

## A Multi-pronged Strategic Approach to Prevent Ventilator-Associated Pneumonia in ICU

SO Hang Mui Nurse Consultant (Intensive Care), HKEC 8 May 2014





## Ventilator Associated Pneumonia (VAP)

## **Definition:**



Pneumonia that occurs in a patient who was intubated and ventilated at time of or within 48 hours before onset of pneumonia.

NHSN, CDC, <a href="www.cdc.gov/nhsn">www.cdc.gov/nhsn</a>
(National Healthcare Safety Network)

NHS Report 2010

### **VAP**

### **Incidence & Impact**

- 10-20% of MV patients
- Highest in Neurosurgical,

Edwards JR, e

0-5.8 per 1000 ventilator days

**Aware** ↑↑↑ VAP rate in **ICU of PYNEH** (40-70 per 1000 ventilator days In 2010) Dudec Report 2010

• 1 to 12.5 per 1000 device-days, attributable mortality: 13% (n=6284, Nelson WG et al, Lancet Infect Dis 2013)

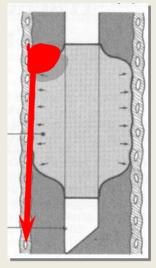
## Revisit the VAP Process

### 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**





Shiao

Evidence-based interdisciplinary knowledge for high acuity and critical care



- ✓ Antiseptic oral rinse
- ✓ Perform hand hygiene
- ✓ Assess patient's readiness to wean and to extubate
- ✓ Prevent condensate from entering patient's airway
- ✓ Maintain proper care to respiratory consumables
- ✓ Conduct ongoing VAP surveillance

衛生防護中心 Centre for Health Protection

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

#### 2006

#### **Getting Started Kit:**

Prevent Ventilator-Associated Pneumonia

How-to Guide

#### **VENTILATOR ASSOCIATED PNEUMONIA**

#### e Alert Statements

patients receiving mechanical ventilation, as well as those at high risk for aspiration (e.g., decreased level of sciousness; enteral tube in place), should have the head of the bed (HOB) elevated at an angle of 30 to 45° unless dically contraindicated. "7" (Level VI)

e an endotracheal tube (ET) with a dartioning of tracheal secretions that ac not routinely change, on the basis o

#### rting Evidence

cally ill patients who are intubated for umonia (VAP)<sup>1,2,16,20</sup> and those intubude decreased level of consciousnes ention, presence of gastric or small intention to occur at rates of 10 to 35 car.

