete or missing data, N = 24,618.

19% of patients who died. In the case of hypotension or hypovolemia, nurses often detect the complication by monitoring vital signs, notifying the appropriate physician of any concerns, and administering fluids to restore hemodynamics.

Certain complications were strongly associated with particular tumor types in a predictable fashion (e.g., postoperative pneumothorax for patients with lung cancer). However, complications in patients with some tumor types were not directly linked to the procedures performed (e.g., respiratory compromise in patients with pancreatic cancer). The findings suggest that increased surveillance, allocation of more experienced nurses to care for high-risk patients, and alterations to patient care plans might protect patients from poor outcomes. For most of the complications studied, the rates were higher for patients admitted through emergency departments. This finding most likely reflects that patients who are less stable are more likely to present initially in the emergency department. These patients are easy to identify, experience a high rate of complications, and can be the focus of specific nursing interventions to monitor and manage complications.

Limitations

Strengths of the study include a sizable patient sample from a large number of hospitals and detailed information on patients' clinical condition on admission and during hospitalization. Most prior studies of surgical oncology outcomes using claims data have relied on Medicare data; the sample studied had a large proportion of patients younger than age 65, which increases generalizability.

The study has several limitations. Data are from one state in the United States and the proportion of nonwhite patients is lower than other areas of the country. Potential issues with claims data include omission of pertinent diagnosis and procedure codes because of limitations in available data fields. The authors capitalized on an opportunity to link hospital claims data and tumor registry information; therefore, data reported are from 1998–1999. Confirmation of the findings in more recent and representative data, augmented with detailed clinical information, would contribute greatly to the understanding of failure to rescue in patients with cancer. Failure to rescue has been studied more commonly in the surgical patient population; continued development of the measure for use in medical patient populations would be welcome. The original failure to rescue definition developed by Silber et al. (1992) includes an additional 34 ICD-9 codes that reflect "unspecified complications." The diagnosis codes include accidental puncture or laceration during a procedure (ICD-9 code 998.2), blood transfusion reactions (999.4–999.8), and other, unspecified complications (999.9). The unspecified complications were excluded from this study because they are not specific enough to discuss the nursing interventions to manage the diverse set of complications.

Nursing Implications

The findings contribute to the dialogue in nursing about how best to organize nurses and systems to deliver safe patient care and maximize outcomes (Hinshaw, 2008; Page, 2004). Respiratory complications were a frequent and fatal complication in the present study. A literature review concluded that early intervention for respiratory issues results in favorable postoperative outcomes (Duff, Gardiner, & Barnes, 2007). Evidence-based oral care protocols have documented efficacy

Table 4. Selected Complication Rates by Emergency Department Source of Admission

	Emergency Department Source of Admission				
	Yes (N = 4,040)		No (N = 20,578)		
Complication[a]	n	%	n	%	Chi Square
Any complication	2,903	71.9	9,037	43.9	1,055.49
Gastrointestinal bleeding	760	18.8	2,486	12.1	133.66
Electrolyte or fluid abnormality	711	17.6	1,483	7.2	449.27
Respiratory compromise	477	11.8	1,222	5.9	181.01
Hypotension or hypovolemia	463	11.5	539	2.6	676.04
Congestive heart failure	442	11.0	905	4.4	279.49
Aspiration pneumonia	305	7.5	852	4.1	87.63
Renal dysfunction	427	10.6	1,089	5.3	162.74

[a] $p < 0.001$ for all complications

Note. Because of incomplete or missing data, N = 24,618.

in reducing ventilator-associated pneumonia (Ross & Crumpler, 2007). Pronovost et al. (2006) documented a sustained eradication of catheter-related bloodstream infections in surgical intensive care units after strict adherence to an evidence-based intervention was maintained. This intervention was co-led in study hospitals by nurses and physicians, which supports a successful model of multidisciplinary, evidence-based interventions to improve outcomes for a prevalent and serious issue. The use of a clinical warning tool, based on abnormal vital signs, to trigger calls for medical assistance significantly reduced pulseless cardiac arrests and mortality after discharge (Green & Williams, 2006). Identification and adoption of evidence-based interventions, based on prevalence and risk of the complication, likely would decrease failure to rescue rates in hospitals. The case study cited in Figure 1 is one example of a successful rescue from a postoperative complication.

