

# The Prevention of Ventilator-associated Pneumonia: Local Practice in ICUs of Hong Kong

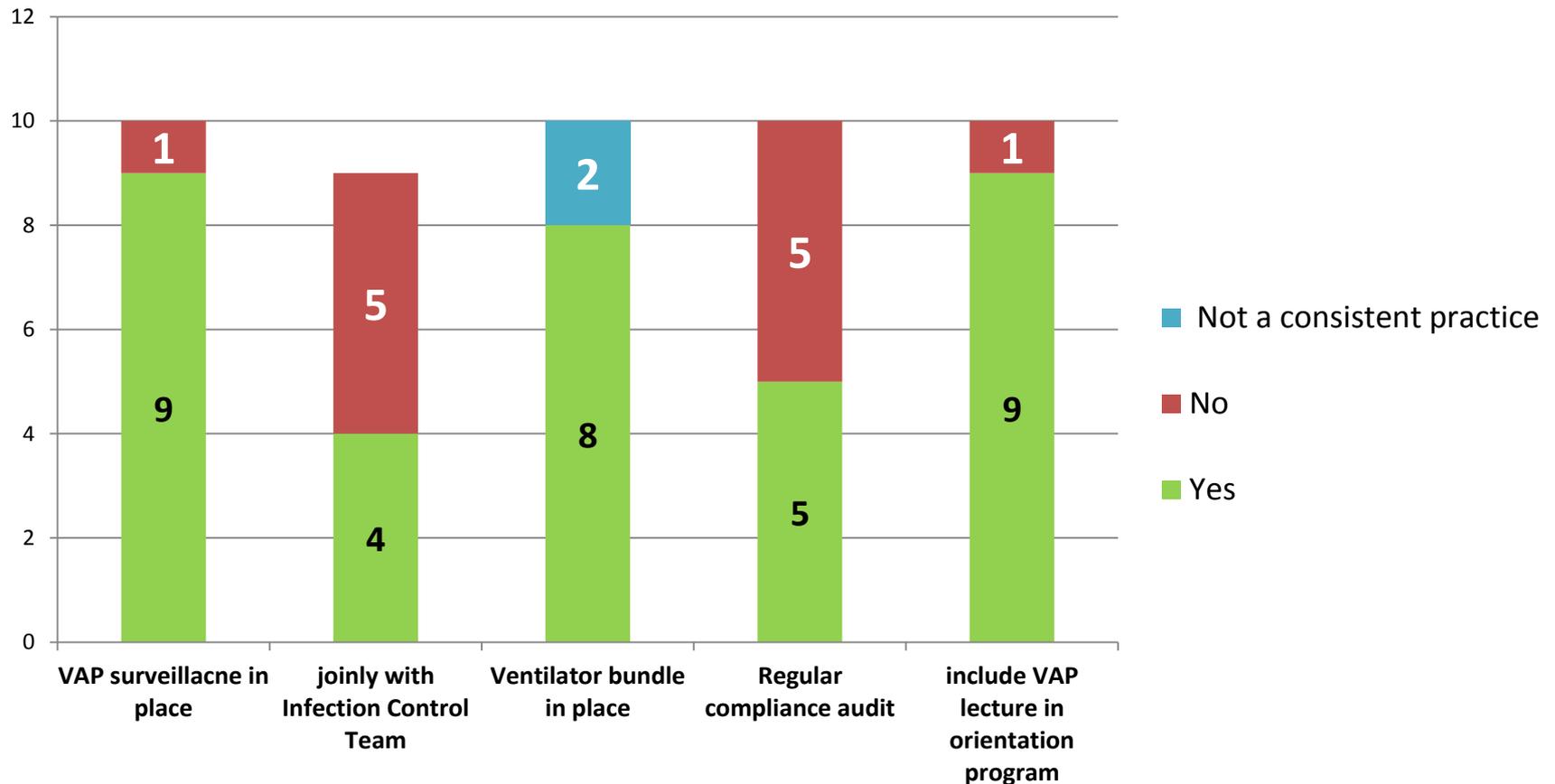
SO Hang Mui  
Nurse Consultation (Intensive Care)  
HKEC  
16 April 2013

# The 7 Clusters of Hospitals



# The Prevention of VAP Practice in ICUs of HA Hospitals in Hong Kong: an Overall View

10 out of 14 ICUs participated in the survey



# PYNEH



3 Lok Man Road, Chai Wan, Hong Kong

# Our First VAP Prevention Program in ICU of PYNEH

## Ventilator-Associated Pneumonia (VAP) Audit (PAGE 1) - PROTOCOL

### Protocol

#### A. Aims

1. to determine the baseline VAP rate
2. to determine the VAP during the enforcement of preventive measures of VAP
3. to look for reasons why some prevention measures of VAP cannot be carried out

#### B. Phases of study

1. Dec 2006: Pilot + feedback and amendment
2. Jan 2007: Baseline VAP rate (fill in Items A – C only)
3. Feb 2007: VAP rate with enforcement of Items 1 – 13 (fill in Items 1 – 13 and Items A – C)

#### C. Inclusion criteria

1. Patients of age > 13 yrs old in adult ICU & require mechanical ventilation for ≥ 48 hours
2. Patients in adult ICU & required reintubation after extubated for ≥ 48hours

#### D. Exclusion criteria (please circle the reason if the case is excluded)

1. On mechanical ventilation for < 48 hours
2. At the time of intubation:
  - a. Known HIV Ab +ve, or
  - b. total WBC < 1 x10<sup>9</sup>/L, or
  - c. known solid or haematological tumour, or
  - d. on immunosuppressive therapy or prednisolone-equivalent of ≥ 10mg/D for ≥ 3M
3. DNR decision within 48 hours after intubation

#### E. Stop Surveillance on the case once VAP detected

#### F. When the audit form is completed, please attach the following to this form (circle if attached):

1. APACHE data sheet with APACHE scores (II, III, IV)
2. Microbiological results of all tracheal aspirates saved (only those recorded in this form)
3. Discharge summary

Attach patient label here

#### G. Reference:

##### Onset of VAP=

1. CPIS >6, &
2. a new pneumonia after 48 hours of mechanical ventilation, &
3. with a cause that cannot otherwise be explained

#### Clinical pulmonary Infection Score (CPIS)

Variables	Points		
	0	1	2
Temp °C	≥ 36.5 & ≤ 38.4	≥ 38.5 & ≤ 38.9	≥ 39 or ≤ 36.5
WBC x10 <sup>9</sup> /L	≥ 4 & ≤ 11	< 4 & > 11	< 4 or > 11 + band forms ≥ 0.5
Secretions	Rare	Abundant	Abundant + Purulent
PaO <sub>2</sub> /FIO <sub>2</sub>	≥ 240 (> 32 if kPa) or ARDS	-	≤ 240 (≤ 32 if kPa) & no ARDS
CXR	No infiltrate	Diffuse or patchy infiltrate	Localized infiltrate

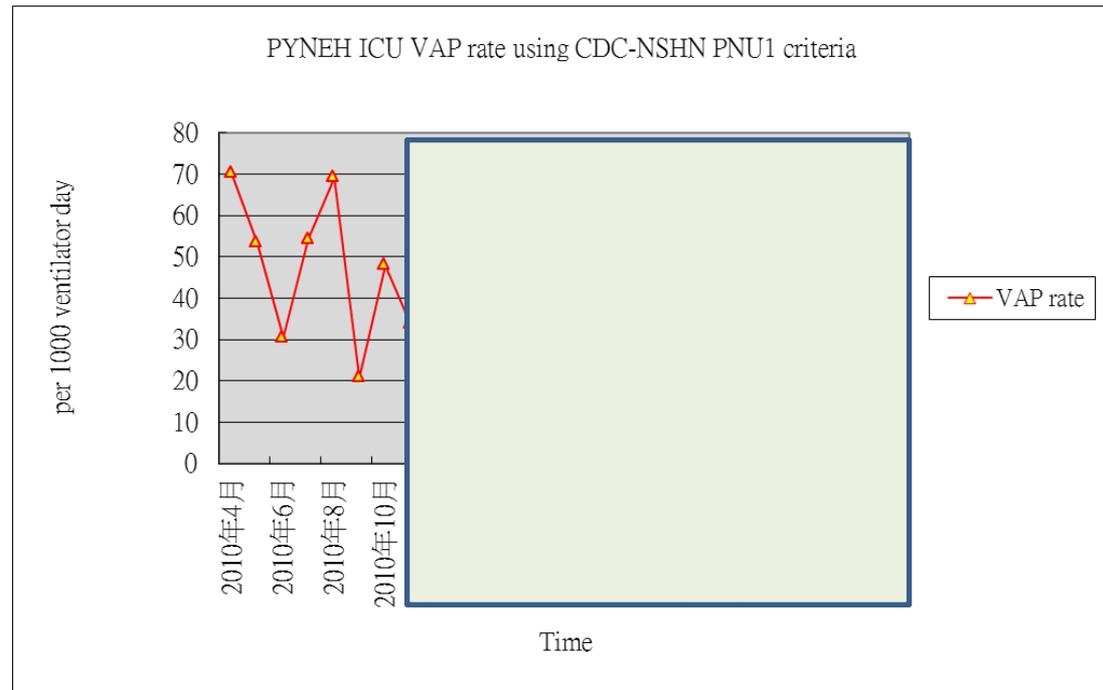
- In 2007
- Clinical Pneumonia Infection Score (CPIS) as diagnostic criteria for VAP

VAP rate = 1 / 264 ventilator-days  
(projected: 3.8 per 1000)

