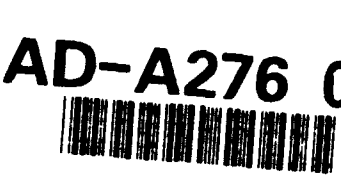

(2)

ONR Grant #N00014-91-J-1540

Report Date: February 9, 1994 Quarter #: 11

Report Period: 11/01/93 - 1/31/94

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Title: Development and Enhancement of a Model of Performance and Decision Making Under Stress in a Real Life Setting

Institution: University of Maryland at Baltimore and
Maryland Institute for Emergency Medical Systems

Current staff with percent effort of each on project:

Colin F. Mackenzie	22%	Peter Hu	5%
William Bernhard	5%	Paul Delaney	5%
Cliff Boehm	5%	Denise Ovelgone	50%
Brian McAlary	5%	Robert Durocher	50%
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		David Mahaffey	33%

QUARTERLY REPORT

A large portion of the quarter has been taken up with video-analysis and administrative requirements for re-approval of the protocol by the Institutional Review Board. A few additional cases have been videotaped in conjunction with Holter monitoring and blood pressure (BP) recording of the anesthesia care providers.

Video-analysis

The following tasks have been achieved:

1. Completion of subjective stressors scores on all videotapes #50-100. The seven subjective ratings of stress and stressors are being transcribed into the Paradox database. We will be using a Neural Networks analysis to determine which components among the six stressors are most predictive of the overall stress score.

2. Completion of intubation sequence analysis on 43 videotapes showing tracheal intubation. The intubation analysis form (Attachment #1) has been completed by subject matter experts other than those who participated in a given case, for 43 cases involving tracheal intubation (Airway Management). Sixteen were in elective circumstances, eleven semi-emergencies and sixteen show emergency airway management. An abstract describing a presentation by the PI at a conference at the University of Basel, Switzerland, is attached (Attachment #2).

3. Assessments of inter-rater reliability for subjective stressor scores and intubation analysis. Inter-rater reliability has been tested by having the PI and one other SME review the same 15 videotapes. The two SME's have scored one minute interval stressors (n=6) and also completed the intubation analysis form for all 15 videotapes. Further, we have taken one videotape, and six individual SME's who have reviewed other videotapes, a" independently reviewed this one tape. Subjective ratings of stress and an intubation analysis form were completed by all six reviewers. The case chosen for review by the six SME's was thought, by the PI, to have procedural and decision-making errors, but the other reviewers were unaware of this. These data have not yet been fully analyzed but initial reviews show a remarkable inter-rater correlation. These data are to be included in the video-analysis methodology paper.

4. Further Analysis of Post-Trauma Treatment Questionnaire (PTQ) Data

As discussed in our last quarterly progress report, previous analyses of the PTQ data had utilized primarily Spearman Rank Order Correlations (i.e., non-parametric correlation). These analyses had suggested a number of interesting relationships between the more "objective" measures (patient injury severity, anesthesiologist fatigue, and anesthesiologist experience) and the more "subjective" measures (ratings of perceived stress, fatigue, teamwork, case difficulty, and own performance). More recently we have delved further into these relationships, using parametric statistical techniques when appropriate and looking at combinations of predictor variables in accounting for the variance in the subjective ratings of interest. The initial analyses had not taken account of the fact that some anesthesiologists contributed more than others to these questionnaire data (i.e., some had completed more video taped cases and thus had filled out more PTQ forms). Our more recent analyses, utilizing parametric regression, were able to partial out the variance that was associated with inter-rater differences. This resulted in some attrition in statistically significant effects, although the stronger relationships among variables that had been apparent in the Rank Order Correlations were also apparent in these subsequent regression analyses. By using a polynomial regression model, we have also now been able to delineate whether the nature of the relationships between specific pairs of variables are linear or quadratic.

We have also used Principal Components Factor Analysis in two ways. First, we have used factor analyses to learn more about the underlying dimensionality of our measures of patient injury severity, anesthesiologist fatigue, and experience. These factor analyses revealed two separable dimensions of experience (one weighted heavily on the questions addressing duration or quantity of experience and the other weighted heavily on the questions addressing the recency of relevant experience), two dimensions of fatigue (one related to the questions concerning time awake and the other related to the amount of sleep incurred when last slept), and one underlying dimension of patient injury severity (seemingly related to degree of trauma). Second, having thus reduced the group of questionnaire items concerning patient severity, fatigue, and experience to these underlying dimensions, we then calculated factor scores for each new dimension and used these as the predictor variables in regressions with the subjective rating variables as criterion variables. Of interest are differences in the pattern of significant relationships between these various underlying dimensions of the data.

