GET THE **FACTS**

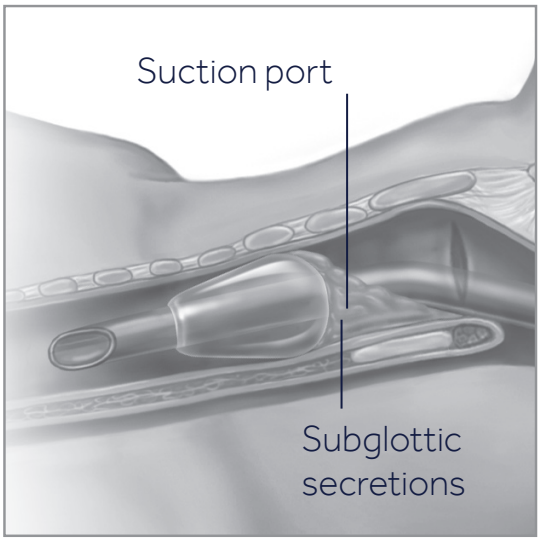
The facts about ventilator-associated pneumonia (VAP) and subglottic secretions drainage (SSD)

VAP incidence and mortality

- VAP is the second most common nosocomial infection in the United States. It's estimated to occur in 9 to 25% of ICU patients.[1-3]
- VAP is associated with increasing ICU stays by up to 22 days and hospital stays by up to 25 days.[4]
- Mortality directly attributable to VAP is estimated to be as high as 27.1%.[5]

Pathogenesis and risk factors

- Aspiration of oral and/or gastric secretions is the primary route of bacterial entry into the lungs and is believed to be a primary factor in the development of VAP.[6]
- Each day on mechanical ventilation increases patient risk for VAP by 1 to 3%.[6]
- Independent predictors of VAP include burns, trauma, central nervous system disease, respiratory disease, cardiac disease, mechanical ventilation in the previous 24 hours, witnessed aspiration, and paralytic agents.[6]
- Clinical investigation has shown evidence of aspiration of gastric contents in 88.9% of ICU patients even when head of bed (HOB) elevation was monitored regularly.[7]



Subglottic secretions drainage (SSD)

- SSD removes oral and/or gastric secretions from above the endotracheal tube cuff before they can be aspirated. SSD must be done with a specialized endotracheal tube with a separate dorsal suction lumen.
- Thirteen randomized, controlled studies examined the efficacy of SSD in reducing VAP. Their findings are summarized in the chart on the following page.

