

## 16th Annual Meeting

*The only event exclusively devoted to  
the specialized needs of critical care anesthesiologists!*

Friday, October 10, 2003  
San Francisco Hilton Hotel  
San Francisco, California



A conference jointly sponsored by the American Society of Anesthesiologists

# *ASCCA Annual Meeting Highlights*

*The American Society of Critical Care Anesthesiologists acknowledges the following sponsors who are also providing educational grants in support of the Society's mission to promote education and research in critical care anesthesia. ASCCA encourages you to meet these companies and visit with their representatives in the exhibits area during the Annual Meeting.*

*Abbott Laboratories  
Baxter Healthcare  
Cook Inc.  
ESP Pharma, Inc.*

*Abbott Laboratories, ASCCA 2003 Platinum Award Sponsor,  
has generously offered to sponsor this year's luncheon! ASCCA, FAER and Abbott will  
announce the creation of the "New Physician Scientist" award!*

## *Today's Menu*

### *Hilton Salad*

*A Medley of Seasonal Baby Greens with Cherry Tomatoes, Belgian Endive, Julienne of Carrot and Jicama Balsamic Mustard Dressing*

### *Mirin Glazed Cold Poached Filet of Salmon*

*Buckwheat Soba Noodle Salad with Edamame, Bean Sprouts, Tofu and Cucumber  
Radish Sprouts and Shiso Salad, Miso and Rice Vinegar Dressing, California Roll with Wasabi Oil Infusion*

*Or*

### *Braised Flank Steak "London Broil"*

*With Sonoma Pepper Jack Mashed Potatoes, Asparagus, Herbed Baby Carrots  
Green Peppercorn and Pinot Noir Sauce*

### *White Chocolate Raspberry Mouse Cake*

## *You're invited....*

*ESP Pharma, ASCCA 2003 Gold Award Sponsor,  
has generously offered to sponsor this year's evening reception!*

*Friday, October 10, 2003*

*Immediately following the ASCCA Annual Business Meeting  
Meet the ASCCA Board of Directors, ESP Pharma and critical care's  
finest anesthesiologists. Join your colleagues for light hors d'oeuvre and cocktails.*



# **American Society of Critical Care Anesthesiologists**

## **16<sup>th</sup> Annual Meeting Syllabus**

**October 10, 2003**

**San Francisco Hilton Hotel**

**San Francisco, California**



**American Society of Critical Care Anesthesiologists**  
**520 N. Northwest Highway**  
**Park Ridge, IL 60068**  
**Phone: (847) 825-5586**  
**Fax: (847) 825-5658**  
**[ascca@asahq.org](mailto:ascca@asahq.org)**  
**[www.ascca.org](http://www.ascca.org)**  
**\$25.00**

This activity has been planned and implemented in accordance with the Essentials and Standards of the Accreditation Council for Continuing Medical Education through the Joint Sponsorship of the American Society of Anesthesiologists and the American Society of Critical Care Anesthesiologists. The American Society of Anesthesiologists is accredited by the Accreditation Council for Continuing Medical Education to sponsor continuing medical education for physicians. The American Society of Anesthesiologists designates this educational activity for a maximum of 8.0 hours in Category 1 credit towards the AMA Physicians Recognition Award. Each physician should claim only those hours of credit that he/she actually spent in the educational activity.

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***The American Society of Critical Care Anesthesiologists prohibits the recording/taping of any portion of the Annual Meeting without prior written consent.***

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Each presenter is required to disclose the existence of any financial interest and/or other relationship(s) (e.g. employee, consultant grant recipient/research support he/she might have with a) the manufacturer(s) of any commercial product(s) to be discussed during his/her presentation and/or b) the commercial contributor(s) of the activity.

Key: 1 = Research Support	4 = Other Financial Support
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Michael J. Breslow, M.D. (1) VISICU

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Neal H. Cohen, M.D.

Sten D. Lindahl, M.D., Ph.D.

Douglas B. Coursin, M.D.

Roger W. Litwiller, M. D.

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Clifford S. Deutschman, M.S., M.D., F.C.C.M.

Edward E. George, M.D., Ph.D.

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Ozan Akca M.D.  
Conan McCaul, M.D.  
William T. Peruzzi, M.D.

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(1) I.A.P.A., A.A.S.B.I., P.R.E.A., C.I.H.R.  
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Aryeh Shander, M.D.

### *ASCCA Annual Meeting faculty who made proper disclosure with no financial relationships to disclose:*

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Judith Hellman, M.D.  
Andreas Hoyer M.D.  
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Anupama N. Wadhwa, M.D.  
Michael H. Wall, M.D.  
Chad E. Wagner, M.D.

## **American Society of Critical Care Anesthesiologists Program Information**

### **Lifetime Achievement Award Recipient:**

Members of ASCCA will honor Sten G. Lindahl, M.D., Ph.D., F.R.C.A. as this year's ASCCA Lifetime Achievement Award winner. This award recognizes Dr. Lindahl's distinguished service and outstanding contributions to critical care medicine. Dr. Lindahl is an internationally renowned clinician, scientist and leader who has made extraordinary contributions to anesthesiology, critical care and medicine. He is Professor of Anesthesiology and Intensive Care Medicine at the Karolinska Institute in Stockholm, Sweden.

His investigations in the field of pulmonary physiology are widely recognized for their innovation and impact. He is the author of 100 original scientific publications in this and related areas of research, exploring the ventilatory and metabolic responses to anesthesia. In 1992 Dr. Lindahl was elected a member of the Nobel Assembly at the Karolinska Institute, and in 1999 he became Deputy Chair of the Nobel Committee for Physiology or Medicine. In 2001 he assumed the Chair of the Nobel Committee for Physiology or Medicine.

### **Young Investigator Award:**

In its efforts to promote multidisciplinary critical care and to encourage research by young investigators, the Society will once again present the ASCCA Young Investigator Award. The Award is presented to the resident or fellow whose abstract submission is selected as the best overall research submitted by a young investigator for presentation at the ASCCA 2003 Annual Meeting.

### **Annual Meeting Learning Objectives**

- To present an update on activities and efforts undertaken by the American Society of Critical Care Anesthesiologists.
- To provide a briefing on matters that affect anesthesiologists in their practice of critical care medicine.
- To learn from a clinical care lifetime achievement award recipient about the state-of-the-art critical care anesthesia.
- To present a viewpoint on the role that anesthesiologists could or should play in the intensive care unit.
- To present current national efforts at promoting safety and quality in intensive care units and health care in general.
- To discuss how a critical care division or anesthesia department can translate national safety initiatives into a change in practice at the local level.
- To present information of importance to anesthesia intensivists on biological, chemical, and nuclear terrorism.
- To present how hospitals and healthcare are responding to the healthcare needs for homeland security.
- To present the ethical dilemmas, controversies, requirements, and responsibilities involved in clinical research in critically ill patients.
- To present how use of information technologies has the potential to change critical care practice.
- To discuss how critical care is compensated, and how to navigate the requirements of CMS, HIPPA, and payors.

**American Society of Critical Care Anesthesiologists  
Annual Meeting Agenda**

**Friday, October 10, 2003**

7:00 a.m. – 7:55 a.m. Registration and Continental Breakfast

7:55 a.m. – 8:00 a.m. Welcome  
**William E. Hurford, M.D.**  
Annual Meeting Program Chair  
Massachusetts General Hospital  
Boston, Massachusetts

**Scientific Session I**

8:00 a.m. – 9:00 a.m. Oral Abstracts Presentations

**Moderator:** **Michael H. Wall, M.D.**  
Scientific Paper Chair  
Wake Forest University School of Medicine  
Winston-Salem, North Carolina

9:00 a.m. – 9:30 a.m. Young Investigator Award  
**Presented by:** **Michael A. Wall, M.D.**  
Scientific Paper Chair

9:30 a.m. – 10:20 a.m. Lifetime Achievement Award Presentation and Lecture  
**Presenter:** **Neal H. Cohen, M.D.**

*Oxygen Sensing-Uptake-Utilization*  
**Recipient:** **Sten D. Lindahl, M.D., Ph.D.**

10:20 a.m. – 10:50 a.m. Coffee Break and Poster Viewing

**Scientific Session II**

10:50 a.m. – 11:10 a.m. *New Mission of the ASCCA*  
**Clifford S. Deutschman, M.S., M.D., F.C.C.M.**  
University of Pennsylvania  
Philadelphia, Pennsylvania

11:10 a.m. – 11:30 a.m. *Anesthesiologists in the ICU*  
**Douglas B. Coursin, M.D.**  
University of Wisconsin at Madison  
Madison, Wisconsin

11:30 a.m. – 12:00 a.m. *Address by the ASA President-Elect: ASA Update*  
**Roger W. Litwiller, M. D.**  
American Society of Anesthesiologists  
Park Ridge, Illinois

12:00 noon – 1:00 p.m. Luncheon – Sponsored by Abbott Laboratories



### Scientific Session III

1:00 p.m. – 2:00 p.m.

*Safety and Quality in Critical Care  
Safety and Quality Initiatives*

**Todd Dorman, M.D.**

John Hopkins Medical Institutions  
Baltimore, Maryland

*Promoting Patient Safety*

**Neal H. Cohen, M.D.**

University of California San Francisco  
San Francisco, California

2:00 p.m. – 3:00 p.m.

*Emergency Preparedness*

*The Threats: (Bio, chem, conventional, other)*

**Richard C. Prielipp, M.D.**

Wake Forest Medical School  
Winston Salem, North Carolina

*The Response: FEMA; DMAT; IMSuRTs*

**Edward E. George, M.D., Ph.D.**

Massachusetts General Hospital  
Boston, Massachusetts

3:00 p.m. – 3:20 p.m.

Break and Poster Viewing

### Scientific Session IV

3:20 p.m. – 4:20 p.m.

*Ethics in Critical Care Research*

**E. Greg Koski, Ph.D, M.D.**

Massachusetts General Hospital  
Boston, Massachusetts

**Michael Matthay, M.D.**

University of California San Francisco  
San Francisco, California

4:20 p.m. – 5:20 p.m.

*Making Critical Care Practice Work*

*New Technologies in Critical Care Practice*

**Michael J. Breslow, M.D.**

VISICU  
Baltimore, Maryland

*Medicare Compliance: Why, How and What To Do When Things Go  
Wrong*

**Gerald A. Maccioli, M.D.**

Raleigh Practice Center  
Raleigh, North Carolina

5:20 p.m. – 5:50 p.m.

Business Meeting

5:50 p.m. – 7:00 p.m.

Reception – Sponsored by ESP Pharma

**American Society of Critical Care Anesthesiologists  
Scientific Session I**

- 8:00 a.m. – 9:15 a.m.      Oral Abstracts Presentations  
**Moderator:            Michael H Wall, M.D.**  
Scientific Paper Chair
- 8:00 a.m. – 8:15 a.m.      *Hypercapnic Acidosis Preconditions Brain Slices to Hypoxia*  
**Ozan Akca, M.D.**  
Outcomes Research™ Institute, Brain Attack Lab  
Department of Anesthesiology  
University of Louisville  
Louisville, Kentucky
- 8:15 a.m. – 8:30 a.m.      *Epinephrine Causes Fatal Cardiac Dysfunction In  
Cardiopulmonary Resuscitation*  
**Conan McCaul, M.D.**  
Department of Anesthesia  
Hospital for Sick Children  
University of Toronto  
Toronto, Canada
- 8:30 a.m. – 8:45 a.m.      *Cardiopulmonary Bypass Alters Dopamine Kinetics In  
Adult Cardiac Surgery Patients*  
**Chad E. Wagner, M.D.**  
Wake Forest University School of Medicine  
Winston-Salem, North Carolina
- 8:45 a.m. – 9:00 a.m.      *Cardiac Specific Promoter For Myocardial Gene  
Transfer*  
**Oliver Y. Bernecker, M.D.**  
Cardiovascular Research Center

## HYPERCAPNIC ACIDOSIS PRECONDITIONS BRAIN SLICES TO HYPOXIA

Ozan Akça M.D.\*, Ralphiel S Payne Ph.D., Franz Kehl M.D., Ph.D.,  
Daniel I Sessler M.D., and Avital Schurr Ph.D.  
Outcomes Research™ Institute, Brain Attack Lab, Dept. Anesthesiology,  
University of Louisville, Louisville, Kentucky

**Background:** Hypercapnia is highly protective in experimental models of acute ischemic myocardium, lung, and brain injury. Ischemic preconditioning (IPC) is a powerful defense mechanism in which brief periods of ischemia render tissue resistant to subsequent ischemic episodes. IPC occurs in heart, brain, small intestine, skin-muscle free-flaps, and kidney. ATP-sensitive potassium ( $K_{ATP}$ ) channel openers protect the heart against ischemia-reperfusion (I/R) injury, and  $K_{ATP}$  channel blockers prevent this protection. IPC in brain may also be mediated by the opening of mitochondrial  $K_{ATP}$  channels. Hypercapnic acidosis, mostly the proton effect, activates  $K_{ATP}$  channels in an ATP-independent, histidine-dependent manner. We, therefore, tested the hypothesis that acute preconditioning with hypercapnia reduces neuronal damage in rat hippocampal slices. We similarly evaluated the effects of preconditioning with metabolic acidosis on hypoxic neuronal damage.

**Methods:** With the approval of the University of Louisville Institutional Animal Care and Use Committee, 7 Sprague-Dawley rats were studied. After anesthesia induction with ether, rats were decapitated; hippocampal slices were prepared and randomly placed in an incubation/recording dual-compartment chamber in equal numbers. In one compartment, the slices were exposed for 15 min to either 12% or 20%  $CO_2$  (balance  $O_2$ , Hypercapnia), and in the other compartment, slices were exposed to 5%  $CO_2$  (balance 80%  $O_2$ , 15%  $N_2$ , Control). Fifteen min later, slices in both compartments were exposed to 13-min hypoxia (95%  $N_2$ /5%  $CO_2$ ) followed by 30-min reoxygenation (80%  $O_2$ , 15%  $N_2$ , 5%  $CO_2$ ). Amplitudes of extracellularly recorded, orthodromically evoked CA1 population spikes (neuronal function) were quantified in 158 hippocampal slices from 7 rats. Hippocampal slices from an additional 3 rats were preconditioned by exposing them to metabolic acidosis (pH 6.6-6.8) for 15 minutes, again with a 30-minute recovery period. Control slices were kept near the normal pH of 7.40. HCl was used to acidify the bathing medium (artificial CSF). Data were compared with paired t-tests;  $P < 0.05$  was considered statistically significant.

**Results:** Neuronal function was recovered in  $51 \pm 7\%$  (mean  $\pm$  SEM) of the control slices (5%  $CO_2$  and 80%  $O_2$ ). Hypercapnia reduced the degree of neuronal damage;  $65 \pm 12\%$  ( $P=0.042$ ) of the slices exposed to 12% or 20%  $CO_2$  recovered neuronal function. The metabolic acidosis group showed an improvement of neuronal function of about 11% compared to the control (normal pH) group. This difference was not statistically significant, possibly because of the small sample size (only 3 rats).

**Conclusions:** Short-term application of hypercapnia preconditioned brain slices to subsequent ischemia. However, similar protection seemed to be provided by metabolic acidosis. It thus appears that low pH is the major mechanism behind the protection against subsequent ischemia (i.e., preconditioning), whether the excess protons result from respiratory or metabolic acidosis.

## EPINEPHRINE CAUSES FATAL CARDIAC DYSFUNCTION IN CARDIOPULMONARY RESUSCITATION

Conan McCaul, P McNamara, D Engelberts, A Redington, BP Kavanagh  
Departments of Anesthesia, Critical Care Medicine, Pediatrics (*Neonatology, Cardiology*) and the  
Lung Biology Program, Hospital for Sick Children, University of Toronto

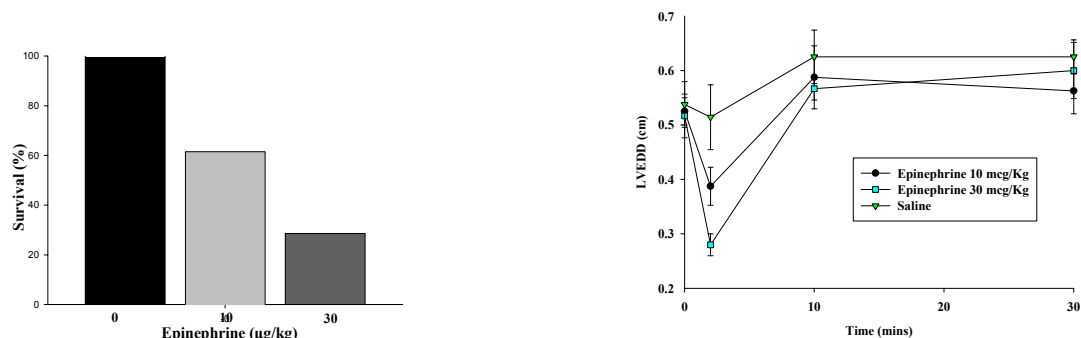
**BACKGROUND:** Epinephrine is recommended during cardiopulmonary resuscitation, but amplifies cardiac depression following ventricular fibrillation. In pediatric practice, cardiac arrest is almost always due to asphyxia, and while the effects of catecholamines are unknown, their use is ubiquitous.

**OBJECTIVES:** [1] to characterize the myocardial effects of epinephrine following asphyxial cardiac arrest; and [2] to investigate the physiologic/biochemical mechanisms of dysfunction.

**METHODS:** Sprague-Dawley rats (350-400 g) were anaesthetized and exposed to one-minute asphyxial cardiac arrest. Standardized resuscitation was attempted with mechanical ventilation ( $FiO_2$  1.0), chest compressions and intravenous medication. Three experimental series were completed. The effects of epinephrine (10 or 30  $\mu\text{g}\cdot\text{kg}^{-1}$ ) vs. control (saline) were examined using non-invasive ECHO (**Series #1**), and by direct (*open chest*) measurement of left atrial pressure ( $P_{LA}$ ) (**Series #2**). The impact of calcium channel blockade (*verapamil* 0.1  $\text{mg}\cdot\text{kg}^{-1}$ ) on epinephrine induced effects (30  $\mu\text{g}\cdot\text{kg}^{-1}$ ) was also evaluated by ECHO (**Series #3**). Monitoring comprised serial transthoracic echocardiography (*shortening fraction-LVSF*; *end-diastolic diameter-LVEDD*), invasive systemic arterial pressure and blood gas analysis at baseline and up to 2 h post-resuscitation.

**RESULTS:** Epinephrine increased mortality (*Fig. 1*), and caused a dose-dependent decrease in diastolic function (*reduced LVEDD*; *Fig. 2*). The diastolic dysfunction was associated with increased  $P_{LA}$  ( $P<0.05$ ) suggesting myocardial hypercontraction. *Finally*, verapamil eliminated epinephrine-induced mortality ( $P<0.002$ ), and attenuated the diastolic dysfunction ( $P<0.05$ ).

**CONCLUSIONS:** Epinephrine administration for CPR following asphyxial cardiac arrest is



associated with dose-dependent diastolic dysfunction, left atrial hypertension, and increased mortality. These effects are attenuated by calcium channel blockade. These data provide mechanistic insight and point to potential therapeutic approaches in pediatric cardiac arrest.

**Support:** Association of Anaesthetists of Great Britain and Ireland; International Association of Paediatric Anaesthetists; Canadian Institutes of Health Research; PREA.