Further ongoing analyses are now examining interactions among the different types of "objective" variables in accounting for the various "subjective" variables. For example, given that patient injury severity was strongly related to the ratings of case difficulty, we can ask whether experience interacts with patient severity in determining case difficulty. One might expect that relevant experience would, to some extent, mitigate the effects of patient injury severity, i.e., the more experience with a given type of injury, no matter how severe, the less difficult the case might seem. Fatigue, on the other hand, might potentiate the sense of case difficulty, given a particular severity of patient injury. By using factor scores instead of the raw questionnaire responses in these analyses, we both reduce the number of multiple regression analyses being performed and succintly reveal any differences in such interactions between the different separable dimensions (i.e., factors) of fatigue and experience.

A detailed report of these analyses is being prepared for submission to a refereed journal and will be provided to ONR under separate cover.

5. Revision of Anesthesiology paper and re-submission in response to editorial comments.

6. A first draft paper of communication analysis on 30 videotape transcriptions has been completed. Similarly, a methodology paper describing the video acquisition system is in first draft form.

Administrative

The PI has had to spend approximately 100 hours in the past three months in obtaining re-approval of this protocol by the Institutional Review Board (IRB). First, the IRB requested review by legal council of the hospital and University. Next, we were required to obtain approval of the protocol under the Quality Assurance Guidelines then the PI was requested to present the rationale behind the protocol and answer questions from the staff working in the Admitting Areas and Operating Rooms of Shock Trauma.

The PI also had to present the material to the IRB, to a subcommittee of the IRB and send out questionnaires to all the participant anesthesia care providers to ensure that they were not being coerced into participation in videotaping. This has been achieved and approval was granted for us to continue videotaping.

<u>Videotaping has recommenced with the objectives of:</u>

1. Obtaining Holter (electrocardiogram rate rhythm and ST segment analysis) monitoring of the anesthesia care providers. In addition, we are measuring blood pressure non-invasively. Both Holter monitoring and BP recording have been carried out throughout the

twelve hour shift and a diary of stressful events and videotapes of patient care have also been completed (to date in three cases).

2. Completing recall questionnaires after videotaping to determine how much detail the participant anesthesia care provider can recall about the case before viewing the videotape (See Attachment #3).

We will compare subjective ratings of stress obtained by viewing videotapes with the objective measures of blood pressure, heart rate and rhythm and ST segment changes. It is hoped we will be able to validate our subjective stress scores.

Presentations Planned PI

1. A 1.5 hour discussion with videotape demonstration of "Trauma Patient Airway Management" at the 68th Clinical and Scientific Congress of the International Anesthesia Research Society Congress, Orlando, March 5-9.
2. Material described in Attachment #2 will be presented at the 14th Myron B. Laver International Postgraduate Course at the University of Basel, Switzerland, March 17-19.
3. LOTAS group presentation at the 6th International Trauma Anesthesia and Critical Care Society Meeting, Paris, April 22-24.
4. The PI has been invited to join Naturalistic Decision-Making Conference 2. This conference is organized by Klein Associates, Dr. Bogner (FDA), Dr. Orasanu (NASA) and others, to be held in Dayton, Ohio, June 13-15.
5. The PI will present in a panel at the International Ergonomics Association Meeting Toronto Aug 15-19th Title: Communications during emergency and elective airway management. Other panel members are Drs Gopher, Donchin, Gaba, Woods and Javaux.
6. Panel presentation on Human Error and Human Factors, at 38th Human Factors and Ergonomics Society Meeting, Nashville, TN, Oct 24-28.

The PI has also presented data at the Shock Trauma Quality Assurance meetings. The impact of this feed back to the anesthesia care providers who are participants in videotaping will be judged by review of the videotapes that we will be completing in the next quarter.

Quarterly.rep

Attachment 1

Intubation Analysis

The object of the intubation sequence analysis is to gather detailed information about emergency and elective tracheal intubation. We will construct a database using the enclosed questionnaire that we will complete for each intubation case (we have about 60-70 such cases).