# ↑ VAP Rate When CDC PNU1 Criteria Are Used

Definition by: CPIS	PNU 1	
2007	Before intervention 2010	
3.8 per 1000 ventilator days	51 per 1000 ventilator days	

A pioneer work (dissertation on VAP ) by Dr. Arthur Kwan using CDC PNU 1 criteria showed wide difference in VAP rate



# High VAP Rate When Compared to Overseas Data

Table 6. Pooled means and key percentiles of the distribution of ventilator-associated PNEU rates and ventilator utilization ratios, by type of location, DA module, 2011

Ventilator-associated PNEU rate*				Percentile					
Type of location	No. of locations +	No. of VAP	Ventilator -days	Pooled mean	10%	25%	50% (median)	75%	90%
<b>Acute Care Hospitals</b>									
<b>Critical Care Units</b>									
Burn	31 (30)	88	17,844	4.9	0.0	0.0	4.2	8.8	12.5
Medical -Major teaching	89	188	174,412	1.1	0.0	0.0	0.7	1.8	3.0
Medical -All other	156 (141)	152	156,191	1.0	0.0	0.0	0.0	1.0	3.0
Medical cardiac	161 (152)	138	128,369	1.1	0.0	0.0	0.0	1.3	3.8
Medical/surgical -Major teaching	123 (118)	461	215,214	2.1	0.0	0.0	1.0	2.3	5.4
Medical/surgical -All other ≤15 beds	397 (482)	296	267,272	1.1	0.0	0.0	0.0	1.2	4.3
Medical/surgical -All other >15 beds	317 (315)	527	509,492	1.0	0.0	0.0	0.6	1.6	2.8
Neurologic	19	64	17,656	3.6					
Neurosurgical	66 (65)	161	70,894	2.3	0.0	0.0	0.7	3.0	5.9
Pediatric cardiothoracic	15	12	28,756	0.4					
Pediatric medical	11	6	7,385	0.8					
Pediatric medical/surgical	121 (112)	146	135,585	1.1	0.0	0.0	0.0	1.4	3.2
Respiratory	6	0	3,984	0.0					
Surgical -Major teaching	70	290	122,472	2.4	0.0	0.6	1.7	3.5	6.4
Surgical -All other	83 (81)	165	82,363	2.0	0.0	0.0	0.1	2.8	4.7
Surgical cardiothoracic	168 (164)	268	154,234	1.7	0.0	0.0	0.6	2.4	5.3
Trauma	36	499	106,857	4.7	0.0	0.9	3.1	7.5	13.5

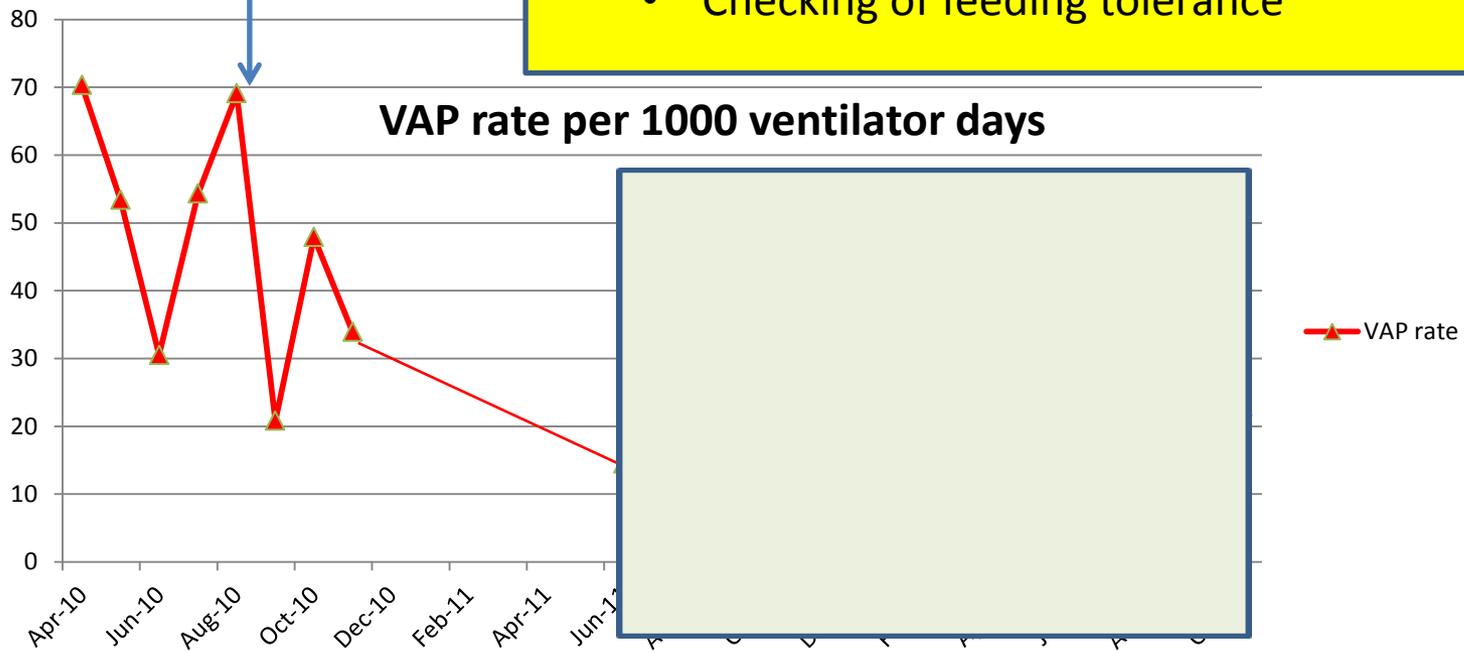
# High VAP Rate When Compared to Overseas Data

Definition by: CDC Pneumonia 2009 PNU 1	VAP rate per 1000 ventilator days	VAP rate Percentile (90%)	Ventilator Utilization ratio (Pooled mean / 90% Percentile)
ICU PYNEH	51 (in April 2010 )		0.502 /
Critical Care Units	(pooled mean)		
Burn	4.9	12.5	
Trauma	4.7	13.5	
Neurological	3.6		
Medical/surgical All other >15 beds	1.0	2.8	0.35 / 0.51
Neurosurgical	2.3	5.9	
Other medical/respiratory /surgical /cardiac thoracic	0-2.4	3-5.3	

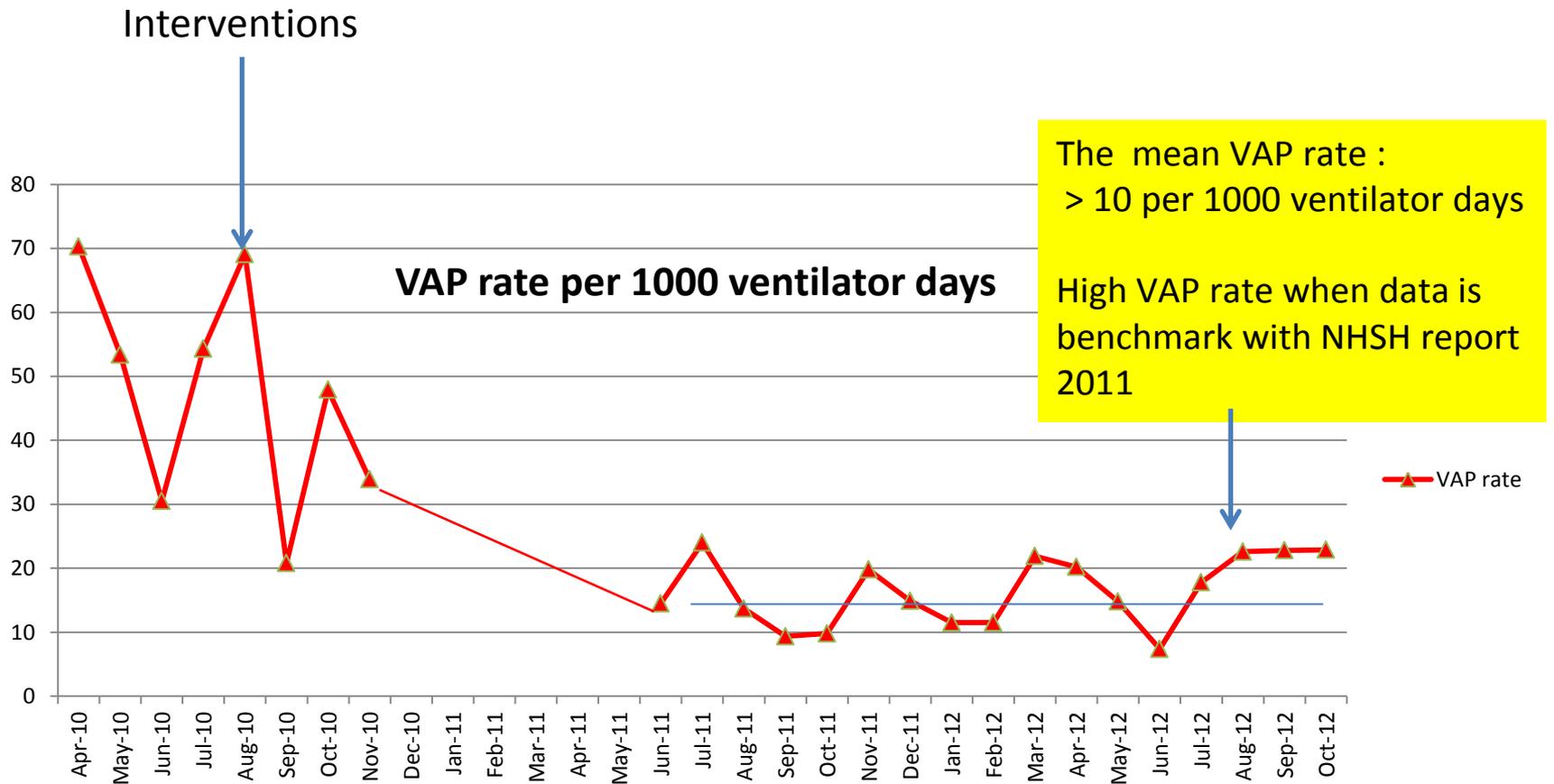
# What were These Interventions ?

