Identification of Patient–Ventilator Asynchronies and their Impact on Patient Outcomes: A Delphi Study

Round One Survey Report

The Round one survey was created on a 'Google Forms' platform. The survey went live on August 29, 2024, with a window of 5 days for responses until September 2, 2024, at 5 PM (GMT).
This survey was sent to 11 experts and all of them completed the survey. There were 2 questions in the survey, with one each of ordinal Likert scale-based qualitative statements and multiple-choice questions (MCQ). A detailed report of the results of each question with the comments is presented below for your perusal. Minor edits have been made in the comments received to maintain the anonymity of the Experts. The steering committee has created a Round TWO questionnaire based on this report.

The steering committee, following extensive discussion, has made no changes in the questionnaire, based on the responses and comments in round one.

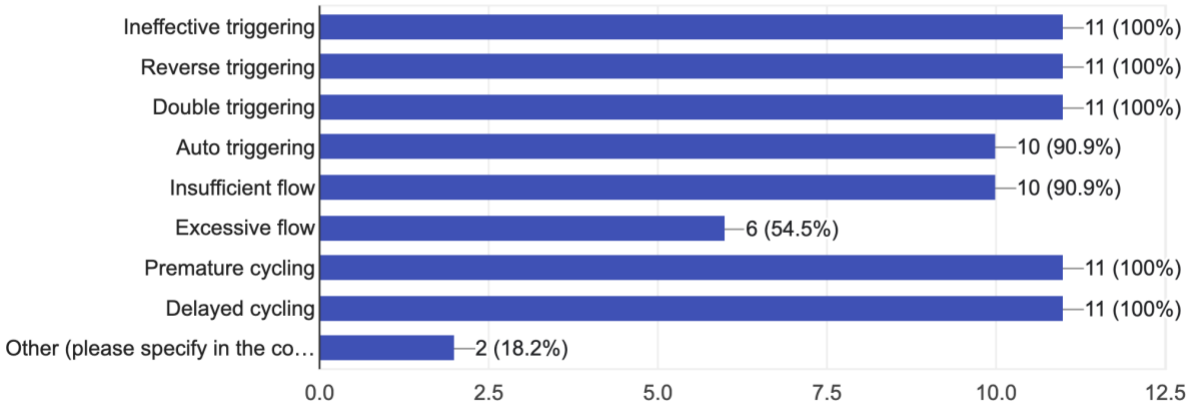
Consensus	≥ 70% in favour of agree/disagree in Likert–scale, or any option in MCQ	Aim for stability
Stability	Chi-square or Kruskal-Wallis test for analysis, p-value <0.05 is significant (not applicable for round 1)	To analyse and aim for stable consensus or dissensus. If stable, the question is dropped from the next round.

Consensus Matrix

Round	**1**	
Sections	1	
Question	2 (1 Likert-scale+1 MCQ)	Total
Comment	9	
Sections	**1**	
Total questions	2	2
Consensus	2	2 (100%)

1. Which of the following events can be considered a PVA? (Multiple choice)

11 responses



Status	Consensus	Stability
Consensus achieved	Yes (Option 1-5,7,8)	Not Applicable (NA)

Anonymous comments

1. Nomenclature is always challenging. For instance double triggering is linked to two consecutive breathing cycles. However, this can be also possible due to reverse triggering. A potential solution could be call that asynchrony as double cycling irrespective of its cause. Thus, you may have double cycling due to excessive effort and actual double trigger, or reverse triggering when the first cycle is machine-initiated. Breath-stacking could be more a consequence rather than a type of dyssynchrony.
2. I miss auto-PEEP - is that an asynchrony as well?
3. Excessive flow is not really an as synchrony. However, over assist could be considered as bad patient-ventilator interaction.

2. Which of the following events can be detected through visual inspection of ventilator waveform alone, i.e., in the absence of oesophagus pressure waveform recordings?

	Statement	Disagreement	Neutral	Agreement
1	Ineffective triggering	2 (18%)	1 (9%)	8 (73%)
2	Reverse triggering	0	3 (27%)	8 (73%)
3	Double triggering	0	0	11(100%)
4	Auto triggering	1 (9%)	4 (36%)	6 (55%)
5	Insufficient flow	1 (9%)	2 (18%)	8 (73%)
6	Excessive flow	3 (27%)	2 (18%)	6 (55%)
7	Premature cycling	2 (18%)	1 (9%)	8 (73%)
8	Delayed cycling	2 (18%)	2 (18%)	7 (64%)

Status	Consensus	Stability
Consensus achieved	Yes (Options 1–3, 5, 7)	NA

Anonymous comments

1. To detect by waveform it is required that airflow is started. If there is no flow (insufficient triggering or insufficient flow not resulting in a breath) the waveform does not help. Therefore, the answer 3.
2. I have assigned 4 to types of asynchronies that usually can be detected with ventilator waveforms but sometimes can be a little less obvious to detect, and 3 to auto triggering because it can be easily detected only when it is due to cardiac oscillations that are visible in the pressure and flow waveforms, but sometimes are a lot less obvious.
3. Auto-triggering and delayed cycling-off can sometimes, but not always be detected from ventilator waveforms. Reverse triggering can be detected from ventilator waveforms after a specific manoeuvre -that is placing the patient on CPAP. Excessive flow is not an asynchrony.
4. I think some types of as-synchronies that affect expiratory flow (premature cycling, ineffective effort, reverse triggering) are challenging to differentiate and their interpretation should be along with clinical context. In addition, consider that some asynchronies may present different phenotypes (i.e., reverse triggering)
5. None

Any other comments related to this survey?

- Not sure whether is possible or not but, I think nomenclature should be addressed at some point. For instance, from asynchrony or dyssynchrony to early or premature cycling

Identification of Patient–Ventilator Asynchronies and their Impact on Patient Outcomes: A Delphi Study

Round Two Survey Report

The Round two survey was created on a 'Google Forms' platform. The survey went live on September 4, 2024, with a window of 5 days for responses until September 9, 2024, at 8 PM (GMT).
This survey was sent to 11 experts and all of them completed the survey. There were 2 questions in the survey, with one each of ordinal Likert scale-based qualitative statements and multiple-choice questions (MCQ). A detailed report of the results of each question is presented below for your perusal. Minor edits have been made in the comments received to maintain the anonymity of the Experts. The steering committee has created a Round Three questionnaire based on this report.

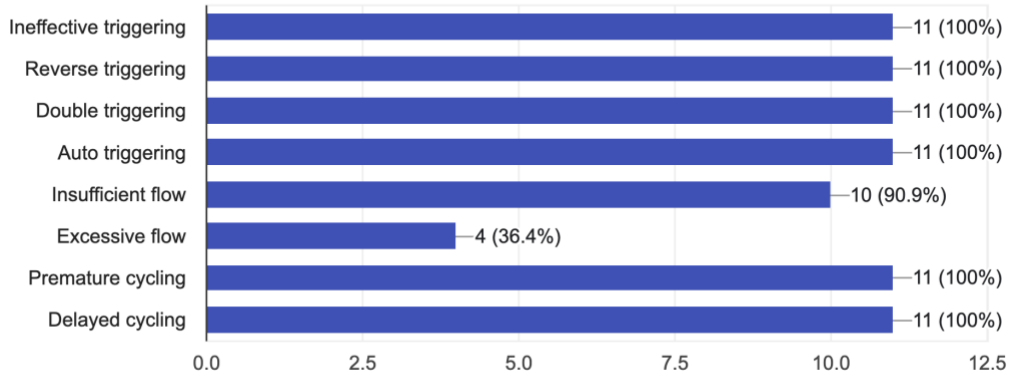
Consensus	≥ 70% in favour of agree/disagree in Likert–scale, or any option in MCQ	Aim for stability
Stability	Chi-square or Kruskal-Wallis test for analysis, p-value <0.05 is significant (not applicable for round 1)	To analyse and aim for stable consensus or dissensus. If stable, the question is dropped from the next round.

Consensus Matrix

Round	**1**		**2**	
Sections	1		1	
Question	2 (1 Likert-scale+1 MCQ)	Total	2 (1 Likert-scale+1 MCQ)	Total
Comment	9		1	
Sections	**1**		**1**	
Total questions	2	2	2	2
Consensus	2	2 (100%)	2	2 (100%)
Question dropped	NA		0	0
Question added	NA		0	0
Question changed	NA		0	0
Options changed	NA		0	0
Stability checked	NA		2	2
Stability acheived	NA		2	2 (100%)

1. Which of the following events can be considered a PVA?

11 responses



Status	Consensus	Stability
Consensus achieved	Yes (Option 1-5,7,8)	Yes (0.99)

2. Which of the following events can be detected through visual inspection of ventilator waveform alone, i.e., in the absence of oesophagus pressure waveform recordings?

	Statement	Disagreement	Neutral	Agreement	Stability
1	Ineffective triggering	1 (9%)	1 (9%)	9 (82%)	Yes (0.29)
2	Reverse triggering	0	3 (27%)	8 (73%)	Yes (0.79)
3	Double triggering	0	0	11 (100%)	Yes (0.47)
4	Auto triggering	1 (9%)	3 (27%)	7 (64%)	Yes (0.64)
5	Insufficient flow	1 (9%)	1 (9%)	9 (82%)	Yes (0.89)
6	Excessive flow	4 (36%)	4 (36%)	3 (27%)	Yes (0.34)
7	Premature cycling	0	1 (9%)	10 (91%)	Yes (0.60)
8	Delayed cycling	0	5 (45%)	6 (55%)	Yes (0.97)

Status	Consensus	Stability
Consensus achieved	Yes (Options 1–3, 5, 7)	Yes (1–7)

Any other comments related to this survey?

- Insufficient or excessive flow can lead to PVA but are not PVA per se.

Identification of Patient–Ventilator Asynchronies and their Impact on Patient Outcomes: A Delphi Study

Round Three Survey Report

The Round three survey was created on a 'Google Forms' platform. The survey went live on September 11, 2024, with a window of 7 days for responses until September 17, 2024, at 5 PM (GMT).
This survey was sent to 11 experts and all of them completed the survey. There were 6 questions in the survey, with one each of ordinal Likert scale-based qualitative statements and multiple-choice questions (MCQ). A detailed report of the results of each question is presented below for your perusal. Minor edits have been made in the comments received to maintain the anonymity of the Experts. The steering committee has created a Round Four questionnaire based on this report.

Consensus	≥ 70% in favour of agree/disagree in Likert–scale, or any option in MCQ	Aim for stability
Stability	Chi-square or Kruskal-Wallis test for analysis, p-value <0.05 is significant (not applicable for round 1)	To analyse and aim for stable consensus or dissensus. If stable, the question is dropped from the next round.

Consensus Matrix

Round	**1**		**2**		**3**	
Sections	1		1		1	
Question	2 (1 Likert-scale+1 MCQ)	Total	2 (1 Likert-scale+1 MCQ)	Total	6 (6 Likert)	Total
Comment	9		1		9	
Sections	**1**		**1**		**1**	
Total questions	2	2	2	2	6	6
Consensus	2	2 (100%)	2	2 (100%)	5	5 (83%)
Question dropped	NA		0	0	NA	
Question added	NA		0	0	NA	
Question changed	NA		0	0	NA	
Options changed	NA		0	0	NA	
Stability checked	NA		2	2	NA	
Stability achieved	NA		2	2 (100%)	NA	

PVA severity

1. For ‘patients without ARDS’, please rate the likelihood of the following PVAs to be associated with ‘discomfort’.

	Statement	Least likely	Neutral	Most likely
1	Ineffective triggering	1 (9%)	2 (18%)	8 (73%)
2	Reverse triggering	4 (36%)	5 (46%)	2 (18%)
3	Double triggering	0	1 (9%)	10 (91%)
4	Auto triggering	2 (18%)	4 (36%)	5 (46%)
5	Insufficient flow	0	0	11 (100%)
6	Premature cycling	0	5 (46%)	6 (54%)
7	Delayed cycling	2 (18%)	3 (28%)	6 (54%)

Status	Consensus	Stability
Consensus achieved	Yes (Option 1,3,5)	NA

Comments:

- Not necessarily these PVAs represent discomfort all the moments. Some patients can have some of these PVAs but, under some degree of sedation, do not "realize" the discomfort.
- Depending on the cause leading to Ineffective triggering this might be very uncomfortable (for instance inadequate trigger sensitivity)
- Discomfort in premature cycling is dependent on the patients´ degree of sedation.

2. For ‘patients without ARDS’, please rate the likelihood of the following PVAs to be associated with 'duration of mechanical ventilation’.

	Statement	Least likely	Neutral	Most likely
1	Ineffective triggering	0	2 (18%)	9 (82%)
2	Reverse triggering	4 (36%)	2 (18%)	5 (46%)
3	Double triggering	1 (18%)	4 (36%)	6 (54%)
4	Auto triggering	6 (54%)	2 (18%)	3 (27%)
5	Insufficient flow	3 (27%)	5 (46%)	3 (27%)
6	Premature cycling	6 (54%)	1 (9%)	4 (36%)
7	Delayed cycling	6 (54%)	0	5 (46%)

Status	Consensus	Stability
Consensus achieved	Yes (Options 1)	NA

Comments:

- The duration of MV is prolonged in patients reacting to PVA with agitation resulting in deepening of sedation.

3. For ‘patients with ARDS’, please rate the likelihood of the following PVAs to be associated with 'duration of mechanical ventilation’.

	Statement	Least likely	Neutral	Most likely
1	Ineffective triggering	1 (9%)	0	10 (91%)
2	Reverse triggering	3 (27%)	0	8 (73%)
3	Double triggering	1 (9%)	2 (18%)	8 (73%)
4	Auto triggering	6 (54%)	3 (27%)	2 (18%)
5	Insufficient flow	3 (27%)	4 (36%)	4 (36%)
6	Premature cycling	4 (36%)	2 (18%)	5 (46%)
7	Delayed cycling	5 (46%)	4 (36%)	2 (18%)

Status	Consensus	Stability
Consensus achieved	Yes (Options 1–3)	NA

Comments:

- 1.Consider the occurrence of clusters for ineffective effort. 2. Although not much evidence, flow starvation in the context of excessive effort may affect and prolong the weaning process. 3. Double triggering can be very harmful, but the overall incidence is not high.