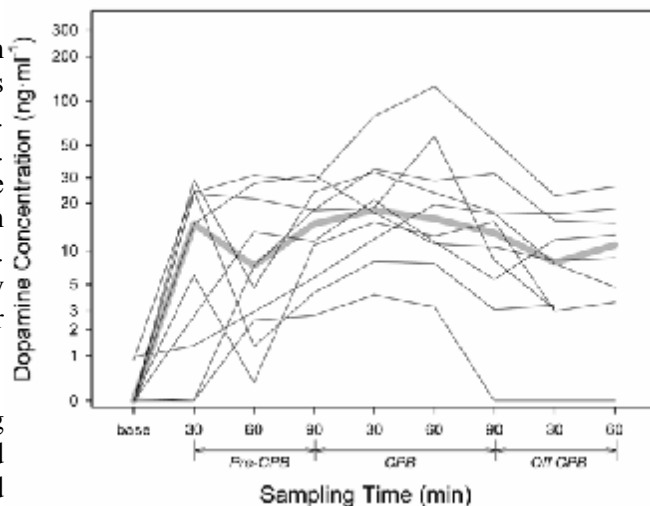
## CARDIOPULMONARY BYPASS ALTERS DOPAMINE KINETICS IN ADULT CARDIAC SURGERY PATIENTS

Chad E Wagner MD, MH Wall MD, JF Butterworth MD, PR Roberts MD and RC Prielipp MD  
Department of Anesthesiology, Wake Forest University School of Medicine, Winston-Salem, NC

**Background.** Dopamine (DA), an agonist at alpha, beta, and dopaminergic receptors, produces variable pharmacologic response depending on rate of infusion. We previously observed that weight-based dosing produced up to 75-fold inter-subject variation in DA plasma concentrations [DA] in healthy male subjects.<sup>1</sup> Therefore, we hypothesized that [DA] during cardiac surgery would vary >10-fold among patients. In addition, we hypothesized that during cardiopulmonary bypass (CPB) [DA] would decrease due to dilution of the CPB prime.

**Methods.** After IRB approval and informed consent, 16 subjects (12 study patients and 4 placebo) were enrolled in the study, all scheduled for CPB. DA 2 mcg/kg/min (Group D) or placebo infusion (Group P) was begun 30 min prior to induction of anesthesia. Blood was sampled at: baseline (bl), 30 min, 60 min, 90 min, 30 min post-start CPB, 60 min post-start CPB, 90 min post-start CPB, 30 min post-CPB, and 60 min post-CPB. The infusions remained constant until 60 min post-CPB. Samples were analyzed by I<sup>125</sup> DA radioimmunoassay (IBL-Hamburg). [DA] were analyzed by mixed models ANOVA (SAS, Cary, NC).

**Results.** Two patients were excluded from the analysis because of technical problems with the DA measurements and data. Group P patients had undetectable [DA]. In Group D [DA] increased with time ( $p=0.0043$ ) and varied 40-fold between patients: 3.2 ng/ml to 124 ng/ml (Figure 1). In addition, [DA] were significantly greater during CPB than either pre- or post-CPB ( $p=0.05$ ).



**Conclusions.** In cardiac patients receiving low-dose DA, [DA] varied 40-fold; and contrary to our hypothesis [DA] increased during CPB. Changes in [DA] at steady-state during and after CPB could be secondary to decreased metabolism and clearance, decreased temperature, decreased hepatic blood flow, or other factors. Increased [DA] during CPB did not result from DA release as part of a stress response since group P [DA] were undetectable during CPB. This study shows that low-dose DA infusions produce unpredictable plasma concentrations before and during CPB. The results confirm work done in healthy male volunteers with similar inter-patient variability.<sup>1</sup> We speculate that wide variation in concentrations contributes to the varying effectiveness of renal dose DA for diuresis and renal protection during and after cardiac surgery.<sup>2-4</sup>

### References.

1. Anesthesiology 2000;92:338-46;
  2. Intensive Care Med 2002;28:877-83;
  3. Lancet 2000;356:2139.
  4. Crit Care Med 2001;29:1526;
  5. J Cardiothorac Vasc Anesth 1992;6:132-9.
- Study supported in part by educational grants from Edward's Lifesciences Corp. and Abbott Laboratories.*

## CARDIAC SPECIFIC PROMOTER FOR MYOCARDIAL GENE TRANSFER

Oliver Y. Bernecker<sup>1</sup>, Wolfgang Böcker<sup>1</sup>, Xinsheng Zhu<sup>2</sup>, Tomohiro Sawa<sup>3</sup>, Federica del Monte<sup>1</sup>, Luanda Grazette<sup>1</sup>, Anthony Rosenzweig<sup>1</sup>, Roger J. Hajjar<sup>1</sup> and Ulrich Schmidt<sup>2</sup>

1. Cardiovascular Research Center, 2. Department of Anesthesia, Massachusetts General Hospital, Harvard Medical School, Boston, MA United States; 3. Department of Anesthesia, Teikyo University School of Medicine, Tokyo, Japan

**Background:** Heart failure is an increasingly common problem. Current pharmacologic treatment does not change the unfavorable outcome significantly. Therefore, interest in novel therapeutic techniques such as gene transfer has been intensified. Adenoviral gene transfer has shown to be effective in cardiac myocytes in vitro and in vivo. A major limitation to the success of myocardial gene therapy, however, is the widespread expression of the therapeutic transgene to other organs than the heart. To minimize extra cardiac transgene expression, we constructed an adenovirus with a promoter specific to cardiomyocytes.

**Methods:** *Construction of the vector:* The myosin light chain-2v (MLC-2v) was selected for its tissue specificity to ventricular myocardium. Four copies of a 250bp fragment of MLC-2v were sub-cloned into an adenoviral backbone, followed by a luciferase reporter gene (Ad.4xMLC). Similar vectors accompanied by a CMV promoter (Ad.CMV) or a promoter-less construct (Ad.luc) was used as a control.

**Gene transfer in vitro:** Neonatal rat cardiomyocytes, HepG2 (liver cells), A549 (lung cells) and COS (kidney cells) cells were infected at a multiplicity of infection (MOI) of 10 pfu/cell. Cells were harvested 3 days after infection and assayed for luciferase activity.

**Gene transfer in vivo:** Gene transfer was performed on male Sprague Dawley rats (200-250g). After anesthesia and thoracotomy, 100µl viral solution (5x10<sup>9</sup> pfu) was injected in the myocardial apex or in the left liver lobe. To evaluate whether a catheter-mediated delivery technique aiming at global heart transfection can further improve cardiac specificity, a catheter was advanced to the aortic root and 200µl viral solution were injected while cross-clamping the aorta and pulmonary artery.

**Measurement of luciferase activity:** Heart, liver, lung and kidney were harvested 3 days after viral transfection and luciferase activity was measured by a standard luciferase assay system (Promega).

**Results:** **Gene transfer in vitro:** In rat neonatal cardiomyocytes Ad.4xMLC.Luc luciferase expression was 20.6% of the CMV promoter. In contrast, in non-cardiac cells luciferase was significantly less expressed under the control of the MLC compared with the CMV promoter. In HepG2 (liver) cell line 4xMLC.Luc activity was 0.97% of Ad.CMV.Luc. Similar results were found in the LLC-PK1 kidney cells (1.87%) and COS cells (2.25%). Promoter activity of 4xMLC was 20.4-fold stronger in cardiomyocytes than in liver cells.

**Gene transfer in vivo:** After coronary perfusion, Ad.CMV showed a significantly higher luciferase activity than Ad.4xMLC in liver (38.4-fold), lung (16.1-fold) and kidney (21.8-fold), whereas activity in the heart was only 3.8-fold higher than in the Ad.4xMLC -group. The transfection rate of cardiomyocytes vs. hepatocytes was 7:1 (4xMLC) vs. 1:1.4 (CMV).

When constructs were directly injected into the left ventricular wall, Ad.4xMCL showed a 131-fold weaker luciferase activity in the liver than Ad.CMV (p<0.001).

**Conclusion:** We demonstrate that the 4xMLC-2v promoter can direct adenovirus-mediated cardiomyocyte expression both in vitro and in vivo. This new vector will be useful to validate therapeutic approaches in animal disease models and offers the perspective for selective expression of therapeutic genes in the diseased heart, while limiting potential side effects due to transgene expression in other organs.

**American Society of Critical Care Anesthesiologists  
Young Investigator Award**

9:00 a.m. – 9:30 a.m.

**Presented by:**     **Michael A. Wall, M.D.**  
Scientific Paper Chair

**Recipient:**         **Martina Richtsfeld, M.D.**  
*Chronic Administration Of Pyridostigmine  
Leads to a Myasthenia-Like State with Down-  
Regulation of Acetylcholine Receptors*

## **CHRONIC ADMINISTRATION OF PYRIDOSTIGMINE LEADS TO A MYASTHENIA-LIKE STATE WITH DOWN-REGULATION OF ACETYLCHOLINE RECEPTORS**

Martina Richtsfeld M.D., Shingo Yasuhara M.D., Ph.D., Manfred Blobner M.D. and Jeevendra Martyn M.D., Department of Anesthesia and Critical Care, Massachusetts General Hospital, Boston, Massachusetts, United States

**Background:** Pyridostigmine for prolonged periods, in varying doses, continues to be used in the treatment of myasthenia gravis. It has also been used prophylactically in soldiers to mitigate the effects of nerve gas poisoning during threat of chemical warfare. Previous studies have documented that administration of reversible acetylcholinesterase (AChE) inhibitors has positive and negative effects on neuromuscular transmission, muscle function and muscle-ultrastructure. The classical theory of receptor control suggests that, AChE inhibition, in the long-term, should down-regulate acetylcholine receptors (AChRs) due to excessive stimulation of the AChRs. Decreased receptor number will lead to a myasthenia-like state including increased sensitivity to non-depolarizing muscle relaxants (NDMR) and/or muscle weakness. This study therefore investigated the chronic effects of pyridostigmine administration on AChR numbers and the sensitivity to the NDMR, atracurium.

**Methods:** After IRB approval, SD rats were anesthetized with pentobarbital and subcutaneous osmotic pumps implanted for continuous administration of pyridostigmine. Two different doses of pyridostigmine (22 mg/ml or 110 mg/ml) were administered for 13 or 27 days, respectively. Controls received the vehicle (saline) only. On day 13 or 27, respectively the osmotic pumps were removed to eliminate the agonistic effects of pyridostigmine on the AChR. At 24 hours after pump removal, the pharmacodynamics of atracurium were tested. For this purpose animals were anesthetized, tracheotomized and ventilated to normocapnia. For hemodynamic monitoring and blood gas analyses the carotid artery was cannulated. The jugular vein was catheterized for drug administration. Neuromuscular transmission was investigated by train-of-four stimulation of the sciatic nerve and the resulting contraction of the tibialis anterior muscle was recorded. A 50% neuromuscular block was established by continuous i.v.-administration of atracurium and maintained for 10 min. The respective infusion-rates (IR) were recorded. At the end of the pharmacodynamic study, the tibialis anterior muscle was excised to quantify AChRs using 125I-bungarotoxin binding method. AChR-numbers and infusion-rates were analyzed by a factorial ANOVA with the two factors, duration of administration and pyridostigmine-dose ( $p < 0.05$ ).

**Results:** Increasing the pyridostigmine dose or the duration of pyridostigmine administration resulted in a significant decrease of AChRs. The infusion-rate of atracurium to maintain a 50% neuromuscular blockade was significantly lower when higher pyridostigmine doses were applied, irrespective of the duration of administration (see table 1).

**Conclusion:** This study demonstrates that chronic administration of the AChE inhibitor, pyridostigmine reduces AChR number, which resembles a myasthenia-like state. This decrease in AChR number increased the sensitivity to atracurium. Subjects exposed to prolonged pyridostigmine administration may therefore simulate a myasthenia-like state.



**Table 1:** Acetylcholine receptor expression, and atracurium infusion rates during steady state 50% neuromuscular paralysis after chronic administration of pyridostigmine (Data are the mean  $\pm$  standard deviation)

	AChR-concentration [fmol/mg protein]		Atracurium-IR [ $\mu$ g/kg/min]	
Duration	13 days	27 days	13 days	27 days
Pyridostigmine 0 mg/ml	27 $\pm$ 5	23 $\pm$ 5	194 $\pm$ 23	208 $\pm$ 40
Pyridostigmine 22 mg/ml	23 $\pm$ 4	20 $\pm$ 5	165 $\pm$ 43	197 $\pm$ 76
Pyridostigmine 110 mg/ml	21 $\pm$ 6	13 $\pm$ 4	107 $\pm$ 36	108 $\pm$ 26

**American Society of Critical Care Anesthesiologists  
2003 Lifetime Achievement Award**

9:30 a.m. – 10:20 a.m.      Presentation and Lecture  
**Presenter:**                  **Neal H. Cohen, M.D.**

*Oxygen Sensing-Uptake-Utilization*  
**Recipient:**                  **Sten G. Lindahl, M.D., Ph.D.**

**American Society of Critical Care Anesthesiologists  
Scientific Session II**

- 10:50 a.m. - 11:10 a.m.    *New Mission of the ASCCA*  
**Clifford Deutschman, M.S., M.D., F.C.C.M.**  
University of Pennsylvania  
Philadelphia, Pennsylvania
- 11:10 a.m. – 11:30 a.m.    *Anesthesiologists in the ICU*  
**Douglas B. Coursin, M.D.**  
University of Wisconsin at Madison  
Madison, Wisconsin
- 11:30 a.m. – 12:00 noon    *Address by the ASA President-Elect: ASA Update*  
**Roger W. Litwiller, M.D.**  
American Society of Anesthesiologists  
Park Ridge, Illinois

**American Society of Critical Care Anesthesiologists  
Scientific Session III**

1:00 p.m. – 2:00 p.m.

***Safety and Quality in Critical Care***

*Safety and Quality Initiatives*

**Todd Dorman, M.D.**

John Hopkins Medical Institutions  
Baltimore, Maryland

*Promoting Patient Safety*

**Neal H. Cohen, M.D.**

University of California San Francisco  
San Francisco, California

2:00 p.m. – 3:00 p.m.

***Emergency Preparedness***

*The Threats: (Bio, chem, conventional, other)*

**Richard C. Prielipp, M.D.**

Wake Forest Medical School  
Winston Salem, North Carolina

*The Response: FEMA; DMAT; IMSuRTs*

**Edward E. George, M.D., Ph.D.**

Massachusetts General Hospital  
Boston, Massachusetts

3:00 p.m. – 3:20 p.m.

Break and Poster Viewing

**Please contact the ASCCA office at (847) 825-5586  
for the first section contained in the printed syllabus.**

## Safety & Quality Initiatives in the ICU



Todd Dorman, MD, FCCM  
Associate Professor  
Departments of Anesthesiology/CCM,  
Medicine, Surgery, and Nursing  
Johns Hopkins Medical Institutions

## Would Patients Say We Are Providing High Quality Care?



## Why do we need to improve care?

In U.S. Healthcare system

- 44,000- 98,000 preventable deaths
- \$50 billion in total costs

IOM report "To err is human"

Similar results in UK and Australia

Equivalent to a 747 crashing every 5 hours  
killing all 250 passengers on board 365 days a  
year

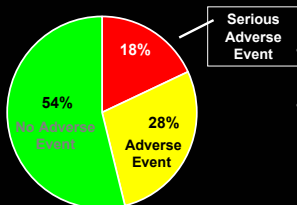


Even if the number is as low as 54,000 deaths/year this  
is equivalent to a 747 crashing every 1.5 days

## The ICU Today

### The Prevalence of Adverse Events

Study of 1,047 Patients

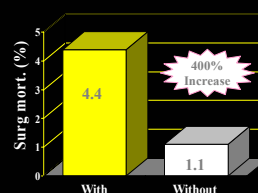


- Trained observers concurrently recorded avoidable errors
- 39% result in physical disability or death
- Threefold increase in LOS for patients with adverse events

\* Andrews LB: An Alternative Strategy for Studying Adverse Events in Medical Care. Lancet, 1997

## Complications Increase Mortality

Iezzoni,et.al.(1994)



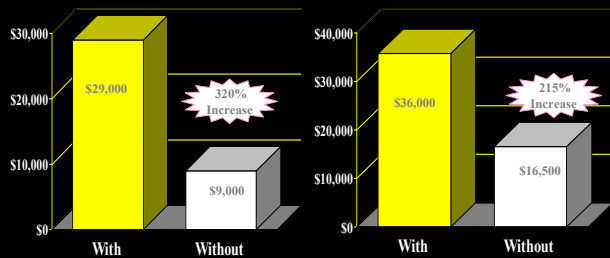
Pronovost,et.al.1999)

Septicemia	OR = 6.1
Acute renal failure	OR = 5.0
Acute MI	OR = 5.7
Reintubation	OR = 1.9

## Complications Increase Cost

Iezzoni, et.al. (1994)

Pronovost, et.al. (1999)



## JCAHO 8 ICU Core Measures

- Ventilator Associated Pneumonia (VAP) Prevention
- Appropriate Peptic Ulcer Disease (PUD) Prophylaxis
- Appropriate Deep Vein Thrombosis (DVT) Prophylaxis
- Appropriate Sedation
- Central Line-Associated BSI rate and CL Utilization ratio
- ICU Length of Stay
- ICU Mortality (Risk Adjusted)
- Use of Intensivists

<http://www.jcaho.org/pms/core+measures/>

## Quote

“Toyota revolutionized our expectations of production; Federal Express revolutionized our expectations of service. Processes that once took days or hours to complete are now measured in minutes or seconds. The challenge is to revolutionize our expectations of health care; to design continuous flow of work for clinicians, and a seamless experience of care for patients.”

Donald Berwick, MD



## Searching for Quality:

- If you are placed in charge of an ICU, what quality level (compliance with EBM practices) would you accept?
  - 95%
  - 96%
  - 97%
  - 98%
  - 99%

## If 99+% is Good Enough, then....

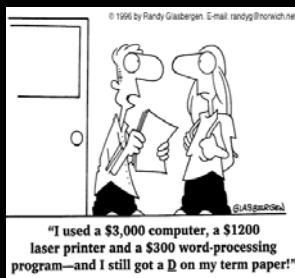
- 5,000 incorrect surgical operations per week
- 15,000 newborns will be accidentally dropped per year
- 18,322 pieces of mail will be mishandled per hour
- 2,000,000 documents will be lost by the IRS this year
- 2 short or long landings at most major airports each day
- 20,000 incorrect drug prescriptions each year

## Six Sigma Performance: 99.99966% correct

- 680 wrong prescriptions per decade
- 88 incorrect operations per year
- 5 newborn babies dropped per year
- Less than 6 lost articles of mail per day
- Less than 1 short or long landing in 8 years

## Traditional problem solving approaches

- Use people to solve the problem
- Use money to solve the problem
- Implement policies & rules
- Implement *accountability* - supervision
- Reorganize
- Blame



## Our Approach

- Outcome
    - mortality
    - catheter-related BSI
  - Process
    - time to antibiotic administration
    - PUD & DVT prophylaxis
    - full barrier precautions
- Adv/Disadvantages
- |  |  |
|--|--|
| <ul style="list-style-type: none"> <li>– important to patients</li> <li>– long cycle</li> <li>– require risk adjustment</li> </ul> | <ul style="list-style-type: none"> <li>– short cycle</li> <li>– feedback meaningful</li> <li>– no risk-adjustment</li> </ul> |
|--|--|

## Our Approach

- Create a measure
  - balance burden vs validity
- Simple Rules
  - Create redundancy
  - Reduce complexity
- PDSA Cycles

## Performing Perfectly

No. Elements	Probability of Success, Each Element			
	0.95	0.99	0.999	0.999999
1	0.95	0.990	0.999	0.9999
25	0.28	0.78	0.98	0.998
50	0.08	0.61	0.95	0.995
100	0.006	0.37	0.90	0.99



## Quality Measure Characteristics

- Evidence to guide our practice
- Impact on morbidity and mortality
- Variation in practice
- Must be able to change practice

## Results

- 66 studies met inclusion criteria
- many different interventions associated with improved outcomes
- Good evidence for process measures

Journal of Crit Care 2002

## Ventilator Bundle



- Prevention of VAP
- Appropriate PUD prophylaxis
- Appropriate DVT prophylaxis
- Appropriate sedation
- Daily assessment of readiness to extubate
- Glucose  $\leq 110$  gm/dl

## Metric Development

Head of bed elevation	<i>Numerator:</i> # of ventilator days where the HOB is elevated $\geq 30$ degrees <i>Denominator:</i> Total # of ventilator days
Appropriate sedation	<i>Numerator:</i> # of ventilator days in which 1) sedation was held for $\geq 12$ hrs or until patient followed commands OR 2) patient followed commands w/o sedation held <i>Denominator:</i> Total # ventilator days
Appropriate PUD prophylaxis	<i>Numerator:</i> # of ventilator days where patients received PUD prophylaxis <i>Denominator:</i> Total # of ventilator days
Appropriate DVT prophylaxis	<i>Numerator:</i> # of ventilator days where patients received DVT prophylaxis <i>Denominator:</i> Total # of ventilator days

