Intrahospital Transport of the Critically Ill Adult
A Standardized Evaluation Plan

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Background: Intrahospital transport of the critically ill adult carries inherent risks that can be manifested as unexpected events.
Objective: The aim of this study is to evaluate the implementation of a standardized evaluation plan for intrahospital transports to/from adult intensive care units.
Methods: Nurses at a level I trauma/academic center captured clinical data throughout transport. Outcome measures included compliance with the organization’s transport policy and unexpected events.
Results: There were 502 transports audited. Most nurses were compliant with the policy, except for the stabilization process (n = 174, 34.7%). Forty-one transports (8.2%) had an unexpected event, and 11 of these transports (26.8%) were aborted. Most of the events were hemodynamic (12), sedation (11), respiratory (10), and gastrointestinal (5). Fewer events occurred with the transport team (P = .036) and among nurses with a bachelor of science in nursing or higher degree (P = .002). Events were higher among transporting nurses with only 0 to 2 years of intensive care unit experience (P = .002), “stabilized” transports (P = .022), and patients with higher Acute Physiology and Chronic Health Evaluation scores (P = .009).
Conclusions: Health care organizations should have a policy that includes both transport and evaluation plans for intrahospital transport. Guidelines should be revised with specific criteria for the stabilization process and unexpected events. Revision should also have a standardized evaluation plan that includes an audit tool to measure incidence of unexpected events and a rapid change quality improvement method.
Intrahospital transport of the critically ill adult (ITCA) is necessary when it is not feasible to perform diagnostic/interventional procedures and tests at the bedside. Unfortunately, these transports carry risks that are manifested as unexpected events (UEs), often referred to as adverse events, complications, insults, or mishaps. Examples include acute change in vital signs, mental status, ineffective sedation, cardiopulmonary arrest, and death.\textsuperscript{1-5} Factors contributing to UEs have been described as patient related (severity of illness, hemodynamic stability), equipment related (transport equipment malfunction), personnel related (availability/experience of personnel, patient handoff communication), and environment related (transport destination).\textsuperscript{2} Potential complications resulting from these events include pneumonia,\textsuperscript{3} neurological insults,\textsuperscript{4} and cardiac arrhythmias.\textsuperscript{5} Although there are no national data on the incidence of UEs during ITCA, a recent review suggests that ITCA is potentially dangerous, with adverse event rates up to 70\%.\textsuperscript{6}

In 1993, the Society of Critical Care Medicine, the American College of Critical Care Medicine, and the American Association of Critical Care Nurses developed guidelines for ITCA.\textsuperscript{7} These guidelines, which are based mainly on single-center, fairly well-designed observational studies, recommend a standardized transport process that includes (1) at least 2 people, including a critical care nurse, to accompany the patient; (2) transport equipment that includes basic life support tools (ie, airway management, oxygen supply, cardiac defibrillator) and advanced cardiac life support (ACLS) medications (ie, epinephrine and atropine); and (3) monitoring equivalent to that in the intensive care unit (ICU).\textsuperscript{7} The guidelines also suggest that hospitals implement a written policy that incorporates transport and evaluation plans. Because of the nature of the clinical problem, experimental studies have not been conducted, and considering the dearth of well-designed clinical outcome studies, these guidelines have not been revised since their development.

Nevertheless, a review of the literature on ITCA reveals several studies\textsuperscript{2,4,8-23} that support the fundamental elements of the standardized transport process noted in the guidelines. Since the publication of the guidelines, a synthesis of the evidence\textsuperscript{2,8,12,14-16} reveals 2 recurring themes: (1) the need to evaluate risks of ITCA with well-designed clinical studies and (2) a need to reduce transport risks (eg, hemodynamic or respiratory compromise) by implementing ITCA policies with transport and evaluation plans that reflect the guidelines. According to a recent review of ITCA literature,\textsuperscript{6} policies should include specially trained personnel,\textsuperscript{8,9,24} an established transport plan,\textsuperscript{25} and an evaluation plan that refines the transport plan regularly using standard quality improvement (QI) processes.\textsuperscript{1,25-27} A policy that incorporates both transport and evaluation plans can reduce UEs,\textsuperscript{24} enhance patient safety,\textsuperscript{25} and evaluate impact on patient outcomes.\textsuperscript{28} These key points are illustrated in a conceptual framework for ITCA (Figure 1).

Background

A large level 1 trauma and academic center in Central North Carolina has had an ITCA policy since 1990. The policy was revised with the development of the guidelines in 1993 and has been in place ever since. This institution is the only health care organization (HCO) in the region with an ITCA policy that incorporates a team of dedicated personnel, the Adult Specialty Care Team (ASCT). This team, a small group of ACLS certified critical care nurses with 5 to 20 years of ICU experience, facilitates approximately 200 transports for critically ill adults per month. Team members work 12-hour day/night shifts and are primarily responsible not only for ITCA but also for moderate sedation, peripheral intravenous access, and rapid response consults. They receive a minimum of 3 months on the job training with the most experienced team member. However, when ASCT personnel are not available, because of high demand for services, ICU bedside nurses are responsible for performing their patient’s transport. Although the institution had a policy that was based on the ITCA guidelines, it was incomplete as it did not have an evaluation plan or QI process that could assess compliance to the ITCA policy/guidelines and UE incidence. Therefore, in 2009, under the leadership of the study coordinator, the ASCT developed and implemented an evaluation plan to assess UE incidence, improve patient safety during ITCA, and complete the institution’s policy.