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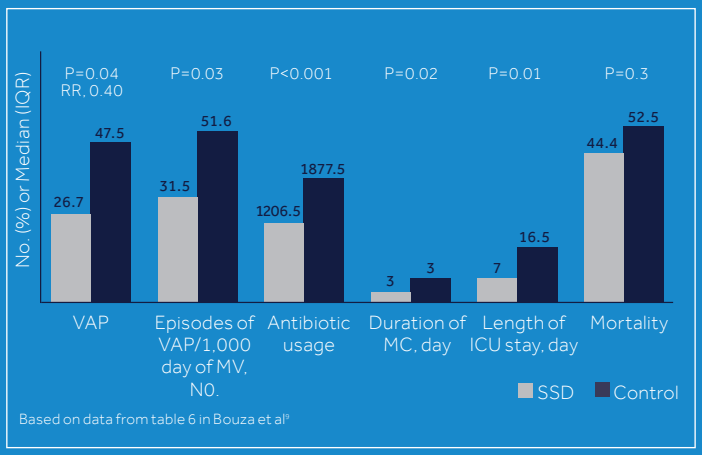
Author and Publish Date	Patient Profile	Percent VAP Rate Study	Percent VAP Rate Control	Relative Risk Reduction	Additional Outcome Improvements	VAP Interventions Already in Place During Study
Damas 2014[8]	ICU patients requiring mechanical ventilation for >48 hours	8.8%	17.6%	50%		▪ Semirecumbent position of at least 30 degrees ▪ Oral care and teeth brushing with chlorhexidine 0.2%, followed by the application of 1% chlorhexidine gel ▪ Cuff pressure control of the endotracheal tube between 20 and 30 cm H_2O ▪ Daily assessment of sedation
Hudson 2014[9]	Cardiac ICU patients requiring mechanical ventilation	1.9%	5.6%	66.1%	The CASS group had lower 30-day in-hospital mortality (2.1% vs. 3.3%; $p < 0.007$), median ventilation time (8.42 vs. 7.3 hours; $p < 0.0001$), and shorter median ICU LOS (1.77 vs. 1.17 days; $p < 0.0004$) compared with the control group.	▪ Semirecumbent positioning ▪ Daily evaluation of readiness for extubation ▪ Oral care and decontamination with chlorhexidine ▪ Initiation of safe enteral nutrition within 24 to 48 hours of ICU admission
Tao 2014[10]	ICU patients requiring mechanical ventilation	13%	40.4%	67.8%		
Perez granda 2013[11]	Cardiac ICU patients requiring mechanical ventilation	16.46%	23.92%	31.2%	The Mallinckrodt™ TaperGuard evac ETT group had a decreased cost of antimicrobials (€71,384 vs. €63,446; $p < 0.002$) and days of mechanical ventilation (507.5 vs. 377.5; $p < 0.009$) compared with the control group.	
Lacherade 2010[12]	ICU patients expected to require mechanical ventilation for >48 hours	14.8%	25.6%	42.2%		▪ Enteral delivery of nutritional support ▪ Cuff pressure maintained between 20 and 30 cm H_2O ▪ Semirecumbent body position
Bouza 2008[13]	Patients expected to be ventilated >48 hours	26.7%	47.5%	44%	In patients intubated >48 hours, use of CASS reduced ICU length of stay by 9.5 days and reduced duration of mechanical ventilation by 4 days. Hospital antibiotic use in daily defined doses (DDD) was less in the CASS group (1213 vs. 1932, $p < 0.001$, and 1392 vs. 1932, $p < 0.001$)	▪ All patients received stress ulcer prophylaxis ▪ In patients intubated >48 hours, all patients but one were maintained in a semirecumbent position when possible.
Lorente 2007[14]	Medical/surgical ICU patients expected to be ventilated >24 hours	Early-onset VAP (<4 days) 3.6%	10.7%	66%		▪ Semirecumbent body position of 40 degrees ▪ Periodic verification every 4 hours of intracuff pressure of 25 cm H_2O ▪ Oral care with chlorhexidine every 8 hours
		Late-onset VAP (>4 days) 9.5%	26.7%	64%		
Liu 2006[15]	Patients expected to be ventilated >48 hours	6%	20%	70%		
Smulders 2002[16]	Surgical ICU patients expected to be ventilated >72 hours	4%	6%	75%		
Bo 2000[17]	Surgical ICU patients expected to be ventilated >72 hours	23%	45%	49%		
Kollef 1999[18]	Cardiothoracic patients (average ventilation 1.5 days)	5%	8.2%	Not statistically significant		
Valles 1995[19]	Medical/surgical ICU patients expected to be ventilated >72 hours	18.4%	32.5%	43%		
Mahul 1992[20]	Medical/surgical ICU patients expected to be ventilated >72 hours	13%	29%	55%		

Defining early- versus late-onset VAP

- Early-onset VAP is defined as VAP occurring <4 days following initial intubation.
- Late-onset VAP is defined as VAP occurring ≥4 days following initial intubation.[21]
- Late-onset VAP is often associated with high-risk pathogens such as methicillin-resistant staphylococcus aureus (MRSA) and with a greater negative impact on patient outcomes and hospital cost.[22]

IN PATIENTS VENTILATED >5 DAYS		
	WITHOUT VAP	**LATE-ONSET VAP**
Hospital stay (days)	29.1[18]	42.7[18]
Duration of mechanical ventilation (days)	12.6[18]	25[18]

Clinical outcomes in patients receiving mechanical ventilation for >48 hours



Based on data from table 6 in Bouza et al[9]

A meta-analysis by Dezfulian et al of 5 studies found that in patients expected to be ventilated >72 hours, removal of subglottic secretions decreased ICU length of stay, decreased duration of mechanical ventilation, and delayed the onset of VAP by 6.9 days.[23]

Cost

- VAP is associated with an increased, incremental cost of $40,000 to the hospital.[4]
- Late-onset VAP is associated with $60,000 in incremental cost to the hospital.[4]