4. For ‘patients with ARDS’, please rate the likelihood of the following PVAs to be associated with 'mortality’.

	Statement	Least likely	Neutral	Most likely
1	Ineffective triggering	2 (18%)	1 (9%)	8 (91%)
2	Reverse triggering	4 (36%)	1 (9%)	6 (54%)
3	Double triggering	2 (18%)	3 (27%)	6 (54%)
4	Auto triggering	7 (64%)	2 (18%)	2 (18%)
5	Insufficient flow	6 (54%)	4 (36%)	1 (9%)
6	Premature cycling	5 (46%)	3 (27%)	3 (27%)
7	Delayed cycling	6 (54%)	2 (18%)	3 (27%)

Status	Consensus	Stability
Consensus achieved	Yes (Options 1)	NA

Comments:

- There is some evidence showing association between PVA and mortality, however, I think the clinical context might be more relevant (severity, diagnosis, magnitude of breathing effort).
- Any PVA associated with prolongation of MV is theoretically associated with increased mortality. However, the question does not address the time factor. If PVA is detected and corrected within minutes there should be no effect on mortality.

5. For ‘postcardiac surgery patients’, please rate the likelihood of the following PVAs to be associated with ‘discomfort’.

	Statement	Least likely	Neutral	Most likely
1	Ineffective triggering	2 (18%)	0 (9%)	9 (82%)
2	Reverse triggering	3 (27%)	4 (36%)	4 (36%)
3	Double triggering	0	3 (27%)	8 (73%)
4	Auto triggering	0	6 (54%)	5 (46%)
5	Insufficient flow	0	2 (18%)	9 (82%)
6	Premature cycling	3 (27%)	2 (18%)	6 (54%)
7	Delayed cycling	4 (36%)	1 (9%)	6 (54%)

Status	Consensus	Stability
Consensus achieved	Yes (Options 1,3,5)	NA

6. For ‘postcardiac surgery patients’, please rate the likelihood of the following PVAs to be associated with ‘ ‘hemodynamic instability’.

	Statement	Least likely	Neutral	Most likely
1	Ineffective triggering	3 (27%)	5 (46%)	3 (27%)
2	Reverse triggering	3 (27%)	4 (36%)	4 (36%)
3	Double triggering	2 (18%)	2 (18%)	7 (64%)
4	Auto triggering	5 (46%)	3 (27%)	3 (27%)
5	Insufficient flow	4 (36%)	5 (46%)	2 (18%)
6	Premature cycling	6 (54%)	3 (27%)	2 (18%)
7	Delayed cycling	7 (64%)	2 (18%)	2 (18%)

Status	Consensus	Stability
Consensus achieved	No	NA

Comments:
The answers strongly depend on the degree of sedation. The answers above refer to a relatively awake patient

Any other comments related to this survey?
The degree of sedation (RAS score) could be included in the questions in order to clarify.

Identification of Patient–Ventilator Asynchronies and their Impact on Patient Outcomes: A Delphi Study

Round Four Survey Report

The Round four survey was created on a 'Google Forms' platform. The survey went live on September 23, 2024, with a window of 8 days for responses until September 30, 2024, at 5 PM (GMT).
This survey was sent to 11 experts and all of them completed the survey. There were 6 questions in the survey, with one each of ordinal Likert scale-based qualitative statements and multiple-choice questions (MCQ). A detailed report of the results of each question is presented below for your perusal. Minor edits have been made in the comments received to maintain the anonymity of the Experts.

Consensus	≥ 70% in favour of agree/disagree in Likert–scale, or any option in MCQ	Aim for stability
Stability	Chi-square or Kruskal-Wallis test for analysis, p-value <0.05 is significant (not applicable for round 1)	To analyse and aim for stable consensus or dissensus. If stable, the question is dropped from the next round.

Consensus Matrix

Round	**1**		**2**		**3**		**4**	
Sections	1		1		1		1	
Question	2 (1 Likert-scale+1 MCQ)	Total	2 (1 Likert-scale+1 MCQ)	Total	6 (6 Likert)	Total	6 (6 Likert)	Total
Comment	9		1		9		2	
Sections	**1**		**1**		**1**		**1**	
Total questions	2	2	2	2	6	6	6	
Consensus	2	2 (100%)	2	2 (100%)	5	5 (83%)	6	6(100%)
Question dropped	NA		0	0	NA		0	0
Question added	NA		0	0	NA		0	0
Question changed	NA		0	0	NA		0	0
Options changed	NA		0	0	NA		0	0
Stability checked	NA		2	2	NA		6	5
Stability achieved	NA		2	2 (100%)	NA		5	5 (83%)

PVA severity

1. For ‘patients without ARDS’, please rate the likelihood of the following PVAs to be associated with ‘discomfort’.

	Statement	Unlikely	Neutral	Likely	Stability
1	Auto triggering	1 (9%)	3 (27%)	7 (64%)	0.47
2	Double triggering	0	0	11 (100%)	0.03
3	Ineffective triggering	0	2 (18%)	9 (82%)	0.64
4	Reverse triggering	2 (18%)	5 (46%)	4 (36%)	0.32
5	Insufficient flow	0	0	11 (100%)	0.15
6	Delayed cycling	1 (9%)	2 (18%)	8 (73%)	0.74
7	Premature cycling	0	0	11 (100%)	0.65

Status	Consensus	Stability
Consensus achieved	Yes (Option 2,3,5–7)	No (2)

2. For ‘patients without ARDS’, please rate the likelihood of the following PVAs to be associated with 'duration of mechanical ventilation’.

	Statement	Unlikely	Neutral	Likely	Stability
1	Auto triggering	6 (54%)	4 (36%)	1 (9%)	0.71
2	Double triggering	1 (9%)	1 (9%)	9 (82%)	0.37
3	Ineffective triggering	0	0	11 (100%)	0.22
4	Reverse triggering	2 (18%)	4 (36%)	5 (46%)	0.86
5	Insufficient flow	0	6 (54%)	5 (46%)	0.25
6	Delayed cycling	3 (27%)	1 (9%)	7 (63%)	0.13
7	Premature cycling	7 (63%)	1 (9%)	3 (27%)	0.74

Status	Consensus	Stability
Consensus achieved	Yes (Options 2, 3)	Yes (1-7)

3. For ‘patients with ARDS’, please rate the likelihood of the following PVAs to be associated with 'duration of mechanical ventilation’.

	Statement	Unlikely	Neutral	Likely	Stability
1	Auto triggering	6 (54%)	5 (46%)	0	0.47
2	Double triggering	1 (9%)	0	10 (91%)	0.15
3	Ineffective triggering	0	0	11 (100%)	0.25
4	Reverse triggering	2 (18%)	0	9 (82%)	0.86
5	Insufficient flow	0	5 (46%)	6 (54%)	0.25
6	Delayed cycling	4 (36%)	4 (36%)	3 (27%)	0.57
7	Premature cycling	5 (46%)	3 (27%)	3 (27%)	0.69

Status	Consensus	Stability
Consensus achieved	Yes (Options 2–4)	Yes (1–7)

4. For ‘patients with ARDS’, please rate the likelihood of the following PVAs to be associated with 'mortality’.

	Statement	Unlikely	Neutral	Likely	Stability
1	Auto triggering	9 (82%)	2 (18%)	0	0.55
2	Double triggering	0	2 (18%)	9 (82%)	0.22
3	Ineffective triggering	0	1 (9%)	10 (91%)	0.26
4	Reverse triggering	2 (18%)	2 (18%)	7 (63%)	0.41
5	Insufficient flow	5 (46%)	6 (54%)	0	0.87
6	Delayed cycling	7 (63%)	4 (36%)	0	0.82
7	Premature cycling	8 (73%)	2 (18%)	1 (9%)	0.57

Status	Consensus	Stability
Consensus achieved	Yes (Options 2, 3, 7)	Yes (1–7)

5. For ‘postcardiac surgery patients’, please rate the likelihood of the following PVAs to be associated with ‘discomfort’.

	Statement	Unlikely	Neutral	Likely	Stability
1	Auto triggering	0	2 (18%)	9 (82%)	0.1
2	Double triggering	1 (9%)	0	10 (91%)	0.08
3	Ineffective triggering	0	1 (9%)	10 (91%)	0.37
4	Reverse triggering	2 (18%)	2 (18%)	7 (63%)	0.97
5	Insufficient flow	0	0	11 (100%)	0.05
6	Delayed cycling	3 (27%)	0	8 (73%)	0.79
7	Premature cycling	2 (18%)	0	9 (82%)	0.28

Status	Consensus	Stability
Consensus achieved	Yes (Options 1–3, 5–7)	Yes (1–7)

6. For ‘postcardiac surgery patients’, please rate the likelihood of the following PVAs to be associated with ‘ ‘hemodynamic instability’.

	Statement	Unlikely	Neutral	Likely	Stability
1	Auto triggering	8 (73%)	1 (9%)	2 (18%)	0.31
2	Double triggering	1 (9%)	1 (9%)	9 (82%)	0.47
3	Ineffective triggering	3 (27%)	4 (36%)	4 (36%)	0.82
4	Reverse triggering	1 (9%)	3 (27%)	7 (63%)	0.31
5	Insufficient flow	5 (45%)	4 (36%)	2 (18%)	0.92
6	Delayed cycling	8 (73%)	1 (18%)	2 (18%)	0.89
7	Premature cycling	6 (54%)	4 (36%)	1 (9%)	0.64

Status	Consensus	Stability
Consensus achieved	Yes (1, 2, 6)	Yes (1–7)

Any other comments related to this survey?
All depends on the sedation of the patient. If the patient is awake insufficient flow causes discomfort if the patient is deeply sedated it will cause no discomfort.

Identification of Patient–Ventilator Asynchronies and their Impact on Patient Outcomes: A Delphi Study

Round Six Survey Report

The Round six survey was created on an email. The survey went live between January 15, 2025, and February 1, 2025. There were 18 questions in the survey, on an ordinal Likert scale-based qualitative statement.

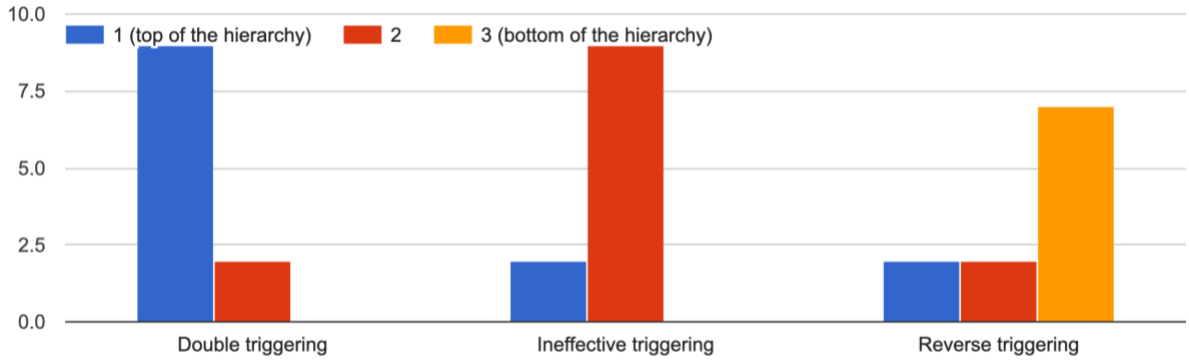
Consensus	≥ 70% in favour of agree/disagree in Likert–scale, or any option in MCQ	Aim for stability
Stability	Chi-square or Kruskal-Wallis test for analysis, p-value <0.05 is significant (not applicable for round 1)	To analyse and aim for stable consensus or dissensus. If stable, the question is dropped from the next round.

Consensus Matrix

Round	**6**			
Question	18 (18 Likert-scale)			Total
Comment	9			
Sections	**1**	**2**	**3**	
Total questions	6	6	6	18
Consensus	4	0	0	4 (22%)
Question dropped	NA	NA	NA	NA
Question added	NA	NA	NA	NA
Question changed	NA	NA	NA	NA
Options changed	NA	NA	NA	NA
Stability checked	NA	NA	NA	NA
Stability achieved	NA	NA	NA	NA

Hierarchy of PVAs: Patients with ARDS

1. For a patient with ARDS, transitioning from controlled to support ventilation, please rank the PVAs from 1 (top of the hierarchy) to 3 (bottom of the hierarchy), in relation to one another, based on the assumed severity in relation to its potential association with duration of ventilation, when the PVA is undetected and unresolved.