The team’s evaluation plan incorporated an audit tool for data collection and rapid change QI methods. During monthly staff meetings, the team received feedback about their practice (eg, audit results pertaining to UE incidence). The team then gave their feedback on UE prevention, barriers to compliance with transport policies, and ways to improve practice/safety. These brief and informal meetings served as frequent feedback loops, which encouraged individual and rapid team problem solving. Qualitative feedback revealed inconsistencies in
documentation (eg, computerized/paper charting or not charting at all), barriers to compliance (eg, limited computer access to document during the transport), and systems issues (eg, lack of drug dispensing equipment in certain procedural areas). Quantitative data revealed a UE rate of 11%, and many of the events were related to issues with intravenous access and ineffective sedation. The evaluation plan (audit tool and QI method) allowed ASCT to evaluate current practice, elicit feedback frequently, and change practice immediately. By the following year, the ASCT UE rate dropped to 7%, and there were positive systems changes; however, the evaluation plan did not assess compliance with the ITCA policy/guidelines or the UE incidence of ICU bedside nurses transporting patients when the ASCT was not available for the transport. As a result, the evaluation plan was assimilated into the ASCT’s daily practice. Unfortunately, the evaluation plan (audit tool and QI method) was not adopted by the HCO and formally incorporated into the ITCA policy.

Sufficient evidence exists for HCOs to evaluate current practices and improve/change practice by implementing a policy that reflects the ITCA guidelines. Standardized processes for ITCA, which are emphasized by the guidelines, are imperative for benchmarking or comparative data analysis. To establish best practice for ITCA and influence the revision of the ITCA guidelines, there must first be a standard way of evaluating practice, using the same quality metrics. Furthermore, differences in UEs when the ASCT versus the bedside ICU nurse transports the patient should be examined. Therefore, the purpose of this study is to evaluate the implementation of a proposed standardized evaluation plan for ITCA (audit tool and QI method), based on the successful ASCT model, as a means to complete the institution’s existing policy and improve patient safety during ITCA. A secondary analysis will compare UEs reported by transport by the ASCT team and the bedside ICU nurse.

**MATERIALS AND METHODS**

**Study Design**
A 4-month, single-center observational study with quantitative/qualitative design was used. Quantitative design elements involved collection of objective demographic and clinical data, including UEs during transport. Qualitative elements involved collection of subjective data pertaining to compliance to the guidelines, including nurses’ self-report of barriers to compliance with ITCA policy and descriptions of UEs. Patient care was not manipulated and participating nurses were not identified.
Description of the Organization and Sample
The clinical setting for this study is at a level I trauma and academic center in central North Carolina. This 780-bed facility has 6 adult ICUs composed of 9 to 21 beds per unit. The project was implemented in the surgical/trauma (SICU), neurosurgical (NSIU) and medical (MICU) ICUs. These units share a similar structure such that they each have 16 to 18 beds, a free charge nurse, rapid response duties, and high volume of transports. The SICU population consists of general surgery, trauma, and liver transplant patients; the NSIU population consists of head trauma, stroke, epileptic, and neurosurgery patients; and the MICU population consists of patients with single-organ/multiorgan system failure, overdose, complications from diabetes, and nonoperative neurological disorders. Occasionally, these units may experience overflow and care for patients outside of their service.

A convenience sample of critically ill adults needing intrahospital transport from NSIU, MICU, and SICU was obtained. Inclusion criteria were transports to/from diagnostic and procedural departments where an ASCT member or bedside critical care nurse must accompany the patient. Excluded transports were those in which the patient transferred to a lower level of care (ie, step-down unit or acute-care floor) and not returning to the ICU. The nurses transporting the patients were also surveyed.

Description of the Intervention: Proposed Evaluation Plan
During ITCA, nurses were expected to monitor and care for the patient per the organization’s ITCA/ICU policies and document clinical observations using computerized charting systems and/or documentation forms that were approved by the organization. However, this documentation system did capture enough pertinent data regarding UEs; therefore, an audit form (see Appendix A) was developed to capture clinical, demographic, and qualitative data throughout ITCA. Nurses escorting critically ill adults, ASCT and ICU bedside nurses, were asked to fill out the form before transport, complete the form upon return to the unit, and place completed audit forms into a drop box located in each unit. The audit forms were collected weekly, transcribed, deidentified, and stored in a database on the organization’s server by the study coordinator for data analysis. Nursing education sessions about the ITCA policy/guidelines and utility of the audit form were held the month before data collection during unit staff meetings and shift change report. A laminated reference card was also provided to transporting nurses to guide proper completion of the audit form (see Appendix B).

Rapid change QI methods involved monthly feedback loops that provided nursing staff with unit-specific audit results including results on UE categories/incidence and feedback on UE prevention and ways to improve practice. This information was sent by the study coordinator via e-mail bulletins and face-to-face meetings with the units’ nurse managers, clinical nurse educators, charge nurses, and bedside nurses.

This study was approved by the institutional review boards of the University of North Carolina at Chapel Hill and Duke University, Durham, North Carolina.

Measures
The audit form was developed based on the ITCA policy/guidelines and used to measure compliance with the policy/guidelines and UEs that occurred during the transport. The form also included a checklist for potential contributing factors to UEs (eg, order status or urgency of the transport). Qualitative measures included nurses’ narratives on perceived barriers to compliance and UE descriptions.

