Gestione delle Vie Aeree

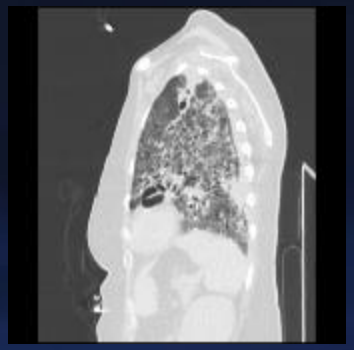
Cosa ci ha insegnato la pandemia da Covid-19 ?

Tecniche, pianificazioni, percorsi

L'esperienza di due ospedali al centro dell'emergenza

Guido Merli

U.O. Anestesia e Rianimazione
ASST Crema – Ospedale Maggiore



Covid-19 Emergency Background

Severe hypoxemic respiratory failure

Very high number of acute patients

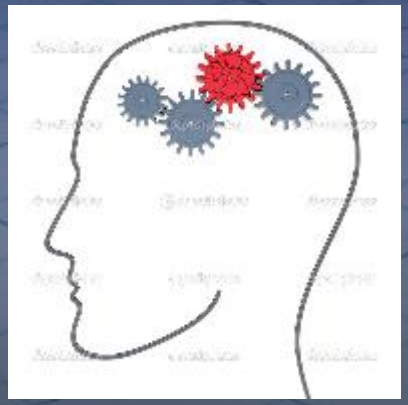
Limited structural and medical resources

Need for new therapy protocols and strategic approach

High risk of spread of the infection among staff

"Hypoxia not only stops the machine,
it wrecks the machinery"

Attributed to J.S.Haldane, 1921



Coordinamento delle Terapie Intensive Lombarde

Regione Lombardia

	Nuovi ricoveri	Deceduti	Dimessi
	TOT	TOT	TOT
Totale da febbraio 2020	12430	4677	7327
1° ondata: da febbraio 2020 al 30 giugno 2020	4615	1941	2637
2° ondata: dal 1 agosto 2020 al 31 gennaio 2021	3890	1344	2070
3° ondata: dal 1 febbraio 2021 ad oggi	3925	1392	2620
Dal 1° giugno 2021	243	81	254
ultima settimana	25	7	10
da ieri alle ore 00.00	3	0	1

deceduti/(deceduti+dimessi), %	
Totale da febbraio 2020	39.0
1° ondata: da febbraio 2020 al 30 giugno 2020	42.4
2° ondata: dal 1 agosto 2020 al 31 gennaio 2021	39.4
3° ondata: dal 1 febbraio 2021 ad oggi	34.7

The extent of the problem

Probably the biggest challenge of airway management in ICU patients remains the

UNDERLYING PATHOPHYSIOLOGY

Adverse impact on airway management

Adversely affected by airway management

No more

ANATOMICALLY DIFFICULT AIRWAY

But

PHYSIOLOGICALLY DIFFICULT AIRWAY

High Risk Airway Management

The Royal College of Anaesthetists

The Difficult Airway Society

4th National Audit Project o
The Royal College of Anaes

Major co
of airway
in the United Kingdom

Report and findings
March 2011

BJA

British Journal of Anaesthesia 106 (5): 617–31 (2011)
Advance Access publication 29 March 2011 · doi:10.1093/bja/aer058

SPECIAL ARTICLES

Major complications of airway management in the UK: results of the Fourth National Audit Project of the Royal College of Anaesthetists and the Difficult Airway Society. Part 1: Anaesthesia†

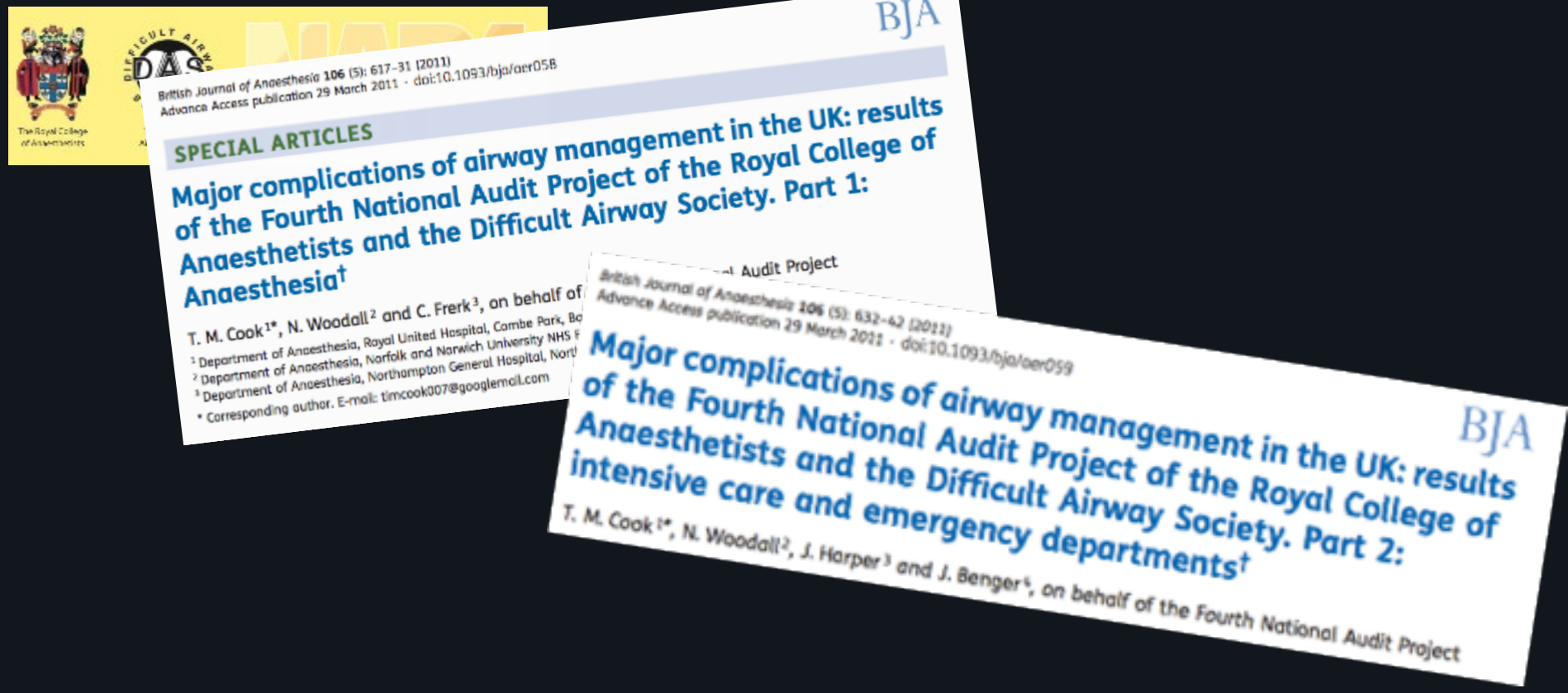
T. M. Cook[1]*, N. Woodall[2] and C. Frerk[3], on behalf of the Fourth National Audit Project

[1] Anaesthesia, Royal United Hospital, Combe Park, Bath BA1 3NG, UK
[2] Norfolk and Norwich University NHS Foundation Trust, UK
[3] Northampton General Hospital, Northampton, UK
* E-mail: tmcook@doctors.org.uk

British Journal of Anaesthesia 106 (5): 632–42 (2011)
Advance Access publication 29 March 2011 · doi:10.1093/bja/aer059

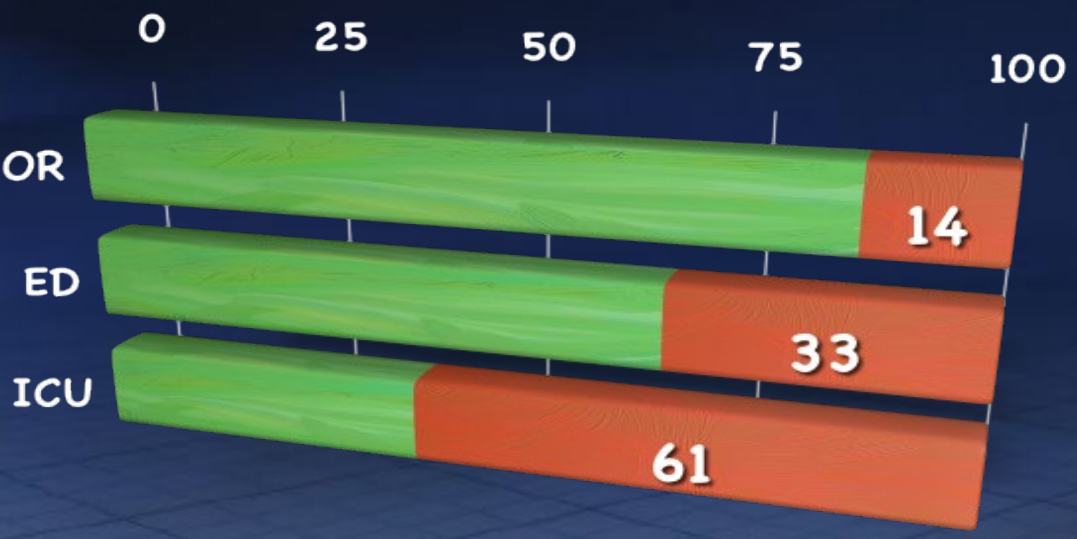
Major complications of airway management in the UK: results of the Fourth National Audit Project of the Royal College of Anaesthetists and the Difficult Airway Society. Part 2: intensive care and emergency departments†

T. M. Cook[1]*, N. Woodall[2], J. Harper[3] and J. Benger[4], on behalf of the Fourth National Audit Project



	Total	Anaesthesia	Emergency Dpt	ICU
Critical Airway Events	184	133	15	36
		1:22000	1:1300	1:1600
Death/Brain Damage	46	19	5	22
		1:153000	1:4000	1:2600

