Society for Technology in Anesthesia • March 2014

INTERFACE

President's Message

By Joan Spiegel, MD

As my first official task as STA President, I wish to thank all of those that made the 25th annual STA in Orlando, Florida a success including my Program Co-Chair Brian Rothman, Abstract Chair Allan Simpao, all the presenters and moderators, the industry sponsors, our Executive Director, Jane Svinicki and her staff . I would also like to thank STA Past President John Pawlowski for his leadership of STA during 2013, and his advice and guidance as I take the President's position.

The success of the STA annual meeting can be gauged by how well it facilitated and encouraged the communication and education among interested physicians, nurses and industry groups. Those attending enjoyed the interaction between attendees that is typical for STA meetings.

The burgeoning technological expansion in operating rooms was recognized by the ASA years ago. The ASA took steps to address the need for knowledge and standards by forming subcommittee groups such as Patient Safety and Risk Management, Monitoring and Engineering Technology, and the Committee on Equipment. Information relevant to anesthesia practice was distributed through the Anesthesia Patient Safety Foundation newsletter. Although serving a purpose of channeling the information to a central source, these subcommittees did not provide a forum where research could be presented, ideas could be fostered, and information disseminated.

Enthusiastic leaders of the first STA feasibility meeting met with about 50 others for the first time at 6AM in San Francisco, at the 1988 ASA Annual Meeting and agreed to form the new society. The first Board of Directors was assembled. Ty Smith (President), Allen Ream (VP), Frank Block (Secretary), Alan Grogono, Jerry Calkins, Bob Chilcoat, and JS Gravenstein were its leaders. The platform of the society developed them remains the same today: clinically oriented, international in scope, broad interests but a narrow name, and welcomes all clinically, technically, and industrially oriented members. STA has always strived to maintain close relationships with other societies, either as a component society or as a parent to other component societies.

A more official meeting was convened for the newly charter members of the STA the following year in New Orleans at the ASA. I imagined that during the period between meetings, there was a large effort to recruit interested individuals to participate in the new society. The first ASA-STA breakfast panel was held on the morning of October 18th, 1989, and was a debate on who or what was to take credit for improvements in patient safety: the clinician or the technology or something else?

Although it appears that the first annual meeting for STA was set for January of 1990,

President's Message
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In This Issue!

The Root of Brain Function Monitoring

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Report from the Executive Director

By Jane Svinicki, CAE

Disney Magic!

It has been a long time since I was at any of the Disney theme parks. No longer a child and having no children, my visits to Disney theme parks were over, or so I thought. During the STA Annual Meeting in Orlando, I had a free evening, so Marie, Sam and I headed out to experience the Disney magic at Epcot.

Unless you were raised in complete isolation, memories of childhood start coming back quickly once you arrive. I never went to Disneyland or Disneyworld as a kid, but I remember seeing it during the 'Wonderful World of Disney' television show. That was a no-miss show for me as a kid, sitting in the living room, watching with my brothers and sisters.

Visiting in 2014, Disney still has the magic - the marketing magic, the technology magic and the mass psychology magic! The Disney Company is expert at enhancing, protecting and expanding their brand. They take your money in large amounts, but provide a one of a kind experience, and you don't care (at least not while you are at the park).

Upon entering Epcot, your ticket looks like a credit card. It is bonded to you through fingerprint technology at the entry gate. No other person can use your unique ticket at Epcot.

Photographers just inside Epcot, take your photo in front of the big 'ball' (Spaceship Earth) and give you a photo ID card. Everywhere photographers lurk to take your photo. They scan the photo ID card at each location. The next day, if you type in a code every photo of your group is available (for purchase) online. Beautiful, high quality photos with Disney characters, only $14.95 each.

At the Royal Banqueting Hall, where we had dinner, reservations are set-up every 5 minutes. You wait, you are called into the restaurant, you wait, you are called to a photo with a Disney Princess, you have your photo taken, you go to your table. Dinner is three courses delivered efficiently (you can even have some beer or wine), then the rest of the Disney Princesses come around, perfectly spaced out, to each and every table, in character, chatting and posing for photos. After exactly one hour, you leave the restaurant as the fireworks, laser and music show begins over the lake in the middle of the park at Epcot.

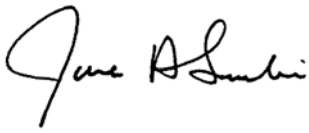
Your whole experience is being managed. From arrival to departure, everything and everyone is there to provide an unforgettable experience of Disney magic.

What can we learn from Disney? Is the patient experience in your organization being managed from arrival to departure? Everyone wants to go to Disney, nobody wants to go to the hospital.