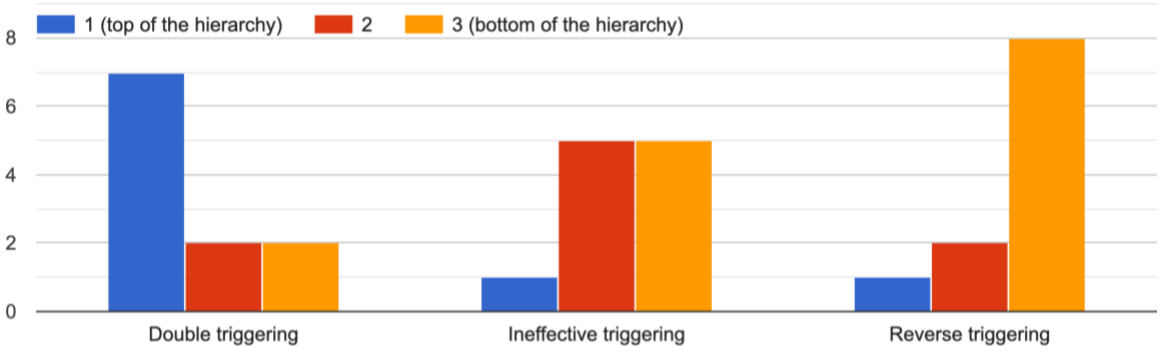
	Hierarchy (ranking)	Consensus
Double Triggering	1	Yes (82%)
Ineffective Triggering	2	Yes (82%)
Reverse Triggering	3	No (64%)

Comments:

1. In this scenario double triggering is most likely to (1) cause lung injury from high distending pressures and (2) be associated with low respiratory system compliance and high respiratory drive, which is usually caused by metabolic acidosis and lung inflammation -all these conditions indicate unresolved disease and thus can be associated with prolonged mechanical ventilation. In this scenario IE can be associated with low drive due to residual sedation, a condition that is fully reversible. Reverse triggering, although similar in effects with double triggering is mainly associated with deeper sedation and thus can resolve without intervention in a patient in whom sedation is decreased to facilitate transition to assisted ventilation
2. DT leading to increased VT and pendelluft may be most harmful. IT may induce strong negative inspiratory Ptrans, but volutrauma may be more injurious than atelectrauma. RT may be least harmful.
3. Double triggering leads to higher volumes, pressures and VILI, that's why number 1, and ineffective triggering can also lead to this, including diaphragm fatigue. I scored reverse triggering as second because it could be potentially helpful, when reverse triggering occurs during inspiration, it is potentially beneficial to the diaphragm because it reduces atrophy due to passivity of the diaphragm.
4. Undetected double triggering can lead to agitation and even impact gas exchange, leading to increased sedation and return to controlled ventilation, prolonging MV. Reverse triggering does not concern me much for patients transitioning to spontaneous ventilatory modes like PSV, they will cease, that’s why I place it at the bottom of the hierarchy.

5. Double and Reverse triggering are associated with more VILI possibilities and worst prognosis as systemic inflammatory effects and death. Ineffective trigger is associated with worse in muscular strength and this can affect duration of ventilation.
6. Reverse triggering in ARDS may lead to breath stacking and loss of protective ventilation, thus, counteracting the healing process of the ARDS lung. Ineffective triggering has been shown to prolong mechanical ventilation in studies with small patient numbers and double triggering can lead to breath stacking depending on the underlying disease (especially in COPD patients).
7. Double triggering are frequent at the transition phase with restrictive respiratory mechanics and might cause discomfort
8. Double triggering increases the risk of VILI and volutrauma. Ineffective triggering increases the risk of VIDD. Reverse triggering will not happen in support ventilation.
9. 1.Double triggering cause excessive tidal volume and potential lung injury. 2. There is some evidence that IIEE is associated with outcomes when is frequent or in clusters 3. Most evidence about reverse triggering shows that it occurs with low level of breathing effort, therefore low risk (unless you have double cycling). There is also some observational data that high rate RT might be associated with being extubated or in spontaneous mode. Finally, some preclinical evidence has shown that the effects RT on diaphragm injury could be in two directions depending on the level of breathing effort (But usually RT occurs with low breathing effort).

2. For a patient with ARDS, transitioning from controlled to support ventilation, please rank the PVAs from 1 (top of the hierarchy) to 3 (bottom of the hierarchy), in relation to one another, based on the assumed severity in relation to its potential association with duration of ventilation, when the PVA is detected and resolved.

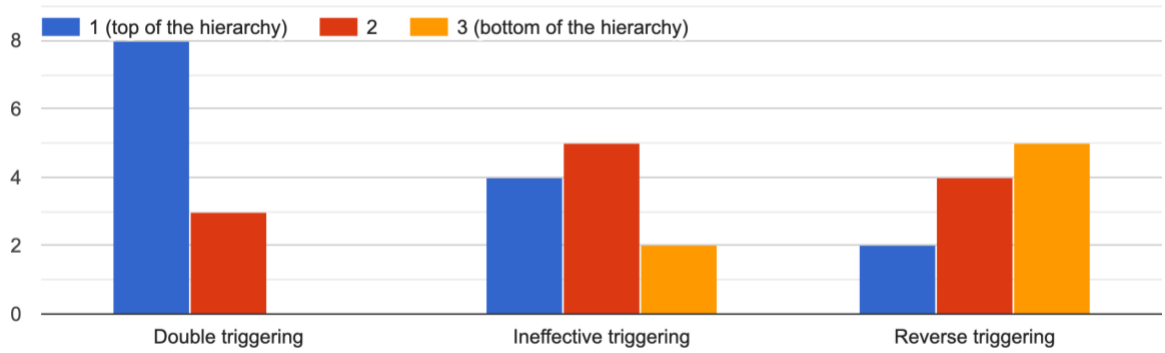


	Hierarchy (ranking)	Consensus
Double Triggering	1	No (64%)
Ineffective Triggering	2	No (45%)
Reverse Triggering	3	Yes (71%)

Comments:

1. The rationale is the same as above, double triggering, even if resolved as asynchrony, is more frequently, in this case, associated with unresolved disease if the patient has predisposing factors to diaphragm weakness (e.g has been in passive mechanical ventilation for a prolonged period of time, has preexisting muscle weakness) then IEs would be markers of muscle weakness and could be ranked first
2. Same explanation as above
3. Double triggering leads to higher volumes, pressures and VILI, that's why number 1, and ineffective triggering can also lead to this, including diaphragm fatigue. I scored reverse triggering as second because it could be potentially helpful, when reverse triggering occurs during inspiration, it is potentially beneficial to the diaphragm because it reduces atrophy due to passivity of the diaphragm.
4. The same reasoning applies here. It is good that PVS was resolved but it was intense, so double triggering continues to be my main concern
5. If they are kept for more than 8hs the bad effects has more clinical consequences. But if they are solved asap when detected this can avoid harm. I think the hierarchy is the same
6. When PVAs are detected and resolved promptly, there should be no or little impact on the time of mechanical ventilation. This should apply to double triggering, ineffective triggering, or reverse triggering. Exceptions are possible of course: if reverse triggering in a COPD patient with ARDS leads to pneumothorax the duration of ventilation can be negatively impacted.
7. Same as above (even if you correct the effect before correction is the same)
8. If corrected, potential consequences might be due to previous effect. thus, double triggering could be more injurious

3. For a patient with ARDS, transitioning from controlled to support ventilation, please rank the PVAs from 1 (top of the hierarchy) to 3 (bottom of the hierarchy), in relation to one another, based on the assumed severity in relation to its potential association with duration of ventilation, when the PVA is persistent despite intervention.

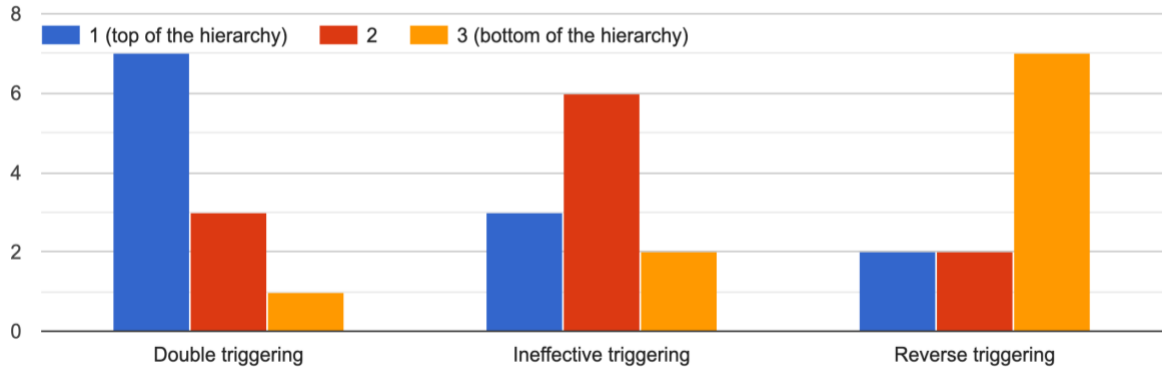


	Hierarchy (ranking)	Consensus
Double Triggering	1	Yes (82%)
Ineffective Triggering	2	Yes (45%)
Reverse Triggering	3	Yes (45%)

Comments:

1. Ineffective triggering due to severe muscle weakness is more challenging to resolve than double triggering due to high drive, while reverse triggering is resolved after interruption of sedation. Therefore persistent IEs after eliminating other reasons for low drive are most likely associated with muscle weakness, which, frequently has a prolonged course to recovery
2. same explanation as above
3. double triggering leads to higher volumes, pressures and VILI, that's why number 1, and ineffective triggering can also lead to this, including diaphragm fatigue. I scored reverse triggering as second because it could be potentially helpful. When reverse triggering occurs during inspiration, it is potentially beneficial to the diaphragm because it reduces atrophy due to passivity of the diaphragm.
4. In this case, double triggering continues to be a major problem, and many clinicians may feel inclined to sedate the patient, leading to prolonged MV. In this case, unresolved reverse triggering can lead to breath staking in some cases, and also induce clinicians to increase sedation (although that may increase the occurrence of RT).
5. Double and Reverse triggering are associated with more VILI possibilities and worst prognosis as systemic inflammatory effects and death. Ineffective trigger is associated with worse in muscular strength and this can affect duration of ventilation. If it keeps occurring in time the duration can be worst.(longer)
6. Persistent ineffective triggering and reverse triggering have been shown to prolong mechanical ventilation in ICU patients. For double triggering I am not aware of any study addressing the duration of ventilation.
7. Same as above.
8. The effect of RT will depend on the level of breathing effort.

4. For a patient with ARDS, transitioning from controlled to support ventilation, please rank the PVAs from 1 (top of the hierarchy) to 3 (bottom of the hierarchy), in relation to one another, based on the assumed severity in relation to its potential association with mortality, when the PVA is undetected and unresolved.

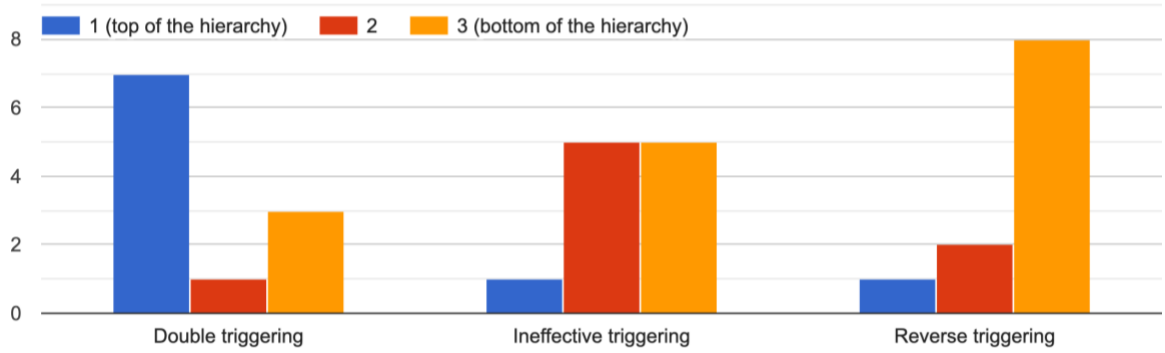


	Hierarchy (ranking)	Consensus
Double Triggering	1	No (64%)
Ineffective Triggering	2	No (55%)
Reverse Triggering	3	No (64%)

Comments:

1. The rationale is the same as in Q1
2. Double triggering leads to higher volumes, pressures and VILI, that's why number 1, and ineffective triggering can also lead to this, including diaphragm fatigue. I scored reverse triggering as second because it could be potentially helpful. When reverse triggering occurs during inspiration, it is potentially beneficial to the diaphragm because it reduces atrophy due to passivity of the diaphragm.
3. Double triggering can lead to breath staking, which has a potential to be harmful and associated with mortality. Reverse triggering does not concern me much for patients transitioning to spontaneous ventilatory modes like PSV.
4. The fact of not even be detected (and so, impossible to be resolved) allows that Double and Reverse triggering keeps worsening VILI continuously, compromising prognosis, worsening and affecting other organs, with Multiple Organ Dysfunction Syndrome (MODS). Ineffective trigger is associated with worse in muscular strength and this can affect duration of ventilation, and, eventually can worse the chain of mechanisms that can cause death.
5. This was decided on mere "feeling", because it has not been examined so far.
6. Same as above. I believe if there is any effect on mortality, the hierarchy is the same for the same reason above
7. Double triggering based on excessive tidal volume and lung injury, IIEE based on observational data

5. For a patient with ARDS, transitioning from controlled to support ventilation, please rank the PVAs from 1 (top of the hierarchy) to 3 (bottom of the hierarchy), in relation to one another, based on the assumed severity in relation to its potential association with mortality, when the PVA is detected and resolved.