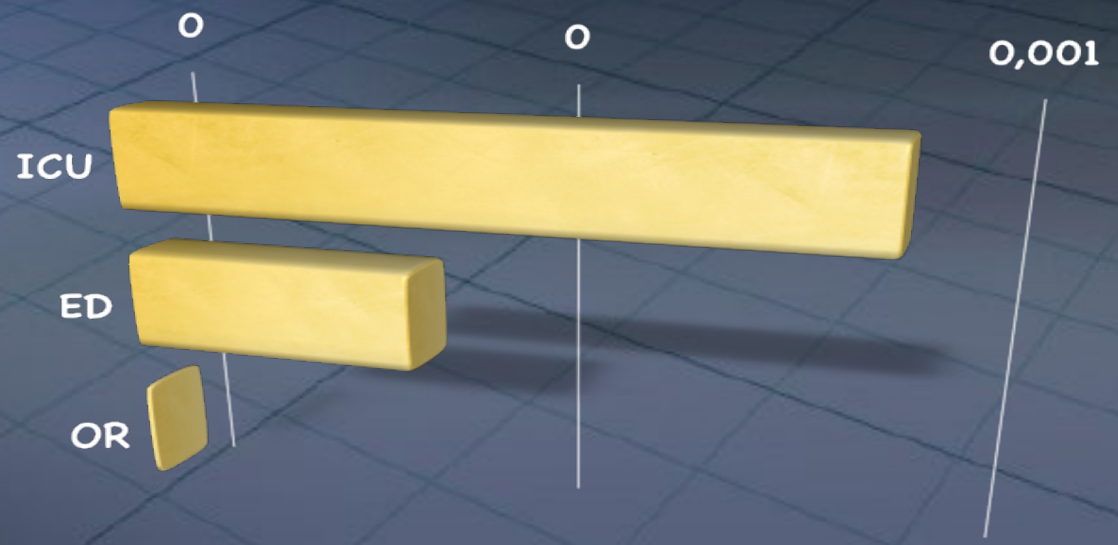
Mortality/Morbidity/Critical events



If corrected on same number of cases, highest mortality/morbidity was observed in ICU>ED>OR

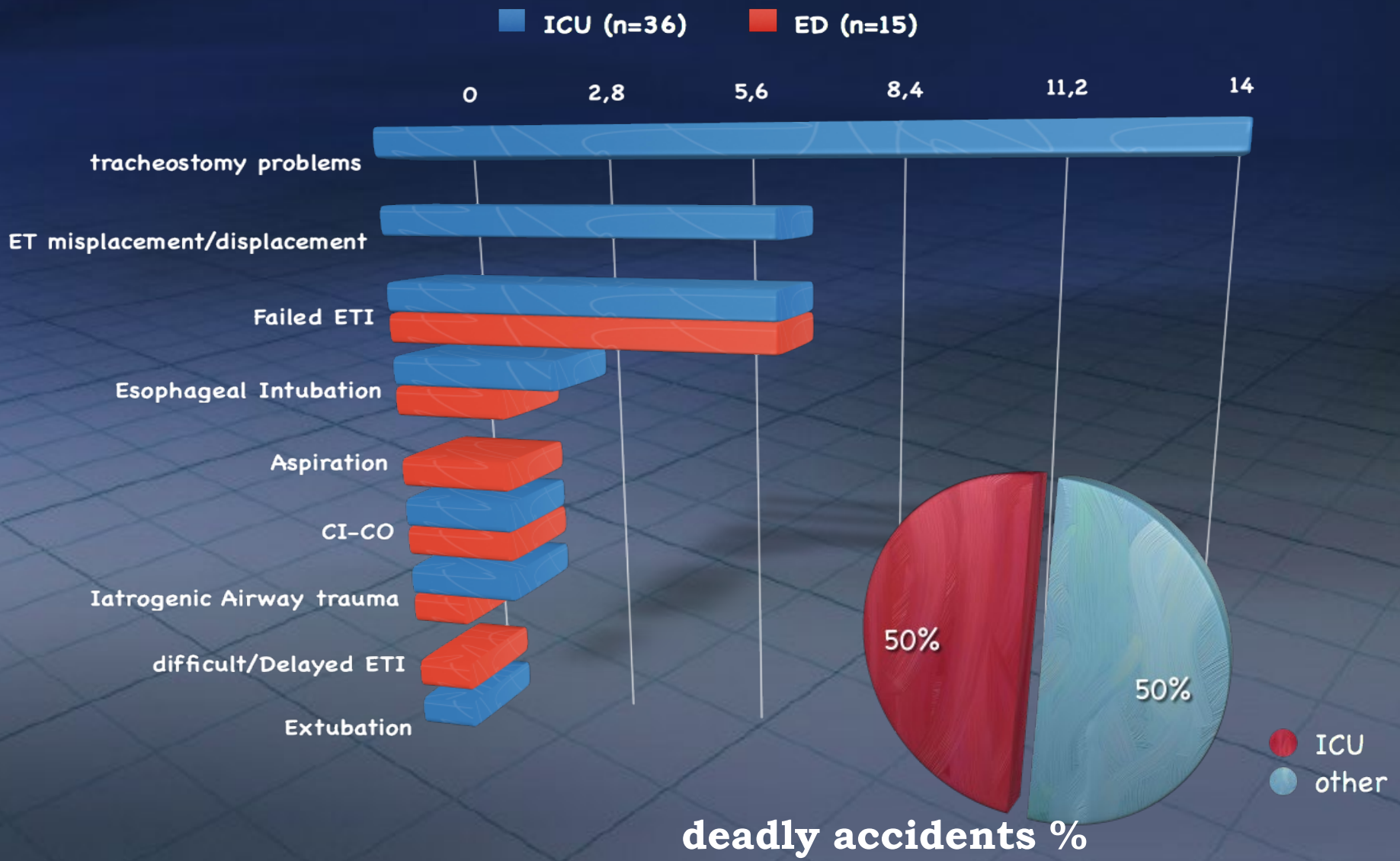
% no D/BD % D/BD

If corrected per number of cases, highest number of critical accidents was observed in ICU>ED>OR



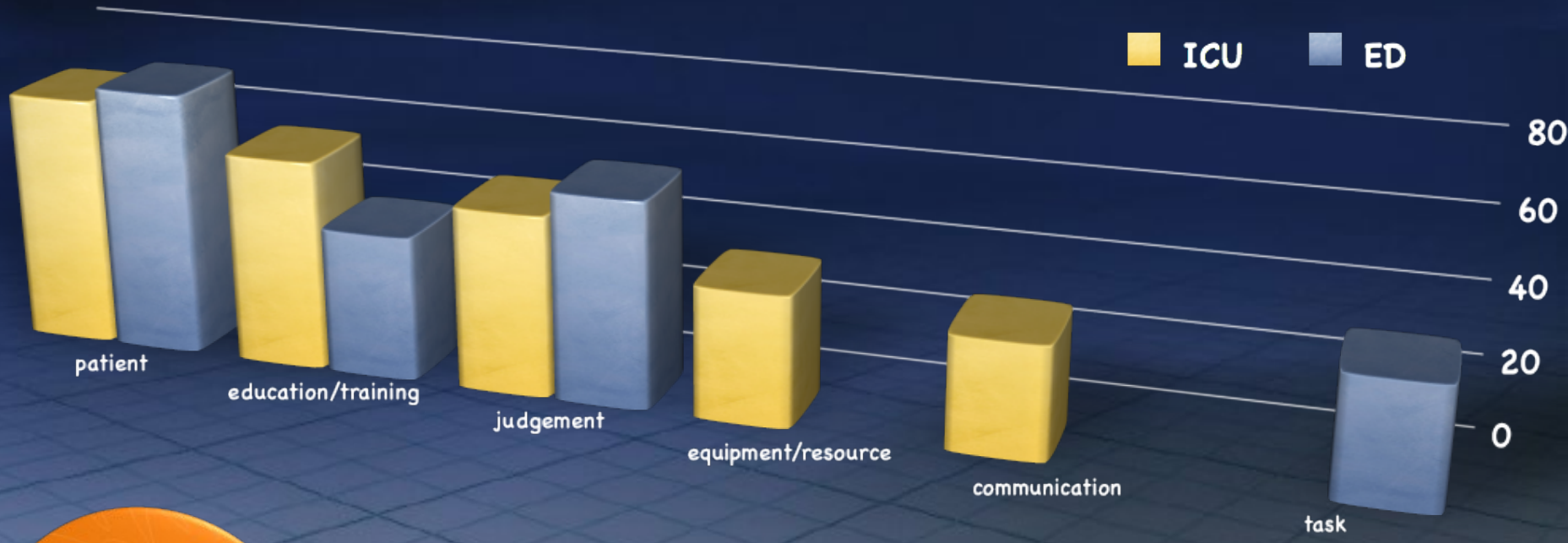
#events/#cases

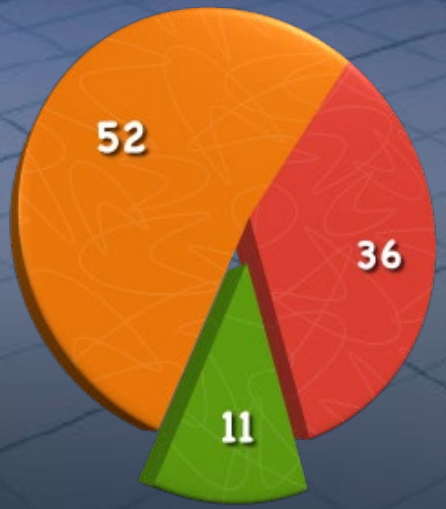
Events in ICU and ED



deadly accidents %

Factors contributing to cause events



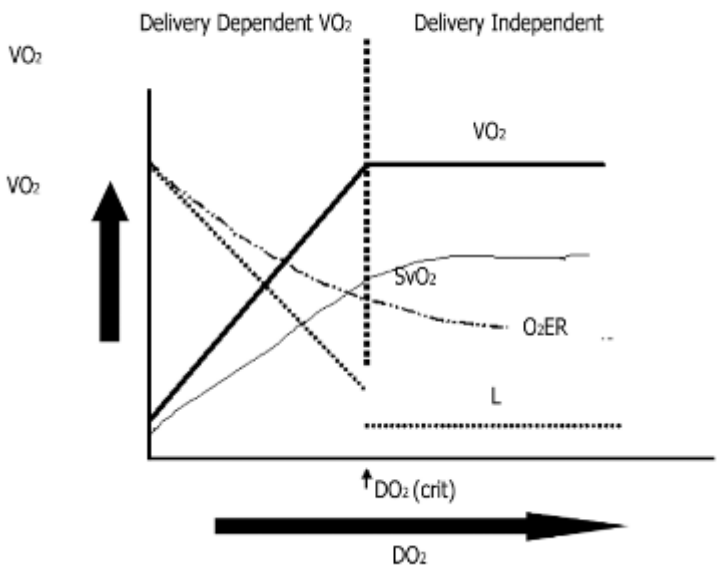


Quality of airway management conduct

good mixed poor

Critical Care Patients

- Impairment in the balance DO_2/VO_2
- Impairment in the balance VO_2/O_2 reserve
- Low tolerance to hypoxemia
- Underlying pathologies
- Complex medications
- Comorbidities



Airway Management in Critical Care Patients

Time-limited:

Tolerance of absolute or relative hypoxemia

Time of airway management (worsening hypoxemia)

Difficulty-limited:

Higher difficulties due to underlying pathologies

Patients anatomic and anthropometric characters

Difficult proper airway evaluation

Poor resources

Which are the strategies to treat or to prevent severe hypoxemia ?