Compliance. This measure was defined as level of adherence, in percentages, to the organization’s policy and guidelines for ITCA. Categories measured transport structure and process.

Transport structure was operationalized as transport personnel and equipment. Personnel were measured as the number of persons accompanying the transport. According to policy, a minimum of 2 persons, including a critical care nurse, should accompany every transport. Equipment was measured as the minimum required for transport. According to policy, required equipment includes basic life support tools (ie, ambu bag, oxygen, and cardiac defibrillator), ACLS medications (ie, epinephrine, atropine, and lidocaine), and ICU transport monitors equivalent to those in ICU with the ability to monitor heart rate, respiratory rate, oxygen saturation, and blood pressure.

Transport process, as described in the guidelines, consisted of pretransport coordination, communication and stabilization, monitoring, and documentation. Pretransport coordination was measured as coordination with ancillary services and departments about the transport and services needed (eg, respiratory therapy, providers and radiology staff). Pretransport communication was measured as communication with nurses, respiratory therapists, and practitioners regarding the patient’s clinical status and treatment during the transport (eg, inability to lay flat, frequent suctioning, and sedation requirements). Pretransport stabilization was measured as consideration of the appropriateness of transport given the patient’s clinical status (eg, hemodynamic stability) and potential for a diagnostic procedure or intervention to alter management (ie, change the plan of care) or patient outcome (eg, decrease mortality or length of stay).

Monitoring was defined as physiological monitoring during transport equivalent to that in the ICU. According to the institution’s ITCA policy, critically ill patients should be monitored hourly at minimum, every 15 minutes for patients...
requiring titration of vasoactive medications, and every 5 minutes for patients receiving moderate sedation.

Documentation was defined as charting during transport that includes vital signs, medications administered, transport duration, and UEs. According to the institution’s ITCA policy, transporting nurses were expected to document electronically or in writing on documentation forms approved by the institution. Documentation should also reflect monitoring frequency (ie, monitoring and charting every 5 minutes during moderate sedation). Of note, the audit form was used exclusively for this study, was not part of the patient chart, and was totally separate from the institutions approved documentation. Therefore, nurses were asked to document according to policy in addition to completing the audit form for the study.

**Unexpected Events.** The major quality indicator measured was the number of events that occurred during transport and was defined as unanticipated events or acute changes from the patient’s baseline clinical status lasting more than 5 minutes that may or may not require intervention (Table 1).

**Contributing Factors**
Factors that might impact UEs were incorporated into the audit form and categorized as patient related, personnel related, equipment related, and environment related2 (Table 2). Patient acuity was measured within 24 hours of the transport using the Acute Physiology and Chronic Health Evaluation (APACHE-II) (Table 3). On the basis of Based on the APACHE, patients were

<table>
<thead>
<tr>
<th>TABLE 1 Unexpected Physiologic and Non-physiologic Events, Categories, and Descriptions (502 Transports)</th>
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<tbody>
<tr>
<td><strong>Classification</strong></td>
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<tr>
<td>Physiologic</td>
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<tr>
<td>Sedation</td>
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<tr>
<td>Respiratory</td>
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<td>Gastrointestinal</td>
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<td>Neurological</td>
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<td>Genitourinary</td>
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<tr>
<td>Access</td>
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<tr>
<td>Pain</td>
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<tr>
<td>Cardiopulmonary arrest</td>
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<tr>
<td>Cardiac</td>
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<tr>
<td>Death</td>
</tr>
<tr>
<td>Fall</td>
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<tr>
<td>Nonphysiologic Equipment</td>
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<tr>
<td>Delay of care</td>
</tr>
<tr>
<td>Other</td>
</tr>
<tr>
<td>Medication</td>
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</tbody>
</table>

Abbreviations: DNR, do not resuscitate; ICU, intensive care unit.
classified by their likelihood of ICU mortality, reported in percentage.

DATA ANALYSIS

Data were collected from September 2011 to December 2011 and were analyzed by the study coordinator to assess level of compliance with the policy, identify perceived barriers to compliance, determine UE incidence, and identify factors contributing to UEs. Qualitative data were analyzed using conventional content analysis of open-ended questions on the audit form. Quantitative data were analyzed using SPSS-18 statistical software to perform descriptive, parametric (analysis of variance, Pearson r and, the independent t test), and nonparametric ($\chi^2$ and the Mann-Whitney U) statistical analyses. All assumptions were met for each test and specific statistical tests used are noted below in parentheses along with their numerical result. All P values were 2 tailed and values <.05 were considered statistically significant with 95% confidence interval for all proportions.