STA members strive to provide the safest patient experience through the best care and enhanced technology. You are managing the patient experience. Mickey and Minnie may be magic, but so is making people well. Doing it right requires collaboration, research, experimentation and study.

Listening to the Gravenstein awardee, Dr. Chester Phillips, this year was inspiring. It was an example of one person, with an idea, striving to change the world for the better. It makes you grateful for all the innovators like Dr. Phillips and Walt Disney working to make the world better.

As Mickey would say, "Hot Dog!"



Jane A. Svinicki, CAE
Executive Director

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President's Message *continued from cover*

the first meeting was officially recorded as taking place in Orlando, Florida, January 18-20, 1991. While there is still room for discussion on the exact date, most recognize the beginnings of the STA as occurring within the year 1989. With that being said, I found it appropriate that on the 25th Anniversary of STA we returned to Orlando.

As I looked back into STA's history, I found it interesting to read submitted abstracts from that first meeting in Orlando. For those of you who are just as interest as I was you can find the abstracts in the Journal of Clinical Monitoring, Volume 7 No. 1 published in 1991. Within this special publication are abstracts relating to closed loop technology, custom software in patient monitoring (J Feldman), capnography, and details of new patient safety devices. In one abstract, the author describes the prevalence of the intraoperative anesthesia information management system (AIMS), which was being used by only 12 hospitals worldwide. Gas Man and agent monitoring (JH Philip) was also described in those first STA abstracts publication. A surprise, but improvement in alarm technology was discussed both in the 1991 meeting and in the 2014 meeting. Certain technologies remain fascinating enough to continue their discussion, exploration and refinement a quarter century later. Happy Anniversary STA!

What are the plans for STA this year? As I sit watching the occasional transport ship travel the waterways in and out of Cape Cod Bay, the notion of holding the course steady comes to mind. The four objectives that John set forth in his 2013 message are being addressed continually and successfully: meeting organization, meaning and relevancy of the society, increasing membership, and financial stability.

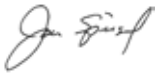
While the 2014 meeting content was outstanding and the STA membership has been on the rise, 2013 saw corporate sponsorship fall off the mark. The unfortunate combination of industry regulation and less available funds, have led to a precarious balance sheet. While other medical societies survive through membership and meeting dues alone, it was always understood that the STA would have a close and necessary affiliation with industry, and be encouraged to maintain this mutually beneficial association. This has been a difficult stance recently, but perhaps not unique to the STA.

Thus, with the growing need for continued sponsorship to keep our society solvent, we have formed a dedicated Commercial Support Taskforce to address the goal of improving industry recognition, involvement and support. Our objective is to raise at least $30,000 more for our society than we did for the 2014 meeting.

I do encourage those who are not lifetime members to consider it in support of STA. I will personally pledge this for 2014. The STA remains vital, especially now, as a conduit of communication between educators, clinicians, industry, residents, and the community, in all areas of technology, as it continues to evolve in unexpected and complex ways. Managing technology and information has itself become a hospital and patient safety concern, and a dilemma that would have been relatively obscure back in the infancy stage of the STA 25 years ago.

As your new President, I wish everyone a healthy and prosperous year ahead. I truly look forward to seeing some of you in October, and look forward to seeing everyone again, in beautiful Arizona in January of 2015.

With Sincerity,



Joan Spiegel, MD
Beth Israel Deaconess Medical Center, Boston, MA

2014 Annual Meeting Photos

Dr. Bette Idemoto, Best Clinical Application Abstract Winner, of Vascular Pathways, Inc. with their exhibit booth.

Representatives from AccuVein pose with Annual Meeting Co-Chair Dr. Brian Rothman.

Dr. David Feinstein (right) with Annual Meeting attendees at the Friday Evening Dinner Event.

Dr. Chester Phillips III, 2014 J.S. Gravenstein Award winner, addresses attendees over lunch.

A panoramic view of the exhibitor hall.

2014 Annual Meeting Photos *continued on next page*

2014 Annual Meeting Photos continued

Immediate Past President, Dr. John Pawlowski presents Dr. Spiegel and Dr. Rothman their plaques for Chairing the 2014 Annual Meeting.

Past President, Dr. John Pawlowski (left) with Marie Roy (middle) and Heidi Hughes (right).

Attendees enjoy the 2014 Annual Meeting opening reception in the exhibitor hall.