- Preoxygenation
- Sustaining DO_2 determinants

- Identifying “at risk” patients
- Senior physician attending (competence in DAM)
- Available equipment and resources
- Control and monitoring

- Dedicated devices

- Plans and strategies

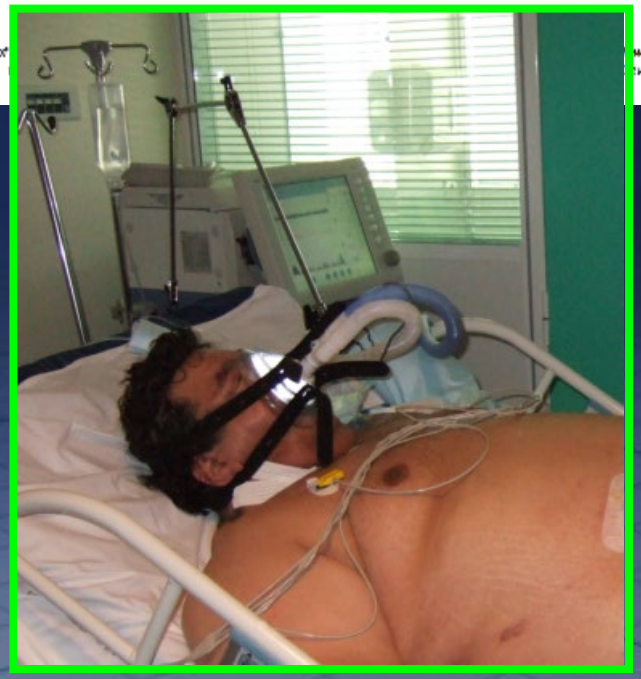
- Education - Training and simulation

Preoxygenation: critically ill

[Ann Emerg Med. 2012;59:165-175.


AIRWAY/REVIEW ARTICLE

Preoxygenation and Prevention of Desaturation During Emergency Airway Management



Causes of < DAWD

Hearth and lung atologies
Increased oxygen consumption
Reduced cardiac output
Reduced respiratory volumes
Ventilation/Perfusion mismatch
Airways obstruction
Respiratory depression
Anemia
Trauma
Pain
Hypermetabolism
Emergency

Tecniques of preoxygenation

Positioning (according to patient conditions)
High flows of O_2 (not rebreathing)
Application of CPAP / NIV (PS+PEEP)
Hemodynamic and volume support
Proper evaluation of difficulties (ventilation / intubation)
Monitoring

Preoxygenation: phisiology

Can J Anesth/J Can Anesth (2009) 56:449–466
DOI 10.1007/s12630-009-9084-z

CONTINUING PROFESSIONAL DEVELOPMENT

Optimizing preoxygenation in adults

Issam Tanoubi, MD · Pierre Drolet, MD · François Donati, MD, PhD

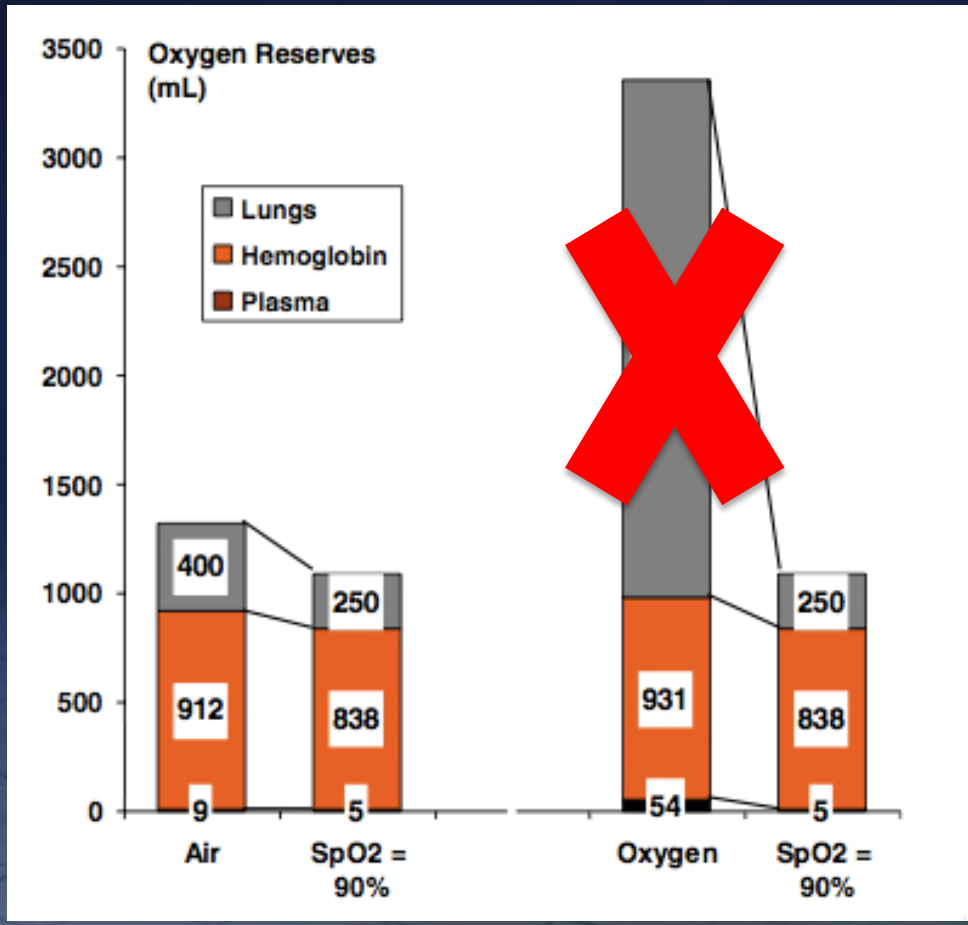
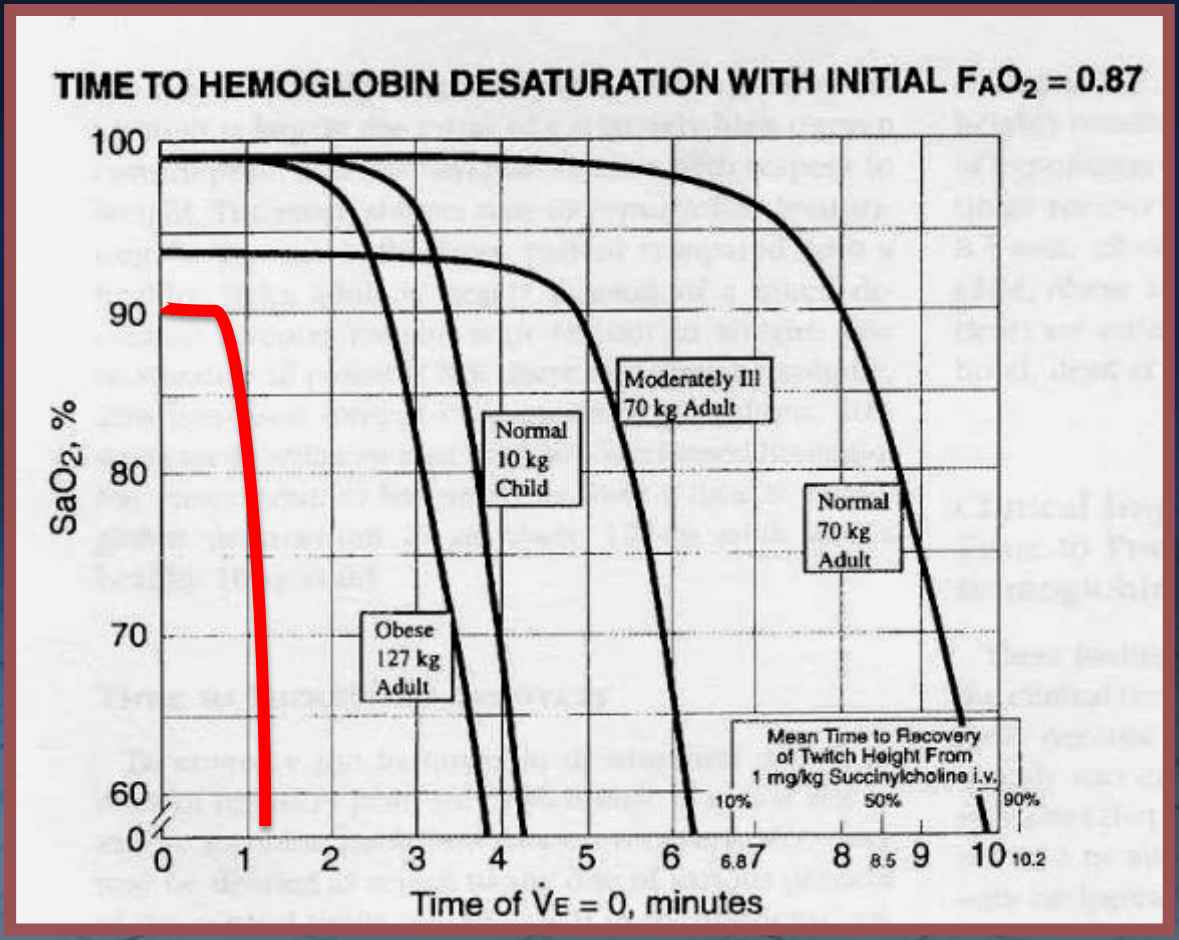


Table 1 Typical examples of duration of apnea without desaturation (DAWD) in different patients

	FRC (mL)	F_{EO_2} after preoxygenation	F_{EO_2} at $SpO_2 = 90\%$	O_2 consumption (mL · min^{-1})	DAWD (min)
No preoxygenation	2500	16	10	250	0.6
Normal preoxygenation	2500	90	10	250	8.0
Poor preoxygenation	2500	60	10	250	5.0
Obese	1250	90	10	350	2.9
Obese head-up	1500	90	10	350	3.4
Pregnant	1000	90	10	400	2.0
Elderly	2250	90	10	200	9.0

