Reducing the Duration of Invasive Mechanical Ventilation in the Medical Intensive Care Unit

Dr Sim Wenyuan[1] | Ms Emelin Tan Pei Xin[2]

[1]Department of Respiratory & Critical Care Medicine (RCCM) | [2]Respiratory Therapy Service

Mission Statement

Decrease the duration of Invasive Mechanical Ventilation (IMV) in Medical Intensive Care Unit (MICU) by 33% from 8.8 days to 5.9 days in a year.

Team Members

	Name	Designation	Department
Team Leaders	Dr Sim Wenyuan	Consultant	RCCM
	Ms Emelin Tan	Principal Respiratory Therapist	Respiratory Therapy
Team Members	Dr Sharlene Ho	Associate Consultant	RCCM
	Dr Edmund Lim	Senior Resident	
	Ms Han Shujuan	Senior Staff Nurse	Nursing
	Ms Pei Yaxin	Senior Staff Nurse	
	Mr Eric Wu	Senior Respiratory Therapy	Respiratory Therapy
Sponsors	A/Prof John Abisheganaden (HOD of RCCM), Ms Lynn Lee Xuan Lin (HOS of Respiratory Therapy & Dr Sennen Lew Jin Wen (MICU Director)		
Mentors	Ms Christina Chia Hui Ling & Adj A/Prof Tai Hwei Yee		

Evidence for a Problem Worth Solving

Cumulative exposure to IMV is associated with potentially harmful co-interventions (e.g. sedation, immobilisation), increased morbidity (e.g. VAP - ventilator-associated pneumonia) and mortality, as well as long-term functional sequelae and cognitive impairment. Furthermore, longer durations of IMV also increase the complexity and cost of healthcare.

Risk for VAP is greatest during the first 5 days of mechanical ventilation (3%) with the mean duration between intubation and development of VAP being 3.3 days [1], [7]. This risk declines to 2 %/day between days 5 to 10 of ventilation, and 1 %/day thereafter [1], [8]. Earlier studies placed the attributable mortality for VAP at between 33-50%, but this rate is variable and relies heavily on the underlying medical illness [1]. Over the years, the attributable risk of death has decreased and is more recently estimated at 9-13% [9], [10], largely because of implementation of preventive strategies. Approximately 50% of all antibiotics administered in ICUs are for treatment of VAP [2], [4].