The database will include:

1) Clinical Information (indication for intubation, monitors used, difficulties occurring, drugs used)

2) Rules for Intubation (practices that are considered usual for "pre", "during", and "after" phases of intubation management.)

3) Assessment of Psychomotor Skills (and factors that impair these skills and some quantification of how much they delayed intubation.)

4) Decision-making/cognitive skills/Knowledge based skills (we want to tie this in with:)
   a) our subjective ratings of stressors
   b) the decision trees

5) Precise timing of major events in the intubation sequence (among different cases)

6) Psychological aspects of decision-making (Communication / preparation / decision tree issues.)

7) Data (to enable a survey of practices and identify subgroups for comparison of decision-making under stress.)

We will start by reviewing the anesthesia record and case summary and OCS summary files. Then start the video tape about 10 min before intubation was thought to occur. Watch the video making mental notes of your overall impression. Complete the intubation sequence analysis questionnaire. You will certainly have to review the 10 min before, during and after intubation sequence several times to complete the form. You must have OCS Tools running to record times.

STATUS:

AIS _____ **GCS** _____ **ASA** _____ **TAG** _____

Check all applicable catagories:

1. Teaching tape ___
2. Ergonomic issue ___
3. Critical incident ___
4. Equipment malfunction ___
5. Man/machine problem (eg. monitor/ventilator) ___
6. Error detected ___

Case #_____Reviewed by:_____Date:_____

O.C.S. START TIME FOR INTUBATION SEQUENCE: _____:_____:_____._____
(When anesthesiologist mask is placed on for preoxygenation)

I) **Indication for Intubation** (Check all that apply)

A) _____ Airway obstruction that cannot be simply relieved
B) _____ Hypoxemia *
1) _____ PaO_2 <80 mm Hg (SaO_2 <95) on mask O_2 or
2) _____ PaO_2 <60 mm Hg (SaO_2 <90) on air
C) _____ In shock *
1) _____ Systolic BP <80 mm Hg
D) _____ Head injury
E) _____ Unconsciousness
F) _____ Lung contusion suspected
G) _____ Surgery highly likely
1) _____ Obvious Fx/bleeding sites, or
2) _____ Elective case
H) _____ Enable placement of monitors / investigations / peritoneal lavage, etc. in combative patient: AA Protocol implementation necessitates intubation. (Combative/patient: lack of cooperation appears to be the reason for intubation; there should be NONE of the other indications present.)
J) _____ * If not meeting these criteria please identify
1) _____ PaO_2 _____
2) _____ SBP _____

II) **Monitors** (Can be seen or heard.)

A) In place at time of intubation (circle below):

1) SaO_2 2) $ETCO_2$ 3) BP 4) ECG 5) CVP 6) PA

7) Temp 8) Nerve Stimulator 9) Other

B) During and immediately after intubation (circle below):

1) SaO_2 2) $ETCO_2$ 3) BP 4) ECG 5) CVP 6) PA
7) Temp 8) Nerve Stimulator 9) Other

III) **Intubation Drugs** (Drugs used - circle drug used and write dose. State if dose not recorded.)

A) Induction

1) Pentothal _____
2) Ketamine _____
3) Etomidate _____
4) Propofol _____
5) Other (Identify) _____

B) Muscle Relaxant

1) Succinylcholine _____
2) Pancuronium _____
3) Vecuronium _____
4) Atracurium _____
5) Curare _____
6) Other (Identify) _____

IV) **Intubation Route** (from record - circle below):

A)
1) ORAL 2) NASAL 3) CRICOTHYROID 4) TRACHE

B) Cervical Collar Used? Y / N

V) **Intubation Assist**

A) Gum Elastic Bougie Y / N
B) Stylet Used Y / N
C) Laryngeal Mask Y / N
D) Other _____ Y / N (Identify)

VI) **Status**

A) Identify Whether: (Circle)

1) Elective

2) Semi-Emergency (not time critical but urgent)

3) Real-Emergency (Precipitous requirement for Intubation)

B) Identify location: (Circle)

1) OR 2) AA

C) Instrumentation:

1) Tube size Recorded _____

2) Number of Attempts _____

3) Difficulty: (Circle)

a) Not Difficult b) Normal c) Very Difficult

4) Blade Size _____

D) Was there a critical Incident?
(vomit / esoph intubation / hypotension etc...)