Examples only. Actual values may vary. The DAWD is calculated as FRC (F_{EO_2} − F_{EO_2} at $SpO_2 = 90\%$)/O_2 consumption

Desaturation during apnea



Anesthesiology
1997; 87:979-82

Critical Hemoglobin Desaturation Will Occur before Return to an Unparalyzed State following 1 mg/kg Intravenous Succinylcholine

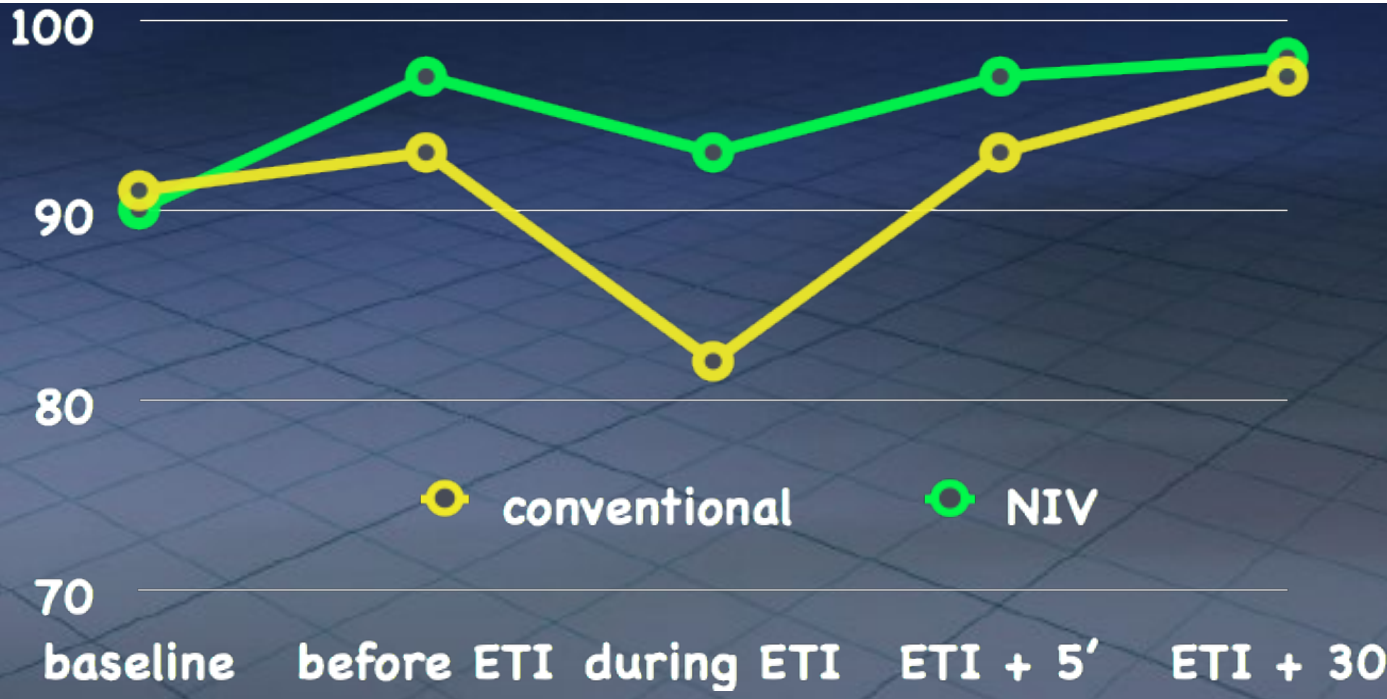
Jonathan L. Benumof, M.D., Rachel Dagg, M.S.,† Reuben Benumof, Ph.D.‡*

Preoxygenation

Am J Respir Crit Care Med Vol 174. pp 171–177, 2006

Noninvasive Ventilation Improves Preoxygenation before Intubation of Hypoxic Patients

Christophe Baillard, Jean-Philippe Fosse, Mustapha Sebbane, Gérald Chanques, François Vincent, Patricia Courouble, Yves Cohen, Jean-Jacques Eledjam, Frédéric Adnet, and Samir Jaber



Conclusion: For the intubation of hypoxemic patients, preoxygenation using NIV is more effective at reducing arterial oxyhemoglobin desaturation than the usual method.

Which are the strategies to treat or to prevent severe hypoxemia ?

Preoxygenation
Sustaining DO_2 determinants

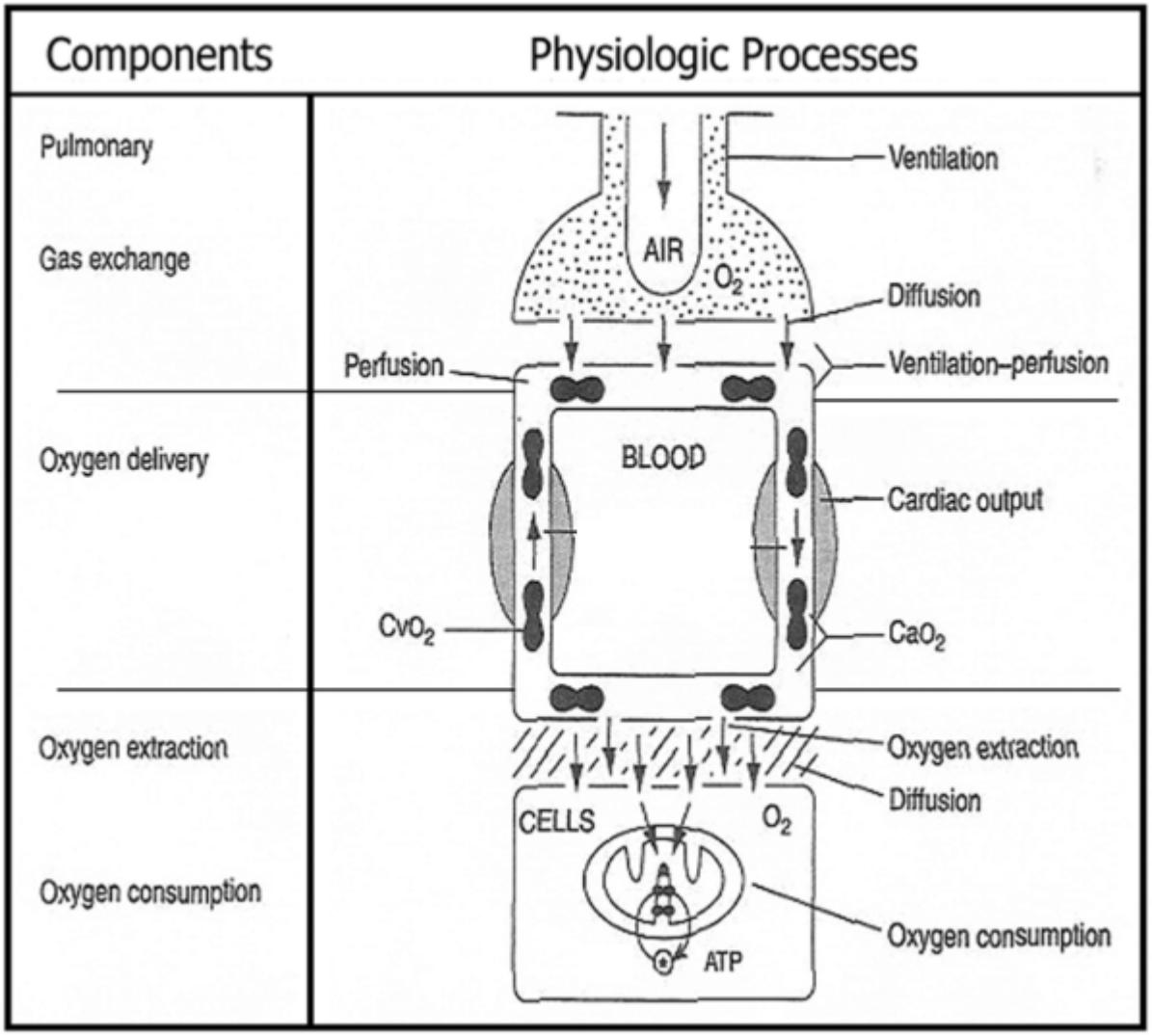
Identifying “at risk” patients
Senior physician attending
Available equipment
Control and monitoring

New and advanced devices

Plans and strategies

Education - Training and simulation

Oxygenation physiology



Intensive Care Med (2010) 36:248–255
DOI 10.1007/s00134-009-1717-8

ORIGINAL

Execution of 10 "bundles"

Samir Jaber
Boris Jung
Philippe Corne
Mustapha Sebbane
Laurent Muller
Gerald Chanques
Daniel Verzilli
Olivier Jonquet
Jean-Jacques Eledjam
Jean-Yves Lefrant

An intervention to decrease complications related to endotracheal intubation in the intensive care unit: a prospective, multiple-center study

Pre-procedure
1. Presence of two operators
3. Preparation of long-term sedation
2. Fluid loading
4. Preoxygenation with NIPPV

During procedure
5. Anesthetic drugs
   - Hypnotics
     - Etomidate
     - Ketamine
     - Others hypnotics
   - Muscle relaxants
     - Succinylcholine
     - Other muscle relaxant
6. Sellick maneuver

Post-procedure
7. Capnography use
8. Early vasopressives drugs
9. Initiation of long-term sedation
10. Initial "protective ventilation"

