European Society for Computing and Technology in Anaesthesia and Intensive Care

12th Annual Meeting

Budapest Hungary

25 – 27 October 2001

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Hungarian Society of Anaesthesiology and Intensive Care Medicine

Final Program

Edited by Géza Nagy

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Danubius Thermal Hotel HELIA,
H-1133 Budapest, Kárpát u. 62-64
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Registration hours

Thursday, 25 October	8.00-18.00
Friday, 26 October	8.00-18.00
Saturday, 27 October	8.00-13.00

Official Language

English

Registration Fees

	before 20 July 2001	after 20 July 2001
ESCTAIC members	260 €	280 €
non members	280 €	300 €

Registration fee includes

Admission to all scientific sessions, Congress kit, Coffee, Working lunch

Social Program (included in the registration fee)

Thursday, 25 October, 19.00	Welcome Coctail in Hotel Helia
Friday, 26 October, 20.00	Congress Dinner in Hotel Helia

Local currency

Hungarian Forint (HUF) 1 € = 245 HUF

Shopping hours

09.00 – 18.00

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FINAL PROGRAM

Abbreviations

OC – Opening * S – Session * CB – Coffee Break * ECB – Extended CB * SE - Social Event * GA – General Assembly

Thursday, October 25

09.30	**OC Opening** **Welcome Addresses:** A. Jávor, M. Janecskó, G. Nagy, G. Trillo **Guest Lecture**: Knowledge Based Solutions in the Health Information System. *A. Jávor, Hungary*	**Page** 66
10.45	**CB Coffee Break**	
11.00	**S1 Future Communication of Medical Data. *11.00 – 13.00*** **Chairs: G. Nagy, G. Trillo**	
11.00	Do we need Data Management Systems when we have HIS? *G. Trillo, Italy*	66
11.20	E-programs in Anaesthesia and Critical Care – Important Parts of HIS *Z. Ónódi Szűcs, Hungary*	66
11.40	Mobile and Wireless Solutions *F. Dinnyés, Hungary*	66
12.00	Wireless communication: advantages – report from clinical trial *G. Nagy et al, Hungary*	08
13.00	**Lunch**	
14.00	**S2 New Technologies in Clinical Environment *14.00 – 15.30*** **Chairs: G. Kenny, K. Darvas**	
14.00	Drug Delivery *G. Kenny, Great Britain*	09
14.20	Xenon Anaesthesia *G. Froeba, Germany*	10
14.40	Video Optical Airway Management *P. Biro, Switzerland*	11
15.00	New Weaning Technologies *Ch. Haberthür, Germany*	66
15.30	**CB Coffee Break**	
15.45	**ECB1 ID Berlin *15.45 – 16.45***	
16.45	**S3 Free Paper Session *16.45 – 18.15*** **Chairs: R. Hagenouw, W. Koller**	
16.45	Pitfalls in the Interpretation of Digitally Transmitted Diagnostic Images at Point of Care *L. Fried et al, Canada*	13
16.55	Information Technology in Anaesthesia and Intensive Therapy – Domestic Perspectives *I. Schäffer, Yugoslavia*	14
17.05	Effectiveness of Drug Administration Via Microinfusion Pump at Spinal Level in Rats *E. Csüllög et al, Hungary*	15
17.15	A Modified APACHE II Score for Complete Automatic Computation in an Operative ICU *A. Junger et al, Germany*	16
17.25	Visual Display of Real Time Operating Room (OR) Activity Created as a Management Tool to Increase Performance of OR Activity *C. De Deyne et al, Belgium*	17
17.35	Display of Real Time Operating Room (OR) Activity on all Hospital Wards Significantly Reduces Delay in OR Activity Resulting from Late Arrivals *R. Heylen et al, Belgium*	18
17.45	On Line Decentral Scheduling of OR Procedures May Improve Accuracy of Patient and Procedure Information *R. Heylen et al, Belgium*	19
17.55	Length of Case Estimation by the Surgeons Themselves Results in More Accurate and Efficient OR Management *C. De Deyne et al, Belgium*	20
19.00	**SE1 Welcome Cocktail**	

Friday, October 26

Saturday, October 27

Abstracts – S1

WIRELESS COMMUNICATION: ADVANTAGES – REPORT FROM CLINICAL TRIAL

Geza Nagy, M.D., Sandor G. Vari, M.D.** Zoltan O. Szucs, M.D.*** Gabor Avar*****
*Semmelweis Hospital, medaninf@alpha.bzlogi.hu
**Varimed Ltd varimed@mail.matav.hu http://www.varimed.hu
***HospNET Ltd. onodiszucs@flexum.hu http://www.hospnet.hu
****Bull Hungary Ltd. gabor.avar@bull.hu http://www.bull.hu

BACKGROUND: One of the most instrument demanding and expensive supplying sectors of the Health Care Systems is the anaesthesia and the intensive therapy. In this professional sector with the support of our work a precise information system would be carried out and with the support of it not only the quality assurance and control but after applying a suitably elaborated standards, and indices financial analysis could be carried out[1]. The applied technical equipment based on user-friendly requirements e.g. mobility, easy handling, easy application in OR and ICU.
OBJECTIVE: Our main aim was to establish an easy data entry at the place where it's originated. In the field of anaesthesia and critical care we can find a several systems [2,3] but using the mobile computing systems that can solve this aim not so frequent.
METHODS: We have selected suitable equipment to solve this problem. This is an intelligent remote terminal with touch screen using 2.4 GHz RF wireless networks for connection to wired LAN and the other is PCMCIA card to note book application or new type of tablets. The technical level makes the hardware usage in the theatres a routine job and either hygienic or applicable objections cannot be raised against it. It can be used at the preoperative examinations, at the intraoperative recording and the postoperative data entering as well. The application of this technical level we will try it to use in wards willingly and make the steps of development for its ward application e.g. in the Intensive Care Units. The advantage of its possible application either in a intensive or normal ward is not negligible because either at the doctor's rounds or medicine dispensation the medicine- and instrument flow can be followed by a simple but at the same time precise instrument.
The structure of anaesthesia and critical care LAN is simple. We use server and lot of thin and fat clients. The server consists of Windows 2000 and SQL 7 software and health care applications. The clients are access points, wireless remote terminal, desktop PC and notebook with PCMCIA radio LAN card.
RESULTS: We are in the testing period of our project. The early results are very promising. The system can provide sufficient data for the health care professionals in the Operating Room or in the Intensive Care Unit and it is able to reduce the workload of medical staff. The mobile computing systems are absolutely suitable to satisfy all requirements of point of care philosophy. Working in the large European project, RETRANSPLANT [4] we extend our system to special application in the field of organ transplant. The software is under development at the moment we use only trial version.
CONCLUSIONS: At the completion of our work we can realise the electronic documentation systems in Anaesthesia and Intensive Therapy as well, and we can create a useful and standard database. Because the system is modular and base on open architecture we can easy adapt it to special requirement e.g. RETRANSPLANT project and further application.

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Crit Care Clin, 1999 Jul, 15:3, 499-522
4. RETRANSPLANT project funded by the European Commission DG XIII. Contract number: HC 4028 & IN 4028.

Abstracts – S2

DRUG DELIVERY

Gavin NC Kenny,
BSc(Hons), MB ChB, MD, FRCA, FANZCA Professor and Head of Department
Glasgow University Department of Anaesthesia

The introduction of any new technology will only succeed if it fulfils one of two possibilities. It must either undertake a task which would be impossible without the technology or it should perform a task better than with present technology. Techniques of drug delivery have improved greatly over the past few decades and we can consider them under closed loop and open loop systems.

A closed loop control system uses an input signal, such as blood pressure, to alter the infusion of some vasoactive drug such as sodium nitroprusside and aims to provide a stable blood pressure for a patient by automatically altering the vasodilator infusion rate. The input signal is probably the most important element of a closed loop system and it must be accurate and reliable. Closed-loop systems have been developed for blood pressure[1], muscle relaxants and general anaesthesia.[2] Patient controlled systems can be considered as a type of closed-loop drug administration system and have provided valuable in several clinical settings.[3-6]

Open loop control systems have no input signal but improve the delivery of drugs by, for example, using a variety of models and equations to produce a predicted blood concentration.[7] With this type of control system, the physician selects the blood concentration considered appropriate for the individual patient.

The essential requirement of any drug delivery system is safety and where microprocessors are used, safety must apply both to the hardware and software. The hardware and software components of the system must be designed and constructed to ensure fault tolerance.

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XENON ANAESTHESIA, UPDATE 2001.

G Froeba
Department of Anaesthesiology, University of Ulm, Germany

The noble gas xenon posses many characteristics of an ideal anaesthetic:
A blood-gas-solubility coefficient of 0.14 leads to rapid emergence from anaesthesia. The MAC in humans is 71%. At this concentration, in contrast to other anaesthetics, a maximal cardiovascular stability is reported. Furthermore, xenon does not alter any electrical, mechanical or metabolic factors of the heart. With respect to the high density, ventilation pressure increases during xenon ventilation, but oxygen exchange is not influenced, even when bronchospasm is induced. During xenon washout, no diffusion-hypoxia is reported. Results of an animal investigation and investigation of isolated muscle fibres of malignant hyperthermia-susceptible human patients showed no changes indicative for triggering an episode of malignant hyperthermia.
On the other hand, xenon is one of the rarest noble gases, being present in atmospheric air in a concentration of no more than 0.086 ppm. Xenon is recovered in the process of air liquidation, and after several separation processes, a prurity of 99.995% can be obtained. The current world production is six million liters per year, one million liters is expanded in medical use. Using 1 MAC of xenon in a closed rebreathing system, the average uptake for the first 2 hours of anaesthesia is approximately 9-15 l. By using the total yearly production, not more than 400,000 anaesthetic procedures could be performed with this amount of gas.
With respect to that small number of anaesthetic procedures, it is unlikely that xenon will gain widespread use, it may be highly useful alternative in selected patients, e.g., those with limited cardiovascular reserve.

VIDEO-OPTICAL AIRWAY MANAGEMENT

P. Biro and M. Weiss
Dept. of Anaesthesiology, University Hospital Zürich, Switzerland

The rapid evolutionary development of optical transmission via fibreglass or by means of electronics has lead to the recent availability of easy to handle and low cost devices for the management of the human airway in anaesthesia, intensive care and in emergency situations. These techniques not only improved the visualisation of airway structures in the difficult intubation situation. The latter was mainly the trigger for this development. But a multitude of new applications for optical devices have been described as well, such as teaching und surveillance of regular intubation or positioning, adjustment and control of various airway-securing devices.

There is not only a huge amount of equipment and methods, which can be used to manage the majority of occurring difficult airway situations. We have learned to act according to well-accepted algorithms and to evaluate and repeatedly to re-evaluate the appropriateness of our measures. Usually, a step by step increasing level of invasivity on the one hand, but also of risk and material and logistic expenditure on the other, is a widely accepted approach to deal with a prevailing difficult airway. A decisive feature of the airway difficulty is, however, whether it has been predicted or if it occurs unexpectedly. Predictable difficulties allow a thorough planning and the preparation of various techniques and last but not least the supply of adequately trained and experienced personnel. In contrast, the unpredicted airway difficulty and in the worst case the persisting inability to intubate when this is very necessary, still remains a major threat to patients undergoing surgery or intensive care.

Unfortunately, none of the regularly used instruments seems really to be efficient enough and at the same time simple in handling to achieve the necessary results. Particularly, in the unpredicted difficult airway situation, even the „gold standard“ device, the flexible fiberoptic often fails to be a sufficiently successful technique as it is otherwise in the elective situation. The here presented new video-optical equipment may offer the desired combination of high efficacy and simple handling that seem to be a relevant step towards a higher success rate.

We can assume that video-optical equipment still belong to the so called first line devices but offer the efficacy and comfort of sophisticated material such as the flexible fiberscope. The video-optical devices are part of a completely new class of tools, which can be summarised under the term “video assisted airway equipment”. This comprises video assisted intubation as well as video assisted laryngoscopy (VIL). While the latter is nearly self-explaining, video assisted intubation may be performed either with a video-optical stylet (VOIS) or with a visualised endotracheal tube (VET).

The VOIS is a 2 m long flexible and narrow fiberoptic, which has a stiffened and malleable distal end. It is introduced into the endotracheal tube (ETT) and bent according to the habits and needs of the user. Steering of the mounted ETT is achieved by direct manual movement in exactly the same manner as with any other conventionally styleted ETT. The only difference is, that the view from the stylet tip is additionally displayed on a nearby positioned video-screen, that can be used by the intubating person (as well as by his supervisor) to locate the ETT tip, to advance it under full visual control, and to correct its final position if necessary. The video-optical laryngoscope contains also a 2 m long flexible and narrow fiberoptic, which in contrast to the VOIS is not malleable. It is introduced through the laryngoscope handle and led with its tip to the blade, where it is positioned approximately where usually the light bulb is located. There it delivers the necessary light for direct laryngoscopic visualisation of the glottis, and additionally it also transmits from there the view onto the glottis to a bedside monitor, thus enabling the visualisation of the intubation procedure.

Naturally, all components such as the light source, CCD-camera and the flat screen monitor have to be compatible with all kinds of these fiberoptics (and even conventional fiberscopes as well), and can be composed by various parts of different sizes, capacities and costs.In order to promote the low cost character of this kind of equipment, a small and integrated system, the “Video Intubation Unit” (VIU) has been recently designed and is by now available.

Tracheal intubation with the VOIS is performed in the same manner as regular intubation. Conventional direct laryngoscopy belongs to the technique as well as guidance of the ETT according the video image which is mediated by the stylet. Swift conversion from conventional to video-optical view and vice-versa at any time during the entire procedure is a prerequisite of this method. The same is true for the application of VIL during the video assisted laryngoscopy. This method also enhances the success and ease of naso-tracheal intubation, thus expressing its unique dual benefits: public display of the actual state of the intubation procedure, and less pressure that has to be applied by the laryngoscope. An important additional feature of both methods is the availability of a visual control of

the resulting ETT position, thus avoiding unrecognised oesophageal or unilateral endobronchial tube positions.

The main advantages of video assisted intubation and laryngoscopy are: simple handling analogue to the familiar conventional intubation technique (lower psychological threshold for its first application), fast familiarisation with the technique, long range of the device providing sufficient distance to the video screen and optimal comfort, fast assembling, easy sterilisation (no working channel), simple re-establishing after use, and finally the relatively inexpensive fiberoptic. And these are the shortages of these techniques: they are suitable for use in anaesthetised patients only (not for awake application), no inbuilt steering capability of the fiberoptic, inappropriateness for nasotracheal intubation (VOIS only), the endotracheal view is sometimes not sufficient, no working channel available (for suction of secretions or oxygen insufflation).

In conclusion, VOIS and VIL are not intended to replace the flexible fiberoptic in the elective difficult airway situation where the latter unequivocally remains the „gold standard“, but they represent good substitutes for the flexible fiberscope in the unexpected, anaesthetised difficult airway and in the airway management teaching environment. If indicated, VOIS and VIL are more convenient than the flexible fiberscope, due to their simple handling, ease of application and superior availability.

Abstracts – S3

PITFALLS IN THE INTERPRETATION OF DIGITALLY TRANSMITTED DIAGNOSTIC IMAGES AT POINTS OF CARE

Fried, L. MD, FRCPC, Metcalfe, D., ACR, Hochsinger, A.J., MA, LLB
Dalhousie University, Faculty of Medicine and QE2, Health Sciences Centre
Halifax, NS, Canada

The purpose of our study is to point out some of the pitfalls *clinicians* may encounter at their workstations while receiving, manipulating and interpreting the diagnostic images transmitted via dedicated systems, intranet or internet.

The recent peruse of a website dedicated to the creation, storage and transmission of digitized images, yielded 437 entries between May 30, 2000 and June 1, 2001. Discussion of the disadvantages pertinent to our topic is virtually absent.

The study is based on our experience at the Diagnostic Imaging Department of QE2, a university affiliated health care institution. 350,000/year-imaging studies (7 terabytes = $7x10^{12}$) are performed at the completely digitised department.

The images are available to the users on dedicated display stations, intranet or combination of intra- and Internet. The points of use are the imaging department, ER, ICU, patient wards, and intra- or extra-muros offices of clinicians and radiologists. The great advantages of digital diagnostic images became almost immediately obvious to the radiologists, and, somewhat surprisingly also to the clinicians.

The impetus to this study was the recognition that parallel to the advantages, the pitfalls for clinicians interpreting images without the help of the radiologist would probably become exaggerated. The results of our study showed that there indeed are disadvantages related to technical, perceptual and cognitive factors, which, combined, may lead to misinterpretations by clinicians at points of use. The potential for medico-legal consequences may be considerable.

