Prevenirea pneumoniei asociate ventilaţiei artificiale (VAP)- situaţia de azi cu gândul la ziua de mâine.....

Prof. Dr. Gabriel M. Gurman
Universitatea Ben Gurion , Beer Şeva
Directorul Clinicii ATI Spitalul Mayanei Hayeshuah, Bnai Brak, Israel

Tg Mures September 2012

The 100,000 Lives Campaign of the Institute of Health-Care Improvement is promoting six evidence-based safety interventions

***deployment of rapid-response team**

***acute MI**

***medication reconciliation**

***prevention of central line infection**

***surgical-site infection**

***VENTILATOR ASSOCIATED PNEUMONIA**

Collard HR et al.
Ann Int Med 2003;138:494

MEDLINE

1980-2012

3191 articles on VAP

VAP definition

***fever**

***leukocytosis**

***purulent secretions**

***inflitrate on chest x-ray**

O primă întrebare:

- Care din frazele de mai jos sunt adevărate?
- Procentul de VAP e în jur de 10% din pacienţii intubaţi şi ventilaţi
- Mortalitatea pacienţilor cu VAP e mai ridicată decât a celor fără VAP
- În schimb costul îngrijirii medicale a pacienţilor cu VAP e la fel ca a celor fără VAP

Epidemiology

- **9-40% of all intubated patients**
- **15-45% mortality (twice more than in non-VAP ventilated patients)**
- **Cumulative risk of VAP : 1% for each day of mechanical ventilation *(Patel, Semin Resp Crit Care Med 2002;23:415)***
- **Increase in length of stay and cost**

<u>Length of stay in ICU</u>

+4.3 days (*Heyland, Am J Resp Crit Care Med 1999;159:1249*)

+ 7.2 days (*Hugonnet, Infect Control Hosp Epidemiol 2004;25:1090*)

Cost : + $ 24,727 vs 17, 438 *(Hugonnet)*

Germs…….

Early onset	Late onset
< 4 days	➢4 days
Community acquired bacteria	➢Antibiotic-resistant nosocomial organisms (Gram negative, aerobes)

Some authors use the 2-day cut off point for separating early from late onset :

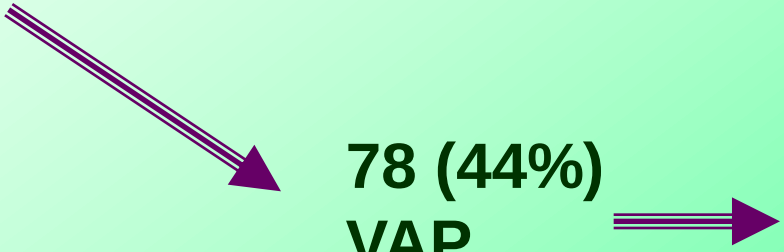
***Smulders K, Chest 2002;121:858**

***Chastre J, Resp Care 2005;50:975**

The full story……

(Stephan F et al. Anesthesiology 1996;104:235)

175 intubated and ventilated patients



78 (44%) VAP

18 (23%) ALI/ARDS

***acute onset**

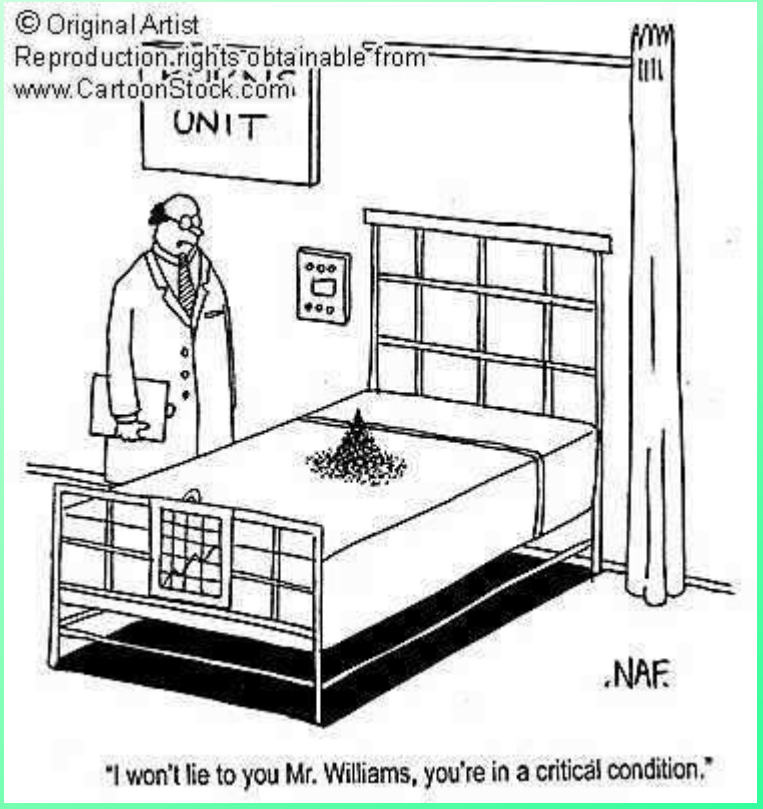
***bilateral inflitrates on chest x-ray**

PaO2/FiO2

***<300 for ALI**

***<200 for ARDS**

A historical glance on risk factors of VAP



Factors of risk
(Kollef MH. JAMA 1993;270:1965)

- **Multiple organ failure**
- **Age > 60**
- **Prior administration of antibiotics**
- **Supine head position during the first 24 hrs of mechanical ventilation**

Thirteen years later…….
(Koleff MH, NEJM 2006;355:2691)

- **Recent hospitalization**
- **Admission from a chronic care environment**
- **Current hemodialysis**
- **Immunocompromised state**
- **Late-onset infection**
- **Prior use of antimicrobial agents during current period of hospitalization**

Why does it happen ?!

from: www.j.wolfe.clara.net/Humour

This is a normal defense mechanism

Normal individual aspirates during sleep

The aspirate : supravocal cords bacteria

but

No germs in the lower respiratory tract and pulmonary parenchima, because of :

***cough reflex**

***mucus**

***mucociliary clearance, AND….**

<u>Blood defense :</u>

-leukocytes

-immunoglobulins

-complement

BUT,

In the intubated patient (+/- mechanically ventilated) a number of factors compromise the normal host defense mechanisms