Interventions

- Conduct refresher lectures on prevention of VAP
- Start to keep ETT cuff pressure at 30 cmH<sub>2</sub>O
- Conduct compliance audit to
  - proper oral care with tooth brushing
  - HOB
  - Checking of feeding tolerance



# Still High VAP Rate: Where was The Gap?



# What Can We DO?

**Set up a task force at cluster level**

**Initiate an quality improvement project**

- Gain senior endorsement
- Invite ICU/CCU to participate

Quality Improvement Project: Prevention of Ventilator-associated Pneumonia (VAP) in Critical Care Areas, HKEC

H → Key Members as at 26 Nov. 2012 & updated on 25 Feb 2013.

Project Champions	Dr. Lau Yuk Kong Ms. Monica Ng Dr. Yan Wing Wa Ms. Nora Kwok	Consultant, C/CICU DOM, C/ICU COS, ICU DOM, ICU	RHTSK RHTSK PYNEH PYNEH
Project Sponsors	Ms. Cecilia Chan Ms. Civy Leung	GMN GMN	RHTSK PYNEH
Project Managers	Dr. Raymond Liu So Hang Mui	SMO, C/ICU Nurse Consultant (Intensive Care)	RHTSK HKEC
Project Leaders	Ms. Tang Sui Lan Ms. Lau Lan	WM, C/ICU WM, ICU	RHTSK PYNEH
Team members	Ms. Chan Yuen Shan Patricia Ms. So Yuk Lan Dr. Lau Chun Wing Dr. Alwin Yeung Dr. Lam Sin Man Ms. Chiu Mei Chun Ms. Mok Chi Man Ms. Wong Po Man Ms. Lam Yin Ha	Nursing Officer, C/ICU  RN, C/ICU Associate Consultant, ICU Associate Consultant, Medicine Associate Consultant, ICU APN, ICU RN, ICU RN, ICU WM, CCU	RHTSK  RHTSK PYNEH RHTSK PYNEH PYNEH PYNEH PYNEH PYNEH

Quality Improvement Project: Prevention of Ventilator-associated Pneumonia (VAP) in Critical Care Areas, HKEC

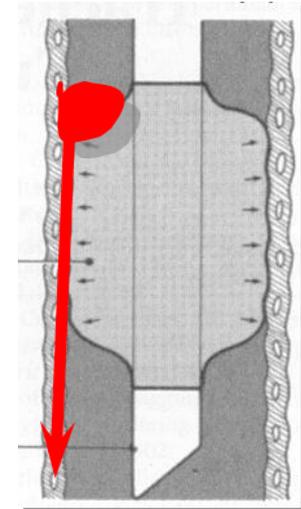
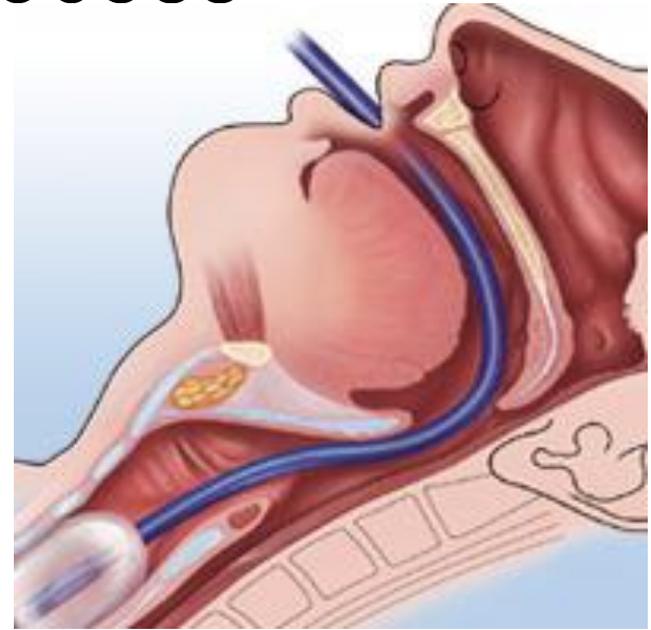
- A. Aims:** to decrease the rate of VAP by implementing all elements of the ventilator bundle to more than 95% of ventilator patients in critical care areas within 2 years
- B. Objectives:**
1. To determine the baseline VAP rate
  2. To determine the VAP after the enforcement of ventilator bundle
  3. To look for reasons why some preventive measures of VAP cannot be carried out
  4. To conduct ongoing outcome surveillance for VAP and process surveillance to ventilator bundle.
- C. Scope of project:** This is a Hong Kong East Cluster based project.
- D. Phases of Project**
1. Phase I : Pilot the tool for monitoring patient for incident of VAP and pilot the audit tool for current practice to prevent VAP ( **complete before 15 Dec 2012** )
  2. Phase II : clinical audit to determine baseline VAP rate x 2 months ( **Period: 1 Jan 2013 – 28 Feb 2013** )
  3. Phase III: Review ventilator bundle and conduct training to all staff on VAP prevention program ( **complete before 1 Mar 2013** )
  4. Phase IV : Enforcement of ventilator bundle ( **start time : on 1 Mar 2013** ) **Duration : 2 year**



# Revisit the VAP Process

## Pathogenesis of VAP

- Bacteria enter the lower respiratory tract via two pathways:
  - Aspiration of organisms from the oropharynx and GI tract (most common cause)
  - Via ventilatory circuit & tracheal tube



# Review Evidences

2004

## CLINICAL GUIDELINES

### Evidence-Based Clinical Practice Guideline for the Prevention of Ventilator-Associated Pneumonia

Peter Dodek, MD, MHS; Sean Keenan, MD, MSc(Epid); Deborah Cook, MD, MSc(Epid); Daren Heyland, MD, MSc(Epid); Michael Jacka, MD, MSc; Lori Hand, RRT; John Muscedere, MD; Debra Foster, RN; Nav Mehta, MD; Richard Hall, MD; and Christian Brun-Buisson, MD, for the Canadian Critical Care Trials Group and the Canadian Critical Care Society

**Background:** Ventilator-associated pneumonia (VAP) is an important patient safety issue in critically ill patients.

**Purpose:** To develop an evidence-based guideline for the prevention of VAP.

**Data Sources:** MEDLINE, EMBASE, and the Cochrane Database of Systematic Reviews.

**Study Selection:** The authors systematically searched for relevant randomized, controlled trials and systematic reviews that involved mechanically ventilated adults and were published before 1 April 2003.

**Data Extraction:** Physical, positional, and pharmacologic interventions that may influence the development of VAP were considered. Independently and in duplicate, the authors scored the validity of trials; the effect size and confidence intervals; the homogeneity of results; and safety, feasibility, and economic issues.

**Data Synthesis:** **Recommended:** The orotracheal route of intubation, changes of ventilator circuits only for each new patient and if the circuits are soiled, use of closed endotracheal suction

systems that are changed for each new patient and as clinically indicated, heat and moisture exchangers in the absence of contraindications, weekly changes of heat and moisture exchangers, and semi-recumbent positioning in the absence of contraindications. Consider subglottic secretion drainage and kinetic beds. **Not recommended:** Sucralfate to prevent VAP in patients at high risk for gastrointestinal bleeding and topical antibiotics to prevent VAP. Because of insufficient or conflicting evidence, no recommendations were made about systematically searching for maxillary sinusitis, chest physiotherapy, the timing of tracheostomy, prone positioning, prophylactic intravenous antibiotics, or intravenous plus topical antibiotics.

**Limitations:** No formal economic analysis was performed, and patient perspectives were not considered.

**Conclusion:** If effectively implemented, this guideline may decrease the morbidity, mortality, and costs of VAP in mechanically ventilated patients.