We found that at the early stages faulty post-processing at the monitors, or consequent manipulation by numerous inexperienced users, lead to uninterpretable images in about 30%. One of the most important factors seems to be the phenomenon that “you see what you want to see”: to find in the diagnostic image supporting evidence for a pre-conceived diagnosis. This is related to the lack of special training in the interpretation of diagnostic images. Such non-technical factors were difficult to quantitate.

The solution for the technical problems is the increased availability of expert help at the sites of use (5 persons at present). The perceptual and cognitive problems can be solved by education, training, and most importantly by the 24 hour availability of imaging specialists for telephone or web site consultation on the intranet or internet with synchronized cursors and other coordinated post-processing tools (“diagnostic chat-rooms”).

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INFORMATION TECHNOLOGY IN ANAESTHESIA AND INTENSIVE THERAPY DOMESTIC PERSPECTIVES

Dr. Ilona Schäffer
Department of Anaesthesia and ICU, Medical Centre, Kikinda, Yugoslavia
schaffer@eunet.yu

INTRODUCTION: Beneficials and importance of the information technology (IT) in the working processes of the anaesthesiologist are huge. In developed countries IT has taken very important place in all phases of the perioperative period. From the preoperative data collecting and data storing through the automated record keeping during the operation by modern computerized anaesthesia workstations great amount of data are generated and analysed by different anaesthesia information management systems (AIMS). In the intensive care unite (ICU) the patient electronic medical record further can be filled by different data about the monitored and supported vital parameters. Anaesthesiologist through the perioperative information management system many relevant and important decisions can make which is frequently life saving in high-risk patients. By these systems the quality of anaesthesia and intensive therapy can be improved. The communication between medical stuff through different networking intrahospitally *(Intranet*) or interhospitally *(Internet)* has became faster and better. In Eastern Europe countries (mainly in those which are "in transition") during the last years revolutionally changes are made by introduction of the information technology in different medical fields. The aim of this paper is to present the situation on this topic in Yugoslavia and to estimate the trends and the perspectives.
METHODS: By the questionnaires (which contained relevant questions about the implementation of the computers and information technology in anaesthesia and intensive therapy) perspective multicenter study was performed in different time interval (1997 and 2000) on the territory of Serbia (including province Vojvodina). The feedback answers and data of 25 bigger hospitals/clinics (with 342 anaesthesiologist) were analysed.
RESULTS: showed that in the year 2000 the number of computers and computer user anaesthesiologist has increased and is greater than it was in 1997.The increasing in the hospitals is 62% at home 72%. In the operating rooms and ICU-s only few clinics/hospitals (4%) have possibilities for automatic data recording and data-transfer through the AIMS and CIMS. The reason is mainly in the poor and old technical equipment. The age of anaesthesia machines and monitors are between 12-20 years. The respirators and patient monitors in the ICU-s are also over-aging. Despite these facts many anaesthesiologist has followed the "information revolution" by buying own computers and tried/try to be "up to date" in own medical field. The number of the computer-educated anesthesiologist is satisfactory. 24% of the asked anaesthesiologist has finished some computer courses and near half is a regularly user of the the beneficials of the Internet like the continual medical education (CME), fast access to topical medical literature (35%) and communication by e-mailing (59%).
CONCLUSION: By the global modernizing of the anaesthesia and intensive therapeutical equipment we can have a very good perspectives to reach the level of the other countries in transition and even some EU countries. A group of younger anaesthesiologist try to make new standards in anaesthesia and ICU in our country. As a model, the standards of some EU-countries would be used. We hope that during this decade we succeed to build-up the healthcare information system architecture (HISA) and after that we can have a good chance to join some European projects like TANIT (I.-II.) or other one.

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EFFECTIVENESS OF DRUG ADMINISTRATION PUMP AT SPINAL LEVEL IN RATS

E. Csullog, G. Kekesi*, G. Joo*, G. Horvath*+, I. Dobos* and G. Benedek**
University of Szeged, *Faculty of Medicine, Department of Physiology, 6701 Szeged PO Box 427,
+Faculty of Health Science, Department of Physiotherapy

Introduction: Although there are several possibilities for pain therapy, this problem is still unsolved until now. The continuous drug administration through microinfusion pump into the subarachnoid space is a novel alternative method to investigate the actions of different drugs at spinal level and to achieve a well-controlled analgesia.
The purpose of the present study was to investigate the antinociceptive effect of the continuously applied intrathecal endomorphin-1 (a newly discovered endogenous peptide with high selectivity and affinity for the μ-opioid receptor) on carrageenan induced thermal hyperalgesia by means of paw withdrawal test (PWD) in awake rats.
Methods: After institutional ethical approval had been obtained from our animal care committee intrathecal catheters were implanted into male Wistar rats. After 4 days of recovery, for the pain test, the rats were placed on a glass surface in a plastic chamber and allow to acclimatize and baseline hindpaw withdrawal latencies were obtained (pre-carrageenan values at –180 min). Unilateral inflammation was induced by intraplantar injection of 1.5 mg carrageenan into the right hindpaw. The paw withdrawal latencies were obtained again 3 h after the carrageenaan injection (post-carrageenan values at 0 min) and then every 10 min for 130 min. Animals were connected to a microinjection syringe pump (2Biological Instruments, Italy) which ensures endomorphin 1 administration at doses of 0.1, 0.3, 1 and 2 $\mu g \cdot \mu l^{-1} \cdot min^{-1}$ for 70 min. Control experiments were carried out with vehicle. For the statistical analysis groups were compared with ANOVA and $p<0.05$ was considered as significant.
Results and discussion: In the control group a significant decrease was observed in the paw withdrawal latency on the inflamed side during the whole period. Continuous administration of endomorphin-1 dose-dependently decreased the thermal hyperalgesia, even higher doses totally relieved it. After the cessation of the microinfusion the hyperalgia reappeared. None of the doses of the endomorphin 1 influenced the withdrawal latencies of the non-injected paws. The rapid onset after the initiation of the continuous infusion and the rapid development of the elevation in the nociceptive threshold is consistent with the lack of any cumulation of active drug. This study demonstrates that continuous drug delivery system at spinal level is a well-controllable method for relieving thermal hyperalgesia in rats.

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A MODIFIED APACHE II SCORE FOR COMPLETE AUTOMATIC COMPUTATION IN AN OPERATIVE ICU

A. Junger (1), J. Engel (1), S. Böttger (1), M. Benson (1), L. Quinzio (1), A. Michel (2), R. Röhrig (1), G. Hempelmann (1)

(1) Department of Anesthesiology and Intensive Care Medicine

(2) Department of Medical and Administrative Data Processing University Hospital Giessen

Introduction: In this study, we investigated the discriminative power on mortality of a modified APACHE II score for complete automatic computation in an operative intensive care unit (ICU). It was our aim to exclusively use clinical routine data without any additional user data input for score calculation.

Material and Method: Based on SQL-scripts (Structured Query Language), the APACHE II score [1] of 524 patients who stayed at ICU between April 1st, 1999 and March 31st, 2000 was calculated. Only routine data were used which were supplied by a patient data management system [2]. Score evaluation was modified in registering unavailable data as being not pathological. For economical reasons, certain parameters were only then determined when a pathological result was suspected or when the result may have been of therapeutic value. The main outcome measure was survival status at ICU discharge. The discriminative power on mortality of this modified APACHE II score was checked with a receiver operating characteristic (ROC) curve. Calibration was tested using the Hosmer-Lemeshow goodness-of-fit test.

Results: The 459 survivors had an average APACHE score of 17.6 ± 5.3. The score of the 65 deceased patients averaged 22.6 ± 4.8. The area of 0.765 below the ROC curve was significantly greater than 0.5 ($p < 0.01$). A confidence interval (CI) of 95 % covers the area (CI: 0.705 – 0.824). The calculated odds ratio was 1.205 (CI: 1.139 – 1.275). The goodness-of-fit test showed well calibration ($H=2.39$, 7 df, $p=0.90$; $C=4.75$, 8 df, $p=0.784$).

Conclusion: The APACHE II score may be completely automatically calculated based on routine data. The obtained results generally lie within the expected range. Due to increasingly tighter medical budgets, this does not justify the routine determination of laboratory parameters for score calculation only. For this reason, the described score evaluation method has its benefits.

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VISUAL DISPLAY OF REAL-TIME OPERATING ROOM (OR) ACTIVITY CREATED AS A MANAGEMENT TOOL TO INCREASE PERFORMANCE OF OR ACTIVITY

C. De Deyne, MD PhD, R. Heylen, MD PhD
Dept of Anesthesia and Critical Care Medicine - Eastern Limburg General Hospital ZOL Genk (Belgium)

Introduction : Operating room information systems should guide the allocation of the optimal amount of block time for every surgeon. This should minimize the sum of costs of unused block time as it should minimize the costs of elective cases being performed outside normal block time. In the present paper, we want to illustrate how the introduction of a visual display of OR activity, as part of an Operating Room Scheduling and Management System (ORSMIS) influenced our daily OR activity performance in view of unused or excess OR time.
Methods : As part of an ORSMIS project, we developed an airport-like screen, chronologically displaying all scheduled OR activity pro OR suite. This OR status screen is linked in real-time activity with all OR suites, where predefined tracking events (start and ending of OR procedure) are automatically captured by network technology. Since January 2001, this OR status screen is used by our central managers of OR theatres to guide daily OR activity. In this paper, we want to analyse if the introduction of this real-time visual display changed our daily OR activity performance. Therefore, we compared all data of OR activity performance for abdominal surgery for the first half of 2000 to the first half of 2001, using the Mann-Whitney U-test.
Results : From January to June 2000, 764 elective cases were performed, whereas 775 elective cases were performed during the first half of 2001. For both periods, the total OR time allocated to abdominal surgery for this 6 months period was 805 hours. For 2000, the total length of OR activity registered for elective abdominal surgery was 1044h50min, whereas for 2001 a total of 1127h35min was registered. For 2000, this results in 147h20min excess time (exceeding the time limits of normal OR activity and inducing extra costs) and in 46h45min of unused OR time. For 2001, we observed an excess time of 123h04min and an unused time of 35h21min. This means that for 2001 62% (209h31min or 322h35min minus 123h04min) of the total over-time of 322h35min (1127h35min minus 805h) did not result in actual excess time nor in extra costs. This was significantly better than for 2000, where only 41% of the total over-time did not result in excess time. This change should be interpreted in view of a better real-time overview of general OR activity over all theatres., enabling optimal utilization of disposable OR time.
Conclusions : The use of an airport like-screen, displaying all ongoing OR activity, resulted in an increased performance of OR activity, with more OR procedures performed despite less excess time. At our institution, the visual display of ongoing OR activity guided a more efficient and anticipating OR management.

DISPLAY OF REAL-TIME OPERATING ROOM (OR) ACTIVITY ON ALL HOSPITAL WARDS SIGNIFICANTLY REDUCES DELAYS IN OR ACTIVITY RESULTING FROM LATE ARRIVALS

R. Heylen, MD PhD, C. De Deyne, MD PhD
Dept of Anaesthesia and Critical Care Medicine - Eastern Limburg General Hospital ZOL Genk (Belgium)

Introduction: Daily operating room (OR) activity constitutes a unique and most dynamic environment in the hospital, with a close interaction between patient and different physicians, nursing and supporting staff, between material needs and equipments and between the hospital admission process from pre-admission to discharge home. Efficient OR management can only be realized if all above mentioned variables can be monitored, and whenever necessary, controlled for. In the present paper, we want to present how the implementation of the continuous display of real-time OR activity, supported by a software tool, throughout all the hospital facilities influenced the actual OR activity.
Materials and Methods: As part of an Operating Room Scheduling and Management system (ORSMIS), we developed an airport-like screen, chronologically displaying all scheduled OR activity pro OR suite. This OR status screen is linked in real-time activity with all OR suites, where predefined tracking events (called for OR, arrival in OR, start and ending of OR procedure) are automatically (no clerk function) captured by network technology. Since jan 2001, this OR status screen became available on all OR supporting facilities (such as nursing wards, central hospital admission desk, day clinic facilities, sterilization departments etc…) in order to enable an optimal teamwork between all facilities. At our institution, a significant part of late OR starts was caused by long and unpredictable time delays between call and arrival to the OR. Therefore, we supposed that the readily availability of the actual OR activity on all OR supporting facilities could possibly improve these arrival delays of patients to the OR. In this paper we compared the mean times between call and arrival in the OR from the month of February 2000 with those of February 2001, using the Mann-Whitney U-test.
Results: Time between call and arrival to the OR was analysed for 817 procedures in February 2000 and for 758 procedures in February 2001. Mean times for February 2001 (10.9 min) revealed to be significantly shorter than mean times for February 2000 (16.9 min). The mean time between call and arrival to the OR for the first case of the day was significantly longer for as well 2000 as for 2001. But in 2001, we found a significantly reduced mean time for the first case compared to 2000 (16.3 min compared to 26.4 min).
Conclusions: The all-over-the-hospital availability of the real-time display of OR activity enables in-time anticipation from all referring wards and results in a significantly shortened delay of arrival to the OR, and hence in significantly less late starts in OR.

ON-LINE DECENTRAL SCHEDULING OF OR PROCEDURES MAY IMPROVE ACCURACY OF PATIENT AND PROCEDURE INFORMATION

R. Heylen, MD PhD, C. De Deyne, MD PhD
Dept of Anaesthesia and Critical Care Medicine - Eastern Limburg General Hospital ZOL Genk (Belgium)

Introduction: An accurate scheduling of operating room (OR) activity predicts staffing, availability of patient, equipment and correct instruments, and results in a smooth and efficient running OR activity. In this paper, we want to present how the introduction of a software system, developed as part of a central hospital administration system, and enabling a direct on-line connection between all surgical booking offices and the central OR management influenced the accuracy of surgical booking for OR activity.
Material and Methods: Using the central hospital network (based on a thin client-server technology) an OR scheduling module was developed most comparable to the general hospital scheduling system. This enabled accurate scheduling from OR cases by the surgeons using intranet/internet access to the system. All information relevant to the efficient running of daily OR activity is automatically asked for (correct &information on OR procedure, information on surgical time, evt need for specific material equipment….). All administrative information (correct patient identification, hospital admission data…) are immediately procured by the central hospital administration system and are available in the OR scheduling module. This OR scheduling module was introduced in January 2001. In order to evaluate its effects on the accuracy of OR scheduling, we compared all scheduling errors (missings and incorrect information) that occurred during the month of february 2000 to those occurring during february 2001, using the Mann-Whitney U-test.
Results: All information concerning patient and OR procedure were systematically analysed for possible errors or missings. Concerning the missing of information, we observed a strongly significant decrease (from 8.2% for 2000 to 0% for 2001). In february 2000, we found 23.2% of incorrect data concerning patient identification and 16.5% of incorrect data concerning the OR procedure characteristics. In 2001, both were significantly reduced (6.3% for patient identification and 8.4% for OR procedure characteristics).
Conclusions: Booking of OR procedures by the surgical booking offices themselves into the OR scheduling system resulted in a significant increase in availability and accuracy of data, as well concerning patient as OR procedure characteristics.

LENGTH OF CASE ESTIMATION BY THE SURGEONS THEMSELVES RESULTS IN MORE ACCURATE AND EFFICIENT OR MANAGEMENT

C. De Deyne, MD PhD, R. Heylen, MD PhD
Dept of Anaesthesia and Critical Care Medicine - Eastern Limburg General Hospital ZOL Genk (Belgium)

Introduction: An accurate time estimation of length of cases enables a smooth and efficient running of OR activity. In this paper, we want to present how the introduction (in our OR scheduling information system) of the modality to estimate the length of case by the surgeons themselves influenced the accuracy of length of case estimation. We were especially interested to analyse if there was any difference between accuracy of estimates between different surgical disciplines.
Methods: Since recently, we introduced an OR scheduling module enabling direct scheduling from OR cases by the surgeons using intranet/internet access. All information relevant to the efficient running of daily OR activity is automatically asked for. This also includes an estimation of length of case. For this estimation, we provided the system with the mean surgical times collected over the last ten years (so-called local standard times), but the surgeons are actively asked for to correct, if necessary, these time estimates. We analysed the accuracy of all length of case estimates, as suggested by the surgeons, with the accuracy of our local standard times, for the month of January 2001.
Results: A total of 934 surgical procedures were analysed, including 79 neurosurgical procedures. For all procedures, the mean accuracy of our local standard times was 84% whereas the mean accuracy of the surgical estimates was 79%. However, for the long-lasting (defined as more than 2 hour) neurosurgical procedures we observed a significant increase in accuracy from 68% for our local standard times to 84% for the surgical estimates. From these data, it seems that specific needs (as well patient-related as equipment-related), largely influencing case of length for long-lasting neurosurgical procedures, are best estimated by the neurosurgeons themselves.
Conclusions: Length of case estimation performed by the surgeons themselves seems most important for long-lasting procedures that might induce specific material or environment requirements.