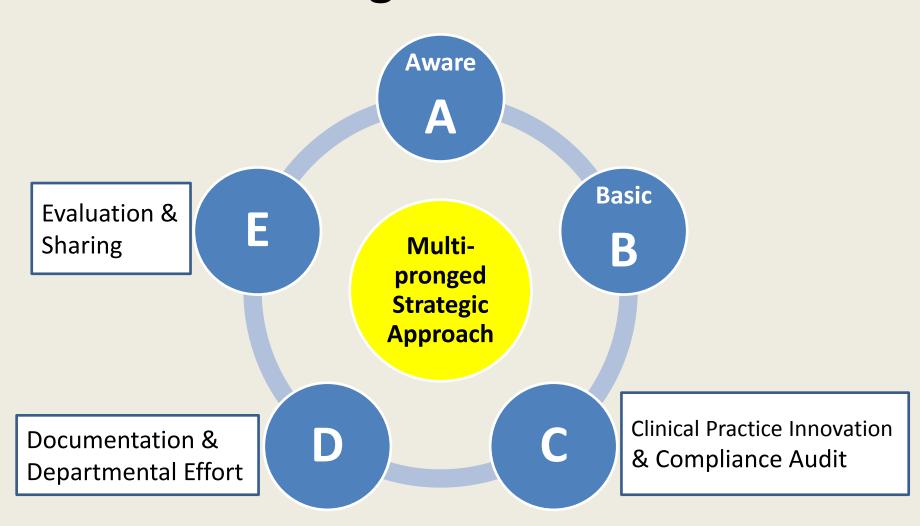


2012

oundation to Fight Against Nosocomial Infections

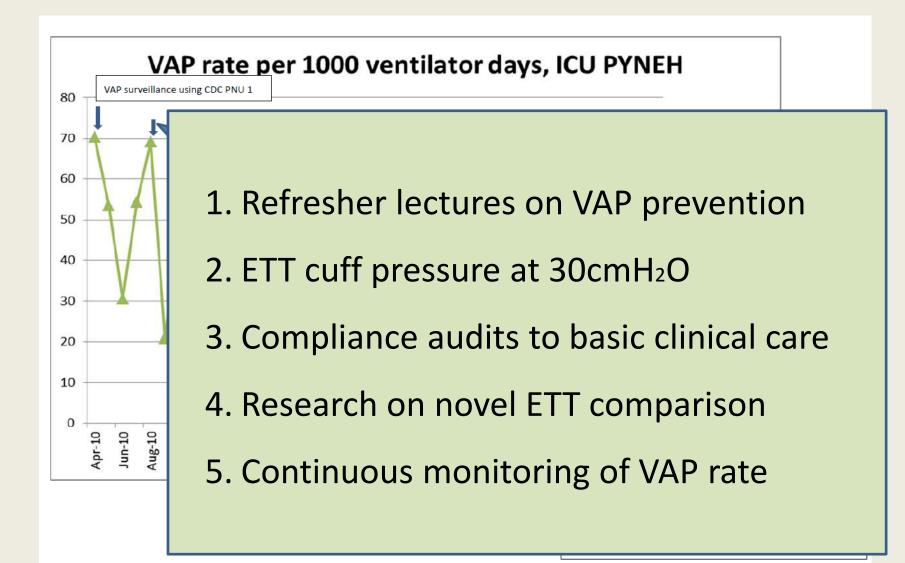
INICC Bundle to Prevent Health Care Associated Pneumonia in Intensive Care Units: An International Perspective.