Ann Intern Med. 2004;141:305-313.  
For author affiliations, see end of text.

www.annals.org

2007

Evidence-based interdisciplinary knowledge for high acuity and critical care



衛生防護中心  
Centre for Health Protection

### Evidence-Based Practice: Use of the Ventilator Bundle to Prevent Ventilator-Associated Pneumonia

Arlene F. Tolentino-DelosReyes, Susan D. Ruppert and Shyang-Yun Pamela K. Shiao

Am J Crit Care 2007;16:20-27  
© 2007 American Association of Critical-Care Nurses  
Published online <http://www.ajcconline.org>

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### Recommendations on Prevention of Ventilator-associated Pneumonia

Scientific Committee on Infection Control, and Infection Control Branch, Centre for Health Protection, Department of Health

June 2010

June 2010

衛生防護中心之衛生管理  
及控制專業架構  
The Centre for Health Protection is a  
professional arm of the  
Department of Health for  
disease prevention and  
control

2006

### Getting Started Kit: Prevent Ventilator-Associated Pneumonia

### How-to Guide



1/2008



### VENTILATOR ASSOCIATED PNEUMONIA

**Alert Statements:**

patients receiving mechanical ventilation, as well as those at high risk for aspiration (e.g., decreased level of consciousness; enteral tube in place), should have the head of the bed (HOB) elevated at an angle of 30 to 45° unless contraindicated.<sup>1-7</sup> (Level VI)  
An endotracheal tube (ET) with a dorsal lumen above the endotracheal cuff to allow drainage by continuous suctioning of tracheal secretions that are not routinely change, on the basis of

**Alerting Evidence:** Critically ill patients who are intubated for pneumonia (VAP)<sup>1,2,18-20</sup> and those intubated with a decreased level of consciousness, presence of gastric or small intestine, or other factors are at risk for VAP. Reported to occur at rates of 10 to 35 ca



www.INICC.org  
International Nosocomial Infection Control Consortium

2012

www.FLIN.org.ar  
Foundation to Fight Against Nosocomial Infections



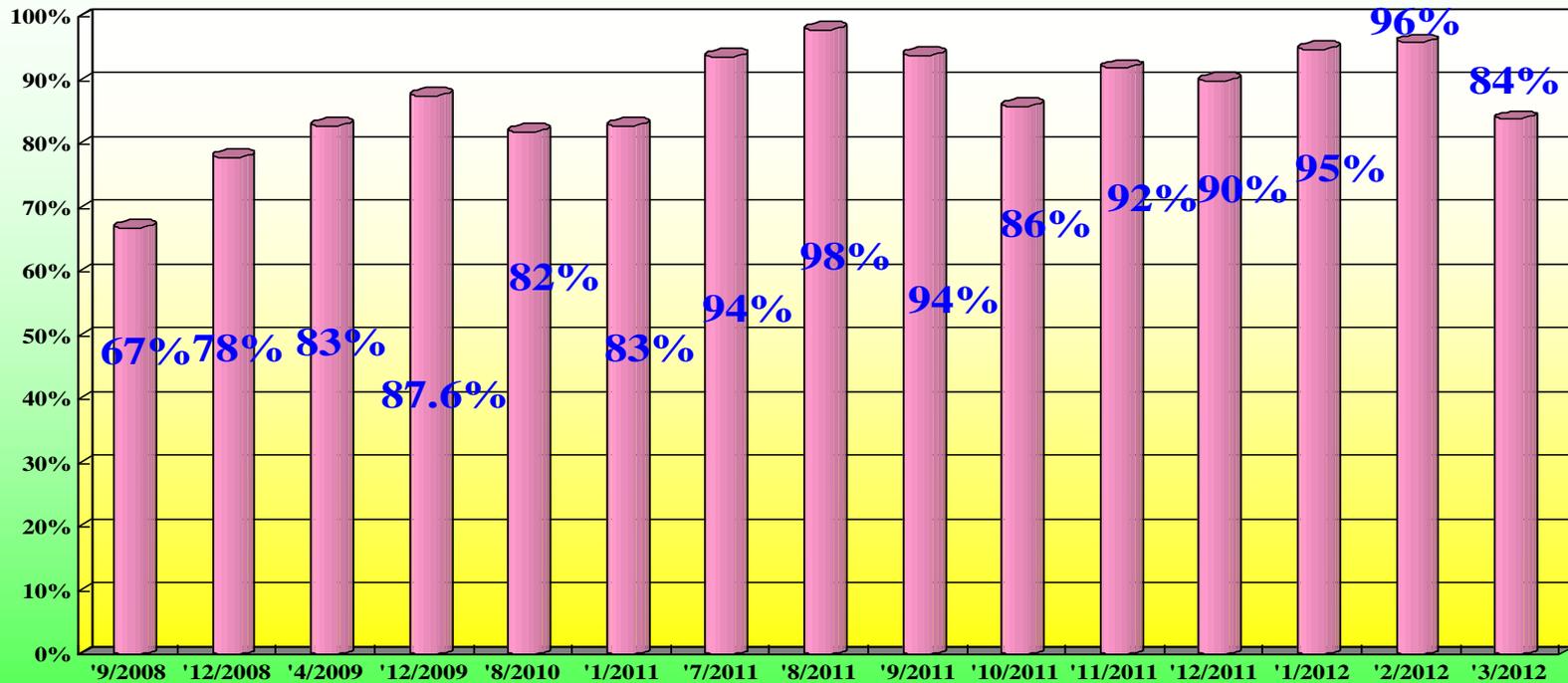
### INICC Bundle to Prevent Health Care Associated Pneumonia in Intensive Care Units: An International Perspective.

# Revisit Hong Kong Bundle to Prevent VAP

- Elevate head of patient to at least 30°
- Provide antiseptic oral rinse to ventilated patients
- Perform hand hygiene before and after each respiratory care
- Assess patient's readiness to wean and to extubate on daily basis
- Prevent condensate from entering patient's airway
- Maintain proper care to respiratory consumables and equipments
- Conduct ongoing active VAP surveillance

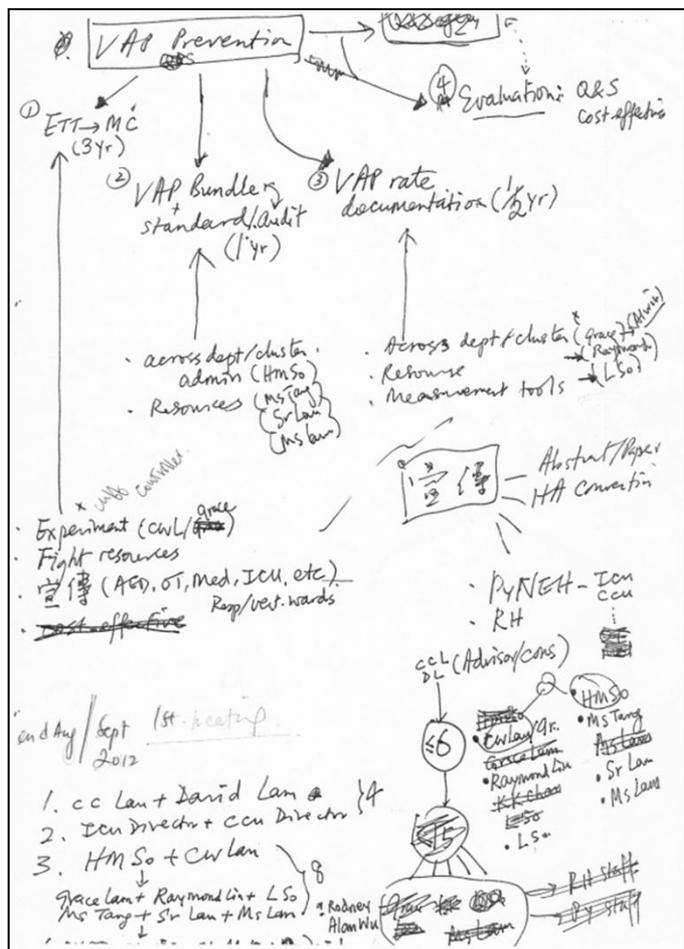
Recommendations on prevention of VAP, June 2010  
Centre for Health Protection, Dep. of Health

# Re-examine Compliance to Maintain Bed Head Elevation



Target:  $\geq 95\%$  compliance

# Brainstorm for Better Strategies (2)



- Multi-pronged approach
- Need to reinforce Hong Kong ventilator bundle
- Need to try new measures
- Repeated administration of these measures over time is crucial
- Dedicated staff to
  - promote & monitor the process,
  - engage and motivate staff and
  - finally share the success to keep the momentum of change

# Strategy 1: Do the Basics

- Reinforce Hong Kong ventilator bundle through repeated educational talks to
  - Doctors, nurses, physiotherapists and
  - Health Care Assistants

