## Patient-ventilator asynchrony reference card

### Asynchrony | Description | On the waveform | Waveform example | Common possible causes
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**Trigger asynchronies - during the beginning of inspiration**<br>Delayed triggering<br>The time interval between the patient's inspiratory effort and the delivery of a mechanical breath is increased<br>**Flow** waveform: Look for a longer-than-normal time interval between the positive deflection in flow \(^1\) and the delivery of ventilatory support \(^2\)<br>![Flow waveform example](image)
- Trigger threshold set too high
- Ventilator pneumatics
- Presence of AutoPEEP
- Low respiratory drive
- Weak inspiratory effort

Ineffective effort<br>The patient's inspiratory effort fails to trigger the delivery of a mechanical breath<br>**Flow** waveform: Look for an abrupt change in the steepness of the waveform \(^1\) (decrease in expiratory flow or increase in inspiratory flow) that is not followed by ventilatory support \(^2\)<br>![Flow waveform example](image)
- Trigger threshold set too high
- Pressure support too high
- Set frequency and/or inspiratory time too high (in controlled modes)
- Tidal volume set too high
- Presence of AutoPEEP
- Low respiratory drive
- Weak inspiratory effort
- Sedation

Auto triggering<br>A mechanical breath delivered without an inspiratory effort<br>**Pressure** waveform: Look for a delivered mechanical breath showing no drop in airway pressure \(^1\) at the beginning of the inspiratory phase<br>![Pressure waveform example](image)
- Trigger threshold set too high
- Air leaks in the endotracheal tube cuff, ventilator circuit, or chest tube
- Flow oscillations (water or secretion in the circuit, cardiac oscillations)

**Flow asynchronies - during the gas delivery**

Flow asynchrony<br>The delivered flow does not meet the patient's inspiratory flow demands<br>**Pressure** waveform: Look for an upward concavity \(^1\) preceding the end of the mechanical breath<br>![Pressure waveform example](image)
- Inappropriate selection of ventilation mode (more frequent in volume-controlled modes)
- High inspiratory effort
- In volume-controlled modes:
  - Inappropriate flow settings
- In pressure-controlled modes:
  - Inappropriate P-ramp settings

### Notes:
- 'Correct' waveform, in case of good patient-ventilator synchrony
- Patient factors | Ventilator-related factors | Patient-ventilator interface
<table>
<thead>
<tr>
<th>Asynchrony</th>
<th>Description</th>
<th>On the waveform</th>
<th>Waveform example</th>
<th>Common possible causes</th>
</tr>
</thead>
</table>
| Termination asynchronies - during the end of inspiration | Double triggering - Two (or more) mechanical breaths are delivered during one single inspiratory effort | **Flow** waveform: Look for two assisted breaths without expiration between them or with an expiration interval of less than half of the mean inspiratory time (often visually displayed as a waveform with two inspiratory peaks) | ![Waveform](image) | - Cycling criteria (ETS) set too high  
- Pressure support too low  
- P-ramp too short  
- Flow starvation  
- High respiratory drive  
- Time constant too short  

Double triggering can be an effect of and/or promoted by reverse triggering or early cycling.  

| Early cycling | The duration of the mechanical breath is shorter than the duration of the patient’s inspiratory effort | **Flow** waveform: Look for a small bump 1 at the beginning of expiration (after peak expiratory flow) followed by an abrupt initial reversal in the expiratory flow 2 | ![Waveform](image) | - In pressure support ventilation:  
  - Cycling criteria (ETS) set too high  
  - Low levels of ventilator pressure support  
  - Time constant too short  
- In time-cycled ventilation:  
  - Short inspiratory time  

| Delayed cycling | The duration of the mechanical breath is longer than the duration of the patient’s inspiratory effort | **Flow** waveform: Look for a change in the slope of the inspiratory flow: a fast decrease 1 followed by an exponential (less steep) decline 2 | ![Waveform](image) | - In pressure support ventilation:  
  - Cycling criteria (ETS) set too low  
  - Pressure support too high  
  - P-ramp too long  
- In pressure control ventilation:  
  - Cycling criteria (ETS) set too low  
  - Inspiratory time too long  
- In volume control ventilation:  
  - Low flow  
  - Long inspiratory time  
  - High tidal volume  

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References  