# How did we deal with a high VAP & bring it down?



# **Multi-pronged Strategic Approach**

#### Started from late 2010



## Staff Education : Do the Basics

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



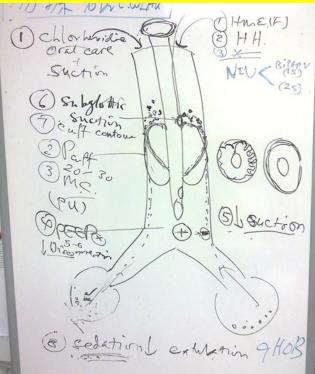
Included in orientation of new staff

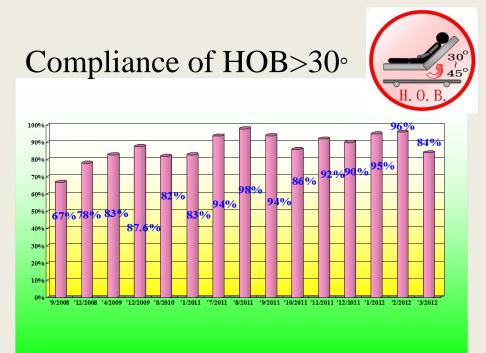
# Visual display for better promotion

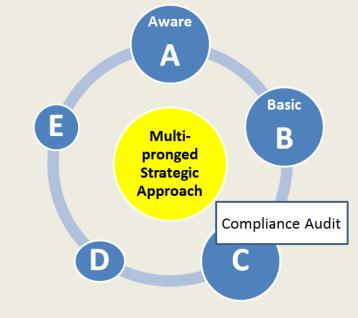
Basic

Multipronged

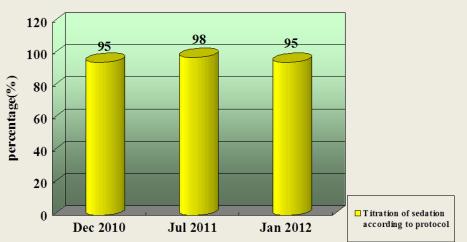
Strategic Approach



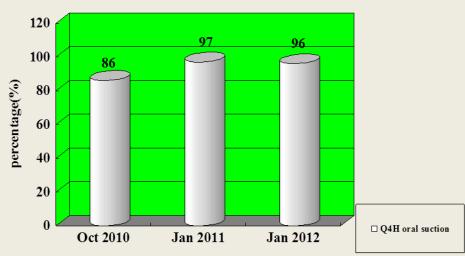




The compliance on titration of sedation



The compliance on oral suction



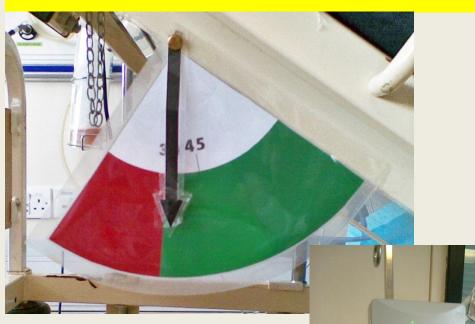
Process audit on staff compliance to VAP prevention measures, ICU PYNEH

#### **Try New Tricks:**

(1)Promote HOB with Visual Indicators

Tilt Sensor

#### **Innovative home-made HOB indicator**



Green light showed HOB at 30-45°

#### Reverse trendelenberg

**Basic** 

Clinical Practice Innovation

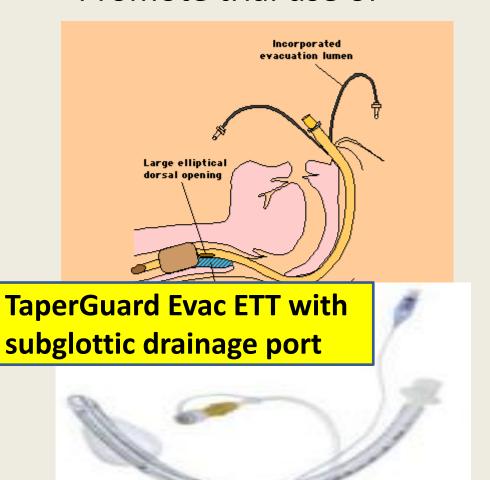
Multipronged

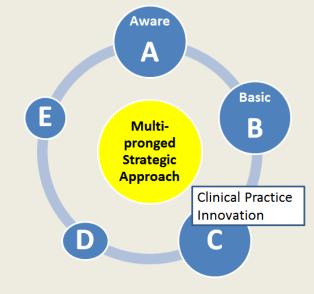
Strategic Approach

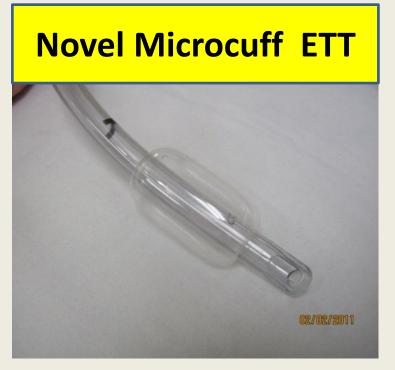


# (2) Minimize Micro-aspiration with New ETT designs

Promote trial use of







# (3) Results of a recent research of our group on novel ETT

Benchtop study of leakages across the Portex,  $_{A-R-T-1}^{O-R-1}$   $_{C-L-E}^{N-A-L}$  TaperGuard and Microcuff Endotracheal tubes under simulated clinical conditions

Arthur CW Lau 劉俊穎 SM Lam 林倩雯 WW Yan 殷榮華

ONLINE FIRST

print version.

DOI: 10.12809/hkmj133930

This article was published on

22 July 2013 at <www.hkmj.org>.

This version may differ from the

Objectives To compare three endotracheal tubes for leakage across the cuff (microaspiration) under a comprehensive set of simulate clinical situations. These were the Mallinckrodt TaperGu (Covidien, US) with a tapered polyvinyl chloride cuff; KimVent Microcuff (Kimberly-Clark Health Care, US) wi cylindrical polyurethane cuff, and a conventional Portex (Sn Medical International Ltd, UK) with a globular polyvinyl chlo cuff.

Design A benchtop experimental study.