1) Y / N (Circle)

(If YES, explain) _____

VII) **Rules of Intubation:** State whether followed or not (circle)

A)	Pre	1) Pre-oxygenate.	Y	N
		2) Head positioned before intubation	Y	N
		3) In-line stabilization used	Y	N
		4) Suction ready?	Y	N
		5) SaO_2 monitored pre-induction?	Y	N
		6) $ETCO_2$ monitored pre-induction?	Y	N
		7) BP monitored pre-induction.	Y	N
		8) HR monitored pre-induction.	Y	N
		9) Cricoid pressure indicated.	Y	N
		10) Cricoid pressure correctly applied.	Y	N
		11) Cricoid pressure maintained until cuff up and ventilated.	Y	N
		12) IV running pre-intubation.	Y	N
		13) Drugs given satisfactorily?	Y	N
		14) Did anesthesiologist and/or CRNA have stethoscope?	Y	N
		15) Was this sequence exactly followed: preox, monitors, cricoid, drugs.	Y	N

B) During	1) Intubation equipment ready?	Y	N
	2) Check neuromuscular block before DL?	Y	N
	3) If 3 attempts fail is pt re-oxygenated?	Y	N
	4) Is cuff inflated to adjust seal?	Y	N
	5) Is tube insertion distance checked?	Y	N
	6) Is left and right side of chest auscultated by anesthesiologist, CRNA, or other?	Y	N
	7) Is upper abdomen auscultated by anesthesiologist, CRNA, or other?	Y	N
	8) If cuff not inflated to just seal, is cuff inflation re-checked?	Y	N
	9) Is tube taped or tied in position?	Y	N
	10) Was timeliness of intubation appropriate?	Y	N

C) After	1) Is the chest listened to after connected to ventilator?	Y	N
	2) Is $ETCO_2$ monitored within 2 min after intubation?	Y	N
	3) Is $ETCO_2$ monitored within 4 min after intubation?	Y	N
	4) Is NM block checked before giving non-depol block?	Y	N

VIII) Logistics of Intubation

A) Tasks	1) Was there appropriate assistance?	Y	N
	2) Was it an efficient intubation?	Y	N
	3) Did anesthesiologist specifically delegate tasks?	Y	N

IX) Psychomotor Skills

A) During Intubation Sequence (mark the analog scale)

1) Mask Ventilation Best _____ Worst

2) Laryngoscopy Best _____ Worst

3) Equipment Handling Best _____ Worst

4) Intubation Best _____ Worst

5) Post intubation checks Best _____ Worst

B) Overall score Psychomotor Skills (circle score)

1)
- 5 Very smooth, rapid, no hitches
- 4 Smooth, average speed, no hitches
- 3 Average smoothness, slower than average, minor hitches
- 2 3 attempts or more, takes longer, equipment failure
- 1 Multiple attempts, major problems, very slow

C) What were the major psychomotor factors that impaired performance when a score of 1, 2, 3, or 4 (from above) was obtained?
(List; estimate time delay for successful intubation.)

MIN SEC

1) _____ 00:____:____.00

2) _____ 00:____:____.00

3) _____ 00:____:____.00

X) **Decision-Making/Cognitive Skills during Intubation Sequence**

A) Were there errors in decision-making? Y N
If yes, identify: _____

B) Were drugs used appropriate? Y N
If no, identify: _____

C) Were drug doses appropriate? Y N
If no, identify: _____

D) Was intubation decision approached appropriately? Y N
If no, identify: _____

E) Was equipment preparation appropriate? Y N
If no, identify: (suggest how it impaired performance)
_____

F) Were there contingencies present, that may have pointed the anesthesiologist down different branches of the emergency tracheal intubation decision tree? Y N
If yes, state contingencies: _____

G) Was patient monitoring appropriate before induction? Y N
If no, why: _____

H) What stressors were present in higher than usual levels or levels that would impair your performance if you were doing the intubation (please check)

1) _____ Adverse non-anesthesia team interactions
2) _____ Adverse anesthesia team interactions
3) _____ Noise
4) _____ Time pressure
5) _____ Task workload
6) _____ Uncertainty
7) _____ Overall stress levels
8) _____ Other stressors (list)_____

XI) **Timing of events** (Please use: OCS Tools time code/Computer Time) (If the events are not carried out state NOT DONE)

A) Before Intubation:

1) ____:____:____.____ Start time of Pre-oxygenation using anesthesia mask? (do not state time when O_2 given by nasal tube O_2 tent or non-rebreather O_2 mask).