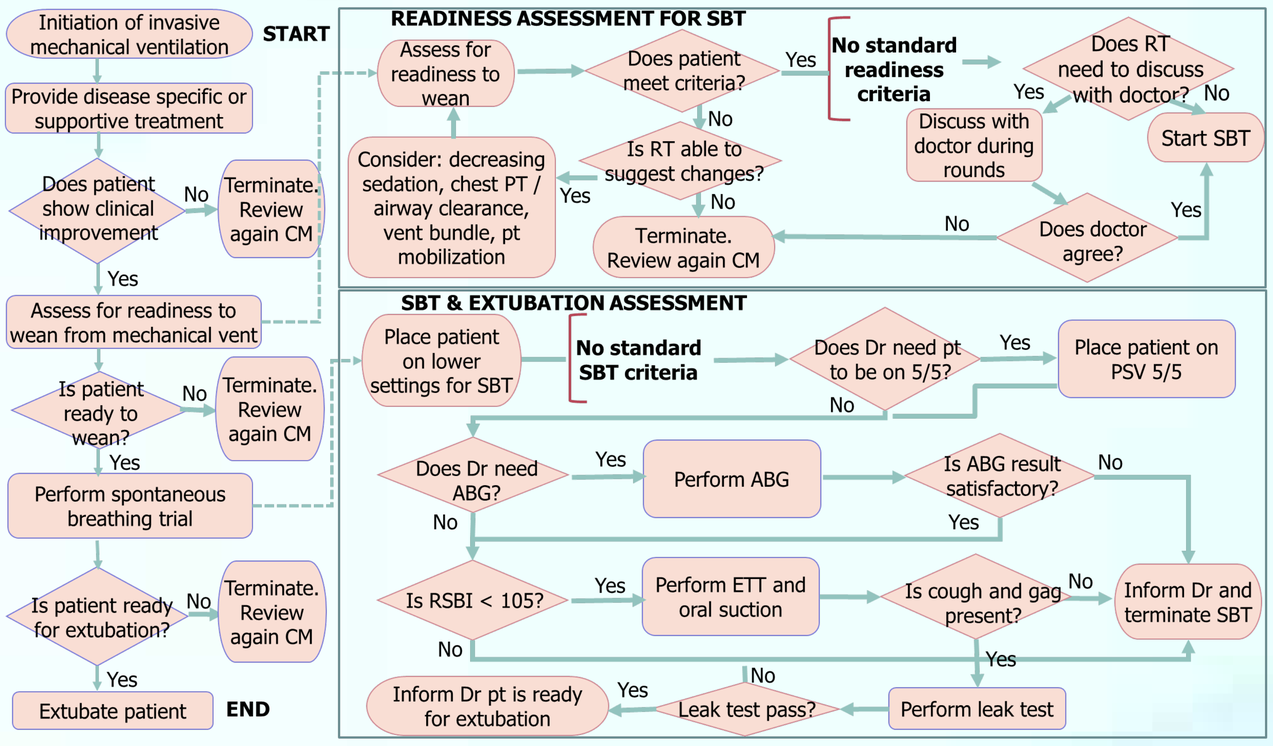
Kalanuria, Atul Ashok et al. "Ventilator-associated pneumonia in the ICU". Critical care (London, England) vol. 18,2 208.

International