## Impact on morbidity and mortality

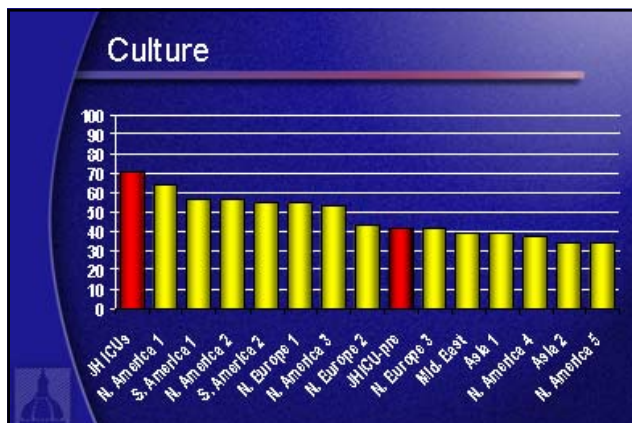
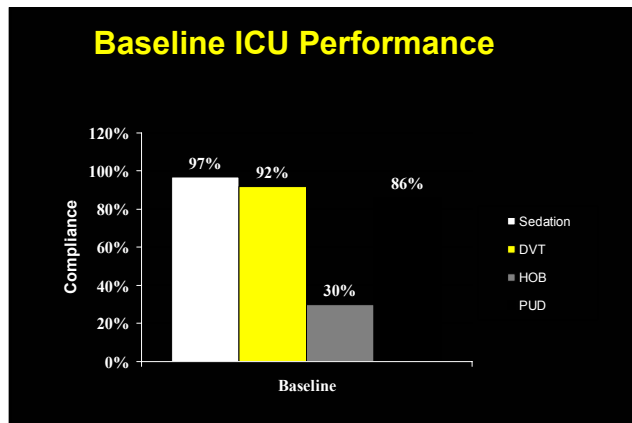
Process Measures	NNT	Days prevented
Head of bed elevation	4	14 hospital days
Appropriate Sedation	NA	4 ICU days
Appropriate PUD prophylaxis	47	5 ICU days
Appropriate DVT prophylaxis	6	9 hospital days

## Baseline IDICU Performance

	Mean Performance	Range
HOB Elevation	97 %	42 – 99 %
Appropriate Sedation	64 %	2 – 100 %
DVT Prophylaxis	87 %	48 – 98 %
PUD Prophylaxis	89 %	71 – 98 %

IHI collaborative

ICU	Mechanical Ventilator Weaning Assessment	HOB Elevated >= 30 Degrees	Patient Followed Command	PUD Proph	DVT Proph
A	100	100	100	100	100
B	100	100	97	100	100
C	100	100	94	100	98
D	97	98	94	98	96
E	91	100	86	100	100
F	100	89	89	100	100
G	83	97	43	98	100
H	100	100	100	100	100
I	100	100	100	100	100
J	100	100	100	100	100
K	100	100	100	93	100
L	87	100	100	100	100
M	100	98	82	93	100
N	93	91	96	80	75
O	100	96	88	100	100
P	31	93	71	91	96
Q	55	94	59	98	98
R	86	97	74	93	85
S	68	89	72	89	94
T	32	97	52	87	61
U	48	94	51	85	77
V	84	86	42	97	100
W	87	68	74	92	81
X	100	100	100	100	100
Y	100	100	100	100	100



### What is the opportunity to improve?

Mean Performance at Baseline (29 ICUs)

Process	Adverse Events	Excess costs

532 Deaths and \$72 million annually

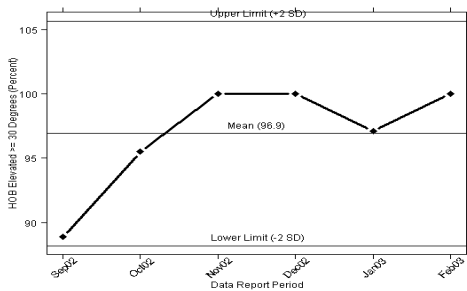
VHA, TICU Project

### Breakdown per ICU(~10 bed)

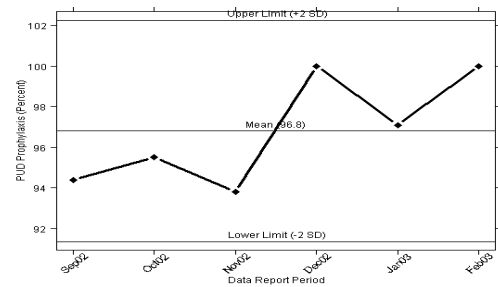
- ~ 2000 patient days saved
- ~18 lives saved
- ~\$2.4 million saved

### Real World Example

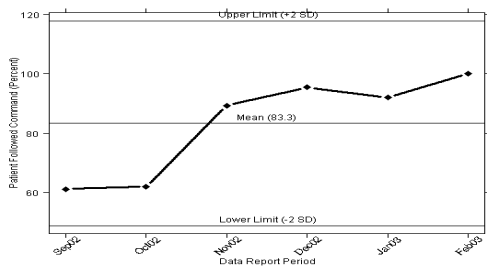
### HOB >= 30 Degrees Ball Memorial Hospital, Muncie, IN



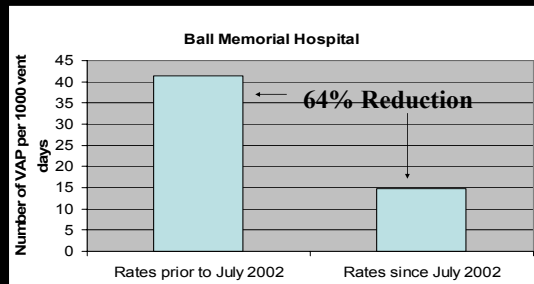
### PUD Prophylaxis Ball Memorial Hospital, Muncie, IN



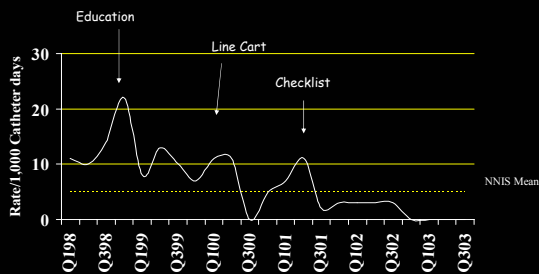
### Appropriate Sedation Ball Memorial Hospital, Muncie, IN



### Reduced Ventilator-Associated Pneumonia (VAP)



### Impact on catheter-related BSI

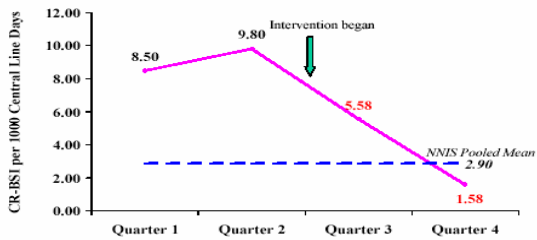


### SICU catheter-related BSI

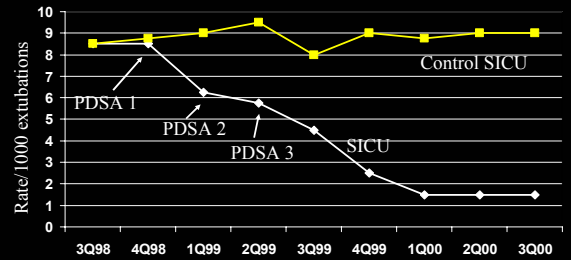
Estimated to prevent

- 35 Catheter-related BSIs per year
- 7 deaths per year
- 490 excess hospital days per year
- \$294,000 in savings per year

## 2002 CSICU Catheter-related BSI (CR-BSI)



## Improved Failed Extubation

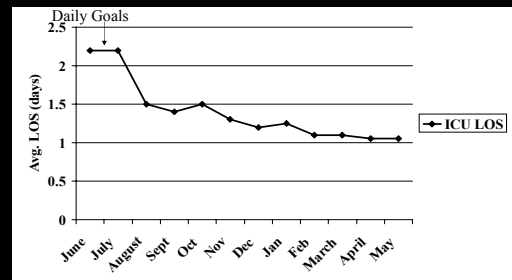


Pronovost, Jencks, Dorman, Jt Commission Journal Quality Care 2002;28:595-604.

## Goal Sheet

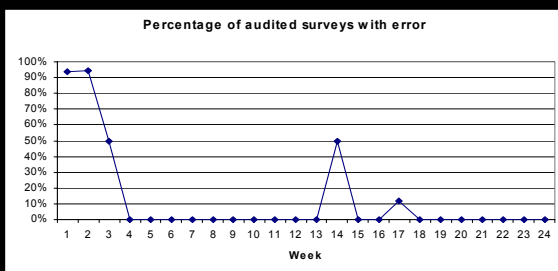
Pronovost, Berenholtz, Dorman et al, J Crit Care 2003;18:71-75

## Impact on ICU Length of Stay



654 New Admissions: 7 Million Additional Revenue

## Medication Reconciliation



## Development Phase

- MI bundle
- Sepsis bundle
- Transfusion bundle

## Process Improvement

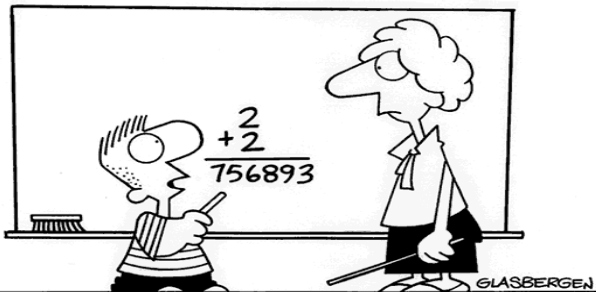
- Focus on a process that is currently broken
- Seek root cause of problems
- Base the process on the PDSA Model
- Focus on many routine and systematic changes
- Begin with a study of the current activity
- Make a daily routine in your organizations

## Quote

“The bad leader is he who the people despise. The good leader is he who the people praise. The great leader is he who the people say, “We did it ourselves.”

Lao-tzu

© 1996 by Randy Glasbergen. E-mail: randyg@norwich.net



**“In an increasingly complex world, sometimes old questions require new answers.”**

## TEAM

- JHUSOM
  - Peter Pronovost
  - Sean Berenholtz
  - Pedro Mendez-Tellez
  - Brad Winters
  - Adam Sapirstein
  - Theresa Hartsell
  - Pam Lipsett
  - Eddie Cornwell
  - Kurt Campbell
- JHSPH
  - Albert Wu
  - Laura Morlock
  - Fern Dickman
- JHH
  - Chris Holzmüller
  - David Thompson
  - Lisa Lubomski
- VHA
  - Marcy McDowell
- SCCM
- IHI

## Resources

- PDSA Cycles
  - Langely et al. The Improvement Guide; The practical approach to enhancing organizational performance.
- ICU Safety Reporting System
  - [icurs.org](http://icurs.org)
- Institute for Healthcare Improvement
  - [www.ihl.org](http://www.ihl.org)
- National Coalition on Health Care
  - [www.nchc.org](http://www.nchc.org)

## Daily Goals

**Room Number** \_\_\_\_\_ **Date** \_\_\_\_/\_\_\_\_/\_\_\_\_

--

**Initial as goals are reviewed -**

		0700-1500	1500-2300	2300-0700
What needs to be done for patient to be discharged from the ICU?				
What is patient's greatest safety risk and how can we decrease risk?				
Pain Mgt / Sedation (held to follow commands?)				
Cardiac / volume status; Net goal for midnight; Beta blockade; review EKGs				
Pulmonary/Ventilator (HOB, PUD, DVT, weaning, glucose control); OOB				
ID, Cultures, Drug levels				
GI / Nutrition / Bowel regimen				
Medications: PO, renal fx, discontinue				
Tests / Procedures today				
Review scheduled labs				
AM labs and CXR?; critical pathway				
Consultations				
Is the primary service up-to-date?				
Has the family been updated? Have social issues been addressed?				
Can catheters/tubes be removed?				
Is this patient receiving DVT/PUD prophylaxis?				
Anticipated LOS > 3 days: fluconazole PO, LT care plans. LOS > 4 days: epo				
Are there events or deviations that need to be reported? ICUSRS?				

**For Weinberg only: ICU status    IMC status**

**Fellow/Attg Initials:** \_\_\_\_\_

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## Promoting Patient Safety

### Opportunities and Challenges for the Critical Care Anesthesiologist

Neal H. Cohen, MD, MPH, MS  
Professor, Anesthesia and Medicine  
Vice Dean, Academic Affairs  
CEO, UCSF Medical Group  
UCSF School of Medicine

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## Promoting Patient Safety

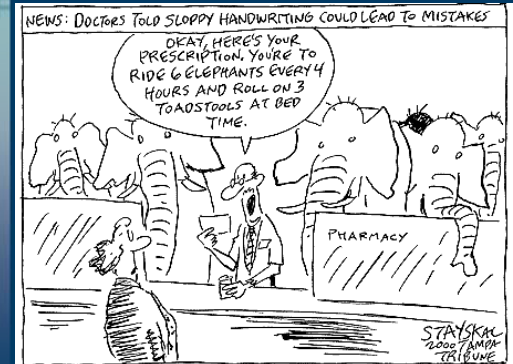
- Clinical Mandates
  - ◆ Improve Outcomes
  - ◆ Ensure (Promote) Patient Safety
- Implications
  - ◆ Measure Quality
  - ◆ Monitor Outcomes
  - ◆ Define Risk and Benefit
  - ◆ Clarify Goals

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## Patient Safety Opportunities for Improvement

- Institute of Medicine
  - ◆ "Too Err is Human"
  - ◆ "Crossing the Chasm"
- Leapfrog Safety Initiatives
  - ◆ CPOE
  - ◆ Intensive Care Mandates
  - ◆ Volume Measures for Specific Procedures
- JCAHO Outcomes Measures
- UHC Benchmarking Efforts
- California SB 1875
  - ◆ Reduce Medication-Related Errors by 2005
- Pay for Performance Initiatives

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## Patient Safety Opportunities for Improvement

- Nearly All ICU Patients Suffer At Least One Potentially Life-Threatening Adverse Event
- Most Common Causes
  - ◆ Human Error
  - ◆ Equipment Malfunction
- A Single Error Does Not Usually Result in Patient Harm
  - ◆ "Rule of 3s"

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## Patient Safety Issues

- General Categories
  - ◆ Informed Consent/Communication
  - ◆ Monitoring
  - ◆ Equipment Malfunction
  - ◆ Medication Errors
  - ◆ Infection Control
- Common Clinical Problems
  - ◆ Medical Administration
  - ◆ Analgesia and Sedation
  - ◆ Respiratory Care/Airway Management
  - ◆ Vascular Access
  - ◆ Neurologic Injury

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## Patient Safety Opportunities for Improvement

- Medication errors
  - ◆ Common Cause of Morbidity & Mortality
  - ◆ Adverse Drug Events (ADE)
    - 4-30 % of Hospital Admissions
    - 9 % Lead to Death
    - 28 % are Preventable
  - ◆ Economic Cost of Medication Errors is High
    - \$2,500 per ADE
    - \$4,500 per preventable ADE
  - ◆ Source of Errors
    - Associated with Order/Administration 49%
    - Transcription 11%

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## Patient Safety Opportunities for Improvement

- Increasing Transparency Regarding Patient Safety
- Risk Management Implications
  - ◆ Providers and Patients Believe Medical Errors Should be Identified and Disclosed
  - ◆ Most Errors are *Not* Disclosed to Patients (or Administrators)

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## Promoting Safety Implications for Critical Care Anesthesiologists

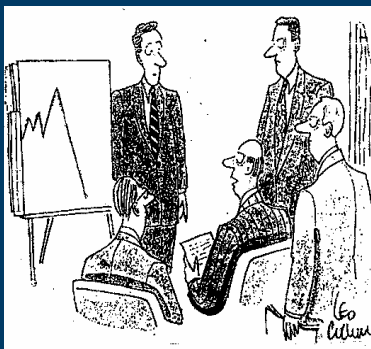
- Critical care physicians are in a position to take a leadership role in advancing patient safety initiatives
- Patient safety must be an essential element of the activities of the department
  - ◆ Departmental Commitment to Patient Safety Initiatives
    - Quality Improvement
    - Educational Programs
    - Research Activities
  - ◆ Evaluation of Clinical Competence

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## Patient Safety Responsibilities for the ICU Physicians

- Create an Environment that Promotes and Values Patient Safety Initiatives
- Ensure Environment is Conducive to Delivery of Safe Patient Care
  - ◆ Multiple Providers
  - ◆ Subspecialty Services
  - ◆ Communication, Cooperation
  - ◆ Work Conditions, Work Hours
- Provide Incentives for Patient Safety Initiatives

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Would you please elaborate on  
"then something bad happened".

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## Promoting Patient Safety ICU Responsibilities

- Create Culture of Safety
  - ◆ Encourage Reporting
- Monitor Outcomes
  - ◆ Clinical Information Systems, Databases
  - ◆ Sentinel Event Review/Root Cause Analysis
- Utilize Educational Programs to Support Patient Safety Efforts
  - ◆ Interdisciplinary Educational Programs
  - ◆ Systematic Morbidity and Mortality Reviews
  - ◆ Mandatory Training Modules

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## **Promoting Patient Safety** **ICU Responsibilities**

- **Clinical Protocols, Guidelines**
  - ♦ Ventilator Management
  - ♦ DVT Prophylaxis
  - ♦ Heparin Therapy Protocols
  - ♦ Diabetes Management (Insulin Infusion Orders)
- **Communication**
  - ♦ Among Providers
  - ♦ During Transitions of Care
- **Information Technology**
  - ♦ Facilitate Access to Clinical Information
  - ♦ Foster Communication
  - ♦ Provide Current Clinical Management Information

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## **Promoting Patient Safety** **Overcoming the Potential Risks**

- **Protocol Driven Therapy**
  - ♦ Current, (Peer Review) Evidence Based
  - ♦ Engage the Clinicians
  - ♦ Facilitate Communication
  - ♦ Foster Clinical Innovation
- **Information Technology**
  - ♦ Ensure Quality of Data
  - ♦ Prevent Information Overload

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## **Patient Safety** **Institutional Opportunities for Critical Care** **Anesthesiologists**

- **Quality Improvement/Quality Management**
- **Risk Management**
  - ♦ Adverse Event Reporting/Review Process
  - ♦ Root Cause Analysis/Sentinel Event Review
- **Code Blue Committee**
- **Patient Safety Activities**
- **Ad Hoc Responsibilities**
  - ♦ ICU Utilization
  - ♦ Monitoring Standards
  - ♦ Pain Management
  - ♦ Sedation Protocols

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## **Patient Safety** **Research Opportunities in Critical Care**

- **Clinical Information Systems**
- **Outcomes Research**
- **Clinical Competence Evaluation Tools**
- **Health Policy Initiatives**
- **Technology Transfer**
- **Product Development**

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## **Patient Safety** **Assessing Clinical Competence**

- **Align Clinical Competence and Expectations**
  - ♦ Validate Knowledge and Skills
    - Board Certification?
    - Reference Checks Documenting Clinical Competence
  - ♦ Clinical Outcomes Database?
  - ♦ National Practitioner Database?
- **Develop Evaluation Tools**
  - ♦ Formal Evaluation (Residents, Peers, Patients)
  - ♦ Simulators?
  - ♦ Re-Certification?

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## **Promoting Patient Safety** **The Traditional Academic Model**

- **Appointment Process**
  - ♦ Research
  - ♦ Teaching
  - ♦ Clinical Care
  - ♦ Community and Public Service
- **Academic Advancement**
  - ♦ Research Productivity
  - ♦ Teaching Evaluations
  - ♦ "Other Creative Activities"

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## Balancing Multiple (Conflicting) Expectations



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## Promoting Patient Safety The Ideal Academic Model

- Appointment process should include as thorough an evaluation of clinical competence as of other criteria
  - ♦ All clinicians are not created equal!
  - ♦ Clinical competence is not defined by membership in professional societies!

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## Evaluating Clinical Competence

"Dr. ... is a member of the American Society of Anesthesiologists, the International Anesthesia Research Society, the California Society and Anesthesiologists..."

... is a world class authority in patient safety and outcomes in intensive care medicine ...

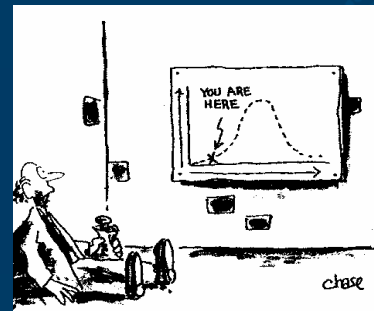
... is an invited lecturer at national and international meetings...