Thank You to our 2014 Exhibitors on page 14

2014 STA Abstract Winners

Best Clinical Application
"Randomized Controlled Comparison of IV Catheter with Coiled Tip Guidewire and Conventional Peripheral IV Catheter"
Presenting Author: Bette K. Idemoto, PhD, RN, UHCMC
Co-Author: James R. Rowbottom, MD, UHCMC

Excellence in Technology
"Robust Closed-loop Control of Anesthesia in Adults Undergoing Elective Surgery"
Presenting Author: Aryannah Umedaly, BSc
Co-Authors: Nicholas West, MSc; Klaske van Heusden, PhD; Matthias Görges, PhD; Guy Dumont, PhD; J. Mark Ansermino, MBBCh; Richard Merchant, MD, FRCPC; Christian Peterson, PhD

Honorable Mention
"Detecting Sleep Apnea Events in Children Using the 'Phone Oximeter'"
Presenting Author: Ainara Garde, PhD
Co-Authors: Parastoo Dehkordi[1], PhD Student, David Wensley[3], MD, J M. Ansermino[2], MBBCH, Guy A. Dumont[1], PhD.
[1]Department of Electrical and Computer Engineering, The University of British Columbia
[2]Department of Anesthesiology, Pharmacology and Therapeutics, The University of British Columbia
[3]Division of Critical Care, BC Children's Hospital

Honorable Mention
"A New Monitoring Display Improves Intraoperative Hemodynamic Management: Alert Watch"
Presenting Author: Amy Shanks, MS, PhD (candidate) University of Michigan Medical School
Co-Authors: Sachin Kheterpal, MD, MBA; Kevin K. Tremper, PhD, MD, University of Michigan Medical School

Honorable Mention
"Automated Triggering of NIBP Measurements Using Oximetry Data"
Presenting Author: James N Watson1, Ph.D., Technical Fellow, Covidien Respiratory & Monitoring Solutions, Edinburgh, Scotland, UK
Co-Authors: Rakesh Sethi[1], MSc; Graeme Lyon1, MEng and Sergio D. Bergese[2], MD.
[1] Covidien, Respiratory and Monitoring Solutions;
[2] Departments of Anesthesiology and Neurological Surgery, The Ohio State University

Randomized Controlled Comparison of IV Catheter with Coiled Tip Guidewire and Conventional Peripheral IV Catheter

Presenting Author: *Bette K. Idemoto, PhD RN, UHCMC*
Co-Authors: *James R. Rowbottom, MD, UHCMC*

Introduction: Intravenous therapy is a frequent treatment modality (90%) for hospitalized patients. However, this modality can be associated with pain/discomfort and risk of phlebitis/infections; therefore, first attempt success and dwell time for IV catheters are important outcomes. Currently first attempt success averages 40%, complications occur 47% and IVs dwell time average is 44 hrs. Multiple attempts at insertion, multiple IVs during each admission result in poor patient and clinician satisfaction as well as unnecessary costs. A new peripheral catheter technology that uses a proprietary coiled tip guidewire design previously seen only in central lines is now available (AccuCath™). This prospective study compared AccuCath™ and conventional IV catheters in adult patients. Outcomes that were evaluated included: higher rate of successful placement on first attempt, higher rate completion of therapy, fewer complications, longer dwell times, increased patient and clinician satisfaction and lower overall costs of therapy than conventional IV catheters. With INS (Infusion Nursing Society) standards now stating IVs can dwell until complication there is significant opportunity to improve patient outcomes with guidewire technology that offers greater first attempt success and longer dwell time with AccuCath™.

Methods: Industry and Hospital IRB approval were obtained prior to beginning the study. Adult Medical-Surgical patients who required a non-emergent IV catheter were enrolled and consented. The SICU and telemetry step-down were initially the sites, but the study was expanded with IRB approval to include all of Medical-Surgical adult patients. Randomized enrollment was ensured with sealed envelopes, opened once patient consent was obtained. Study forms were completed by the RN after insertion. The study was conducted over four months with a total of 248 patients (AccuCath™ 123, conventional 125). Data was collected using a standardized instrument. Outcomes were assessed using parametric and non-parametric tests.

Results/Analysis: The study included 248 patients total: 123 AccuCath™; 125 Conventional IVs. First attempt success was 88.6% with AccuCath™ compared to 43.2% with Conventional ($p=< 0.001$ Fisher's exact). Complications including infiltration, phlebitis, occlusion, infection occurred only 8% of the time with AccuCath™ and 52% with Conventional ($p=<0.001$ Fisher's exact). Dwell time significantly improved with AccuCath™ at mean of 4.39 days compared to Conventional IVs at 1.46 days ($p=<0.001$ Fisher's exact). Completion of therapy (IVs in place until no longer needed) was 89% with AccuCath compared to Conventional at 34% ($p=<0.001$ Two-sided Fisher's exact). Patient satisfaction with IV insertion for AccuCath™ using a 5 point Likert Scale scored a mean of 4.6 compared to Conventional at 3.06 ($p=0.001$ Two-sided t test). Patient comfort rating of procedure for AccuCath™ was 4.2 compared to Conventional IVs at 2.9 ($p=0.001$ Two-sided t test). Patient satisfaction with overall performance scored 4.8 with AccuCath compared to 2.8 with Conventional ($p=0.001$ Two-sided t test). Overall clinician satisfaction for AccuCath using a 5 point Likert scale scored a mean of 4.5. Cost savings in a Return on Investment model was also significant due to the need to start 50% fewer peripheral IVs.