Setting and materials A silicone cylinder serving as the model trachea with each of the three endotracheal tubes, one 20 mL of water were added above the cut every minute for 20 minutes under ventilation scenarios, including ositive end-expiratory with and without spontaneous pressure levels, and disco breathing efforts. nario was studied under three cuff and 30 cm H<sub>s</sub>O, and then repeated with the pressures of 19 of a continuous suction force of 200 cm H<sub>2</sub>O, and ge measured every minute for 3 minutes.



Results The outcome of interest was the cumulative amount of leakage. The Microcuff endotracheal tubes with an ultrathin polyurethane cuff consistently provided the best protection against microaspiration under all simulated clinical situations, followed by TaperGuard with a tapered cuff, and lastly Portex with a globular polyvinyl chloride cuff. Clinical scenarios associated with the greatest leakage were mechanical ventilation with zero positive end-expiratory pressure, circuit disconnection with spontaneous breathing efforts, application of suction, and a low cuff pressure.

Conclusions Microcuff endotracheal tubes outperformed TaperGuard and Portex endotracheal tubes in preventing microaspiration,

Basic Multipronged Strategic Approach Clinical Practice Innovation

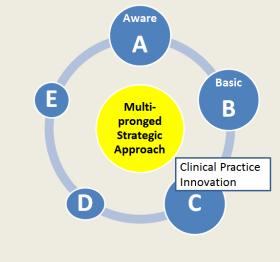
**Results: Microcuff ETT** provide the best protection against microaspiration



Ref: Lau ACW, Lam SM, Yan WW. HKMJ 2014, Vol.20 No.1 p.7-15

## (4): Minimize Micro-aspiration with **New Cuff Monitoring Device**

Promote use of continuous cuff monitoring device







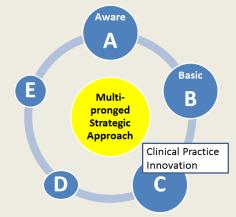


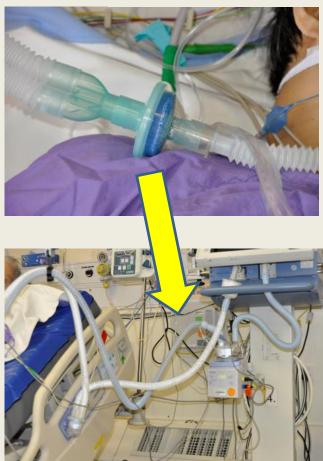
 VAP when compared with intermittent pressure control device.

Lorente, et al. (2014). Critical Care, 18: R77

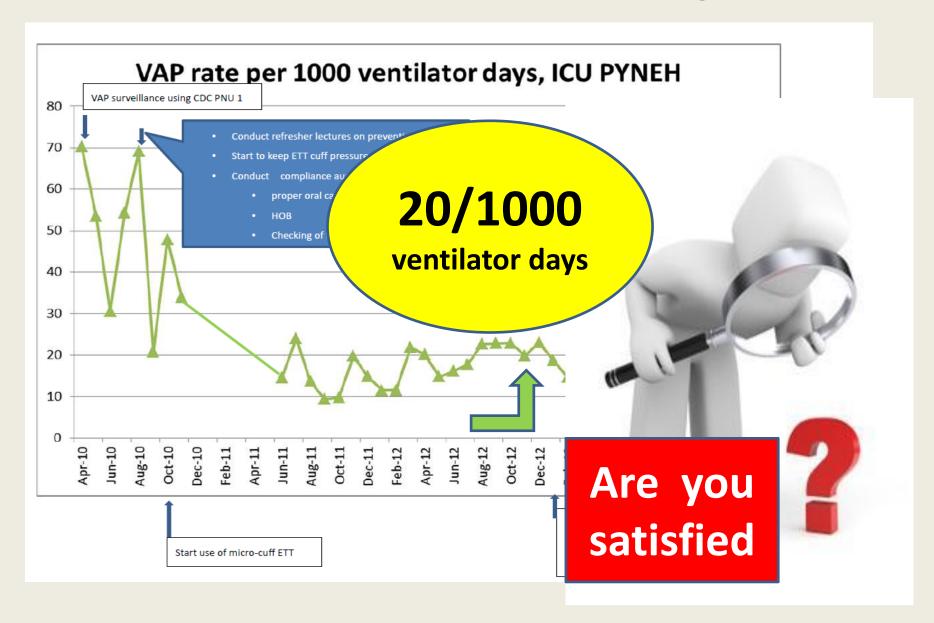
# (5)To do more .....