Median duration: **3 days**
Mean duration: **5.9 days**

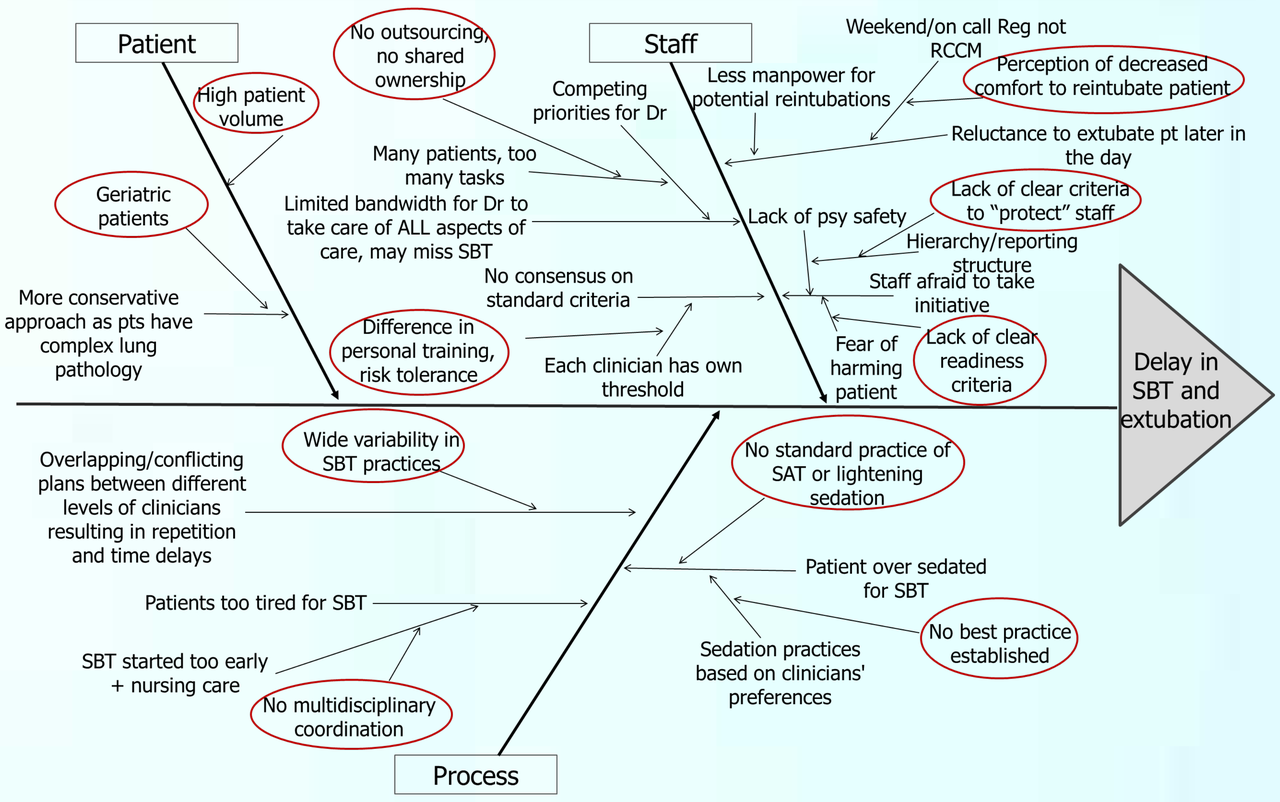
TTSH MICU (Jan-Dec 2021)
Median duration: **4 days**
Mean duration: **8.8 days**