In summary, Dr. ... is an outstanding clinician ..."

... to do WHAT?

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## Moving Patient Safety to the Forefront



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# Weapons of Mass Destruction: Are You Ready?

**Richard C. Prielipp, MD, FCCM**

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Editor, Spring 2002, Volume 17, Issue 1: **SPECIAL ISSUE:**

**Anesthesiologists Now Must Prepare for Biologic, Nuclear, or Chemical Terrorism**

## Weapons of Mass Destruction Educational Task Force

The APSF has sponsored the development of a task force on Biological, Chemical, and Nuclear Terrorism. Members of this task force include Drs. Douglas Coursin, Paul Mongan, Michael Murray, Richard Prielipp, and Michael Wall.

## BIOTERRORISM MAY OVERWHELM MEDICAL RESOURCES:

**Douglas B. Coursin, MD, Jonathan T. Ketzler, MD,**

**Anand Kumar, MD, Dennis G. Maki, MD**

In the aftermath of the September 11 tragedies and subsequent anthrax mail deliveries, society and physicians scrambled to become familiar with the identification and treatment of the most likely bioterrorist agents (1-12). It is no longer a question of if bioterrorism will occur, but when will it happen again, and how will we recognize and manage such occurrences. Future bioterrorist events may be overt and publicized or they may be covert and associated with delays in identification, containment, and treatment. Either overt or covert attacks may stress medical systems dramatically and overwhelm our existing healthcare resources.

The development of new, emerging, or re-emerging modified pathogens is also on the horizon. It is frightening to realize how easily highly infectious agents can be produced, transported, and deployed. The elimination of sources of bioterrorist weapons, prevention of dissemination, and early recognition of attack are keys to limiting the devastating physical, emotional, and financial effects of these weapons of mass destruction.

This article will selectively discuss potential bioterrorist-initiated infections, address initial triage and pathogen identification, and touch on specific concerns for anesthesia and critical care providers in the management of biological exposures. Immediate access to state-of-the-art care is facilitated by information available on reliable web sites from agencies such as the Centers for Disease Control and Prevention (CDC), public health organizations, medical societies, and the military and Defense Department. Therefore, this review closes with a list of readily obtainable publications and web-based guides on bioterrorism, since the information about

**Table 1. Properties of an "Ideal" Biological Weapon\***

Easy to produce in large quantities  
Readily transported and disseminated  
Inexpensive  
Highly infectious and contagious resulting in rapid person-to-person transmission  
Result in a widespread severe morbidity and mortality  
Lack natural immunity  
Be odorless and tasteless  
Survive drying and aerosolization  
Place significant demands on public health and governmental resources  
Result in panic and social disruption

\*Airborne or inhalational spread of many agents appears to be more effective than oral ingestion, which in turn is more effective.

**Table 2. Critical Biological Warfare Agents\***

### Category A

- Bacillus anthracis (Anthrax)†
- Variola major (Smallpox)†
- Yersinia pestis (Plague)†
- Clostridium botulinum (Botulism)†
- Francisella tularensis (Tularemia)†
- Viral hemorrhagic fever: Ebola, Lassa, Marburg, Argentine

### Category B

- Coxiella burnetii (Q fever)
- Vibrio cholerae (Cholera)†
- Burkholderia mallei (Glanders)†
- Food safety threats: various enteric pathogens (E. coli 0157:H7, Salmonella, Shigella)†
- Water safety threats: Cholera, Cryptosporidium
- Various encephalitic viruses
- Various biologic toxins: Staph aureus enterotoxin B, Ricin toxin†

### Category C

- Emerging threats: Various equine encephalitic viruses, Nipah virus, Hantavirus,
- Many others

\*This is not an all-inclusive list and may change over time. Many of the agents in Category A and B are already in place or have been used previously. Some of the newer agents or unidentified agents may be actively under development.

†Weaponized in the past.

specific approaches to bioterrorism are likely to be in rapid flux.

Properties of the ideal bioterrorist infectious agent are outlined in Table 1. Tragically, a host of agents are readily available and additional ones are currently under development. In June 1999, a group of national

Table 3. Basics of Identification of Biological Exposures or Infections	Table 4. Basic Initial Management of Suspected Victim of Bioterrorism
<p>Given the current security environment, bioterrorism and biowarfare must be considered as a possibility with any unusual infection or toxic syndrome cluster. Scenarios of particular concern include:</p> <ol style="list-style-type: none"> <li>1) Unusually high attack or mortality rate of disease cluster</li> <li>2) Single case of unusual pathogen (e.g., inhalation anthrax, small-pox)</li> <li>3) Cluster of patients with suspicious clinical illness such as:             <ol style="list-style-type: none"> <li>a) flu-like illness leading to acute respiratory distress syndrome, shock, meningitis (anthrax)</li> <li>b) acute febrile illness with pustular exanthem/enanthem (smallpox)</li> </ol> </li> <li>4) Occurrence of disease outside its natural geographic boundaries, e.g., hemorrhagic fever in the developed world, tularemia or plague in American coastal urban centers</li> <li>5) Occurrence of disease outside of usual temporal/seasonal association, e.g., non-herpetic viral encephalitis during winter months</li> <li>6) Unusual age distribution of otherwise common disease, e.g., cluster of varicella in adults (may represent smallpox)</li> <li>7) Cluster of patients with acute flaccid paralysis with prominent bulbar paralysis (suggestive of botulinum toxin release)</li> <li>8) Any acute disease cluster associated with a restricted geographic (e.g., common attendance at a social event) or temporal (time of presentation and known incubation period suggests common source outbreak) exposure</li> <li>9) Clustering of diseases that affect animals as well as humans</li> </ol>	<ul style="list-style-type: none"> <li>! Maintain high index of suspicion based on cohorting of unusual illnesses or large number of patients with infectious disease.</li> <li>! Healthcare workers (HCW) should wear gowns, non-sterile glove, and N-95 high-filtration masks.</li> <li>! Immediately notify hospital infection control experts, and public health and government officials.</li> <li>! Decontaminate sick and all exposed.</li> <li>! Triage—some may require quarantine and isolation.</li> <li>! If a highly contagious disease appears likely (e.g., smallpox, pneumonic plague, or a hemorrhagic virus) a hospital ward and/or ICU should be evacuated and designated as an isolation-quarantine area for care of the victims. A defined group of healthcare professionals (MDs, RNs, RTs, pharmacists, and other healthcare workers) should be, designated to care for these patients only and not have any contact with unexposed patients.</li> <li>! Patients who can be discharged from the hospital should be and unexposed patients should be deferred to other facilities.</li> <li>! Label all labs from affected patients with bioterrorist-biohazard tags and appropriately package for transfer to the laboratory.</li> <li>! Treatment of the ill:             <ul style="list-style-type: none"> <li><b><u>Supportive therapy:</u></b> fluids, ventilation, circulatory support, etc.</li> <li><b><u>Anti-infectives</u></b> <ul style="list-style-type: none"> <li>• Anthrax: Ciprofloxacin ([Cipro], possibly other quinolones) &gt; Penicillin (PCN) or Doxycycline (Doxy)</li> <li>• Smallpox: Ribavirin, Cidofovir</li> <li>• Plague: Gentamicin (Gent) or Doxy</li> <li>• Brucellosis: Doxy + Rifampin</li> <li>• Tularemia: Gent or Doxy</li> <li>• Hemorrhagic fever viruses: Ribavirin + immune serum</li> <li>• Botulism: 3 or 7 valent antitoxin</li> </ul> </li> </ul> </li> </ul>

experts was convened to assess the potential threat of biological agents that might be used in bioterrorist attack

or biowarfare as a prelude to public health preparedness efforts. The group categorized potential agents as Category A, B, or C with Category A agents having the greatest potential for adverse public health impact with mass casualties and requirements for broad-based public health preparedness efforts (Table 2). Category A agents also have moderate to high potential for large scale dissemination or heightened general public awareness that could cause mass public fear and civil disruption. Category B agents are a slightly lower priority, and Category C are likely to be emerging biologics. Tables 3 and 4 outline some basic epidemiologic and therapeutic approaches to several group A infections.

Healthcare providers must remain alert to illness patterns and diagnostic clues that might signal an unusual infectious process secondary to a bioterrorist attack (e.g., 2 or more patients presenting with signs and symptoms of fever, cough, sepsis, and rapidly progressive respiratory failure with marked mediastinal adenopathy on chest x-ray as occurred in the recent cases of inhalational anthrax). Healthcare members who suspect such a cluster of infectious diseases or unusual illness should immediately contact their local and state health department. Various factors that might indicate the intentional release of a biologic agent are listed in Table 3. Although anesthesia and critical care personnel may not be at the point of origin of a biologic attack

or initiating primary assessment of patients with suspected biological toxicity, they may be involved in the care of acutely ill victims in the emergency room, operating room, and intensive care unit. These clinicians may be responsible for the provision of life-sustaining therapy such as airway management, resuscitation, hemodynamic monitoring, and ventilatory support, and initiation of definitive antimicrobial therapy. Anesthesia and critical care personnel so involved will be at increased risk for inhaled exposure, direct contact with pathogens, or spread of blood-borne infection. In times of emergency, it behooves the acute care anesthesia healthcare provider and intensivist to be familiar with basic isolation as well as decontamination techniques and to strictly adhere to them. It is crucial to have a suitable index of suspicion of a bioterrorist event and to rapidly isolate, decontaminate, and triage potential patients while notifying proper public health and defense authorities to initiate appropriate actions that include techniques to control the source of exposure, prophylax exposed individuals including healthcare providers, vaccinate as needed, and identify and eliminate the source of current and additional biological threats. If patients arrive to your emergency department with suspected exposure to biological agents it is important to triage them outside normal patient care areas and take them to a designated decontamination area to prevent secondary exposures.

### Specific Agents

Anthrax (Table 5), a gram-positive bacillary infection, varies as to mode of delivery of infection, be it respiratory (inhaled), gastrointestinal (GI), or contact (cutaneous) vector. Inhalational anthrax begins with a brief prodrome that appears to be similar to a viral upper respiratory infection with fever, myalgias, and malaise (Table 6 differentiates anthrax from influenza). A brief period of

improvement may then occur, but is quickly followed 2 to 4 days later by hypoxia, dyspnea, meningitis, and radio-graphic evidence of widening of the mediastinum. Inhalational anthrax is the most lethal of the 3 forms of anthrax. Incubation prior to active infection averages 1-7 days, but may be as long as 60 days. Prophylaxis or prior immunization may alter the incubation period. Patients with GI anthrax develop severe generalized abdominal pain followed by fever and signs and symptoms of sepsis. It is usually associated with eating raw or undercooked meat. The incubation period after exposure is 1-7 days. GI anthrax can develop anywhere along the GI tract from the oropharynx to the lower bowel. Cutaneous anthrax is characterized by a painless papule that becomes vesicular en route to forming a depressed eschar. The incubation period for cutaneous anthrax ranges from 1 to 12 days. Patients frequently develop fever, headache, malaise, and lymphadenopathy.

In contradistinction to inhalational anthrax, appropriate antibiotics are associated with significant improvement in survival for patients with cutaneous anthrax.

**Table 5. Anthrax (Pasturella anthracis, a gram positive bacillus)**

Infectiousness:	Airborne High infective dose 50 (ID50) ~4,000-8,000 spores
Incubation period:	1-7 days
Features:	Inhalational: Flu-like illness followed by respiratory distress, shock, meningitis Gastrointestinal: Abdominal pain, peritonitis may progress to shock Contact or cutaneous: Painless ulcers progressing to black eschar
Mortality:	Inhaled or GI: 80-95% (Death within 3-5 days) Contact: 25%
Chance of secondary infection or spread:	Little to none in someone who has an established infection. Bleach on environmental surfaces. For human contamination, no bleach, just wash clothes and shower.
Diagnosis:	Blood gram-stain and culture. See or grow gram positive bacilli; PCR; immunohistochemical staining. Widened mediastinum on chest x-ray or CT.
Precautions:	Avoid contact
Treatment:	Ciprofloxacin (Cipro) > Penicillin (PCN) or Doxycycline (Doxy)
Prophylaxis for exposed patients:	Cipro (Doxy/Amoxicillin) x 60 d, vaccination possible

**Table 6. Differentiation of Anthrax from Influenza**

	Viral Flu-like Illness	Early Inhalation Anthrax
Fever, chills, myalgias	Yes	Yes
Nasal coryza*	Yes	No
Sore throat	Common	Occasional
Cough	Yes	Yes
Substernal chest pain*	Rare	Common
Dyspnea*	Rare	Common
Abdominal pain*, N/V	Rare	Common
Leukocytosis (left shift)*	No	Yes
Hypoxemia (SaO <sub>2</sub> <90%)*	Rare	Common
Sepsis syndrome*	Rare	Common
Mediastinal adenopathy (CXR)	No	Yes

\*Drawn from a review of current and older literature.

Smallpox (Table 7), caused by the variola virus (a DNA virus) of the orthopoxvirus family, has been absent from the world-wide flora since the last outbreak in Somalia in 1977. However, there are reports of stockpiles of smallpox that have been bioengineered to be more virulent and contagious. Smallpox spreads readily from person-to-person via droplet nuclei or aerosols from the oropharynx of infected patients or by direct contact from contaminated clothing or bed linen. Infectivity wanes quickly in infected patients as lesions scab over. After a 3-4 day asymptomatic period when the virus spreads hematogenously from the oropharynx, a second viremia occurs by day 12 to 14 after exposure and results in high fever, malaise, and prostration with headache, backache, and severe abdominal pain and delirium for some patients. A widespread maculopapular rash becomes vesicular and subsequently pustular.

"Hemorrhagic" small-pox is a more abrupt and usually fatal form of the disease to which pregnant women are particularly susceptible. "Malignant" smallpox is frequently fatal as well, with rapid onset of symptoms, but rarely progresses to pustular skin lesions. Strict isolation of suspected or known cases of smallpox is crucial to limit the spread of this highly contagious virus. Supportive care for affected patients is the backbone of therapy while timely identification and vaccination of exposed individuals should be undertaken as quickly as possible.

<b>Table 7. Smallpox (Variola major)</b>	
Infectivity:	High (ID50 <100 virions)
Incubation period:	7-14 days
Features:	Fever, headache, cough, and centripetal pustular rash involving the palms and soles
Mortality:	Overall 35%  No prior vaccination* 52+% Vaccinated >20 years prior to exposure 11.1% Vaccinated within 10 years of exposure 1.4%
Chance of secondary infection or spread:	Huge!! - 1→10→100 . . .
Diagnosis:	Electron microscopic evaluation of pustular materials, culture, PCR
Precautions:	Strict isolation (air+contact in a negative pressure room) of suspected or known infected patients
Treatment:	Supportive, cidofovir or ribovarin (?), antibiotics for secondary bacterial infection
Prophylaxis for exposed patients and healthcare providers:	Vaccination within 4 days of exposure may prevent significantly ameliorate infection
*Americans have not received routine vaccination since 1972.	

Although modern public health practices, advances in sanitation, and modern antibiotics have limited widespread outbreaks of plague (Table 8), it remains an important potential aerosolized biologic that is no longer dependent on the flea as a vector for transmission directly to humans or rodents. The pneumonic form of disease is the most likely result of inhalation of this gram-negative bacillus, which causes a reported mortality of 25%. The aerosolized plague bacillus is viable for up to an hour after being released, and infected patients may spread additional bacilli by coughing. Patients with pneumonic plague initially present with signs and symptoms of severe respiratory infection such as tachypnea, dyspnea, and cyanosis. Auscultation of the chest reveals consolidation. Patients may rapidly progress to shock and end-organ failure. Patients with advanced disease may develop purpuric lesions and necrotic digits.

<b>Table 8. Plague (Yersinia pestis, a gram positive bacillus)</b>	
Infectiousness:	Moderate to high with pneumonic form
Incubation period:	2-8 days
Features:	Pneumonic form: fever, mucopurulent sputum (gram negative bacilli), chest pain, hemoptysis; chest x-ray bronchopneumonia; buboes may be absent; severe toxicity typical; shock common
Mortality:	50% non-pneumonic form; 100% pneumonic form if treatment delayed
Chance of secondary infection or spread:	High with pneumonic form
Diagnosis:	Sputum and blood culture
Precautions:	Respiratory/contact isolation for 48 hr post-initiation of antibiotics or negative sputum culture
Treatment:	Streptomycin, gentamicin, or tetracycline
Prophylaxis for exposed patients and healthcare providers:	Post-exposure prophylaxis for 7 d with tetracycline, doxycycline, sulfonamides, or chloramphenicol

<b>Table 9. Tularemia (<i>Francisella tularensis</i>)</b>	
Infectiousness:	High
Incubation:	3-5 days
Features:	Abrupt onset acute, nonspecific febrile illness, dry cough, pleuritic chest pain, chest tightness, pleuropneumonitis with chest x-ray changes of atypical pneumonia
Mortality:	If misdiagnosed, 30%
Chance of secondary infection or spread:	None
Diagnosis:	High index of suspicion needed; blood and sputum cultures; serology
Precautions:	No isolation required
Treatment:	Streptomycin; possibly fluoroquinolones
Prophylaxis for exposed victims:	Streptomycin

Bioterrorist-mediated tularemia (Table 9) would be caused by aerosolization of this small gram-negative coccobacillus resulting in a plague-like respiratory illness characterized by fever, pharyngitis, bronchitis, pneumonia, pleuritis, and hilar lymphadenitis developing 3-5 days after exposure. It is less fulminate and less lethal than infections secondary to *Yersinia pestis*. Transmission of tularemia from person to person has not been documented. A relapsing and debilitating illness may develop in undiagnosed and untreated patients.

<b>Table 10. Botulism (<i>Clostridium botulinum</i>, a gram positive bacillus)</b>	
Infectiousness:	Moderate to high with intentional GI or inhalational exposure. The lethal inhaled dose is 0.7-0.9 micrograms.
Incubation period:	12-36 hr post-ingestion or – inhalation
Features:	Acute, bilateral neuropathies with symmetrical descending weakness; patient alert, fever absent, no sensory deficit, no substantial hemodynamic instability
Mortality:	25% index case; <5% with appropriate supportive care
Chance of secondary infection or spread:	None
Diagnosis:	Toxin detection in blood or stool by Elisa or mouse bioassay
Precautions:	Toxin itself is not contagious
Treatment:	Trivalent equine antitoxin
Prophylaxis for exposed victims:	Close monitoring; antitoxin if signs of symptoms

Botulinum (Table 10) toxin is odorless, tasteless, and colorless. It is formed by the spore forming gram-positive bacillus, *C. botulinum*, and is the most poisonous substance known. It irreversibly blocks the vesicular release of acetylcholine at the neuromuscular junction. This results in an acute, afebrile, symmetric, descending flaccid paralysis that always starts in the bulbar musculature as evidenced by visual abnormality, and difficulty with speech and swallowing. The onset of symptoms is related to the dose of toxin absorbed and may vary from hours to up to 8 days. The disease varies from those with mild weakness to those who appear comatose with dense plegia. Axonal regeneration, which takes weeks to months, is required to reverse the effects of the toxin.

<b>Table 11. Hemorrhagic Fever Viruses (Ebola, Marburg, Lassa, Machupo viruses)</b>	
Infectiousness:	Modest (inhalational)
Incubation period:	5-10 days (range 2-19 days)
Features:	Abrupt onset fever, myalgia, headache typical; nausea and vomiting, diarrhea, chest pain, cough, pharyngitis common; maculopapular rash maximal on trunk after about 5 days of illness; hemorrhagic complications (petechiae, ecchymoses, and overt hemorrhage as disease progresses)
Mortality:	25-90% depending on virus and supportive care
Chance of secondary infection or spread:	Modest
Diagnosis:	High index of suspicion required; EM of tissues, buffy coat; ELISA (?)
Precautions:	Respiratory and contact isolation
Treatment:	Rivavirin, possibly immune serum
Prophylaxis for exposed victims or healthcare providers:	?Ribavirin or immune serum

The Viral Hemorrhagic Fever (VHF) Syndrome (Table 11) is the clinical entity used to describe an infectious process caused by a group of RNA viruses that includes Ebola, Lassa, Marburg, and the South American hemorrhagic viruses. Although mainly spread in nature by arthropod vectors, these viruses are highly infectious when weaponized as aerosols. The syndrome causes an abrupt onset febrile illness characterized by malaise, prostration, generalized signs of vascular

permeability, and blood pressure compromise. The various hemorrhagic viruses have an incubation period of

2 to 19 days. A truncal maculopapular rash starts approximately 5 days after the onset of acute illness followed by petechiae, ecchymoses, and frank hemorrhage as the disease progresses. Fulminate VHF typically evolves to shock and generalized mucous membrane hemorrhage. VHF is accompanied by evidence of direct neurological, hematopoietic, or pulmonary involvement, while hepatic dysfunction and renal failure develop in proportion to cardiovascular compromise.