2) Y / N Was O_2 being given by other means before anesthesia mask is on?

3) ____:____:____.____ Time for positioning of head and neck for intubation?

4) ____:____:____.____ Start time(s) for cricoid pressure?
____:____:____.____ , ____:____:____.____

5) ____:____:____.____ Stop time(s) for cricoid pressure?
____:____:____.____ , ____:____:____,____

6) _____ Number of times cricoid pressure applied?

7) ____:____:____.____ Start time of IV induction agent?

8) ____:____:____.____ Start time of muscle relaxant?

B) During Intubation:

1) ____:____:____.____ Start Time(s) for each suctioning of
____:____:____.____ the airway?
____:____:____.____ , ____:____:____.____

2) _____ Number of times suction catheter put in and out of mouth?

3) ____:____:____.____ Start Time(s) for each insertion of
____:____:____.____ laryngoscopy?
____:____:____.____

4) ____:____:____.____ Stop Time(s) for each insertion of
____:____:____.____ laryngoscopy?
____:____:____.____

5) _____ Number of times laryngoscope put in and out of mouth before successful laryngoscopy?

6) ____:____:____.____ Start Time(s) tracheal tube inserted in
____:____:____.____ mouth / into nose?
____:____:____.____ , ____:____:____.____

7) _____ Number of times tube put in and out of mouth before successful intubation?

8) ____:____:____.____ Start time for cuff inflation?

C) After Intubation:

1) ____:____:____.____ Time manual ventilation recommences after intubation?

2) (Check) 1st ventilation mode after intubation.
a) _____ Resuscitator bag
b) _____ Anesthesia circuit
c) _____ Mechanical ventilator (without manual vent.)

3) ____:____:____.____ Start Time for listening over right chest?

4) ____:____:____.____ Start Time for listening over left chest?

5) ____:____:____.____ Start Time for listen over upper abdomen?

6) ____:____:____.____ Start Time when ventilator was connected?

6.5) ____:____:____.____ Time when mechanical ventilator ventilates patient

7) ____:____:____.____ Start Time for listening over chest to confirm ventilator ventilating?

8) ____:____:____.____ Start Time when anesthesiologist and CRNA first look for CO_2 signal?

9) ____:____:____.____ Finish Time when tube was taped?

10) ____:____:____.____ Start Time when tube cuff inflation / overinflation checked?

11) ____:____:____.____ Start Time when tube depth is checked?

XII) **Cognitive Skills in association with intubation**

A) Laryngoscopy Performed by: (circle)

1) MD Attending 2) MD Fellow 3) CRNA 4) Non-anesthesia personnel

B) Difficulty of Intubation?

Easy _____ Most Difficult

C) Timeliness of the intubation in relation to the clinical situation?

Delayed _____ Hasty

D) Was intubation necessary?

Necessary _____ Not Necessary

E) Did the anesthesiologist consider all the relevant issues / complications associated with intubation?

All issues considered _____ Lack of Planning

F) Was preparation for intubation adequate?

very adequate _____ Inadequate

G) Did the anesthesiologist use all available history / clinical exam / lab data?

Used data efficiently _____ Data clearly not used

H) How often did the anesthesia team look at patient monitors?

Frequently _____ Infrequently

I) Was it clear from the communication heard on the video tape what the intentions were:

1) Of the anesthesia team?

Clear _____ Unclear

2) The surgical team?

Clear _____ Unclear

J) Was it clear what the patient's injuries were, and how the team was managing the patient?

Clear _____ Unclear

XIII) **Communication Overview**
(if a specific incident of poor communication, explain under appropriate analog scale)

A) Was needed information communicated among the anesthesia team?

Effective Communication _____ Poor Communication

B) Between anesthesia team and surgical team?

Effective Communication _____ Poor Communication

C) How much extraneous chatter was there?

No extraneous chatter _____ lots of extraneous chatter

D) Were tasks delegated appropriately?

Ideal task delegation _____ Poor task delegation

E) Were requests for information made by the anesthesia team responded to?

Always _____ Never

F) Were requests for info made by the surgeons responded to?

Always _____ Never

G) Were anesthesia management strategies communicated effectively?

Effectively _____ Poorly

H) Was surgical management strategy communicated effectively?

Effectively _____ Poorly

COMMENT here on noteworthy aspects of video!