A patient who remains on IMV for 10 days would have a 25% risk of VAP which increases to 35% at 20 days

Flow Chart of Process

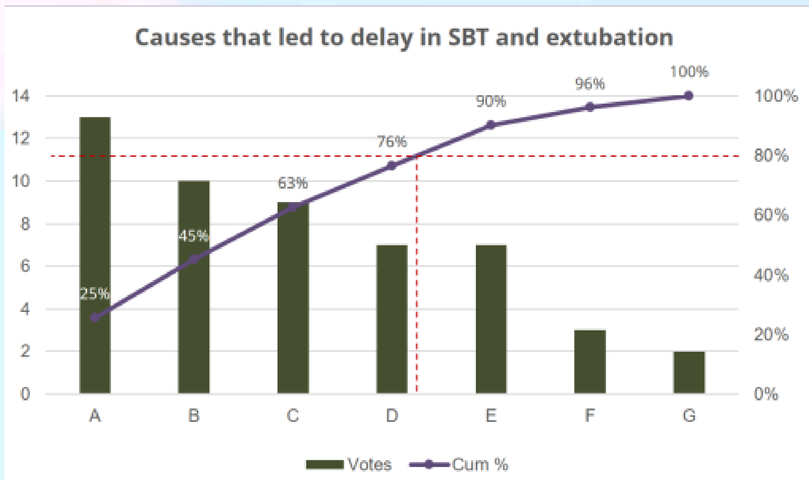


Cause and Effect Diagram



Pareto Chart

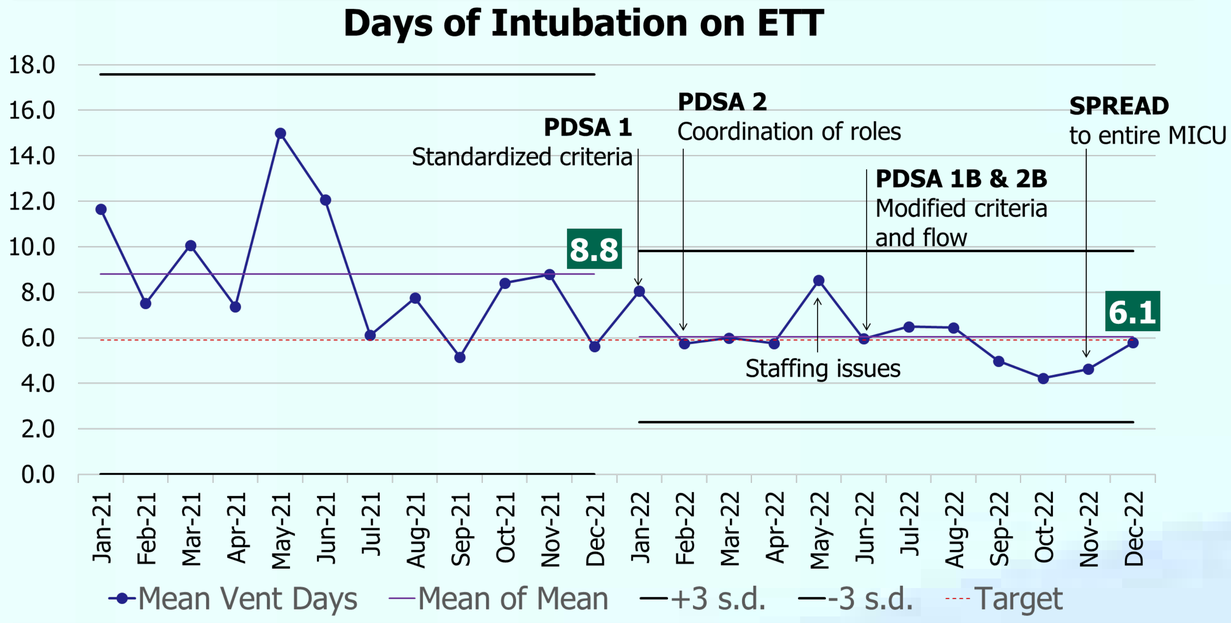
Gap	Cause
A	Wide variability in SBT practices
B	No multidisciplinary coordination
C	Lack of clear readiness criteria
D	No outsourcing, no shared ownership
E	No standard practice of SAT or lightening sedation
F	Difference in personal training, risk tolerance
G	Perception of decreased comfort to reintubate patient



Implementation

CAUSE / PROBLEM	INTERVENTION	DATE OF IMPLEMENTATION
Cause A: Wide variability in SBT practices **Cause C:** Lack of clear readiness criteria	• Standardized readiness criteria • Standardized SBT settings • Standardized SBT pass/fail criteria	January 2022
Cause B: No multidisciplinary coordination **Cause D:** No outsourcing, no shared ownership	Coordination of roles and responsibilities as part of a workflow ▪ A4 sheet with criteria and workflow to be placed on patient's case notes upon ICU admission ▪ Signs to be placed on patient's door during/after SBT	Mid-February 2022

Results



Cost Savings

Assuming a reduction in the duration of IMV results in a corresponding reduction in the duration of ICU stay

	Pre-Intervention	Post-Intervention
Length of Stay in MICU (Per Patient)	8.8 Days	6.1 Days
MICU Cost of Stay (Per Patient)	8.8 x $2,080 = $18,304	6.1 x $2,080 = $12,688
Cost Savings (Per Patient)	$18,304 - $12,688 = **$5,616**	
Cost Savings (Yearly) Based on 2022 data where MICU had 488 intubated patients in a year	$5,616 x 488 = **$2,740,608**	

Note: Unit cost per day per patient in ICU = $2,080

Problems Encountered

- High workload was a barrier to consistently performing the SBT in the morning. As such, the time period to initiate SBT was relaxed and the smartphrase function in EPIC was leveraged to ease the documentation burden.
- Concerns raised over an increase in reintubation rates (balance measure) from 3.2% to 3.7% in 2022. Considering a reintubation rate of 14% reported internationally (Krinsley JS et al., 2012), it is likely that our interventions did not have a significant impact on reintubations.

Strategies to Sustain

- Continue to collect compliance data and IMV duration data
- Look into having a "ventilator liberation champion" in MICU to help ensure that people are aware of the protocol and are using it
- Aim to expand the protocol to other ICUs – spread to NCID ICU from June 2023 onwards
- Look into other micro workflows
  - Management of pain
  - Management of agitation/sedation
  - Management of delirium
  - Early mobility and exercise