Many postoperative complications are sensitive to the organization and delivery of nursing care. Delays or bureaucratic hurdles in this chain of events can lead to ineffective response by providers and poor patient outcomes (Page, 2004). Administrative processes have been proposed to support clinical nurses in identifying and managing postoperative outcomes. The effects of rapid response teams, which incorporate criteria for alerting trained emergency care providers, have been mixed in the literature (Winters, Pham, & Pronovost, 2006). The small number of randomized, adequately powered studies to examine outcome differences suggests additional research is required before widespread adoption of this intervention is recommended (Schmid, Hoffman, Happ, Wolf, & DeVita, 2007). Despite research gaps, rapid response teams have become commonplace in hospitals. Nurses can contribute to the conversation by sharing outcome data such as the kind reported in this article to identify complications implicated in adverse patient outcomes.

Nurse practitioner care of vulnerable patient populations has been tested in oncology, neonatology, and cardiology settings with consistent, supportive evidence (Brooten et al., 1995; Brooten, Youngblut, Deatrick, Naylor, & York, 2003; Cunningham, 2004; McCorkle, Siefert, Dowd, Robinson, & Pickett, 2007). Features of nurse practitioner care models include inpatient assessment, comprehensive discharge planning, telephone or in-person visitation after discharge from the acute care setting, and coordination of follow-up care among medical specialties. Such a model could be used for surgical patients with cancer determined to be at high risk for postoperative complications and could augment the existing organization of nursing care in hospitals. Because failure to rescue extends beyond hospital doors by measuring 30-day mortality after a complication, the transition from hospital to home or other setting is a critical piece to safe care delivery. Extension of the model to the population of patients who are at risk for or experience a postoperative complication is worthy of exploration.

Clinical care innovations must coincide with supportive environments for nurses to practice (Hinshaw, 2008; Page, 2004). Support for staffing patterns that recognize the clinical severity of patients, appropriate use of ancillary personnel to supplement nursing monitoring, and practical information technology all are interventions that, when executed well, enable nurses to spend more time with patients. Operational disruptions, such as searching for equipment and execution of non-nursing tasks, decreases time for patient care; such time can be critical in the early identification of postoperative events (Tucker & Spear, 2006). Examination of complication and failure to rescue rates when organizational changes are implemented can help managers determine the effectiveness of the changes. Clinicians and managers can use the metric of failure to rescue not only to measure quality of care, but also to drive changes in practice that benefit patient care.

The authors gratefully acknowledge Lysa S. Magazu, BS, for research assistance.

Author Contact: Christopher R. Friese, RN, PhD, AOCN®, can be reached at cfriese@umich.edu, with copy to editor at ONFEditor@ons.org.

References

Agency for Healthcare Research and Quality. (2004). AHRQ quality indicators. Retrieved February 9, 2004, from http://www.qualityindicators.ahrq.gov

Aiken, L.H., Clarke, S.P., Cheung, R.B., Sloane, D.M., & Silber, J.H. (2003). Education levels of hospital nurses and patient mortality. *JAMA, 290*(12), 1617–1623.

Aiken, L.H., Clarke, S.P., Sloane, D.M., Sochalski, J., Busse, R., Clarke, H., et al. (2001). Nurses' reports on hospital care in five countries. *Health Affairs, 20*(3), 43–53.

Aiken, L.H., Clarke, S.P., Sloane, D.M., Sochalski, J., & Silber, J.H. (2002). Hospital nurse staffing and patient mortality, nurse burnout, and job dissatisfaction. *JAMA, 288*(16), 1987–1993.

Aiken, L.H., Sochalski, J., & Lake, E.T. (1997). Studying outcomes of organizational change in health services. *Medical Care, 35*(11, Suppl.), NS6–NS18.

Bach, P.B., Cramer, L.D., Schrag, D., Downey, R.J., Gelfand, S.E., & Begg, C.B. (2001). The influence of hospital volume on survival after resection for lung cancer. *New England Journal of Medicine, 345*(3), 181–188.

Begg, C.B., Cramer, L.D., Hoskins, W.J., & Brennan, M.F. (1998). Impact of hospital volume on operative mortality for major cancer surgery. *JAMA, 280*(20), 1747–1751.

