The work culture of anesthesia – how fatigue in anesthesia care practitioners may affect patient care: a systematic review protocol

Laura Bonanno, CRNA, DNP\textsuperscript{1,2}
Susan Orlando, DNS, APRN, NNP-BC\textsuperscript{1,2}
Juanita Derouen, CRNA, Doctor of Nursing Practice student\textsuperscript{1,2}

1. Louisiana State University Health Sciences Center at New Orleans, School of Nursing
2. The Louisiana Center for Evidence-Based Nursing at LSUHSC-NO School of Nursing:
   An Affiliate Center of the Joanna Briggs Institute

Corresponding author
Laura Bonanno
lbonan@lsuhsc.edu

Review question/objective

The objectives are to identify the effect of fatigue in anesthesia care providers on patient safety. This review aims to answer the following specific questions:

- Does fatigue in anesthesia care providers impact patient safety?
- Considering validity and reliability, are anesthesia care providers accurate in their assessment of their fatigue?
- Does the current work culture of anesthesia precipitate practitioner fatigue?

Background

Anesthesia requirements

Like many other health care specialties, the practice of anesthesia demands that the practitioner be available to provide anesthesia services 24 hours a day, seven days a week. Many hospitals today require an in-house anesthetist to be available for after hour emergency anesthesia care and care for labor and delivery patients around the clock. This on-demand type of service has the potential to affect the natural circadian rhythm that keeps one’s mind and body in balance and alert. Howard et al found that the human body’s need for sleep and the natural cycle of sleep is often at odds with the demanding work cycle of the anesthetists’ job.1 In the highly skilled profession of anesthesia, does fatigue, caused by circadian disruptions, have the potential to directly affect an anesthetist’s patient care?
Characteristics of anesthetists

Howard et al. have compared the culture of anesthesia to other professions such as airline pilots and freight train operators that require attentiveness. Where take-off and landing of an aircraft are the points at which most problems may occur, induction of anesthesia and emergence from anesthesia can often be critical times due to the potential for airway compromise. During the average surgical case, induction of an anesthetic and emergence typically present critical moments for the patient. Many of the medications used to begin an anesthetic and maintain it are cardiosuppressive so care is needed to preserve optimal cardiac output and tissue perfusion. Induction medications also cause airway compromise for the patient and thus airway manipulation and support are needed. Except in the instance of emergency, anesthesia patients undergo a preoperative evaluation prior to surgery in order to identify potential co-existing disease processes or potential airway issues that may lend the patient to further evaluation or optimization prior to surgery. Blood pressure, heart rate and respiratory changes are expected upon induction of anesthesia. Anesthesia care providers are trained to expect these changes and respond accordingly to ensure the patient’s safety. Once the anesthetic has begun and the airway is secured, the anesthetist titrates the maintenance medications to the appropriate level of anesthetic and to the patient’s needs as directed by the patient’s history, their vital signs and the type of operative case that is to be done.

When the surgical case is complete, the anesthetist begins weaning the patient off of the anesthetic gasses and medications used to maintain the required level of anesthesia. As the patient begins to physiologically take back control of their airway and respirations, the anesthetist then uses clinical judgement to determine when supportive airway devices should be discontinued. This is another point at which critical events can occur and potentially compromise the patient.

In contrast to the obvious assiduousness required at induction and emergence of anesthesia, the time between induction and emergence of anesthesia has been idiomatically referred to as “auto pilot”. During surgery for an anesthetist; however, changes in the patient’s status inherent to co-existing disease processes or progression of the surgery have the potential to have major effects on the patient’s outcome. These vacillating changes require constant, alert observation by the anesthetist in order to deliver the changes in the anesthetic to maximize perfusion of tissues and maintain the body’s homeostasis. The tedious nature of continuous monitoring needed during anesthesia can be compounded by fatigue caused by sleep loss or sleep disruption inherent in the work culture of anesthesia. The cognitive requirements of constant monitoring required during administration of an anesthetic also have the potential to lead to fatigue. Fatigue caused by sleep loss can lead to increased reaction times and can lower work performance such as decreased vigilance, diminished memory and decision-making. Fatigue in an anesthetist during less eventful times of anesthesia may deviate the course of anesthesia to a less safe path. According to Murray et al., vigilance constitutes a tremendous portion of workload in the profession. There is no room for complacency. Continuous patient monitoring requires the anesthetist to be ever vigilant and recognize patterns, trends and acute changes in the patient in order to accurately treat emergencies or declining physiological trends and sometimes acute changes in the patient in order to effectively guide the patient’s anaesthetic plan of care to a safe outcome.
In the United States, the hours worked by anesthesia care providers fluctuate. Whether an anesthetist has set scheduled hours or works on a salary basis, the potential to stay late at work exists daily as surgery schedules are dynamic. As in-patient institutions, such as hospitals, need an available anesthetist to cover emergency or add on cases as well as the population of patients in labor and delivery, anesthetists ordinarily rotate calls. There is often in-house calls that require the anesthetist to remain in the hospital for 16-24 hours and cover emergency cases and gravid patients in labor and delivery units. A backup or second call may be needed and taken from home with a designated response time from the anesthetist when needed. There may also be calls for anesthesia care needed for specialty cases such as emergency coronary artery bypass surgery or transplant cases. Because anesthesia is a service provided to the surgical and other medical staff as needed, the operative schedules and total number of hours worked by the anesthesia care provider is unpredictable. Regardless of the schedule set up, the dynamic environment of the operative suite dictates that anesthetists are required to cover all surgical cases.