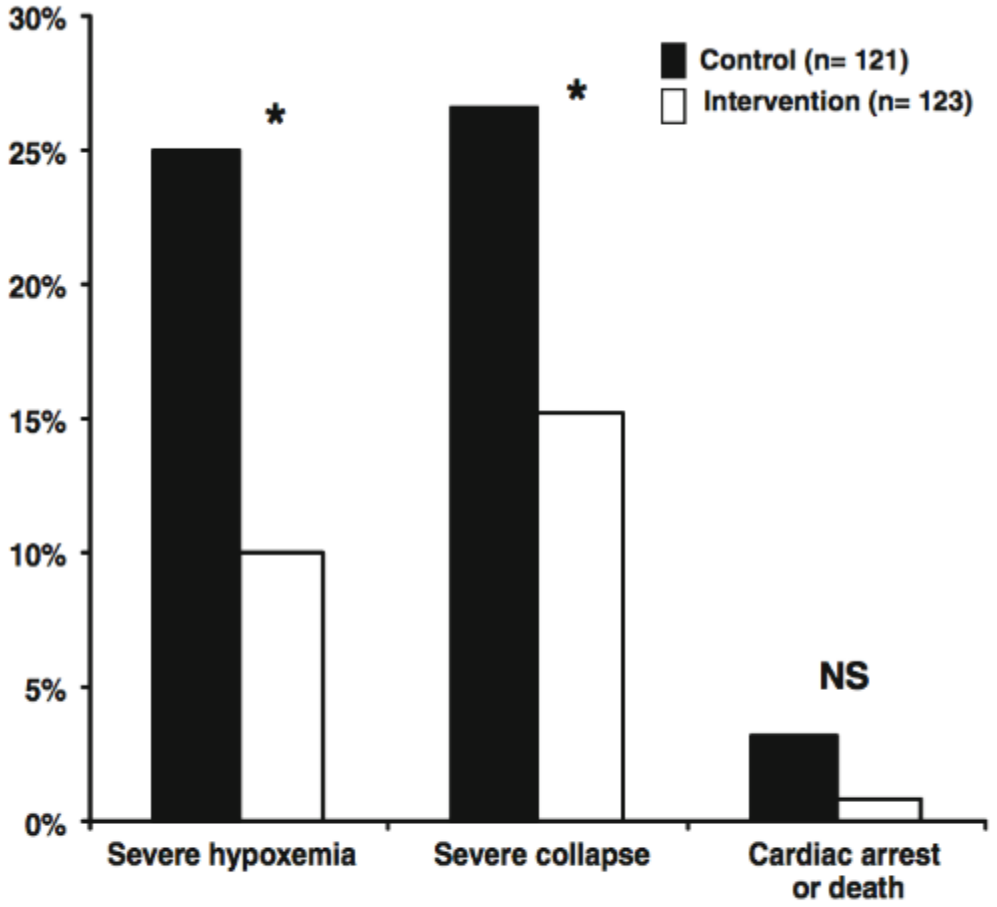


Fig. 1 Life-threatening complications occurring after all intubations performed during the control ($n = 121$) and the intervention ($n = 123$) phases. $*p < 0.05$ versus control phase. *NS* not significant

Intensive Care Med (2010) 36:248–255
DOI 10.1007/s00134-009-1717-8

ORIGINAL

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An intervention to decrease complications related to endotracheal intubation in the intensive care unit: a prospective, multiple-center study

Execution of 10 "bundles"

In conclusion, we showed that a ten-point care bundle management of intubation in the ICU, including fluid loading, preoxygenation with non invasive positive pressure ventilation, rapid sequence induction and capnography to check the endotracheal tube position, decreased the rate of severe hypoxemia and hemodynamic collapse occurring within the firsst hour following intubation. Future studies should, however, investigate whether a decrease in immediate life-threatening complications can lead to the improvement of outcomes upon ICU discharge.

Knowing and assessing the devices

J Anesth (2010) 24:811–814
DOI 10.1007/s00540-010-0996-0

SHORT COMMUNICATION

National survey to assess the content and availability of difficult-airway carts in critical-care units in the United States

Jahan Porhomayon · Ali A. El-Solh · Nader D. Nader

Creation of dedicated “difficult airway trolley” in ICU

Checklist of drug and equipment

Decision Support for the Capacity Management of Bronchoscopy Devices: Optimizing the Cost-Efficient Mix of Reusable and Single-Use Devices Through Mathematical Modeling

Günther M. Edenharter, MD,* Daniel Gartner, MS,† and Dominik Pförringer, MD‡

(Anesth Analg 2017;XXX:00–00)

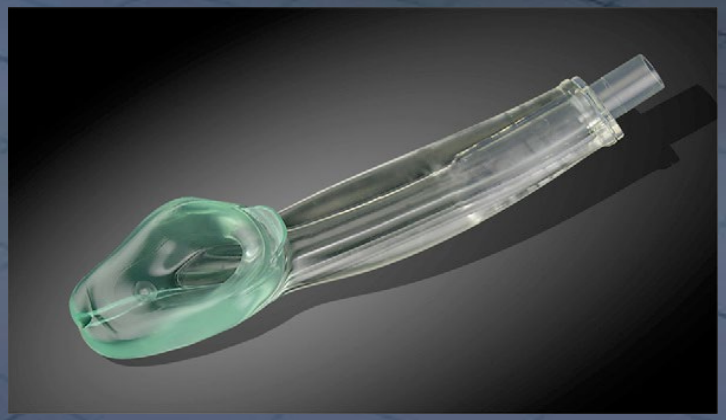
CONCLUSIONS

The underlying study compares costs and availability of 2 entirely different bronchoscopic device systems. Procurement and reprocessing costs as well as uncertain demand are taken into account. It is shown that the purchase of a mix of disposable and reusable devices can pose a cost-efficient and demand-satisfying solution. Future research will consider the operational decision level allowing for intraday demand variation.

Single use devices

Rescue devices

Rescue techniques



Anaesthesia 2014 doi:10.1111/anae.12878

Original Article

Defining and developing expertise in tracheal intubation using a GlideScope® for anaesthetists with expertise in Macintosh direct laryngoscopy: an in-vivo longitudinal study

P. Cortellazzi,[1] D. Caldiroli,[1,2] A. Byrne,[3] A. Sommariva,[1] E. F. Orena[4] and I. Tramacere[5]

1 Consultant Anaesthetist, 2 Director, 4 Consultant Psychologist, Department of
5 Consultant Statistician, Department of Neuroepidemiology, Fondazione Istitut
Milan, Italy
3 Professor, Institute of Medical Education, School of Medicine, Cardiff Universi

Achieving skill and expertise is necessary for the prudent and safe use of any device

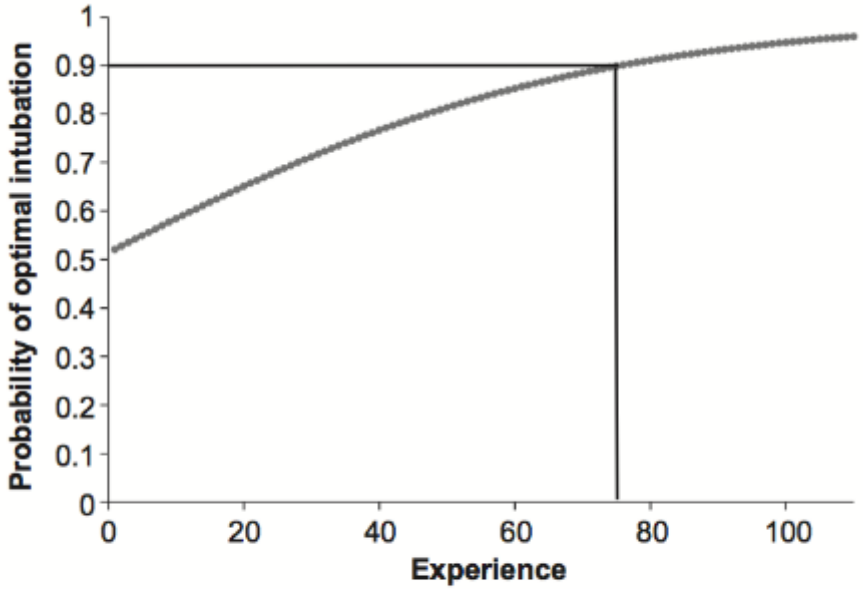


Figure 1 The probability of optimal intubation predicted by mixed-effects logistic regression model.

Monitoring - Capnography

Anaesthesia
Journal of the Association of Anaesthetists of Great Britain and Ireland

Anaesthesia, 2010, **65**, pages 462–467 doi:10.1111/j.1365-2044.2010.06308.x

ORIGINAL ARTICLE

The use of capnography and the availability of airway equipment on Intensive Care Units in the UK and the Republic of Ireland*

A. P. Georgiou,[1] S. Gouldson[2] and A. M. Amphlett[3]

1 Specialist Registrar, Department of Anaesthesia and Intensive Care Medicine, Royal United Hospital, Bath, UK 2 Specialist Trainee, Department of Anaesthesia and Intensive Care Medicine, Bristol Royal Infirmary, 3 Specialist Trainee, Frenchay Hospital, Bristol, UK

$ETCO_2$ for intubation

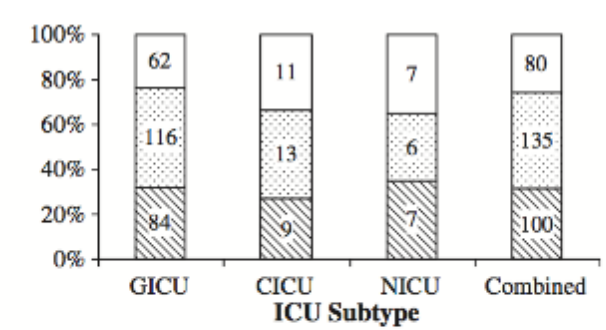


Figure 1 Percentage of ICUs in the UK and Republic of Ireland using capnography for intubation (□: never; ⊡: sometimes; ▨, always). Units are subdivided into: general, satellite and hepatobiliary (GICU); cardiac (CICU); and neuro (NICU). Figures within the columns indicate the actual number of units.

always
32% 25%

sometimes
43% 35%

never
25% 40%

$ETCO_2$ for ventilation

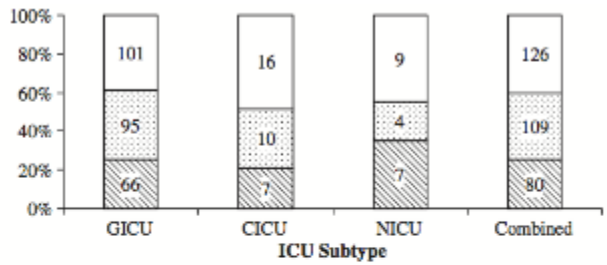
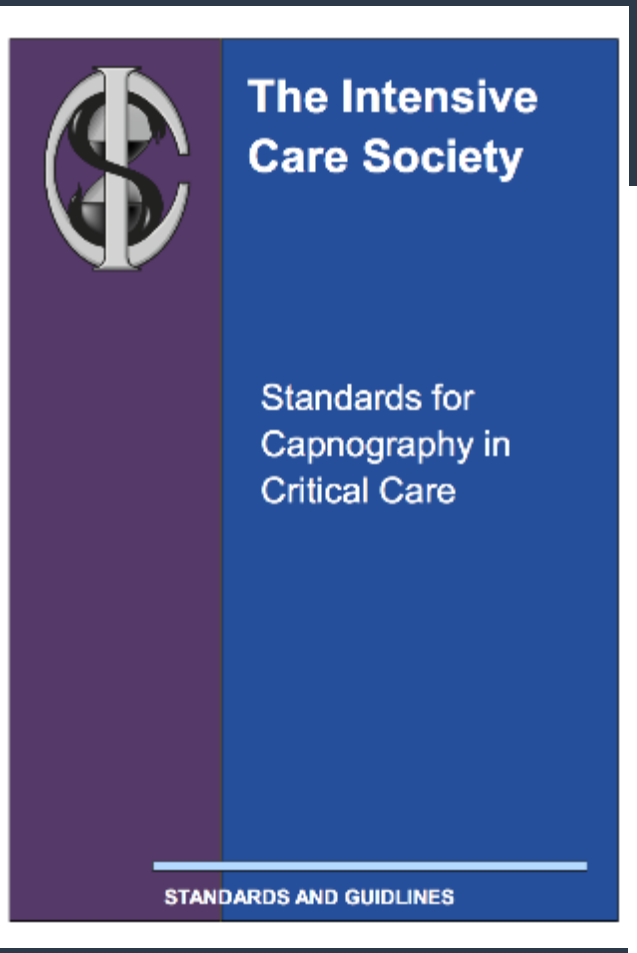