Here are some of them

Critical illness, comorbidities, malnutrion	***Streter et al. Curr Opin Infect Dis 2003;16:193***
Inhibition of cough reflex	***Gal TJ. Probl Anesth 1988;2:191***
Impairment of mucociliary clearance mechanism	***Kleiner As et al. Am J Med 1975;58:674***
Injury of the tracheal epitelial cells	***Cooper JD, Grillo HC. Surg Gynec Obst J 1969;129:1235***
Decrease of bacterial adherence to tracheal epitelial cells	***Franklin AL, Todd TR, Gurman, G. Infect Immunity 1987;55:1523***

One more word about bacterial adherence

In normal conditions :

Germs adhere to cilia of tracheal epitelial cells and are evacuated by mucus and cough

But, in the intubated patient

No adherence to cilia

No cough reflex

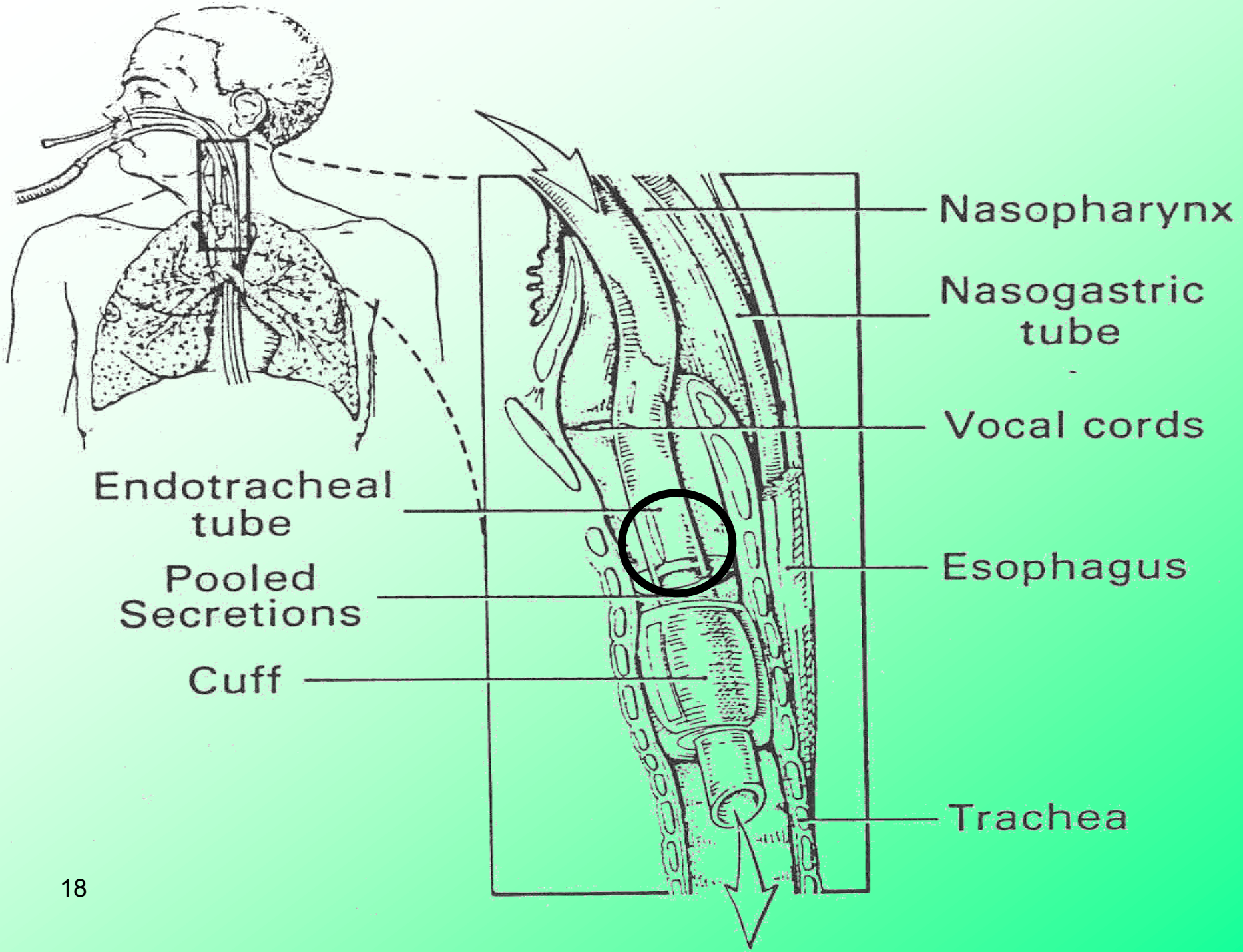
A biofilm is created around the tracheal tube, with a high resistance to antibiotics