- 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

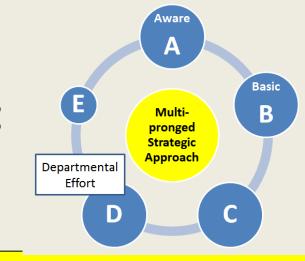




## 2012: VAP rate similar, rising?



# Departmental Effort : A Quality Improvement Project



#### 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

- 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)

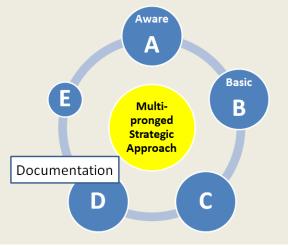
- Phase III: Review ventilator bundle and conduct training to all staff on VAP prevention program (complete before 1 Mar 2013)
- 4. Phase IV : Enforcement of ventilator bundle (start time : on 1 Mar 2013) Duration : 2 year

### Set up a task force

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

H - Key Members as at 26 Nov. 2012 -

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



No Dr's Signature

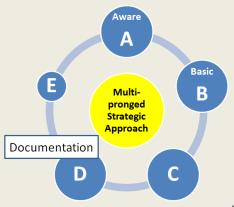
#### Structured Surveillance on VAP

#### CDC surveillance criteria 2009-Pneumonia flow diagram

	Preve	ntion of	Ventilat	or-associ	ated Pne	umonia (	VAP) In C	ritical Ca	re Areas,	HKEC
Data col	llection	form (upd	ated on 24 <sup>th</sup>	Jan 2013)						
Fill in, ci	ircle or	put a √wl	ere it is ap	propriate.						
D10/B10	0 Bed no	0				Affix pati	ent label he	ere		
Date of	ICU adn	nission								
Transfer	r in from	AED/ OT/	general wa	rd/ other ho	spital					
Admissio	ion : Elec	ctive/ Eme	rgency/ Tra	uma						
Specialt	y : Surg	ery/ Medio	ine/ Neuro	surgery/ Oth	ners					
Date of	intubati	ion					Type of E	TT : Standar	rd/Microcuf	f/Others
Date & t	time of	extubation								
Data of	rointub	ation								
	•					•			y V	4P
Refer to	the flo	wchart ov	erleaf for d	fferent crite	eria (PNU1,	PNU2, PNU	3) used in d	lefining VA	Р.	
			n and moni nsferred to I		until 48 ho	urs after ex	tubation (in	clude those	patients hav	ing
Assess p	patient f	for VAP an	d fill in the	form daily l	by case MO	preferably	before 1pm	ı.		
Date										
Y	Yes									