Figure 2 Percentage of ICUs in the UK and Republic of Ireland using capnography for continuous monitoring of ventilated patients from the time of intubation through to the time of extubation (□: never; ⊡: sometimes; ▨, always). Units are subdivided into: general, satellite and hepatobiliary (GICU); cardiac (CICU); and neuro (NICU). Figures within the columns indicate the actual number of units.

Capnography



Recommendations

1. Capnography should be used for all critically ill patients during the procedures of tracheostomy or endotracheal intubation when performed in the intensive care unit.

Grade of recommendation: **Strong**

Based on:

A moderate level of evidence.

Advantages and disadvantages: Capnography reduces the risk of death and major disability as a result of airway misadventure. Capnography clearly does not remove the risk and, if incorrectly used, may contribute to the risk. The risk is relatively small for each patient but the negative outcomes would be catastrophic for the patient and relatives. For staff, there are additional major advantages in reducing the potential for a major complication associated with an intervention rather than an underlying disease process.
Values and preferences: The lack of other major or minor side effects of the intervention makes it likely that patients would express a strong preference for the intervention.
Economic evaluation: There has been no economic evaluation of the introduction of capnography.

2. Capnography should be used in all critically ill patients during mechanical ventilation in the ICU.

Grade of recommendation: We are unable to make a recommendation.

Based on:

We have not made a recommendation due to the lack of direct evidence that continuous capnography reduced the chances of catastrophic harm occurring due to an airway misadventure during routine mechanical ventilation. This clearly indicates an area for further study.

3. Capnography should be used in all critically ill patients who require mechanical ventilation during inter-hospital or intra-hospital transfer.

Grade of recommendation: **Strong**

Based on:

The level of recommendation has been upgraded to strong based on the increased chances of airway misadventure during transfer and the difficulties associated with the diagnosis of tube misplacement in difficult clinical environments.

Plans and Strategies

Regional Level
Coordinamento delle Terapie Intensive Lombarde

Hospital Level
Unità di Crisi Ospedaliera

ICU Level
Responsabili Unità di Terapie Intensiva
Condivisione protocolli all'interno dell'U.O.
Condivisione/comunicazione con altre U.O.

Coordinamento delle Terapie Intensive Lombarde

Regione Lombardia

Coordinamento centralizzato di circa 60 ospedali regionali

Gestione di oltre 12000 pazienti durante le tre fasi

Sistema informatizzato visibile in tempo reale

Riunioni e aggiornamenti anche quotidiani

Condivisione di procedure e protocolli

Analisi comune di problemi clinici ed organizzativi

Comunicazione diretta con la dirigenza regionale

Clima di aperta comunicazione

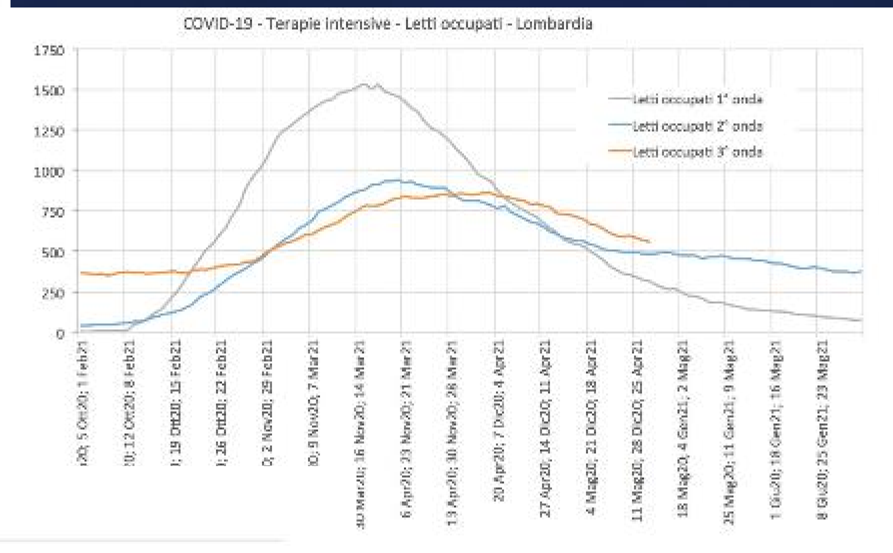
Coordinamento delle Terapie Intensive Lombarde

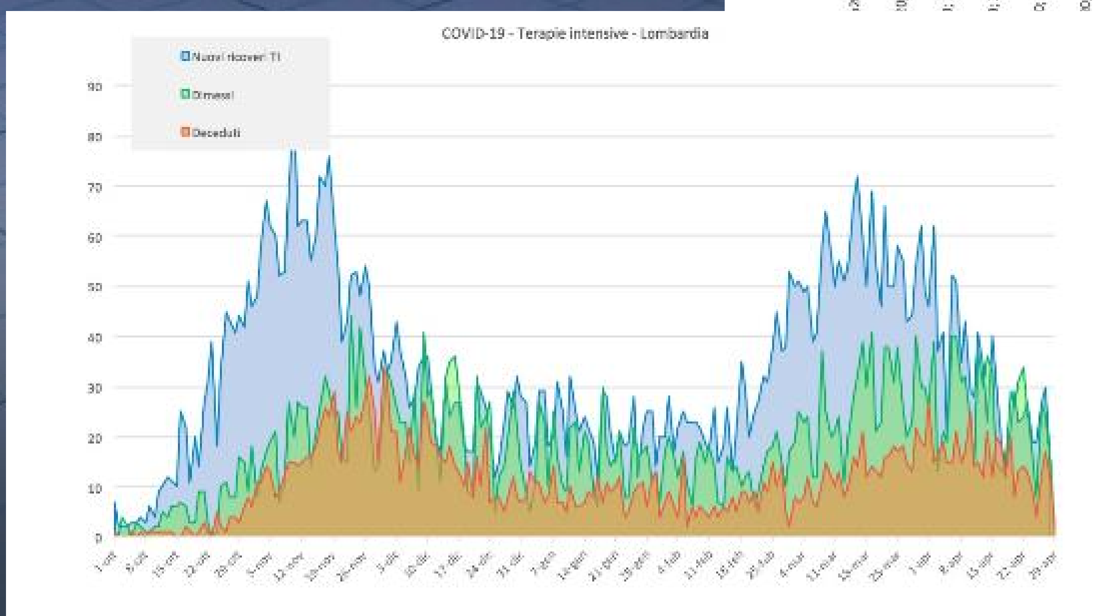
Regione Lombardia

Nome Reparto	Letti totali
Bergamo	32
BS Civili	3
BS Poliambulanza	15
BS Sant'Anna	4
Busto Arsizio	14
Buzzi	3
Cantù	6
Castellanza Humanitas	3
Cernusco sul Naviglio	3
Chiari	7
Cinisello	12
Città Studi	4
Civili BS 1	14
Civili BS 3	8
Codogno	2
Como	15
Como Valduce	6
Crema	8
Cremona	14
Desenzano	3
Desio	7
Erba	7
Esine	4
Fatebenefratelli	1
TOT	689

Nome Reparto	Letti totali
Fiera MI N	11
Fiera MI O	11
Fiera MI P	8
Fiera MI Q	8
Fiera MI R	8
Fiera MI S	8
Fiera MI T	15
Galeazzi	2
Gavardo	4
Gravedona	6
Humanitas Gavazzeni	9
Humanitas Rozzano	20
Lecco PTS	10
Legnano	8
Lodi	9
Manerbio	6
Mantova	12
Melegnano	10
Melzo	5
Merate	6
Mondino	3
Multimedica Sesto San Giovanni	6
Niguarda - TI Bozza	10
Niguarda - TI Rossini	13
Oglio Po	5
Olona	5
Paderno Dugnano	7
Pieve	7

Nome Reparto	Letti totali
Policlinico di Milano	14
Policlinico di Monza	10
Ponte San Pietro	5
Rho	5
Sacco	20
San Carlo - TI UTIC	5
San Donato Covid 1	9
San Donato Covid Cardio	5
San Gerardo	8
San Gerardo CCH	11
San Matteo Pavia DEA	[illegible]
San Matteo Pavia 1 e 2	5
San Matteo Pavia RL	[illegible]
San Paolo	2
San Paolo - TI 100	8
San Raffaele CCH	3
San Raffaele Palazzo	[illegible]
Seriate	5
Sondalo	[illegible]
Treviglio	[illegible]
Varese CCH	[illegible]
Varese Generale	9
Varese NCH Covid	9
Varese NCH Covid Overt	5
Vigevano	5
Vigevano DIM	4
Vimercate	8
Voghera	[illegible]
Zingonia	4