Germs adhere to the injured tracheal epitelium and stay there

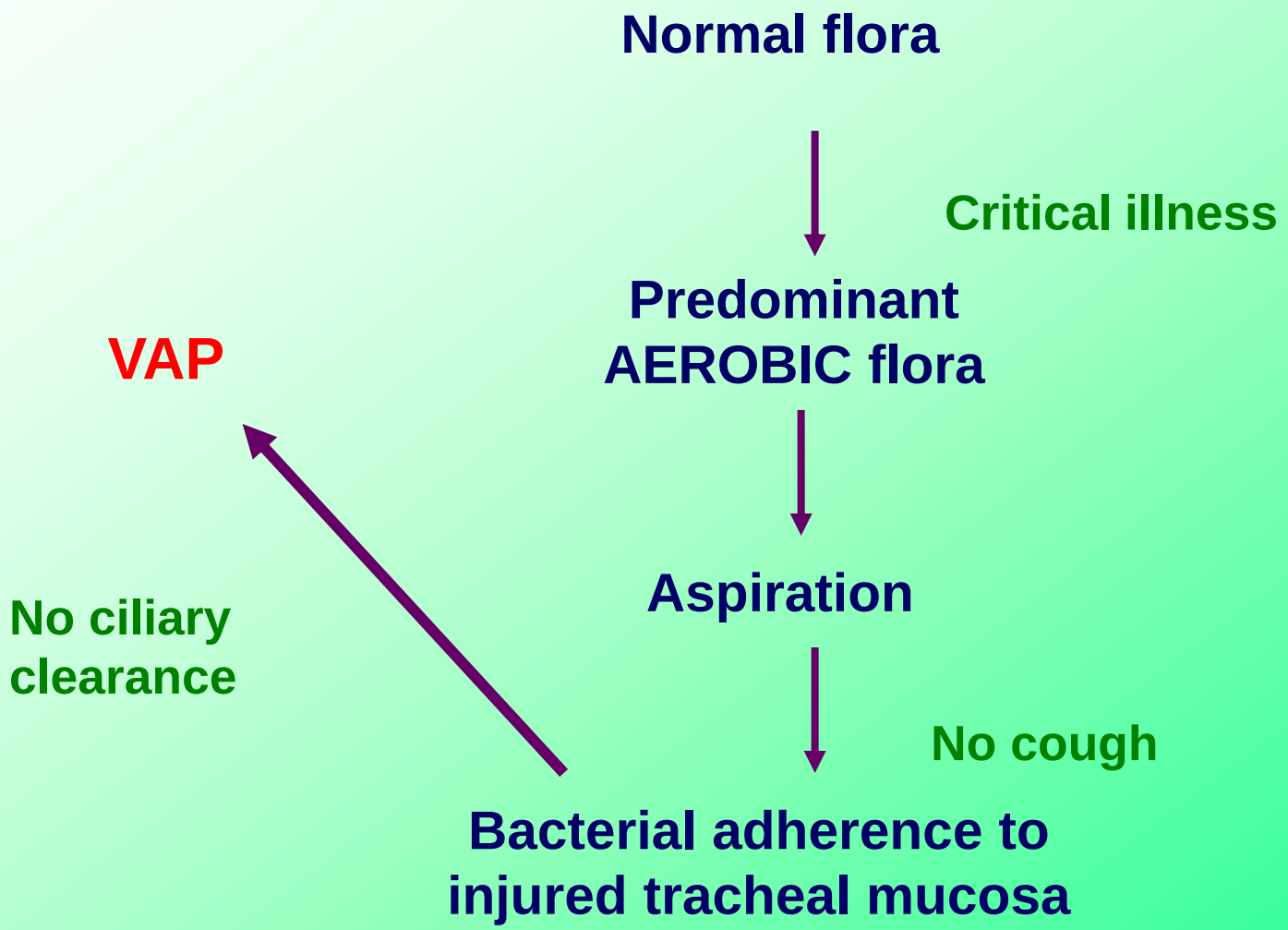
This is a site of persistent colonization !!!

This is why some authors proposed to change the name of the entity:

Endotracheal-intubation-related-pneumonia !!!


Nasopharynx
Nasogastric tube
Vocal cords
Endotracheal tube
Esophagus
Pooled Secretions
Cuff
Trachea

This is the sequence of oropharyngeal colonization and VAP



de la Torre FJ et al

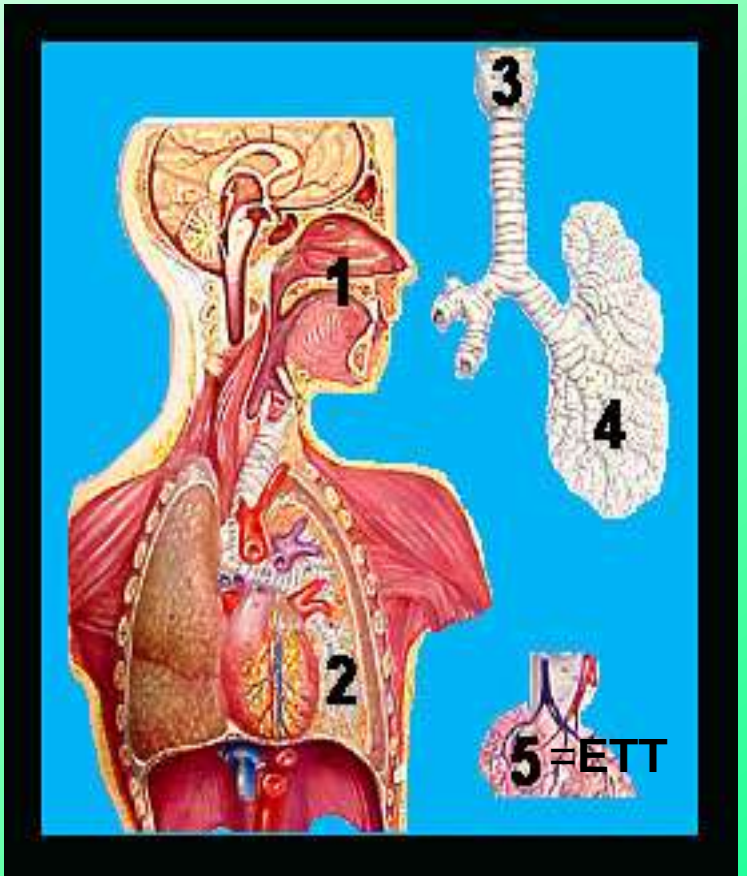
Am J Resp Crit Care Med 1995;152:1028

46% of the microorganisms isolated from the intubated trachea have been previously isolated from the pharynx !

Feldman C et al. Eur Resp J 1999;13:546

- **Cultures from oropharyngeal, gastric, respiratory tract AND tracheal tube (ETT) , twice daily for five days**

Sequence of colonization



1=oro- 36 hrs

2=stomach-36-60 hrs

3=trachea- 48-60 hrs

4=lower resp tract-60-84 hrs

5=ETT-60-96 hrs

Prevention of VAP

DE Craven 1996
R.Thompson 1994
DH Livingston 2000

The most effective way to prevent VAP is to avoid aspiration of contaminated oropharyngeal or gastric secretions

Collard HR et al Ann Int Med2003;138:494
Safdar N Resp Care 2005;50:725

Nine practical fields of VAP prevention

- Patient position
- Preservation of gastric pH
- Aspiration of subglottic secretions
- Oscillating beds
- Selective digestive decontamination
- Ventilator circuit management strategies
- Special methods of enteral feeding
- Noninvasive ventilation
- Aerosolized antimicrobials

