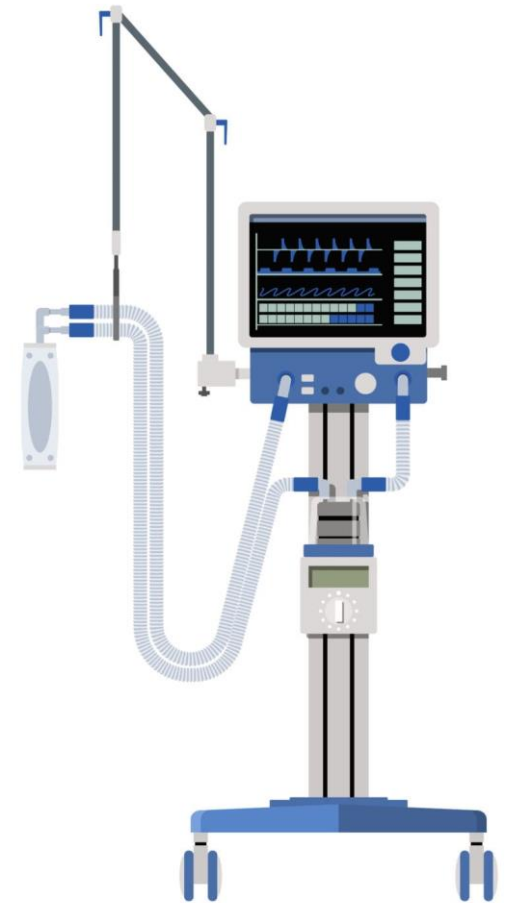




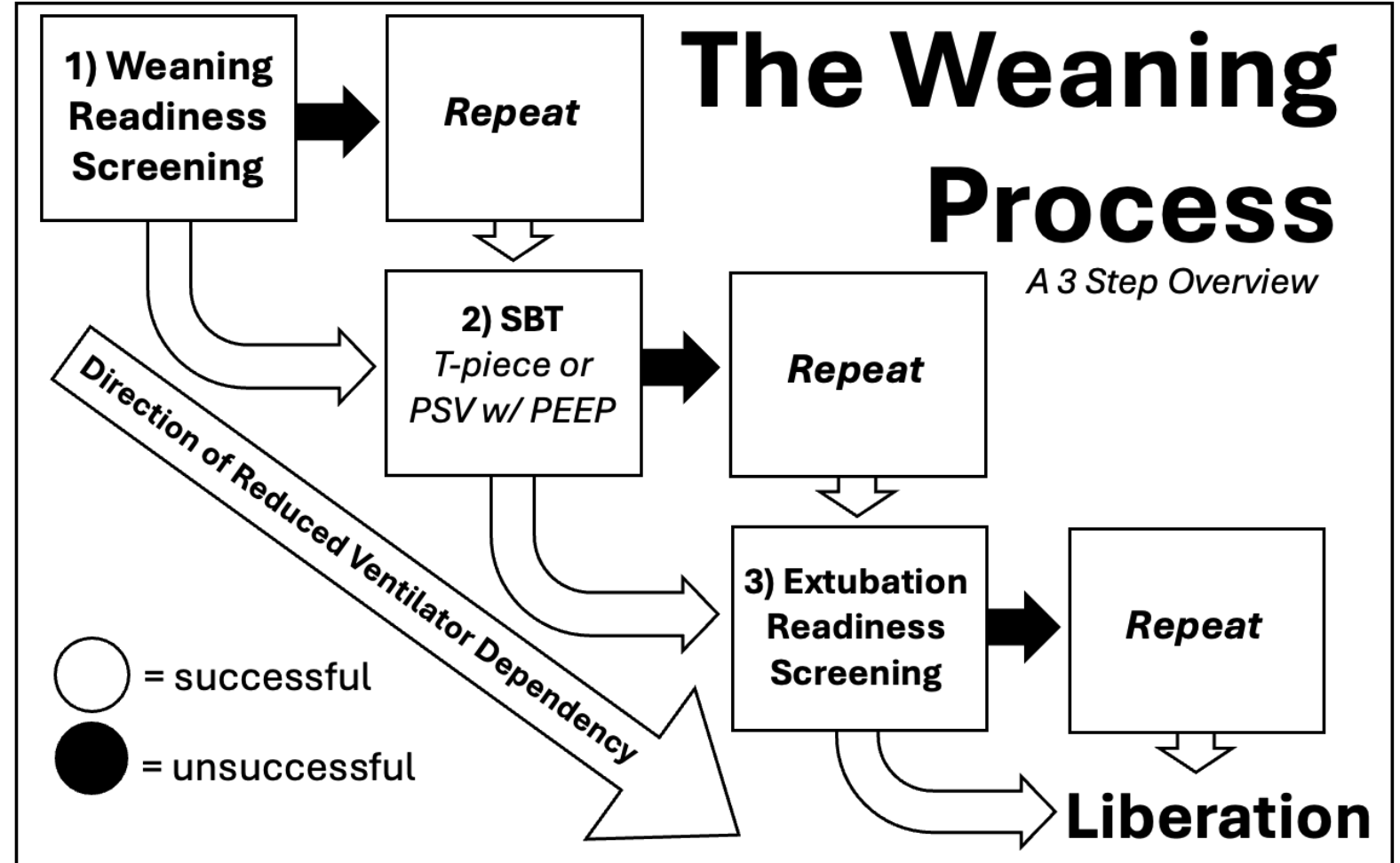
# Longitudinal Monitoring of Physiological Variables During Mechanical Ventilation and Weaning