For many anesthetists in the United States, a day off after a day of calls is an opportunity to work at another facility. A vacation from a full time employer is considered prime time to take a *locum tenens* placement job for a week or two at an outside facility. Some anesthetists that work scheduled shifts, choose to work at other facilities prior to coming into their main employer if their hours permit. According to the American Association of Nurse Anesthetist’s work schedule survey results, an average of 27.7% of anesthetists have anesthesia related jobs outside of their primary anesthesia employer. The reason for working extra is multifaceted and complex. Anesthetists may work at outside facilities to keep their skills up. If one facility does not offer ample time or allow for regional anesthesia, the anesthetist may choose to work extra hours at another facility to remain sharp. The pay for extra work is also financially rewarding and enticing to young graduates with mounting student loans or other financial obligations. Leichfried et al. found that there was not a substantial influence on circadian disruption after working a single 24-hour shift. If the anesthetist chooses to work another shift at another facility after working a full 24-hour shift, what potential exists for fatigue to affect patient care?

Historically anesthesia care providers have delivered safe patient care. However, the many hours worked by the anesthetist combined with the culture to work “extra” at other hospitals or clinics, has the potential to lead to fatigue in the anesthetist. This fatigue may have implications on the individual anesthetist and potentially to those patients in whom their care has been entrusted. Data from a survey by Howard et al revealed that more than 50% of anesthesia caregivers reported error in patient care judgment related to fatigue. Long work hours have been implicated in adverse patient outcomes. In one case, an anesthesiologist fell asleep during a case where an 8-year-old child died. In addition needle sticks or other self-inflicted job related injuries are more common after the ninth consecutive hour of work. Murray et al. conducted a driver simulation study on sleep disrupted anesthetists to assess vigilance after a night of call and found that sleep-disrupted anesthetists had lower vigilance scores than those that were rested. With vigilance being a key component of an anesthetist’s care, and with the unpredictable nature of anesthesia care, it would seem that the potential exists for increased complications with patient care when the anesthetist is fatigued.

Fatigue may play a role in procedural complications such as unintended dural puncture when placing an epidural for a regional anesthetic. A prospective analysis of 1489 consecutive epidural anesthetic procedures was done and the analysis showed that there was an increased risk of dural puncture in
epidurals that were performed at night. This same study also implicated skill level as a separate factor affecting the incidence of unintended dural puncture. Riad et al. found that the anesthesia profession demands long work hours, continuous vigilance, stressful circumstances, pressure to complete cases in a timely manner, and proficiency compounded by the constant looming fear of litigation. There are no systematic reviews as yet on this topic.

**Keywords**

anesthesia care; fatigue; patient safety; patient outcomes; anesthesia errors

**Inclusion criteria**

**Types of participants**

This review will consider studies that include nurse anesthetists, anesthesiologists, student nurse anesthetists, anesthesiology residents, and anesthesia assistants regardless of gender, race, age or nationality.

**Types of intervention(s)/phenomena of interest**

This review will consider studies that evaluate fatigue among the participant groups of interest.

**Types of outcomes**

This review will consider studies that include the following outcome measures: the incidence of error and potential error attributable to fatigue such as medication errors, procedural errors (such as, unintended dural puncture in epidural patients), or omission of pertinent patient history, the incidence of impaired vigilance in an anesthesia provider related to fatigue as measured by vigilance tests, self reports, and neurocognitive tests following a night of call or intentional sleep deprivation for simulated studies.