### Summary

Americans are revisiting the long history of biological warfare that dates back to the Dark Ages when plague-infected corpses were catapulted into besieged cities. The scourge of biological warfare has grown dramatically during the past century through modern biological warfare research and weaponization of previously controlled or emerging pathogens. We must combine prevention of attack and solid epidemiologic vigilance with local, regional, and national preparation that includes education, public awareness, development of vaccines, and ready transport and availability of evolving therapies. As the Steve Miller Band said, "We're traveling fast to things in the past, it's a Brave New World."

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12. Drugs and vaccines against biological weapons. Med Lett 2001;43:87-9.



### **Biological and Chemical Terrorism Websites**

(We suggest that when you download from these sites, download information as a PDF file so that symbols, figures, and tables are accurately reproduced.)

1. [www.bt.cdc.gov](http://www.bt.cdc.gov)

CDC Bioterrorism and Response Web Page, accessed 2/24/02.

2. <http://www.cdc.gov/ncidod/EID/index.htm>

The website of the new Emerging Infectious Diseases journal sponsored by CDC. Accessed 2/21/02.

3. [www.hopkins-biodefense.org/index.html](http://www.hopkins-biodefense.org/index.html)

A plethora of information based at Johns Hopkins. Accessed 2/24/02.

4. [www.ama-assn.org/ama/pub/category/6206.html](http://www.ama-assn.org/ama/pub/category/6206.html)

Up-to-date resource sponsored by the AMA; a CD-ROM of useful sites and information is also available. Accessed 2/24/02.

5. [www.apic.org/bioterror/news/](http://www.apic.org/bioterror/news/)

Timely resource. Accessed 2/24/02.

6. [www.bioterrorism.slu.edu/](http://www.bioterrorism.slu.edu/)

In-depth and current resource sponsored by St. Louis University. Accessed 2/24/02.

### **Important Emergency Contacts**

FBI Special Information Operations Center

203-324-0259

FEMA 24-hour hotline

800-424-8802

USPHS Office of Emergency Preparedness

800-USA-NDMS

CDC (to report an incident)

770-488-7100

Defense Threat Reduction Agency (DTRA)

800-424-8802

## **CONSIDERATIONS FOR RADIOLOGICAL TERRORISM**

**Paul D. Mongan, MD, Cynthia Shields, LTC MC, Darin Via, MD**

Since September 11, U.S. intelligence agencies have issued alerts that terrorists continue to plan for further attacks. In the past months, U.S. intelligence agencies have uncovered plans of U.S. nuclear power plants at terrorist bases in Afghanistan. There is also evidence of plans designed to cause mass casualties and spread deadly radiological debris by a bombing or airline attack on a U.S. nuclear power plant or one of the Energy Department's nuclear facilities. This type of attack, known as radiological warfare (RW), is the deliberate use of radiological materials to produce injury and death. The explosion of a radiological weapon, similar to that of an ordinary bomb, causes damage by the heat and blast liberated at the time of detonation. While such attacks have not occurred, many experts agree that it is a matter of "when" and not "if" such an event will occur. Unfortunately, the proliferation of nuclear material and technology has made the acquisition and terrorist use of ionizing radiation more likely than ever. Fortunately, the treatment of most radiation casualties is both effective and practical to decrease the morbidity and mortality from the use of nuclear and radiological weapons.

Currently there are 3 threat scenarios for radiological terrorism. The most probable scenario for the near future would be a radiological dispersion device. Such a weapon can be developed and used by any terrorist with conventional weapons and access to radionuclides. This is an expedient weapon, in that radioactive waste material is relatively easy to obtain from any location that uses radioactive sources. These sites could be a nuclear waste processor, a nuclear power plant, a university research facility, a medical radiotherapy clinic, or an industrial complex. The radioactive source is disseminated by using conventional explosives, and the debris is subsequently scattered across the targeted area. In 1996, Islamic rebels from Chechnya planted, but did not detonate a device packed with Cesium 137, one of the most highly radioactive by-products of nuclear fission, in a Moscow park. Depending on the size of the explosive and the surrounding population density, the medical effects of the explosion could produce a significant number of deaths, while many thousands would suffer from radiation exposure.

A terrorist attack could also be made on a nuclear power plant using a commercial jet, heavy munitions, or internal sabotage. This type of attack would have an effect similar to a radiological bomb and could cause far greater casualties. If such an attack were to cause either a meltdown of the reactor core or a dispersal of the spent fuel waste, extensive casualties could be expected. To date, the significant medical effects of the radiological accident at Chernobyl provide the model for this type of radiological event, and the possibility that terrorists may attempt to attack such facilities has led to the implementation of more stringent security measures at nuclear facilities.

While the traumatic effects of blast and thermal injury are visible and tangible, the effects of radiation are not directly apparent and can only be discerned by the secondary effects. This is evident in the aftermath of the effects of the nuclear accident that took place in Chernobyl on April 26, 1986. On that day, an explosion secondary to loss of cooling capacity destroyed the nuclear reactor at Chernobyl. This explosion sent a cloud of radioactive material and gases 1 km high. Two workers died as a direct effect of the explosion. Those who remained in shielded areas of the plant survived while those that went to fight the fires eventually died of radiation effects. Sources of radiation exposure in this catastrophe came from the short-term gamma/beta emissions in the explosion and the subsequent gamma/beta radiation from the reactor core debris. Because of a lack of waterproof protective clothing and respirators, another principal source of radiation was from the deposition of particulate matter on the skin and mucous membranes of personnel in the area. The primary sources of residual radiation were due to iodine 131, strontium 90, and cesium 137.<sup>1,2</sup> During the acute event in this low population density area, 29 casualties were evaluated in the first 30 minutes. In the next 24 hours, 140,000 people were evacuated from the 30 km surrounding Chernobyl, and potassium iodate tablets distributed. Over the next few weeks, 230 patients were hospitalized with priority given for the early onset of nausea and vomiting, skin and mucous membrane radiation burns, and a decrease in the lymphocyte count to  $<1000/\text{mm}^3$ . Infectious disease therapy consisted of standard regimens for the neutropenic patients. Bone marrow transplantation was attempted in 19 patients receiving  $>6$  Gy irradiation. However, this did not seem promising, as 17 of 19 died due to the associated radiation burns. All told, radiation burns (40-90% BSA) contributed to the deaths of 21 patients. In addition, 82 patients had

respiratory difficulty secondary to oropharyngeal radiation burns. Over the next 4 years, the average radiation exposure around Chernobyl was 4H normal, primarily due to residual ground contamination with cesium 137. Despite the relatively low number of acute casualties given the magnitude of the accident, the long-term impact predicts 24,000 excess cancers in Europe and 280 in the region around Chernobyl.<sup>3-5</sup>

The worst scenario, and the least likely, is a terrorist organization diverting an existing nuclear device or procuring enough material and expertise to manufacture a nuclear device. In this scenario, a terrorist group could try to purchase a nuclear weapon, as the Japanese Aum Shinrikyo cult tried to do in Russia, or build a crude device on its own and utilize ground or ship transport to deliver the weapon to the point of detonation. Evidence suggests that some groups, including the Al-Qaeda network, have attempted to obtain weapons grade material. Since 1993, there have been 175 cases of trafficking in nuclear material, 18 of which involved substantial quantities of weapons-grade material. After acquiring fissionable nuclear material, sophisticated terrorists could design and fabricate a workable atomic bomb. The wake of a nuclear terror attack would be large numbers of casualties with combined injuries generated from the periphery of the lethal zone. Infrastructure, economic centers, and communications would be destroyed or disrupted by the electromagnetic pulse. The large numbers of fatalities and casualties in conjunction with the psychological effects and long-term radiation effects would impose a massive burden on available medical facilities. For example, a relatively small nuclear device of 15-kilotons detonated in Manhattan could immediately kill upwards of 100,000 inhabitants, followed by a similar number of deaths afterward. In addition, advanced medical care would be available only outside the area of immediate destruction and contamination. Consequently, the primary management importance would be placed on early evacuation of casualties to other available medical centers throughout the United States.

Because of the unique nature of radiological injury, the theory and treatment of radiological casualties is taught in the Medical Effects of Ionizing Radiation Course offered by the Armed Forces Radiobiology Research Institute at Bethesda, Maryland. In addition, the course content is published in THE MEDICAL MANAGEMENT OF RADIOLOGICAL CASUALTIES, which is available at <http://www.afri.usuhs.mil>.

The key principle in managing radiation casualties is an understanding of the sources and effects of radiation exposure. Exposure to radiation may result from external and/or internalized radiation sources. External sources can be the radiation emitted during a nuclear explosion and the residual particulate matter that remains after the explosion. Neutrons in addition to, gamma, alpha, and beta radiation, can cause radiation injuries. During a nuclear detonation, gamma radiation and neutrons are the most serious radiation threats (neutron damage was not detected after the Chernobyl incident). Dust and weapons fragments from a nuclear explosion or radiation dispersal continue to emit alpha, beta, and gamma radiation. While the residual gamma radiation, which is similar to x-rays, is much less intense than that emitted during the first minute after a nuclear explosion, it is highly energetic, passes through matter easily, and causes whole-body exposure. Alpha particles are a negligible external hazard, but as an internalized radionuclide source, they can cause significant local damage. Beta particles are very light, charged particles that are primarily found in radiation fallout. These particles travel a short distance in tissue; but if large quantities are involved, they can produce radiation burns that are similar to a thermal burn. Sources of internal radiation come from radioactive particles absorbed through open contaminated wounds or by inhaled and ingested radioactive material.

After exposure, the radiation effects can be grouped into acute and latent effects and are dependent on the radiation dose (Table 1). In the United States, the radiation absorbed dose (rad) is the measure of absorbed radiation. However, this is being replaced by the International System unit for radiation absorbed dose, the gray (Gy) (1 joule/kg); 1 Gy = 100 rad; 1 centigray (cGy) = 1 rad. The earliest and effects of radiation exposure are limited to early transient incapacitation (ETI) during extensive exposure and nausea and vomiting during lesser exposures. ETI is associated with very high, acute doses of radiation (20 to 40 Gy) and has only occurred during fuel reprocessing accidents. This level of exposure is unlikely in a terror attack. After an initial brief loss of consciousness during ETI, the patient lapses into coma within 1-3 days and dies from vascular instability. The severity and onset of the other effects after radiation exposure are predictable. The 3 most significant radiosensitive organ systems in the body are the skin, mucosa, hematopoietic, and the gastrointestinal systems. The specific effects that occur after a variable latent phase of days to weeks are 1) thermal burn-like effects to skin and mucosa, 2) gastrointestinal enteritis, 3) bone marrow suppression with

immunological dysfunction and secondary infections, and 4) hemorrhagic complications from thrombocytopenia.

<b>Table 1. Acute Radiation Syndromes</b>							
		Whole Body Radiation from External Radiation or Internal Absorption					
Phase	Feature	Subclinical range		Sublethal range		Lethal range	
		0-100 rad (cGy)	100-200 rad (cGy)	200-600 rad (cGy)	600-800 rad (cGy)	600-3000 rad (cGy)	>3000 rad (cGy)
Prodromal Phase	Nausea and Vomiting	none	5-50%	50-100%	75-100%	90-100%	100%
	Onset		3-6 hrs	2-4 hrs	1-2 hrs	<1 hr	<1 hr
	Duration		<24 hrs	<24 hrs	<48 hrs	<48 hrs	<48 hrs
	Lymphocytes			<100 @24 hr	<500 @24 hr	<500 @ 24 hr	<500 @ 24 hr
Latent Phase	Duration	>2 wks	7-15 days	0-7 days	0-2 days	None	
Illness Phase	Sign and Symptoms	none	moderate leukopenia	severe leukopenia, purpura, hemorrhage, infection		diarrhea, fever, electrolyte disturbance	convulsions, ataxia, tremor, lethargy
	Onset		>2 wks	2 days - 2 wks		2-3 days	1-48 hrs
	Organ System	none		hematopoietic and respiratory (mucosal) systems		GI tract, mucosal systems	CNS
	Hospitalization	0	<5% 45-60 days	90% 60-90 days		100% 90+ days	100% 2 weeks
	Fatality	0%	0%	0-80%	90-100%	90-100%	
	Time of Death			3 wks-3 months		1-2 wks	1-2 days

While information regarding the comprehensive medical management of radiation injury is extensive, there are general guidelines that apply to decontamination, diagnosis, and management of radiological and combined injuries. Ideally, decontamination should be performed outside the hospital. Since this will not always be possible, decontamination procedures should be part of the operational plans of any treatment facility. Decontamination consideration for non-injured casualties requires standard universal precaution and removal of patient clothing. Contaminated clothing should be carefully removed, placed in marked plastic bags, and removed to a secure location within a contaminated area. Passing a radiation detector over the entire body can readily assess the presence of radiological contamination. If present, decontamination of the skin and hair is accomplished by washing. However, open wounds should be covered before decontamination. If practical, the decontamination effluent should be sequestered and disposed of appropriately.

In the case of injury and radiological exposure, aggressive therapy will be required to allow survival. Surgical priorities for acute or life-threatening injury must precede any treatment priority for associated radiation injury. Because radiologic contamination poses little risk to healthcare providers, these patients are prioritized by standard trauma protocols. In the presence of traumatic injury, hypotension must be considered to be due to hypovolemia and not radiological injury. While the skin is impermeable to most radionuclides, particles can be absorbed through wounds. Therefore, contaminated wounds should be decontaminated with copious irrigation. It should be noted that any residual fluid in the wound might hide weak beta and alpha emissions from detectors. Because wound healing is markedly compromised by radiation injury, open wounds that are allowed to heal by secondary intention will serve as a potentially fatal nidus of infection in

the radiologically injured patient. If possible, all wounds should be extensively debrided and closed as soon as possible.

For internal contamination, chelation therapy may be indicated and recommendations can be obtained by a Radiation Safety Officer or Nuclear Medicine Physician. If radioiodine (from a reactor accident) is suspected, prophylactic potassium iodide (Lugol's Solution) should be administered within the first 24 hours in order to be efficacious. After inhalation, particles less than 5 microns in diameter can be deposited in the alveoli. Larger particles will be limited to the mucociliary apparatus of the oropharynx. In either area, soluble particles will be absorbed into the blood stream and the lymphatic system. Insoluble particles will continue to irradiate surrounding tissues until cleared from the respiratory tract. This will cause inflammation and result in fibrosis and scarring. Absorption of ingested radioactive particles depends on the solubility of the contaminant. Iodine 131 and cesium 137 are rapidly absorbed while plutonium, radium, and strontium are not. The lower GI tract is the target organ for insoluble particles that pass unchanged in the feces.

For all patients with confirmed or suspected exposure, a complete blood count should be obtained on presentation and after 24 hours to determine the absolute lymphocyte count. At 24 hours, an absolute lymphocyte count  $<1000/\text{mm}^3$  suggests moderate exposure and  $<500/\text{mm}^3$  suggests severe exposure. All body orifices (each nostril, both ears, mouth, rectum) should be swabbed and a 24-hour stool and urine collection should be done if internal contamination is considered. The swabs and 24-hour collections should be assayed for radioactivity.

The initial care of radiologic casualties with moderate and severe radiation exposure should include early measures to reduce pathogen acquisition. These could include low-microbial-content food, clean water supplies, frequent hand washing, and air filtration. When possible, oral feeding is preferred to intravenous feeding to maintain the immunologic and physiologic integrity of the gut.

During the neutropenic phase of the radiation syndrome, the prevention and management of infection is the mainstay of therapy. These patients should be treated with a hospital's standard regimen for neutropenic patients.<sup>6-8</sup> Empiric antibiotic regimens should be selected based on the pattern of bacterial susceptibility and nosocomial infections in each institution. In addition, hematopoietic growth factors, such as filgrastim (Neupogen<sup>®</sup>), a granulocyte colony-stimulating factor (G-CSF), and sargramostim (Leukine<sup>®</sup>), a granulocyte-macrophage colony-stimulating factor (GM-CSF), are potent stimulators of hematopoiesis and may shorten the duration of neutropenia and thus reduce morbidity and mortality.<sup>9-11</sup> As with all neutropenic patients, blood products administered should be fresh, irradiated, and CMV negative.

In summary, it is obvious that terrorist groups have investigated actions using radiological material or nuclear devices. If such an attack were to occur, the strain on medical resources will be significant due to the severity of bone marrow suppression that occurs after even moderate exposure to radioactive substances. However, the relatively slow onset of the syndromes and the advances in medical care will dramatically improve the survivability of such injuries.

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4. <http://www.epa.gov/radiation/rert/>
5. <http://www.doctrine.usmc.mil/mcrp/view/mcr4111b/mcr4111b.pdf>
6. <http://www.fema.gov/pte/rep/>

# CHEMICAL WEAPONS AND PROVIDER SAFETY:

## Michael J. Murray, MD, PhD, FCCM

### Historical Overview

There were over one million casualties from chemical weapons during World War I, leading to approximately 90,000 deaths, and untold morbidity and misery. Though chemical warfare was widely condemned and most nations have signed international treaties refusing to use chemical weapons, the unfortunate reality is that they have been used a number of times since World War I—in 1935 by Italy against Ethiopia (mustard gas was sprayed from aircraft), by Japan when they invaded China in 1936, by Egypt in the 1960s (phosgene and mustard gas by aerial bombs) in the Yemeni Civil War, and by Iraq during the Iran-Iraq war and on their own people, the Kurds (using sulfur mustard and nerve agents). More than 25 countries are thought to still be producing chemical warfare agents (CWA).

Unfortunately, CWAs have also been used by terrorists. The Japanese Aum Shinrikyo cult used sarin, a nerve agent, in a terrorist attack in Matsumoto in June of 1994, and again in the Tokyo subway system in March of 1995. It is the latter incident that has received much attention because of the number of people injured (over 5,000) and killed (12), and because the sect also had released anthrax in previous attacks and had produced other nerve and biologic agents. In addition, the agent was released in a subway. Subway systems are of great concern to planning agencies because there are massed concentrations of people at specific times and the sites have limited accessibility.

Though repugnant to all of us, it is not surprising that chemical weapons are used, purely on a cost-effectiveness basis. Conventional weapons (based on data from the 1960s) cost \$2,000 to produce mass casualties per square kilometer, nuclear weapons cost \$800, chemical weapons cost \$600, and biologic weapons cost \$1. Treating such chemical weapons, however, requires massive investment of medical resources to deal with results that are psychologically as or more devastating than any other weapon. In treating casualties, it is important to protect oneself, more so than in treating casualties from any other weapon of mass destruction. From an anesthesia perspective, patients who have been exposed to nerve agents or their antidotes may require modification of the anesthetic plan if they require surgery for other reasons.

One must also take into account that, because of the likelihood of an industrial accident, we may be more likely to see patients injured by chemical agents than by nuclear or biologic agents. The best example would be an industrial accident in which large amounts of chlorine were released either from an explosion, a train derailment, or truck crash.

### Chemical Agents

There are four main groups of CWA (Table 1). The chemical weapons, in addition to their generic names with which we are familiar, also have military-designated codes (Table 1). Volatility must be taken into account when discussing these agents. Most of these chemicals are in liquid form at standard temperature and pressure (STP). Phosgene and cyanide are the most volatile, while the volatility of sarin, interestingly enough, is similar to that of water. Sulfur mustard and VX are the least volatile. When vaporized, with the exception of hydrogen cyanide, all are heavier than air and concentrate in trenches, basements, or foxholes. If exposed, individuals should ascend to higher levels within a subway system or building; one should avoid low-lying areas. Even standing can provide some protection as opposed to lying down.