**Quality Improvement Project:** 

P	atient with underlying diseases 12 has a ental X-rays with one of the following:	2 or more Pa	tient without underlying diseases 12 has 1 or more rial X-rays, with one of the following:
			New or progressive and persistent infiltrate
0	Consolidation	a a	Consolidation
0	Ca vitation		Cavitation
	Pneumatoceles, in ≤1 y. o.		Preumatoceles, in ≤1 y.o.
	ř	$\perp$	1
	At least one of the following:  D Fever (> 38° C/100.4° F) with	Control of the Contro	At least one of the following in an immunocompromise of patient <sup>13</sup> :  Di Fever (> 38° C/100.4° F) with no
	Leukopenia (< 4,000 WBC/mm*)	n ) at leukoc ytosis	othercause
	☐ Altered merital status with no e	othercause, in ≥70 yo	Altered mental status with no other dause, in ≥ 70 y o
			New onset of purulent sputum,3 or change in character of sputum, or
Atleas	t two of the following:	At least one of the following:	↑ respiratory secretions, or ↑ suctioning requirements⁴
O N	ew onset of purulent sputum.3	☐ New onset of purulent spe	utum,3
	change in character of outum, or 1 respiratory	or change in character of s or Traspiratory secretions	, or D Raiss® or bronchial breath sounds
8	actations, or 1 suctioning equirements.4	↑ suctioning requirements	□ Worsening gas exchange (e.g., O
- N	ew onset or womening cough,	<ul> <li>New onset or worsening or or dyspnea, or tach yone at</li> </ul>	denote to a Part /Pirt a sent 7
0	r dyspnea, or tach ypnea <sup>5</sup>	☐ Rales® or bronchial breath	Hemoptysis
	ales <sup>6</sup> or bronchial breath ounds	eounds  ☐ Worsening gas exchange	O Discribe short only
0 v	Vorsening gas exchange (e.g.,	O <sub>2</sub> desats [e.g., Pa O <sub>2</sub> /FiO <sub>2</sub> ≤240] <sup>7</sup> ↑ O <sub>3</sub> req, or ↑ ven	
4	y desats [e.g., PaO₂/FiO₂ 240],7 ↑ O₂ req.or ventilation demand)	±2401 ° ↑ O₂ req. or ↑ ven demand)	tilation
			Manage Manage Account
	At least and of the following:    Positive blood culture nor related to another infection   Positive pleared fluid culti-   Positive pleared fluid culti-   Positive quantitative culti- from minimally conta mini- LRT specimen (e.g., BA I protected specimen brushing)   2 9th BA Lobtained cells contain intracellular back on direct microscopic exe on direct microscopic exe histopathelogic exe main- and or the following:  - Abaces formation or for or consolidation with intense PMN accumulate on in bronchioles and al vooil  - Positive quantitative culture* of lung pasenchyma.	At least and of the folio  Positive culture of  proper of the folion of	wing 19-92.  White of spolland by of Vital antigen septratory of Vital antigen septratory.  OR)  At least tone, of following:  Metaphing positive is dood and sputime cultures with Candidate spot 19-72.  OR (a) deam (g C) for Usernam vitalese.  Chiamydia or following:  Diamydia or following:  At least tone, of following:  Metaphing positive is dood and sputime cultures with Candidate spot 19-72.  We deeme of fungi from minimally content native LICT specimen 6-2, 8-84.  Diamydia or fine following:  Diamydia or following:  Metaphing positive is dood and sputime cultures with Candidate spot 19-72.  Diamydia or following:  Metaphing positive is dood and sputime cultures with Candidate spot 19-72.  Diamydia or following:  Metaphing positive is dood and sputime cultures with Candidate spot 19-72.  Province of following:  Metaphing positive is dood and sputime cultures with Candidate spot 19-72.  Diamydia or following:  Diamydia or following:  Metaphing positive is dood and sputime cultures with Candidate spot 19-72.  Diamydia or following:  Diamydia or
