

# Effect of Sampling Rate and Summary Measure Type on Quantification of Secondary Insults in General Intensive Care Patients.

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## Background and Aims

Secondary Insults (SI) such as arterial hypotension in patients with traumatic brain injury [1] or sepsis [2] are associated with worse clinical outcomes. We aimed to identify and quantify SI in the general ICU population using continuous waveform monitoring.

## Methods

High-resolution waveform ECG and BP data were prospectively recorded from ten consented patients receiving invasive mechanical ventilation in ICU at the Royal Infirmary, Edinburgh. Secondary Insults of  $\geq 5$  minutes duration were categorised into mild (Grade 1), moderate (Grade 2) or severe (Grade 3) based on the Edinburgh University Insult Grade (EUSIG) system (FIGURE 1) [1]. Twenty-nine recording sessions across 10 patients (60 hours of 200Hz waveform data) were down-sampled into two cohorts of 3,618 minute by minute samples or 218,581 second-by-second samples. Insults were described in terms of number, absolute duration in minutes or as percentage of total monitoring time. Maximum, minimum, mean and median summary measures were calculated across both sampling rate cohorts.

## Results

- FIGURE 2. Bradycardia: no episodes
- Tachycardia: (0.9%) 31 minutes - Grade 1/2/3: 25/0/6 mins
- Hypotension: (10.0%) 361 minutes - Grade 1/2/3: 209/0/52 mins
- Hypertension: (16.8%) 638 minutes - Grade 1/2/3: 426/167/45 mins.
- FIGURE 3. Significantly more SI were detected using second sampling compared with minute-by-minute ( $p < 0.05$ ),
- FIGURE 4. Hypotension were best detected using a MIN summary measure; Hypertension or Tachycardia via a MAX summary measure ( $p < 0.05$ ),
- 20% of hypotension/hypertension SI were associated with a clinical event (eg: tracheal suction, patient turns, sedation hold)

## Conclusion

Hypotension and hypertension were common occurring in nearly 25% of monitoring time. It is possible to identify and quantify SI in the general ICU population using continuous waveform data. This may improve identification of adverse events for quality improvement and research studies. Next steps include an ICU wide assessment to determine the incidence of SI across different admission pathologies.

## References

- [1] Jones et al, J Neurosurg. Anaesth.6(1) 4-14, 1994.  
 [2] Ferrer et al, Crit Care Med 2014; 42:1749-1755

Edinburgh University secondary insult grades (EUSIG) in adults >14 yr

	Grade 1	Grade 2	Grade 3
Hypotension mm Hg systolic or mean	$\leq 90$ $\leq 70$	$\leq 70$ $\leq 55$	$\leq 50$ $\leq 40$
Hypertension mm Hg systolic or mean	$\geq 160$ $\geq 110$	$\geq 190$ $\geq 130$	$\geq 220$ $\geq 150$
Tachycardia bpm	$\geq 120$	$\geq 135$	$\geq 150$
Bradycardia bpm	$\leq 50$	$\leq 40$	$\leq 30$

Figure 1: Edinburgh University Secondary Insult Grades (EUSIG). Highlighting the Thresholds Used for arterial Hypotension, Hypertension, Bradycardia and Tachycardia