RESULTS

There were 502 eligible transports for study (NSIU, 292; MICU, 108; and SICU, 102); however, total cases may differ for measures not recorded on the audit form by the transporting nurse (see Table 4). The most frequented destinations (n = 473) were computed tomography (CT) scan, 52.4%; magnetic resonance imaging, 24.1%; vascular interventional radiology, 12.1%; and x-ray, 5.1%. Only 26 transports (5%) went to 2 destinations. A total of 286 transports (57%) were performed at night between 7 PM and 7 AM. Order status recorded for 469 transports included stat (36.5%), expedite (42.8%), and routine (30.7%). The median recorded time for transport was 45 minutes (range, 10-255 minutes; n = 477). The mean (SD) APACHE score for transported patients was 16.69 (6.911) (range, 0-37; n = 235). There were transports without APACHE scores because of lack of an arterial blood gas, which is required for score calculation. Fifty-seven percent of transports (n = 442) were nonvented, and 47.2% did not have intravenous pumps (range, 0-7 pumps; n = 475). For all transports (n = 502), the number of medications administered during the transport ranged from 0 to 3, whereby 70.1% did not have any medications; 19.9% had 1 medication; 8.2% had 2 medications; and 1.8% had 3 or more medications. The major types of medications given were sedation (n = 70, 13.9%) and analgesia (n = 67, 13.3%).

Transporting nurses had a range of ICU experience: more than 10 years, 52.3%; 6 to 10 years, 35.2%; 3 to 5 years, 11.4%; and 0 to 2 years, 2.8% (n = 493). Most of all transports were performed by nurses who were college prepared (bachelor of science in nursing [BSN], 82.9% and master of science in nursing, 12.7%). Nearly all transporting nurses were ACLS certified (98%); however, only 123 (24.5%) transports were performed by nurses certified in critical care (CCRN). The ASCT performed more transports (n = 484) than bedside nurses did; however, there was no significant difference between

<table>
<thead>
<tr>
<th>Score</th>
<th>Mortality, %</th>
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<tbody>
<tr>
<td>0-4</td>
<td>4</td>
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<tr>
<td>5-9</td>
<td>8</td>
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<tr>
<td>10-14</td>
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<td>15-19</td>
<td>25</td>
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<td>20-24</td>
<td>40</td>
</tr>
<tr>
<td>25-29</td>
<td>55</td>
</tr>
<tr>
<td>30-34</td>
<td>75</td>
</tr>
<tr>
<td>&gt;34</td>
<td>85</td>
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</tbody>
</table>

Abbreviations: APACHE, Acute Physiology and Chronic Health Evaluation; ICU, intensive care unit.
ASCT and bedside nurses by CCRN certification, APACHE classification, monitoring frequency, shift, number of pumps, transport duration, order status, and number of medications administered during transport. Of note, individual nurses were not tracked by the audit form; therefore, the actual number of nurses that went on transports is unknown and it is possible that the same nurse went on multiple transports.

**Compliance**

At least 2 persons accompanied 65.9% of transports (n = 493). Most of all transports (n = 502) had the minimum required equipment: ICU monitor, 97.2%; defibrillator/ACLS drugs, 96.4%; oxygen, 94%; and bag-valve-mask, 79.1%. For all transports, adherence to pretransport plan coordination was 80.7%, communication was 80.1%, and stabilization was 34.7%. Most of these transports were reported as being monitored frequently—42.2% every 5 minutes, 17.3% every 10 minutes, 25.9% every 15 minutes, 7.4% every 30 minutes, and 4.8% every 60 minutes. Documentation included computerized charting (7.7%) and forms approved by the institution (6.6%). Barriers to compliance were reported by transporting nurses as an inability to document during transport due to quick transports or lack of computer access, to bring certain transport equipment due to equipment malfunction, and to perform pretransport stabilization.

**Unexpected Events**

Unexpected events were classified as physiologic (ie, related to changes in the patient’s clinical status) or non-physiologic (ie, related to issues with equipment or personnel) (Table 1). Events recorded as “other” were related to communication issues between nurses, providers, and ancillary staff; therefore, these events were classified as nonphysiologic along with delay of care, medication, and equipment events. There were a total of 110 UEs reported, of which 63 (57%) were nonphysiologic. These events can reflect the quality of equipment, the efficiency of organizational departments, and staff communication; however, for this study, only physiologic events were considered for further analysis because they are a reflection of undesired changes in patients’ clinical status. Forty-one transports (8.2%) had at least 1 physiologic event, and 11 of these (26.8%) resulted in an aborted transport. These aborted transports were associated with 13 unexpected physiologic events: 5 hemodynamic, 4 sedation, 3 respiratory, and 1 cardiopulmonary arrest. Potential contributing factors to physiologic UEs are related to the patient, personnel, equipment, the environment, and “other” (Table 2). For data analysis, UEs are measured per transport and presented as mean total UEs or the average number of UEs per transport.

**Factors Contributing to Physiologic UEs**

**Patient Related.** Unexpected events were higher among patients with 75% likelihood ICU mortality by APACHE classification ($F_5, 229 = 3.175, P = .009$). The APACHE score positively correlated with UEs among bedside nurses ($r = 0.571, P = .026$). Patients transported from MICU in the 75% mortality APACHE classification tended to have more UEs than those from other units ($F_3, 57 = 5.183, P = .001$). There was no significant difference in events by airway status.

**Personnel and Equipment Related.** Fewer UEs were reported during transports by ASCT than by bedside nurses ($t = −2.151, P = .036$), and fewer were reported during transports by transporting nurses with a BSN or higher degree than by those without (Mann-Whitney U test).
There were more UEs among transports that were compliant with the stabilization process than among transports that were noncompliant \( (t = -2.324, P = .022) \). Transporting nurses with fewer than 5 years of ICU experience did not stabilize transports as often as those with more experience \( (\chi^2 = 24.965, P = .001) \). The great majority (89.3\%) of transports that did not go through the stabilization process \( (n = 328) \) were performed by ASCT. Among unstabilized transports with APACHE scores \( (n = 147) \), 90\% had lower than 55\% likelihood of ICU mortality. There were no significant differences in UEs by critical care certifications, number of personnel per transport, frequency of monitoring, or number of pumps per transport.

