

Reducing the Duration of Invasive Mechanical Ventilation in the Medical Intensive Care Unit (Sustainability Phase)

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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 over a sustained period

Team Members

	Name	Designation	Department
Team Leaders	Dr Sim Wen yuan	Consultant	RCCM
	Ms Emelin Tan	Head & Principal Respiratory Therapist	Respiratory Therapy
Team Members	Dr Sharlene Ho	Consultant	RCCM
	Dr Edmund Lim	Registrar	
	Ms Han Shujuan	Senior Staff Nurse	Nursing
	Ms Pei Yaxin	Senior Staff Nurse	
	Mr Eric Wu	Senior Respiratory Therapist	Respiratory Therapy
Sponsor	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

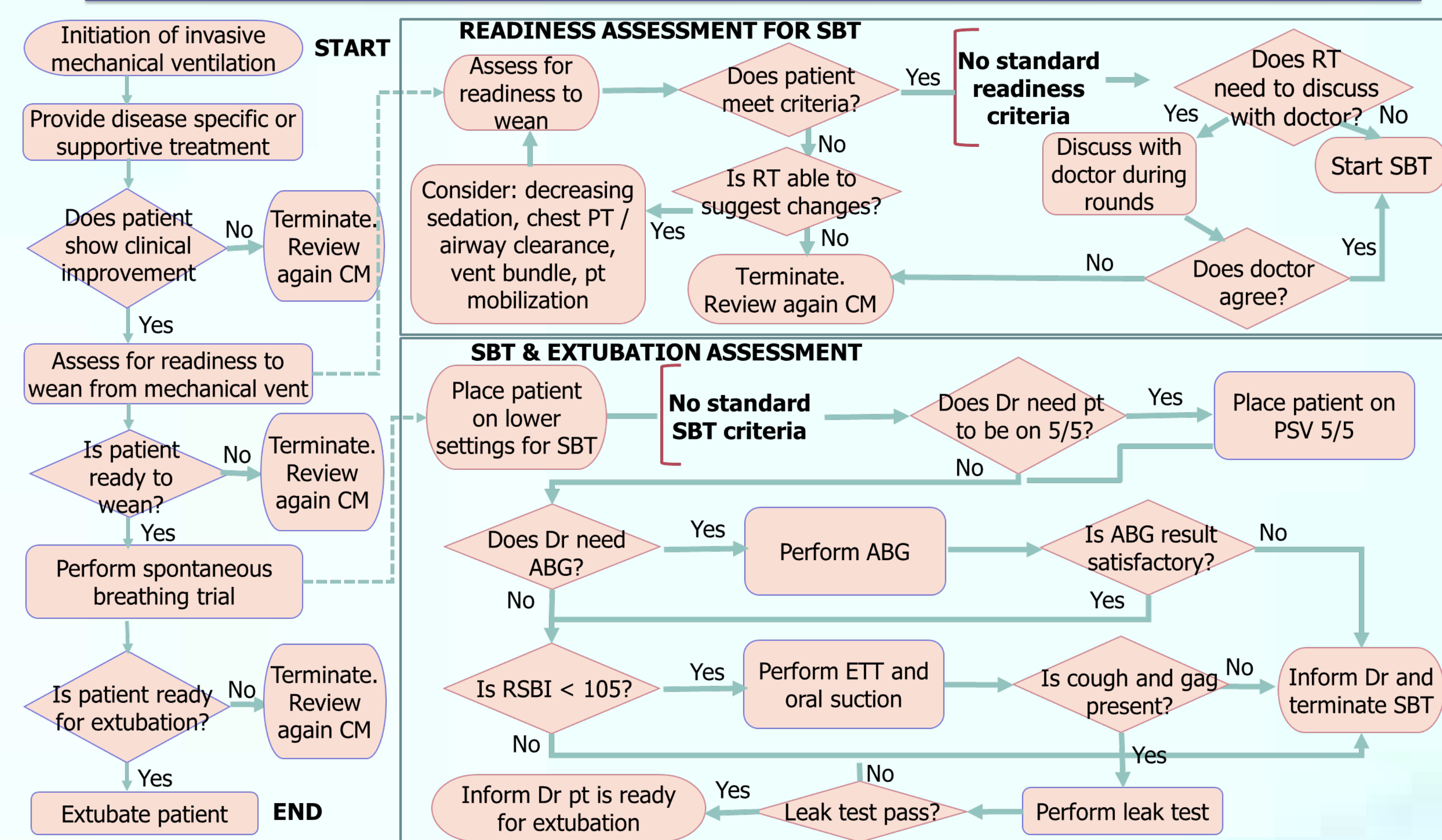
Median duration: **3 days**
Mean duration: **5.9 days**