- Why do patients need Mechanical Ventilation (MV)?
  - $O_2$  and  $CO_2$  balance
  - Heart failure, sepsis, trauma and more (Esteban et al., 2000)
- The problem with MV
  - Not normal human breathing (Levine et al., 2008)
  - Side-effects: Ventilator Associated Pneumonia, Ventilator Induced Lung Injury (Goligher et al., 2020; Zilberberg et al., 2020)
- What are modes of ventilation?
  1. Controlled = machine initiates breath
  2. Spontaneous = patients initiate breath (Chatburn et al., 2007)



Note. From shutterstock  
[Image], Hospital Ventilator

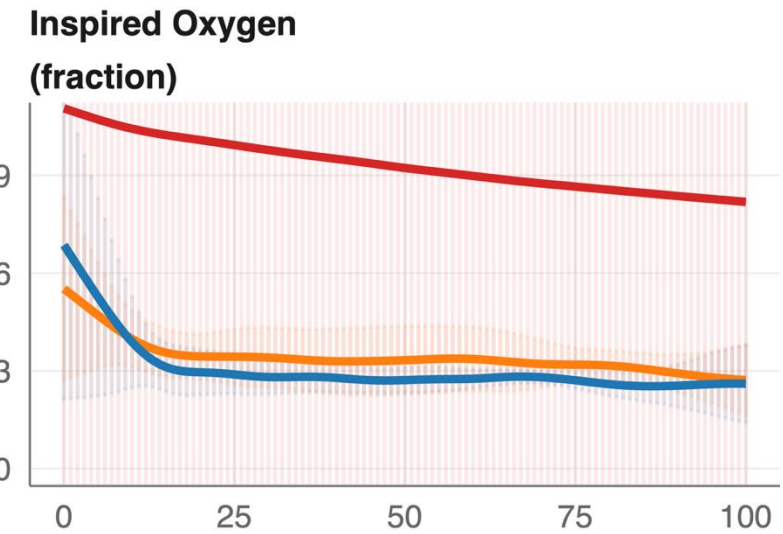
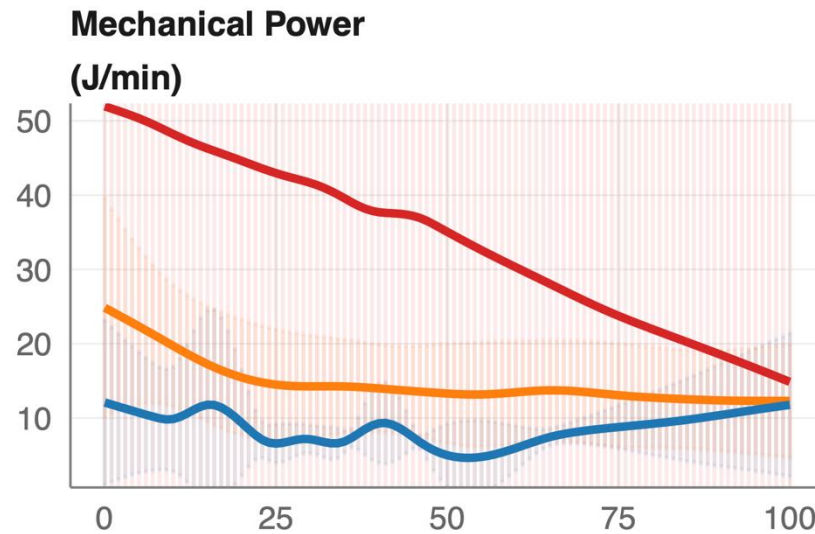
- Goals:
  - Exploratory analysis
  - Descriptive statistics
- Methods:
  - R code using RStudio
  - Data set with 37 patients on MV
  - Visualizing and summarizing trends