Position	Semi recumbent
Sucralfate	May be when there is no danger for GI bleeding
Aspiration of secretion	When mechanical ventilation > 3 days
Oscillating bed	Consider in surgical and neurological patients
Decontamination	No place, except tracheostomy
Circuits change	Less frequent changes
Special methods of enteral feeding	No place
Noninvasive ventilation	Yes, when possible
Aerosolized antibiotics	No place

Other recommendations

Use orotracheal and orogastric tubes to reduce % of sinusitis (although no connection was established between VAP and sinusitis)

Rouby JJ et al. AM J Resp Crit Care Med 1994;150:776

Limit the use of sedation and paralytic drugs (depress the cough mechanism)

Limit the ETT cuff pressure (reduces degree of tracheal mucosal erosion)

Cook D et al. JAMA 1998:279:781

Combes X et al. Anesthesiology 2001;95:1120

Postpiloric feeding might reduce % ICU acquired VAP

Heyland DK et al. CCM 2001;29:1495

In the last couple of years ……

- **Two kinds of clinical studies tried to give an answer to the efficacy of different methods for preventing VAP**

1.Application of the "VAP Bundle" policy

(mostly published in nursing literature)

2.Addition of various single procedures to the classical protocol of VAP prevention

Single procedure results

Method	Reference	Results
Chest physiotherapy (X 6/day)	Patman S. Intens Care Med 2009;35;258	No difference between physio and non physio-
Early tracheostomy (less than 7 days)	Schneider GT. Otolaryngol Head Neck Surg 2009;140:25	29% less VAP in early tracheo- group
Saline instillation before suction	Caruso P. CCM 2009;37:32	Reduced microbiological proved VAP (p =0.008)
Cleaning teeth with antiseptic solutions	Sona C. J Int Care Med 2008, November 17	Reduction infection rate for 1000 ventilator days from 5.2 to 2.4
Preventive PEEP (5-8 cm water)	Manzano F. CCM 2008;36:2225	9.4% VAP in PEEP group vs 25% in ZEEP
Silver-coated ETT (2003 patients!!)	Kollef MH. JAMA 2008;300:805	4.8% VAP vs 7.5% (in uncoated ETT) p=.04

One very fresh paper

(Muscedere J et al Crit Care Med 2011;39:1985)

- **Meta-analysis of 13 studies on the influence of subglottic secretions drainage for prevention of VAP**
- **2442 randomized patients**
- **Results:**

***Reduced**

VAP rate

ICU stay

duration of ventilation

***Increased time to 1st episode of VAP**

- **But also a critical view on other proposed methods:**

***Positioning ++**

***Digestive decontamination –**

***Oral cavity hygiene +**

***Silver-coated tubes +/-**


29. 10. 2001

The Ventilator/VAP Bundle

- **References:**

***O'Keefe-McCarthy S et al**
Worldviews Evid Based Nurs 2008;5:193
***Fields LB**
J Neurosci Nurs 2008;40:291
***Chao YF**
J Clin Nurs 2009;18:22
***Tsai HH et al**
Am J Med Sci 2008;336:397

A long list of preventive measures to be taken every single moment, every single day for every single patient!!

Controversial results……

First of all, the list of measures proposed to be part of the bundle is much too long!!

The classical list

- Head-of-bed elevation
- "Sedation vacation" (daily interruption)
- DVT prophylaxis
- Peptic ulcer prophylaxis
- Oral suction before each positional changes
- Oral chlorexidine Q12H
- Continuous subglottic suction
- Initiating early mobilization

And this is the addendum!!

- Maintaining the ETT cuff pressure > 20 cm H2O
- Orogastric (and not nasogastric) feeding tube
- Avoiding gastric overdistension
- Eliminating non-esential tracheal suction

Bouadma L et al. Clin Infect Dis 2010;51:1115

- **Implementation of the "ventilator-bundle" policy (VAP prevention program) reduced VAP rate by 43% (45 months of study)**

BUT…..

- **No statistically change in :**

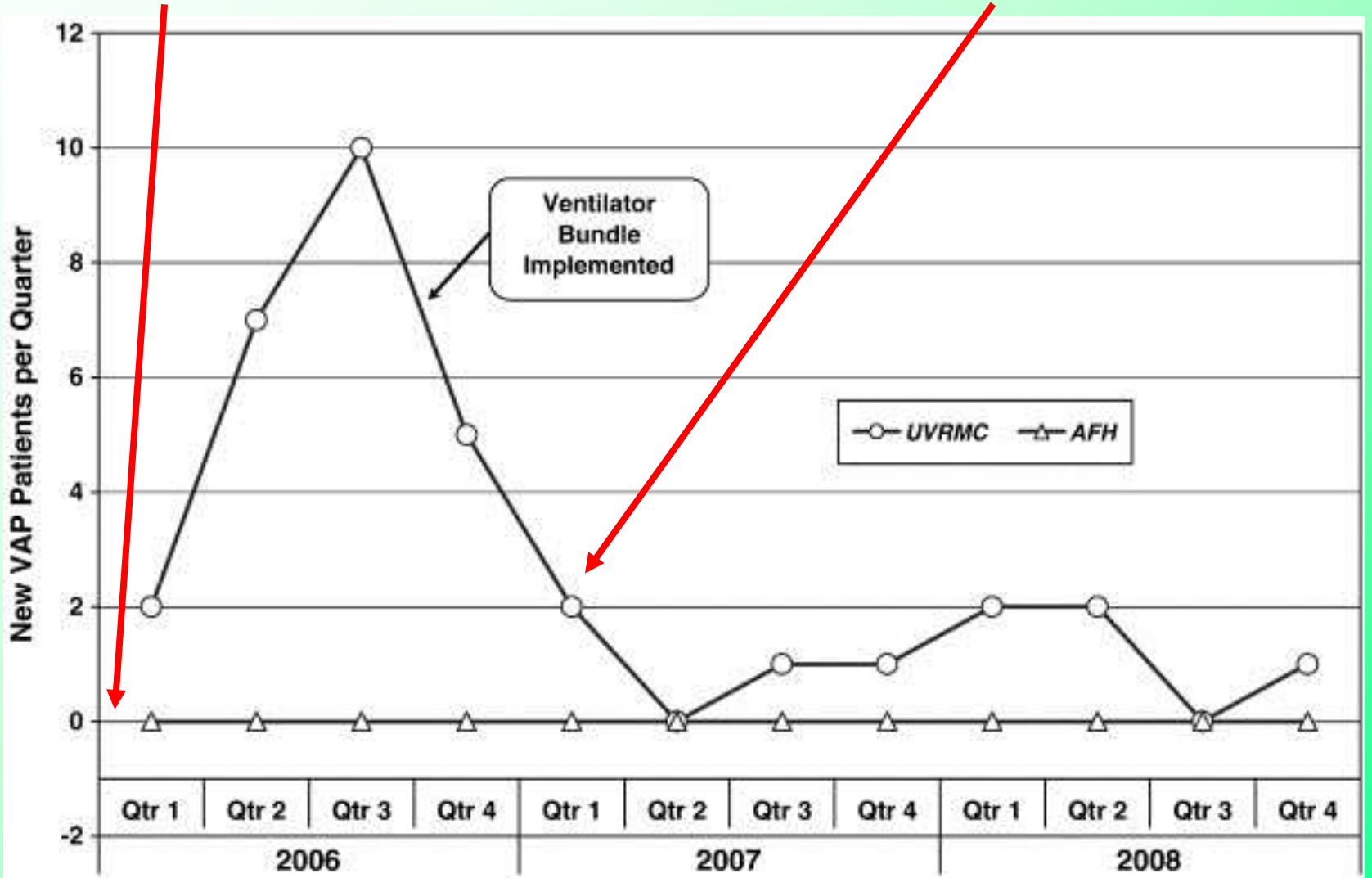
***patients' median duration of ventilation**