TTSH MICU (Jan-Dec 2021)

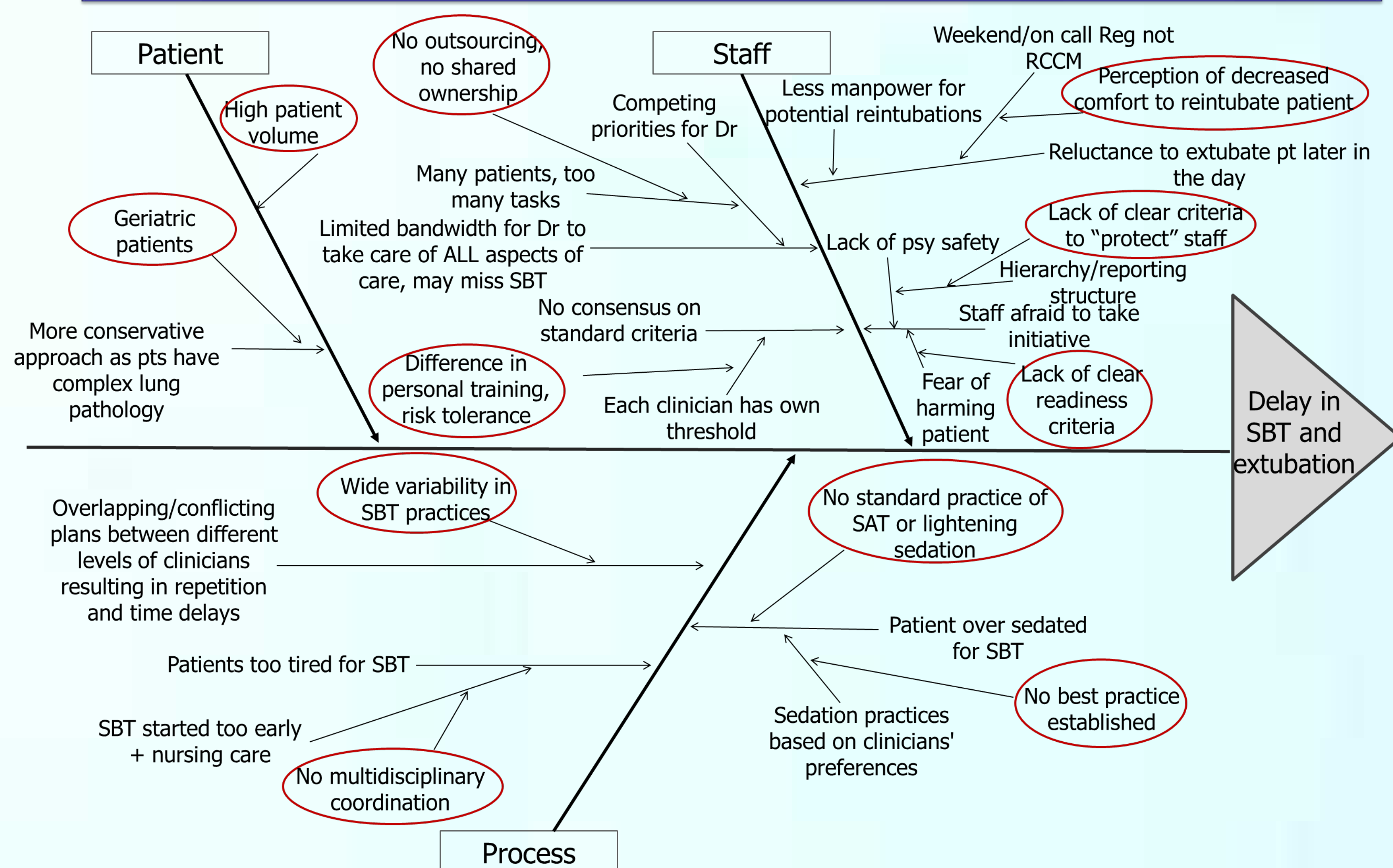
Median duration: **4 days**
Mean duration: **8.8 days**