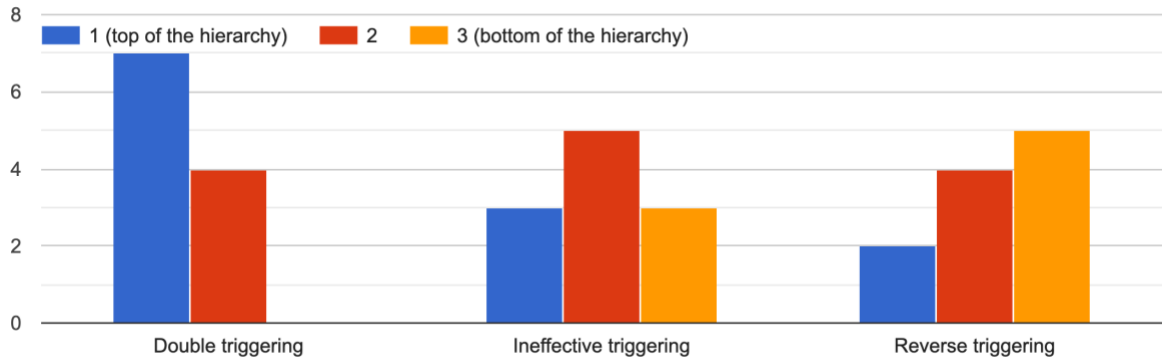


	Hierarchy (ranking)	Consensus
Double Triggering	1	No (64%)
Ineffective Triggering	2	No (45%)
Reverse Triggering	3	Yes (71%)

Comments

1. The rationale is the same as in Q2
2. double triggering leads to higher volumes, pressures and VILI, that's why number 1, and ineffective triggering can also lead to this, including diaphragm fatigue. I scored reverse triggering as second because it could be potentially helpful. When reverse triggering occurs during inspiration, it is potentially beneficial to the diaphragm because it reduces atrophy due to passivity of the diaphragm.
3. The same reasoning applies here. It is good that PVS was resolved but it was intense, so double triggering continues to be my main concern
4. The cessation of PVAs can diminish VILI , with better prognosis due to this problem.
5. Prompt detection of all three forms of asynchrony should not have an effect on mortality.
6. As above

6. For a patient with ARDS, transitioning from controlled to support ventilation, please rank the PVAs from 1 (top of the hierarchy) to 3 (bottom of the hierarchy), in relation to one another, based on the assumed severity in relation to its potential association with mortality, when the PVA is persistent despite intervention.



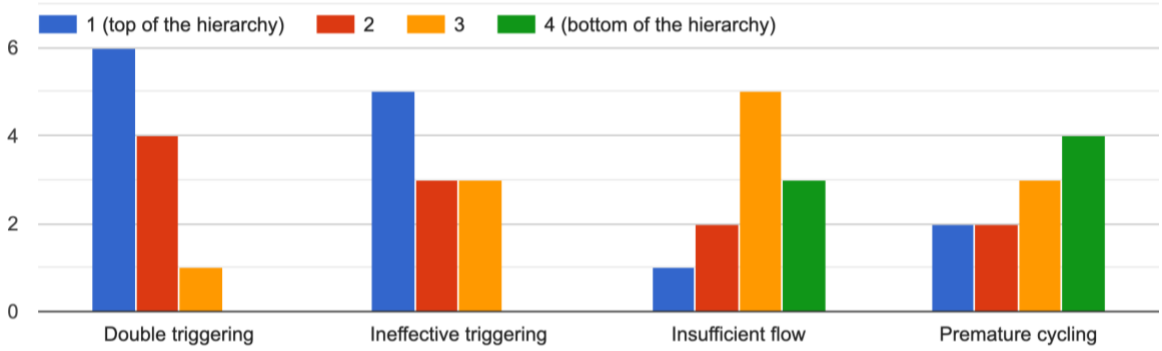
	Hierarchy (ranking)	**Consensus**
Double Triggering	1	No (64%)
Ineffective Triggering	2	No (45%)
Reverse Triggering	3	No (45%)

Comments:

1. The rationale is the same as in Q3
2. Double triggering leads to higher volumes, pressures and VILI, that's why number 1, and ineffective triggering can also lead to this, including diaphragm fatigue. I scored reverse triggering as second because it could be potentially helpful. When reverse triggering occurs during inspiration, it is potentially beneficial to the diaphragm because it reduces atrophy due to passivity of the diaphragm.
3. The same reasoning for duration of MV applies here. Persistent double triggering will result in Unprotective ventilation, and may lead to increased sedation and other complications that are associated with mortality. Unresolved RT will also induce clinicians to sedate.
4. The persistence of PVAs, even with ineffective interventions were done, allows that Double and Reverse triggering keeps worsening VILI continuously, compromising prognosis, worsening and affecting other organs, with Multiple Organ Dysfunction Syndrome (MODS). Ineffective trigger is associated with worse in muscular strength and this can affect duration of ventilation, and, eventually can worse the chain of mechanisms that can cause death.
5. This is an assumption. I am not aware of studies examining this. Additionally, I think this is possibly an indicator for central nervous system problems because it is related to neural signalling.
6. As above

Hierarchy of PVAs: Patients without ARDS

1. For a patient without ARDS, transitioning from controlled to support ventilation, please rank the PVAs from 1 (top of the hierarchy) to 3 (bottom of the hierarchy), in relation to one another, based on the assumed severity in relation to its potential association with duration of ventilation, when the PVA is undetected and unresolved.



	Hierarchy (ranking)	Consensus
Double Triggering	1	No (55%)
Ineffective Triggering	2	No (45%)
Insufficient flow	3	No (45%)
Premature Cycling	4	No (36%)

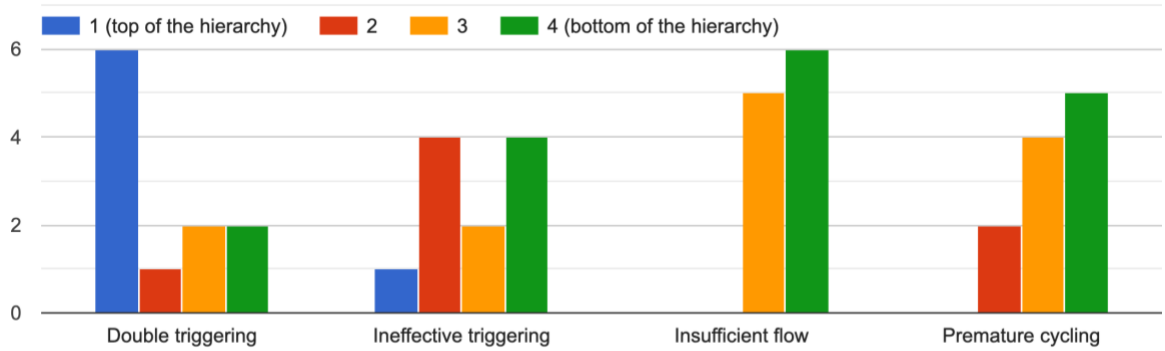
Comments:

1. In this scenario both double triggering and premature cycling are most likely associated with low respiratory system compliance and high respiratory drive, which is usually caused by metabolic acidosis and lung inflammation -all these conditions indicate unresolved disease and thus can be associated with prolonged mechanical ventilation. in this scenario IE can be associated with low drive due to residual sedation, a condition that is fully reversible insufficient flow occurs when volume control mode is used in a patient able to generate adequate negative pressure - indicating strong respiratory muscles. it is easily resolved by changing the mode of ventilation to a fully assisted mode
2. Insufficient flow may induce discomfort, but may be least harmful in regards of the defined outcomes.
3. Double triggering could lead to higher pressures and volumes, therefore auto PEEP, VILI leading to longer duration. ineffective efforts can lead to higher pressures as well as diaphragm
4. For non ARDS, ineffective triggering is the most prevalent PVA, and when undetected and unresolved can lead to hyperinflation and impact weaning. Double triggering can lead to agitation and increased sedation. Insufficient flow is uncomfortable and may also lead to increase sedation. Premature cycling, when not paired with double triggering, is probably uncomfortable but may have minimal other implications
5. Double triggering can bring more chance of VILI by causing tidal recruitment, improving driving pressure and tidal volume, tidal hyperdistention. Ineffective

trigger can affect inspiratory muscles and causa fatigue, weaning failure and prolonged duration. Insufficient flow and Premature Cycling can contribute for both mechanisms but my clinical perception is that they usually can be less harmful.

6. Ineffective triggering leads to insufficient ventilation with very likely metabolic changes such as an increase in PaCO2, and thus, is likely to prolong mechanical ventilation. Insufficient flow leads to patient agitation frequently treated with an increase of sedative drugs, thus, prolonging mechanical ventilation. Premature cycling is associated with suboptimal ventilation, associated with atelectasis formation, and/or lung overdistension. I regard double triggering as a little less harmful to ventilatory mechanics.
7. As previous comments, and insufficient flow is more important than premature cycling
8. Double triggering based on lung injury but less than ARDS since no baby lung and Insufficient flow based on discomfort. Consider premature cycling without inducing double triggering.

2. For a patient without ARDS, transitioning from controlled to support ventilation, please rank the PVAs from 1 (top of the hierarchy) to 4 (bottom of the hierarchy), in relation to one another, based on the assumed severity in relation to its potential association with duration of ventilation, when the PVA is detected and resolved.

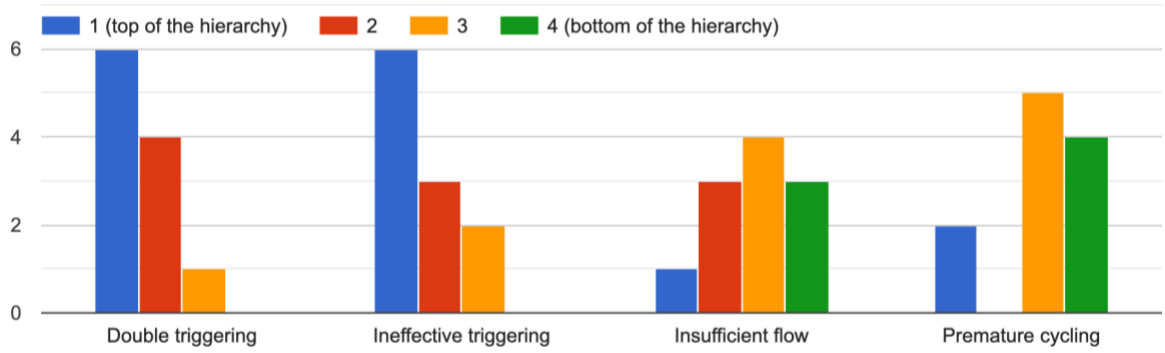


	Hierarchy (ranking)	Consensus
Double Triggering	1	No (55%)
Ineffective Triggering	2	No (36%)
Insufficient flow	3	No (55%)
Premature Cycling	4	No (45%)

Comments:

1. The rationale is the same as above
2. As above. but in general less harmful than not detected or persistent
3. Double triggering could lead to higher pressures and volumes, therefore auto PEEP, VILI leading to longer duration. ineffective efforts can lead to higher pressures as well as diaphragm fatigue, similar regarding outcomes association
4. The same reasoning as above, since intensity also matters
5. When PVAs are solved, if they do not were kept for a long time (i.e, asap when detected), the effects are stopping the consequences described above, with potential improvements of outcome.
6. If the problem is detected fast and resolved none of the PVAs (with exceptions) should have an impact on the duration of mechanical ventilation.
7. As above.

3. For a patient without ARDS, transitioning from controlled to support ventilation, please rank the PVAs from 1 (top of the hierarchy) to 4 (bottom of the hierarchy), in relation to one another, based on the assumed severity in relation to its potential association with duration of ventilation, when the PVA is persistent despite intervention.



	Hierarchy (ranking)	Consensus
Double Triggering	1	No (55%)
Ineffective Triggering	1	No (55%)
Insufficient flow	3	No (36%)
Premature Cycling	3	No (45%)

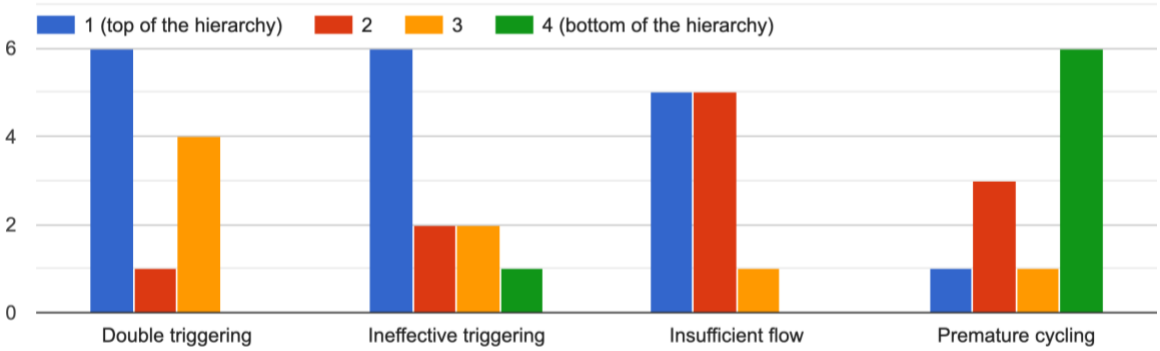
Comments:

1. Ineffective triggering due to severe muscle weakness is more challenging to resolve than double triggering due to high drive, while insufficient flow is mode-specific and thus always resolved. Therefore persistent IEs after eliminating other reasons for low drive are most likely associated with muscle weakness, which, frequently has a prolonged course to recovery
2. As above
3. Double triggering could lead to higher pressures and volumes, therefore auto PEEP, VILI leading to longer duration. ineffective efforts can lead to higher pressures as well as diaphragm
4. Unresolved, IT continues to be the most concerning to me, as it may lead to increase sedation. DT will also prompt more sedation, but is not as prevalent as IT. Persistent insufficient flow will almost certainly lead to increase sedation, while premature cycling without DT may be tolerated
5. If the intervention did not resolved and PVAs are going on, Double triggering can bring more chance of VILI by causing tidal recruitment, improving driving pressure and tidal volume, tidal hyperdistention. Ineffective trigger can affect inspiratory muscles and causa fatigue, weaning failure and prolonged duration. Insufficient flow and Premature Cycling can contribute for both mechanisms but my clinical perception is that they usually can be less harmful.
6. Signalling problems for all PVAs? Underlying neurological problem? Additionally, ineffective ventilation that cannot be resolved over a prolonged time leads usually to a switch to controlled ventilation with the deepening of sedation. All of the

mentioned PVAs usually do not lead to protective ventilation and can in the worst case lead to diaphragmatic trauma.

7. As above

4. For a patient without ARDS, transitioning from controlled to support ventilation, please rank the PVAs from 1 (top of the hierarchy) to 4 (bottom of the hierarchy), in relation to one another, based on the assumed severity in relation to its potential association with discomfort, when the PVA is undetected and unresolved.