	Positive blood culture no related to another infection.  Positive givernif fluid culti- Positive givernif fluid culti- Positive quentitative culti- from minimally conta mini- LET epoclimen (e.g., BAI protected appenden- prusibling).  29% BAI bottained cells contain intracellular back- on direct microcoppie exa mel- ana, of the following:  Abscess formation or if of consolidation with internee PMN accumulation in bronchioles and al void:  Positive quantitative cultives of the control of the contro	At least and of the folio  Positive detection  Positive detection  Positive detection  Positive detection  Positive detection  and antibody from a secret ons you, at lead  or antibody from a secret ons you, at lead  and antibody from a secret ons you, at lead  positive Pos	wing 19-12.  Virus or splinted by of Virul arridge in application of At Seast cos. of following:  Of Virul arridge in application of At Seast cos. of following:  Of Virul arridge in a splinted by of Virul arridge in a splinted by one of At Seast cos. Of the Cardidia splinter in a splinted by one of Propured Search of Tender of Propured Search of Tender of Propured Season of Tender of of
	Positive blood culture no related to another infection.  Positive givernif fluid culti- Positive givernif fluid culti- Positive quantitative culti- Infection minimally conta mini- LET epoclimen (e.g., BA) protected appearimen brusibing.  2 99 BA Lobtained cells contain intsocialist contain intsocialistance on direct misrocopole exe on after the containing of the collection.  Histopathologic exe on a handle of the collection of the collection of the collection.  Abscess formation or for consolidation with intense PMN accumulation in brunchioles and at wolf - Positive quantitative cultural for the collection.  Positive quantitative cultural for the collection of the parameters of the parameters of the cultural for the cultural fo	At least one of the folio Positive culture of positive detection pathogon (p.g., inf Chiamydia)  Positive PCR to r Mycoplasma  Positive positive production of Legional app from secretion of Legional approximation  Detection of Lagrange and positive program machine in unine to 4nd d rise in f. pm antibody there to a part of the positive positive or consideration of positive program machine in the positive program machine in t	wing 19-9:  Virus or spoilable by of Viral arridge in septratory.  Of Viral arridge in septratory.  OR)  At least <u>cone</u> of following:  Matching positive is code and aputum cultures with Cardidal sppt 4-7.  OR (a) de aim (g.C) for ununum viruses.  Columny dia or in turning the continuation of the collowing:  Disamy dia or in turning the continuation of the following:  Disamy dia or in turning from <u>and of the following:</u> Disamy dia or in turning from <u>and of the following:</u> Disamy dia or in turning from <u>and of the following:</u> Disamy dia or in turning from <u>and of the following:</u> Positive culture of fungil  Immunoconsyromsed
	Positive blood culture no related to another infection.  Positive givernif fluid culti- Positive givernif fluid culti- Positive quantitative culti- Infection minimally conta mini- LET epoclimen (e.g., BA) protected appearimen brusibing.  2 99 BA Lobtained cells contain intsocialist contain intsocialistance on direct misrocopole exe on after the containing of the collection.  Histopathologic exe on a handle of the collection of the collection of the collection.  Abscess formation or for consolidation with intense PMN accumulation in brunchioles and at wolf - Positive quantitative cultural for the collection.  Positive quantitative cultural for the collection of the parameters of the parameters of the cultural for the cultural fo	At least and of the folio Positive culture of positive culture of positive culture of positive culture of positive detection of antibody from re- scored on s. (po. 8) and a secret on s. (po. 8) bettetion of Legional aspropriate machine in under b. and of secret on s. (positive unitare or positive unitare or Legional aspropriate machine in under b. and odd rise in d. pre- antibody titer to a secret on society and positive unitare or antipositive unitare or an	wingle-le:  vinus or  spiratory  of Viral antigen respiratory