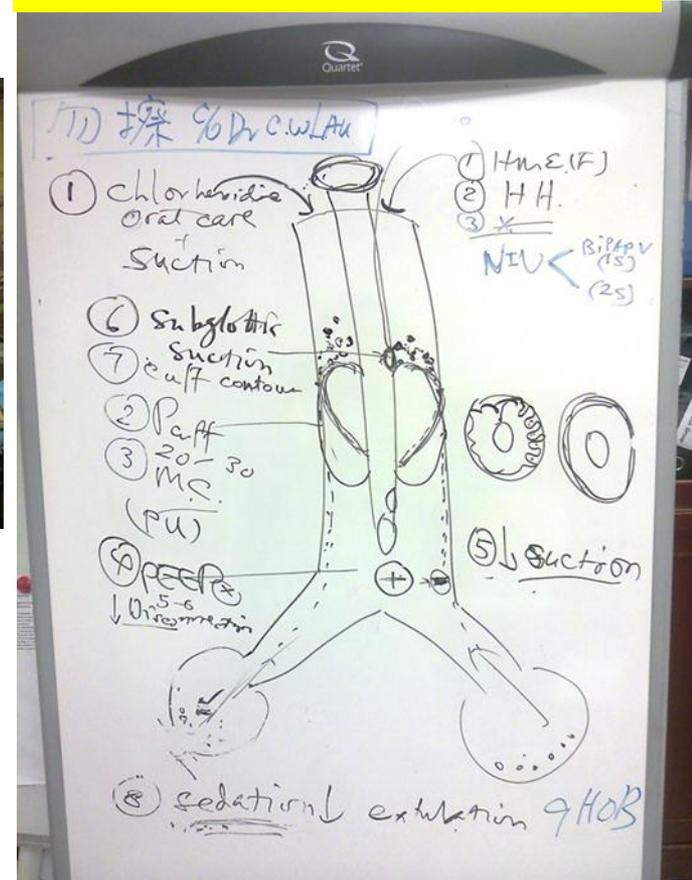
Visual display for better promotion



Refresher lecture on VAP

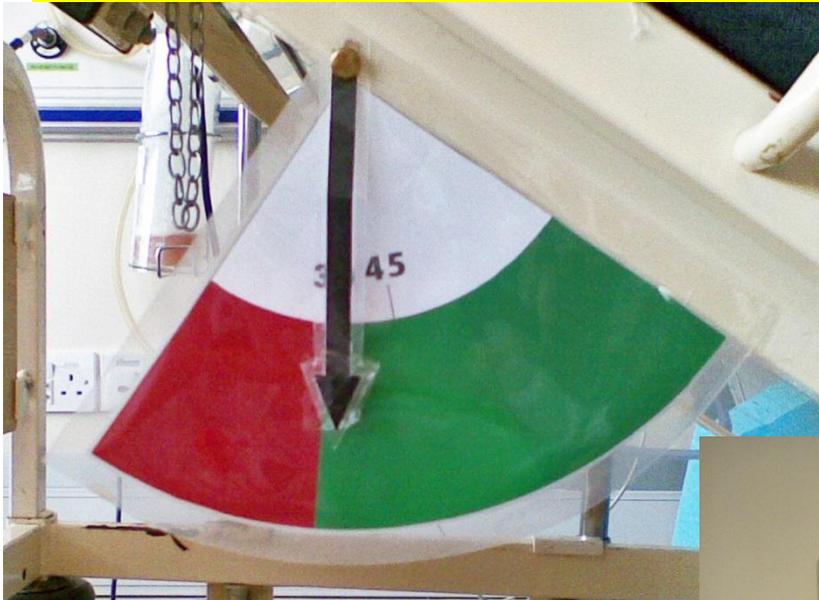


Brief talk at bedside



# Strategy 2: Promote HOB with Visual Indicators

Innovative home-made HOB indicator



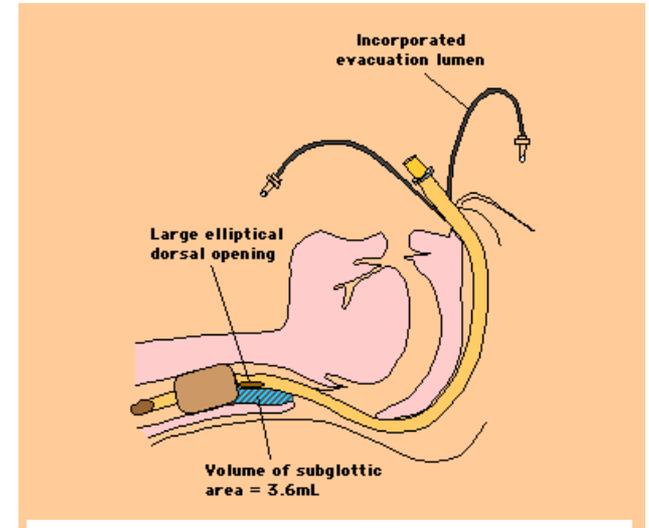
Reverse trendelenberg



Green light showed HOB at 30-45°

# Strategy 3: Minimize Micro-aspiration with New ETT designs

- Promote trial use of
  - TaperGuard Evac ETT with subglottic drainage port
  - Novel Microcuff



Workshop on healthcare associated infections and pathogens in ICU



# Microcuff ETT Outperformed the other ETTs in Preventing Microaspiration



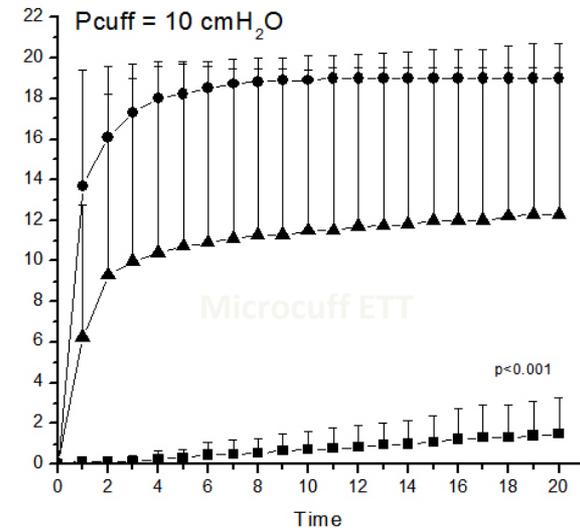
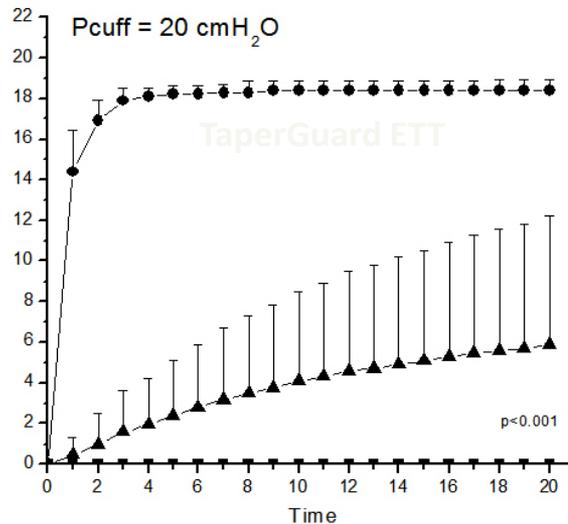
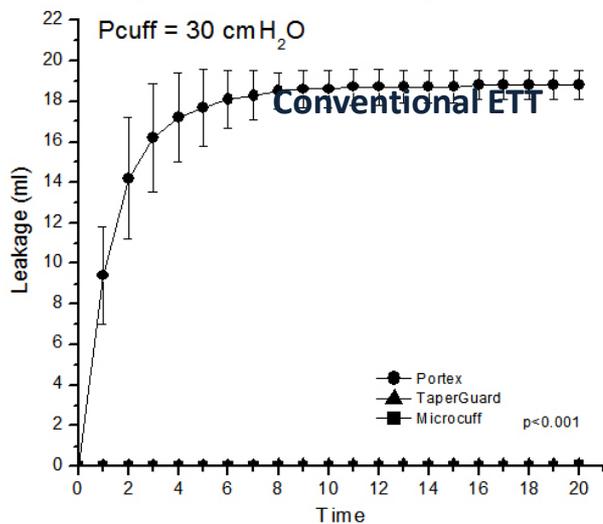
Conventional ETT

TaperGuard ETT

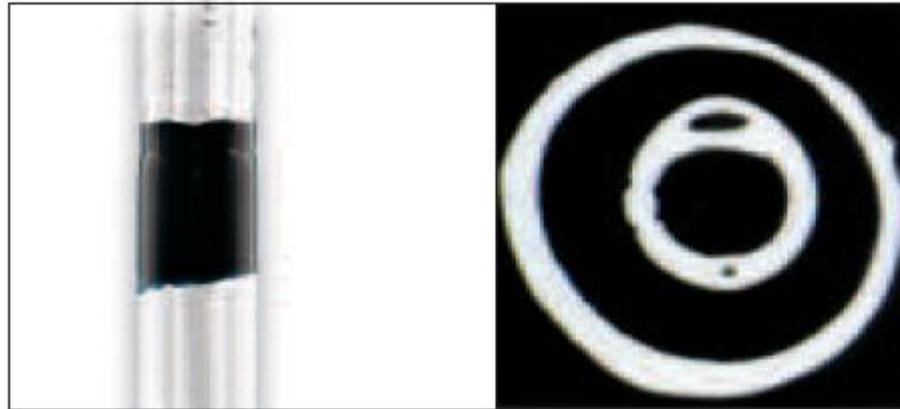
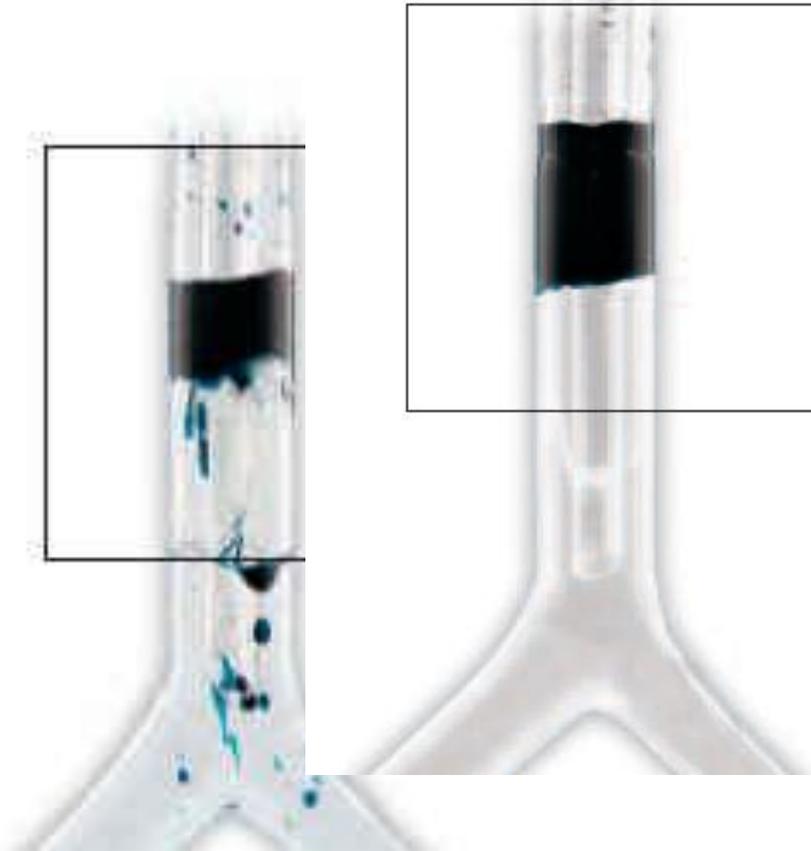
Microcuff ETT