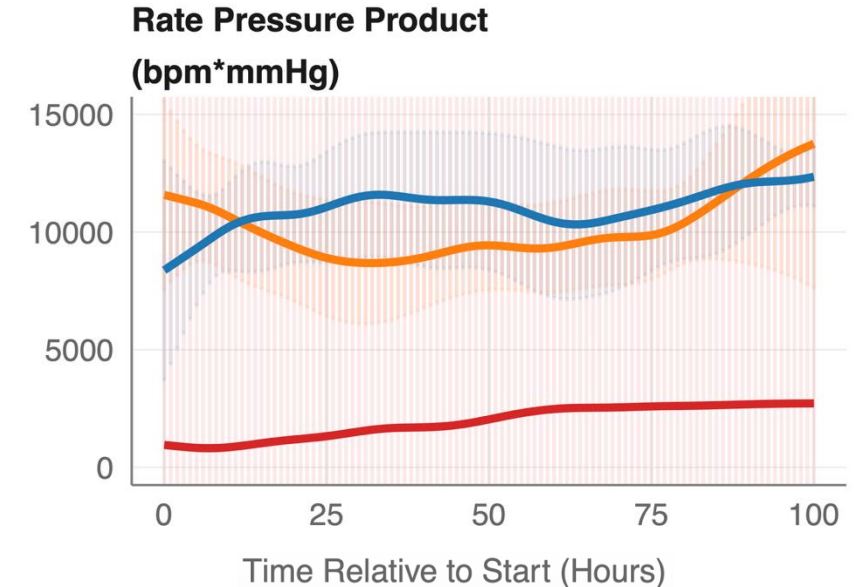
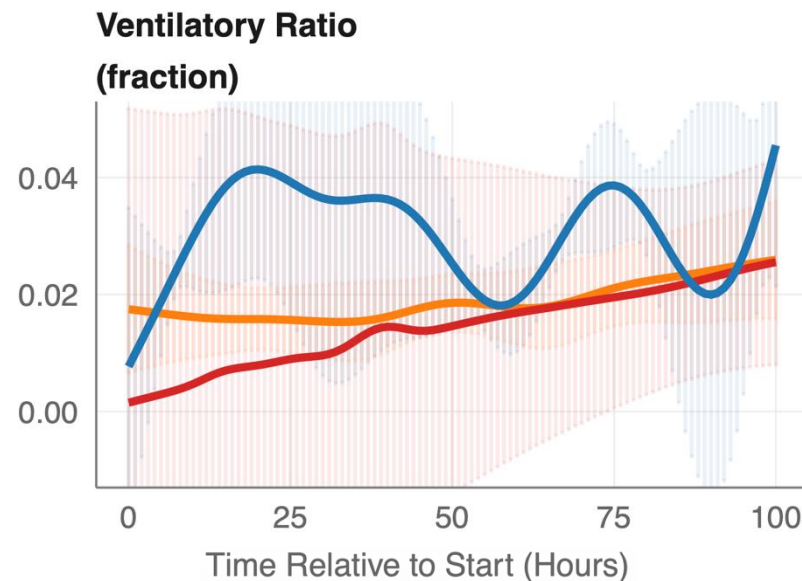
## Mean of Per Patient GAM Splines by Variable Relative to Start