Berwick, D.M., Calkins, D.R., McCannon, C.J., & Hackbarth, A.D. (2006). The 100,000 lives campaign: Setting a goal and a deadline for improving health care quality. *JAMA, 295*(3), 324–327.

Birkmeyer, J.D., Dimick, J.B., & Birkmeyer, N.J.O. (2004). Measuring the quality of surgical care: Structure, process, or outcomes? *Journal of the American College of Surgeons, 198*(4), 626–632.

Boyle, S.M. (2004). Nursing unit characteristics and patient outcomes. *Nursing Economics, 22*(3), 111–119.

Brooten, D., Naylor, M., York, R., Brown, L., Roncoli, M., Hollingsworth, A., et al. (1995). Effects of nurse specialist transitional care on patient outcomes and cost: Results of five randomized trials. *American Journal of Managed Care, 1*(1), 35–41.

Brooten, D., Youngblut, J.M., Deatrick, J., Naylor, M., & York, R. (2003). Patient problems, advanced practice nurse (APN) interventions, time, and contacts among five patient groups. *Journal of Nursing Scholarship, 35*(1), 73–79.

Centers for Medicare and Medicaid Services. (2008). Hospital compare: A quality tool for adults, including people with Medicare. Retrieved February 24, 2008, from http://www.hospitalcompare.hhs.gov

Chassin, M.R., Park, R.E., Lohr, K.N., Keesey, J., & Brook, R.H. (1989). Differences among hospitals in medicare patient mortality. *Health Services Research, 24*(1), 1–31.

Clarke, S.P., & Aiken, L.H. (2003). Failure to rescue: Needless deaths are prime examples of the need for nurses at the bedside. *American Journal of Nursing, 103*(1), 42–47.

Cunningham, R.S. (2004). Advanced practice nursing outcomes: A review of selected empirical literature. *Oncology Nursing Forum, 31*(2), 219–232.

Duff, B., Gardiner, G., & Barnes, M. (2007). The impact of surgical ward nurses practising respiratory assessment on positive patient outcomes. *Australian Journal of Advanced Nursing, 24*(4), 52–56.

Finlayson, E.V., & Birkmeyer, J.D. (2003). Effects of hospital volume on life expectancy after selected cancer operations in older adults: A decision analysis. *Journal of the American College of Surgeons, 196*(3), 410–417.

Finlayson, E.V., Goodney, P.P., & Birkmeyer, J.D. (2003). Hospital volume and operative mortality in cancer surgery: A national study. *Archives of Surgery, 138*(7), 721–725.

Friese, C.R., Lake, E.T., Aiken, L.H., Silber, J.H., & Sochalski, J. (2008). Hospital nurse practice environments and outcomes for surgical oncology patients. *Health Services Research*, *43*(4), 1145–1163.

Green, A., & Williams, A. (2006). Staff experiences of an early warning indicator for unstable patients in Australia. *Nursing in Critical Care, 11*(3), 118–127.

Hillner, B.E., & Smith, T.J. (1998). Hospital volume and patient outcomes in major cancer surgery: A catalyst for quality assessment and concentration of cancer services. *JAMA, 280*(20), 1783–1784.

Hinshaw, A.S. (2008). Navigating the perfect storm: Balancing a culture of safety with workforce challenges. *Nursing Research, 57*(1, Suppl.), S4–S10.

Hodgson, D.C., Fuchs, C.S., & Ayanian, J.Z. (2001). Impact of patient and provider characteristics on the treatment and outcomes of colorectal cancer. *Journal of the National Cancer Institute, 93*(7), 501–515.

Hodgson, D.C., Zhang, W., Zaslavsky, A.M., Fuchs, C.S., Wright, W.E., & Ayanian, J.Z. (2003). Relation of hospital volume to colostomy rates and survival for patients with rectal cancer. *Journal of the National Cancer Institute, 95*(10), 708–716.

Jencks, S.F., Williams, D.K., & Kay, T.L. (1988). Assessing hospital-associated deaths from discharge data. The role of length of stay and comorbidities. *JAMA, 260*(15), 2240–2246.

Leape, L.L., Brennan, T.A., Laird, N., Lawthers, A.G., Localio, A.R., Barnes, B.A., et al. (1991). The nature of adverse events in hospitalized patients. Results of the Harvard Medical Practice Study II. *New England Journal of Medicine, 324*(6), 377–384.