Conclusion: Use of the AccuCath™ was associated with positive outcomes (first attempt success, dwell time, higher completion of therapy), fewer complications and decreased cost of therapy. This study demonstrated that the use of the AccuCath™ was feasible for hospitalized adults, associated with better outcomes without increasing overall cost of care and significantly improved patient satisfaction. Larger studies are needed to validate this technology in other populations and multiple care settings.

References (optional):

1. Barton AJ, Danek G, Johns P, Coons M. Improving patient outcomes through CQI: vascular access planning. *J Nurs Care Qual.* 1998; 13(2):77-85.
2. Danek G, Kilroy R. IV CQI Study: impact of a vascular access planning algorithm on patient outcomes. *Friday's Focus Hospital Newsletter at Shands (University of Florida).* April 1998:1-5.
3. Santolucito JB. A retrospective evaluation of the timeliness of physician initiated PICC referrals. *JVAD.* 2001:20-26.
4. Wolosin RJ. Largest study of patient satisfaction ever conducted. *The Press Ganey Satisfaction Report.* August 2003; VII:2-4.
5. Kokotis K. Cost containment and infusion services. *J Infusion Nurs.* 2005; 28(3S):S22-S32.
6. Kokotis K. The role of the IV therapist. *JVAD.* 1999; Winter: 22-27.
7. Van Donk P, Rickard C, McGrail M, Doolan G. Routine replacement versus clinical monitoring of peripheral intravenous catheters in a regional hospital in the home program: a randomized controlled trial. *Infection Control and Hospital Epidemiology.* Sept 2009;V3(9).
8. Maki DG, Ringer M. Risk factors for infusion-related phlebitis with small peripheral venous catheters. *Annals Int Med.* 1991;114:845-854.
9. Frey AM, Schears GJ. Why are we stuck on tape and suture? *J Infusion Nursing.* 2006; 29(1):34-38.
10. Schears GJ. Summary of product trials for 10,164 patients. *J Infusion Nursing.* 2006; 29(4):225-231.
11. Spader C. IV insertion, still a special skill. *Nursing Spectrum.* Feb 2006.
12. Infusion Nursing Society (INS). Infusion nursing standards of practice. *J Infusion Nursing.* 2011;34(1S):S57.
13. Sheppard K, LeDesma M, Morris N, O'Connor K. A prospective study of two intravenous catheter securement techniques in a skilled nursing facility. *J Infusion Nursing.* 1999;22(3).

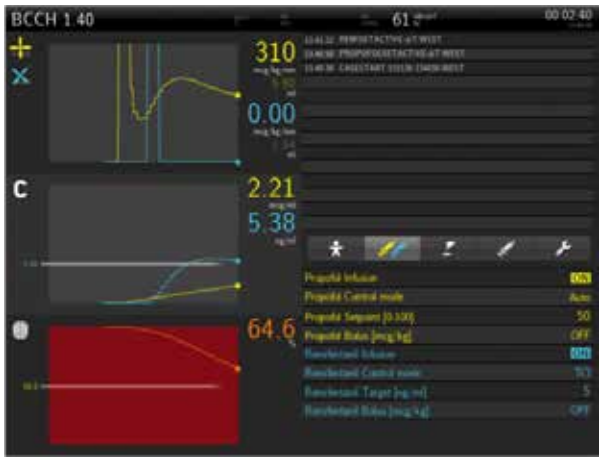
Robust Closed-loop Control of Anesthesia in Adults Undergoing Elective Surgery

Authors: *A Umedaly1, N West[1], K van Heusden2, M Görges[2], CL Petersen[1], GA Dumont[2], JM Ansermino[1], RN Merchant[1]*
[1]Department of Anesthesiology, Pharmacology & Therapeutics; [2]Electrical and Computer Engineering Department
The University of British Columbia, Vancouver, Canada

Background: Closed loop control of total intravenous anesthesia involves the continuous adjustment of drug infusion rates according to measured clinical effect [1]. Depth of Hypnosis (DoH) measures, such as the WAV_{CNS} index [2], can provide feedback suitable for closed loop control. A study that will culminate in the design of a robustly tuned controller automatically determining propofol and remifentanil infusion rates is currently ongoing. In the first phase of this study, propofol infusion was controlled by the closed-loop system while remifentanil was administered using a target controlled infusion (TCI)[3]. Collected data is then used to model the effects of varying remifentanil utilisation on the EEG and design an automated remifentanil infusion controller. In the second phase, remifentanil will be automatically titrated to counteract brief disturbances in the WAV_{CNS} that are assumed to be a result of nociceptive stimulation. Propofol will continue to be used to achieve the overall DoH setpoint. The data reported summarises the initial phase.