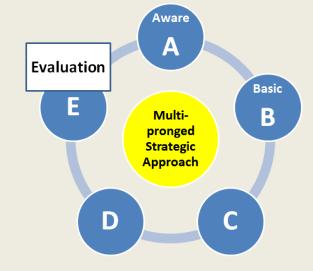


# Design an Ventilator Bundle Checklist

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

Get familiar with the ventilator bundle

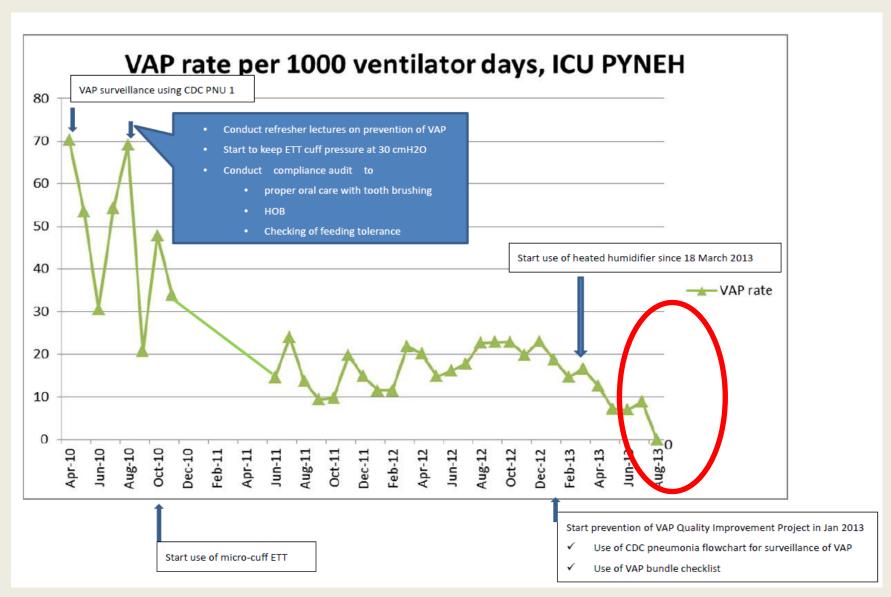
#### **Process Evaluation**



- Obtain baseline compliance rate on ventilator bundle
- Conduct compliance audit at regular period to monitor the sustainability of the good practice

### **2013: VAP rate**





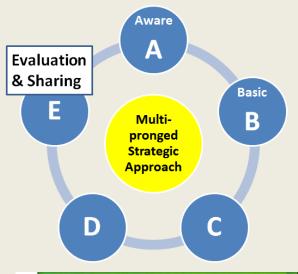
# Reinforce good practice: feedback to staff

- Evaluation & Sharing

  E Multipronged Strategic Approach
  - D C

- ✓ Report monthly VAP rate
- ✓ Eye catching display board
- ✓ Disseminate compliance results





# **Share Good Practices**

#### Articles on Prevention of VAP

- Lau, ACW, Lam SM, Yan WW (2014).
   Benchtop study of leakage across the Portex, TaperGuard and Microcuff Endotracheal tubes under simulated clinical conditions. HKMJ, Vol. 20 No.1, p. 7-15.
- An Old Topic with New Tricks. SO HM Jan 2013
- CICO's Biweekly Update (June 2013)

#### Can access the articles via web

- Hong Kong Resp Med: www.hkresp.com
- Hong Kong Society of Critical Care Medicine: www.hksccm.org
- Hong Kong Medical Journal www.hkmj.org

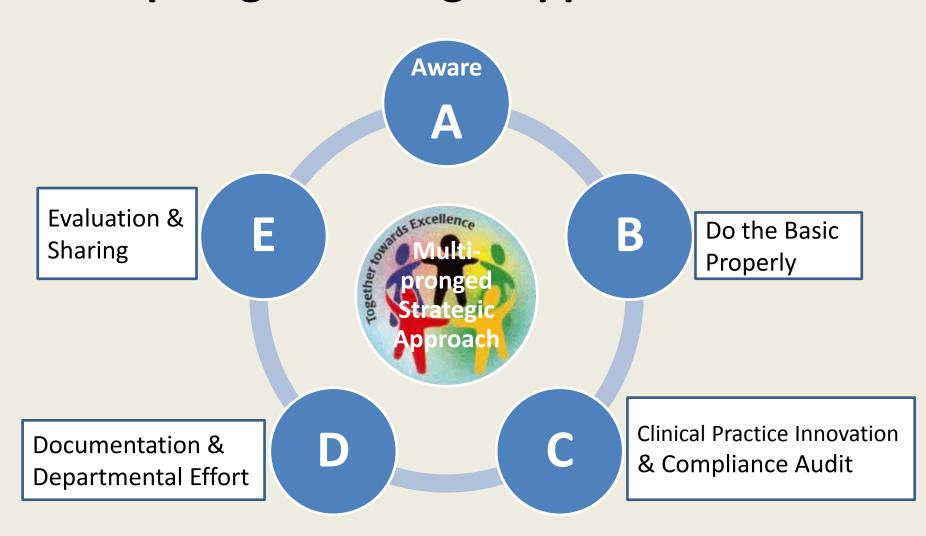


An Old Topic with New Tricks

Ms Hang-Mui SO

Nurse Consultant (Intensive Care), Hong Kong East Cluster

# **Conclusion: Multi-pronged Strategic Approach: ABCDE**



### Thanks to all staff involved

#### On behalf of the team, ICU PYNEH

Chiu Mei Chun, APN

Mok Chi Man, RN

Wong Po Man, RN

Dr Lam Sin Man, AC

Dr Lau Chun Wing, AC

Lau Lan, WM

Nora Kwok, DOM

Dr Yan Wing Wa, COS