Video camera in the Emergency Room: To improve patient care

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There are many facets of emergency room care that can be assessed by analysis of videotapes of the real environment. For the purposes of this presentation, the facet that will be discussed is management of the airway.

To acquire data for analysis, we interfaced patient physiological monitors with the video-acquisition system in four locations at the University of Maryland Shock Trauma Center. Two locations were emergency admission bays and two were operating rooms. Vital signs (heart rate, arterial, venous or pulmonary arterial pressures, end-tidal CO_2, oxygen saturation and temperature) were updated every five seconds and displayed as an overlay on the video image in real time.

We collected videotapes of 43 intubations of the trachea, including elective circumstances (n=16), semi-emergency tracheal intubation (n=11), (defined as not time critical, but urgent) and emergency tracheal intubation (n=16) (defined as a precipitous requirement for airway management). We hypothesized that detailed analysis of the intubation sequence would reveal human engineering factors, cognitive decision-making issues and quality assurance data that would be helpful in improving patient care, education and training. For the purposes of analyzing the videotapes, we considered the intubation sequence to start with preoxygenation using an anesthesia face mask and to finish ten minutes after the tracheal tube was secured in place. In this interval, we analyzed all the tasks carried out by the anesthesia care providers in preparation for, during and after intubation. In addition, we transcribed and categorized all the recognizable utterances, plotted physiological data, obtained laboratory results of blood sampling and copied the anesthesia record.

We devised a standard of practice guideline for use in task analysis of the maneuvers carried out in the intubation sequence from pre-oxygenation to tying the tracheal tube and confirming its correct placement and the adequacy of ventilation. These guidelines included 15 items before tracheal intubation, 10 during intubation and 7 occurring after passage of the tracheal tube. Each videotape was systematically examined to determine if these 32 items were carried out by the anesthesia care providers.

Communications were transcribed and coded using OCS Tools (Triangle Research Collaborative, Inc.) a commercial video analysis software package. Physiological data was graphed and out of normal range (high or low) variables were noted of all monitored parameters. Laboratory data relevant to airway management (blood gases and pH, electrolytes, hemoglobin and hematocrit) were collected from the patient database together with a copy of the anesthetic record. The anesthesia care provider also completed a two page questionnaire in relation to the videotaped patient management. The videotapes were then reviewed by the anesthesia care providers after the events. A commentary made by them was audiotaped. Every one minute throughout the intubation sequence ratings were made of seven subjective stressors including noise, non-anesthesia team interactions, anesthesia team interactions, workload time stress, uncertainty and an overall rating of stress. A second review of the videotape was made by a non-participant anesthesiologist who was nonetheless an experienced trauma anesthesiologist.

Commentary and one minute subjective stressor scores were also audiotaped by the non-participant subject matter expert (SME). The commentary was transcribed. Synchronization of the videotape, audiotrack, physiological data, OCS tools communication analyses, participant and non-participant SME commentaries was achieved by stamping all data with the same machine-readable time-code generated by a board in the 386 PC's used for data collection and analysis.

There were major differences in compliance with the standard of practice guidelines between elective, semi-emergency and emergency intubations. In emergency intubation where it is most important to check correct tracheal tube placement and adequacy of ventilation there was the longest delay in monitoring $ETCO_2$ and a dependency on others to listen to the chest to confirm adequacy of bilateral ventilation and lack of breath sounds in the abdomen.

Communications were different during emergency than elective tracheal intubation. There were more utterances during emergency than elective intubations and more verbalizations before than either during or after intubation. There were more comments conveying strategies or plans and verbalizations giving directives, instructions or delegating tasks in emergency than elective tracheal intubations.

Physiological data collection showed that during emergency tracheal intubation, there were more out of range variables than during elective intubation. Written Anesthesia records bore little resemblance to summary data acquired directly from the patient physiological monitors.

Several changes have been implemented since analysis of these videotapes. Firstly, it was apparent that in the patient admission bay the pulse oximeter/CO_2 analyzer (Nellcor 1000) was inappropriately positioned behind several other pieces of equipment. This has been repositioned. The delay in monitoring $ETCO_2$ occurred because there was no CO_2 analysis port included in the resuscitator bag used for emergency resuscitation. This has been rectified. Failure to listen to the chest and abdomen after tracheal intubation has been addressed by presentation to the anesthesia care providers at Quality Assurance (QA) meetings. Reduction of stressors and improved communication are important areas that may result in better performance. We are currently studying the effects of stress on decision-making in this environment. We are also assessing whether changes in the monitor position, the end-tidal CO_2 port and the QA presentation have changed clinical practice.