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

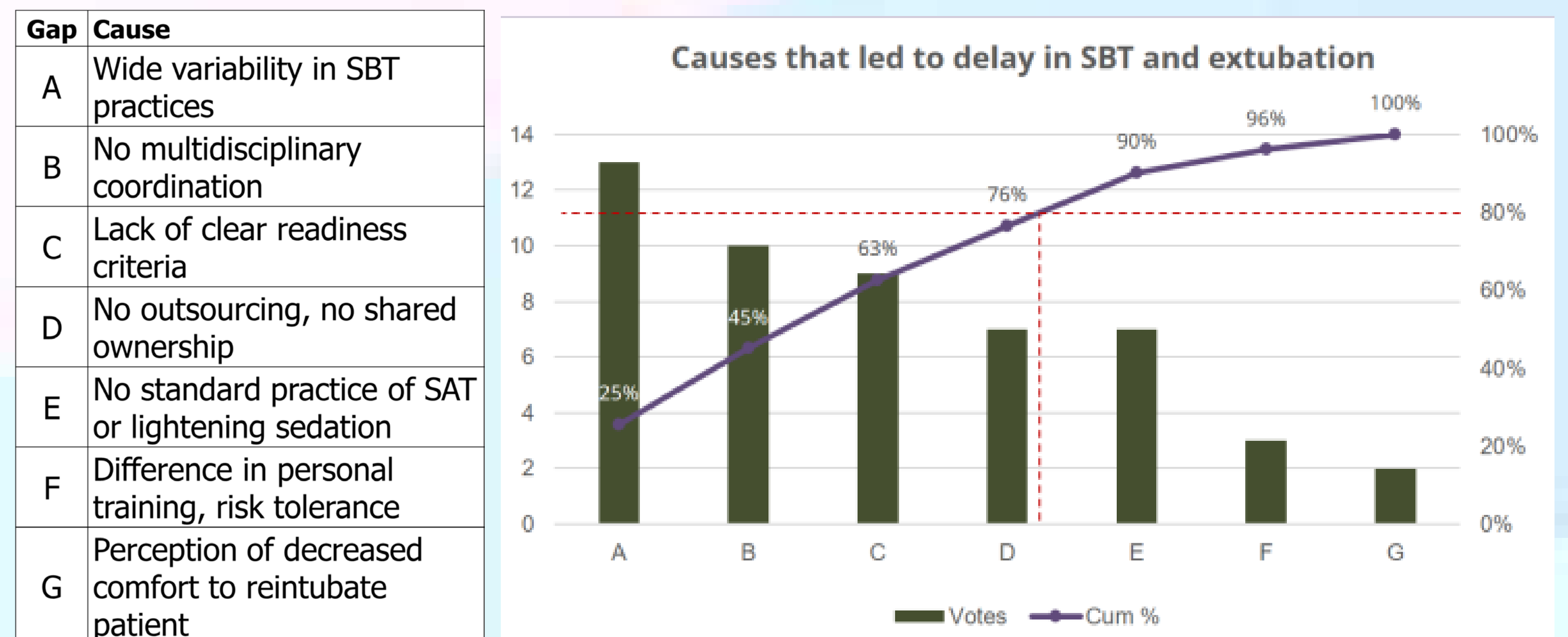
Flow Chart of Process



Cause and Effect Diagram



Pareto Chart



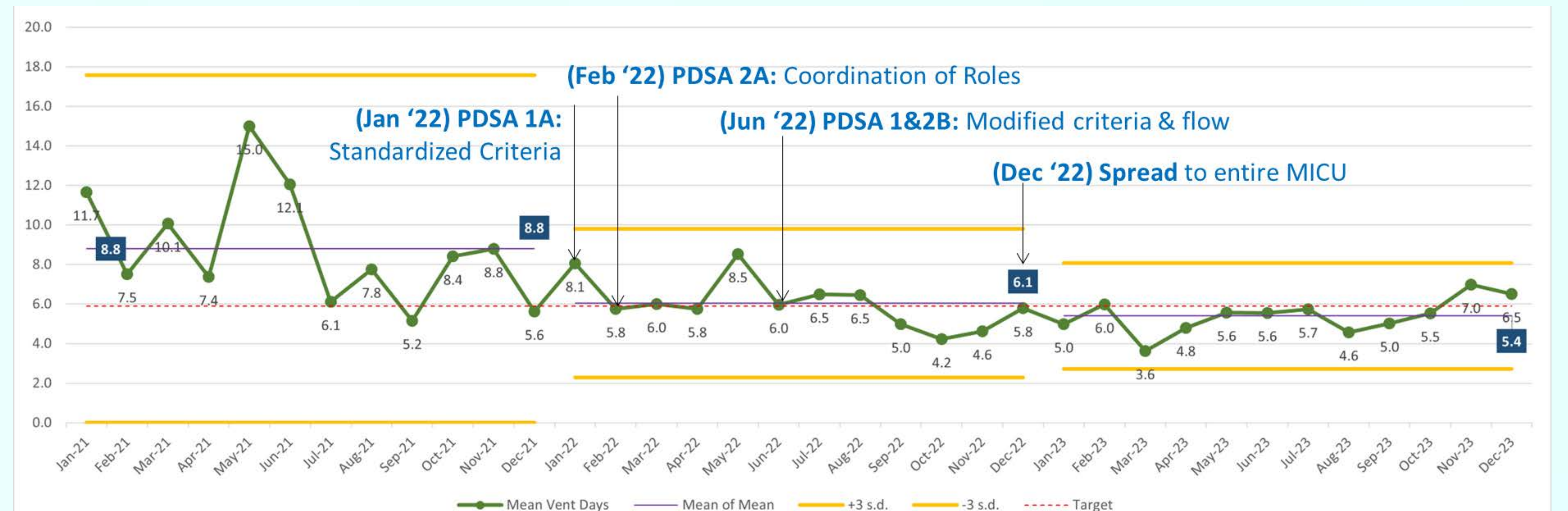
Implementation

CAUSE / PROBLEM	INTERVENTION	DATE OF IMPLEMENTATION
Cause A: Wide variability in SBT practices Cause C: Lack of clear readiness criteria	<ul style="list-style-type: none"> 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 <ul style="list-style-type: none"> 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

Sustainability Runchart: Days of Intubation on ETT

Period: Jan 2021 to Dec 2023



Mean (Jan 2021 to Dec 2021)	Mean (Jan 2022 to Dec 2022)	Mean (Jan 2023 to Dec 2023)
8.8 Days	6.1 Days	5.4 Days

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	5.4 Days
MICU Cost of Stay (Per Patient)	8.8 x \$2,080 = \$18,304	5.4 x \$2,080 = \$11,232
Cost Savings (Per Patient)	\$18,304 - \$11,232 = \$7,072	
Cost Savings (Yearly)	\$7,072 x 518 = \$3,663,296	

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 smartpharse 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
- Expanded protocol to NCID ICU since June 2023
- Look into other micro workflows
 - Management of pain
 - Management of agitation/sedation
 - Management of delirium
 - Early mobility and exercise