Abstracts – S4

XML – A UNIVERSAL DATA FORMAT?

Martin Sedlmayr
martin.sedlmayr@faw.uni-ulm.de

Hardly any data format has had such a great impact lately on the industry than the standardisation of eXtensible Mark-up Language XML. XML is an open standard for meta languages controlled by the World Wide Web Consortium and belongs to the SGML family. The key idea of SGML is to structure data (e.g. content of a document) rather than saying how it should be processed or presented on a specific media. XML is a streamlined version of SGML with most of its features, but simpler in usage and with better tool support. This lead to its huge success and broad usage in comparison to SGML.
XML became a *buzzword* in science and industry for marketing software as “modern”, “standardised” and “open”. But what is XML, what are advantages in using XML and what is the big misunderstanding about XML?
XML uses *tags* as basic element for structuring text; pieces of content of a document are always surrounded by tags classifying the content (e.g. <age>32</age>). A valid sequence and hierarchy of tags can be specified (called document type definition) and any document written by an author can then be validated against such a schema, hence enforcing an author to stick to certain rules. The strict structure of the content makes it possible to *search for, extract and reference content*. Therefore, hierarchical, object-oriented, networked data structures can be stored in an XML document. Hence, XMS seems to be a universal data format.
A whole variety of co-standards and applications have been published. *Co-standards* are supplementary standards such as a XML query language and XML-to-XML translation rules. A well-known example is the very forward transformation of XML into HTML, but it can be as complex as the translation of a patient record into a bill. A XML *application* is a document type definition containing the syntactical rules for valid documents. There are many new applications available as well as traditional data formats that have been migrated towards XML. Examples are SMIL for multimedia presentations, the Clinical Document Architecture (CDA) by the HL7 group or the XML versions of HL7 and EDI.
By nature XML defines only the syntax of the structure, not the meaning of the data within a document. The most common misunderstanding of XML is, that it is basically just that – a *language for defining data formats*. Therefore it is often called a meta language. Each developer, vendor or standardisation committee can release XML applications and although they use the same syntax to define their data structures, they will not necessarily yield the same logical structure of the data. Although the tags of two XML applications may be equal in syntax, the content can have different meanings; e.g. <duration> 10 </duration> can mean 10 hours or 10 years.
There are a whole variety of tools available for parsing, processing and communicating data in XML format, many of them as open source with no cost for in-house and scientific development. With the help of such tools, e.g. turbine and cocoon by the apache software group (http://www.apache.org) it is possible to generate a database scheme, a persistence layer (in Java) and HTML forms from a single XML source containing the data model in virtually no time. The main advantage is that this core is bug free and relieves the developer from many tedious and error prone tasks of implementing data access and communication.
To conclude, XML has many advantages, e.g. when developing software. This will yield more products using XML. The usage of a common language for defining data formats will also promote the compatibility of the data models. However, XML is not an universal format in itself and it can only efficiently be used on medium and small sized textual data because of the overhead of the additional tags.

DATA MINING FOR CLINICAL KNOWLEDGE ACQUISITION

Dr. Ulrich Bothner, MD, MS
Department of Anaesthesiology, University of Ulm
Email: ulrich.bothner@medizin.uni-ulm.de

The golden promise of scientific medicine, which is optimal care for individual patients, is seriously threatened if medical research is solely based on the analysis of group behaviour. The concepts of random sampling and population derived quantitative judgements have been extremely successful in numerous areas of human activity. However, at the most fundamental operational and philosophical level, there are many impediments and potential error if we apply inductive and deductive conclusions to solve medical problems of the individual. Moreover, the complexity of the human biology and mind makes each patient bewilderingly unique. Is medicine still more art than science today?
The most important intellectual contribution of the Managed Care movement is the ascending primacy of a data centric health care system. High quality and comprehensive administrative, financial, and clinical data have become the engines of competitive advantage. The question remains: will clinicians be able to enhance the effectiveness of their work through expert level analysis of clinical data sets?
Data mining, which has been defined as "the nontrivial extraction of implicit, previously unknown, and potentially useful information from data", is a field of enormous interest and spectacular information technology investment within the general business community. Why is it still a nascent discipline within health care informatics?

Paradigm Shift

Scientific medicine may have reached the limit of its current experimental paradigm. The randomised controlled clinical trial, while still being the current gold standard for clinical investigation, has a number of serious limitations and cave ats:

The study of rare diseases is difficult or impossible since studies may not have sufficient statistical power to detect statistically significant therapeutic benefits.
Large multi-centre trials of common illnesses will demonstrate statistically significant differences between treatment groups, independent of any genuine or relevant treatment differences (e.g., drug marketing studies).
Study results from academic centres are not broadly generalizable to non-academic patient populations (referral bias).
Designing and conducting clinical trials involves conscious constraints of the patient population. Exclusion criteria select for the "purest cases" of any given illness. This limitation of patient heterogeneity is scientifically justifiable in order to increase the confidence that variations in dependent variables are statistically attributable to study treatment rather than to intrinsic biological variability of the study population (selection bias). However, this same process also seriously undermines the ability to generalise study results to the more diverse and unselected natural patient population.
The foundations and the necessity to perform randomised controlled trials stem from the beginning of the last century, where computationally intensive multivariate statistics was either unknown or prohibitively complex to be calculated by hand.
Placebo controlled double blind studies are getting prohibitively expensive because of the serious administrative and operational efforts. Important questions may not be studied without a direct financial incentive (e.g., industrial sponsoring).
Knowledge is not static. Due to fast technology changes, RCT results may be irrelevant even at the time of their publication.

"Evidence based medicine" is certainly a laudable approach and matures worldwide. We must, however, acknowledge the relative scarcity of valid and clinically relevant data available to scientifically guide treatment decisions (e.g., development of standards and guidelines). If "evidence" only stems from RCTs and their meta-analysis, don't we face the same limitations as with each single RCT? Chaos systems theory suggests that reality is simultaneously simpler and less deterministically predictable than that modelled by classical methods. Consequently, many of the mathematical models and methods currently in vogue for the analysis of biological and medical research are poor fits to the "chaotic" nature of biological systems.

An ubiquitously employed electronic medical record and the imminent accessibility of comprehensive clinical databases will give a totally new perspective. Data mining may provide a potent and cost effective method of knowledge discovery with a direct applicability to heterogeneous and real world clinical populations.

Data mining techniques

Data mining builds on basic sciences such as knowledge engineering, statistical analysis, machine learning, and other artificial intelligence techniques to present knowledge in a format that is easily comprehensible. Relevant data subsets are extracted from the data warehouse. The data set then undergoes "cleaning". This laborious, unglamorous, but vital process generally consumes 60-80% of the time involved in accomplishing any data-mining project. "Garbage in, garbage out" is the fundamental law of data mining. Meaningful insight only results from meticulous preparation of the data set.

Data mining is not a unitary process. Its central idea is that valuable knowledge is hidden within the data, which is not discoverable by simple SQL queries. Consequently, the process of data mining involves the use of a tool set. This tool set includes: graphical data visualisation, multivariate statistical techniques, clustering and segmentation, decision trees, association rules, neural networks, Bayesian networks, genetic algorithms, and many more.

Knowledge discovery is performed best by the supervision of a clinical domain expert. This requirement is particularly important in the semantically rich medical knowledge domain. Knowledge must always be presented within an appropriate context. Knowledge discovery is distinctly different from the unjustifiable practice of post hoc "massaging" of experimental data. In conventional statistical analysis, post hoc multiple comparison ("shot gunning") is unwarranted, misleading, and statistically reprehensible.

Conclusion

So will we witness or contribute to a paradigm shift in knowledge acquisition in clinical medicine? The electronic capture of ever increasing amounts of clinical data may result in expanding opportunities for enhancing individual patient care through the use of expert level data mining of clinical data warehouses. The deficiencies of randomised clinical trials for discovery of clinical evidence are obvious. New knowledge acquisition techniques should help to transform the current health service research policy.

USING ANESTHESIA INFORMATION SYSTEMS FOR QUALITY ASSURANCE AND OUTCOMES RESEARCH

David L. Reich, M.D
Mount Sinai School of Medicine New York, NY USA

This presentation will summarize the issues that are involved in using data from anesthesia information systems (AIMS) for quality assurance or research purposes. Examples of research projects that have resulted directly from AIMS data will be cited.

The infrastructure and personnel that are required to initiate the AIMS-based research and quality assurance program include the hardware and software that automatically collect anesthesiology information (the AIMS), a computer scientist or programmer who is familiar with basic database queries, a biostatistician, links with reliable outcomes databases, links to other institutions with identical AIMS to increase the study population, and support by the AIMS vendor in constructing software to improve access to the data. Our first quality assurance/research AIMS project grew out of a regulatory requirement of New York State. Pulse oximetry was required as a continuous monitor, but computerized records documented frequent gaps in SpO2 monitoring. Other institutions without AIMS had handwritten records that never documented any missing SpO2 data. Our research project demonstrated the types of cases and demographic variables that were associated with missing SpO2 data. These included ASA physical status 3 or higher, cardiac or vascular surgery, hypotension, and hypertension, but not advanced age. We were then able to demonstrate to the regulatory agencies that missing SpO2 data is an expected phenomenon.[1]

Most anesthesiologists believe that modulation of sympathetic responses and rigorous intraoperative hemodynamic control decreases perioperative cardiovascular morbidity and mortality. Using AIMS, we tested this hypothesis in a two-center trial of patients undergoing CABG surgery. We specifically analyzed whether intraoperative hemodynamic instability was associated with death, stroke or MI. We were aided in this effort by the existence of a mandatory New York State database of cardiac surgical risk factors and outcomes that we matched against the hemodynamic performance of patients in our two institutions. We studied 2149 patients at two hospitals. The mortality rate was 2.3%, the stroke rate was 2.4% and the perioperative MI rate was 7.1%. Specific intraoperative hemodynamic aberrations were independently associated with death, stroke, and MI. These included low mean arterial pressure during cardiopulmonary bypass and elevated diastolic pulmonary arterial pressure post-cardiopulmonary bypass. It remains to be seen whether aggressive interventions to correct hemodynamic abnormalities alter these adverse outcomes.[2]

We also studied subjects undergoing non-cardiac surgery (n=797). We determined the physiological component of the POSSUM risk scoring system for each patient preoperatively. We then used the computerized anesthesia record to retrieve all heart rate and blood pressure data. We defined a "negative surgical outcome" (NSO) as a hospital stay >10 days or death during hospital stay. Both hypotension and hypertension were independently associated with NSO in this cohort.[3]

We are currently analyzing the hemodynamic data from over 400 patients who underwent orthotopic liver transplantation and have preliminary data showing an association between hypotension during graft reperfusion and poor outcomes. Pulmonary hypertension is similarly associated with bad outcomes.

Another point of interest is the validity of data from handwritten records as valid source material for clinical, administrative, and research purposes. We analyzed computer and handwritten in 81 matched pairs of neurosurgical anesthetics immediately before and after the introduction of the AIMS. We found that peak systolic pressures were lower, trough diastolic pressures were higher and the variability between adjacent recordings was less ("smoothed") in the handwritten records.[4]

Unpublished data will also be presented to demonstrate the utility of AIMS for various other purposes, such as assessment of the timing of prophylactic antibiotic administration.

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IMPACT OF DATA ON QUALITY MANAGEMENT AT THE ICU

Dr.Heinz Brock
Department of Anaesthesiology and Intensive Care Medicine General Hospital Linz

Quality in health care usually is assessed as the quality of the structure, quality of the processes, and quality of results. Indicators and measures for each dimension of quality recently have been introduced into the managerial practice of intensive care medicine. The structure of an ICU is characterized by its case-mix and by the professional level of care. Scores like the APACHE II and SAPS II are used to compare patient populations. Technology and training requirements for ICUs are defined by standards and guidelines. The quality of ICU processes has a strong impact on outcome. Adherence to evidence based therapeutic strategies is recommended to reduce variations in the quality of care. Precise and easy-to-measure indicators are to be developed for the control of key processes. Improvement of outcome is the final goal of critical care. The most important variable of quality of outcome is in-hospital mortality. Yet it is still a difficult task to calibrate a system in respect to a standardized mortality ratio. More important than measuring various quality indicators is connecting them by causal relationships. Continuous efforts for improvement are enhanced by applying a total quality management strategy and by participating in international and local quality improvement projects.

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Abstracts – S5

HUMAN RESOURCES IN ANESTHESIA AND CRITICAL CARE

L. Quinzio (1), A. Junger (1), M. Benson (1),B. Gottwald (2), D. Brammen (1), G. Hempelmann (1)
(1) Department of Anesthesiology and Intensive Care Medicine
(2) Department of Medical Psychology Justus-Liebig-University, Giessen, Germany

Introduction: A considerable amount of studies deal with user satisfaction of medical staff with information technologies (IT) in medicine. It is an interesting fact that even well-designed software from a technical point of view sometimes is not accepted by medical users [1]. Compared to the introduction of new software in administrative work, the introduction of IT in medicine should consider that the technology must be balanced with the ”art of caring” to be accepted by health care workers. To find out whether our Anesthesia Information Management System (AIMS) is designed to support the medical users and meets their special requirements, we conducted a survey among anesthesiologists at the University Hospital Giessen, Germany after five years of routine work.

Methods: A questionnaire comprising of 75 items divided into four sections (demographic items, personal attitude towards computerized medical records, workstation and hardware, software and user interface) was developed and distributed to 73 anesthesiologists using the AIMS of the University Hospital [2]. The items should be answered on a 5 point verbal scale. Responses from 44 subjects (60 %) were analyzed.

Results: Our results indicate that user expectations of electronic record keeping were generally fulfilled (3.6±0.9; n=44; range 1–5). Respondents think that the AIMS improved the quality of their work (3.7±1.2; n=43; Range 1–5) and that they do not want to switch back to paper records (4.3±1.2; n=44; Range 1–5). A reduced satisfaction was found for program stability, computer performance and functionality (3.4±1.2; n=44; range 1–5, 3.1±1.4; n=44; range 1–5, 3.6±1.1; n=44; range 1–5). Other deficits found were: too little time savings from electronic record keeping, insufficient connections to other existing data management systems and lack of training.

Discussion: The users of our AIMS were not satisfied with some technical details, that will have to be improved in future program versions, but in contrast to other studies [3] the overall attitude towards the AIMS was positive. The question whether such systems are beneficial to the patient for example was rated far more positive compared to the study by Wang et al [4]. The good acceptance of our AIMS could be a result of the fact that a basic AIMS version was further developed based on the experiences of the medical users. In addition, we know from the research in man-machine-interaction that the possibility of participation and the consideration of proposals of the future users creates a positive attitude towards technological innovations. This is underlined by the findings of a similar study of user acceptance of a Patient-Data-Management-System (PDMS) in four Intensive Care Units where users, who were not as much involved in the software development process, stated that their general expectations were not fulfilled [3]. Our findings show that it is not only the data but as well the human resources which have to be managed when developing an AIMS.

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REMODELING OF WORK PROCESSES – THE *TOPICS* METHOD

Marsolek, I.; Friesdorf, W.
Department for Human Factors Engineering, TU Berlin

INTRODUCTION

Within the last few years the requirements for clinical process flows became nearly the same to those within classical work systems, where a rising cost pressure, increasing quality demands and a growing request for customer orientation and transparency define the need for a systematical optimization of existing process flows. While those requirements are nearly the same, clinical process flows themselves are still extremely different from their classical counterparts: caused by the uncertainty of the patient treatment and the enormous number of treatment alternatives as well as involved clinical specialists, clinical process flows are much more difficult to analyze and to improve.
Therefore all strategies and methods, that have already been successfully used within the classical work systems, have to be adapted very carefully to the requirements of the work system hospital, first of all focusing on a reduction of the existing process complexity, but also resulting in a lasting and sustainable optimization of the work system itself.

METHOD

In this context a method as been developed especially focusing on the clinical staff: *TOPICS – Together Optimizing Processes In Clinical Systems*. The defined goal of this method is not only a singular process optimization, but furthermore the establishment of a *continuous process management*, which is based on a three phased cycle:
1. a *systematical process analysis phase*, where problem areas are analyzed together with the involved clinical staff as *process experts*
2. a *participatory process optimization phase*, where the identified process deficits are improved together with the involved clinical staff as *process partners*
3. a *continuous process control phase*, where optimized process flows are realized and thereafter watched continuously by the *process responsible staff* itself

RESULTS

This optimization procedure has been tested within several different hospitals, where especially the first two project phases already showed their potential for the improvement of identified process deficits and the establishment of a new process consciousness throughout the involved clinical staff. But although the majority of the involved clinical staff assessed the used method as a very helpful optimization tool, nearly all work systems still showed enormous difficulties within the realization of their identified improvement potential. Therefore within the additional continuous process control phase those already planned process optimizations have to be realized together again with external support, while specific process benchmarks make process improvements visible. At the same time the responsibility for the remodeled processes has to be transferred back to the staff itself.