**Environment Related.** There was no significant difference in events by unit or destination alone; however, there were more UEs in transports to nuclear medicine, magnetic resonance imaging, and vascular interventional radiology than to other destinations. There were no significant differences in UEs by shift except for NSIU, which had more events during the day (Mann-Whitney \( U P = .045 \)).

**Other Related Factors.** Unexpected events were more frequent when anxiolytics \( (\chi^2 = 24.854, P = .001) \), fluid boluses \( (\chi^2 = 14.127, P = .001) \), antiemetics \( (\chi^2 = 38.148, P = .001) \), and blood products \( (\chi^2 = 8.519, P = .014) \) were administered during transport. The administration of both fluids and antiemetics was associated with UEs \( (F_{1,495} = 6.811, P = .009; F_{1,495} = 26.686, P = .001) \), respectively. There were no significant differences in UEs by duration of transport or order status. Feedback loops did not have an impact on events because there was no significant difference in UEs over time; however, there was a noticeable downward trend in UEs among NSIU transports over time.

**DISCUSSION**

This evaluation plan identified areas for QI, and results suggest that influences on ITCA outcomes are multifactorial. Physiologic events were related to the stabilization process, transporting nurse characteristics, patient acuity, and medications given during transport (Table 5).

**Physiologic Events**

One of the implicit goals of this study is to emphasize the inherent risks of transport, which are more a reflection of patient acuity and independent of the transporting nurse, regardless of their level of experience. Even though most of the transports in this study were performed by ASCT, who are experts in critical care nursing and proficient in identifying/mitigating potential issues during transport, many UEs were still reported. The authors decided to interpret only the physiologic UEs because they did not want to highlight issues that were not related to the patient and could be considered as specific to organizational practices or departmental culture. For example, if the organization provides the ICU with equipment that consistently fails (ie, portable ICU monitor batteries not holding a charge or malfunctioning stretchers), those UEs are independent of the patient and the transporting nurse. These data would be more beneficial to the organization when considering renewing or cancelling purchase agreements with health equipment providers. Likewise, non-physiologic UEs categorized as “delay of care” reflect those events that can be considered as departmental culture issues. For example, if transporting nurses are consistently delayed by more than 5 minutes once arriving to CT scan with a critically ill patient, those UEs are independent of

### Table 5: Factors Contributing to Physiologic Unexpected Events, Incidence, Test, and Significance

<table>
<thead>
<tr>
<th>Factor</th>
<th>Description</th>
<th>UE Incidence</th>
<th>Statistical Test</th>
<th>( P )</th>
</tr>
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<tbody>
<tr>
<td>Patient related</td>
<td>Patients w/ APACHE score &gt;29</td>
<td>Higher</td>
<td>( F_{5,229} = 3.175 )</td>
<td>.009</td>
</tr>
<tr>
<td></td>
<td>Patients w/ higher APACHE scores transported by bedside nurses</td>
<td>Higher</td>
<td>( r = 0.571 )</td>
<td>.026</td>
</tr>
<tr>
<td>Personnel-related</td>
<td>ASCT as transporting nurse</td>
<td>Lower</td>
<td>( t = 2.151 )</td>
<td>.036</td>
</tr>
<tr>
<td></td>
<td>Transporting nurse w/ BSN degree or higher</td>
<td>Lower</td>
<td>Mann Whitney-U</td>
<td>.002</td>
</tr>
<tr>
<td></td>
<td>Transporting nurse w/ &lt;2 y of experience</td>
<td>Higher</td>
<td>( F_{5,495} = 5.079 )</td>
<td>.022</td>
</tr>
<tr>
<td></td>
<td>Stabilization process performed</td>
<td>Higher</td>
<td>( t = -2.324 )</td>
<td>.022</td>
</tr>
<tr>
<td>Other</td>
<td>Anxiolytics administered</td>
<td>Higher</td>
<td>( \chi^2 = 24.854 )</td>
<td>.001</td>
</tr>
<tr>
<td></td>
<td>Fluid bolus administered</td>
<td>Higher</td>
<td>( \chi^2 = 14.127 )</td>
<td>.001</td>
</tr>
<tr>
<td></td>
<td>Antiemetics administered</td>
<td>Higher</td>
<td>( \chi^2 = 38.148 )</td>
<td>.001</td>
</tr>
<tr>
<td></td>
<td>Blood products administered</td>
<td>Higher</td>
<td>( \chi^2 = 8.519 )</td>
<td>.014</td>
</tr>
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</table>

Abbreviations: APACHE, Acute Physiology and Chronic Health Evaluation; ASCT, Adult Specialty Care Team; BSN, bachelor of science in nursing; UE, unexpected event.
the patient and the transporting nurse. These data would be more beneficial to the CT department when considering workflow strategies to improve patient throughput.

Stabilization
Ideally, a stabilization process should outline a pre-risk assessment that is designed to prevent UEs from occurring during transport (which may be why it is suggested in the guidelines); however, this study found just the opposite—transports that were “stabilized” actually had more events. This finding may be related to the subjectivity of the stabilization process, transporting personnel characteristics and patient acuity.