Volatility is inversely related to the persistence of an agent—the more volatile, the quicker it evaporates and

Table 1. Chemical Agents	
Common Name	US Military Code
Nerve Tabun Sarin Soman	GA GB GD GF VX
Pulmonary Phosgene Chlorine	CG CL
Skin (vesicants) Sulfur mustard Lewisite Phosgene	HD L CX
Blood (cyanide) Hydrogene cyanide Cyanogen chloride	AC CK

dissipates; the less volatile, the greater the persistence. Most industrial chemicals such as hydrochloric acid are relatively nonpersistent. Chemicals used for military use, however, tend to be persistent (e.g., VX or sulfur mustard). The more persistent an agent, the more likely it is to penetrate the dermis and to result in greater injury. These agents, therefore, also pose the greatest threat to paramedics and emergency medical personnel.

Toxicity is also an important component. In terms of toxicity, i.e., in  $\text{mg}/\text{min}/\text{m}^2$ , soman > sarin > sulfur mustard > cyanide > phosgene > chlorine. We are used to terms such as mean effective dose ( $\text{ED}_{50}$ ) or mean lethal dose ( $\text{LD}_{50}$ ), but chemical agents are also discussed as a concentration-time (Ct) product. Ct takes into account the concentration of an agent in the atmosphere factored by the amount of time that an individual is exposed to that concentration and expressed as  $\text{mg}/\text{min}/\text{m}^3$ . An  $\text{LD}_{50}$  relates to dose and the  $\text{LCT}_{50}$  relates to exposure. Dose does not equal exposure.

A final factor that must be taken into account is time of onset, e.g., latency. Mustard, phosgene, and chlorine have the longest latency, whereas the nerve and blood agents have the shortest onset times, usually within seconds to minutes.

### **General Principles of Treatment**

In a situation in which there is chemical exposure, one must clearly demarcate the contaminated zone, there must be protected entry and exit points, and there must be procedures in place and resources available to protect oneself and to decontaminate patients.

#### **Self-Protection**

Depending on the nature of the injury, if it is a pulmonary agent one must wear a “self-protective mask” (gas mask). If dealing with a nerve agent or vesicant, a chemical-protective agent must be worn. If healthcare providers care for a patient who has been exposed to any of these classes of compounds, they may acquire the agent on their skin or through latex gloves and become a casualty. The best protection is from a chemical-protective garment that is impermeable to all classes of agents.

#### **Decontamination**

In the event of any such large scale use of chemical weapons, there are specialized teams throughout the United States that would respond and facilitate decontamination. All hospitals, however, as part of their disaster preparedness plan, should have decontamination facilities available, especially those hospitals situated close to large chemical plants. In addition, antidotes to specific agents should be readily available (see below). Such antidotes would be in one of the 8 national pharmaceutical stockpiles (NPS) and would be rushed to the site, but unfortunately, to treat nerve agents and cyanide toxicity, antidotes must be administered within minutes rather than hours. There are also detectors used by the military and available to the civilian sector that can be used to identify specific agents.

Contaminated clothing must be removed and the skin should be rapidly decontaminated; it is best if done within a minute, but this is rarely achieved. Ideally, patients should be decontaminated at the scene before transportation, but this again infrequently occurs. Soap and water are effective decontaminates, and if available a dilute solution of hypochlorite (household bleach) can be used to decontaminate the skin. The military uses 0.5% and most emergency medical teams use 1 to 2% concentration (household bleach is 5%) hypochlorite.



## Specific Agents

**Nerve Agents.** The 5 chemicals in this group are derived from organophosphate compounds first synthesized in Germany in the 1930s that inhibit acetylcholinesterase. They are liquid at room temperature and in vapor form penetrate the cornea, dermis, and respiratory tract. VX, though it has greater toxicity, has lower volatility than any other nerve agent. The antidotes for acetylcholinesterase poisoning include atropine at fairly high doses, on the order of several milligrams to hundreds of milligrams in some cases, and pralidoxime, up to 8 mg. Because of the military's prophylactic use of pyridostigmine, anesthesiologists caring for soldiers in the operating room must be aware of this possibility if one is contemplating using a neuromuscular blocking agent. Neuromuscular blockers should be used with caution, or avoided in patients who may have received pyridostigmine.

The effects of these agents are due to unopposed action of acetylcholine at muscarinic and nicotinic receptors. Initial effects are related to the muscarinic effects including rhinorrhea, salivation, miosis, and headache. With severe poisoning, nicotinic effects can be observed. The combination of muscarinic and nicotinic effects are manifested by bronchospasm, vomiting, incontinence, muscle fasciculation, convulsions, respiratory failure, and death.

**Pulmonary Agents.** Chloride and phosgene produce pulmonary toxicity. With inhalation, there is destruction of epithelium and endothelium with resultant pulmonary edema, which can lead to hypoxia and death. There are not specific antidotes for phosgene or chlorine. Patients must be removed from further exposure, given supplemental oxygen, and be evaluated and managed as would any other patient in whom you were worried about acute lung injury or ARDS. The need for airway skills and ability to ventilate large numbers of patients would have to be anticipated and emergency response plans implemented.

**Blood Agents (Cyanide).** Cyanide has toxicity because of binding to hemoglobin with the production of cyanohemoglobin; patients die of tissue hypoxia. The antidote for cyanide is the same as what we would use for patients who had an overdose of sodium nitroprusside, i.e., sodium thiosulfate. Amyl nitrate is more readily available but not as effective.

**Skin Agents.** Sulfur mustard is an oil at room temperature and will remain in liquid form in a cold environment, but will evaporate in a warm, dry environment. Mustard gas can penetrate ordinary clothing. It is an alkylating agent and, therefore, binds with most biologic molecules. Though mortality is low, the resulting effects on the eyes, skin, and respiratory tract can be quite debilitating. In high dose, it can also have effects on the hematopoietic system leading to leukopenia and anemia. There are no specific antidotes for sulfur mustard other than cleansing the skin as already commented upon. Dimercaprol is a specific antidote to lewisite.

## Summary

A plan for dealing with chemical agents should be part of any hospital's or healthcare provider's plan to respond to an event or attack in which weapons of mass destruction may be used. One must consider exposure to a chemical agent in any situation where there are multiple casualties without a logical explanation or if patients present with unusual symptoms. If survival is to be improved, the diagnosis must be made and treatment given expeditiously, especially with nerve agent or cyanide poisoning. Healthcare providers must remember to protect themselves, lest they also become a casualty and place further burden on the healthcare system. The preliminary response to a chemical attack involves decontamination at the scene, with removal of clothes, shaving of contaminated hair, and irrigation with soap and water or dilute 0.5 to 2% hypochloride. Antidotes can be given to specific agents if they are suspected or proven. The best response to any such scenario can only be achieved through preparedness.

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# **The Response**

## **FEMA, DMAT's and IMSuRT's**

### **Ed George M.D., Ph.D.**

#### Outline:

- I. Historical perspective
- II. Federal response plan
- III. National Disaster Medical System
- IV. Operational perspectives (DMAT and IMSuRT)
- V. Addressing the perceived threat

The federal government has historically provided assistance to regions, states and municipalities in the United States in times of emergencies, epidemics and natural disasters. It is of interest to note that while these efforts have occurred throughout the history of the United States, it is only recently that formalized plans and procedures have been established to better address the wide range of contingencies that may occur, often with minimal advance warning. With the World Trade Center disaster, the Federal Government has initiated the most comprehensive process, to date, to ensure that Federal response to a given contingency be provided in the most expeditious and efficient manner possible.

The current guidelines by which the Federal Government provides/facilitates assistance to states and local governments are outlined in the Federal Response Plan (FRP). With the establishment of the Department of Homeland Security, the FRP is evolving into the more comprehensive National Response Plan (NRP).

From an historical prospective the FRP developed with the inception of the Federal Emergency Management Agency under the administration of President Carter. Initially drawing from guidelines to address issues associated with natural disasters, such as earthquakes and floods, the FRP, as it currently exists, is a coordinating document among 27 Federal Departments and Agencies and the American Red Cross. It provides the mechanism for coordinating the delivery of Federal assistance and resources to augment efforts of State and local governments overwhelmed by a major disaster or emergency. And, it supports the implementation of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended (42 USC 5121), as well as individual agency statutory authorities.

The Federal Response Plan is comprised of a number of annexes to address recovery function, support, incident and emergency support function. Emergency support function (ESF) annex 8 deals with the area of health and medical services. In that the ESF annexes deal with specific areas, such as transportation or energy, a lead agency is generally assigned the responsibility for a mission under FEMA guidance. Until recently, FEMA was an independent federal agency, reporting to the President. Tasked by the FRP, the Secretary for Health and Human Services was operationally responsible for health and medical services support. This was accomplished through the U. S. Public Health Service and its National Disaster Medical System (NDMS). The NDMS was chartered in 1983 to provide medical care in the United States following disaster that damages and/or overwhelms existing local medical resources and infrastructure. Initially NDMS was formed to serve the function of coordinating the use of civilian hospital beds in times of national disasters, as well as to establish medical teams for service during emergencies. With the establishment of the Department of Homeland Security, the National Disaster Medical System, along with FEMA, have transitioned to the Emergency Preparedness and Response Directorate of the DHS.

The National Disaster Medical System is a cooperative asset-sharing program among Federal Government agencies, state and local governments, and private businesses and civilian volunteers to ensure resources are available to provide medical services following a disaster that overwhelms the local health care resources. It represents a federally coordinated system that augments the Nation's emergency medical response capability. The overall purpose of the NDMS is to establish a single, integrated national medical response capability for assisting state and local authorities in dealing with the medical and health effects of major peacetime disasters. The National Disaster Medical System is also responsible for providing support to the military and Veteran's Health Administration medical systems in caring for casualties evacuated back to the United States from overseas armed conflicts.

A vital component of the NDMS mission is the development of Disaster Medical Assistance Teams (DMAT). These civilian volunteer teams (DMATs) are groups of professional and paraprofessional medical personnel, supported by teams of logistical and administrative staff, designed to provide emergency medical care during a disaster or other event. There are approximately 50 teams, nationwide, sponsored by hospitals, medical centers and public safety organizations, with additional teams in various stages of development. This sponsorship may entail the use of facilities, equipment, and regional expertise, as well as financial support and liaison to local public health community. Additional teams such as Disaster Mortuary Operational Response Teams (DMORT) and Veterinary Medical Assistance Teams (VMAT) are also situated throughout the country to provide specific expertise in times of disaster.

This pre-planned and positioned Federal response system is essential to an effective effort in time of disaster. With few exceptions, disasters provide little time for preparation. While some natural disasters may be "forecast" in advance, the variability of scope and duration provide little opportunity for reaction. As world events now repeatedly demonstrate, many disasters, such as those resulting from acts of terrorism, rely on unpredictability and the element of surprise for maximum effect.

The utility of providing a federalized medical response offers critical elements that save time and provide flexibility in times of emergency. The concept of task-organized medical teams offers the capability to provide a full complement of personnel, to include physicians, nurses, paramedics and emergency medical technicians, as well as a support team to deal with logistics, security and administrative issues. These personnel are fully credentialed in the Public Health System, are trained and equipped (to include personal protective gear) and are supported with renewable medical supplies. The teams offer the ability to fully integrate with on-going rescue efforts, utilize standardized record-keeping procedures and offer reliability, accountability and quality control that is essential in situations where infrastructure may be seriously compromised.

Utilizing regular training activities, on the local, state and Federal level, these teams are in a continual state of readiness. By virtue of coordinated national training guidance and exercises, when teams are called into action, their integration is near seamless.

To better understand the employment of these teams, it is necessary to look at the phased response to a disaster or emergency. Regardless of the scope, the initial response to any emergency will be from local assets. Local police, fire and emergency medical personnel will be the initial teams to respond to and evaluate a given situation. If the scope of the situation exceeds or overwhelms local capabilities to respond, additional assets in the form of regional, state and Federal resources are called upon. In the case of the need for Federal response, as authorized under the Stafford Act, Federal support is provided under the guidance of personnel from the Federal

Government (FEMA), in coordination with local agencies. In the event of medical response, this assistance is brought to bear in distinct phases.

The initial phase involves search and rescue. As victims are identified and recovered, they are entered into the critical phase of triage and stabilization. While standard medical care in hospitals and clinics is rarely limited, emergency operations in the field must consider the limitation of resources, both from the perspective of equipment and personnel. Priorities are determined, initial care is provided and individuals are moved on to the phases of definitive care in the field and finally to evacuation by any variety of means available. This evacuation phase may often involve military personnel and assets. The Disaster Medical Assistance Teams provide the capability of integrating personnel in all phases of the operations involving disaster response. And this capability is essentially instantaneous upon arrival by virtue of the nature of the Team's training and equipment.

The teams are capable of providing Advanced Trauma Life Support (ATLS), field teams with Advanced Cardiac Life Support (ACLS) capabilities and provide deployable rapid assembly shelters for use as clinics and field hospitals. Definitive care in the areas of trauma, burns, orthopedics, pediatrics and surgery are immediately available. Over the past several years these teams have been utilized in support of a wide range of disaster and rescue missions to include natural disaster relief and in response to the World Trade Center disaster.

While this ability to provide rapid medical assistance has been refined over the past decade, events in 1998 demonstrated a vulnerability and shortfall in our Nation's ability to provide assistance to its citizens outside of the country. Specifically on August 7, 1998, American Embassies in Kenya and Tanzania were the targets of terrorist attacks. In Kenya 44 U.S. Government employees were killed with hundreds injured. Available U.S. medical personnel were limited to 1 physician, 2 nurses and a nurse practitioner. With the closest additional U.S. medical personnel being drawn from U.S. bases in Germany, and these being extremely limited by operational tempo, the ability to provide medical care was limited by the meager local facilities.

As a result of these events the U.S. Government chartered the development of a Disaster Medical Assistance Team with international capabilities. Staffed through the National Disaster Medical System and under the operational control of the Department of State, the first International Medical Surgical Emergency Response Team (IMSuRT) was formed under the sponsorship of the Massachusetts General Hospital, in Boston, under the direction of Dr. Susan Briggs, and comprised of elements from the existing Boston DMAT. The specific mission is to provide international medical and surgical response capabilities to manage American casualties of international disasters and acts of terrorism, with the primary objective of the reduction of morbidity and mortality.

Basic functions of the Teams will encompass:

- Triage and initial stabilization
- Definitive medical care
- Evacuation
- Treatment of host nation casualties
- Assistance to search and rescue operations

The Team has been trained and equipped with the ability to respond to adult and pediatric trauma and burns, is deployable within 6 hours of notification and is a completely self-sufficient emergency field hospital. Deployed in 2 phases, the initial advance team of surgeons, anesthesiologists/intensivists, emergency physicians, nurses, paramedics and logistic,

administrative and security personnel, are all cross-trained to serve in several key positions in the group. This providing an additional layer of flexibility. The team may be transported by commercial or military assets and arrive on station with the ability to provide immediate emergency care. Elements of this unit were sent to New York City on September 11, 2001 and established 4 clinics on the excavation site. A more recent deployment found members of the unit in Guam, in December 2002, providing emergency medical assistance due to severe typhoon damage.

Composition of the various teams is in a large part task-organized around the specific nature (and constraints) of the disaster. However to facilitate rapid response and coordination, generic tables of organization and equipment have been developed to serve as the framework for the advanced and main components of a deployment.

The IMSuRT Deployment Staff Model deploys an advance group of approximately 26 personnel, under the direction of a Supervising Medical Officer, in the following manner:

Trauma Surgeons (2)	OR Nurses (2)
Specialty (vasc/ortho) Surgeon (1)	Surgical (pedi/burns) Nurses (2)
Anesthesiologists/Intensivists (2)	Intensive Care Nurses (2)
Emergency Physicians (2)	Emergency Nurses (2)
Deputy Team Leader (1)	Paramedics (4)
Administrative Officer (1)	Pharmacist (1)
Communications Officer (1)	Biomedical Technician (1)
Logistics Officer (1)	Respiratory Therapist (1)

The concept of operations specifies activation by request of the Department of State to the Emergency Response Directorate of the Department of Homeland Security. Within a 4 to 6 hour time frame, the Team is able to fly directly to the site of operations or to an intermediate staging site. The Team is completely self-sufficient, with all equipment carried by Team members. The Team is capable of establishing a base of operations upon arrival in a variety of facilities ranging from existing hospitals and clinics to improvised sites at the airport of insertion. The Team may also be utilized for domestic operations at the request of the Department of Homeland Security. Given the limited nature of personnel and equipment, all support personnel will also possess clinical capabilities.

The equipment carried by the advanced team is configured to permit sustained trauma surgery for up to 3 days of continuous operation. The configuration of the follow-on main component, both in the areas of personnel and equipment, is influenced by the nature of activity conducted by the advanced team. With a target time frame of 10 to 14 days of operation, the Team is extremely dependent upon other agencies of the Federal Government for logistics and security. With the ever-changing scope of international terrorism, increased training emphasis has been directed toward the care of victims of weapons of mass destruction.

Through the vision and efforts of individuals from many departments of the Federal Government and under the leadership of Dr. Briggs, 2 additional teams are being established in Florida and Washington. These additional teams, expected to be operational in 2003, will further improve the ability to respond to international events in a more timely and efficient manner.

As changing world events continually present us with challenges regarding the public safety, groups such as IMSuRT are gaining more notoriety with the general public. Support extends from the grassroots of the communities to the highest levels of government. As institutions

look to modernize (or initiate) disaster planning, the expertise of IMSuRT and other groups is being called upon to help guide local institutions in their planning for disaster. With this added exposure to the public, there has been an increased interest on the part of many skilled medical personnel to participate in the Teams. It is in this manner that new ideas and resources may be brought to bear on the problems facing this country in the area of medical disaster response.

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#### *Web Sites:*

[www.cdc.gov](http://www.cdc.gov) Center for Disease Control:

current information regarding biothreats

[www.dhs.gov](http://www.dhs.gov) Department for Homeland Security:

master site for threat index -- excellent links to other agencies

[www.fema.gov](http://www.fema.gov) Federal Emergency Management Association

now within the DHS, this site offers excellent information regarding training opportunities

[www.fbi.gov](http://www.fbi.gov) Federal Bureau of Investigation

much more comprehensive than in the days of Inspector Erskine.  
lead law enforcement agency for the United States

**American Society of Critical Care Anesthesiologists**  
**Scientific Session IV**

3:20 p.m. – 4:20 p.m.

*Ethics in Critical Care Research*

**E. Greg Koski, Ph.D., M.D.**

Massachusetts General Hospital

Boston, Massachusetts

**Michael Matthay, M.D.**

University of California San Francisco

San Francisco, California

4:20 p.m. – 5:20 p.m.

*Making Critical Care Practice Work*

*New Technologies in Critical Care Practice*

**Michael J. Breslow, M.D.**

VISICU

Baltimore, Maryland

*Medicare Compliance: Why, How and What To Do When Things Go Wrong*

**Gerald A. Maccioli, M.D.**

Raleigh Practice Center

Raleigh, North Carolina

5:20 p.m. – 5:50 p.m.

*Business Meeting*



**Ethics in Critical Care Research Session:**  
**ARDS Net Clinical Trials, OHRP Controversy and Outcomes**  
**Michael A. Matthay, M.D.**

In this presentation, I will summarize the recent history of the Office of Human Research Protection's (OHRP) investigation of the NIH/ARDS network clinical trials. I will also provide the responses to the allegations that formed the basis of the OHRP investigation.

In late July 2002, the OHRP received a complaint that the NIH clinical study published in 2000 (1) was unethically designed because the control group did not represent standard care. The authors of the complaint were Drs. Eichacker et al., members of the intramural branch of the NIH (2). On July 25, 2002, the NIH/ARDS network voluntarily suspended our current trial of fluid management and central venous versus pulmonary arterial catheterization in patients with lung injury (FACTT) in order to respond to the concerns of the OHRP and to allow the NHLBI and the OHRP to conduct an independent blue ribbon panel to assess the allegations. The primary allegations can be summarized as follows:

1. The control group (patients with a tidal volume of 12 ml/kg/ideal body weight) did not represent standard care and mortality was excessive in this group.
2. The 6ml/kg/ideal body weight tidal volume was detrimental, not beneficial.
3. There should have been a wild type group, in which clinical care was carried out with no guidelines, just allowing the physician to do what he/she wished, for both the original tidal volume study as well as the current fluid catheter trial (FACTT).