Methods: With both Health Canada and REB approval and written informed consent, ASA I-III adults, requiring general anesthesia for a wide variety of elective surgical procedures (expected to last ≥ 1hr) were enrolled in the study. The WAV_{CNS} was used to provide continuous feedback to the control system for induction and maintenance of anesthesia with propofol. An initial WAV_{CNS} setpoint of 50 was used in all cases. Remifentanil was administered according to an effect side target [3] specified by the clinician throughout induction and maintenance of anesthesia. Changes to the WAV_{CNS} setpoint and remifentanil target as well as bolus dosing of both drugs were permitted by the system (Figure 1).

Results: Results are reported as median (interquartile range). Forty-five adults age 63 (49-69) years and body mass index (BMI) 27.7 (25.1-30.2) were enrolled. Length of time required to complete induction (WAV_{CNS} below 60 maintained for 30 seconds) was 3.8 (3.3-4.7) mins. Required induction dosage of propofol was 1.5 (1.1-1.9) mg/kg, which corresponds to a calculated effect-site concentration [4] of 4.6 (3.9-5.8) mg/ml at the end of induction. Propofol utilisation during the maintenance phase of anesthesia was 117.0 (90.3-146.6) µg/kg/min. Remifentanil utilisation during maintenance was 0.10 (0.08-0.14) µg/kg/min. WAV_{CNS} during the maintenance phase remained within 10 units of the specified setpoint for 85% of the time (72%-91%).



Conclusion: These results suggest that closed-loop control of propofol with a stable background infusion of remifentanil is feasible for induction and maintenance of total intravenous anesthesia in adults undergoing a wide variety of elective surgical procedures. Additional research will be required to demonstrate the benefit of automatically adjusting the remifentanil infusion rate.

References:

1. Anesth Analg. 2013;117(5):1130-8.
2. J Clin Monit Comput. 2011;25(1):81-7.
3. Anesthesiology. 1997;86(1):24-33. [
4. Anesthesiology. 1998;88(5):1170-82.

Detecting Sleep Apnea Events in Children Using the "Phone Oximeter"

Presenting Author: *Ainara Garde, PhD*
Co-Authors: *Parastoo Dehkordi[1], PhD Student, David Wensley[3], MD, J M. Ansermino[2], MBBCH, Guy A. Dumont[1], PhD. [1]Department of Electrical and Computer Engineering, The University of British Columbia [2]Department of Anesthesiology, Pharmacology and Therapeutics, The University of British Columbia [3]Division of Critical Care, BC Children's Hospital*

Introduction: Approximately 2% of children [1] and 2.5%-6% of adolescents are affected by obstructive sleep apnea (OSA) [2]. OSA poses a serious threat to the healthy growth and development of these children [3]. Polysomnography (PSG), the gold standard for diagnosis of OSA, is highly resource intensive and is confined to overnight sleep laboratories. The Phone Oximeter (Figure 1) is a mobile device that integrates a pulse oximeter with a cell phone, providing blood oxygen saturation (SpO2) and signal of changes in blood volume (PPG). Although SpO2 pattern characterization has been successfully applied to identify subjects with significant OSA [4], some proportion of OSA events occur in the absence of SpO2 desaturation. The aim of this project is to combine SpO2 characterization and Heart Rate Variability (HRV) to identify events with OSA using the Phone Oximeter.

Methods: After REB approval and written informed consent/assent, overnight pulse oximetry data was collected using the Phone Oximeter, simultaneous to standard PSG from 160 children visiting the sleep laboratory at BC Children's hospital. The sleep technician scored all OSA events with and without desaturation. The proposed algorithm characterizes SpO2 pattern [4] and estimates HRV from the PPG (based on pulse to pulse [PP] analysis) [5], both in time-frequency domain, using a 1-min sliding window (no overlap). Based on OSA scores, each 1-min window was labeled as: OSA with desaturation, OSA without desaturation or non-OSA. The statistically significant parameters extracted from SpO2 and HRV analysis, were used to automatically identify OSA events through logistic regression using 10-fold cross validation.