*Lau ACW, Lam SM, Yan WW (2013). A Benchtop Study of leakages Across the Portex, TaperGuard and Microcuff Endotracheal Tubes Under Simulated Clinical Condition. Hong Kong Medical Journal*

*Mechanical Ventilation at PEEP = 0 with different cuff pressures*



# New ETT to prevent aspiration of subglottic secretion



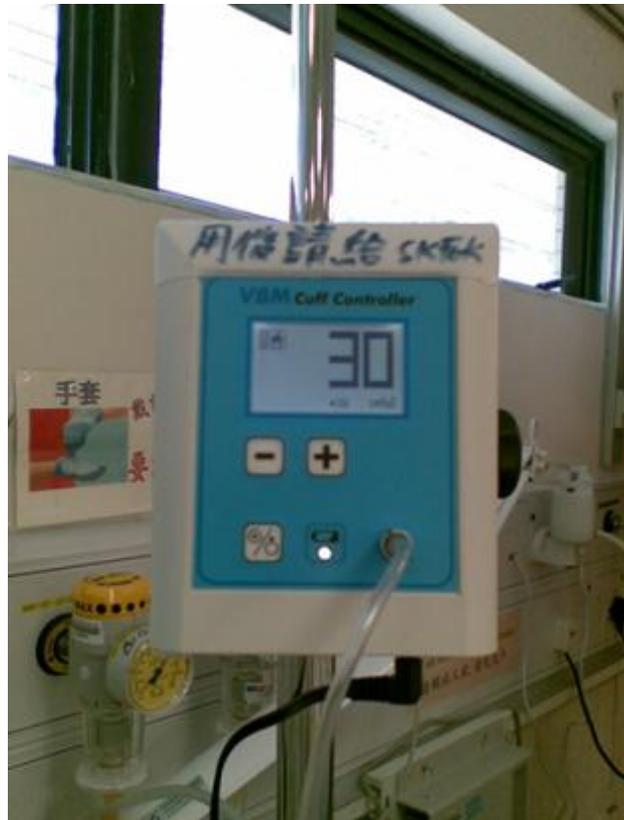
Note the absence of visible channel openings in the MICROCUFF\* tube

CT scan<sup>3,4</sup> (transversal) of an inflated KIMBERLY-CLARK\* MICROCUFF\* Tube in excised animal trachea (cuff pressure: 20 cm H<sub>2</sub>O)

The MICROCUFF\* tube has advanced microthin polyurethane cuff material that allows the channels to "self-seal," reducing the possibility of leakage

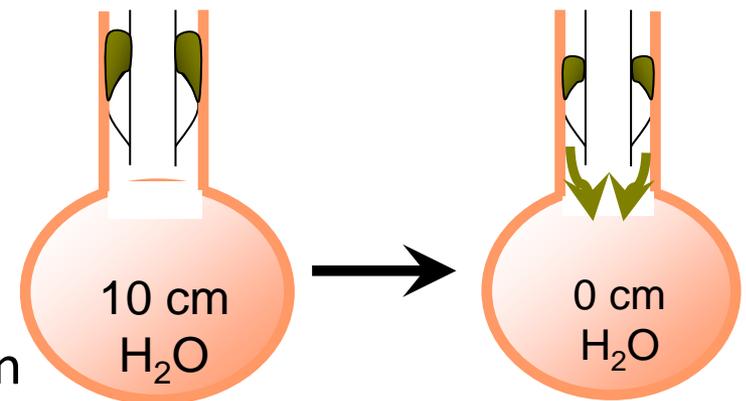
# Strategy 4: Minimize Micro-aspiration with New Cuff Monitoring Device

- Promote use of
  - continuous cuff monitoring device



# Strategy 5: Minimize Micro-aspiration with Revised Ventilator Care Practice

- Promote minimal disconnection of ventilator circuit
  - Use of heated humidification instead of HME
  - Perform ETT suction only as needed
  - Perform oropharyngeal suction at regular interval and before disconnection of ventilator circuit



Trial use of Hamilton ventilators (can be used for transport)



Circuit breaks promote aspiration especially in high PEEP

# Strategy 6 : A Quality System in Place (1)

	<b>PAMELA YOUDE NETHERSOLE EASTERN HOSPITAL</b>	Doc. no.	PYN-ICU-AA-GL-046-R0
		Effective date	30 Oct 2009
	<b>Intensive Care Unit</b>	Review date	3 Jan 2012
		<b>Guideline on Mechanical Ventilation</b>	Custodian

## 1. Objectives

- 1.1 To provide guidance to junior medical staff on the use of mechanical ventilation and the prescription of initial ventilator settings in mechanically ventilated patients in ICU
- 1.2 To provide guidance to nurse on the specific nursing care to patient with mechanical ventilation and the reference of initial ventilator setting in standby mode.

..... |  
 9.3.6 Attend to ventilator alarms promptly (Appendix II)

9.3.7 Carry the following infection control measures to prevent VAP:

- √ Elevate head of bed at least 30-45 °
- √ Perform endotracheal and oral suctioning as needed,

# Strategy 6 : A Quality System in Place (2)

## Quality Improvement Project:

### Prevention of Ventilator-associated Pneumonia (VAP) In Critical Care Areas, HKEC

Data collection form (updated on 24<sup>th</sup> Jan 2013)

Fill in, circle or put a ✓ where it is appropriate.

D10/B10 Bed no. \_\_\_\_\_

Date of ICU admission \_\_\_\_\_

Transfer in from AED/ OT/ general ward/ other hospital

Admission : Elective/ Emergency/ Trauma

Specialty : Surgery/ Medicine/ Neurosurgery/ Others

Date of intubation \_\_\_\_\_ Type of ETT : Standard/Microcuff/Others \_\_\_\_\_

Date & time of extubation \_\_\_\_\_

Date of reintubation \_\_\_\_\_

Date of tracheostomy \_\_\_\_\_

Affix patient label here

Refer to the flowchart overleaf for different criteria (PNU1, PNU2, PNU3) used in defining VAP.

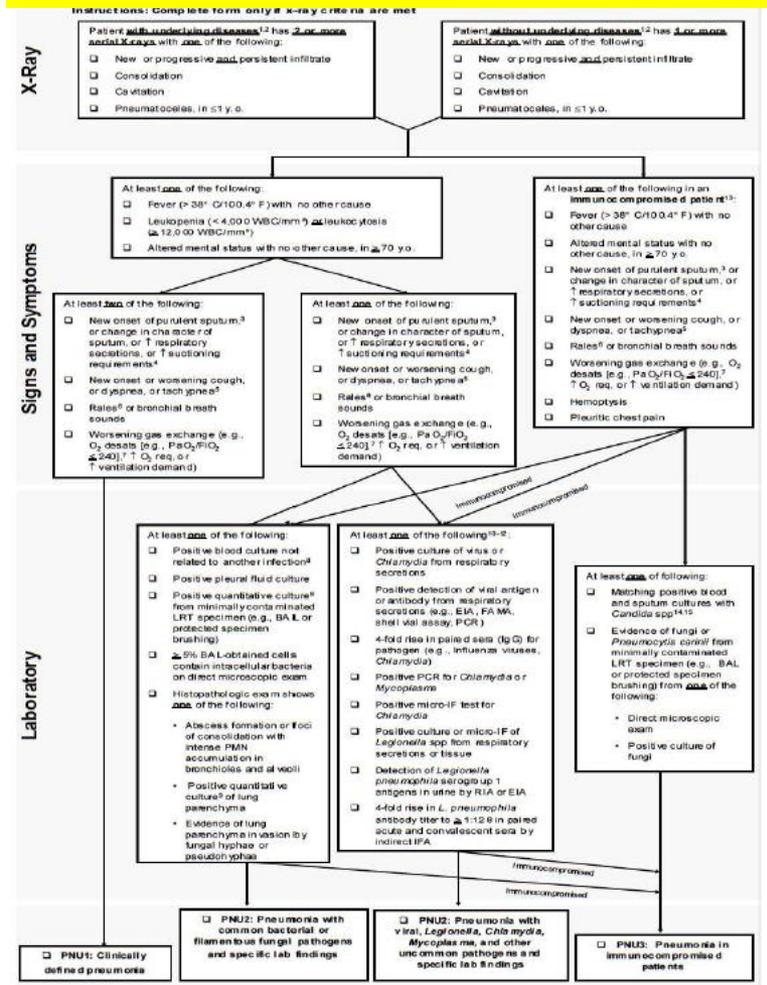
Continue to fill in the form and monitor for VAP until 48 hours after extubation (include those patients having extubation in OT & being transferred to ICU post-op)

Assess patient for VAP and fill in the form daily by case MO preferably before 1pm.

