

# Matching irregular EHR intensive care data to create an accurate & analyzable dataset

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### BACKGROUND

1. Electronic health record (EHR) data believed to be the holy grail of health services research, especially in an intensive care setting abound with data from ventilators, medication pumps, telemetry, vitals, et-cetera.
2. Much of the data are numerical, with units of measurement, and a timestamp.
3. However, these data are irregular and sparse—creating a challenge for the statistician trying to create an analyzable clinical picture as the times do not align (whether by seconds or hours).

### METHODOLOGICAL AIM

Devise an algorithm for aligning sparse longitudinal data among a cohort of ventilated intensive care patients.

Original Tables

| Subject | Intubation         | Extubation         |
|---------|--------------------|--------------------|
| 11111   | 1/1/2022 13:59:01  | 1/1/2022 14:12:32  |
| 11112   | 3/24/2022 23:10:53 | 4/12/2022 07:15:21 |

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| Subject | DateTime           | VentMode | DateTime2       |
|---------|--------------------|----------|-----------------|
| 11111   | 1/1/2022 13:59:01  | PRVC     | 1/1/2022 13:59  |
| 11111   | 1/1/2022 14:10:27  | PC       | 1/1/2022 14:10  |
| 11112   | 3/24/2022 23:10:53 | PC       | 3/24/2022 23:10 |

| Subject | DateTime           | TV  | DateTime2       |
|---------|--------------------|-----|-----------------|
| 11111   | 1/1/2022 13:59:01  | 6.0 | 1/1/2022 13:59  |
| 11111   | 1/1/2022 14:04:34  | 6.5 | 1/1/2022 14:04  |
| 11111   | 1/1/2022 14:11:28  | 0.0 | 1/1/2022 14:11  |
| 11112   | 3/24/2022 23:10:53 | 8.0 | 3/24/2022 23:10 |

| Subject | DateTime           | PEEP | DateTime2       |
|---------|--------------------|------|-----------------|
| 11111   | 1/1/2022 13:59:01  | 3.5  | 1/1/2022 13:59  |
| 11112   | 3/24/2022 23:10:53 | 4.0  | 3/24/2022 23:10 |

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| Subject | DateTime        |
|---------|-----------------|
| 11111   | 1/1/2022 13:59  |
| 11111   | 1/1/2022 14:00  |
| 11111   | 1/1/2022 14:01  |
| 11111   | 1/1/2022 14:02  |
| 11111   | 1/1/2022 14:03  |
| 11111   | 1/1/2022 14:04  |
| 11111   | 1/1/2022 14:05  |
| 11111   | 1/1/2022 14:06  |
| 11111   | 1/1/2022 14:07  |
| 11111   | 1/1/2022 14:08  |
| 11111   | 1/1/2022 14:09  |
| 11111   | 1/1/2022 14:10  |
| 11111   | 1/1/2022 14:11  |
| 11111   | 1/1/2022 14:12  |
| 11112   | 3/24/2022 23:10 |
| 11112   | ...             |

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| Subject | DateTime        | VentMode | TV  | PEEP |
|---------|-----------------|----------|-----|------|
| 11111   | 1/1/2022 13:59  | PRVC     | 6.0 | 3.5  |
| 11111   | 1/1/2022 14:00  |          |     |      |
| 11111   | 1/1/2022 14:01  |          |     |      |
| 11111   | 1/1/2022 14:02  |          |     |      |
| 11111   | 1/1/2022 14:03  |          |     |      |
| 11111   | 1/1/2022 14:04  |          | 6.5 |      |
| 11111   | 1/1/2022 14:05  |          |     |      |
| 11111   | 1/1/2022 14:06  |          |     |      |
| 11111   | 1/1/2022 14:07  |          |     |      |
| 11111   | 1/1/2022 14:08  |          |     |      |
| 11111   | 1/1/2022 14:09  |          |     |      |
| 11111   | 1/1/2022 14:10  | PC       |     |      |
| 11111   | 1/1/2022 14:11  |          |     |      |
| 11111   | 1/1/2022 14:12  |          |     |      |
| 11112   | 3/24/2022 23:10 |          |     |      |
| 11112   | ...             | PC       | 8.0 | 4.0  |

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| Subject | DateTime        | VentMode | TV  | PEEP |
|---------|-----------------|----------|-----|------|
| 11111   | 1/1/2022 13:59  | PRVC     | 6.0 | 3.5  |
| 11111   | 1/1/2022 14:00  | PRVC     | 6.0 | 3.5  |
| 11111   | 1/1/2022 14:01  | PRVC     | 6.0 | 3.5  |
| 11111   | 1/1/2022 14:02  | PRVC     | 6.0 | 3.5  |
| 11111   | 1/1/2022 14:03  | PRVC     | 6.0 | 3.5  |
| 11111   | 1/1/2022 14:04  | PRVC     | 6.5 | 3.5  |
| 11111   | 1/1/2022 14:05  | PRVC     | 6.5 | 3.5  |
| 11111   | 1/1/2022 14:06  | PRVC     | 6.5 | 3.5  |
| 11111   | 1/1/2022 14:07  | PRVC     | 6.5 | 3.5  |
| 11111   | 1/1/2022 14:08  | PRVC     | 6.5 | 3.5  |
| 11111   | 1/1/2022 14:09  | PRVC     | 6.5 | 3.5  |
| 11111   | 1/1/2022 14:10  | PC       | 6.5 | 3.5  |
| 11111   | 1/1/2022 14:11  | PC       | 6.5 | 3.5  |
| 11111   | 1/1/2022 14:12  | PC       | 6.5 | 3.5  |
| 11112   | 3/24/2022 23:10 | PC       | 6.5 | 3.5  |
| 11112   | ...             | PC       | 8.0 | 4.0  |

## ALGORITHM

1. Create a longitudinal file, whereby for each subject create an entry from time of intubation to extubation by the minute.
2. For each file containing parameters of interest, create a new date field—truncated to the minute.
3. Left join each of these files to the longitudinal file.
4. Use last observation carried forward to fill in the last known ventilator value for each observation

### DISCUSSION

- This yields a long table, containing a minute-by-minute record of the entire period of intubation—with all appropriate measurements
- This allows for calculation parameters of interest
  - *e.g.* SOFA score (or components thereof),
  - Driving pressure,
  - Elastance
- Or for calculation of exposure times
  - *e.g.* Time exposed to lung-protective ventilation
- Identifying spontaneous breathing trials
- Identifying adherence to site-specific clinical pathways or clinical best-practices



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