In late August, 2002, the NIH/ARDS network presented detailed responses to all of the allegations to an independent, 5-person panel, blue ribbon commission. Representatives from both the NHLBI and the OHRP were present. All of the panel members had been approved by both the NHLBI and the OHRP. In my presentation, I will provide a detailed response to the allegations that the network provided. This 5 person, blue ribbon panel unanimously rejected the allegations from Drs. Eichacker and colleagues and unanimously concluded on August 31, 2002 that the current and prior trials were well-designed, safe, and important, and they should resume at once.

In September, 2002, Claude Lenfant, M.D., Director of the NHLBI concurred with the blue ribbon panel assessment, and concluded that the FACTT trial should be resumed and that the current and prior clinical trials by ARDS network were safe and well designed. However, on October 7, 2002, Dr. Carome from the OHRP indicated that he was not satisfied and that there were still concerns regarding the design of the clinical trial relative to standard care.

It should be appreciated that there was an extensive scientific and ethical review of the clinical trials that had been done previously. Specifically, an independent NIH protocol review committee reviewed the scientific and ethical quality of these trials several times before the FACTT trial was instituted in 2001. Secondly, 19 different university-based institutional review boards also reviewed and approved the FACTT trial. Furthermore, the Data Safety and Monitoring Board (DSMB), an independently constituted group of experts in the field, reviewed the ongoing data in all the clinical trials, including the current FACTT trial, and concluded that the trials were entirely safe and should be continued. In fact, the DSMB met in December 2002 and reviewed the data on the first 411 patients enrolled in the FACTT trial, and concluded that the trial was safe and should continue without a change in the protocol. In spite of these favorable reviews, Dr. Carome at the OHRP persisted in not allowing the NIH/ARDS network to resume the trial. The OHRP was also very slow in responding to the detailed responses that the ARDSnet had provided in writing to all of the concerns.

Finally, perhaps in part because of pressure from several expert groups including The American Thoracic Society and the New England Journal of Medicine, the new interim Director of the OHRP agreed that further delays were inappropriate. A completely new 8-person blue ribbon panel was constituted by the OHRP. No members of the panel that had been recommended by the NIH or the NIH/ARDS network. In early June 2003, the NIH/ARDS network again presented a detailed rebuttal to all of the allegations. This blue-ribbon prior concluded, as had the prior one in August 2002, that the FACTT trial was safe and well designed and should resume. The OHRP has now agreed that the trial should resume, and the consent documents have been modified to reflect in a more detailed way all of the risks that patients may be exposed to in entering one of these clinical trials.

In response to the specific allegations from the Eichacker and associates, the ARDS network has provided detailed responses (3, 4). First of all, there is ample evidence that the two tidal volumes used in the original 861 clinical patient trial (6 or 12 ml/kg ideal body weight) were well within the range of clinical practice (see illustrations presented in this talk). Furthermore, there was also convincing evidence that mortality in the control group of 12 ml/kg/ideal body weight was comparable to several other clinical trials in which a higher tidal volume had been used in recent studies. Furthermore, another clinical trial had also demonstrated a reduced tidal volume with a low tidal volume plateau pressure approach (5, 6). Furthermore, there is no evidence that there is any systematic relationship between plateau pressures and tidal volumes that were selected before randomization of patients into the clinical trial (see slide to illustrate this to be presented in this talk)(3).

The second major question pertained to the design of fluid and catheter treatment trial (FACTT). Data that was available from prior ARDSnet clinical trials demonstrated that the two arms of the FACTT trial (liberal versus conservative fluid administration) were both well within the range of clinical practice encompassed in the large number of patients in the prior trials.

Dr. Drazen, editor of *The New England Journal of Medicine*, and other experts in the field have addressed the question of whether a wild type group should be compared with other arms (7). The use of a wild type group to compare with the protocolized tidal volume strategies would potentially have jeopardized patient safety by prolonging the duration of the trial, making it very difficult to achieve statistical significance between the two tidal volumes that were evaluated, and also provided no information regarding how a usual care group was actually managed. The vast majority of clinical trials of cardiology, oncology, and critical care medicine do not use a usual care arm design. Dr. Drazen has explained the reasons why a usual care arm control group is actually detrimental and not at all beneficial. *The New England Journal of Medicine* also has detailed the chronology of events in the OHRP investigations (8, 9), as have other journals (10).

In summary, the recent OHRP investigation of the NIH/ARDSnet trials was well intentioned but misguided and poorly managed. The OHRP does not have the scientific expertise to evaluate clinical trial design, and this became apparent throughout the course of this investigation. Furthermore, it remains entirely unclear why the OHRP did not accept the findings of the initial 5-person blue ribbon panel in August 2002. The NIH/ARDS network was always willing to respond to issues of informed consent in order to make sure that patients were fully aware of all of the potential risks in being enrolled in any of the clinical trials. On a positive side, the investigation has led to a careful re-evaluation of guidelines that should be provided in carrying out clinical trials, both in consent documents as well as institutional review at the local level. The NIH/ARDS network is very pleased that the outcome of the investigation concluded that prior and current NIH/ARDS clinical trials were designed to protect patient safety and that the trial should resume. Our intention is to look forward to completing the current clinical trial, "Fluid

management versus central venous versus pulmonary arterial catheterization”(the FACTT trial) and to test other potentially valuable clinical therapies for clinical acute lung injury (ALI) in the future.

The results of the ARDSnet’s first clinical trial (1) provided the first unequivocal evidence in a large multicenter trial that mortality could be reduced in patients with acute lung injury (11). In that trial, mortality declined to 31% compared to the control group of 40% (1). In a follow-up trial, in which the ARDS network tested the impact of a higher positive end- expiratory pressure level in patients with acute lung injury with both groups being treated with a 6ml/kg tidal volume strategy, mortality in both groups declined to 26%. It is noteworthy that the severity of illness scores, as measured by Apache III, was comparable in these ALI patients to the scores in prior trials. Thus, this follow-up trial provides evidence that the lung-protective strategy with a low tidal volume and plateau pressure limit continues to be associated with a marked reduction of mortality in patients with acute lung injury.

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# **Making Critical Care Practice Work New Technologies in Critical Care Practice Michael J. Breslow, M.D., F.C.C.M.**

## **The Need for Change**

The past decade has seen considerable maturation of the specialty of critical care medicine. A host of peer-reviewed publications have confirmed the advantages of dedicated intensivist staffing models, clinical research has identified a variety of best practices associated with superior patient outcomes and several articles have highlighted the positive contribution of select organizational processes. However, while this information has increased our understanding of the value of specific practices, few hospitals are able to integrate these into day-to-day ICU practice. There are multiple reasons for this, including: 1) the general failure of hospital leadership to recognize the need for extensive change in ICU practice and allocate the appropriate resources and political will, 2) the national shortage of intensivists and other key ICU personnel, and 3) the increasing numbers and complexity of ICU patients as a result of the aging of the population. However, not all the shortcomings can be attributed to external problems. As intensivists, we bear the primary responsibility for the programs of care in our ICUs. All too often we strive to excel as individuals but shy away from the much more difficult and time-consuming task of managing the ICU. We recognize the value of standardization of care processes but settle for less than 100% compliance. While we care deeply about the ICU - and strive to do the best job possible with limited time and resources - we have not confronted the need for changes in organizational focus and practice structure nor demanded technology tools to enhance our efficiency and effectiveness.

As we consider how to improve the practice of critical care, we must acknowledge the extraordinary changes unfolding in healthcare in the United States. Led by a broad coalition of patients, physicians, policy makers and purchasers, there is an emerging recognition that current systems of care are neither efficient nor safe. Newspapers throughout the US publicized the Institute of Medicine's estimate of 98,000 avoidable deaths annually attributable to errors of commission. Their follow-on publication, *Crossing the Quality Chasm*, provided a detailed analysis of root causes and identified the changes that are needed to fundamentally improve the quality of US healthcare. Their basic conclusion - existing systems of care are flawed and new systems must be developed. The issue is not how hard people work but how well the system supports workflow and provides safety mechanisms. A recent NEJM article suggests that almost 50% of patients fail to receive appropriate therapies. While most of us would like to believe that our ICUs function at a higher level than this, it is instructive to consider that other industries strive for error rates well below 1% (the six sigma approach to error reduction targets an error rate of 3 per 1,000,000 opportunities). Most intensivists are quite familiar with the Leapfrog Group's call for dedicated intensivist staffing models in all non-rural US hospitals and view this as a tremendous boost for our profession. However, the underlying premise of the Leapfrog Group is that industry no longer trusts healthcare to deliver safe and efficient care for its employees. All this amounts to a strong impetus for change.

It is no coincidence that industry is leading the charge for change in healthcare - their survival is dependent upon their ability to minimize errors and maximize operating efficiency, and they clearly understand the magnitude of improvement that is possible if we invest similar energy in transforming our business. Industry's extensive efforts to optimize their operations provide us a wealth of valuable lessons about where we need to focus energy and invest resources as we set about to re-engineer ICU care. While there are many different approaches in use, and an extensive literature that provides detailed descriptions of specifics, there are key features common to all. First, there must be system-wide focus on what needs to be accomplished. This starts with senior

leadership (e.g. CEO, COO, CFO) and extends down to every member of the organization. As part of this, everyone needs to understand why this is important to the organization. Second, considerable time and energy must be devoted to creating a comprehensive plan to achieve the goals of the program. All aspects of workflow must be dissected and optimized, an effort that requires extensive input from those who actually perform the work. Once the blueprint is complete, the team leaders have to develop detailed procedures and protocols that will be used by all in their day-to-day operations to ensure workflow standardization and maximum efficiency. Oftentimes it will be necessary to create new tools to implement select aspects of the program and/or assist individuals accomplish their tasks faster, safer and with greater consistency. Technology has played a major role in transforming many industries. Finally, and perhaps most importantly, monitoring tools must be developed so that team leaders can audit each step in the process. This information, which must be quantitative and trackable over time, provides hard data about how well goals have been met and shows where changes need to be made to further optimize system performance.

Many in healthcare will argue that medicine is different from other industries. The organizational structure doesn't exist to execute coordinated changes in practice. The financial resources are not available and the incentives of hospitals and physicians are not aligned. And, the argument heard most often, that medicine is an art, not a science – that care cannot be standardized. There are elements of truth in all of these. Yet the reality is that there is considerable opportunity to change. None of the above issues precludes major reorganization of care. Yes, creativity will be required, as will innovation, and – most importantly - a willingness to change how we do our work. As discussed previously, the public and payors are all pushing for new systems of care. That political force, combined with the enormous financial pressures coming to bear on hospitals, makes change a certainty. We can either stand by and watch or take a leadership role in charting the future.

### **Infrastructure Requirements for Optimal ICU Practice**

In order for ICU reorganization to achieve meaningful results it must incorporate the core principles outlined in table 1.

Table 1.

Hospitals and physicians must recognize that they have a common goal to improve the quality of ICU care and work together to achieve this objective

Limited resources and the need for consistency across units mandate that hospital systems must develop system-wide solutions

Intensivists must assume responsibility for managing ICU care

Technology tools must be used to leverage personnel, increase efficiency, reduce errors, and standardize practices

The first core concept embodies the need for a broad commitment to improving ICU patient care, the allocation of necessary resources, the willingness to remove political obstacles and the ability to align incentives. Hospitals (and increasingly hospital systems) are the key to implementing new care programs. They alone have the resources and the wherewithal to effect change. All too often, hospitals have avoided direct involvement in patient care, instead focusing energy on back-office operations like accounts receivable and supply chain management. However, the unprecedented financial pressures being applied to hospitals by third party payors (including CMS) are forcing them to look at how they can improve their core business – taking care of patients. Driving this newfound interest in improving clinical processes is the recognition that better patient care is less expensive patient care. Avoidable complications and other adverse events prolong hospital stay and increase resource consumption. The Leapfrog Group understands this – a stated secondary goal

of the organization is to reduce the cost of healthcare for its corporate members. However, for hospitals to change clinical practice they must work directly with physicians - physicians are responsible for almost all patient care decisions. This coordination of effort does not come easily to either party. Hospitals will need to increase the role of physicians in administration (and create new salary lines for this) and develop strategies for aligning incentives – likely involving direct reimbursement for ICU patient care activities. Physicians will need to accept more direction over their activities and understand how their clinical decisions affect hospital costs and operating efficiency. However, those institutions that can forge effective alliances with physicians and launch major new clinical initiatives to improve patient care will become market leaders.

The second core concept, the need for system-wide solutions, is particularly relevant to critical care, where traditionally each ICU has functioned independently, oftentimes with separate physician and nursing staffs. This model is inherently inefficient, particularly from the manpower perspective, given the current severe intensivist shortage. Having each ICU function autonomously also impedes efforts to standardize care practices – it is common to see different weaning or sedation practices in use in different ICUs of the same hospital. System-wide solutions also create opportunities for introducing new technologies, where economies of scale allow lower costs per ICU. Finally, perhaps the most compelling justification for system-wide solutions is the enormous disparity in the quality of ICU care that exists between facilities (oftentimes within the same integrated delivery network – or even the same hospital), based upon differences in the number/role of intensivists, the use of protocols and other quality tools and the availability of resources. The recent trend towards multi-hospital systems, frequently comprised of both major teaching facilities and community hospitals, has created a practical basis for implementing system-wide solutions. Modern hospital systems generally have experienced executive leadership teams, coordinated decision-making across facilities, integrated technology systems and the necessary financial resources. By choosing to implement system-wide changes in ICU practice, these organizations can improve the clinical and economic performance of a major service line, increase their ability to care for high acuity patients, extend their brand throughout system facilities and, thus, reap the benefits of their integration efforts. Hospitals that lack the scale for comprehensive reorganization of ICU practice will need to align themselves with larger organizations in their area in order to achieve similar results.

The third core concept enunciates the need for intensivists to assume a much-expanded role in managing ICU practice. In many hospitals, the position of ICU medical director is largely ceremonial and entails little more than participation in select hospital committees. Even in hospitals with dedicated intensivists, the ICU medical director role often is limited to physician scheduling, bed management, quality assurance review and housestaff education. Where ICU medical directors do attempt to improve the quality of patient care by developing protocols and tracking outcomes, these efforts usually reflect the interest of the individual, rather than the primary charge assigned by the hospital. It is easy to attribute the lack of physician leadership to inadequate salary support (needed to ensure sufficient protected time to carry out administrative responsibilities correctly) and the reluctance of hospitals to empower physicians to lead clinical programs. However, physicians have been reluctant to devote meaningful time to such activities, preferring instead to focus on patient care and/or research. While these priorities are understandable, given current financial and academic incentives, physicians must recognize the important contributions they can make with such a career choice. Hospitals that truly want to improve patient care need such individuals. Moreover, given their potential impact on economic performance, hospitals will reward them well. Given how most intensivists have spent their time, most do not understand what is entailed in managing a major program of care and lack the requisite administrative skills. Some hospital systems have created mentoring programs to assist physicians in making the necessary transition. The senior hospital leadership team (CMO, COO, CEO) assists

these individuals with defining the desired program of care, establishing quantifiable performance goals, creating audit tools, developing appropriate training materials and overseeing day-to-day operations of the ICU. Ideally, physician leaders should have budgetary responsibility for the ICU and be compensated based upon achieving predefined performance targets. Complex programs do not function effectively without active management, and ICUs have never effectively addressed this deficiency. Intensivists, because they understand the clinical issues and can effect change in other physicians, are the logical candidates to fill this void.

The fourth core concept calls for greater use of information technology tools to improve practice efficiency and effectiveness. Every other major industry has used technology to increase productivity and improve safety. However, as we enter the 21<sup>st</sup> century, aside from a variety of therapeutic and diagnostic devices, there are few uses of technology in clinical practice. Safety systems prevent planes from landing with their wheels up and fuel rods from being inserted too far into nuclear reactors, yet there are almost no such fail-safe mechanisms to avoid patient care errors. As physicians, we depend on accurate patient data for decision-making; however, these data are often hard to locate/access and are poorly integrated. Communication tends to be by telephone or handwritten notes. We lack tools to assist with practice standardization and are unable to track the compliance of clinicians with validated best practices. On a more global level, we have little information about ICU and/or clinician performance and, thus, lack insight into where change must occur. In short, little has changed in the day-to-day delivery of patient services over the past 50 years. Technology has largely passed us by.

Not surprisingly, hospitals have invested far less money in information technology over the past 15 years than other industries. Most technology investments have focused on automating non-clinical tasks, such as OR scheduling, inventory management and patient billing, and on acquiring new diagnostic and therapeutic tools (e.g. MRI, gamma knives). Hospitals have been very slow to invest in technologies that directly impact patient care delivery, even though this represents their core business and represents the greatest opportunity for gain. This reluctance is multifactorial, and reflects the immaturity of the industry, the lack of information standards, uncertainty about the value of current offerings and physician resistance to adopting technology into their practice. While these barriers are real, the major obstacle to the introduction of valuable technology tools is our failure to standardize clinical practices. Technology tools create value by supporting a well-defined workflow – a workflow that was designed to maximize efficiency and effectiveness. All tools are designed to perform a specific task and to be used in a prescribed manner. Expecting technology tools to provide value to a large population of clinicians with widely divergent practice patterns is analogous to trying to use a screwdriver to drive a nail. Technology tools must be subservient to the optimal practice of medicine.

### **Using Technology to Support ICU Practice**

The prior section lays out the infrastructure required for effective reengineering of ICU practice. The specifics of optimal ICU care revolve around two core activities: 1) formulating a comprehensive daily care plan that incorporates best practices, addresses patient and family needs, and avoids dangerous, wasteful and non-efficacious therapies and 2) monitoring patient status closely so that therapies can be titrated and new problems can be detected and addressed promptly. Technology tools can play an important role in facilitating both activities. This section outlines applications that can help transform ICU practice.

Multiple factors contribute to the creation of effective care plans. Foremost amongst these is the availability of a complete picture of each patient's issues and therapies. Traditional ICU data systems (paper chart, flowsheet, computer-based lab access) do little to support this need. Data often are not available, are not integrated effectively or fail to highlight key information. A variety

of ICU clinical information systems aggregate key data elements such as labs, medications, vital signs, etc. While these systems simplify data access, most are primarily designed to facilitate nurse documentation rather than optimize data presentation for clinical assessment. In order to achieve this latter objective, data must be displayed in the appropriate context (aggregated into logical groupings where appropriate), with temporal changes clearly displayed and visual indicators used to highlight important issues. Another common deficiency of ICU information systems is their failure to capture physician assessments, which often reflect the integration of multiple disparate data sources (history, physical exam, labs test, monitoring devices). When captured only in handwritten physician notes (or electronically stored text files) this information remains static. Finally, most commercially available systems fail to address adequately the need for communication between care providers. Such communication is necessary to ensure continuity of care and coordination of care team members' inputs (physicians, nurses, respiratory therapists, pharmacists, nutritionists, etc.).

A second major area where technology can assist in formulating appropriate care plans is through the provision of decision support. Decision support tools fall into two general types - those that provide access to clinical information and/or decision trees and those that alert clinicians to situations requiring attention. The former can be as simple as providing direct access to medical texts and similar resources. While providing convenient access to educational/reference material, these traditional sources are poorly suited to assisting with real-time decision-making. Applications that focus on assessment and management of acute medical problems are better suited to this purpose. Better still are programs that use patient data and embedded algorithms to direct users to patient-specific recommendations. However, all such forms of decision support suffer from the need for users to recognize they need assistance and initiate the application. In contrast, applications that continuously evaluate clinical data and alert users to situations requiring specific actions are non-volitional, and have been demonstrated to lead to improved adherence to established best practices. Examples include dosage corrections and/or allergy/drug interaction warnings incorporated into order entry tools, prompts that tell clinicians to initiate prophylactic therapies, discontinue non-efficacious agents or change drug dosage when renal function deteriorates, and alerts that suggest consideration of changes in therapy (e.g. discontinuation of heparin when thrombocytopenia develops or change pressor regimen when excessive tachycardia develops). These systems analyze patient data using a sophisticated set of rules. Their value is dependent upon the sensitivity and specificity of the alerting rules, which reflect both the sophistication of the rules and the extent to which the application customizes trigger conditions based upon patient characteristics (dependent again upon the richness of the clinical data set). For example, beta-blockers should be recommended in patients with/at risk for coronary disease, but not if they are hypotensive or have severe bronchoconstriction. Usability is also key to the utility of such systems – priorities include ease of use, the capability to deactivate/reset clinically unnecessary alerts and the need for user-friendly notification.