CONCLUSION

Within all optimization projects the systematical integration of the clinical staff proofed to be the basis for a successful process remodeling. But even more important than the singular process optimization itself is the staff qualification to process experts, process partners and finally process responsible staff, which also ensures a continuous process control and sustainable process improvement whenever necessary in the future.

Abstracts – S5 – Free Papers

MODELLING A PER-OPERATIVE TASK OF THE ANAESTHESIOLOGIST

Joost le Feber and Constanze Pott
Groningen University, Department of Mathematics and Computing Science Groningen, the Netherlands

Introduction: During surgery, the workload experienced by the anaesthesiologist may vary from very low to extremely high. This evokes very different cognitive demands on the anaesthesiologist. In the very quiet periods the main difficulty is to remain vigilant, while in hectic situations track may easily be lost. Our goal is to develop a monitoring system that adjusts its interface to the instantaneous workload to better support the cognitive processes of the anaesthesiologist. To identify these processes we developed a model of a per-operative task of the anaesthesiologist. Furthermore this model may be used to automatically calculate an indication of the instantaneous workload.

Method: To get insight into the way anaesthesiologists perform their task during operations we had two consecutive group discussions with anaesthesiologists with work experience in the range novice (2 anaesthesiologists) to expert (4 anaesthesiologists). To reveal the intrinsic work constraints we discussed the work domain, the control task, possible strategies and worker competences. This approach avoids constraints that are introduced by the equipment and methods that are currently used (Vicente 1999).
From the first group discussion with three anaesthesiologists we developed a first model of the per-operative task of the anaesthesiologist. This preliminary model was slightly modified in individual discussions with other anaesthesiologists. The modified model was used as input for the second group discussion. The model parameters were quantitatively investigated in a questionnaire to which 11 anaesthesiologists responded yet.

Results: We found that there are two different types of per-operative tasks, which may be characterized as maintenance and repair. The difference between these is that repair tasks are initiated by a certain parameter that gets an undesired value or changes unexpectedly, while maintenance tasks can be anticipated. In this paper we focus on the repair tasks. A repair task ends when the new situation is judged acceptable. The developed model is shown in Figure 1. If more than one parameter value gets out of bounds, parallel tasks are generated. However, in the "*select parameter"* box two parallel tasks may be reduced to a single one. The first decision "*time for proper diagnosis lacks*" differentiates between treatment of a diagnosed problem and pure symptom treatment. If the situation allows time for diagnosis the initiating parameter value is compared to other parameter values until the problem is diagnosed. A treatment based on this diagnosis is more likely to have the desired effect than symptom treatment. However, 91% of our respondents applied symptom treatment when time for proper diagnosis lacked. The decision whether or not there is enough time for diagnosis is usually not a definite yes or no, but varies on a continuous scale between these extremes. In general the less time for diagnosis, the higher the priority given to that tasks by our respondents. Usually a task ends when the initiating parameter value returns to baseline. However, occasionally a problem can not be diagnosed. If the initiating changed parameter value remains constant and does not seem to have further implications on the physical state of the patient, the new value may be accepted as a new baseline value. The time until acceptation depends strongly on the exact situation. In our group of respondents it averaged 12.7 $\pm$ 4.4 (mean $\pm$ SEM) minutes. In both situations the task is ended when the new situation is considered acceptable.
After detection of the initial parameter change, the problem may be diagnosed by comparing it to other parameter values. Usually the parameters are grouped by possible diagnoses. The selected parameter should either confirm or reject a possible diagnosis. In general those parameters are selected first that span the most probable diagnosis. Another strategy used by our respondents was to verify the most dangerous diagnosis.

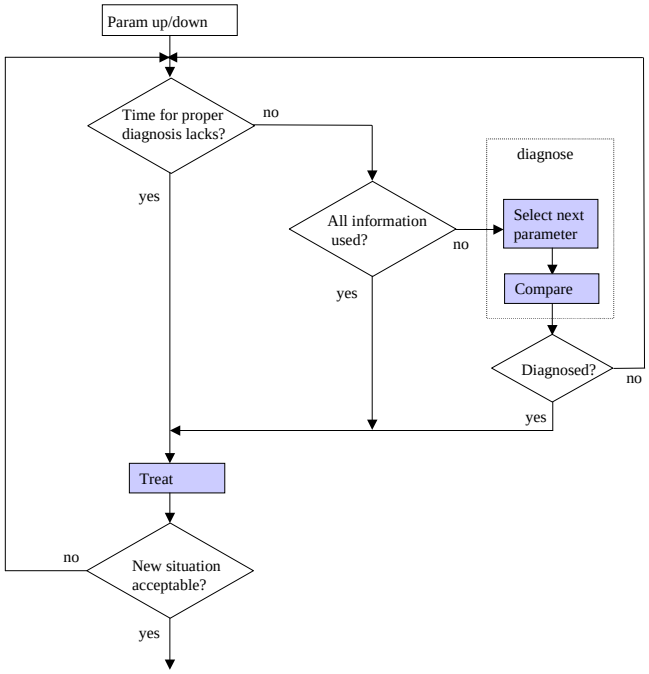

Fig. 1. Schematic drawing of a per-operative task of an anaesthesiologist. A task is triggered by a parameter value that gets out of bounds and is ended when the new situation is judged acceptable.
However, most anaesthesiologists (82%) gave this lower priority than verification of the most probable diagnosis. Occasionally the most recent diagnosis was verified.

Discussion: The model described in Figure 1 is a formalization of a task. In several situations the right hand side loop can be followed in a split second. Sometimes the information needed to diagnose a certain problem is already known by the anaesthesiologist at the moment the task is initiated. Thus it may appear that the symptom is treated immediately and effectively without diagnosis while in fact the right hand loop is followed at least once. Moreover the anaesthesiologists in our group discussions quite often experienced the diagnosing process as an action that took place at eye glance while in fact the loop was followed several times very quickly.
Most anaesthesiologists first select the initiating parameter values of parallel tasks. However, since most anaesthesiologists consider the chance on two independent parallel tasks very small, it is probable that two initially parallel tasks are evoked by a single problem. Thus both initiating parameters usually constitute a single diagnosis. A single reason for both deviating parameter values reduces the number of parallel tasks in our model. The occasionally used selection criterion “most recent diagnosis” probably also reflects the most probable diagnosis as people tend to overestimate the probability of an event just after it actually happened. Therefore we concluded that in general the initiating parameter was compared to other parameter values to either confirm or reject the most probable possible diagnoses. According to our respondents the contribution of a task to the total workload hardly depended on the state of that task (diagnosis vs. treatment). We therefore assume that a task introduces a constant workload until it is finished. A changing parameter value that initiates a task is detected by a computer. The task continues until the value of the parameter has returned to baseline, or until a new stable situation has been reached with a modified value for that parameter. Thus both the initialisation and the end of a task can be detected by a computer, which allows the computer to estimate the instantaneous workload. In hectic situations a monitor may provide more emphasis to parameters to be selected for comparison and thus reduce the time needed for diagnosis. It may also provide a list of possible diagnoses, preferably with an indication of probability. Furthermore the relevance of an alarm can be viewed in the actual situation. For example it may be desirable to suppress alarms of tasks with lower priority than the one that is being worked on. In conclusion, the developed model provides a tool to automatically estimate the instantaneous workload of the anaesthesiologist and gives insight in the possible improvements that may be achieved using an adapting integrating interface in anaesthesia monitors.

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Locally configurable Rule-Based Expert System in Intensive Care

MS Read
Consultant Anaesthetist/Intensivist, University Hospital of Wales, Cardiff, UK,
martyn.read@cardiffandvale.wales.nhs.uk

Introduction: A rule-based expert system in use in Cardiff is described. A daily report for clinical and research staff on the ICU identifies rarely encountered but important disease patterns, common but repeatedly mismanaged clinical situations, and patients who meet inclusion criteria for current research studies. A twice-weekly report lists patients requiring post-discharge follow-up, recent low-risk deaths and recent potentially avoidable complications of ICU. Users can acknowledge messages to prevent their repeated generation.

Program Features: The „DailyRep" program is written in Microsoft™ Foxpro™ and is the subject of continuing development. It analyses data generated by RICP, the audit database in use in Cardiff, (Riyadh Intensive Care Program™ Medical Associated Software House, 19 Chipperfield Park Road, Bloxham, Oxfordshire OX15 4NX), also written in Foxpro. It interrogates copies of the major tables in the RICP database. Rules are based on diagnostic, physiological, or nursing activity data, or combinations thereof. Suggestions that may be generated include the following at present:

"Pt diagnosis suggests that you consider Pabrinex or equivalent and/or Vitamin K"
"Is Pt on inotropes - consider giving phosphate and doing short synacthen test"
"Is there Resp failure for > 7 days and not on antibiotics? (Is there a partial transection of the spinal cord less than 8 hrs old?) - consider Methyl Pred"
"Hypoglycaemia, hypothermia and bradycardia - consider thyroid function tests"
"Trauma diagnosis. Does pt need/has pt had Tet Tox?"
"Pt very oxygen dependant - consider surfactant or oscillator research studies"
"Is the chest problem a nosocomial pneumonia with G.+VE organisms? - consider synercid trial"
"Is there sepsis of infective origin? - consider IL-6 study"
"Organ failure score has increased from 1 to >=2 in last 24 hrs - consider RTPFI study"

The program is set to run at 13:00 h each day using the „Scheduled Tasks" function within Microsoft Windows™. The printed report is available about twenty minutes later. One copy is given to the research staff on the ICU and another is given to one of the trainee doctors on duty for the afternoon. Feedback from these reports identifies messages that have been acted on, are inappropriate or are no longer relevant. This information is placed in the database by clerical staff using a separate program, „Ineligib". The table this writes to is interrogated by „DailyRep" to suppress repeated generation of messages that have been acknowledged. On two days each week, DailyRep produced a second report, which has two functions. The first is to provide a list of patients who require post-ICU follow up visits. These fall into two categories: patients who have been discharged less than one week previously, and all ex-ICU patients who have had a tracheostomy and are still in the hospital. The second function of the twice-weekly report is to list all patients who have died in the previous week who had a day-1 APACHE II risk of death of less than 10%. These then feature in morbidity-and-mortality meetings while the details of the case are still fresh in the minds of staff. Because the programs described have been written by one of the intensivist staff (the author of this abstract) the rules the expert system uses can be changed easily and rapidly. This allows the system to be configured to include new research studies as they commence as well as facilitating development of the program.

Conclusions: A computerised ICU Expert System that is in daily use in a British Intensive Care Unit is described. It recognises disease patterns of varying complexity to provide support in a range of clinical and research activities. It is kept up-to-date by changing the source-code.

EVALUATION OF MATERIAL CONSUMPTION USING AN ANAESTHESIA INFORMATION MANAGEMENT SYSTEM (AIMS)

A. Jost, B. Hartmann, A. Junger, J. Klasen, G. Hempelman
Department of Anaesthesiology and Intensive Care Medicine, University Hospital Giessen

Introduction: There are hidden sources of wasted health care moneys in anaesthesia like drug use inefficiency [1]. The aim of this study was to investigate if an Anaesthesia Information Management System (AIMS) may provide reliable data on consumption of single-use anaesthesia material without making necessary an expensive and time-consuming inventory. Thus the number of selected anaesthesia-related material and the total amount of costs, which the department of anaesthesia had been charged for in the year 2000 in the orthopaedic operating rooms (OR), were compared to the data calculated by the AIMS.
Material and Method: Anaesthesia-related material is being provided at the University Hospital Giessen by a computer-based system of storage facilities (KLIMA II). All arising costs in the orthopaedic ORs are exclusively being charged to one single account. On the other hand, the online-documentation software NarkoData (IMESO GmbH, Hüttenberg, Germany) [2] collects all data on consumption of anaesthesia-relevant single-use material. For the year 2000 the total amount of peripheral (PVC) and central-venous catheters (CVC), urinary catheters (UC), and endotracheal tubes (ET) was counted by the AIMS and compared to the number of the respective data as being accounted by the administration.
Results: In the year 2000, the number of patients treated in the orthopedic ORS totaled 1,865. By means of the AIMS a consumption of 783 CVCs, 644 UCs, and 949 ETs could be documented. In contrast, the administration of the hospital charged for 880 CVCs, 700 UCs, and 1,050 ETs with discrepancies of 11.0 % for CVCs, 8.0 % for UCs and 9.6 % for ETs. Regarding the two most often used CVCs the AIMS failed to document costs of DM 3,237.61. Concerning PVCs (16 gauge and 14 gauge) the official charge was 10.8 % and 46.7 % higher respectively as compared to the documented number in the AIMS. As the number of PVCs totaled 3,400, the AIMS failed to document costs of DM 1,900.80.
Conclusion: Comparison of both methods revealed substantial deficits in documenting cost-relevant materials. This probably is due to significant under-documentation of wasted material and may be overcome by improved instruction into the AIMS. However, especially for anesthesia-related material with infrequent use, the AIMS may provide additional valuable information about possible sources of waste of material.

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Abstracts – S6

ANAESTHESIA AND INTENSIVE CARE MEDICINE – ENTERPRISES OF THE FUTURE IN THE CONTEXT OF A HOSPITAL

Friesdorf, W., Marsolek I., Göbel M.
Dept. f. Human Factors Engineering, TU Berlin

SITUATION & PROBLEMS
People are getting older, and medicine & technology explore new therapies. Both will raise the demand for clinical services continuously. But the society does no longer accept the entailed increase of costs. These conflicting aims can only be matched by improving efficiency i.e. expenditures are reduced while service and quality are ensured or even improved. Nobody really queries a considerable potential for more efficiency but – as the past decade shows – all administrative/political attempts failed to release these potentials. In our opinion the core problem is the complexity of health care systems.

GOAL
Our goal is to develop and establish change management models and tools for a systematic analysis, assessment and reengineering of health care systems to become enterprises performing clinical services efficiently. Within the hospital we focus on ORs and ICUs because they are most expensive units and will be of increased importance in the future.

APPROACH
According to the degree of complexity our strategic approach is multidimensional:
ORs and ICUs are considered as system units. Extensive external communication and cooperation embed the units into the network of a hospital (customer supplier principle). Internally, the units have a structure comparable to enterprises; which let them work as independent business units with well defined competences.
The organisation of the units is patient oriented: primary work processes (w.p) cover patients' treatment, secondary w.p are treatment supportive (e.g. unit lab), tertiary w.p. enable the general work of the unit (e.g. personal management, catering).
Optimisation is guided by effectiveness (focus: tasks and results) and efficiency (focus: work processes and efforts). Ethical aspects and patients' individuality characterize the primary w.p. and thus constitute a significant difference to industrial enterprises.
Methods to optimise complex industrial systems are available, but they must be adapted to clinical requirements. Their general division into (1) man, (2) technology (both related to quality of structure) and (3) organisation (quality of processes) can be helpful if the manifold interrelation between the components is considered carefully.
The optimisation (analysis, assessment and change) of a running unit must be done in small cycles forming an improvement helix. The unit staff should be involved actively for the development of process managing competence, which will speed up the improvement cycles (learning organisation).
Standardisation is a key for effectiveness and efficiency. This can be achieved from a medical point of view (Are we doing the right things?) and from an ergonomic/economic point of view (Are we doing the things right?).
Efficiency of services will be the big challenge for hospitals within the next decade. A broad and intensive cooperation is required on different levels such as traditionally work system oriented scientific societies (e.g. ESCTAIC) but also multidisciplinary cooperation (e.g. Institute for Health Care Systems Management Berlin).

Abstracts – ECB2

CRITICAL TESTING: REQUIREMENTS AND OPTIONS

Chuck Kircher
Vice President International Nova Biomedical

Recently, in hospitals worldwide, the need for whole blood testing for critical care tests is growing and expanding to more patient-focused areas. To provide proper and complete critical care testing, it is imperative to have a whole blood based testing program that includes a comprehensive test menu. Using testing analyzers with inadequate test menus leads to excess patient blood volume requirements, slower TAT and increased personnel. The goal of institutions now is to decrease TAT trough the use of fast, whole blood, complete menu testing systems to allow better and quicker diagnosis and treatment decisions, and also to decrease hospitalization costs and free up 'bed space' in critical care areas. Choosing the proper location within a hospital for performing critical care testing in also a major consideration and one that must be agreed upon by various hospital departments. Finally, the use of automated data management, quality control review, and remote control software programs is now a requirement in many hospitals to connect all critical care systems and allow control and review of the testing processes and results. A review of some case studies/examples using various critical care testing options is also discussed to aid in differentiating the various testing options available.