This review will consider studies that also include the following outcome measures: the number of hours worked by anesthesia care professionals, the number of full time, part time and locums employers anesthesia care professionals have.

**Types of studies**

This review will consider both experimental and epidemiological study designs including simulator driven randomized controlled trials, non-randomized controlled trials, quasi-experimental, before and after studies, prospective and retrospective cohort studies, case control studies and analytical cross sectional studies for inclusion.

This review will also consider descriptive epidemiological study designs including case series, individual case reports and descriptive cross sectional studies for inclusion.
Search strategy

The search strategy aims to find both published and unpublished studies. A three-step search strategy will be utilized in this review. An initial limited search of MEDLINE and CINAHL will be undertaken followed by an analysis of the text words contained in the title and abstract, and of the index terms used to describe article. A second search using all identified keywords and index terms will then be undertaken across all included databases. Thirdly, the reference list of all identified reports and articles will be searched for additional studies. Studies published in English will be considered for inclusion in this review. Studies published from inception of the database through May 2013 will be considered for inclusion in this review.

The databases to be searched include:

CINAHL
Scopus
Web of Science.

The search for unpublished studies will include: theses and dissertations submitted to OpenSIGLE and ProQuest; reports; non-independent research, or other documents produced and published by government agencies, academic institutions and other groups that are not distributed or indexed by commercial publishers; and unpublished scholarly papers.

Initial keywords to be used will be:

Anesthesia care
Anesthetist
Anesthesiologist
Fatigue
Fatigue countermeasures
Anesthesia patient safety
Anesthesia patient outcomes
Anesthesia medication errors
Anesthesia procedural errors
Aesthesia morbidity
Anesthesia mortality
Hours worked by anesthesiologists
Hours worked by anesthetists.
Assessment of methodological quality

Quantitative papers selected for retrieval will be assessed by two independent reviewers for methodological validity prior to inclusion in the review using standardized critical appraisal instruments from the Joanna Briggs Institute Meta Analysis of Statistics Assessment and Review Instrument (JBI-MAStARI) (Appendix I). Any disagreements that arise between the reviewers will be resolved through discussion, or with a third reviewer.

Data collection

Quantitative data will be extracted from papers included in the review using the standardized data extraction tool from JBI-MAStARI (Appendix II). The data extracted will include specific details about the interventions, populations, study methods and outcomes of significance to the review question and specific objectives.

Data synthesis

Quantitative papers will, where possible be pooled in statistical meta-analysis using JBI-MAStARI. All results will be subject to double data entry. Effect sizes expressed as odds ratio (for categorical data) and their 95% confidence intervals will be calculated for analysis. Heterogeneity will be assessed statistically using the standard Chi-square and also explored using subgroup analyses based on the different quantitative study designs included in this review. Where statistical pooling is not possible the findings will be presented in narrative form including tables and figures to aid in data presentation where appropriate.

Conflicts of interest

There are no conflicts of interest.

Acknowledgements

Thanks to Marsha Bennett, DNS for her tireless dedication and scholarly guidance.

This review contributes to the Doctor of Nursing Practice degree award for Juanita Derouen.
References


Appendix I: Appraisal instruments

MAStARI appraisal instrument

<table>
<thead>
<tr>
<th>JBI Critical Appraisal Checklist for Randomised Control / Pseudo-randomised Trial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reviewer: ____________________________ Date: ________________________________</td>
</tr>
<tr>
<td>Author: ____________________________ Year: _______ Record Number: _______</td>
</tr>
</tbody>
</table>

1. Was the assignment to treatment groups truly random?  
   - Yes [ ]  - No [ ]  - Unclear [ ]  - Not Applicable [ ]

2. Were participants blinded to treatment allocation?  
   - Yes [ ]  - No [ ]  - Unclear [ ]  - Not Applicable [ ]

3. Was allocation to treatment groups concealed from the allocator?  
   - Yes [ ]  - No [ ]  - Unclear [ ]  - Not Applicable [ ]

4. Were the outcomes of people who withdrew described and included in the analysis?  
   - Yes [ ]  - No [ ]  - Unclear [ ]  - Not Applicable [ ]

5. Were those assessing outcomes blind to the treatment allocation?  
   - Yes [ ]  - No [ ]  - Unclear [ ]  - Not Applicable [ ]