The stabilization process, as defined by the policy and guidelines, does not incorporate objective measurable criteria and is susceptible to subjective interpretation. Also, medical/nursing staff may not fully consider the appropriateness of the transport if they are not aware of its potential to change the plan of care, decrease mortality, or length of stay.

The ASCT, which had fewer reported events than bedside nurses did, performed most of the transports that were not stabilized; therefore, this finding may just be a reflection of ASCT’s positive impact on patient safety. In addition, transporting nurses with less ICU experience, who had more events, did not stabilize transports as often as those with more experience. This may suggest the importance of the stabilization process for transporting nurses with less experience. Furthermore, transports that were not stabilized had low ICU mortality risk, which may suggest that those transports did not need to be further stabilized. Perhaps, stabilized transports were more likely to have UEs simply because of higher patient acuity.

It is quite possible that stabilization, as it is defined by the guidelines, may be considered by some novice/expert nurses as outside of their scope of practice and therefore they are not able to be compliant. Authors of the guidelines should consider revising the guidelines and changing the definition to “the completion of a pretransport risk assessment” and providing an example for organizations to incorporate in to their ITCA policies.

This study did not address transports that were fully compliant with the guidelines. Future studies on ITCA should focus on UEs when transporting nurses are fully compliant with the guidelines, which would highlight the intrinsic risk of ITCA.

Transporting Nurses
The literature suggests that patient safety is optimized when transports are performed by a dedicated team for ITCA.27,29,31,24 Consistent with this, this study found that regardless of patient acuity and ICU experience, physiologic UEs were lower among transporting nurses who specialized in ITCA (Figures 2 and 3). These findings may suggest that in situations when a transport team is not available, ICUs with high-volume transports should consider having unit-based transporters with a BSN or higher and more than 2 years of ICU experience.

Patient Acuity
This study found that UEs were more frequent among transports of patients with higher APACHE scores regardless of the transporting nurse characteristics, monitoring, or stabilization. This is supported by the literature, which suggests that physiologic changes are due primarily to the patient’s severity of illness rather than the transport itself.17 Guidelines, organizational policies, and QI initiatives for ITCA should incorporate reliable risk stratification tools, such as the APACHE, to objectively identify patients at higher risk of having UEs during transport. Because an ICU patient’s status can change quickly, patient acuity should be determined within 24 hours of transport and considered during the stabilization process. Patients with higher likelihood of ICU mortality (ie, APACHE score >29) require extensive collaboration with providers to determine the necessity of transport and discuss potential changes in patient’s plan of care.

Medications
Premedication should also be considered during pretransport planning. It can be hypothesized that optimizing patient’s fluid status and reducing nausea before transport could have potentially prevented UEs (hypotension and nausea/vomiting) observed in this study.

Limitations
This study analyzed self-reported data of transporting nurses to identify UEs that occurred during ITCA. Although self-reported data have their disadvantages, because of the nature of this study, direct data collection would have required a tremendous amount of resources (ie, dedicated and trained study personnel available 24 hours a day for every transport) that were not available to the study coordinator.

This study was also limited by having a single reviewer for data analysis. Because of resource limitations, the study coordinator was responsible for all aspects of the
study, including data interpretation and analysis. However, the data were reviewed by 2 statisticians, 1 of which was independent of the study, to ensure that these data were cleaned, analyzed, and interpreted appropriately. Because there was not an established way of verifying the reported UEs with/by the transporting nurse, the audit form was designed to include UE description to ensure proper classification of the reported UE. On the basis of the narrative description of the UE, the study coordinator appropriately categorized UEs that were indeed dependent on the transporting nurse regardless of how it initially reported. For example, if a UE was reported as respiratory, physiologic, and the narrative description of the UE revealed the transporting nurse neglected to turn on the oxygen tank during the transport, then the UE would be categorized as medication, nonphysiologic. In this study, there was only 1 reported medication UE.

**CONCLUSION**

Considering the increasing number of intrahospital transports and their potential risks, it is imperative for HCOs to evaluate current practices and implement standardized procedures to minimize risks and lower UE incidence. This study reported a UE rate of 8%, which may be considered to be low relative to the number of transports reviewed and as compared with lower rates reported in other studies; however, these data suggest that 1 in every 12 transports will have a physiologic UE even when a highly skilled and dedicated transport team performs the transport. Therefore, HCOs should not be complacent about clinical practice during ITCA. Also, depending on the outcome variable (ie, death vs hypotension), the UE rate for the same HCO can be drastically different. For example, in this study, there were not any reported deaths, but there were many other UEs (ie, hypotension, vomiting) that occurred during transport that could adversely affect patient outcome (ie, acute kidney injury or aspiration pneumonia). Complications from UEs can be associated with increased length of stay, which may adversely impact health care costs. Therefore, all potential risks during ITCA should be identified and considered in an evaluation plan.