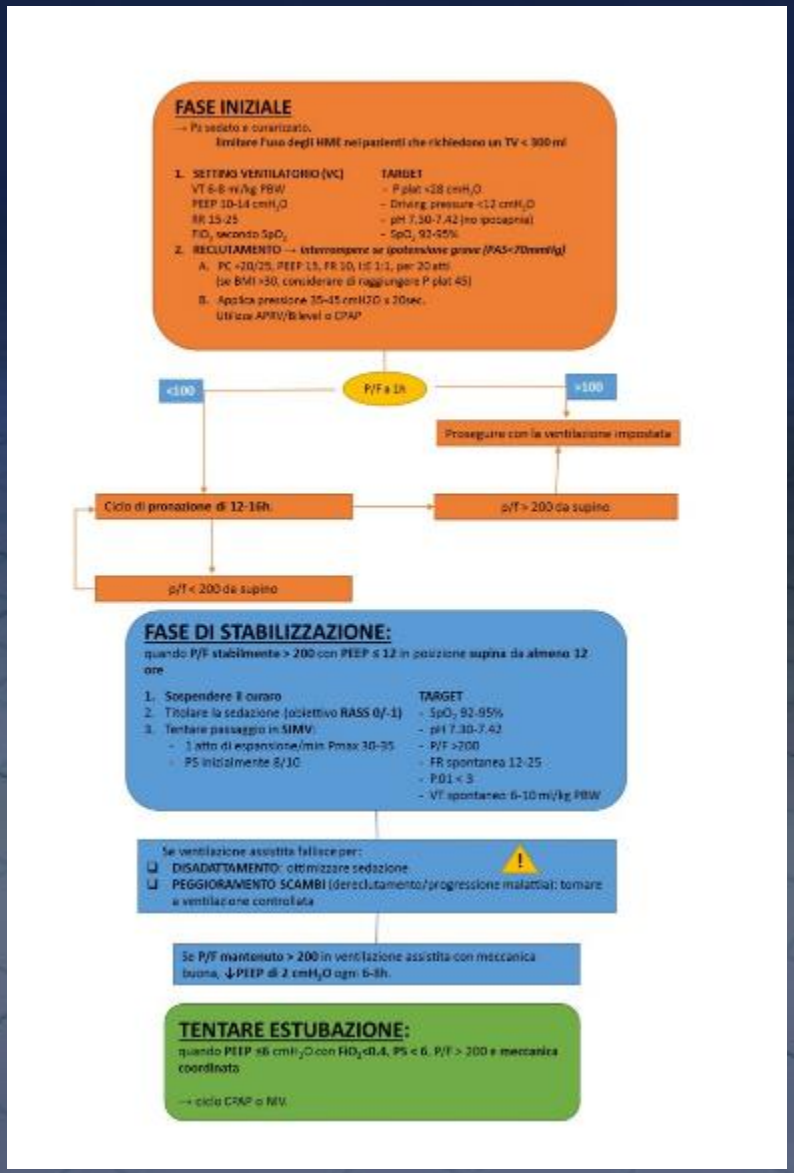
Coordinamento delle Terapie Intensive Lombarde

Regione Lombardia

COORDINAMENTO DELLE TERAPIE INTENSIVE LOMBARDE

Suggerimenti e Raccomandazioni per la gestione dei pazienti Critici Covid 19

06/04/2020



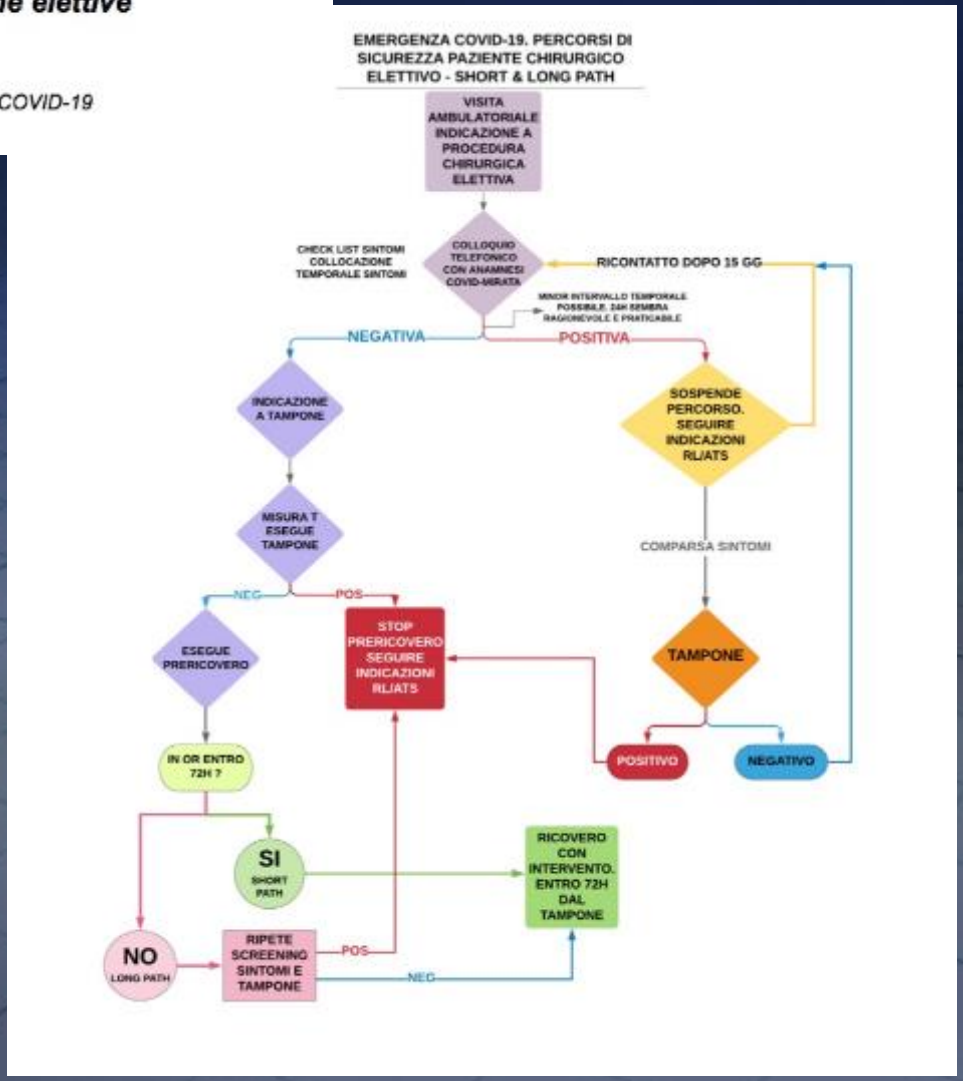
Strategie Ventilatorie

Coordinamento delle Terapie Intensive Lombarde

Regione Lombardia

EMERGENZA COVID-19. Proposta per il percorso dei pazienti candidati a chirurgia e procedure interventistiche elettive

Gruppo di Lavoro Anestesia e Medicina Perioperatoria
Centro Coordinamento Terapie Intensive Lombarde - Emergenza COVID-19



Ripresa Attività Chirurgica

Unità di Terapia Intensiva

Organizzazione di 2 - 3 Unità di Terapia Intensiva a differente intensità di cura

Gestione di circa 120 pazienti critici Covid

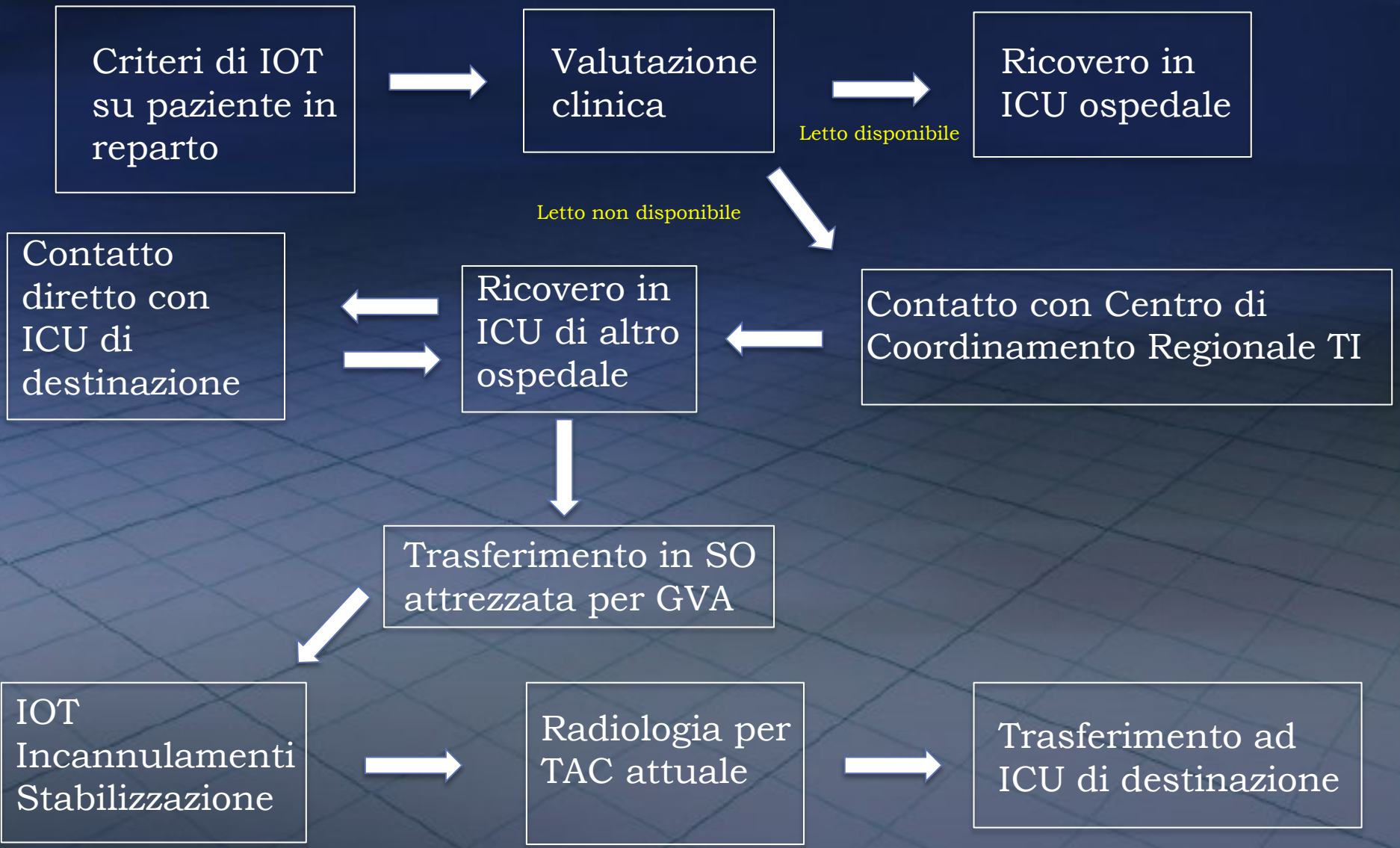
Trasferimento in altri ospedali di almeno 150 pazienti critici

Creazione di percorsi per il trattamento, la stabilizzazione ed il trasferimento intra ed extraospedaliero dei pazienti critici

Condivisione di procedure e protocolli con le unità mediche

Analisi in tempo reale delle condizioni dei pazienti border line

Unità di Terapia Intensiva



Anaesthesia
Journal of the Association of Anaesthetists of Great Britain and Ireland
Anaesthesia, 2011, **66** (Suppl. 2), pages 81–92

Airway challenges in critical care

J. P. Nolan and F. E. Kelly

Consultants in Anaesthesia and Intensive Care Medicine, Royal United Hospital, Bath, UK

Solutions

Recognition of DAM patients
Planning of DAM
DA Trolley
Capnography
Training and simulation

Airway management in the intensive care unit is more problematic than during anaesthesia. In general, critically ill patients have less physiological reserve and complications are more common, both during the initial airway intervention (which includes risks associated with induction of anaesthesia), and later once the airway has been secured. Despite these known risks, those managing the airway of a critically ill patient, particularly out of hours, may be relatively inexperienced. Solutions to these challenging airway problems include: recognition of those patients with a potential airway problem; implementation of a plan to deal with their airway; immediate availability of a difficult airway trolley; use of capnography for every airway intervention and continuously in all ventilator-dependent patients; and appropriate training of all intensive care unit staff including use of simulation.