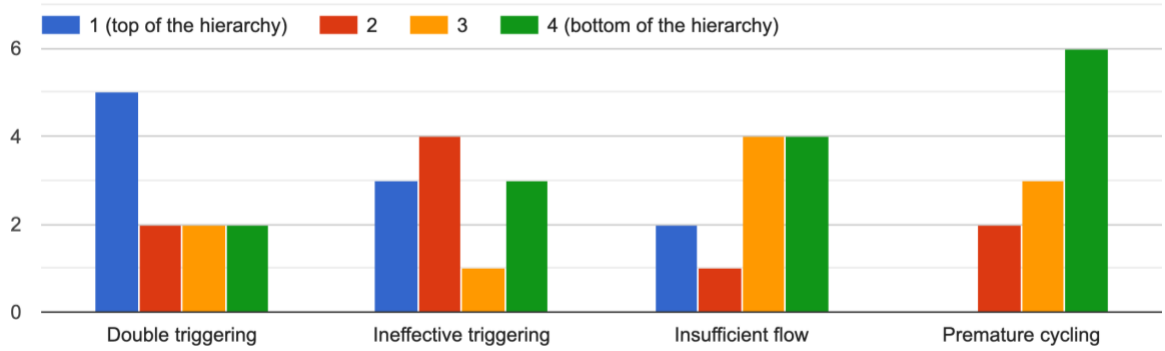
	Hierarchy (ranking)	Consensus
Double Triggering	1	No (55%)
Ineffective Triggering	1	No (55%)
Insufficient flow	2	No (45%)
Premature Cycling	4	No (55%)

Comments:

1. A spontaneously breathing patient ventilated in volume control mode presence of insufficient flow indicates that the patient's instantaneous flow demands are not met, which causes discomfort. double triggering occurs when respiratory drive is high and support relatively low, and this may also be associated with discomfort , Therefore these two dys-synchronies could result to the same extent in discomfort. Premature cycling has the same underlying mechanism as double triggering but implies that patient's effort is a relatively lower and system's time constant relatively higher than what would result in double triggering. Ineffective triggering can be associated with discomfort only in patients with obstructive lung disease and intrinsic PEEP. It should be noted that a patient with PEEPi and IEs due to PEEPi could not develop double triggering.
2. Inspiratory effort without ventilator response may induce the highest degree of discomfort
3. The first 2 are mandatory extra breaths, which could be very uncomfortable, more than the other 2
4. I suspect that insufficient flow for patients with respiratory failure most be the most uncomfortable experience, as when it happens, it typically occurs on every breath. Not being able to get a breath when you want is second worse. and usually DT makes patients more agitated then PC

5. Regarding discomfort, both double and ineffective triggering are at the top of hierarchy, independently of being or not resolved. Of course if they are not resolved the clinical consequences are worse. If they are undetected maybe your team needs training.
6. All of these PVAs are associated with discomfort. "Fighting the ventilator" cannot be comfortable. Insufficient flow is like suffocating, as is ineffective triggering (you want to draw a breath but no air is flowing). Double triggering: your breath was terminated to early is very uncomfortable. Premature cycling: your neurological breath signalling and the ventilator are not in synch. All of the PVAs are uncomfortable. Once you tried ventilation with a CPAP mask yourself it is easy to imagine.
7. I think it's the same hierarchy for discomfort too
8. Insufficient flow is the most uncomfortable since patient is not being supported IIEE and Double triggering can be annoying since the feeling you cannot trigger a breath (isometric contraction) and double trigger sin no exhalation is in between the 2 consecutive cycles

5. For a patient without ARDS, transitioning from controlled to support ventilation, please rank the PVAs from 1 (top of the hierarchy) to 4 (bottom of the hierarchy), in relation to one another, based on the assumed severity in relation to its potential association with discomfort, when the PVA is detected and resolved.

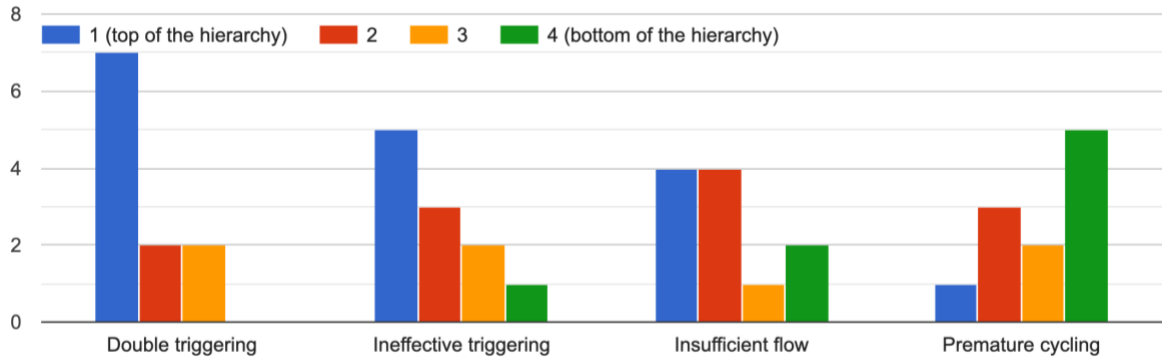


	Hierarchy (ranking)	Consensus
Double Triggering	1	No (45%)
Ineffective Triggering	2	No (36%)
Insufficient flow	3	No (36%)
Premature Cycling	4	No (55%)

Comments

1. I cannot understand this question, a PVA that is resolved and does not exist does not cause discomfort. I grade this question considering if the underlying conditions causing an asynchrony can also be associated with the discomfort.
2. The first 2 are mandatory extra breaths, which could be very uncomfortable, more than the other 2
3. The same reasoning than for when is not detected
4. When PVA is resolved, specially asap (ie, immediately after detection) and the duration were less than 8 hours, this can mitigate VILI mechanisms and be good for the patient.
5. This depends on the patient and how fast the problem is resolved.
6. As above

6. For a patient without ARDS, transitioning from controlled to support ventilation, please rank the PVAs from 1 (top of the hierarchy) to 4 (bottom of the hierarchy), in relation to one another, based on the assumed severity in relation to its potential association with discomfort, when the PVA is persistent despite intervention.



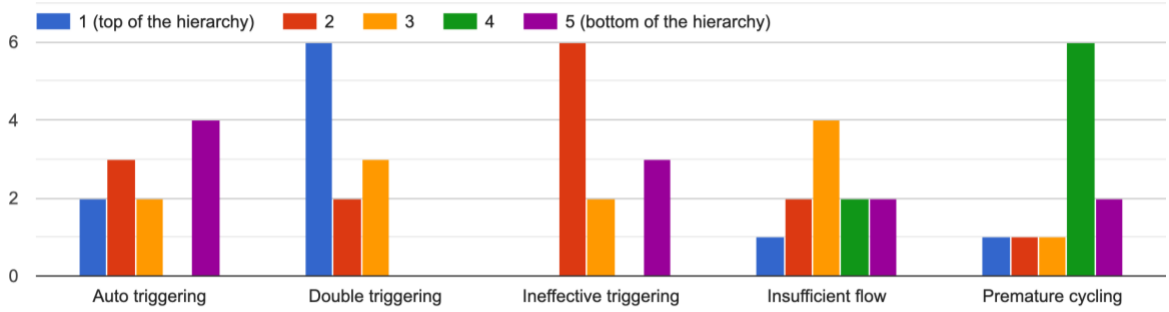
	Hierarchy (ranking)	Consensus
Double Triggering	1	No (64%)
Ineffective Triggering	1	No (45%)
Insufficient flow	2	No (36%)
Premature Cycling	4	No (45%)

Comments:

1. Insufficient flow occurs when volume control mode is used in a patient able to generate adequate negative pressure - indicating strong respiratory muscles. it is easily resolved by changing the mode of ventilation to a fully assisted mode, therefore there cannot be a condition where insufficient flow is unresolved, so I grade this as 4, but actually it would be 'not applicable'. Double triggering occurs when respiratory drive is high and support relatively low, which may be associated with discomfort. Ineffective triggering can be associated with discomfort only in patients with obstructive lung disease and intrinsic PEEP. It should be noted that a patient with PEEPi and IEs due to PEEPi could not develop double triggering.
2. Persistent IT may be still worst. however, persistent insufficient flow may be induce more discomfort than the double trigger.
3. The first 2 are mandatory extra breaths, which could be very uncomfortable, more than the other 2
4. The same reasoning. If unresolved, patients may be sedated or the PVA may be tolerated, and in that case, insufficient flow it the most discomfortable one
5. If the intervention did not resolved and PVAs are going on, Double triggering can bring more chance of VILI by causing tidal recruitment, improving driving pressure and tidal volume, tidal hyperdistention, with important discomfort, especially considering the transition to spontaneous modes, and perhaps less sedation. Ineffective trigger can affect inspiratory muscles and causa fatigue, weaning failure and important discomfort. Insufficient flow and Premature Cycling can contribute for both mechanisms but my clinical perception is that they usually can be less harmful.
6. See question 4.
7. As above.

Hierarchy of PVAs: Cardiothoracic patients

1. For a patient after cardiothoracic surgery, who is waking up after sedation is stopped, please rank the PVAs from 1 (top of the hierarchy) to 5 (bottom of the hierarchy), in relation to one another, based on the assumed severity in relation to its potential association with hemodynamic instability, when the PVA is undetected and unresolved.



	Hierarchy (ranking)	Consensus
Double Triggering	1	No (55%)
Ineffective Triggering	2	No (55%)
Insufficient flow	3	No (36%)
Premature Cycling	4	No (55%)
Auto triggering	5	No (36%)

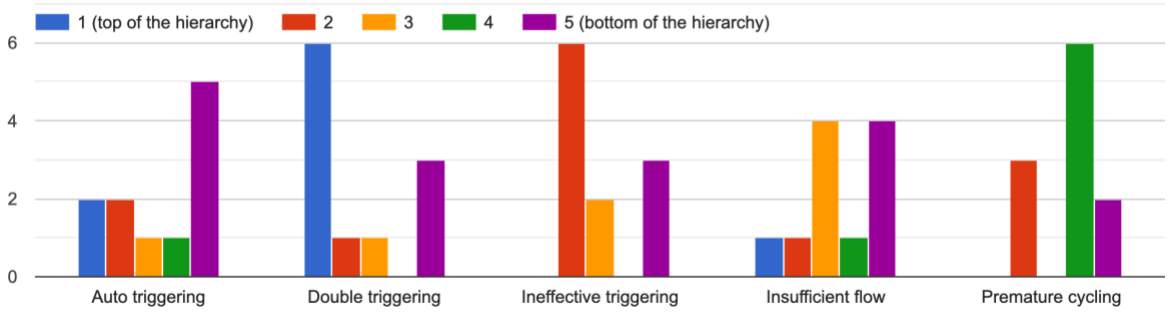
Comments

1. Hemodynamic instability can result from strong inspiratory efforts decreasing intrathoracic pressure and reducing venous return, so asynchronies associated with strong efforts are ranked first. Auto-triggering could potentially result in respiratory alkalosis and arrythmias but this unlikely to occur.
2. DT: higher VT induces higher intrathoracic pressure, additional breaths by auto trigger may also increase intrathoracic pressure and thereby impair haemodynamics. ineffective trigger may on one hand increase venous return by temporarily negative intrathoracic pressure, but the discomfort may be associated with increased sympathicotonus and tachycardia...
3. the first three could lead more to hemodynamic instability because of the pressure switch
4. Insufficient flow will lead to increased inspiratory efforts on every breath, negative intrathoracic pressures, and interfere with venous return. IT can also do that, but not on every breath. Double triggering my lead to hyperinflation and impact venous return. I am not sure that PC would be much of a problem for haemodynamics in this scenario
5. Auto triggering can facilitate Auto-PEEP formation, with increased Paw and Driving pressures, causing impact in Cardiac Output and Venous Return. This can also demand more from heart work, what, depending on the clinical conditions can

affect patient outcomes. Double triggering, if intense, can bring more chance of VILI by causing tidal recruitment, improving driving pressure and tidal volume also; tidal hyperdistention and impact in the Pulmonary Vascular Resistance, with consequences to Right Ventricle, including Acute Core Pulmonale (ACP). Ineffective trigger can affect inspiratory muscles and causa fatigue, weaning failure and prolonged duration and discomfort. Insufficient flow and Premature Cycling can contribute for both mechanisms but my clinical perception is that they usually can be less harmful.

6. Ineffective triggering and insufficient flow are usually associated with blood pressure increase. Extreme blood pressure is undesirable after surgery, especially in heart failure patients. Auto triggering can be very uncomfortable and lead to blood pressure increase as well. Especially disturbing for hemodynamic stability is a situation when the ventilator is delivering a breath and the patient is simultaneously performing a forced exhalation (severe premature cycling?). This leads to insufficient blood flow to the right heart due to increased intrathoracic pressure and can result in fast hemodynamic collapse requiring pharmacological or even mechanical ventilation. This is treated with disconnection from the ventilator. Double triggering from my experience is frequently seen in patients who are still sedated or have a neurological problem.
7. As above and I don't think auto triggering will cause any haemodynamic impact
8. Double triggering causing breath stacking may affect haemodynamics by increasing thoracic pressure whereas insufficient flow can increase level of breathing effort

2. For a patient after cardiothoracic surgery, who is waking up after sedation is stopped, please rank the PVAs from 1 (top of the hierarchy) to 5 (bottom of the hierarchy), in relation to one another, based on the assumed severity in relation to its potential association with hemodynamic instability, when the PVA is detected and resolved.