Auditing/reporting tools are the third type of application with demonstrated utility in modifying physician practices. The most common of these examine ICU population statistics, such as mortality and length of stay. While useful in providing insight into global performance (particularly when adjusted for disease severity), most hospitals collect these data manually, a process that is both labor-intensive and subject to error. A few sites have successfully automated data capture for these global performance metrics – a testimonial both to the robustness of their clinical data repository and their programming expertise. While these global outcome reports provide useful information about ICU performance, they do not help identify necessary changes in practice. For this one needs reports that profile individual physician practice patterns (use of prophylactic therapies, transfusion thresholds). Such reports can be extremely effective at changing behavior, as most physicians respond well to hard data. However, for these reports to be accepted



by clinicians, they must examine validated best practices and adjust successfully for common contraindications. Creating such reports is challenging – the programming logic is complex and the data often are unavailable. However, they can be a valuable tool for standardizing practice patterns and implementing best practices.

The second core function of ICU practice revolves around the constant monitoring of patient status, with titration of therapies and early detection of new problems. This is a core function of intensivists in ICUs with dedicated intensivists, and likely a major contributor to the improved clinical outcomes observed with this staffing model. However, financial constraints and a severe shortage of intensivists make this an unattainable practice model for most ICUs, particularly during nights and weekends. Current data suggest that only 15% of U.S. ICUs have dedicated intensivists during daytime hours - far fewer have 24 x 7 dedicated intensivist staffing. Estimates are that more than 25,000 intensivists would be needed to implement 24 x 7 intensivist staffing in all U.S. ICUs, a number that dwarfs the 5500 practicing intensivists. While many hospitals utilize housestaff during off hours, these trainees possess considerably less expertise than experienced intensivists. Moreover, off-hours housestaff coverage usually follows a full day of work – as a result housestaff tend to respond to emergencies (after notification by a nurse), rather than continuously monitor all patients proactively. Recent changes in federally mandated work rules may limit housestaff availability, further eroding even this level of coverage.

Telemedicine represents one option for extending 24 x 7 intensivist oversight to large numbers of ICU patients. By establishing a dedicated intensivist-led care team that can monitor patients in multiple sites simultaneously when there is no on-site intensivist, hospital systems can extend the dedicated intensivist care model to facilities that lack sufficient intensivists for daytime on-site coverage and implement off-hours coverage to ICUs with only daytime intensivist coverage. Available data suggest that this care model can achieve sizeable reductions in both mortality (25-30%) and length of stay (15%). Establishing a remote care facility requires a sizeable technology infrastructure. Off-site intensivists require access to all key clinical data, including labs, vital signs, medications, I&O, notes, and even emergency x-rays. An electronic information system that centralizes these diverse data inputs and presents them in a useable format is essential, as is access to the bedside monitors in real-time. The remote team must be able to see each patient, which requires high resolution pan-tilt zoom cameras that can be controlled remotely, and be able to communicate verbally with each patient room. All components of the system must be linked through a wide area network that is both reliable and secure. Commercially available systems can cost \$30,000-\$50,000 per networked bed.

In addition to the requisite technology components, qualified intensivists and support personnel must staff the remote facility during all hours when there are no on-site intensivists. Because there is no reimbursement for ICU telemedicine services, the hospital must underwrite all staffing costs, a financial arrangement that appears to be justified by the economic benefits associated with improved ICU outcomes. The remote team must have explicitly defined processes for how they perform their tasks and interact with on-site physicians. The primary goals of the remote care team are to support the daily care plan (developed by the on-site team during morning rounds) and to identify and address new problems. For this model to function smoothly, there needs to be excellent two-way communication – the remote team must have a detailed understanding of each patient, which can only occur with the assistance of the on-site physicians. Similarly, the remote team must document their thoughts and actions and utilize on-site team members and the primary team where appropriate. Invasive procedures stand out as an obvious issue requiring predefined procedures, since the remote team cannot be physically present in the ICU. Sharing care responsibilities creates new challenges but is the only feasible way to achieve true 24 x 7 coverage.

The core activity of the remote intensivist-led team is continuous monitoring – analogous to the continuous rounding that occurs when there are dedicated intensivists in the ICU. The goal is to ensure the same proactive management embodied in the dedicated intensivist staffing model. The remote team is able to recognize when therapies need to be modified (e.g. increase fluids, wean sedatives, change drug doses in response to changing renal function) and identify and treat new problems promptly. The use of physician extenders (ICU nurses, nurse practitioners, others) to assist with data review and patient evaluation enables the intensivist to focus on more complex problems and initiate necessary treatments. This use of ancillary personnel enhances the overall efficiency of the remote team and allows more patients to be monitored. The patient review process (virtual rounding) should be formally structured, occurring at fixed intervals that are dictated by patient acuity (e.g. highest acuity patients reviewed more frequently). The goal is to ensure regular review of all patient data at a frequency sufficient to identify new trends promptly, with sicker patients being more labile and thus requiring closer monitoring.

Having formal protocols for patient data review imposes a useful structure and prevents the common situation where the needs of the sickest patients consume the attention of the team – as a result, lower acuity patients get irregular review until/unless they develop problems demanding immediate attention. However, any rounding system has discrete time gaps between patient reviews, during which new problems can develop. One potential means of circumventing these potentially problematic time gaps is through the use of computerized surveillance. This can take the form of automated review of all incoming vital sign data, using predefined patient-specific thresholds and trend analyses to flag emerging problems. In contrast to bedside monitor alarms, which are generally configured to identify extreme abnormalities requiring instantaneous attention, the goal of computerized surveillance is to flag situations requiring further evaluation. An example might be a post-operative patient with a rising heart rate - this might be indicative of emergence from anesthesia, inadequate analgesia or hypovolemia. The point is that an evaluation of the patient is indicated, one that normally would not occur until the rise in heart rate was noticed and brought to the attention of the responsible intensivist physician.

For such alerts to be useful, they must identify clinical situations of potential importance – this requires sophisticated rules, automated customization based upon patient characteristics (patients with underlying coronary disease need lower heart rate limits than young trauma victims) and methods to eliminate artifacts. As with all alerts, there must be a balance between sensitivity and specificity. Because the remote care team is primarily charged with patient monitoring (as opposed to juggling many different clinical activities) - and is able to view patients and evaluate clinical status - the alerts can be configured for high sensitivity. In contrast, sensitive alerts would be cumbersome if intensivists were not available to perform patient evaluations and write orders - on-site nurses would have to decide, with each alert, whether the problem was of sufficient importance to justify calling the off-site physician. This filtering, which goes on in every ICU, requires nurses to make difficult decisions about whether to seek help - an action they are reluctant to take, understanding the multiple other demands on the physician's time. Similarly, sensitive alerts are problematic if distributed to physicians in their offices or home (e.g. by beeper). These physicians are likely to be engaged in other activities (e.g. office care, family life, sleep) and are ill-prepared to respond appropriately to the problem in the ICU.

In addition to the vital sign alerts described above, a variety of other forms of computerized surveillance are possible. These include alerts that notify clinicians of abnormal or changing lab results, low or falling urine output, unsatisfactory pain scores, omitted and/or unnecessary therapies and needed medication changes. While this technology is still in its infancy, it has great potential to improve patient care, enhance efficiency and reduce errors. Such alerts are dependent upon the aggregation and storage of all relevant clinical data. At present few ICUs have moved in this

direction. Only about 5% of ICUs have clinical information systems (CIS), and most serve primarily as documentation tools. A few offer clinicians the ability to create their own alerts. However, few intensivists have the necessary time, computer knowledge and expertise in refining rules logic. More importantly, as discussed previously, technology tools must act in support of an optimized care model – one that ensures appropriate staffing and embraces validated best practices. If we can agree upon the core tenets of an ICU practice model, then a single set of technology tools can provide value regardless of whether they are being deployed in a med-surg ICU in Duluth or a transplant unit in Miami.

Skeptics will take exception with many of the points made in this essay. They will challenge the need for uniform intensivist staffing (especially during off-hours) and standardization of care practices, contest the feasibility of having hospitals and intensivists work toward a common goal, question whether off-site intensivists can provide effective care, and resist the introduction of new technology tools that will initially increase workload. Their objections have some legitimacy. Change is hard and the obstacles are considerable. However, the need for change is compelling and innovative hospitals and creative intensivists have a unique opportunity to redefine the practice of critical care medicine. There is much to be gained. Equally importantly, not changing is not an option.

## Medicare Compliance: Why, How and What to do When Things go Wrong

Gerald A. Maccioli, MD, FCCM  
Director of Critical Care Medicine  
Critical Health Systems, Inc.  
Raleigh Practice Center  
*ASCCA 16th Annual meeting  
October 2003*

## Program Agenda

- Why: The Enforcement Environment
- How:
  - Applicable laws
  - Compliance efforts
- What to Do When Things Go Wrong:  
Internal Investigations and Self-Reporting

## Why? The Compliance Environment

- Politics
- The Media
- Enforcement Agencies
- Employees
- Patients

## “Politics”



- “Poli”=Many
- “Tics” = Parasites

## A Good Return on Investment

ROI on Fraud and Abuse Efforts:

- 70:1 (Donna Shalala, March, 1998)
- 23:1 (Arizona Assistant U.S. Attorney)

## Lots of Money to Back up the Tough Talk



## A Lot of Action...

- Increasing enforcement efforts:
  - Criminal investigations up 40%
  - Criminal convictions up 241%
  - Civil Investigations up 921%

DOJ Statistics

## 11/12/98 BNA Health Law Reporter (HIPAA \$)

- 1997 Statistics for Justice Dept
  - 1.2 billion recovered
  - 517mm from 3 labs
  - WHISTLEBLOWERS ACCOUNT FOR MORE THAN HALF
  - 33mm paid to qui tam Plaintiffs
  - 217 criminal cases, 363 defendants convicted, 1,000 individuals and businesses excluded 4,000 civil fraud cases opened (up from 2,500 in 96), 282 criminal indictments
  - 285 new attorneys, agents, etc. hired, bringing total health care fraud staff to 551

## Enforcement Agencies

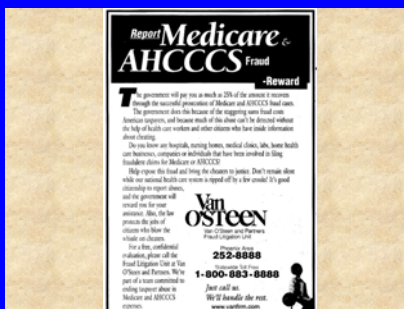
- MFCU
  - State Attorney General's Office
- OIG
- USAO
- FBI
- MFU
  - Carrier
- EIEIO



## The untold story....

OIG "Correction," September, 1997:  
July report failed to consider appeals  
of rejected claims  
(70% overturn rate)

## Lawyers and Your Employees are Interested



## United States vs. Berman

- The Charges
  - Unbundling of lab charges
  - 95,000 claims from 1987-1997 (Potential \$100M fine)
  - Charged \$137 for a \$15 panel
  - Entered charges on separate days to avoid detection
- The Settlement
  - \$1.37M fine (\$200K to employee)
  - No immunity from criminal prosecution or Medicare exclusion
  - Implement compliance plan with reporting, training, audit and self-disclosure obligations

## Patients are Interested

- “Gore Proposes ‘Deputizing’ Senior Citizens in Medicare Fraud Fight”  
Associated Press, June 3, 1998
- “72% of leads received regarding fraud and abuse come from program beneficiaries.”  
BNA Fraud Report, July 1, 1998

## It’s not just the big fish...

- “Arcadia Doctor Pays \$375,000 to ... Resolve Allegations of Medicare Fraud.”

DOJ Press Release, 12/9/97

## “Medicare Audit Shows Decline in Overpayment”

- 1998 Overpayments total \$12.6B (7.1%)
- 1997 Overpayments total \$20.3B (11%)
- 1996 Overpayments total \$23.2B (14%)
- Unnecessary services and upcoding account for \$9.3B (70%) of ‘98 overpayments

Wall Street Journal, February 10, 1999

## Laws Relating to Health Care Fraud and Abuse

- The False Claims Act
- The Stark Amendments
- The Anti-Kickback Statute
- Civil Monetary Penalties
- The Saying Rude Things About Bureaucrats Act

## The False Claims Act

### ELEMENTS

- “**Knowingly** presents”
- To an officer of the United States
- “a false or fraudulent claim for payment or approval”

## False Claims Act Liability

### STATE OF MIND

- “Knowingly and Willfully”
- Reckless Disregard of Falsity
- Deliberate Ignorance of Falsity

## False Claims Liability

### PENALTIES

- \$10,000 per claim (100 x \$10K = \$1MM)
- Treble damages
- Program Exclusion

## Future Applications of the False Claims Act

In a fee-for-service environment, the enforcement agencies guard against the provision of services that are:

- Not covered by Medicare/Medicaid
- Not medically necessary
- Improperly billed

## The Future of Fraud and Abuse

“Law enforcement’s role will become the policing of deliberate denial or limitation of necessary services, and the provision of poor quality services.”

James G. Sheehan, AUSA, Philadelphia PA  
NHLA Healthcare Fraud and Abuse:  
Compliance and Enforcement, Section K  
10/31/97

## STARK AMENDMENTS

### ELEMENTS

- PHYSICIAN REFERRAL TO ENTITY
- WHICH PHYSICIAN OR **IFM**
- HAS FINANCIAL RELATIONSHIP
  - Ownership, e.g., investor
  - Compensation, e.g., medical director
- MEDICARE/AHCCCS PATIENT
- DESIGNATED HEALTH SERVICES

## Exception for ASC Ownership

Applies to Both Ownership and  
Compensation Arrangements

General Prohibition Against Referrals Does  
Not Apply to:

“Services furnished in an ASC... if  
payment for those services is included in the  
ASC rate....”

## Stark Penalties

- Denial of Payment
- \$15,000 per claim
- \$100,000 per claim for “circumvention schemes”
- Exclusion from the program

## Under Discussion

### Significant Stark Reforms

- Thomas proposal
  - Eliminate ban on compensation arrangements
  - Effective on enactment ( w/waiting for regs)
- Stark proposal
  - Create fair market value exception
  - Change “direct supervision” to “full and direct legal, financial and professional responsibility for the services...”

BNA Health Care Fraud Report, August 11, 1999

## ANTI-KICKBACK STATUTE



### Elements

- “Knowingly and willfully”
- Offers or pays remuneration
- As an inducement
- For a referral

## Anti-Kickback Penalties

- \$25,000
- Five years imprisonment

## Civil Monetary Penalties

- 42 USC 1320a-7a (b) (1) prohibits a hospital from making a payment, directly or indirectly, to a physician to induce the physician to reduce or limit services to a patient

## CMPs and Gainsharing

### Gainsharing Concept

- Hospital, CVT Surgeons, Cardiologists and others combine forces
- Goals :increase quality and control costs
- Focus on inpatient services
- Hospitals benefit from DRG payment in excess of expenses
- Physicians share in Hospital savings

## Civil Monetary Penalties

### Bottom Line:

- Review Special Advisory Bulletin
  - [www.dhhs.gov/progorg.oig/frdalrt/gainsh.htm](http://www.dhhs.gov/progorg.oig/frdalrt/gainsh.htm)
- In Joint Ventures between hospitals and physicians, ensure that financial arrangements do not represent hospital inducements to physicians, directly or indirectly, to reduce or limit care



## Civil Monetary Penalties

- Penalties: Hospital and Physician subject to a penalty of \$2,000 for each individual “with respect to whom the payment is made”

## Risk Management For Fraud and Abuse

- Compliance Plans
- Internal Investigations and Self-Reporting

## 1991 Federal Sentencing Guidelines

- Provides sentencing matrix for corporate defendants
- Culpability index aggravates or mitigates penalties
  - as high as 400%
  - as low as 5%.....if you can show commitment to compliance

## Why Develop a Compliance Program?

- Reduces the risk of civil and criminal wrongdoing
- Establishes a Crisis Response Plan
- Dramatically reduces the financial penalties if violations occur

## Under “The Guidelines”

\$350,000



\$17,500

95%

## Why Develop a Compliance Program?

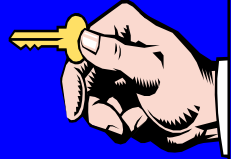
- Establishes a structure to maximize the confidentiality of communications
- Establishes a structure to ensure that legal and policy changes are disseminated to employees quickly
- Improves internal communication and feedback to management

## Why Develop a Compliance Program?

- Makes good business sense to have all employees adhere to approved standards of conduct
- Provides assurance to the Board of Directors (Caremark) and shareholders that the organization is addressing any potential liabilities related to improper conduct

## The Operational Elements of an Effective Compliance Plan (HHS OIG)

- Written standards of conduct for employees
- Written policies promoting commitment to compliance and addressing specific areas of potential fraud



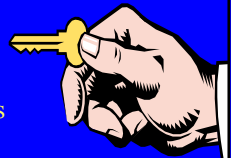
## The Operational Elements of an Effective Compliance Plan (HHS OIG)

- Designation of a chief compliance officer
- Education and training program
- Periodic audit program
- Internal investigation process



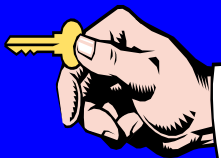
## The Operational Elements of an Effective Compliance Plan (HHS OIG)

- Investigation and remediation of identified problems
- Guidelines for response to requests from outside agencies



## The Operational Elements of an Effective Compliance Plan (HHS OIG)

- Screening new employees and vendors
- Process for Communication (Hotline?)
- Policy on response to violations



## Developing a Compliance Plan

- The Easy Part: Creating the paper

## Free Assistance: OIG Compliance Plan Guidance

- Clinical Laboratories
- Hospitals
- Home Health Agencies
- DME, Prosthetics, Orthotics and Supply
- Third Party Billing Companies
- Hospice Centers

## Developing a Compliance Plan

- The Hard Part (and the Critical Part):  
Making it “effective”

## The Importance of an Effective Compliance Plan

“Programs hastily constructed and implemented without appropriate ongoing monitoring will likely be ineffective and could result in greater harm... than no program at all.”

– OIG Compliance Program Guidance for  
Hospitals, February 1998

## An Effective Compliance Plan

“We’re looking for a plan which encourages genuinely ethical behavior and open problem solving in the institutions.... We’re seeking a change in the corporate culture, which is probably the most difficult part of adopting a compliance plan.”

D. McCarty Thornton, Chief Counsel, OIG,  
DHHS

BNA Health Care Fraud Reporter, 6/3/98

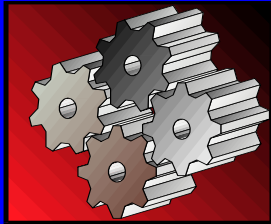
## Is Compliance a part of the Organization’s Culture?



## Is there A “Top Down” Commitment To Organizational Integrity?



## Is the Compliance Program Operational?



## When Things go Wrong: Self-Reporting

- Making the Decision to Investigate
- Risks and Benefits of Self-Reporting
- Essential Elements of a Report
- When to Report
- To Whom to Report

## Making the Decision: Should the Problem be Investigated?

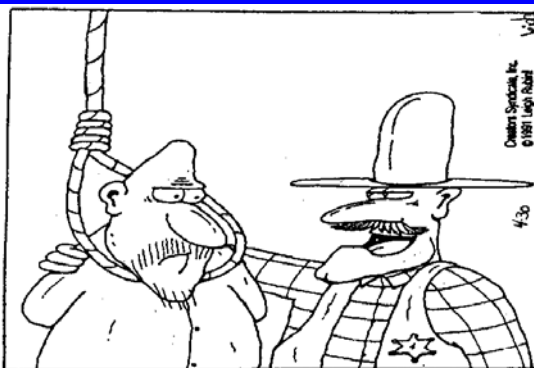
### Implications of the Decision to Investigate

An investigation can change a suspicion of a problem to:

- knowledge
- reckless disregard
- deliberate ignorance

## Making the Decision

- The Obligation to Self-Report: The Statutory Basis
  - 42 U.S.C. § 1320a-7b(3) makes it a **felony** for any person or entity who has knowledge of a Medicare or Medicaid overpayment to **fail to disclose** such overpayment
  - Recent DME Indictment



"Of course I realize that society is partially to blame for the crime y'all committed. Unfortunately, I only have enough rope for you."