Weaning Group: Blue = Uncomplicated | Orange = Difficult | Red = Prolonged (Page 1 of 2)

### Ventilator Settings



### Patient Responses



- Impact Statement: averages in prolonged weaning patients show high burden and poor responses, but are not statistically significant in this data set.
  - Data visualization provides insight into patient treatment and responses
  - Future research can use the R scripts to explore new ventilator data sets with larger sample sizes
- 

Chatburn R. L. (2007). Classification of ventilator modes: update and proposal for implementation. *Respiratory care*, 52(3), 301–323.

Esteban, A., Anzueto, A., Alía, I., Gordo, F., Apezteguía, C., Pálizas, F., Cide, D., Goldwasser, R., Soto, L., Buge, G., Rodrigo, C., Pimentel, J., Raimondi, G., & Tobin, M. J. (2000). How is mechanical ventilation employed in the intensive care unit?: An international utilization review. *American Journal of Respiratory and Critical Care Medicine*, 161(5), 1450–1458. <https://doi.org/10.1164/ajrccm.161.5.9902018>

Goligher, E. C., Dres, M., Patel, B. K., Sahetya, S. K., Beitler, J. R., Telias, I., Yoshida, T., Vaporidi, K., Grieco, D. L., Schepens, T., Grasselli, G., Spadaro, S., Dianti, J., Amato, M., Bellani, G., Demoule, A., Fan, E., Ferguson, N. D., Georgopoulos, D., . . . Brochard, L. (2020). Lung- and Diaphragm-Protective ventilation. *American Journal of Respiratory and Critical Care Medicine*, 202(7), 950–961. <https://doi.org/10.1164/rccm.202003-0655cp>

Levine, S., Nguyen, T., Taylor, N., Friscia, M. E., Budak, M. T., Rothenberg, P., Zhu, J., Sachdeva, R., Sonnad, S., Kaiser, L. R., Rubinstein, N. A., Powers, S. K., & Shrager, J. B. (2008). Rapid disuse atrophy of diaphragm fibers in mechanically ventilated humans. *New England Journal of Medicine*, 358(13), 1327–1335. <https://doi.org/10.1056/nejmoa070447>

Sinha, P., Fauvel, N., Singh, S., & Soni, N. (2009). Ventilatory ratio: a simple bedside measure of ventilation. *British Journal of Anaesthesia*, 102(5), 692–697. <https://doi.org/10.1093/bja/aep054>

Zilberberg, M. D., Nathanson, B. H., Ways, J., & Shorr, A. F. (2020). Characteristics, hospital course, and outcomes of patients requiring Prolonged Acute versus Short-Term Mechanical Ventilation in the United States, 2014–2018\*. *Critical Care Medicine*, 48(11), 1587–1594. <https://doi.org/10.1097/ccm.0000000000004525>

Zhou, J., Li, Y. J., Zhou, X. D., & Wang, L. J. (2024). Rate-Pressure Product is a Novel Predictor for Short- and Long-Term Mortality in Patients with Acute Coronary Syndrome Undergoing Primary PCI/Immediate Invasive Strategy. *Clinical interventions in aging*, 19, 571–579. <https://doi.org/10.2147/CIA.S449905>