Manojlovich, M., & Talsma, A. (2007). Identifying nursing processes to reduce failure to rescue. *Journal of Nursing Administration, 37*(11), 504–509.

McCorkle, R., Siefert, M.L., Dowd, M.F.E., Robinson, J.P., & Pickett, M. (2007). Effects of advanced practice nursing on patient and spouse depressive symptoms, sexual function, and marital interaction after radical prostatectomy. *Urologic Nursing, 27*(1), 65–77.

Meyerhardt, J.A., Catalano, P.J., Schrag, D., Ayanian, J.Z., Haller, D.G., Mayer, R.J., et al. (2003). Association of hospital procedure volume and outcomes in patients with colon cancer at high risk for recurrence. *Annals of Internal Medicine, 139*(8), 649–657.

National Quality Forum. (2004). National voluntary consensus standards for nursing-sensitive care: An initial performance measure set. Retrieved January 6, 2006, from http://www.qualityforum.org/nursing

Needleman, J., Buerhaus, P., Mattke, S., Stewart, M., & Zelevinsky, K. (2002). Nurse staffing levels and the quality of care in hospitals. *New England Journal of Medicine, 346*(22), 1715–1722.

Neergaard, L. (2008). Medicare won't pay hospitals for errors. Retrieved July 31, 2008, from http://www.usatoday.com/news/washington/2008-02-19-hospitalerrors_N.htm

Page, A. (2004). *Keeping patients safe: Transforming the work environment of nurses*. Washington, DC: National Academy Press.

Pennsylvania Health Care Cost Containment Council. (2003). Services—Data collection. Retrieved May 10, 2003, from http://www.phc4.org/dept/dc

Pronovost, P., Needham, D., Berenholtz, S., Sinopoli, D., Chu, H., Cosgrove, S., et al. (2006). An intervention to decrease catheter-related bloodstream infections in the ICU. *New England Journal of Medicine, 355*(26), 2725–2732.

Ross, A., & Crumpler, J. (2007). The impact of an evidence-based practice education program on the role of oral care in the prevention of ventilator-associated pneumonia. *Intensive and Critical Care Nursing, 23*(3), 132–136.

Schmid, A., Hoffman, L., Happ, M.B., Wolf, G.A., & DeVita, M. (2007). Failure to rescue: A literature review. *Journal of Nursing Administration, 37*(4), 188–198.

Schrag, D., Panageas, K.S., Riedel, E., Hsieh, L., Bach, P.B., Guillem, J.G., et al. (2003). Surgeon volume compared to hospital volume as a predictor of outcome following primary colon cancer resection. *Journal of Surgical Oncology, 83*(2), 68–78.

Seago, J.A., Williamson, A., & Atwood, C. (2006). Longitudinal analyses of nurse staffing and patient outcomes: More about failure to rescue. *Journal of Nursing Administration, 36*(1), 13–21.

Silber, J.H., Kennedy, S.K., Even-Shoshan, O., Chen, W., Koziol, L.F., Showan, A.M., et al. (2002). Anesthesiologist direction and patient outcomes. *Anesthesiology, 93*(1), 152–163.

Silber, J.H., Rosenbaum, P.R., & Ross, R.N. (1995). Comparing the contributions of groups of predictors: Which outcomes vary with hospital rather than patient characteristics? *Journal of the American Statistical Association, 90*(429), 7–18.

Silber, J.H., Rosenbaum, P.R., Schwartz, J.S., Ross, R.N., & Williams, S.V. (1995). Evaluation of the complication rate as a measure of quality of care in coronary artery bypass graft surgery. *JAMA, 274*(4), 317–323.

Silber, J.H., Williams, S.V., Krakauer, H., & Schwartz, J.S. (1992). Hospital and patient characteristics associated with death after surgery. A study of adverse occurrence and failure to rescue. *Medical Care, 30*(7), 615–629.

Tucker, A.L., & Spear, S.J. (2006). Operational failures and interruptions in hospital nursing. *Health Services Research, 41*(3), 643–662.

Winters, B.D., Pham, J., & Pronovost, P.J. (2006). Rapid response teams—Walk, don't run. *JAMA, 296*(13), 1645–1647.