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*The LOTAS Group consists of Doctors C.F. Mackenzie (Chair), W. Bernhard, C. Boehm, G. Craig, A. Cyna, K. Dauphinee, F. Forrest, K. Gerold, D. Goldstein, C. Grande, R. Horst, W.A. Hunter, P. Martin, M.J. Matjasko, B. McAlary, F. Millar, L. Niemiro, M.Parr, B. Randalls and Mr. J. Wesolowski.

REFERENCES

Allnutt MF (1987). Human factors in accidents. British Journal of Anesthesia, 59, 856-864.

Mackenzie CF, Horst RL, Mahaffey DL. Group Decision Making During Trauma, Patient Resuscitation and Anesthesia, Proc. Hum Fact & Ergonom Soc. 37th Ann Meeting, 1993, pp 372-376.

Gabe DM (1989). Human error in anesthetic mishaps. International Anesthesiology Clinics, 27, 137-147.

Howard SK, Gabe DM, Fish KJ, Yang G, & Aarnqust FH (1992). Anesthesia Crisis Resource Management Training: Teaching anesthesiologists to handle critical incidents. Aviation, Space & Environmental Medicine, 63, 763-770

Orosanu J. (1993). Team decision making in complex environments. In G. Klein, J. Orosanu & C. Zeambok (Eds), Decision Making in Action: Models and Methods, Norwood, NJ: Ablex.

Weinger MD & Englund CE (1990). Ergonomic and human factors affecting anesthetic vigilance and monitoring performance in the operating room environment. Anesthesiology, 73, 995-1021.

Attachment 3

POST-VIDEO RECALL QUESTIONNAIRE Version 1.2

MIEMSS# ___ Date __/ __/ __ Time since end of case was videotaped ___/___ Min/Hours
Your SS# ____ How long since intubation was completed? ____/___ Min/Hours

Pre oxygenation by anesthesia mask? Y / N
Approximate duration of pre oxygenation? ___ min ___ sec
Circle monitors in use before intubation
SaO_2 $ETCO_2$ BP ECG CVP PA Temp Nerve Stim Other
In-line stabilization of C-spine? Y / N N/A
Suction ready and immediately available? Y / N
Suction used? Y / N
Cricoid pressure used? Y / N N/A
Cricoid pressure applied early or late (=after induction) (circle which)
Cricoid pressure applied until cuff inflated ? Y / N
Intubation equipment ready by patient's head? Y / N
Neuromuscular block check before laryngoscopy? Y / N
Did the patient cough, buck or move at any time during intubation? Y / N
How many times did you pass the laryngoscopy? #____
If more than 1 attempt did you pre-oxygenate between? Y / N
Did any O_2 desat occur (<95%) during intubation attempts? Y / N
Was cuff inflated to 'just seal'? Y / N
Was tube insertion distance checked? Y / N
Was left and right side of chest auscultated? Y / N
Was upper abdomen auscultated? Y / N
Did you personally listen to the chest and abdomen (circle which) Y / N
If cuff not inflated to just seal was it rechecked Y / N
Was the tube taped or tied in position (circle which)
How long did intubation take from preoxygenated cease to cuff inflation? ___ min ___ sec
How long after induction of anesthesia was intubation achieved? ___ min ___ sec
How long did intubation take from preoxygenation cease to tie or tape tube completion? ___ min ___ sec
Was there any oral trauma? Y / N
Do you recall HR, BP, SaO_2 or $ETCO_2$ values immediately before intubation?
HR = BP = SaO_2 = $ETCO_2$ =
Do you recall HR, BP, SaO_2 values immediately after intubation when tying or taping tube was just completed?
HR = BP = SaO_2 = $ETCO_2$ =
Did you protect the eyes? Y / N
with tape / pads / eye ointment (circle which)
Did you measure temperature? Y / N
How long after anesthesia induction did you first record temp? ___ min ___ sec
What was the first recorded temp ___ °C?
When did you first look at the CO_2 monitor?
<2 min after intubation >2 min after intubation (circle which)
Please make comments about factors that may have affected recall
eg. Stress, Fatigue, Excess Noise, Multiple Admissions, Critical Incident, Others(Identify below)

Please use back of form for comments.

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