Induction checklist

Example of an intubation checklist. Items in black are mandatory; those in blue are suggestions.

EMERGENCY INDUCTION CHECKLIST

Prepare Patient

- ❑ Is preoxygenation optimal?
  - ❑ETO_2 > 90%
  - ❑Consider CPAP
- ❑ Is the patient's position optimal?
  - ❑Consider sitting up
- ❑ Can the patient's condition be optimised any further before intubation?
- ❑ How will anaesthesia be maintained after induction?

Prepare Equipment

- ❑ What monitoring is applied?
  - ❑Capnography
  - ❑SPO_2 probe
  - ❑ECG
  - ❑Blood pressure
- ❑ What equipment is checked and available?
  - ❑ Self-inflating bag
  - ❑ Working suction
  - ❑ Two tracheal tubes
  - ❑ Two laryngoscopes
  - ❑ Bougie
  - ❑ Supraglottic airway device
- ❑ Do you have all the drugs required?
  - ❑Consider ketamine
  - ❑Relaxant
  - ❑Vasopressor

Prepare Team

- ❑ Allocate roles;
  - ❑Team leader
  - ❑First Intubator
  - ❑Second Intubator
  - ❑Cricoid Pressure
  - ❑Intubator's Assistant
  - ❑Drugs
  - ❑MILS (if indicated)
  - ❑Rescue airway
- ❑ How do we contact further help if required?

Protections
DPI

Prepare for difficulty

- ❑ If the airway is difficult, could we wake the patient up?
- ❑ What is the plan for a difficult intubation?
  - ❑Plan A: RSI
  - ❑Plan B: e.g. BMV
  - ❑Plan C: e.g. ProSeal LMA
  - ❑Plan D: e.g. Front of neck
- ❑ Where is the relevant equipment, including alternative airway?
  - ❑ DO NOT START UNTIL AVAILABLE
- ❑ Are any specific complications anticipated?

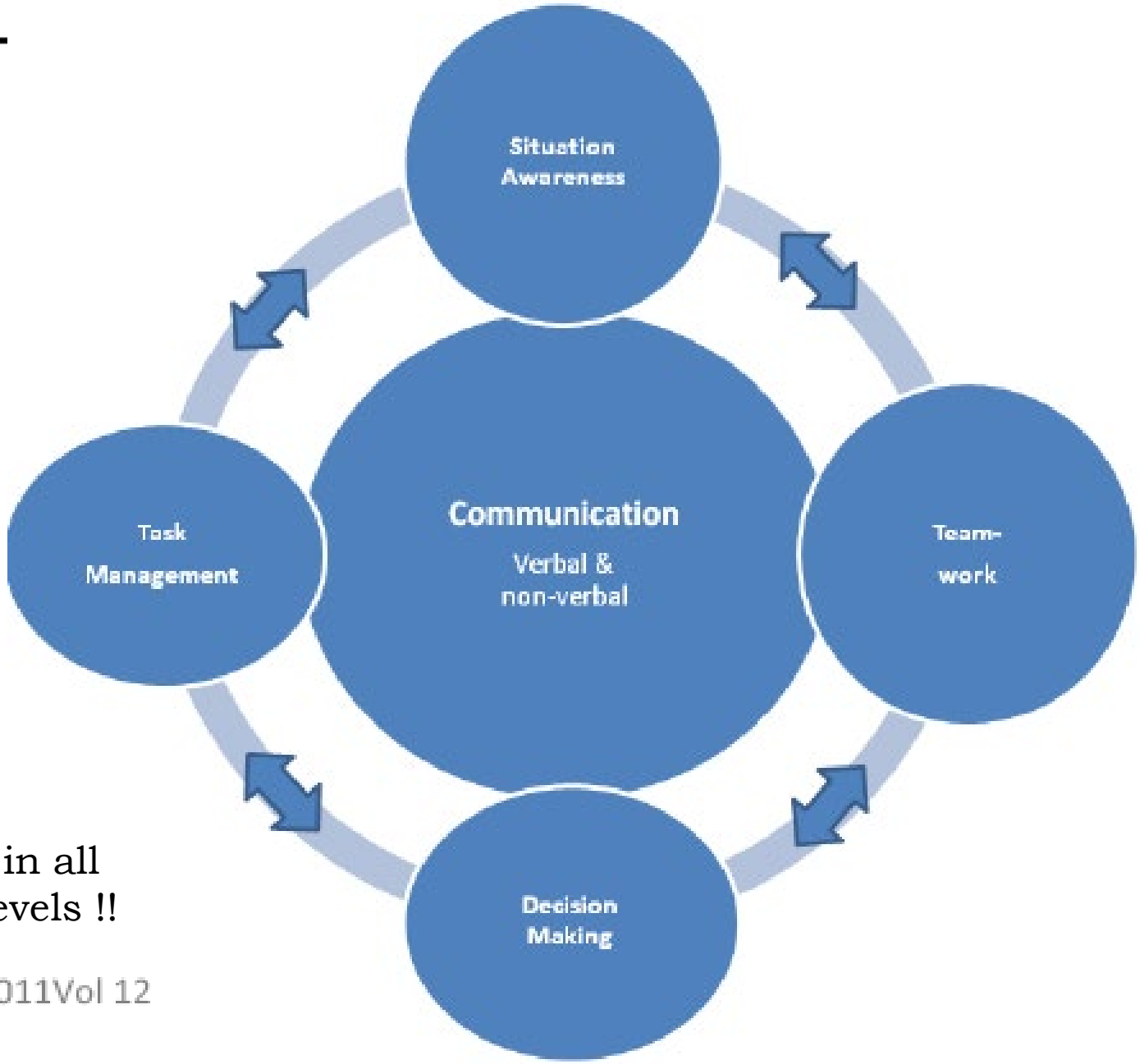
This Checklist is not intended to be a comprehensive guide to preparation for induction

RTIC Severn

Safety Culture and Crisis Resource Management in Airway Management -

Marcus Rall (1)

Peter Dieckmann (2)



Very high value in all organizational levels !!

AJA- Online.com : 2011Vol 12

Which are the strategies to treat or to prevent severe hypoxemia ?

Preoxygenation
Sustaining DO_2 determinants

Identifying “at risk” patients
Senior physician attending
Available equipment
Control and monitoring

New and advanced devices

Plans and strategies

Education - Training and simulation

Education / Simulation

Devices

British Journal of Anaesthesia 108 (1): 140–5 (2012)
Advance Access publication 27 October 2011 · doi:10.1093/bja/aer327

BJA

RESPIRATION AND THE AIRWAY

Simulating face-to-face tracheal intubation of a trapped patient: a randomized comparison of the LMA Fastrach™, the GlideScope™, and the Airtraq™ laryngoscope

R. Amathieu[1,2], J. Sudrial[1,2], W. Abdi[1,2], D. Luis[1,2], H. Hahouache[1,2], X. Combes[3,4] and G. Dhonneur[1,2*]

ORIGINAL INVESTIGATIONS IN EDUCATION
Anesthesiology 2010; 113:214–23

Effect of Just-in-time Simulation Training on Tracheal Intubation Procedure Safety in the Pediatric Intensive Care Unit

Akira Nishisaki, M.D.,* Aaron J. Donoghue, M.D., M.S.C.E.,† Shawn Colborn, R.R.T.,† Christine Watson, R.N.,§ Andrew Meyer, M.D.,‖ Calvin A. Brown III, M.D.,# Mark A. Helfaer, M.D.,** Ron M. Walls, M.D.,†† Vinay M. Nadkarni, M.D.‡‡

Procedures

TS / NTS Correlation ?

British Journal of Anaesthesia 109 (5): 723–8 (2012)
Advance Access publication 31 July 2012 · doi:10.1093/bja/aes256

BJA

Do technical skills correlate with non-technical skills in crisis resource management: a simulation study

N. Riem[1*], S. Boet[2,4], M. D. Bould[3,4], W. Tavares[5] and V. N. Naik[2,4]

[1] Department of Anaesthesiology, Kantonsspital Liestal, University of Basel, Rheinstrasse 26, 4410 Liestal, Switzerland
[2] Department of Anesthesiology, The Ottawa Hospital and [3] Department of Anesthesiology, Children's Hospital of Eastern Ontario, University of Ottawa, Ontario, Canada
[4] The Academy for Innovation in Medical Education, University of Ottawa, 501 Smyth Road, Ottawa, Ontario, Canada
[5] Wilson Centre for Education Research and Centennial College Health Studies Department, University of Toronto, Toronto, Ontario, Canada

* Corresponding author. E-mail: nriem@aol.com

Conclusions

- Airway management is critical in hypoxic patients
- Structured airway intervention
- Severe hypoxemia should be prevented and avoided
- Strategy according to bundles of care
- Technical and non-technical skills are necessary
- Knowledge and skill in devices use and indications
- Protocols and procedures to guarantee safety
- Training and simulation

"The lighted candle respires and we call it flame.
The body respires and we call it life"

J.W. Severinghaus, 1969

Thank you