To improve quality of care, QI methods should involve strategies that focus on the patient, the process and delivery of health care, systems change and data utilization, and teamwork. Organizations can achieve greater impact in outcomes if QI efforts address the content of care (ie, evidence-based practice guidelines) and process of care (ie, standardized policies and procedures). Improvement processes should emphasize several dimensions of quality: technical performance (ie, compliance), effectiveness of care (ie, desired outcomes), efficiency of service delivery (ie, prompt care), safety (ie, low risks), and interpersonal relations (ie, communication between providers). Evaluation of these dimensions may highlight systems issues such as recurrent problems with equipment (ie, transport monitor or stretcher malfunctions), departmental issues (ie, delays of care in certain diagnostic areas), and institutional or unit based culture issues (ie, compliance with policies, incomplete patient handoff, etc). A comprehensive evaluation plan can also identify patterns that, if addressed appropriately, can affect systems change. For example, administrators may consider reallocating nursing resources if an evaluation reveals that certain units, with less experienced nursing staff, have more transports and higher UEs than other units do. Likewise, procedural departments may consider increasing nursing or ancillary staff if an evaluation reveals a greater number of transports of patients with higher APACHE scores. When considering the impact of the HCO on patient safety during ITCA, the identification of systems issues is just as critical as determining UE incidence; therefore, HCOs should implement QI strategies that focus on all dimensions of quality during ITCA.

Traditional QI strategies include but are not limited to provider education, audit and feedback, and organizational change. Rapid change or rapid cycle QI methods (ie, frequent feedback loops) can positively change behavior and thereby improve compliance and outcomes. By focusing on reducing failure rates rather than just improving performance, rapid cycle methodology, in addition to traditional QI tools, can expedite change and results. Therefore, to optimize results, evaluation plans should incorporate rapid cycle QI methods in addition to traditional QI methods.

Given the dynamic nature of patient acuity and the complexity of health care systems, there is a need for ongoing evaluation of ITCA policies and practice. Standardized transport and evaluation plans, with clearly defined quality measures, are required for organizations to assess and compare quality of care during ITCA. The plan used in this study satisfies this requirement while focusing on the dimensions of quality aforementioned. Ultimately, this evaluation plan can be used as a model for identifying practice/systems issues, influencing organizational QI initiatives, benchmarking desired quality outcomes, and catalyzing the revision of organizational policies and professional guidelines for ITCA.
Acknowledgments
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References
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Deirdre K. Thornlow, PhD, RN, CPHQ, is an assistant professor at DUSON, a John A. Hartford Foundation Claire M. Fagin Fellow, and a Senior Fellow in the Duke Center for the Study of Aging and Human Development. She received her doctoral degree from the University of Virginia School of Nursing. Her research interests involve understanding the relationship among hospital characteristics, patient safety practices, and patient outcomes.

Approval for this study was obtained by the institutional review boards at the University of North Carolina at Chapel Hill and Duke University.

The authors have disclosed that they have no significant relationship with, or financial interest in, any commercial companies pertaining to this article.

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Appendix A

RN DATA TRACKING FORM

MR# ____________________________ DATE 7/1/2016

UNIT
- SICU
- NSIU
- MICU
- COORDINATION
- STABILIZATION

PRE-TRANSPORT
- COMMUNICATION
- RT
- NA
- MD

# OF PERSONNEL
- RN
- RT
- NA
- MD

EQUIPMENT
- ICU MONITOR
- DEFIBRILLATOR
- & ACLS DRUGS
- OXYGEN
- BMV
- VENTILATOR
- TRACH
- OBTURATOR

AIRWAY
- VENTED
- NON-VENTED
- TRACH

ASCT

OTHER

# OF PUMPS 1 2 3 4 5 6 7 8 9

DESTINATION #1 1 2 3 4 5 6 7 8 9

DESTINATION #2 1 2 3 4 5 6 7 8 9

DESTINATION KEY
1) XRAY
2) CT SCAN
3) MRI
4) VIR
5) GIP
6) FLUORO
7) NUC MED
8) RAD ONC
9) U/S
10) PV/L
11) ICU
12) STEPDOWN
13) FLOOR
14) PET SCAN
15) OTHER

APACHE KEY
1) AGE
2) TEMP
3) pH
4) HR
5) RR
6) Na
7) K
8) Cr
9) Hct
10) WBC
11) GCs
12) PaO2
13) PaCO2
14) FiO2

APACHE SCORE

DURING TRANSPORT:
- MONITORING FREQUENCY (MIN)
  - q5
  - q10
  - q15
  - q30
  - q60
  - >q60
- DOCUMENTATION TYPE
  - E-chart
  - mod sedation
  - code sheet
- LEVEL OF MONITORING
  - ICU
  - off telemetry
- TRANSPORT STATUS
  - ABORTED
  - COMPLETED
  - MD CANCELLED

UNEXPECTED EVENTS (UEs)
- RESPIRATORY
- HEMODYNAMIC
- NEUROLOGICAL
- GENITOURINARY
- CARDIAC
- GASTROINTESTINAL
- ACCESS
- SEDATION
- NEUROVASCULAR
- FALL
- EQUIPMENT
- CODE BLUE
- PAIN
- DEATH
- DELAY OF CARE
- OTHER

DESCRIPTION OF UE(s):

HOW COULD UE(s) HAVE BEEN PREVENTED?

BARRIERS TO COMPLIANCE:
- Computer access
- Duration of transport
- Transport destination
- Personnel availability
- Equipment
- Other

BARRIER DESCRIPTION:

20504

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TRANSPORT AUDIT FORM DEFINITIONS

Pre-transport coordination: coordination with ancillary services and departments about the transport and services needed (i.e. ASCT, respiratory therapy, practitioners and transport destination staff).