Results: In total, we have 30,995 minutes, 3,606 with OSA (2,269 with desaturation and 1,337 without) and 27,389 without OSA. Regarding HRV analysis, OSA events showed statistically significantly higher normalized power at low frequency (95% CI, -0.18 to -0.17), lower normalized power at high frequency (95% CI, 0.18 to 0.19), lower mean of PP intervals (95% CI, 0.06 to 0.07), higher standard deviation of PP intervals (95% CI, -0.040 to -0.037) and higher root mean square of the difference of successive PP intervals (95% CI, -0.03 to -0.026). With regard to SpO2 characterization in the time domain, OSA events presented statistically significantly greater SpO2 variability through standard deviation (95% CI, -0.8 to -0.6) and lower mean and median values of SpO2 (95% CI, 0.7 to 0.9). Spectral analysis of SpO2 showed higher normalized power at low frequencies in OSA events (95% CI, -0.06 to -0.05). An accuracy of 81%, sensitivity of 82% and specificity of 80% were obtained identifying OSA events (with and without desaturation) through logistic regression using 18 significant features extracted from SpO2 and HRV analysis.

Figure 1: The Phone Oximeter

Conclusion: The combination of SpO2 and HRV characterization extracted from pulse oximetry could improve the sensitivity of the Phone Oximeter in detecting OSA events. This provides the potential for the Phone Oximeter to be used as an OSA screening tool, providing a portable, inhome device, with the capability of monitoring patients over multiple nights. At-home screening will result in less sleep disturbance, facilitate a more natural sleep pattern and prevent unnecessary burden to both families and the health system.

References:

1. J. Pediatr., 2003, 142,(4), 83–389
2. Sleep, 2006, 29, 1135–1142.
3. Pediatrics, 2012, 30 (3), 576–84.
4. In Proc. IEEE-EMBC, 2013, 2531–2534.
5. In Proc IEEE-EMBC, 2013, 6563–6566.

A New Monitoring Display Improves Intraoperative Hemodynamic Management: Alert Watch

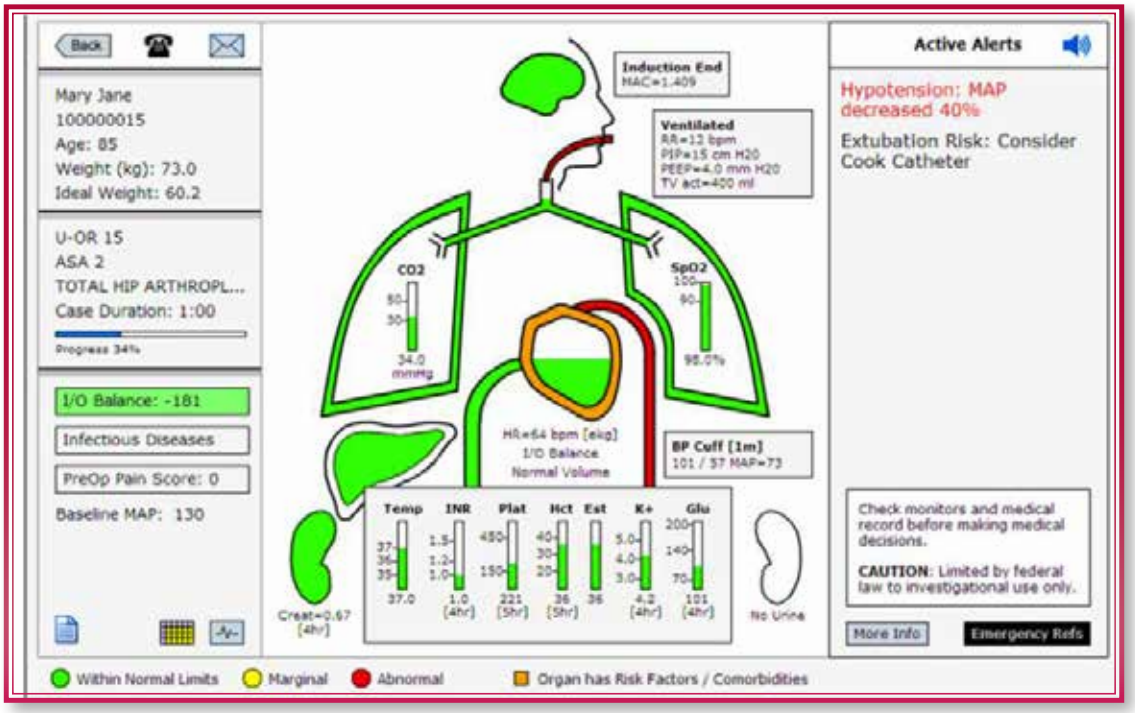
Presenting Author: *Amy Shanks, MS, PhD (candidate) University of Michigan Medical School*
Co-Authors: *Sachin Kheterpal, MD, MBA, and Kevin K. Tremper, PhD, MD, University of Michigan Medical School Children's Hospital*