DYNAMIC INTEGRATION OF POCT TO THE CENRALISED NON-STOP LABORATORY MANAGEMENT

Miklós Kellermayer
Department of Clinical Chemistry, Medical School, Pécs University, Pécs, Hungary

Laboratory testing is assuming an increasingly important position in the diagnostic process, and in monitoring the effects of therapy in modern clinical medicine, especially in critical care medicine (CCM). The laboratory information must be accurate, reproducible and it needs to be delivered rapidly. In the traditional centralized laboratory structure the quality and reliability of laboratory data are preferentially favored over the time, i.e. over the turn-around-time (TAT) and the data delivery. However, parallel with the increase of the importance of CCM within the modern clinical medicine the shortening of TAT has become more and more crucial requirement. The last technological developments have made numerous tests performable at the point of care in a very rapid, reproducible and continuously repeatable manner. At first, the immediate introduction of such technology, i.e. the point of care testing (POCT) seems to be temping to any physician working in the field of CCM, but it must be kept in mind that POCT can not be a replacement for the conventional laboratory services, not even in CCM, only a supplement. The optimal structure for the laboratory services to fulfill the demand of CCM is to manage a “NON STOP” laboratory within the centralized laboratory and develop its close cooperation with POCT units. The “NON STOP” laboratory concept and its possible cooperation with POCT units wild be discussed on the basis of personal judgments.

DEVELOPMENT OF THE SPECTRUM OF LABORATORY DIAGNOSTICS

Tamás Kőszegi
Department of Clinical Chemistry, Medical School, Pécs University, Pécs, Hungary

During the last decade laboratory diagnostics has shown new developments in many different fields. Now the major goal in laboratory medicine is to analyse individual molecules and to try to interpret their role both in the pathogenesis and therapy of the diseases. One aspect of this new tendency is the application of molecular biological methods in the diagnostic and monitoring processes. Another powerful tool of modern laboratory techniques is the introduction of monoclonal antibodies to immunological testing. The use of monoclonal antibodies coupled to sensitive markers such as fluorescent or chemiluminescent dyes makes the determination of a wide variety of individual molecules possible
(e.g. drug monitoring, toxicology measurements, quantitative detection of fibrin degradation products, hormones, inflammatory mediators, etc). In the present paper a special emphasis is made on the analysis of human serum procalcitonin. Serum procalcitonin is considered to be one of the earliest markers of systemic bacterial infection and also has a predictive value for the outcome of the disease.
Another application of antibodies is their use for the identification of individual proteins in complex protein samples. In our experiments we isolated low molecular weight proteins from sera of severely catabolic patients. The amount of the low molecular weight fraction showed good correlation with the pathological processes. High-resolution protein electrophoretic analysis of the samples revealed a unique protein pattern in the 40kDa or less molecular mass region. By the use of specific antibody and immunoblotting technique we could identify the most prominent protein band as alfa-1-acid glycoprotein.

Abstracts – S7

SEVERITY SCORING AND COST CONTAINMENT IN CRITICAL CARE

L. Bogar
Department of Anaesthesia and Intensive Care, University of Pécs, Hungary

BACKGROUND Relatively large proportion of hospital resources is spent on intensive care units (ICUs). It is supposed to account for about 15% of total hospital costs in the USA and France (1). Consequently, the doctors working at ICUs are prompted to assess performance mainly by severity of illness, therapeutic interventions and costs (2). The aim of our retrospective study was to analyse the correlation between APACHE III scores and drug costs of patient treated with mechanical ventilation for at least 72 hours.
METHODS The documentation of 38 patients consecutively admitted to our ICU was analysed. APACHE III scores were calculated on the basis of clinical data documented during the first 24 hours of intensive care treatment. The cost of drugs per patient per day was also determined by analysing every medication prescribed on the first 5 days spent at the ICU.
RESULTS The patients with polytrauma or with abdominal septic focus required statistically higher drug expenditure than the patients after cardiopulmonary resuscitation or with bronchial asthma or pneumonia. The average APACHE III score of patients died at the ICU was significantly higher compared to survivors. Non-survivors received less expensive drug treatment than survivors did. Antibiotic treatment, blood transfusion and administration of human plasma caused the highest drug costs. There was no significant correlation between the APACHE III scores and the cost of drug treatment.
CONCLUSION Scoring systems are commonly used for quality assurance of ICU-performance. Previously, it was demonstrated that the Therapeutic Intervention Scoring System (TISS) reliably measured overall ICU population costs, but the relationship between TISS and cost was less reliable for individual patients (3). It has always been uncertain whether APACHE II or III can reflect drug cost containment because there is a lack of data to verify this correlation. Recent study demonstrates that APACHE III score failed to indicate the drug expenditure in treatment of severe respiratory insufficiency. It is most likely that the TISS is applicable but APACHE III scoring system is not suitable for validation of bulk financing or resource allocation at ICUs.

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PRESENTATION OF SCIENTIFIC AND DIDACTIC MATERIAL

P. Biro
Dept. of Anaesthesiology, University Hospital Zurich

Presentation of scientific and didactic data means mainly visualizing of scientific and didactic material by means of printouts on paper, transparents, making of slides or more recently by presenting directly from the computer. Usually any kind of these presentation methods involves electronic data processing, at least for creating some parts of the material. The computer revealed to be an unprecedentedly effective and flexible tool for this purpose, however, it also offers a vast opportunity for misuse or inadaequate exploitation of the available program features. This leads particularly in the hands of enthusiastic amateurs to overloaded slides full of colorful and unnecessarily animated elements that may deter attention more than attract it.
Lecturers must be aware of their permanent and primary goal, which is to teach, to explain, to instruct and last but not least to entertain an audience. While among us almost all lecturers are professionals in their medical field, the vast majority belongs to the inhomogeneous category of autodidactic amateurs concerning working with the computer as well as in presentation technique. Hence, this lecture here is intended to lend a helpful hand for those who want to improve their abilities to present their scientific or didactic material.
In order to demonstrate both, the good and the bad, this lecture shows the most common sinns as well as the most glorious virtues of slide presentation, which are by their nature of predominantly visual kind and cannot be depicted accordingly in text form. This lecture deals with features such as slide format, background format, combination of various types of elements (text, tables, figures, graphs, pictures, video clips), text formatting, space distribution and covering, colors, animation and the relationship between content structures, amounts and magnitudes to the available time frame for the presentation during a scientific or teaching session. To a certain extent, stylistic and aesthetical questions are also touched, although they may be matter of taste and therefore out of dispute.

Electronic Publishing in Anesthesia and Intensive Care Medicine

Olivier Wenker, MD, DEAA
Associate Professor of Anesthesiology and Critical Care
Director of Technology Discovery Office for Translational Research
The University of Texas MD Anderson Cancer Center Houston, Texas, USA
Editor-in-chief The Internet Journal of Anesthesiology Internet Scientific Publications

Structure

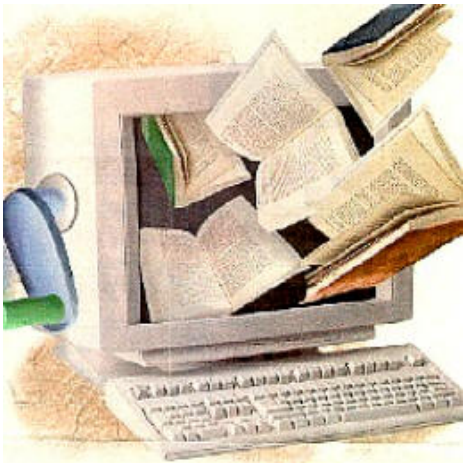
What Is The Web Anyway?
Is The Medical World Connected To the Internet?
Electronic Publishing - What's That?
Advantages Versus Disadvantages
Quality and Credibility - Why Is This So Important?
How Should The Impact Of ePublications Be Measured?
Who Pays The Bill?
Is Electronic Publishing Here To Stay?
New Technologies in Electronic Publishing
Conclusion

Abstract

Electronic publishing is undergoing a revolution. Computers and word processing programs have enabled authors to create electronic files of their articles and streamline their work more efficiently. The Internet gave everyone the opportunity to post articles and other content to be viewed by others at any time and from everywhere in the world. Electronic academic publishing might even be a threat to the traditional print publishing.

This lecture discusses a variety of issues involved in electronic publishing and introduces the reader to some of the technology that will soon impact the way we distribute educational content.

ELECTRONIC PUBLISHING IN ANESTHESIA AND INTENSIVE CARE MEDICINE – Detailed Presentation -



Content:

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This lecture discusses a variety of issues involved in electronic publishing and introduces the reader to some of the technology that will soon impact the way we distribute educational content.

What Is The Web Anyway?

Is it a new technology that is changing our society or the way we communicate.... or is it a monster that not only destroys old established values but tries constantly to commit suicide (see the recent fallout of dotcom's) ... or is it just a toy that is fun to play with?

Figure 1: What is it?

The web certainly started off being a very serious endeavor: an independent crash-protected communication line for the military and later, the research-enhancing network for scientists. Today, well-established hierarchies created by scientists and researchers have been thrown upside-down and the masses have taken over what was originally intended to serve only a few. The web has become a source for instant, free-of-charge (?), high quality (?), credible (?) information for everyone.

Is The Medical World Connected To the Internet?

According to the American Medical Association (AMA) in 2000, only 37 % of US physicians were connected to the Internet. Most of them used the web for E-mail, information gathering, for fun or for online trading. Interactive tools make it possible to search thousands of web sites within seconds for specific information. However, after a few seconds, the user is left with an overwhelming amount of web addresses pretending to offer the most up-to-date information on the requested topic. Nevertheless, never before was it possible to get such instant information around the clock. It is estimated that the web usage among physicians around the world will substantially grow over the coming years and that doctors already using the net will expand their professional online activities.

Electronic Publishing - What's That?

Medical electronic publishing is the presentation of medical content in one of many digital formats. It can be retrieved from computers, CD-ROMs, floppy disks, TV, Palm pilots or pocket PCs, from Intranet's or from the plain " old" Internet. It can be digested in its digital multimedia format or simply

printed from computers and handled the traditional way by reading from a piece of paper. However, there are many advantages of e- publishing: digital platforms usually have no or little restrictions in regard to color images, sound files, or movies. Turnover times for articles submitted to online journals are much shorter and its content can be retrieved 24/7 from all around the world. The visibility for authors is enormous and the publishing content is searchable, making it easy to be found by other physicians seeking about this specific topic. The times in which endless shelves are filled with enormous amounts of paper requiring lots of space and personnel or the need for photocopy machines to reproduce that little fraction of assembled information may come to an end. Interactive online search and printing of selected full text articles on the scientists home/office printers 24/7 may replace the time consuming drive/walk to the library and ultimately save time and money. It really seems that electronic publishing is the way to go. Why are then electronic journals not more popular (yet)? It appears that there are a few more questions in need of answers.

Advantages Versus Disadvantages

Table1-4: Electronic Publishing Versus Traditional Publishing

Advantages of Electronic Publishing
Availability, Accessibility
Interactivity, Searchable
New Dimensions
Low Cost Tool (?)
Speed, Instant Feedback
Quality of Print
Environmental Issues

Disadvantages of Electronic Publishing
Quality Assurance
Reliability
Credibility
Preservation
Low Academic Recognition

Advantages of Print Publishing
Something in your Hands
Better for your Eyes
Academic Recognition
Well Established
No Computer Required

Disadvantages of Print Publishing
Print is Expensive and Labor Intensive
Distribution is Expensive
Publishing Delays
No Multimedia
Requires Storage Space in Libraries
Expensive and Labor Intensive for Libraries

Quality and Credibility - Why Is This So Important?

Electronic publishers have to prove their credibility in order to compete with the traditional brick-and-mortar publishers. Medical content should be of high quality when published online. However, it does not necessarily have to compete with the high-level research distributed by traditional publishers. It

can fill the niche of hands-on multimedia content that is so highly popular among health-care providers. Nevertheless, credibility of the web site and high quality of the content has to be established by strategic alliances with known institutions/names and by serious peer review.

Names of partners/peer reviewers should be clearly visible to the readers (and authors). Quality control, high visibility, indexing by major medical databases, and ultimately recognition by academic institutions will convince authors to submit their high quality content to online publishers. No credibility/quality = no authors = no content = no readers = no online publishing.

Recognition by organizations such as the National Institute of Health (NIH) with its associated National Library of Medicine (NML) and Medical Index Medline/PubMed is of outmost importance for the medical academic world. PubMed Central is an initiative started by NLM to categorize, support, and index medical online resources. Certain quality features are required by publishers to enable them to apply for inclusion in Medline or PubMed Central. Being indexed by PubMed will help to raise academic credibility and stimulate authors to submit their work to this new kind of information distribution (electronic publishing).

Figure 2: Important organizations for online publishers (ARL = Association of Research Libraries)

Organizations such as “Health on the Net Foundation” promote the voluntary acceptance of certain quality criteria. Once such quality criteria are implemented by the web site a HON logo can be posted on the site. Other organizations offer similar services.

Figure 3: HON Code of Conduct logo

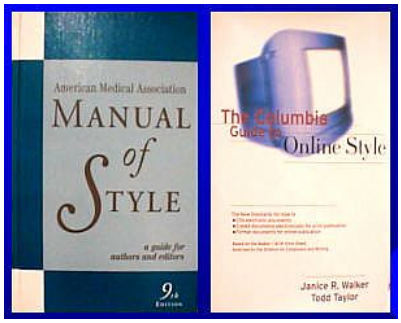
How Should The Impact Of ePublications Be Measured?

Harter measured in 1996 the impact of electronic journals on the scholarly community (http://info.lib.uh.edu/pr/v7/n5hart7n5.html). He analyzed the citations of 36 electronic journals and came to the conclusion that most of them had no or only little impact. However, he was able to measure some impact with e-publications in the fields of science, medicine and social science. In the same year he analyzed 4,317 references in 279 articles published in 74 electronic journals (http://php.indiana.edu/~harter-asis96midyear.html). Only 0.2 % referred to other electronic articles. Worse, 2 years later only 50% of these electronic resources were available online. This has certainly changed with the acceptance of the Internet as a valuable academic resource. However, storage and availability of smaller online publication is still a problem currently addressed by scholarly storage initiatives in Harvard (MIT) and Stanford.

Traditionally, the importance of a publication or a journal is measured by the impact factor (IF). The IF for a given year (i.e., 1999) equals the amount of citations over two years (i.e. 1997/1998) divided by the amount of publications in those two years (1997, 1998). 60 % of all articles in anesthesia are submitted to the 2 top-rated journals (according to their impact factor) Anesthesiology (IF 4.62) and Anesthesia & Analgesia (IF 2.83). The remaining 40 % of submissions go to the other about 100 anesthesia-related journals. Scandinavian and Japanese anesthesia journals complain already about this increasing tendency of submitting articles to journals according to their rank in the IF. The result of this trend is the slow death of smaller or national journals. For the first time in publishing history, another potentially better factor evolves. The web and its digital way of publishing allows to measure how often an article is effectively chosen to be read. This can lead to a new way of measuring the global impact of an article: the reading factor (RF). Other ways to measure some of the impact of electronic publications are the amount of hits an electronic journal gets, or better than just simple hits, how many readers per day click on a specific electronic journal. A variety of search engines offer today the so-called popularity index in which web sites are rated according to their popularity and benchmarked against other similar sites. This index reflects certainly the visibility of an e-publication.

Proper citations of electronic resources will help the articles to find more acceptance and wider distribution. The Manual of Style published by the American Medical Association and The Columbia Guide for online Style are the common resources for authors. Inclusion of the URL (Uniform Resource Locator = Address on the Internet) or better IUI-Code (defines the online location of an article despite potential change of URL) facilitates the search for an online article.

Figure 4: Resources for Authors



Who Pays The Bill?

In 2000, only 2 of the currently over 100 anesthesia-related print journals were available in full text via the Internet (Anesthesiology, Anesthesia & Analgesia). The British Journal of Anesthesia (BJA) and the Australian Journal of Anesthesiology and others planned to follow soon. All these journals are limited in their online access (subscription, passwords). Only 3 full-text electronic anesthesia journals are currently available: The Internet Journal of Anesthesiology (IJA) from ISPUB.com, The Educational Synopsis In Anesthesia (ESIA) from GasNet, and Anesthesia Online from PRIORY.com (not updated since 3 years). All are free of charge and easily accessible.