***no change in ICU mortality**

***no impact on overall hospital mortality**

Sundar KM J Crit Care 2012;27:26-32

Comparison between two ICUs, one who implemented the ventilator bundle from the beginning and one later on



Another proposal…..

- **Staff education**

- **Surveillance of ICU infections**

How powerful is inertia ?!!

Kaynar AM et al. Resp Care 2007;52:1687

- **278 individuals (nurses and technicians) involved in ICU management responded to a questionnaire regarding VAP prevention**

- **81-90% adhere to :**
  ***hand hygiene**
  ***head position**
  ***avoidance of reintubation**

- **BUT**

- **50% still change ventilator circuits**
- **54-70% use chest physiotherapy**

The last systematic review
(Safdar N et al CCM 2005;33:2184)

- **10-20% of patients receiving >48 hrs mechanical ventilation will develop VAP**
- **Critically ill patients who develop VAP are twice likely to die compared to similar patients without VAP**
- **VAP prolongs the ICU stay by an average of 6 days**
- **Cost of VAP= $10,000 additional to the usual cost**

Zero VAP percentage ?!

- **Everything started from a very important economic decision in the USA:**
- **Medicare and Medicaid added VAP on their list of NONREIMBURSABLE**

complications in ICU!!

- ***Klompas, Clin Infect Dis 2010;51:1123***

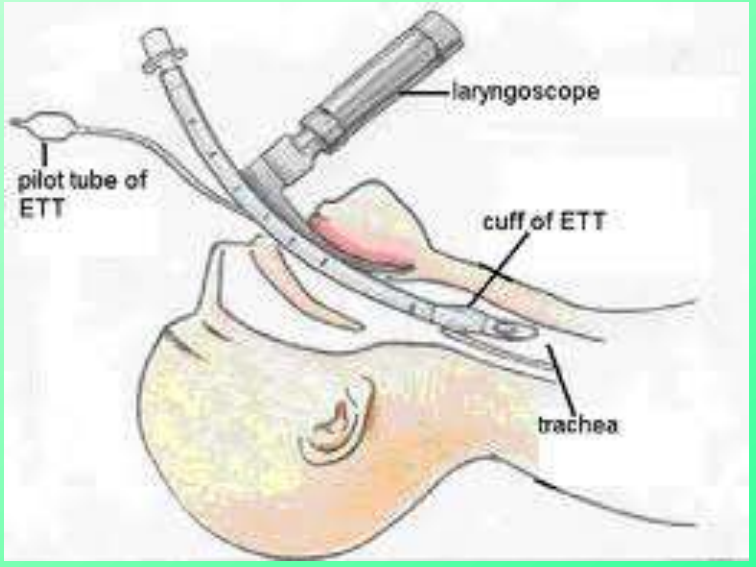
"The increasing visibility of VAP in the eyes of legislators, payers, and quality improvement advocates creates substantial subconscious pressure to lower VAP rates"

If so, one is supposed to look for a new approach to the problem of VAP, a system which would considerably reduce its incidence.

It would save lives and money !

So, let's summarize the problem

- **VAP is a complication of prolonged traacheal intubation +/- mechanical ventilation**
- **The main cause of VAP is ASPIRATION of supra-glottic secretion into alveoli**
- **The ETT cuff is not supposed to prevent aspiration**
- **One never know HOW MUCH secretions enter the lower broncho-alveolar tract and WHEN**
- **One never know if the aspiration system is effective or not**
- **One never know if the cuff is properly inflated**