Introduction: In the operating room, the anesthesiologist is responsible for assimilating the wide range of real-time second-to-second physiologic monitor data, clinical observations, and patient history and physical information. The sheer volume of data and the frequency of artifact signals can overwhelm sustained vigilance of practicing clinicians and has been documented as a major patient safety issue. AlertWatch™ (AW) is a web-based multifunction display which receives, integrates, and presents data from physiologic monitors, electronic health records, and laboratory systems to provide evidence-based alerts. The display is comprised of readily identifiable icons of human organs, whose colors change as measured and calculated parameters go from normal to marginal to abnormal risk-adjusted ranges (Figure 1). AW includes real-time alerts for more than 30 intraoperative processes of care, ranging from hemodynamics to ventilator strategy and malignant hyperthermia. We hypothesized that the use of AW would improve the intraoperative hemodynamic management across a broad range of surgical procedures and patients.

Methods: AW was implemented as a supplementary screen on May 1, 2012 in the adult operating rooms at the University of Michigan Health System. After implementation, individual clinical providers could voluntarily choose to use AW during their case. No additional clinical care protocols were instituted, publicized, or recommended. For blood pressure management, the aortic arch represents the mean arterial pressure (MAP) and changes color to yellow when the MAP drops 30% below the patient's preoperative baseline and changes to red when it drops to 40% of the patient's preoperative baseline. Simultaneous with the color change, there is a three tone audible alert which decreases from high to low pitch. This tone repeats every minute until the blood pressure increases above the 40% drop. For this analysis, all cases that were 60 minutes or greater in length were included; outpatient and cardiothoracic procedures were excluded from this analysis. Data were analyzed in two ways. First, two analysis groups were studied from 5/1/2012 to 11/1/2013: a case was considered "AW-assisted" if it was used for 75% or more of the intraoperative case duration versus "control" if it was used for less than 75% of the case duration. Second, historical controls for 17 months prior to the implementation of AW were compared against "AW-assisted" cases. A sensitivity analysis was also performed comparing "AW-assisted" cases to controls were AW was not used at all during the case (0% of duration).

The primary outcome was hypotension, defined as the percentage of case duration with a MAP below 60 mmHg or 55 mmHg. The secondary outcomes included myocardial ischemia (MI) defined as a postoperative troponin ≥ 0.30 within seven days of the operation. Acute kidney injury (AKI) was defined using the most recent preoperative and peak postoperative serum creatinine within seven days. We used the KDIGO staging criteria

A New Monitoring Display *continued on next page*



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A New Monitoring Display *continued from page*

(stage 1 = 1.5 x baseline or 0.3 mg/dl increase, stage 2 = 2.0 x baseline). SPSS version 21 and tests appropriate for observed normalcy were used for the analysis.

Results: A total of 35,612 cases were included in the primary analysis: 7,391 "AW-assisted" cases, 11,315 parallel controls, and 16,906 historical controls. "AW-assisted" cases exhibited significantly less percentage of the case with MAP below 60 mmHg (median 2.13 IQ range [0-6.7] vs 2.33 [0-7.6] parallel control; 2.13 [0-6.7] vs 2.62 [0 – 8.0] historical control) and 55 mmHg (0 [0-2.08] vs 0 [0 – 2.43] parallel control; 0 [0-2.1] vs 0-2.6] historical control) all p-value < 0.01). In addition, in the parallel control period there was a statistically significant lower incidence of MI for "AW-assisted" versus control cases, 0.7% versus 1.0% (p = 0.0025). There was no difference in AKI in this group. In the historical control analysis, both Stage 1 and 2 AKI were significantly less common in the AW-assisted group (stage 1: 12.5% vs 14.8%; stage 2: 1.6% vs 2.5%), p-value < 0.001. MI demonstrated a lower incidence in AW cases when compared against the historical controls but it did not reach statistical significance, 0.7% versus 0.9% (p = 0.141). The sensitivity analysis demonstrated the same findings for hemodynamic control but did not reach statistical significance for MI or AKI.

Conclusion: Our findings suggest that the use of an integrated display that alerts providers to moderate relative hypotension is associated with a decrease in the incidence of moderate and severe absolute hypotension. We also observed a decreased incidence of myocardial ischemia and acute kidney injury. Caution should be noted when interpreting these results. First, this is an observational study so it cannot causality; second, the historical controls have the bias of time while the parallel controls are subject to treatment or selection bias by the provider choosing to use AW. In spite of these limitations it appears this type of display may allow for improved management and postoperative outcomes.