Figure 5: The Internet Journal of Anesthesiology and its URL

http://www.ispub.com/journals/ija.htm

Figure 6: GasNet with The Educational Synopsis In Anesthesia (ESIA) and its URL

http://www.gasnet.org

Many more would try to join this market if full text online publishing would generate a lot of money. However, it became quickly clear that it is not that easy to generate positive revenues with Internet publishing.

One of the leading medical content providers posted a net loss of approximately US $ 38 millions in 1999 and predicted an even larger loss for 2000/2001. Dr. Koop.com is desperately fighting to survive the summer. Healtheon/WebMD, the largest online health-care player needed some heavy cash infusions (approximately US $ 220 millions) to continue its business. All these sites offer both, information for the public and content for professionals. The general public accounts primarily for the high traffic on these web sites. How can electronic publishers survive by only offering professional content, drawing much less traffic to their sites?

The so much hyped banner advertising on top of web sites is not anymore as attractive as it was in the past. 85 % of the users do not read it anymore and the click-through rates declined steadily from about 8 to 0.2 % over the last couple of years. It is very difficult for pharmaceutical or medical equipment companies to measure the " Return Of Investment" (ROI) of money spent in online advertising and marketing departments are not willing any more to give these dollars just away. Will in the near future the readers or even the authors have to pick up their share of the bill? The coming years will brutally select the survivors in e-publishing and will reveal what the best business model will look like.

Very important for the survival of scholarly electronic publishing are initiatives such as the BlueSky

project (www.blueskyscholars.com). The founder and supporter of this project (Peerview, International Consortium of Advancement of Academic Publication ICAAP, The Athabasca University for Distant Education in Canada, and Internet Scientific Publications) offer high-quality low-cost solution for universities, individual scholars or scientists, small publishers and libraries to support online education. The services reach from online manuscript editing and tracking system, online peer review and review performance capturing, to full-automated output into several electronic formats such as HTML, XML/SGML, PDF, eBook, CD, and others.

Is Electronic Publishing Here To Stay?

Having said all above, one would wonder whether electronic journals are able to survive. Nevertheless, the transition from traditional to electronic publishing has begun. The many advantages of electronic distribution of content are too obvious and will continue to promote online publishing. The leaders in the field will be able to survive and flourish. A few web sites will emerge as being the recognized platform for high quality academic publishing. Both, authors and readers will increasingly enjoy the possibilities of distributing rich multimedia such as color images, sound, or movies and authors will benefit from the high popularity and visibility of online publishing. Academic institutions and universities will soon recognize these emerging sites and except online publishing has an additional tool for academic promotion. Established medical databases will pick the leaders and include them into their index enhancing furthermore the visibility and attraction for authors.

A few questions remain unanswered:
what is the best format for online publishing (HTML, XML, PDF, SGML?),
who owns the copyright (author, publisher, nobody?),
who pays the bill (advertising, grants, readers, authors?),
how should the impact of electronic publishing be measured (hits, page views, readers, impact factor, reading factor?),
who will survive the bursting Internet bubble (traditional publishers, electronic publishers, medical societies, universities, individuals?).

New Technologies in Electronic Publishing

Electronic publishing is moving towards mobile and/or wireless technologies. Many anesthesiologists use already handheld devices in their daily practice. They are mostly used for drug information, download of daily news, and set-up of small databases about anesthesia services or patient information. The International Society for Computers in Anesthesia (SCIA), a subgroup of the Society for Technology in Anesthesia (STA) is presented recently many of these tools and devices during its annual meeting in October 2001 for those interested in such technologies. The meeting was held in Mobile-Alabama at the Marriott Pointe Clear Resort from October 17 to October 20th, 2001. The main topics were “Electronic Publishing”, “Handheld Devices for Anesthesiologists”, “e-Healthcare Resources for Anesthesiologists”.

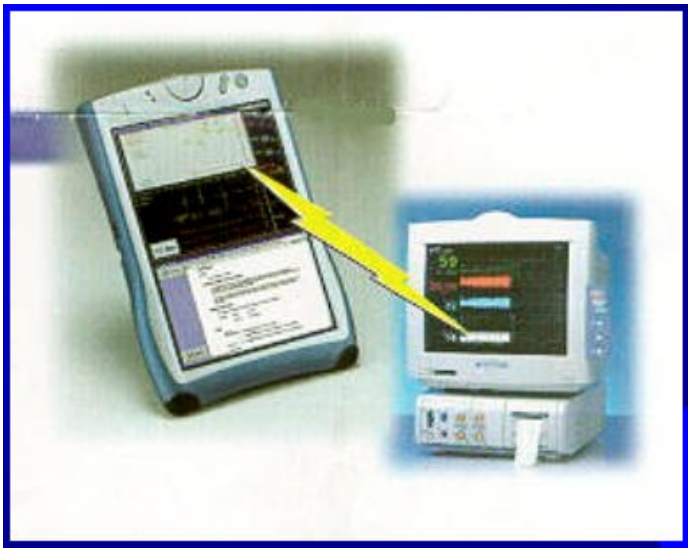
Figure 7: Handheld Devices

Newer devices are just about to come to market. Microsoft, Sony and others are in the final stages of developing “Web-Boards”. These are interactive board-like computers that can easily be connected to the Internet or Intranet. They may be connected to a home PC or use a docking station. They are intended to be a mobile computer, web browser, eBook, and even television.

Figure 8: Web Board Prototype

Another type of Web Boards may soon make its entry into the operating room: the Anesthesia Web Board. This board will be connected wireless to the patient monitor, the pharmacy, the billing office and other places within a hospital. The anesthesiologists will have its own board and will be able to sign on digitally when taking over a case. All patient data will automatically appear on the board. It is a digitized patient record system that signal at the same time to the pharmacy and billing office which and how drugs were used. An Australian company is currently developing such boards. They have even included a web-cam enabling to communicate to other colleagues via this board. A web browser included in the web board will allow anesthesiologists to browse anesthesia-related web sites for up-to-date information on problems occurring in the OR. Whether such features will distract anesthesiologists from their duties will have to be seen.

Figure 9: Anesthesia Web Board



A new and very promising technology is electronic paper. Two companies are currently in the final stages of getting this e-paper ready for commercialization. One of them is Xerox with their technology called Gyrycon. Electronic paper is about 7x thicker than regular paper. It consists of thousand of small spheres lined up between two sheets. The spheres have each one side white and the other side black. Depending on the electric currents in the sheet, the spheres will turn their white or black side up and form letters or images. One sheet of e-paper could store information up to 10 years and can be used up to 10,000 times.

Figure 10: Technology behind ePaper

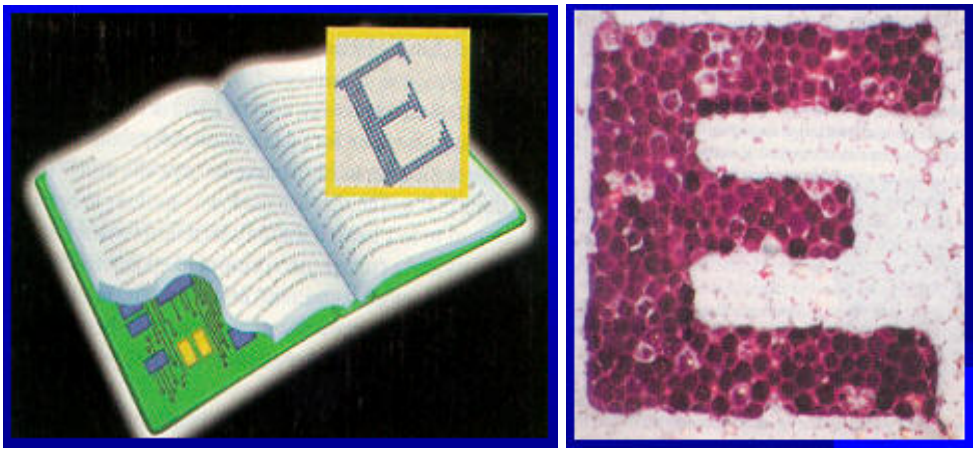
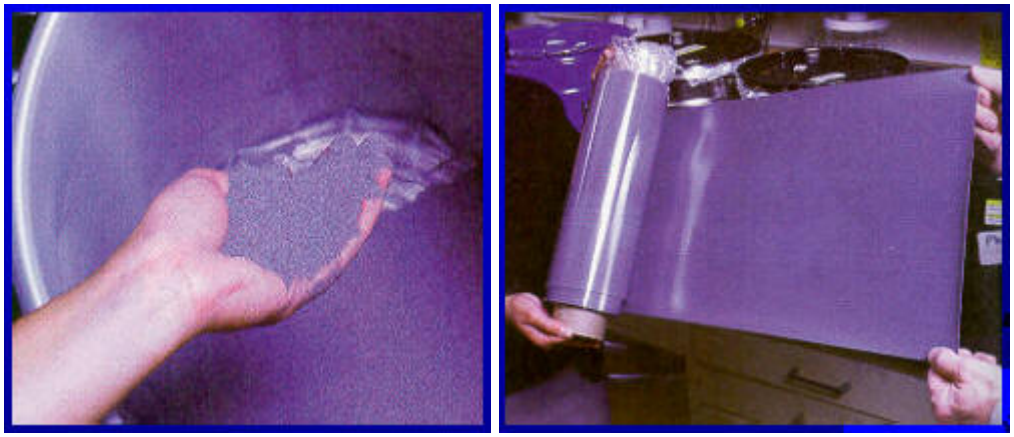


Figure11: Gyrycon from Xerox



Electronic paper will allow generating electronic newspaper. Rolled up in a pipe connected wireless to the publishing house such eNewspaper will be all on 1 sheet. Pages can be loaded wireless every day and made visible by pulling the sheet out of the pipe. Such technology will result in tremendous cost savings (no printing, no mailing, no distribution by distributors).

Figure12: The Future eNewspaper:

Conclusion

The times of cave paintings are over…..

….ePublishing will slowly replace many of the know print journals!
It will take some time but it will happen!

Electronic publishing is here to stay. A shakeout will select the few survivors that will provide high quality medical content for all health-care providers seeking such information including anesthesiologists. Traditional brick-and-mortar print publishing will continue to exist but will be threatened by the possibilities of online publishing. Electronic publishing initiatives such as the BlueSky Project (www.blueskyscholars.com) will enable high-quality low-cost online publishing and support smaller publisher or individual scholars to compete with the large and financially strong traditional publishing houses. Most traditional publishers will offer both, print issues and some kind of electronic format. Medical societies will gain in importance because online publishing gives them the opportunity to offer value-added services to their members (CME content, e-commerce, electronic abstract submission, multimedia education, discussion groups,....). Electronic publishing will thrive and survive! Anesthesiologists around the world will find over time more online educational content.

Disclosure

The author of this article is the editor-in-chief of The Internet Journal of Anesthesiology (http://www.ispub.com/journals/ija.htm). In addition, he is the founder and current CEO of Internet Scientific Publications (ISPUB.com), a leading online medical publishing house and a co-founder of the BlueSky Project. He truly believes in the future of electronic publishing.

Olivier Wenker, M.D., DEAA
Associate Professor of Anesthesiology and Critical Care
Director for Technology Discovery
Office for Translational Research
The University of Texas M.D. Anderson Cancer Center

Abstracts – S7 – Free Papers

ESTIMATES OF FUNCTIONAL RESIDUAL CAPACITY FROM OXYGEN WASHOUT CURVES AND THE EFFECTS OF POSITIVE END EXPIRATORY PRESSURE.

S.E. Rees[a], T. Boruop[a], S. Kjærgaard[b] E.Toft[c] and P.Thorgaard[b]
[a]Centre for Model Based Medical Decision Support Sysyems, Aalborg University, Aalborg, Denmark
[b]Department of Anesthesia, Aalborg Hospital, Aalborg, Denmark
[b]Department of Cardiology, Aalborg Hospital, Aalborg, Denmark

Introduction: Numerous methods have been developed for estimating the Functional Residual Capacity (FRC) of the lung, including single or multiple breath dilution with helium or nitrogen, the use of SF6 as a tracer, or plethysmography[1]. Whilst these methods have found use in the pulmonary function laboratory they are not used routinely in the intensive care unit. Simple, accurate and precise determination of FRC in the ICU would enable monitoring of both disease progression and the effects of therapeutic intervention such as the application of Positive End Expiratory Pressure.
Methods: Frescthner et al. [2] have developed a method of FRC estimation, which might have clinical application in the ICU. Following a change in inspired oxygen fraction (FiO_2) breath by breath measurements of end tidal oxygen fraction (FeO_2) end tidal carbon dioxide fraction ($FeCO_2$) and expiratory volume (Vt) are used to calculate end tidal nitrogen fraction (FeN_2) and hence to calculate FRC from integration of the oxygen washout curve over from zero to 'n' breaths (t is the current breath) using the following formula

$$FRC = \frac{\int_0^n Vt_{(t)}\, FiN_{2(t)} - \int_0^n ((Vt_{(t)} - Vd)\, FeN_{2(t)} + Vd\, FiN_{2(t)})}{FeN_{2(t=n)} - FeN_{2(t=0^-)}}$$

A modified form of the Fretchner method (i.e. excluding FeO_2 calibration from $FeCO_2$, and using a different method for calibration of expiratory volumes for the effects of temperature, humidity, and gas viscosity) has been implemented as a further development of the Automatic Lung Parameter Estimator (ALPE) system [3]. This system combines a ventilator, gas analyser, pulse oximeter and computer to calculate pulmonary gas exchange parameters. By using this set up estimates of FRC can be performed simply from variations in FiO_2.
FRC values have been estimated in two groups: a) Three normal subjects studied whilst sitting. In this group FiO_2 was varied from 21% to 50% several times in each subject. An estimation of FRC was obtained for each FiO_2 variation; b) Pigs prior to an oleic-acid infusion and then subsequently at PEEP levels of 5 cmH_2O, 10 cmH_2O and 18 cmH_2O. FiO_2 was varied by more that 20% on 1 to 3 occasions in each pig at each PEEP level. Estimates of FRC were obtained for each FiO_2 variation.
Results: Table 1 gives values of FRC for each of the normal subjects for each of the FiO_2 perturbations. Values are consistent with textbook values for normal subjects in the sitting position (i.e. 3.0 liters).
Table 2 illustrates FRC estimates in the pigs. Pig 1 is difficuilt to interpret due to errors in data collection prior to infusion and at PEEP = 10 cmH_2O. Pigs 2 and 3 show a clear pattern of reduced FRC following lung damage increasing to pre-injury values at a PEEP= 18 cmH_2O.
Discussion: This abstract has illustrated the use of an FRC estimation method in normal subjects and in pigs following induced lung injury. For normal subjects values were consistent with the literature. For pigs 2 and 3 it appear that variation in FRC estimation was small enough to describe the clinical picture of an increasing FRC at PEEP = 18 cmH_2O. These measurements were performed with equipment routinely avaliable in the ICU and whilst performed on only a small population illustrate the potential for estimating FRC in routine clinical practice using FiO_2 perturbation.

Table 1 – FRC estimates in normal subjects			
Subject	1	2	3
FRC (litres)	3.0, 3.0, 2.5	3.0, 3.2	3.5, 3.2, 3.5

Table 2 – FRC estimates in pigs				
	Prior to infusion	PEEP = 5 cmH20	PEEP = 10 cmH20	PEEP =18 cmH2O
Pig 1, FRC (litres)	Not measured	0.3 0.6	Not measured	0.6 0.7
Pig 2, FRC (litres)	1.0 0.8	0.6 0.6	0.6 0.6 0.7	0.8 0.9
Pig 3, FRC (litres)	1.1 0.7	0.5 0.5 0.5	0.5 0.5	1.0 1.2

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[1] Yernault J-C., Pride N., Laszlo G. How the development of residual volume developed after Davy (1800). European Respiratory Journal. vol 16: 561-564, 2000
[2] Fretschner R., Deusch H., Weitnauer A., Brunner JX. A simple method to estimate functional residual capacity in mechanically ventilated patients. *Intensive Care Medicine.* vol. 19: 372-376, 1993.
[3] Rees SE, Kjærgaard S, Thorgaard P, Toft E, Andreassen S. Non-invasive estimation of pulmonarary gas exchange paramters in 10-15 minutes. Journal of Clinical Monitoring and Computing, in press.
Acknowledgements: This work was partially supported by grants awarded by the Danish Heart Foundation, the Danish Research Academy, and by the IT-committee under the Danish Technical Research Council.