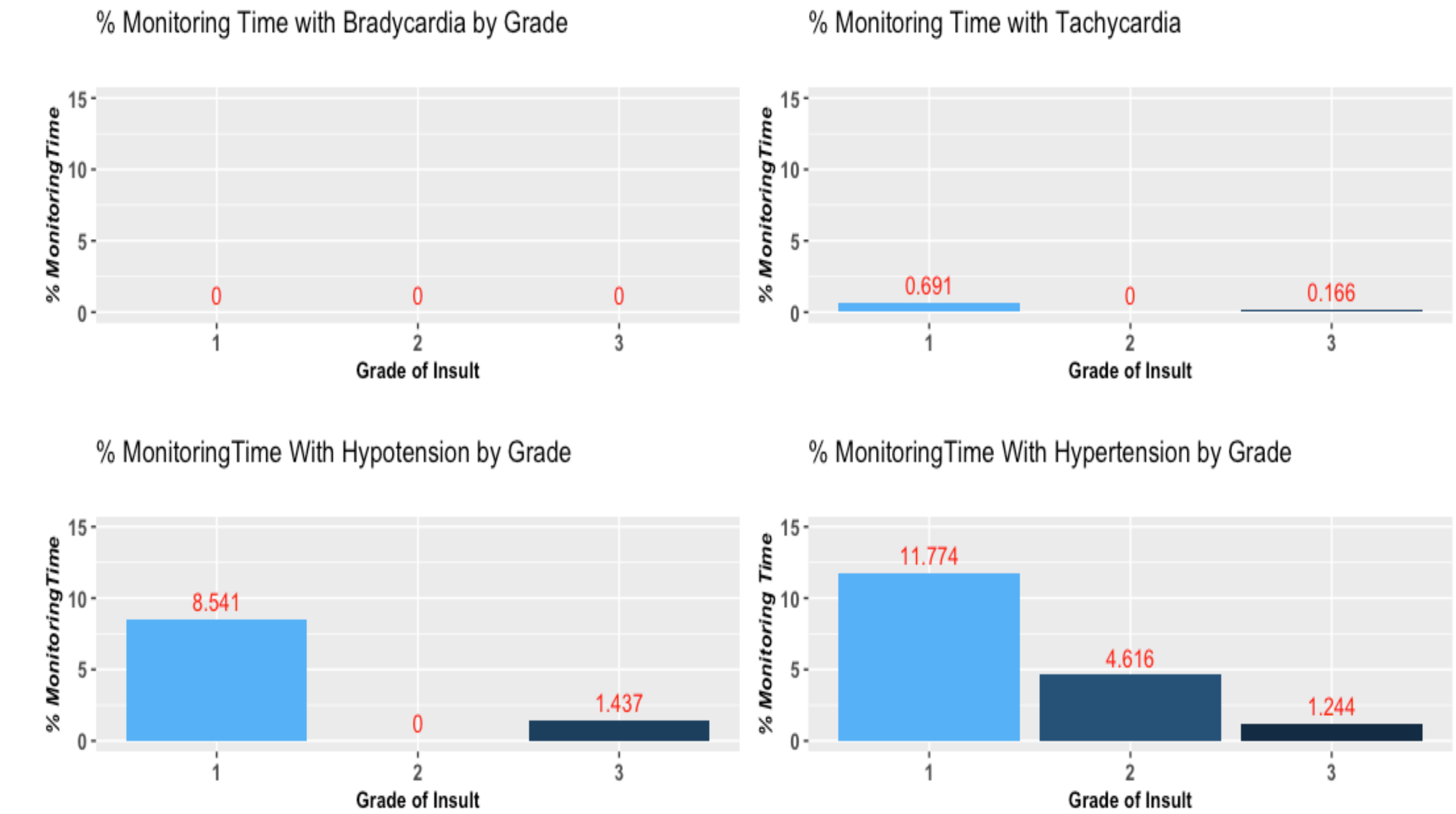


Figure 2: Percentage of Monitoring Time with Secondary Insult (Grades 1, 2, 3) by Type of Insult.

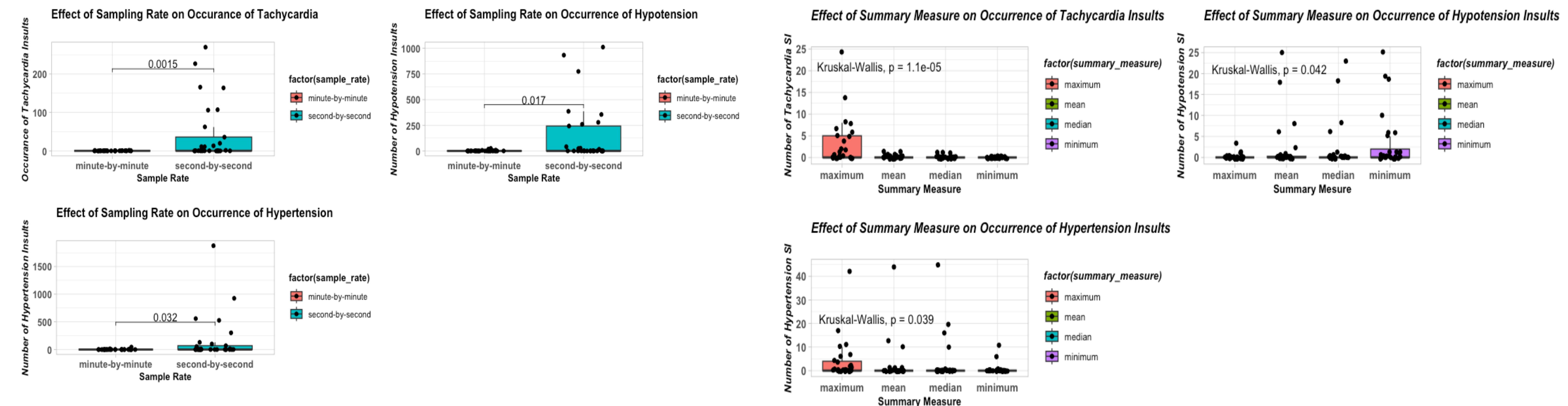


Figure 3: Effect of Sampling Rate on Occurrence of Secondary Insults. Wilcoxon Signed Rank Test.

Figure 4: Effect of Summary Measure on Occurrence of Secondary Insults. Kruskal-Wallis Test.