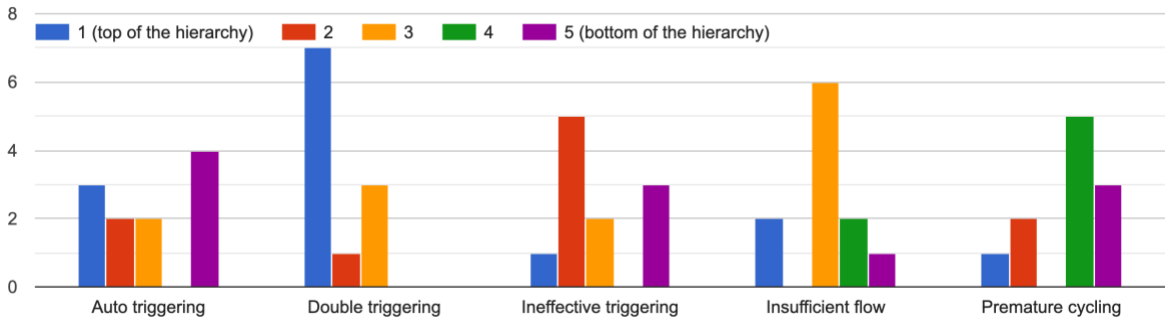


	Hierarchy (ranking)	Consensus
Double Triggering	1	No (55%)
Ineffective Triggering	2	No (55%)
Insufficient flow	3	No (36%)
Premature Cycling	4	No (55%)
Auto triggering	5	No (45%)

Comments:

1. The rationale is the same as above
2. Similar as above, but in general less harmful when resolved.
3. The first three could lead more to hemodynamic instability because of the pressure switches
4. The same reasoning as above
5. If PVA are resolved asap (i.e., when detected) and the duration is less then 8 hours, this can mitigate the mechanisms of VILI and hemodynamic compromise, with potentially improving in the patient outcome
6. Extreme premature cycling (described above) can lead to hemodynamic instability even if the nurse/physician is at the bedside and it is detected immediately and treated with deepening of sedation and disconnection from the ventilator. If auto-triggering, double triggering, ineffective triggering, or insufficient flow are treated fast there is a transient increase in blood pressure that is usually well tolerated. However, a severe increase in blood pressure is endangering surgical anastomosis and can have dramatic consequences.
7. As above

3. For a patient after cardiothoracic surgery, who is waking up after sedation is stopped, please rank the PVAs from 1 (top of the hierarchy) to 5 (bottom of the hierarchy), in relation to one another, based on the assumed severity in relation to its potential association with hemodynamic instability, when the PVA is persistent despite intervention.

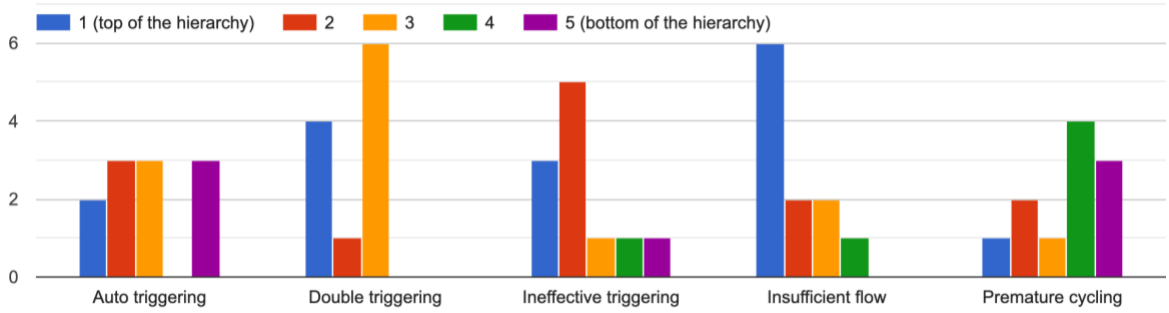


	Hierarchy (ranking)	Consensus
Double Triggering	1	No (63%)
Ineffective Triggering	2	No (45%)
Insufficient flow	3	No (55%)
Premature Cycling	4	No (45%)
Auto triggering	5	No (36%)

Comments:

1. the rationale is the same as above
2. the first three could lead more to hemodynamic instability because of the pressure switches
3. The same reasoning as above, and in a scenario where the team detects the PVAs, may lead to sedation if adjustments do not resolve its occurrence
4. Auto triggering can facilitate Auto-PEEP formation, with increased Paw and Driving pressures, causing impact in Cardiac Output and Venous Return. This can also demand more from heart work, what, depending on the clinical conditions can affect patient outcomes. Double triggering, if intense, can bring more chance of VILI by causing tidal recruitment, improving driving pressure and tidal volume also; tidal hyperdistention and impact in the Pulmonary Vascular Resistance, with consequences to Right Ventricle, including Acute Core Pulmonale (ACP). Ineffective trigger can affect inspiratory muscles and causa fatigue, weaning failure and prolonged duration and discomfort. Insufficient flow and Premature Cycling can contribute for both mechanisms but my clinical perception is that they usually can be less harmful. If despite the intervention this AVP are going on, this can compromise the patient outcome.
5. All of the PVAs lead to hemodynamic instability if they are persistent and the patient is in stress. Double triggering is from my experience hemodynamically tolerated best if persistent.
6. As above
7. Double triggering causing breath stacking may affect haemodynamics by increasing thoracic pressure whereas insufficient flow can increase level of breathing effort

4. For a patient after cardiothoracic surgery, who is waking up after sedation is stopped, please rank the PVAs from 1 (top of the hierarchy) to 5 (bottom of the hierarchy), in relation to one another, based on the assumed severity in relation to its potential association with discomfort, when the PVA is undetected and unresolved.

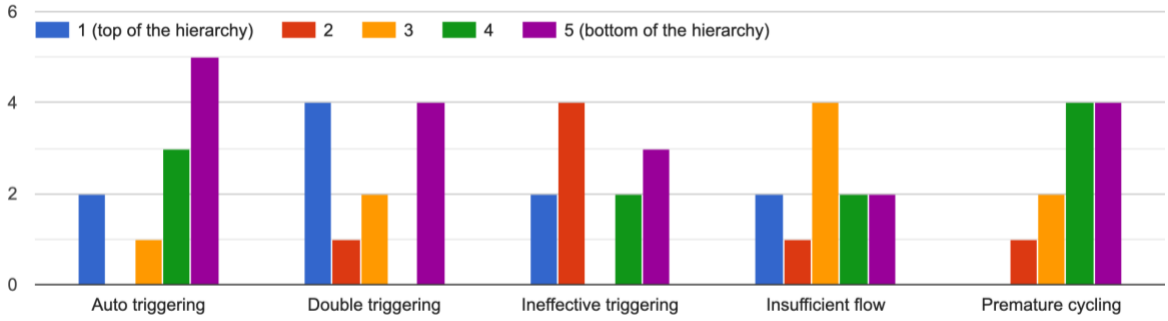


	Hierarchy (ranking)	Consensus
Insufficient flow	1	No (55%)
Ineffective Triggering	2	No (45%)
Double Triggering	3	No (55%)
Premature Cycling	4	No (36%)
Auto triggering	5	No (27%)

Comments:

1. Chose the first three because they are 'mandatory asynchronic breaths' which is very uncomfortable when waking up, and causes agitation
2. I think insufficient flow is the most uncomfortable of these PVAs. IT can also be uncomfortable, but it does not occur on every breath. DT will lead to over assistance, which is less uncomfortable then under assistance, to patients
3. If the PVA is not even detected by the team (what, of course, make it impossible to be solved) all the deleterious mechanisms are maintained, what can compromise the patient outcome. In the specific matter of discomfort this can cause including the needing of more sedation, with impact in duration, more incidence of AVP, and loss of muscle strength, among other consequences. Maybe a training for the team shall be performed.
4. This is difficult to answer because patients are usually fast-tracked after cardiothoracic surgery with permanent attendance of a nurse or doctor at the bedside. Therefore, the situation with persistent PVAs occur rarely. When the patient is awake all of these PVAs are associated with discomfort if it is a permanent situation. Double triggering is from my experience tolerated somewhat better (maybe because patients are usually deeper sedated).
5. I think auto triggering generates more discomfort than flow asynchronies

5. For a patient after cardiothoracic surgery, who is waking up after sedation is stopped, please rank the PVAs from 1 (top of the hierarchy) to 5 (bottom of the hierarchy), in relation to one another, based on the assumed severity in relation to its potential association with discomfort, when the PVA is detected and resolved.

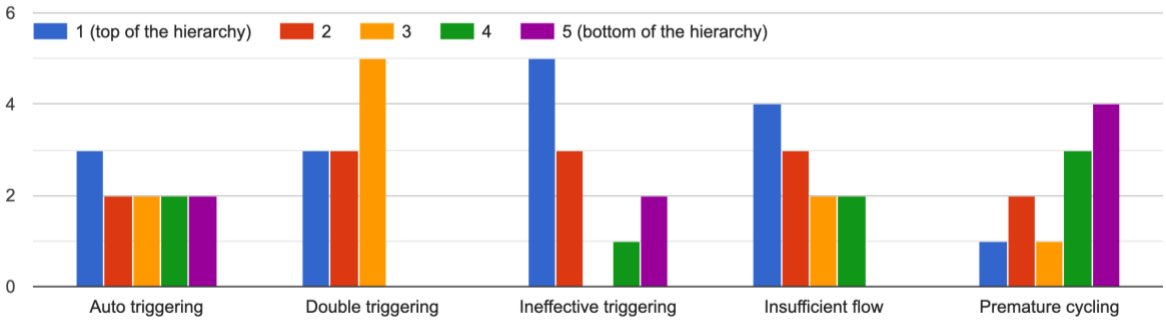


	Hierarchy (ranking)	Consensus
Double Triggering	1	No (36%)
Ineffective Triggering	2	No (36%)
Insufficient flow	3	No (36%)
Premature Cycling	4	No (36%)
Auto triggering	5	No (45%)

Comments:

1. High drive could be associated with discomfort even if the asynchrony is resolved, so PVAs are ranked 1-2-3 with the likelihood of association with high drive.
2. Chose the first three because they are 'mandatory asynchronic breaths' which is very uncomfortable when waking up, and causes agitation
3. The same order applies, even when the PVAs are resolved
4. If PVA are resolved asap (i.e., when detected) and the duration is less then 8 hours, this can mitigate the mechanisms of VILI and hemodynamic compromise, with potentially improving in the patient outcome. Less discomfort will be helpful in a quicker weaning and extubation, mitigating another causes of potential complications as AVP.
5. Fast detection and treatment of PVAs are usually not associated with severe discomfort. However, premature cycling is tolerated worst.
6. As above

6. For a patient after cardiothoracic surgery, who is waking up after sedation is stopped, please rank the PVAs from 1 (top of the hierarchy) to 5 (bottom of the hierarchy), in relation to one another, based on the assumed severity in relation to its potential association with discomfort, when the PVA is persistent despite intervention.



	Hierarchy (ranking)	Consensus
Ineffective Triggering	1	No (45%)
Insufficient flow	1	No (36%)
Auto triggering	3	No (45%)
Double Triggering	1	No (27%)
Premature Cycling	5	No (36%)

Comments:

1. The rationale is the same as above, and the comment that Ins flow can always be resolved by changing mode applies here too.
2. Chose the first three because they are 'mandatory asynchronic breaths' which is very uncomfortable when waking up, and causes agitation
3. The same order applies for persistent PVAs
4. Auto triggering and Ineffective Trigger can facilitate Auto-PEEP formation, with increased Paw and Driving pressures, causing impact in Cardiac Output and Venous Return. This can also demand more from heart work, what, depending on the clinical conditions can affect patient outcomes. This can cause important discomfort. All these Ineffective trigger can affect inspiratory muscles and causa fatigue, weaning failure and prolonged duration and discomfort. Insufficient flow and Premature Cycling can contribute for both mechanisms but my clinical perception is that they usually can be less harmful. If despite the intervention this AVP are going on, this can compromise the patient outcome.
5. It usually is not persistent because patients are sedated if PVAs are severe and after some time reduction of sedation is once more performed. Thus, the main intervention after changing ventilator settings is sedation and controlled ventilation. Some patients require 2-4 attempts of sedation reduction after cardiothoracic surgery before synchronization with the ventilator is successful.
6. As above

Any other comments related to this survey?

1. It is difficult to judge on insufficient flow, as effects may largely depend on how inappropriate the setting is...
2. I believe this can bring more clarity to the paper, despite these answers still keep considering our personal clinical perception about impact of each PVA in these scenarios. Thank you for the efforts in improving this new round. I don’t know if my comments are useful. If they are far from expected, please let me know about, and I can try to modify and improve them. Best regards.

Identification of Patient–Ventilator Asynchronies and their Impact on Patient Outcomes: A Delphi Study

Round Seven Survey Report

The Round seven survey was created on was created on a 'Google Forms' platform. The survey went live between February 6, 2024 and February 24, 2025 (GMT). This survey was sent to 11 experts and all of them completed the survey. There were 18 questions in the survey for ranking of PVAs for the outcomes. A detailed report of the results of each question is presented below for your perusal. Minor edits have been made in the comments received to maintain the anonymity of the Experts.