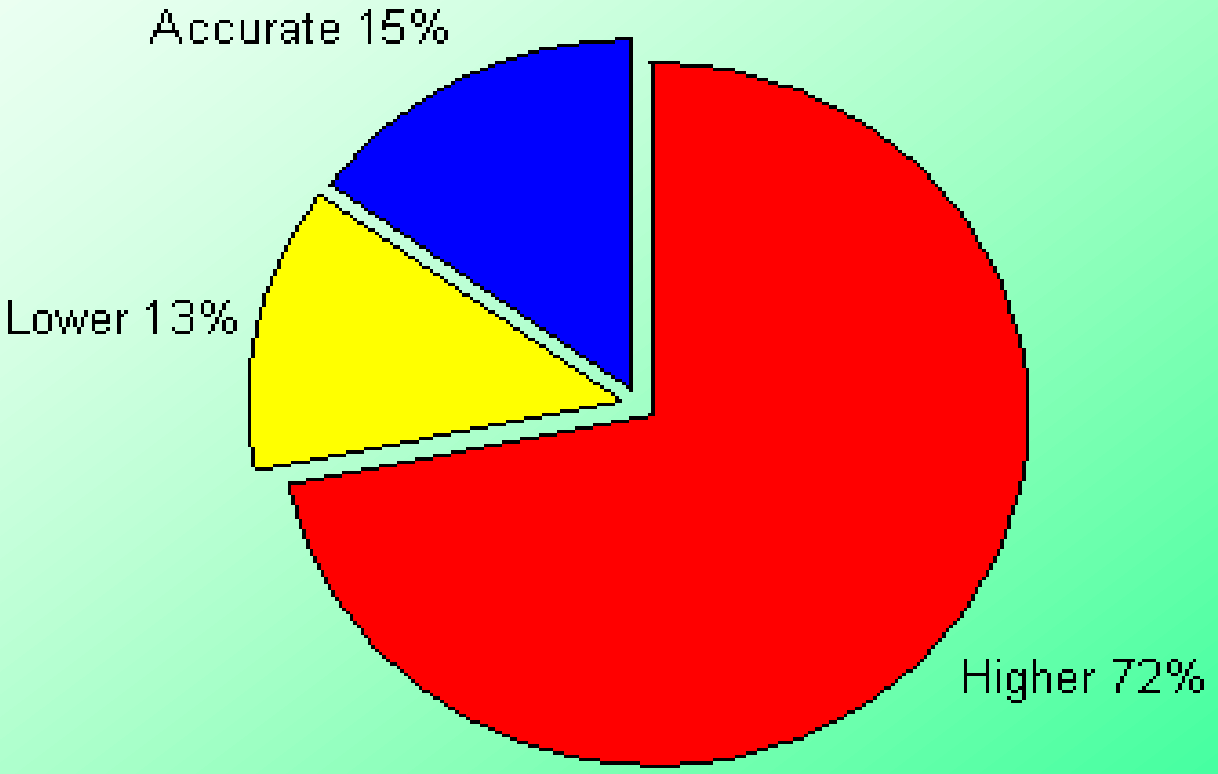


Accuracy of current standard

Human study

Cuff pressure determination:

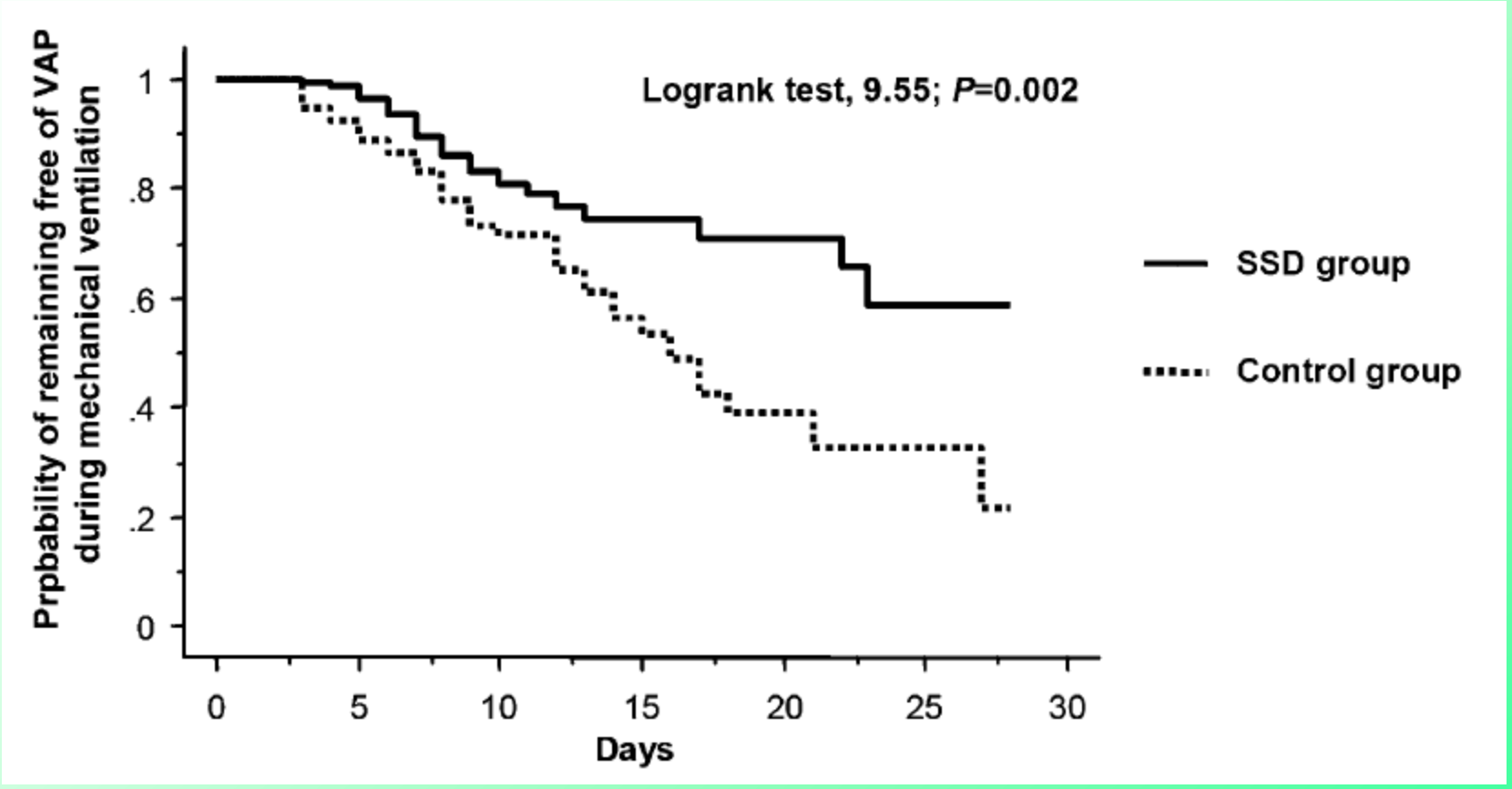
Physician vs. pCO_2



Efrati et al. Anesth Analg 2005

Hospitech Respiration

The ETT Problem



Lacherade et al. Am J Respir Crit Care Med, 2010

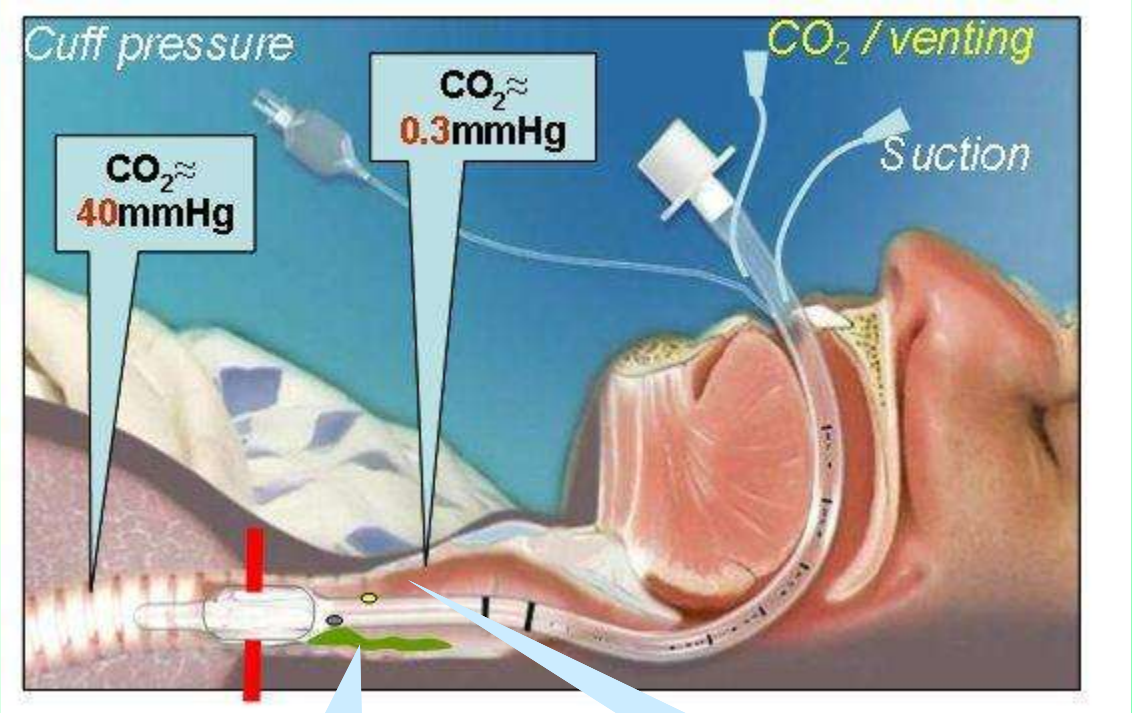
What we do need is:

- **A solution for early detection of any leak around the cuff**
- **A method of automatically inflate the cuff in case of leak and deflate the tube in case of overinflation**
- **A system which would efficiently aspirate the secretion around the cuff**

Here seems to be the solution!

The AnapnoGuard Solution

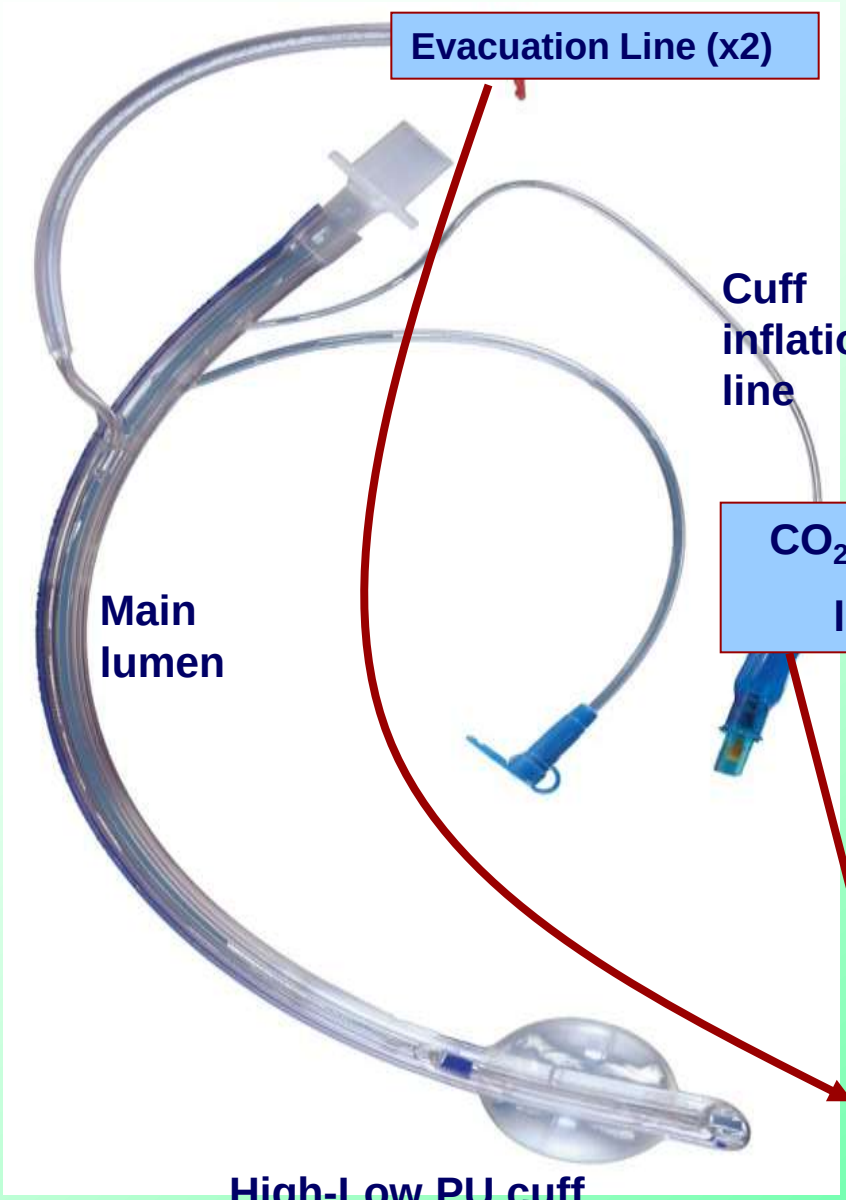
The basic concept - How does it work?