Date									
VAP	Yes								
	No								
Dr's Signature									

Daily round to capture any VAP

## CDC surveillance- Pneumonia flow diagram



# Strategy 6 : A Quality System in Place (3)

<b>Quality Improvement Project: Prevention of Ventilator-associated Pneumonia (VAP) in Critical Care Areas, HKEC</b>						Affix patient label here					
<b>Ventilator Bundle Checklist updated on 28 Feb 2013</b>											
Put "√" if done, "NA" if not applicable & specify reason											
	Check once daily in the morning shift										
Item No.	Ventilator Bundle	Date									
1	Elevate HOB (30 - 45°) & patient not sliding down										
2	Perform regular oral care with antiseptic oral rinse if needed										
3	Perform hand hygiene before and after each respiratory care										
4	Review sedation target daily										
5	Assess readiness to wean and to extubate daily										
6	Drain condensate of the ventilator circuit before repositioning of patient										
7	Carry out disinfection of the respiratory consumables and equipment a/c to protocol										
8	Check & maintain appropriated ETT cuff pressure (25 - 30 cm H <sub>2</sub> O)										
9	Verify correct placement of the feeding tube at regular interval										
10	Regular assessment of patient's tolerance to NG feeding										
	Signed by nurse										
Specific reason if "not applicable" is selected											
Date	Item No.	Reason	Date	Item No.	Reason						

Get familiar with the ventilator bundle with a checklist

# Strategy 6 : A Quality System in Place (4)

- Discuss VAP issue at regular ICU meeting

## 321<sup>st</sup> ICU Meeting

**Date:** 31<sup>st</sup> January 2013 (Thursday)

**Time:** 15:00hour

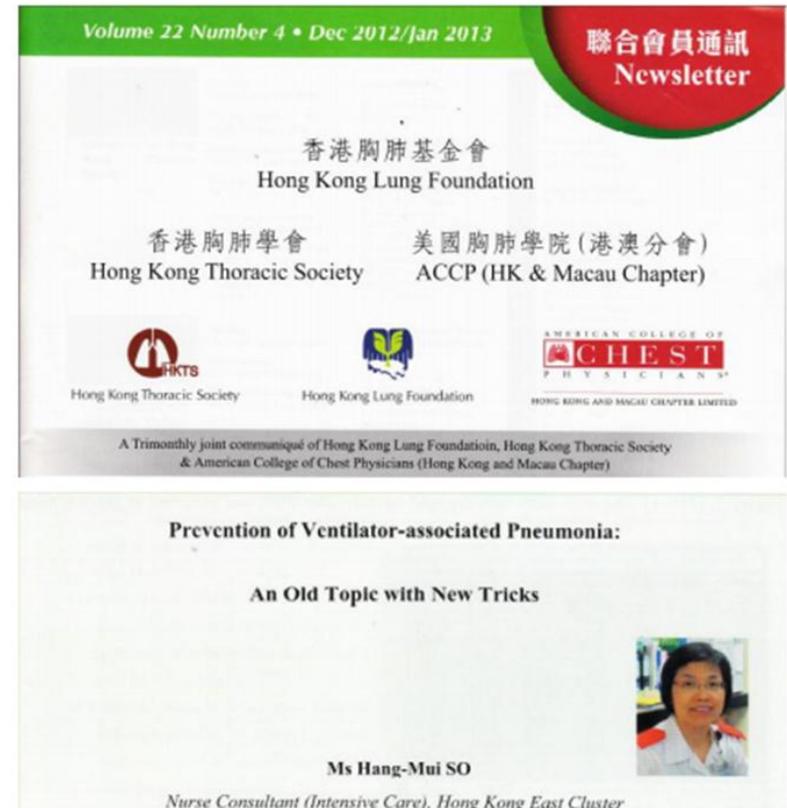
**Venue:** D10, Conference Room, PYNEH

## Agenda

- 1 Confirmation of Last Minutes and Matters Arising from Last Minutes
- 2 Matters Related to Hospital Committees
- 3 Staff Issue
- 4 Avian Flu / Novel Coronavirus / Infection Control
- 5 OSH / AIRS
- 6 CIS
- 7 Core Groups Report
- 8 Incident Review
- 9 ICU Family Satisfaction Enhancement Programme (FAME)
- 10 VAP
- 11 Any Other Business
- 12 Date of next meeting

# Strategy 7: Promotion to Encourage Sharing

- Articles on Prevention of VAP
  - by Novel Endotracheal Tube Designs. Lam S M et al. Feb 2011
  - An Old Topic with New Tricks. SO HM Jan 2013
- Can access the articles via web
  - Hong Kong Resp Med: [www.hkresp.com](http://www.hkresp.com)
  - Hong Kong Society of Critical Care Medicine: [www.hkscm.org](http://www.hkscm.org)

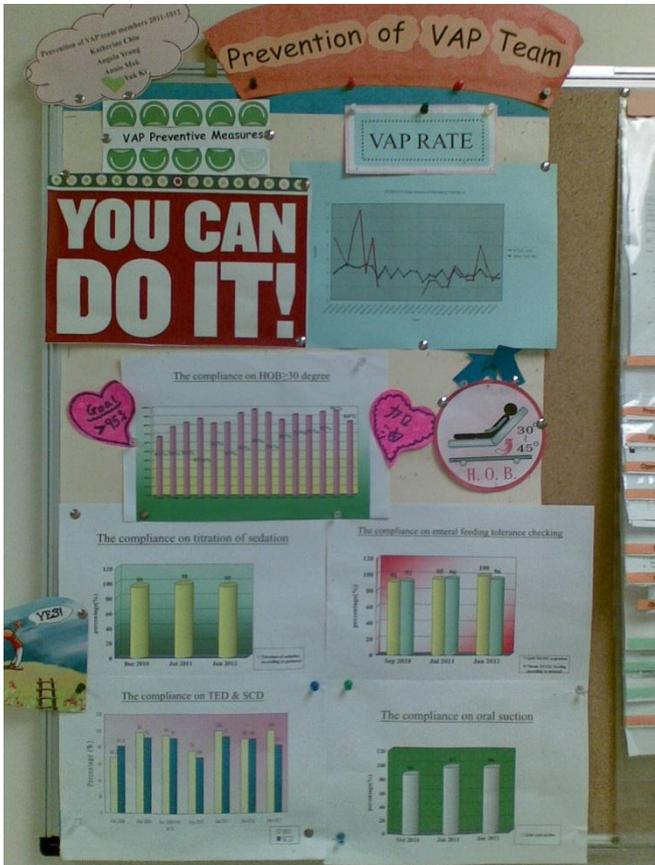


# Process Evaluation

- Obtain baseline compliance rate on ventilator bundle
- Plan to conduct compliance audit at a six month period

# Outcome Evaluation

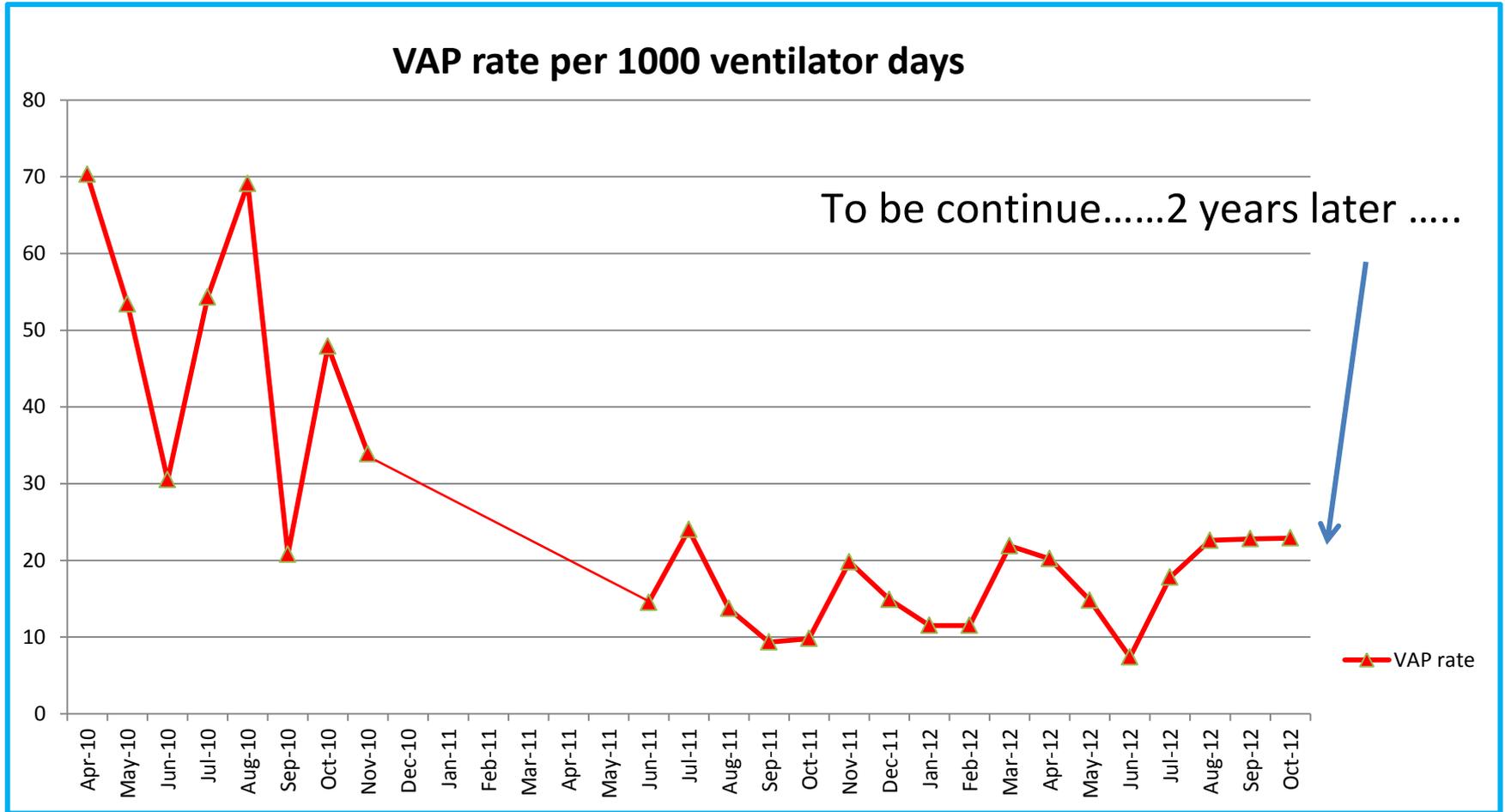
- Monitor VAP rate at a monthly basis
- Post up the VAP rate on display board at a prominent place
- Disseminate compliance audit results