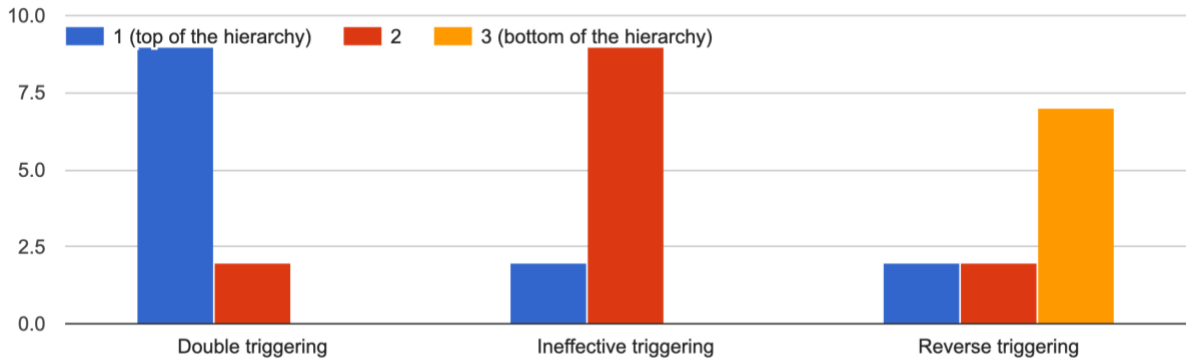
Consensus	≥ 70% in favour of agree/disagree in Likert–scale, or any option in MCQ	Aim for stability
Stability	Chi-square or Kruskal-Wallis test for analysis, p-value <0.05 is significant (not applicable for round 1)	To analyse and aim for stable consensus or dissensus. If stable, the question is dropped from the next round.

Consensus Matrix

Round	**6**				**18**			
Question	18 (18 Likert-scale)			Total	18 (Likert scale for ranking)			Total
Comment	9							
Sections	**1**	**2**	**3**		**1**	**2**	**3**	
Total questions	6	6	6	18	6	6	6	18
Consensus	4	0	0	4 (22%)	6	2	3	11 (61)
Question dropped	NA	NA	NA	NA	0	0	0	0
Question added	NA	NA	NA	NA	0	0	0	0
Question changed	NA	NA	NA	NA	0	0	0	0
Options changed	NA	NA	NA	NA	0	0	0	0
Stability checked	NA	NA	NA	NA	6	6	6	18
Stability achieved	NA	NA	NA	NA	5	5	6	16 (89%)

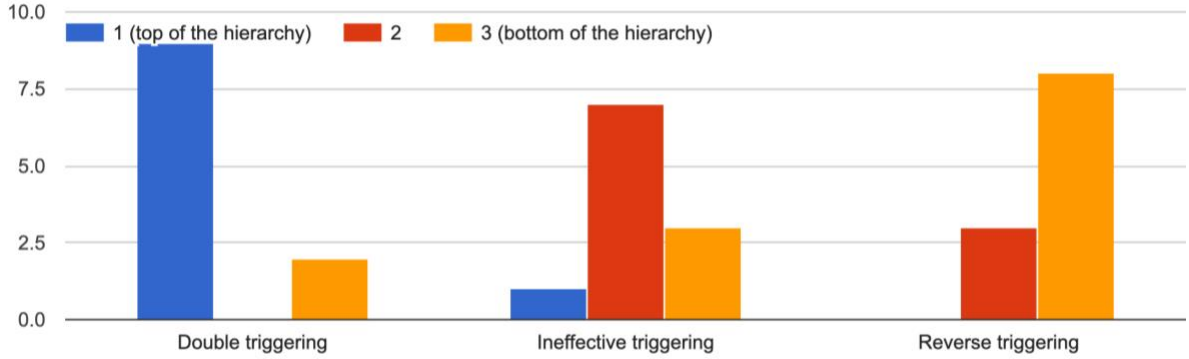
Hierarchy of PVAs: Patients with ARDS

1. For a patient with ARDS, transitioning from controlled to support ventilation, please rank the PVAs from 1 (top of the hierarchy) to 3 (bottom of the hierarchy), in relation to one another, based on the assumed severity in relation to its potential association with duration of ventilation, when the PVA is undetected and unresolved.



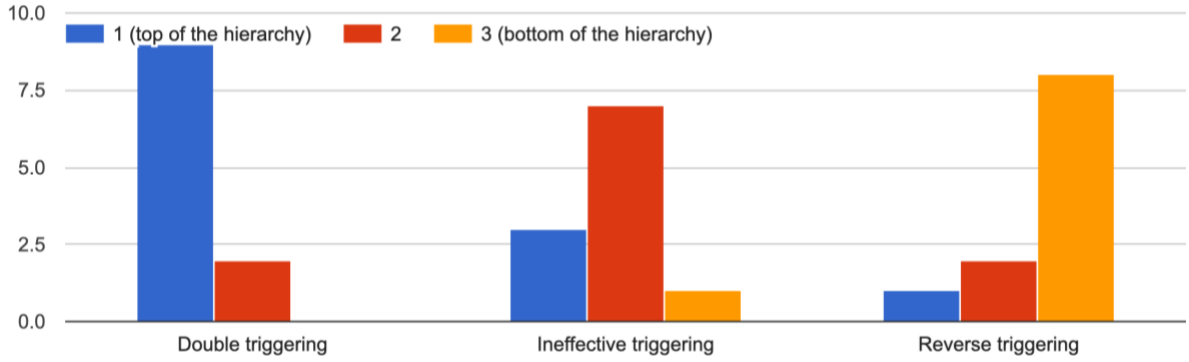
	Hierarchy (ranking)	Consensus	Stability (P-value)
Double Triggering	1	Yes (90%)	Yes (0.77)
Ineffective Triggering	2	Yes (73%)	Yes (0.77)
Reverse Triggering	3	No (73%)	Yes (1)

2. For a patient with ARDS, transitioning from controlled to support ventilation, please rank the PVAs from 1 (top of the hierarchy) to 3 (bottom of the hierarchy), in relation to one another, based on the assumed severity in relation to its potential association with duration of ventilation, when the PVA is detected and resolved.



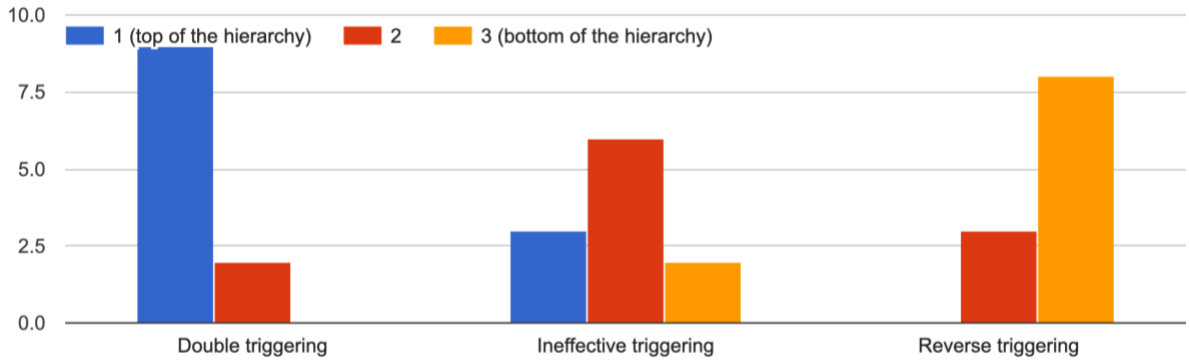
	Hierarchy (ranking)	Consensus	Stability (P-value)
Double Triggering	1	Yes (82%)	Yes (0.55)
Ineffective Triggering	2	No (64%)	Yes (1.0)
Reverse Triggering	3	Yes (73%)	Yes (0.92)

3. For a patient with ARDS, transitioning from controlled to support ventilation, please rank the PVAs from 1 (top of the hierarchy) to 3 (bottom of the hierarchy), in relation to one another, based on the assumed severity in relation to its potential association with duration of ventilation, when the PVA is persistent despite intervention.



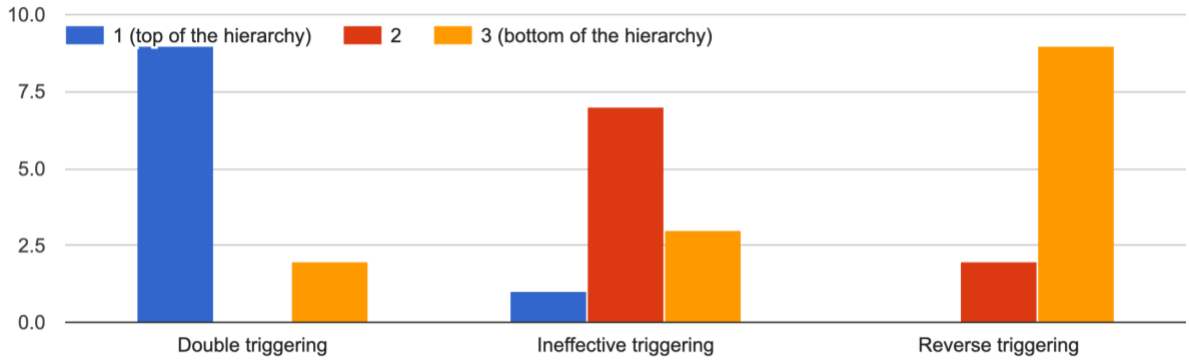
	Hierarchy (ranking)	Consensus	Stability (P-value)
Double Triggering	1	Yes (82%)	Yes (0.72)
Ineffective Triggering	2	No (64%)	Yes (0.95)
Reverse Triggering	3	Yes (73%)	Yes (0.28)

4. For a patient with ARDS, transitioning from controlled to support ventilation, please rank the PVAs from 1 (top of the hierarchy) to 3 (bottom of the hierarchy), in relation to one another, based on the assumed severity in relation to its potential association with mortality, when the PVA is undetected and unresolved.



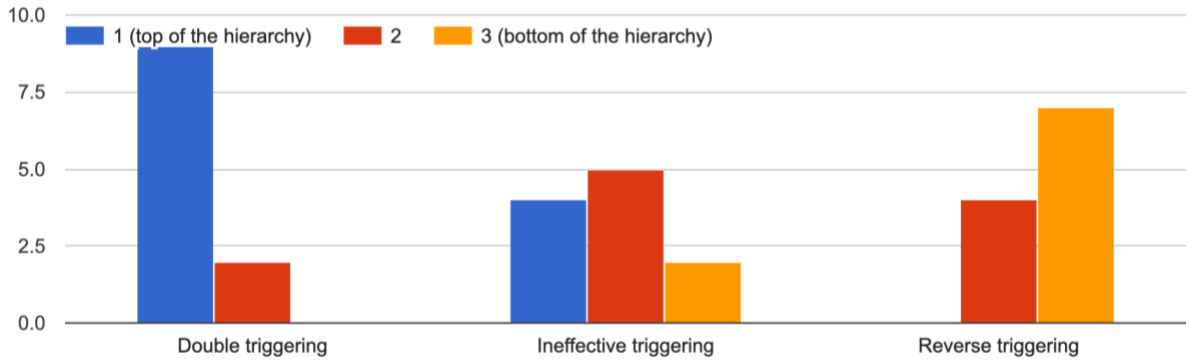
	Hierarchy (ranking)	Consensus	Stability (P-value)
Double Triggering	1	Yes (82%)	Yes (0.43)
Ineffective Triggering	2	No (55%)	Yes (1)
Reverse Triggering	3	Yes (73%)	Yes (0.58)

5. For a patient with ARDS, transitioning from controlled to support ventilation, please rank the PVAs from 1 (top of the hierarchy) to 3 (bottom of the hierarchy), in relation to one another, based on the assumed severity in relation to its potential association with mortality, when the PVA is detected and resolved.



	Hierarchy (ranking)	Consensus	Stability (P-value)
Double Triggering	1	Yes (82%)	No (0.02)
Ineffective Triggering	2	No (63%)	Yes (0.43)
Reverse Triggering	3	Yes (82%)	No (0.01)

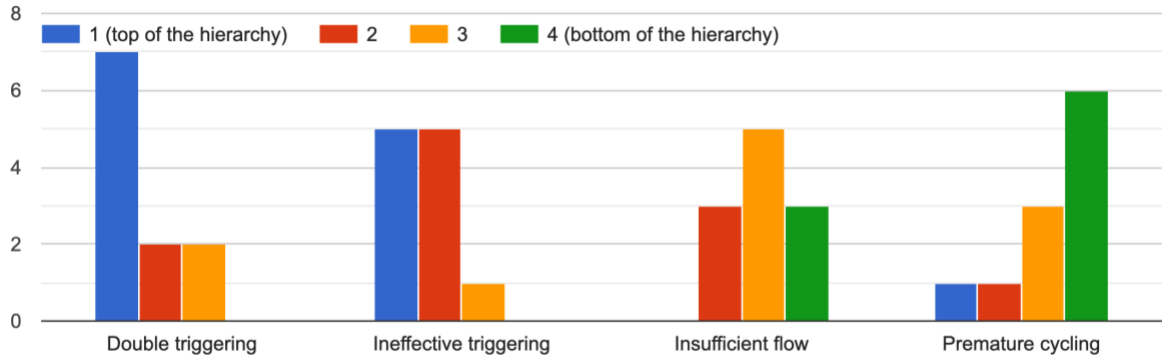
6. For a patient with ARDS, transitioning from controlled to support ventilation, please rank the PVAs from 1 (top of the hierarchy) to 3 (bottom of the hierarchy), in relation to one another, based on the assumed severity in relation to its potential association with mortality, when the PVA is persistent despite intervention.



	Hierarchy (ranking)	Consensus	Stability (P-value)
Double Triggering	1	Yes (82%)	Yes (0.18)
Ineffective Triggering	2	No (45%)	Yes (0.06)
Reverse Triggering	3	No (63%)	Yes (0.32)

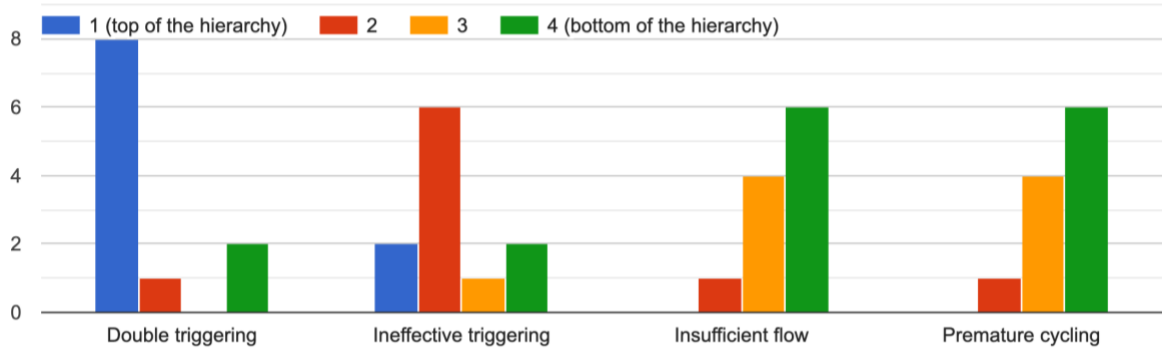
Hierarchy of PVAs: Patients without ARDS

1. For a patient without ARDS, transitioning from controlled to support ventilation, please rank the PVAs from 1 (top of the hierarchy) to 3 (bottom of the hierarchy), in relation to one another, based on the assumed severity in relation to its potential association with duration of ventilation, when the PVA is undetected and unresolved.