Automated Triggering of NIBP Measurements Using Oximetry Data

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Introduction: It has been widely reported that high blood pressure variability (BPV) may be correlated with patient complications and the literature has provided evidence for the prognostic significance of awake systolic BPV [1]. There is also a desire to respond to significant changes in BP in a timely fashion in order to optimize the treatment of patient conditions [2]. The objective of this work is to investigate a patient safety tool that aids in the identification of changes in hemodynamic status between timed cuff inflations, and triggers a new NIBP measurement when appropriate, using standard oximetry data.

Methods: The algorithm is designed to issue a trigger command to an NIBP cuff when the hemodynamic status of a patient has changed. To achieve this proposed objective, the device monitors a series of metrics (HR, % modulation, pulse statistics) derived from the pulse oximeter signal and compares them with reference values, obtained at the previous cuff measurement time These deviations from the reference values are compared with a series of thresholds which, in turn, determines whether to trigger a measurement request or not.

With institutional review board approval and written informed consent, physiologic data obtained from 31 subjects was analyzed to test the feasibility of this device (ASA III/IV; ICU: 5, OR: 26). No specific disease states or pathophysiologic conditions were targeted during enrollment. Pulse oximeter trace sections were divided into pairs with a 'truth' for mean arterial pressure changes between pairs being derived from peripheral arterial line data. To determine the sensitivity and specificity of the method in identifying pressure changes of various degrees a Receiver Operator Characteristics (ROC) analysis was performed.

Results: During periods of no motion, a sensitivity of greater than 95% in identifying pressure changes larger than 30mmHg was achieved at a specificity of 90%. The full ROC curve analysis is presented in Figure 1 for various sensitivity/ specificity pairs over three blood pressure changes (10, 20 and 30mm/Hg).

Conclusion: Automated triggering may enhance the functionality and clinical utility of currently available NIBP devices. In this feasibility experiment the blood pressure trend is more accurately captured and significant changes in blood pressure more quickly identified than when using timed pressure measurements alone ($p < 0.05$).

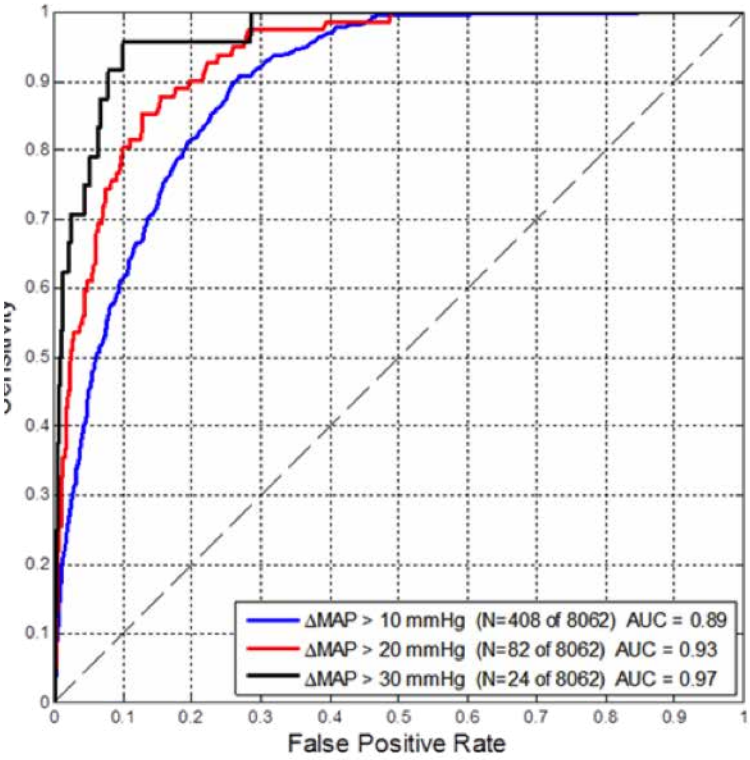

Figure 1. A ROC curve reflecting system efficacy in identifying pressure changes from an in-hospital data set (ICU and OR patients).

References

1. Mena L, Pintos S, Queipo NV, Aizpúrua JA, Maestre G, Sulbarán T. A reliable index for the prognostic significance of blood pressure variability. J Hypertens. 2005 Mar;23(3):505-11.
2. Monk,TG. Anesthetic management and one-year mortality after noncardiac surgery. Anesth Analg. 2005 Jan;100(1):4-10.

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