POINT OF CARE. BEDSIDE ASSESSMENT OF RESPIRATORY MECHANICS IN THE ICU

Lorx András, Pénzes István
Semmelweis University, Dept. of Anaesthesiology and Intensive Therapy Budapest

With the evolution of the new ventilators and ventilatory strategies monitoring respiratory mechanics became more and more important. For setting the correct parameters on the ventilator, to monitor the efficiency of a drug therapy or to evaluate the patient lung function, assessment of lung mechanics has a great importance. In an ICU setting to transport the patient for such measurements is impossible, and on the other hand these patients are unstable and usually needs continuous or frequent monitoring. There are several stand-alone or built-in monitoring units available in the market with different modes of monitoring and calculating techniques and of course with different levels of knowledge. The aim of our study was to summarize our experience with the different techniques of bedside monitoring of respiratory mechanics.
Respiratory monitoring was done synchronously using the Ventrak Respiratory Monitoring System using the Analysis + software and the built in monitors of the next ventilators: Siemens SV 300, Bear-1000, Hamilton Galileo (also with the Galileo Logger software). We compared the presented results of the monitor with our calculations from the tracings of the respiratory curves. All the curves and data were stored for later analysis using a PC with a sampling rate of 10ms.
Our result shows that there is great spread of the results from the monitors compared to the calculated results.
Most of the automated modes have its limitation, which are rarely known, and usually not correct in patients with respiratory disease or spontaneous activity.
More attention should be paid when a result is displayed on a screen and more information should be given about the calculation technique used by the machines.
Only perfect monitoring, with intrathoracic pressure monitoring is reliable for calculations unless special breathing pattern and conditions are used.
We think that misinterpreted or un-understood data are very dangerous, the physician must always know the methods and limitations of the technique which is used to benefit from the advantages of the automated bedside monitoring.

Abstracts – S8

UPDATE ON NEUROLOGICAL MONITORING

Marc J. Bloom MD PhD
Dir. of Neuroanesthesia Program NYU Medical Center – Anesthesia 550 First Ave. New York, NY 10016

Neurophysiologic Monitoring

Useful for identifiable structures at risk
Technically demanding
Equipment is complex and costly
Interpretive training is hard to get

Equipment

Sensitive Neuropsychological Tests
TCD
JVC SaO_2
Cerebral Oximetry
Xenon CT scan
EEG – EP
BIS and Other pEEG

NeuroPsycological Tests

Verbal Assessment of State of Awareness
"Mr./Ms. ____ ; Are you Awake ?"
Reverse Digit Memory

TransCranial Doppler

Detect emboli
Assess vasospasm
Qualitative CBF changes
Not always Possible
Measures velocity, not actual flow
Detects emboli during CEA and CPB
Detects vasospasm after SAH
Detects vertebro-basilar insufficiency
↑ ICP ⇒ No diastolic velocity
Allows immediate assessment of therapy
TCD: Sites of Examination
TCD Changes during CEA
Correlation between TCD change and Stroke
Doppler MicroEmbolic SignalsDuring CEA

Jugular Venous Bulb O2 Saturation

Balance supply and demand for O2
Assess ICP therapy

Jugular Bulb Venous Saturation ($S_{jv}O_2$)

Continuous monitoring possible, but usually done by venous blood gas
Technically demanding placement
Also useful to evaluate hyperventilation and perfusion

Near Infra-red Spectroscopy

Dectcts CO_2 reactivity similarly to TCD
Possible non-invasive alternative to $S_{jv}O_2$

NIRS Cerebral Oximetry

Regional ischemia detector
Limited sample volume
Non-invasive, but limited by hair

Xenon CT Scan of CBF

Exquisitely localized CBF measurement
Must be able to breath < 60% O2
Must take patient to CT scanner

Xe CT for CBF

Exquisite regional resolution
Detects hyper- and hypo- perfusion
Useful to evaluate hyperventilation in Closed Head Injury

EEG & Evoked Potentials

Detection of ischemia
Early intervention
Assessment of therapy
Guide to 'protection measures'

EEG in Anesthesia

Signal processing – much in development, but little applied yet.
Low morbidity rates make cost-justification difficult
CEA – many approaches, all with low stroke rates
Cardiac surgery – many 'disturbances' lead to neuropsychiatric deficits
Monitoring vulnerable to noise

EEG & EP's In Carotid Surgery

Can identify those patients who cannot tolerate temporary carotid clamping without a shunt.
Can detect possible complications such as dissection or embolization.
May help define the allowable limits of BP control.

Motor and Sensory Pathways Are Separate

Sensory tests are well defined
Motor tests are still emerging
Cranial nerve tests are very specific, but vary in sensitivity

Monitoring of spinal cord function

Evoked potentials may be used to monitor perioperative spinal cord function
SSEP's are unable to monitor the anterior column

Motor Evoked Potential Techniques

<u>Stimulus</u>
TransCranial Electrical Stimulation
Magnetic Stimulation
Spinal Cord Stimulation
<u>Response</u>
Epidural Compound Action Potentials
Peripheral EMG recording

MEP Methods In Brainstem and Cervical Surgery

EP's can help distinguish between global insult (e.g. hypotension or hypoxia) and local insult (e.g. compression)
In cases like Arnold-Chiara malformation, EP's allow the surgeon to know if function has improved.
Brainstem Auditory EP's test the entire CN VII pathway

Events Causing BAEP Changes in Retromastoid Craniectomies

Monitoring cerebral "protection" efforts

Pentothal dose for burst suppression is 2-25 mg/kg
Rational dosing requires EEG to measure suppression
All suppression is not equally protective

EEG Monitoring in ICU

Assure adequate sedation during relaxant use
BIS can guide sedative infusions
Follow progression of coma
upward or downward
detect effective or detrimental therapy
Detect Seizures
rapidly adjust therapy dosages

Monitoring anesthetic effects

SEF - Simple to understand, but weak correlation
Median frequency - stable but sluggish response
Discriminant function has high correlation

Drug dosing Schemes (in most clinical practice)

Choose a standard dose (e.g.. ED_{50} or ED_{95}),
Guess the degree to which a patient is tolerant or sensitive to the drug,
Then adjust the dose by trial and error
Avoid toxicity.

Several Components to "Anesthetic Depth"

Sedative/Hypnotic
BIS – most tested
Others in development – Physiometrix, Narcograph, Mid-latency AEP, Chaos or Entropy, Neural Nets
Analgesic
BIS variability
Heart rate variability
Autonomic
HRV, RSV, Anemon-L, others

Statistically-derived multi-parametric indices

Bispectral Index (BIS) - most successful
Mid-latency Auditory Evoked Response Index
Auto-regressive model of MAC - Narcograph
Physiometrix – just coming out
Neural Network model - unproven

BIS Index

Lower drug needs if obtunded
Higher drug needs if enzyme-induced
Rapid assessment at end of surgery
Easier non-relaxant management

BIS is NOT

a MAC-meter
a predictor of future behavior
a detector of cerebral ischemia
a replacement for clinical judgement

Pitfalls of BIS application

Overdosing for BIS elevated by artifact
Depending on BIS to prevent movement without relaxant
Running “too light” before a strong stimulus
Overdosing opiate to lower BIS
“Learning” to use lower dosages even without BIS

What use is a measure of sedative effect

Avoid awareness
Avoid overdosage - 25-40% less drug
Speed emergence - faster into & out PACU
Detect tolerance and over-sensitivity
Manage unstable patients
Learn the real time-course of drug effects (pharmaco-dynamics)

QUANTIFICATION OF ANAESTHESIA - A DIFFICULT, IF NOT IMPOSSIBLE, TASK

Gabriel M. Gurman, M.D.
Division of Anaesthesiology, Soroka Medical Center and Ben Gurion University of the Negev, Beer Sheva 84101, Israel E mail: gurman@bgumail.bgu.ac.il

One of the most evident dilemmas of modern anaesthesiology is the way to decide upon the dosage of anaesthetic agents. The first obstacle is the difficulty in establishing a proper definition of depth of anaesthesia and the ideal range the patient must be kept into its limits. Is hypnosis the main aim of measuring depth of anaesthesia, or analgesia or both? Some experts would consider amnesia as the main target of a proper depth of anaesthesia, but what about implicit memory, which is very difficult to proof and prevent? Data from literature show that the usual calculation, based on body weight is obsolete, and this because of the large individual variability of the response to anaesthetics. The classical signs of depth of anaesthesia, such as blood pressure, heart rate or sweating and tears, proved to have no correlation to the effects of anaesthetics on cortical electrical activity. More than this, monitoring of these signs does not prevent in all cases, episodes of awareness during general anaesthesia. The explanation is that variations of blood pressure or heart rate are signs of sympathetic activity rather than general activity of the cortex. The daily use of muscle relaxants avoids the use of spontaneous movements as sign of superficial anaesthesia, but even without administration of relaxants, movements are to be considered a spinal reflex rather than a direct sing of superficial anaesthesia. Various studies using computerized parameters of EEG do not offer encouraging results either. Spectral edge frequency, median frequency or delta power could not be always related to the plasmatic concentrations of the anaesthetic drugs. Bispectral index (BIS), the newest on the list of EEG variables, proved to reflect only the degree of hypnosis and usual doses of opiates make the index unusable. Beside, there are some case reports of awareness during general anaesthesia even when BIS was kept into the recommended limits.

The depth of anaesthesia dilemma is one of the most interesting challenges of our profession in this new millennium. In the absence of a reliable clinical or instrumental sign of measuring depth of anaesthesia, the anaesthesiologist is obliged to respect a list of rules and guidelines, which would prevent, as much as possible, untoward variations of the depth of general anaesthesia. The first one would be the recognition of those patients belonging to the high-risk groups who might develop episodes of awareness during general anaesthesia (caesarean section, cardiac surgery, morbid obesity). These patients have to be prepared psychologically for such an unpleasant event and followed up postoperatively. A volatile drug is to be always added, even in sub MAC concentrations, in order to minimalize the risk of awareness.
Variations of sympathetic discharge, such as blood pressure and heart rate must be correctly interpreted and proper management should be offered, by judging adequately the patient's clinical condition. Proper OR etiquette should be strictly respected and any hostile word or attitude toward the patient should be avoided.
In spite of the limitation of the use of EEG parameters, it is our opinion that an instrumental device based on continuous monitoring of cortical electrical activity is recommended.

For the future we expect the appearance of new, non-invasive devices with a high percentage of sensitivity and sensibility for monitoring depth of anaesthesia and avoiding untoward situations.

Abstracts – S8 – Free Paper

THE COMBINATION OF AEPEX AND BIS IMPROVES ACCURACY TO DETECT AWARENESS DURING PROPOFOL ANAESTHESIA

Matsuyuki Doi[1], Koji Morita[2], Shigehito Sato[1], Haralambos Mantzaridis[3], Gavin NC Kenny[4]
[1]Department of Anesthesiology and Intensive Care, [2]Surgical Center, Hamamatsu University School of Medicine, Hamamatsu, Japan
[3]Department of Anaesthetics, Victoria Infirmary, Glasgow, Scotland
[4]University Department of Anaesthesia, Royal Infirmary, Glasgow, Scotland

Introduction: The ability to detect awareness during anaesthesia is an essential attribute for a depth of anaesthesia monitor. The objective of the present study was to evaluate the combination of the auditory evoked potential index (AEPex) and the Bispectral index (BIS) for the ability to distinguish consciousness from unconsciousness during propofol infusion.
Methods: After obtaining hospital Ethics Committee approval and informed consent, we studied 12 patients undergoing orthopaedic surgery under spinal anaesthesia. After ensuring adequate regional anaesthesia, a target-controlled infusion of propofol was manipulated to produce alternating periods of consciousness and unconsciousness. The consciousness or unconsciousness was defined as the presence or absence of response to verbal command at 30 s intervals. The BIS was measured using an EEG monitor (A-1000, Aspect Medical Systems). The AEPex was obtained using a similar system to that described in our previous study [1]. Each variable was recorded simultaneously and values were averaged over 15 sec intervals. The values of 30 sec before or after the transition between consciousness and unconsciousness were excluded. The ability of the AEPex, BIS and combined values of the two variables that were calculated in the formula: (k x AEPex + BIS) to predict the presence of consciousness were analysed using the prediction probability (Pk). The k value with the largest Pk value was determined.
Results: Within individual patient both BIS and AEPex had large Pk values for distinguishing consciousness from unconsciousness. The median (minimum, maximum) Pk values of BIS and AEPex were 0.991 (0.869, 1.000) and 0.999 (0.958, 1.000), respectively. When the Pk was calculated for each patient group, BIS and AEPex had smaller Pk values than when individual patients were analysed, but the Pk value of the AEPex (0.968) was larger than that of the BIS (0.923). When the combination of AEPex and BIS was analysed for all patients, using a k value of 1.5 in the formula: (k x AEPex + BIS), the value obtained from all 12 patients had the largest Pk value of 0.991, which was larger than that of BIS or AEPex alone.
Discussion: Inter-patient variability of the BIS was larger than that of the AEPex. This explains the difference for Pk values between the AEPex and BIS when each group of patients was analysed. Using the combination of the AEPex and BIS improved the Pk. This suggested that the AEPex and BIS worked independently and did not always made false responses to detect awareness simultaneously.
Conclusions: When the AEPex and BIS were used together using a formula of 1.5□AEPex + BIS, the calculated value had better ability to distinguish between consciousness and unconsciousness than the AEPex or BIS alone.
Reference [1]British Journal of Anaesthesia 78: 180-184, 1997

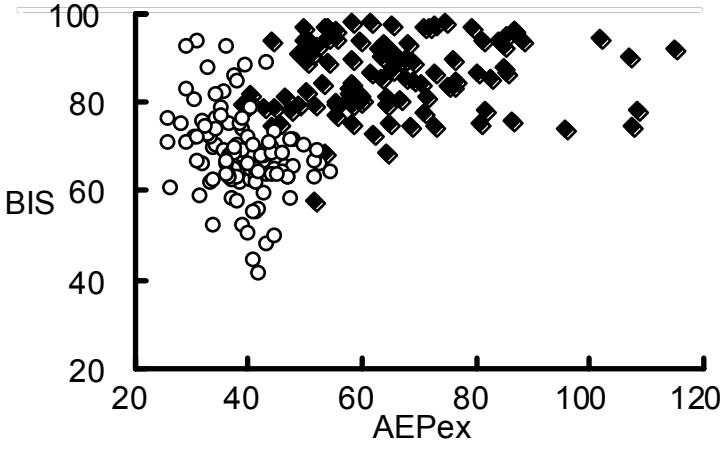

Figure
Distribution of AEPex and BIS in 12 patients.

○ Unconsciousness
◆ Consciousness

Abstracts – S9

IS THE NET SECURE ENOUGH FOR MEDICAL DATA?

René Hagenouw, MD
Department of Anesthesiology, University Hospital Rotterdam, the Netherlands

To judge security of medical data transfer over the Internet one has to look at several aspects, as security has several meanings.

In the first place the reliability of the Internet as a transport medium. The basic building blocks of the Internet are more than 30 years old, and at that time no developer envisioned the scale on which the products of their work would be used. Despite that lack of foresight, the Internet as a whole has been remarkably stable. Even at times of very high bandwidth demands, such as September 11th 2001, the Internet didn't crumble, though transfer times were much higher and many news servers had problems coping with the data requests.

Then there is the reliability of your connection to the Internet. In most parts of Europe fixed Internet access is readily available. The reliability is a function of the price. An ADSL connection may be cheap, but is a 'best effort' product. In my own experience downtimes of less than 3 hours per month are typical. A leased line for 1 Mbit/sec up- and downstream typically costs 7000 Euro/month but has a guaranteed uptime of more than 99%. Whether that is acceptable is a matter of choice, but it is certainly more reliable than conventional transfer of medical files/photo's between hospitals or even within a hospital.

Next comes the reliability of the transfer itself. Can it be intercepted or even diverted by third parties? And if so, can it be read by others? How do you know you received all the information and that it wasn't changed en-route? How do you know that it will end up in the right place? How does the receiver know the information came from the purported sender? These are usually regarded as the key security questions. Standard cryptography traditionally divides these questions up in 5 stages:

- Authorization: Is the sender the person who (s)he claims (s)he is?
- Authentication: Can the receiver be sure the data came from the sender?
- Secrecy: Is it impossible for someone else to read the data?
- Integrity: Is the data complete?
- Non-repudiation: The sender cannot deny (repudiate) he has sent the data

All these matters are well addressed in several shareware and freeware programs. Total security is unachievable, however. But encryption levels available are certainly good enough to make it unfeasible to crack them.

Are there any laws or regulations? At the time of writing I haven't found specific dealing with medical data transfer, but there are certainly laws guaranteeing patient data confidentiality in general. Provided all demands described above are met, these laws and regulations do not appear to stand in the way of electronic communication.

Any chain is a weak as it's weakest link, and one often overlooked issue is the hospital network and the gateway to the outside world. Most hospitals send medical data across their network un-encrypted. It is not difficult for to scan this data en-route en repackage it to send it out into the Internet.