6. Were the control and treatment groups comparable at entry?  
   - Yes [ ]  - No [ ]  - Unclear [ ]  - Not Applicable [ ]

7. Were groups treated identically other than for the named interventions?  
   - Yes [ ]  - No [ ]  - Unclear [ ]  - Not Applicable [ ]

8. Were outcomes measured in the same way for all groups?  
   - Yes [ ]  - No [ ]  - Unclear [ ]  - Not Applicable [ ]

9. Were outcomes measured in a reliable way?  
   - Yes [ ]  - No [ ]  - Unclear [ ]  - Not Applicable [ ]

10. Was appropriate statistical analysis used?  
    - Yes [ ]  - No [ ]  - Unclear [ ]  - Not Applicable [ ]

Overall appraisal:  
- Include [ ]  
- Exclude [ ]  
- Seek further info. [ ]

Comments (Including reason for exclusion):  

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
# JBI Critical Appraisal Checklist for Descriptive / Case Series

Reviewer __________________________ Date ______________________

Author __________________________ Year _______ Record Number _______

1. Was study based on a random or pseudo-random sample?  
   ![ ] Yes  ![ ] No  ![ ] Unclear  ![ ] Not Applicable

2. Were the criteria for inclusion in the sample clearly defined?  
   ![ ] Yes  ![ ] No  ![ ] Unclear  ![ ] Not Applicable

3. Were confounding factors identified and strategies to deal with them stated?  
   ![ ] Yes  ![ ] No  ![ ] Unclear  ![ ] Not Applicable

4. Were outcomes assessed using objective criteria?  
   ![ ] Yes  ![ ] No  ![ ] Unclear  ![ ] Not Applicable

5. If comparisons are being made, was there sufficient descriptions of the groups?  
   ![ ] Yes  ![ ] No  ![ ] Unclear  ![ ] Not Applicable

6. Was follow up carried out over a sufficient time period?  
   ![ ] Yes  ![ ] No  ![ ] Unclear  ![ ] Not Applicable

7. Were the outcomes of people who withdrew described and included in the analysis?  
   ![ ] Yes  ![ ] No  ![ ] Unclear  ![ ] Not Applicable

8. Were outcomes measured in a reliable way?  
   ![ ] Yes  ![ ] No  ![ ] Unclear  ![ ] Not Applicable

9. Was appropriate statistical analysis used?  
   ![ ] Yes  ![ ] No  ![ ] Unclear  ![ ] Not Applicable

Overall appraisal:  
Include [ ]  Exclude [ ]  Seek further info [ ]

Comments (Including reason for exclusion):

__________________________________________

__________________________________________

__________________________________________

__________________________________________
**JBI Critical Appraisal Checklist for Comparable Cohort/ Case Control**

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
<th>Unclear</th>
<th>Not Applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Is sample representative of patients in the population as a whole?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Are the patients at a similar point in the course of their condition/illness?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Has bias been minimised in relation to selection of cases and of controls?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Are confounding factors identified and strategies to deal with them stated?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Are outcomes assessed using objective criteria?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Was follow up carried out over a sufficient time period?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Were the outcomes of people who withdrew described and included in the analysis?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Were outcomes measured in a reliable way?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Was appropriate statistical analysis used?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Overall appraisal: [ ] Include [ ] Exclude [ ] Seek further info. [ ]

Comments (Including reason for exclusion)

________________________________________________________________________

________________________________________________________________________
Appendix II: Data extraction instrument (MASTARI)

**JBI Data Extraction Form for Experimental / Observational Studies**

<table>
<thead>
<tr>
<th>Reviewer</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Journal</th>
<th>Record Number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Study Method**

<table>
<thead>
<tr>
<th>RCT</th>
<th>Quasi-RCT</th>
<th>Longitudinal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Retrospective</th>
<th>Observational</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Participants**

<table>
<thead>
<tr>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

**Sample size**

<table>
<thead>
<tr>
<th>Group A</th>
<th>Group B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Interventions**

<table>
<thead>
<tr>
<th>Intervention A</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Intervention B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

**Authors' Conclusions:**

<p>| |</p>
<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

**Reviewers' Conclusions:**

<p>| |</p>
<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>
Study results

Dichotomous data

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Intervention 1 ( ) number / total number</th>
<th>Intervention 2 ( ) number / total number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Continuous data

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Intervention 1 ( ) number / total number</th>
<th>Intervention 2 ( ) number / total number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>