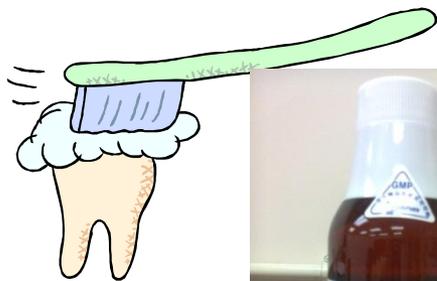
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# The Outcome of the Prevention of VAP Project : VAP rate



# Way Forward (1)



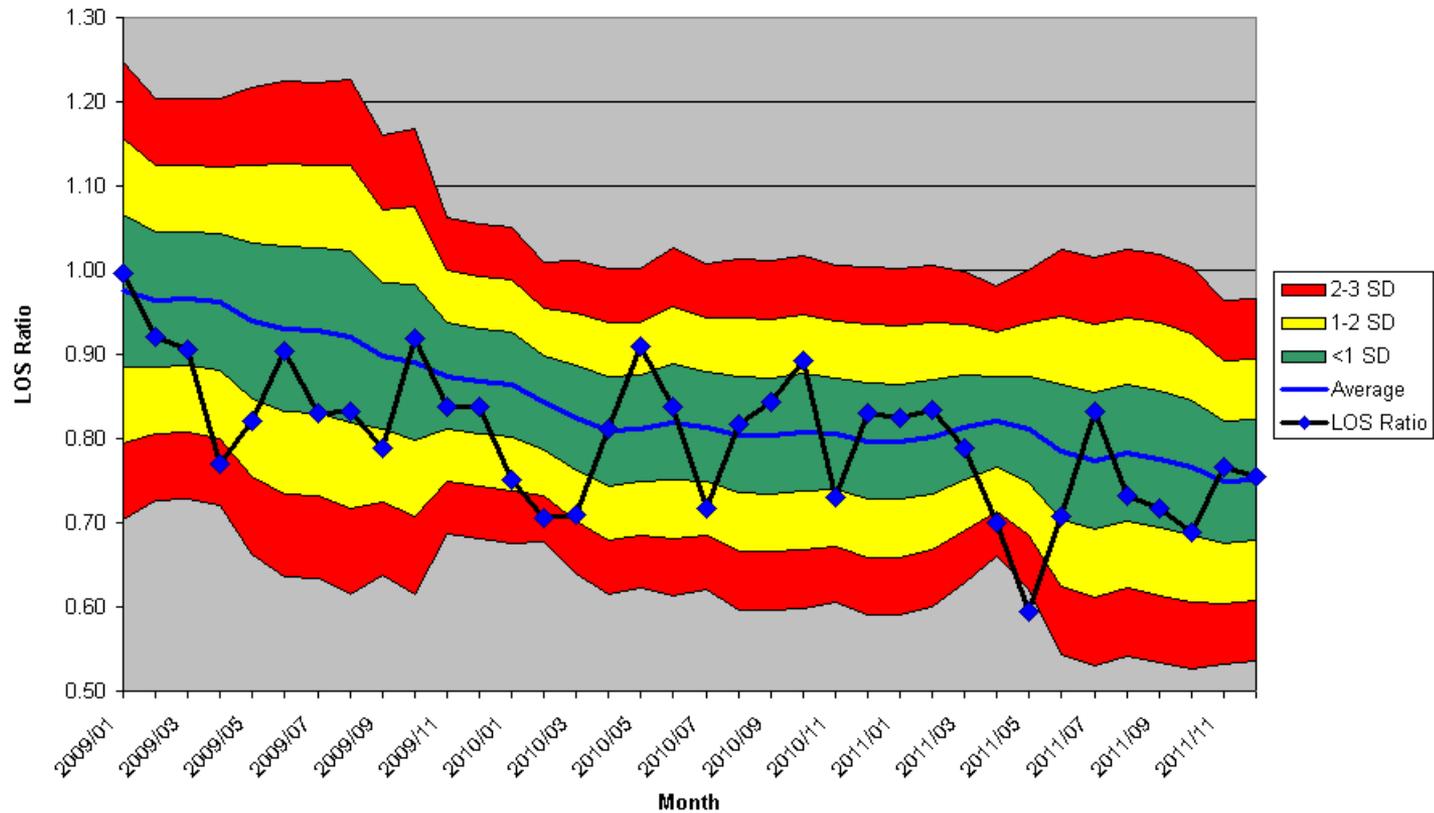
Workshop on healthcare associated infections and pathogens in ICU

# Way Forward (2)

- Dilemma : high VAP rate yet with good ICU performance 
- VAP rate monitoring as a regular item?
- Review ventilator bundle in HK ICUs so as to examine present practice ?
- Multidisciplinary collaboration?

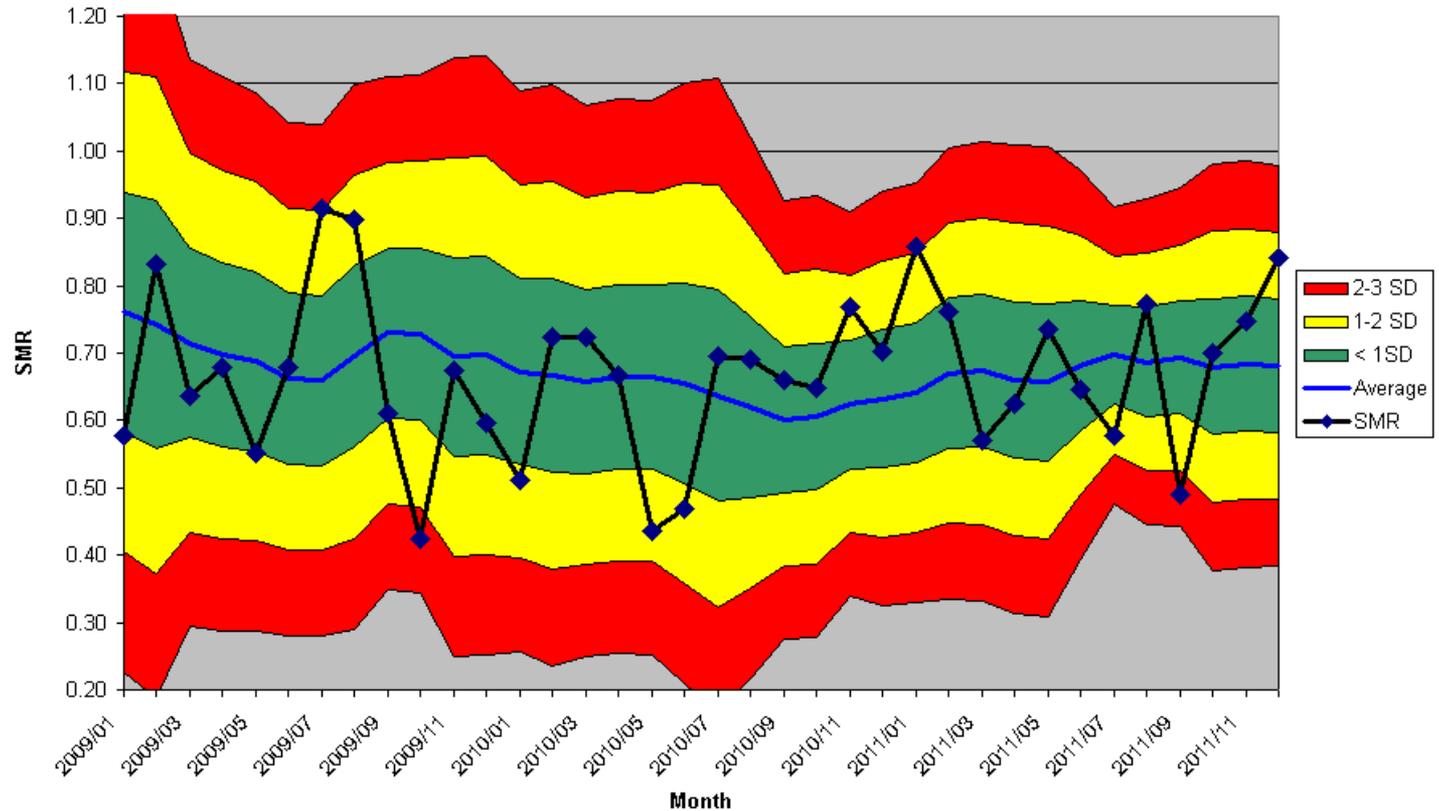
# ICU of PYNEH

s-chart for APACHE IV Length of Stay Ratio  
(Run Length = 12)



# ICU of PYNEH

s-chart for APACHE IV Standardized Mortality Ratio  
(Run Length = 12)



# Way Forward (2)

- Dilemma : high VAP rate yet with good ICU performance. VAP audit as a KPI ?
- VAP rate monitoring as a regular item?
- Review ventilator bundle in HK ICUs so as to examine present practice ?
- Multidisciplinary collaboration?

# Thank You



# Thanks To

- All task force members
- Colleagues from different clusters ICUs
- ICU staff of RH C/ICU and PYNEH ICU

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