Is the Net secure enough for Medical Data? That is matter of opinion: personally, I would say yes. And most hospitals seem to agree looking at the rapid expansion of such traffic. It is certainly possible to make electronic communication more reliable and more confidential than can be achieved by conventional means using paper files.

THE OPEN HOSPITAL: OUTSIDE LINK AND FIREWALLS.

Pollwein B.
Klinik für Anaesthesiologie, University of Munich

Introduction: A firewall is a computer, router or other communications device, which controls access to a protected network. It is hardware and software that intercepts the data between the Internet and your computer. It is the TCP/IP equivalent of a security gate at the entrance to your hospital. All traffic (data) must pass through it, and the security guard (firewall) allows only authorized people (data) to pass into the facility (LAN).
Method: Firewalls create barriers in order to prevent unauthorized data traffic to a network to protect this network from unwanted intrusion from the Internet, while permitting its employees to get access to the Internet services like web, email FTP etc. Firewalls also can be used to only allow certain people or computers to use defined services or hosts of the Internet. At last firewalls allow the controlled access of the hospital's internal network from outside. Understanding how a firewall works means understanding some basic Internet networking concepts. Every connected computer has a unique address known as an IP-address, which consists of four sections that are separated by periods and each contain a number between 0 and 255. Dial-up users typically have a dynamic IP-address set by the provider, which changes each time they log in. This causes less risk. To distinguish different services over one IP-address, port numbers are used. The applications you're using do this behind the scenes by specifying a port number, which is a virtual channel that lets applications exchange information. Many applications use default, so called 'well known' ports from 0 through 1023. Firewalls are typically implemented using one of four primary architectures: *Packet Filters* - The first line of defence in firewall protection, and most basic, is the packet filter firewall, which examines the IP-headers, incoming and outgoing packets and applies a fixed set of rules to the packets, to determine whether they will be allowed to pass. The packet filter firewall is typically very fast because it does not examine any of the data in the packet. *One way Gateways* - This generally means that a client behind the firewall can initiate any type of session, but clients outside the firewall cannot see or connect to a machine protected by the firewall. *Application Proxies* - The application proxy firewall forces all client applications to use the firewall itself as a gateway. The firewall then authorizes each packet for each protocol differently. This is a distinct disadvantage but they are considered as very secure. *Network Address Translation (NAT)* - Firewalls using NAT and/or Port Address Translation (PAT) completely hide the network protected by the firewall by "translating" the outgoing packets to use different addresses. In most implementations there is a single public IP address used for the entire network. Many firewalls use a combination of the above architectures. Additionally to the above discussed central firewall which resides physically between the internet and the hospital network, there are also so called personal firewalls which consist of software and are working inside your computer on the lowest possible level of the operating system just above the physical hardware drivers.
Conclusion: Choosing a firewall is a big step not to be taken lightly. Most firewall products can be made very secure when properly configured. Because most firewall products are extremely flexible, they are also extremely difficult to configure properly. The strongest firewall in the world won't help you if it's configured improperly.

Abstracts – S9 – Free Papers

REQUIREMENTS ENGINEERING FOR REAL TIME MEDICAL SUPPORT SYSTEMS

Constanze Pott[1], *Joost le Feber*[1], *Albert Ballast*[2]
1 University of Groningen, Department of Mathematics and Computing Science
2 University Hospital of Groningen, Department of Anaesthesiology, Groningen, the Netherlands

Introduction: Anaesthetic monitoring equipment usually makes the work of the anaesthesiologist easier, more efficient and more productive but, it can also interfere or even conflict with the work of the anaesthesiologist. Physical and mental overload, boredom (i.e. lack of significant work) or other device independent factors may decrease the capacity to perform and the personal wellbeing of the anaesthesiologist. In order to design effective and efficient interfaces for anaesthesiology monitors in the operating theatre an understanding and integration of intrinsic work constraints of the anaesthesiologist is required. In this study we investigate some of these constraints as well as differences in personal preferences towards interfaces.
Methods: After operating room observations and group discussions with anaesthesiologists we developed a pre-test questionnaire following the theory of Cognitive Work Analysis (CWA) [1] to identify and model the intrinsic work constraints. It consists of open questions and questions with answers on 7 point Likert scales. The CWA consists of 5 different phases, (1) Work Domain Analysis, (2) Control Task Analysis, (3) Strategies Analysis, (4) Social Organisation and Cooperation Analysis and (5) Worker Competencies Analysis. In our study we investigated the phases (1), (3) and (5).
The first phase of the CWA, **Work Domain Analysis**, is intended to identify the information requirements in the operating theatre that are independent of any particular anaesthesiologist, automation, event, task, goal or interface.
According to the CWA, strategies are process representations (descriptions of how the goal can be accomplished in comparison to what should be accomplished in phase 2). There is usually more than one way to achieve any given task goal and anaesthesiologists exploit this redundancy by using different strategies to perform the same task or by switching between strategies (e.g., forced by different workloads). The objective of a **Strategies Analysis** is to identify the requirements that can lead to a support system that is comprehensive enough to provide support for each strategy and that is flexible enough to allow workers to switch seamlessly between strategies.
As all the practitioners in the operating room are experts, we laid the focus of our **Worker Competencies Analysis** on investigating the constraints to their capacities to perform. In our opinion the capacities of every anaesthesiologist are a function of the actual workload and also of the anaesthesiologist's personal physical and mental state. Only if the anaesthesiologist is in a perfect condition and the workload is neither to high nor to low his actual capacity to cope with the problems in the operating theatre is equal to his competencies. Therefore we try to identify the constraints that have influence on the (esp. cognitive) capacity to perform in the OR.
Results: The sample of our pre-test consisted of 11 anaesthesiologists selected from the regular day shift of the department of general surgery at the University Hospital Groningen. We will here present a few interesting results from the 92 questions of the questionnaire.
Work Domain Analysis: Apart from getting relevant information from an external database (e.g. protocols of the department, preoperative data of the following patient) during operations (M=5.9, 1=not important at all, 7=very important) and the need for an electronically available database with information about every patient (M=6.5) there is not much need for information from the internet (M=3.5) in the operating theatre. An excellent measurement technique is evaluated as being very important (M=5.7).
Strategies Analysis: It became obvious that the difference between individuals concerning the helpfulness of decision support and autonomy is huge (M=4.5, 1=not helpful at all to 7=very helpful): *range*=7, SD=2.4. Half of the respondents indicated that they have a personal order in which they check all parameters regularly during surgery. Most of the anaesthesiologists use the same parameters, but the actual order differed between respondents.
Worker Competencies: The capacity to process data is experienced to be lower when the anaesthesiologist gets tired (M=2.4, 1=lower, 7=higher). On the one hand the capacity to process data is subjectively experienced to be higher in a situation that is life threatening to a patient (M=5.4) than in a regular situation. On the other hand the chance to miss important information rises slightly in comparison to a quiet situation, in which the capacity to process all of the displayed information is perceived to be quite high (M=5.2).

From our results it appears that the time to get used to new monitoring equipment is subjectively experienced as acceptable (*M*=4.5, 1=no time at all, 7=very time consuming). Therefore the benefits of introducing a new, improved medical support system are surely higher than the costs of the implementation.

Conclusion: The first thing we can conclude is that the nowadays displayed data is good for normal circumstances in the OR. In stressful situations, however, there should be a selection of data with the useful information. The desired information may depend on the personal preferences of the user. We can conclude that by simple design features of personalisation large effects can be achieved.

After just having a few questionnaires filled out we nevertheless can conclude that our approach of requirements engineering can lead to a significant improvement of the work of the anaesthesiologists. Thus it seems worthwhile to further follow the path of CWA we have chosen.

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A MODEL BASED APPROACH TO SUPPORTING PRESCRIPTION OF INSPIRED OXYGEN FRACTION.

D Murley[1], S Rees[1], BS Rasmussen[2] and S Andreassen[1]
[1]Centre for Model Based Medical Decision Support Systems, Aalborg University, Aalborg, Denmark
[2]Department of Anaesthesia, Aalborg Hospital, Aalborg, Denmark

Introduction: During oxygen therapy sufficiently high levels of inspired oxygen fraction (F_iO_2) must be maintained to prevent hypoxia. Contrary to the need to maintain high levels of F_iO_2 is the fact that at high partial pressures oxygen is toxic to the respiratory, cardiovascular, nervous and gastrointestinal systems [1]. Bryan and Jenkinson [2] recommend that clinicians should prescribe supplemental oxygen at the lowest concentration possible that will still allow adequate tissue oxygenation. Opinion on the amount of F_iO_2 needed to achieve this varies between cases and between clinicians. This and other findings lead Mao et al. [3] to conclude that there is a need for the development of support systems to inform the management of oxygen therapy. This abstract describes an oxygen therapy support system (OTSS) that predicts the patient's arterial oxygen saturation (S_pO_2) at the clinician's prescribed F_iO_2.

Methods: The OTSS uses a mathematical oxygen model of pulmonary gas exchange [4] to predict the patient's S_pO_2 at a prescribed F_iO_2. This prediction is based on knowledge of the patient's two oxygen model parameters. When the OTSS is initially used on a patient there is uncertainty about the correct values for their oxygen model parameters. It is possible to express this uncertainty using probability distributions for the two parameters, as illustrated on the right of figure 1. Before the patient measurements are recorded initial parameter distributions are loaded from a set of distributions generated from similar prior cases. Then when a measurement of respiratory variables is recorded Bayesian theory is used to make the patient's parameter distributions more precise. Thus additional knowledge about the patient's state is acquired. Following the measurement the oxygen model uses the parameter distributions to produce a probability distribution of the possible S_pO_2 values at a prescribed F_iO_2. The shaded area on the oxygen saturation graph shows the plot of the S_pO_2 distribution (figure 1). The peak of this distribution shows that for this patient the most likely S_pO_2 is between 93-94%. While the spread of the distribution along the y axis shows the possible values of S_pO_2 are between 88-98%. To evaluate the risk of hypoxia when setting F_iO_2 to the prescribed level the OTSS calculates the probability of the patient's S_pO_2 dropping below a threshold level. In the testing described this threshold was set at 90% S_pO_2. The OTSS was retrospectively tested on eight postoperative cardiac cases. For each case the oxygen saturation was initially measured at an elevated level of F_iO_2. This single measurement was then used to update the patient's parameter distributions. These distributions were then used to predict the S_pO_2 distribution at the lower measured F_iO_2 value.

Results: The oxygen saturation graph in figure 1 shows two measured data points (A, B) and a predicted S_pO_2 distribution. The figure was captured after the first measured point (A) was used to update the patient's parameter distributions on the right. The predicted S_pO_2 distribution is plotted at an F_iO_2 of 27.6%, which corresponds to the measured F_iO_2 of the second data point (B). The graph shows that the most likely predicted S_pO_2 value is within ±1% of the measured value and there is negligible predicted risk of the patient's S_pO_2 going below 90%. For all the test cases the reduction in F_iO_2 was 26.7%±11.6%; from an initial level of 55.1%±15.4% down to 28.4%±3.9%. The corresponding reduction in S_pO_2 was 3.6%±1.6%. In seven of the eight cases the predicted mean S_pO_2 was within ±1.5% of the measured value. For each of the test cases the probability of an S_pO_2 value below 90% was calculated. For the two cases where the second measured S_pO_2 was 94% the probability of going below the 90% threshold was 0.046 (approximately 1 in 22) and 0.002 (1 in 500). So for these two cases setting the F_iO_2 to 27.6% and 29.7% respectively represented a low risk strategy for reducing F_iO_2.

Conclusion: Initial testing has shown that the model based approach described can reasonably predict the S_pO_2 at a prescribed F_iO_2. Moreover, the OTSS also offers an assessment of the risk of hypoxia when using the prescribed F_iO_2 level. Prospective use of the OTSS for the initial tests cases would have supported reducing the risk of oxygen toxicity while maintaining adequate oxygenation. The initial results are sufficiently encouraging to justify further testing of the system. Currently the OTSS is being evaluated in clinical trials as a component of the Automatic Lung Parameter Estimator [5].

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Acknowledgements: This work was partially supported by grants awarded by the Danish Heart Foundation, the Danish Research Academy, and by the IT-committee under the Danish Technical Research Council.

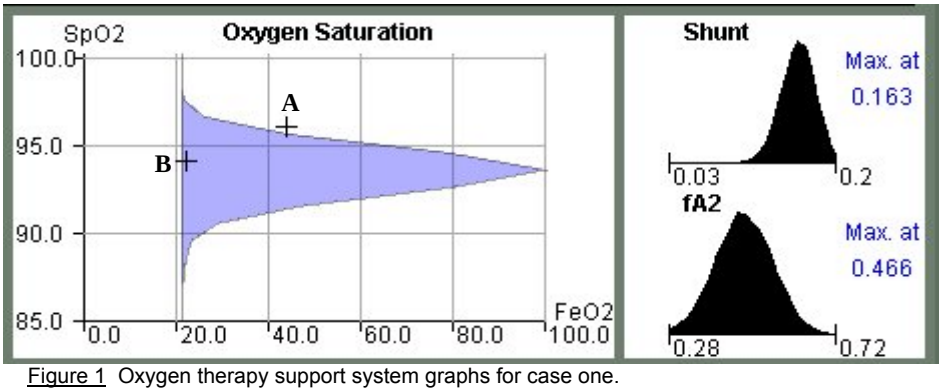

Figure 1 Oxygen therapy support system graphs for case one.

HOSPITAL INFECTIONS SURVEILLANCE ASSISTANT SOFTWARE (HISA): USE EXPERIENCE IN AN INTENSIVE CARE DEPARTMENT

Maviglia R, De Angelis G, D'Amato L, Recchioni G, Marchese M, Sgreccia M
Department of Anaesthesiology and Critical Care Medicine, Catholic University, 00168, Rome, Italy;
corresponding author Tel. 0630154386 – Fax 063013450 – e-mail r.maviglia@mclink.it

Introduction: Aim of this paper is to present our 9 months experience using a computer-assisted infectious disease surveillance and diagnosis software in our intensive care department.
Materials and methods: Literature analysis was performed in order to collect as many objective parameters concurring in the formulation of infectious disease diagnosis as stated in international guidelines or consensus conferences (1,2). All parameters were divided into logical blocks of a paper-based patient daily monitoring form. Mathematical algorithms basing on arbitrary scores, weighted for each parameter contributing to the diagnosis of an infectious syndrome, were created in order to allow data to be managed by a computer aided diagnostic tool. Algorithms were created for different infectious syndromes (SIRS, Sepsis, Severe sepsis and Septic Shock, Pneumonia, Endocarditis, Urinary tract infections, Surgical Wound infection, Meningitis) plus ARDS and ALI. An ad hoc software (HISA – Hospital Infections Surveillance Assistant, UMS – Firenze – Italy) for database management and basic statistical analysis as well as a digital interface to the paper form was developed. Only the over 24 hours admissions were monitored. Personal and demographic data, admission diagnosis as well as clinical scores (SAPS-II, SOFA, GCS, TISS 28, APACHE) for each patient were archived and automatically extracted from the digital clinical record in use in the department (DIGISTAT^{tm}, UMS – Firenze – Italy). A maximum of 11 people (including students, residents, intensivists) was involved in the project during the period. Validation of the software will be performed by statistical evaluations of each patient diagnosis as made by clinicians vs. derived by mathematical algorithms.
Results: Since September 2000 to May 2001 all 963 patients admitted (1082 admissions) to our 21 bed department were enrolled in the surveillance study. Time for each patient form fulfilling was of 8 minutes. More time was spent for microbiological data updating (2 more minutes for each patient result). Digitalisation of each paper form was performed in 2,5 minutes. Minimal set of parameters available for each patient/day was of 51: 1071 parameters for each department/day.
Conclusion: Final population of database and statistical evaluation of patients' data is still ongoing. Availability of a large amount of specific information for epidemiological analysis worth the time spent to get them. As an intermediate result, the use of this standard approach to the infectious disease surveillance in the department revealed to be an excellent learning facility for the educational purposes of our institution. Digital acquisition of bedside information as well as online gathering of chemical and microbiological results will be the next step of the project. Next future in the project will be the integration of neural network analysis tools for computer-aided diagnosis.
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Chart 1: Sections of the daily monitoring form with monitored parameters (most are recorded as objective data, bed side data, non-objective data as well as clinical evaluations are reported as Boolean)

Section	Description
A	Chemical analysis and bed side data (28 parameters)
B	Risk factors (15 parameters)
C	Standard chest X-rays (6 parameters)
D	Microbiological results (60 parameters)
E	Patient visit (21 parameters)
F	Therapy (12 parameters)
Diagnosis	Infectious disease syndrome diagnosis (3 parameters)

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