Outcome improvements with SSD

Clinical investigation by Bouza et al found a significant improvement in patient outcomes with the use of an endotracheal tube providing SSD, including:

- Reduced antibiotic use in the overall patient population by 30%
- Reduced ICU length of stay by 9.5 days
- Shortened duration of mechanical ventilation by 4 days[13]

AMERICAN THORACIC SOCIETY/ INFECTIOUS DISEASES SOCIETY OF AMERICA EVIDENCE LEVELS[21]	
EVIDENCE LEVEL	**DEFINITION**
Level I (high)	Evidence comes from well-conducted, randomized controlled trials.
Level II (moderate)	Evidence comes from well-designed, controlled trials without randomization or large case series with systematic analysis of disease patterns and/or microbial etiology.
Level III (low)	Evidence comes from case studies and expert opinion.

CENTERS FOR DISEASE CONTROL AND PREVENTION GUIDELINES[24]	
Category IA	Strongly recommended for implementation and strongly supported by well-designed experimental, clinical, or epidemiologic studies.
Category IB	Strongly recommended for implementation and supported by some clinical or epidemiologic studies and by strong theoretical rationale.
Category IC	Required for implementation, as mandated by federal or state regulation or standard.
Category II	Required for implementation, as mandated by federal or state regulation or standard.
No Recommendation; Unresolved	Practices for which insufficient issue evidence or no consensus exists about efficacy.

SUMMARY OF PUBLISHED GUIDELINES

For prevention of VAP

Guidelines can be a valuable evidence-based resource for facilities seeking to improve their practices to reduce VAP. Following is a summary of selected guidelines, recommendations, bundles, and practice alerts for the prevention of healthcare-associated or ventilator-associated pneumonia. This summary includes guidelines from the American Thoracic Society (ATS) and Infectious Diseases Society of America (IDSA),[21] the Centers for Disease Control and Prevention (CDC),[24] the Canadian Critical Care Society (CCCS),[25] the Agency for Healthcare Research and Quality (AHRQ),[26] the Institute for Healthcare Improvement (IHI),[27] the American Association of Critical Care Nurses (AACN),[28] Safer Healthcare Now (SHN),[25] and the Society for Healthcare Epidemiology of America (SHEA/IDSA).[30]

For the complete recommendations and supporting documentation from each organization, please refer to the published guideline or document.

INTERVENTION	ATS/IDSA	CDC	CCCS	AHRQ	IHI	AACN	SHN	SHEA/ IDSA
Staff education and involvement	I	IA						✓
Appropriate hand disinfection	I	IA						✓
Surveillance of ICU infections	II	IB						✓
Avoid intubation and reintubation when possible	I	II						✓
Noninvasive ventilation when possible	I	II						✓
Oral vs. nasal intubation and gastric tube placement	II	IB	✓				✓	✓
Continuous aspiration of subglottic secretions	I	II	✓ (Consider)	✓		✓	✓	✓
Maintain endotracheal cuff pressures >20 cm H_20	II							✓
Prevent circuit condensate from entering ET tube or nebulizers	II	IB						✓
Adequate staffing levels in ICU	II							
Semirecumbent positioning	I	II	✓	✓	✓	✓	✓	✓
Enteral vs. parenteral nutrition	I	Unresolved						
Routine use of selective digestive decontamination	Not recommended	Unresolved						
Routine use of oral chlorhexidine	Not recommended	Unresolved						
Daily interruption or lightening of sedation	II				✓		✓	✓
Stress bleeding prophylaxis with either H_2 antagonists or sucralfate	Either	Preference unresolved	Sucralfate not recommended	H_2 antagonists	✓		✓	
Change of ventilator circuits only when visibly soiled; no regular changes		IA	✓			✓		✓
Use of heat and moisture exchangers (HMEs)	Unresolved	Unresolved	✓					
Recommendation for closed suction or single-use open suction	No preference	Closed suction						
Kinetic beds			✓ (Consider)					
Oral hygiene program for high-risk patients		II						✓
Tight glycemic control	I							
Deep vein thrombosis (DVT) prophylaxis					✓		✓	
Avoid gastric overdistention								✓

ATS/IDSA evidence levels and CDC guideline categories are defined on previous page. ✓= Included in organization's recommended practices

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