Pre-transport communication: communication with nurses, respiratory therapists and practitioners regarding the patient’s clinical status and treatment during the transport (i.e. inability to lay flat, frequent suctioning and sedation requirements).

Pre-transport stabilization: consideration of the appropriateness of transport given the patient’s clinical status (i.e. hemodynamic stability) and potential for the diagnostic or intervention to alter management (i.e. change in plan of care) or patient outcome (i.e. decrease mortality or length of stay).

Unexpected events category description

<table>
<thead>
<tr>
<th>Category</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiratory</td>
<td>An oxygen saturation less than 90% or a 10% decrease from baseline; a dislodged endotracheal or nasotracheal tube; new onset shortness of breath; and respirations less than eight or more than thirty breaths per minute that is not related to pain.</td>
</tr>
<tr>
<td>Cardiac</td>
<td>Sustained or new onset arrhythmias to include a heart rate less than forty or higher than 130 beats per minute, atrial fibrillation, ventricular tachycardia, torsades de pointes, supraventricular tachycardia and atrioventricular blocks.</td>
</tr>
<tr>
<td>Hemodynamic</td>
<td>Hemorrhage and/or systolic blood pressures less than ninety or a decrease in systolic blood pressures by more than 20% of baseline.</td>
</tr>
<tr>
<td>Gastrointestinal</td>
<td>Vomiting, dislodgment of a drain, catheter, feeding or rectal tube.</td>
</tr>
<tr>
<td>Genitourinary</td>
<td>Dislodgement of a urinary device, new onset hematuria or urine output less than fifty milliliters for four hours.</td>
</tr>
<tr>
<td>Access</td>
<td>Dislodged or dysfunctional venous access device or invasive monitoring device (i.e. peripheral intravenous device, central venous catheter, pulmonary artery catheter, external ventricular device).</td>
</tr>
<tr>
<td>Sedation</td>
<td>Agitation or inability to maintain adequate level of sedation for diagnostic or procedure.</td>
</tr>
<tr>
<td>Neurological</td>
<td>New onset mental status change that is not related to sedation including but not limited to stroke and seizure.</td>
</tr>
<tr>
<td>Pain</td>
<td>Difficult to control or increase pain level disproportionate to clinical status, diagnostic or intervention.</td>
</tr>
<tr>
<td>Equipment</td>
<td>Failure or malfunction of transport equipment (e.g. defibrillator, ICU monitor, ventilator, pump, stretcher or depleted oxygen tank).</td>
</tr>
<tr>
<td>Delay of care</td>
<td>A delay of care by more than five minutes upon arrival to destination.</td>
</tr>
<tr>
<td>Medication</td>
<td>Inadvertent discontinuation of vasopressive/sedation therapy and/or medication administration errors.</td>
</tr>
<tr>
<td>Cardiopulmonary arrest</td>
<td>A non-perfusing cardiac rhythm or pulseless electrical activity, asystole or apnea</td>
</tr>
<tr>
<td>Death</td>
<td>Patient expiration due to DNR status or failed resuscitation</td>
</tr>
<tr>
<td>Fall</td>
<td>A fall from stretcher, wheelchair, lift/transfer device or standing position</td>
</tr>
<tr>
<td>Other</td>
<td>An event not otherwise described by any of the aforementioned categories. Narrative description of the event is warranted.</td>
</tr>
</tbody>
</table>

Glasgow Coma Scale

<table>
<thead>
<tr>
<th>Score</th>
<th>Eyes</th>
<th>Verbal</th>
<th>Motor</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Remains closed</td>
<td>No response</td>
<td>No response</td>
</tr>
<tr>
<td>2</td>
<td>Opens to pain</td>
<td>Sounds only</td>
<td>Extension</td>
</tr>
<tr>
<td>3</td>
<td>Opens to speech</td>
<td>Words</td>
<td>Abnormal flexion</td>
</tr>
<tr>
<td>4</td>
<td>Spontaneous</td>
<td>Confused</td>
<td>Withdraws</td>
</tr>
<tr>
<td>5</td>
<td>Oriented</td>
<td>Localizes</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

FIo2 conversion

<table>
<thead>
<tr>
<th>FIo2 conversion</th>
<th>Rectal temperature conversion (Celsius)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liters</td>
<td>%FIo2</td>
</tr>
<tr>
<td>-------</td>
<td>------</td>
</tr>
<tr>
<td>1</td>
<td>24</td>
</tr>
<tr>
<td>2</td>
<td>27</td>
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<td>3</td>
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<td>33</td>
</tr>
<tr>
<td>5</td>
<td>36</td>
</tr>
<tr>
<td>6</td>
<td>39</td>
</tr>
</tbody>
</table>

Questions/concerns: Please contact an ASCT nurse at 919-347-0553

APACHE score

- record lab values within 24hrs prior to transport
- go to APACHE II calculator link in Favorites: http://www.mdcalc.com/apache-ii-score-for-icu-mortality
- enter lab values directly into calculator
- convert temperature to rectal using conversion table below
- only calculate A-a gradient if FIO2 >50%, (atmospheric pressure is 760mmHg), leave blank if no ABG available
- convert liters nasal cannula to FIO2 using conversion table below

Medications given during transport

- initiation of drip, rate increase of existing drip or bolus of medication (scheduled or prn) given during transport
- Duration of transport
- do not include preparation time
- record the time leaving from the unit
- record the amount of time it takes to complete the entire transport and return to the unit