2) Intermittent controlled suction, evacuates the secretions above the cuff

1) The CO_2 level above the cuff is used as an objective indication for leakage and for adjustment of cuff pressure

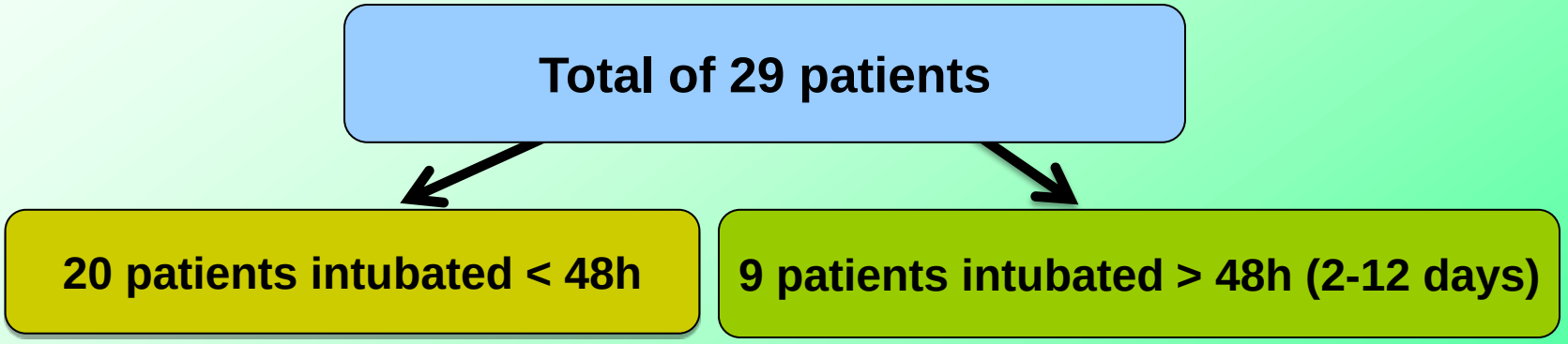
The AnapnoGuard ET Tube



1. It measures the CO_2 ABOVE the cuff
2. It automatically inflates the cuff in case of detection of leak
3. Aspirates the secretions continuously
4. Avoids creation of vacuum around the cuff

Clinical Studies

- Prospective study, 2 ICUs in Romania
- Retrospective control groups with **up to 70% VAP**



- **No new VAP in any of the study patients**

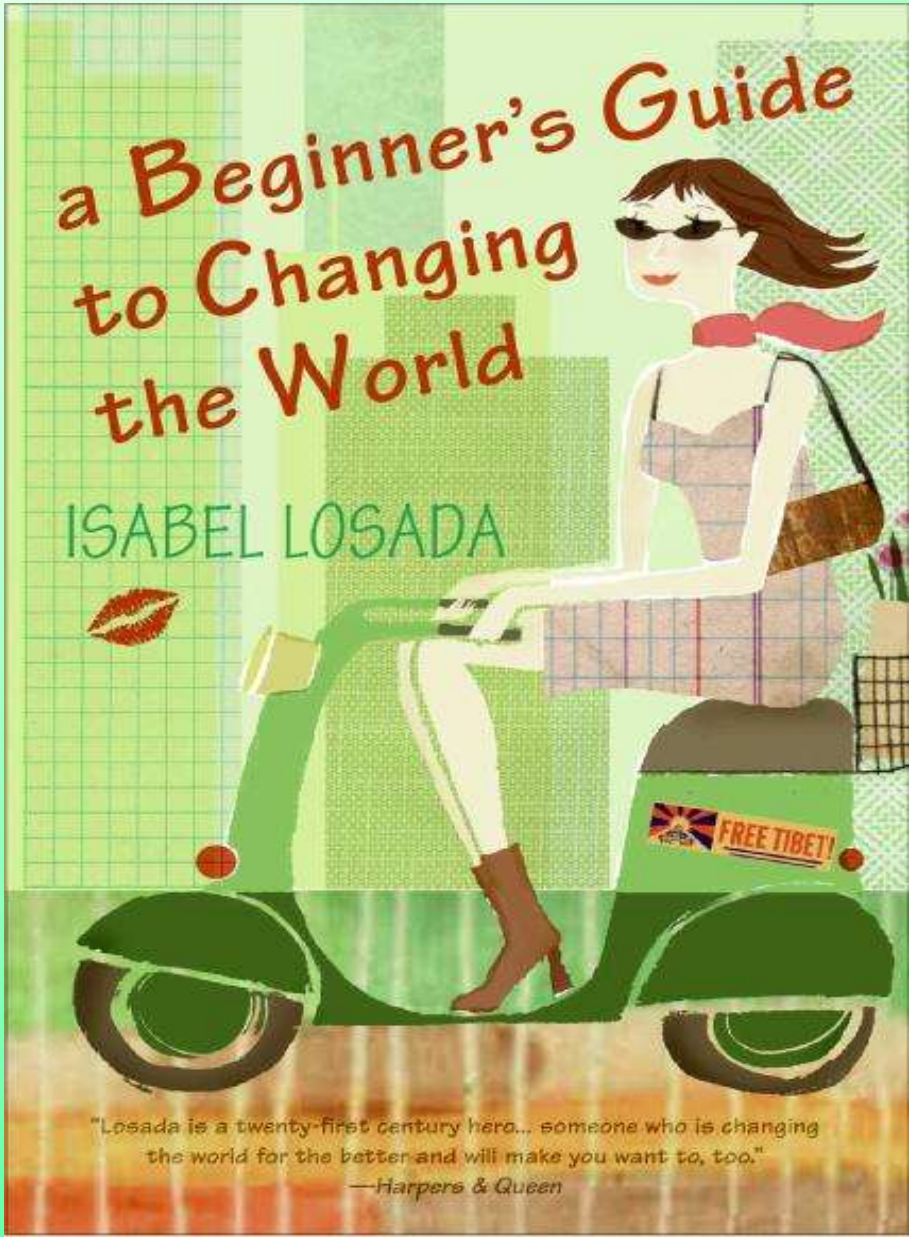
What's next?

- **A clinical randomized study in the hospital of the Universita Catolica in Rome, Italy (started March 1, 2012)**

- **A multi-center study in Europe for including hundreds of patients and proving the efficiency of the system in prevention of VAP**

Never doubt that a small group of thoughtful, committed people can change the world. Indeed it is the only thing that ever had.

(Margaret Mead)



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