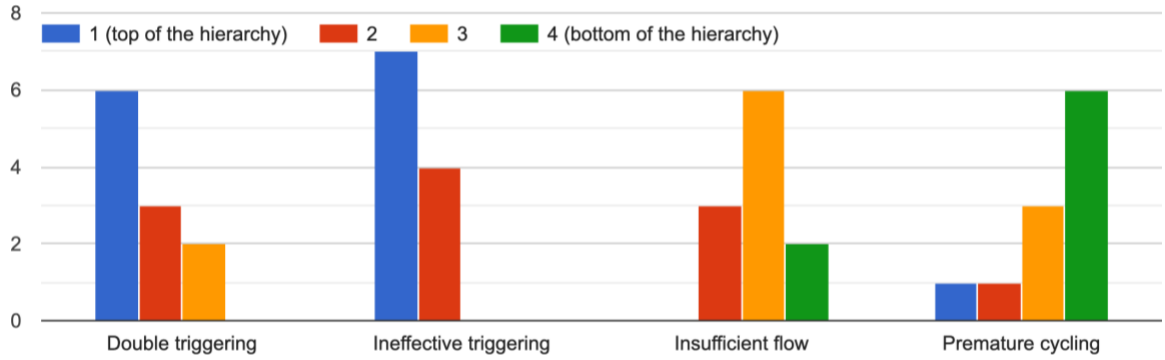
	Hierarchy (ranking)	Consensus	Stability (P-value)
Double Triggering	1	No (63%)	Yes (0.86)
Ineffective Triggering	2	No (45%)	Yes (0.69)
Insufficient flow	3	No (45%)	No (0.10)
Premature Cycling	4	No (55%)	Yes (0.26)

2. For a patient without ARDS, transitioning from controlled to support ventilation, please rank the PVAs from 1 (top of the hierarchy) to 4 (bottom of the hierarchy), in relation to one another, based on the assumed severity in relation to its potential association with duration of ventilation, when the PVA is detected and resolved.



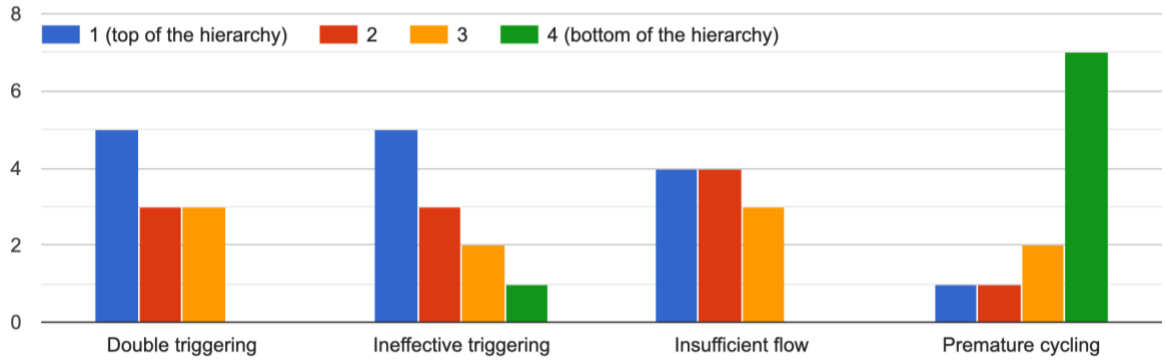
	Hierarchy (ranking)	Consensus	Stability (P-value)
Double Triggering	1	Yes (73%)	Yes (0.51)
Ineffective Triggering	2	No (55%)	Yes (0.25)
Insufficient flow	4	No (55%)	Yes (0.86)
Premature Cycling	4	No (55%)	Yes (0.62)

3. For a patient without ARDS, transitioning from controlled to support ventilation, please rank the PVAs from 1 (top of the hierarchy) to 4 (bottom of the hierarchy), in relation to one another, based on the assumed severity in relation to its potential association with duration of ventilation, when the PVA is persistent despite intervention.



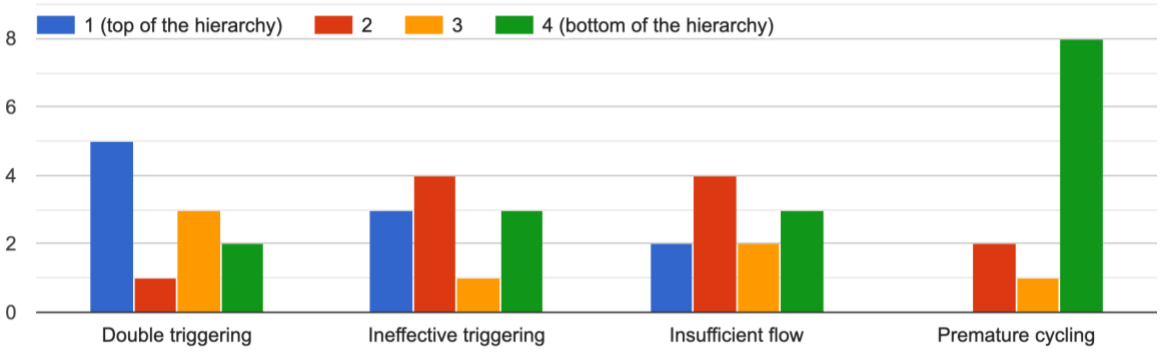
	Hierarchy (ranking)	Consensus	Stability (P-value)
Double Triggering	1	No (55%)	Yes (0.86)
Ineffective Triggering	1	No (63%)	Yes (0.53)
Insufficient flow	3	No (55%)	Yes (0.89)
Premature Cycling	4	No (55%)	Yes (0.51)

4. For a patient without ARDS, transitioning from controlled to support ventilation, please rank the PVAs from 1 (top of the hierarchy) to 4 (bottom of the hierarchy), in relation to one another, based on the assumed severity in relation to its potential association with discomfort, when the PVA is undetected and unresolved.



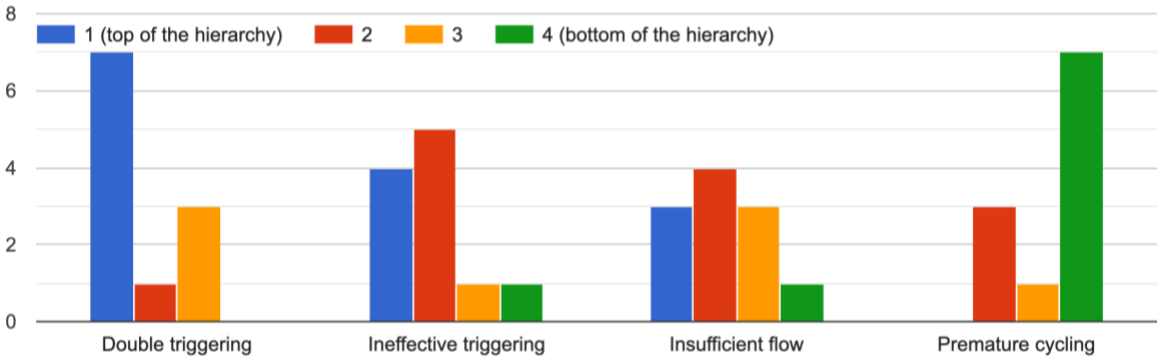
	Hierarchy (ranking)	Consensus	Stability (P-value)
Double Triggering	1	No (45%)	Yes (0.95)
Ineffective Triggering	1	No (45%)	Yes (0.07)
Insufficient flow	2	No (36%)	Yes (0.47)
Premature Cycling	4	No (63%)	Yes (0.62)

5. For a patient without ARDS, transitioning from controlled to support ventilation, please rank the PVAs from 1 (top of the hierarchy) to 4 (bottom of the hierarchy), in relation to one another, based on the assumed severity in relation to its potential association with discomfort, when the PVA is detected and resolved.



	Hierarchy (ranking)	Consensus	Stability (P-value
Double Triggering	1	No (45%)	Yes (0.9)
Ineffective Triggering	2	No (36%)	Yes (1.0)
Insufficient flow	2	No (36%)	Yes (0.45)
Premature Cycling	4	Yes (73%)	Yes (0.55)

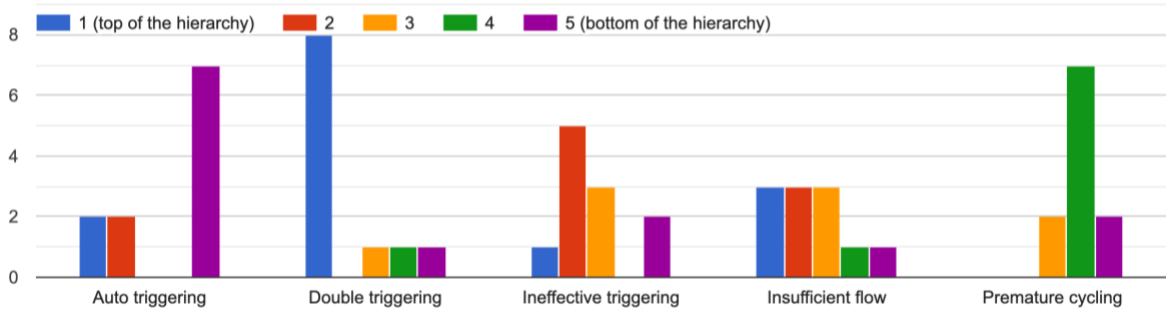
6. For a patient without ARDS, transitioning from controlled to support ventilation, please rank the PVAs from 1 (top of the hierarchy) to 4 (bottom of the hierarchy), in relation to one another, based on the assumed severity in relation to its potential association with discomfort, when the PVA is persistent despite intervention.



	Hierarchy (ranking)	Consensus	Stability (P-value)
Double Triggering	1	No (63%)	Yes (0.9)
Ineffective Triggering	1	No (45%)	Yes (0.92)
Insufficient flow	2	No (36%)	Yes (0.74)
Premature Cycling	4	No (63%)	Yes (0.45)

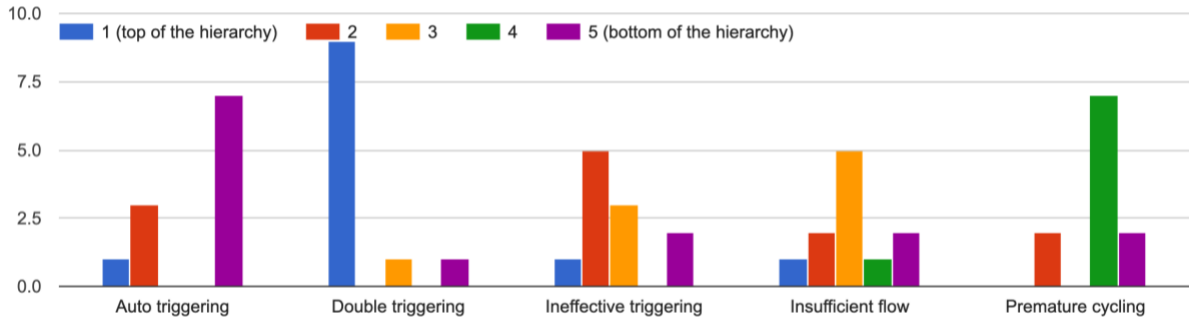
Hierarchy of PVAs: Cardiothoracic patients

1. For a patient after cardiothoracic surgery, who is waking up after sedation is stopped, please rank the PVAs from 1 (top of the hierarchy) to 5 (bottom of the hierarchy), in relation to one another, based on the assumed severity in relation to its potential association with hemodynamic instability, when the PVA is undetected and unresolved.



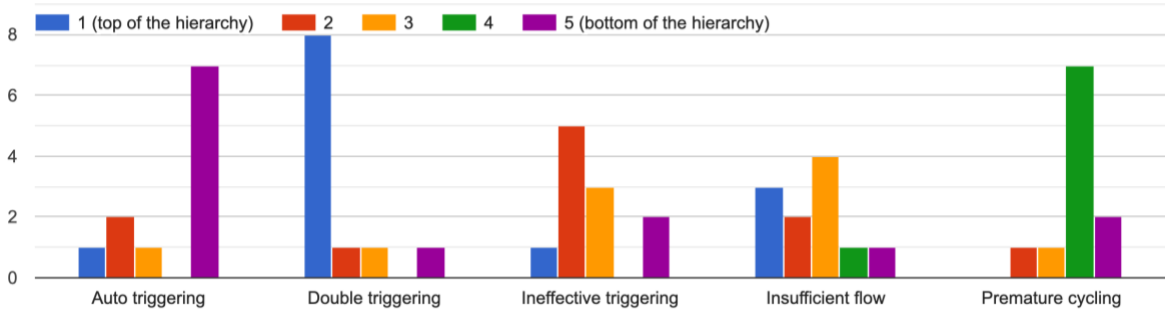
	Hierarchy (ranking)	Consensus	Stability (P-value)
Double Triggering	1	Yes (73%)	Yes (0.74)
Ineffective Triggering	2	No (45%)	Yes (0.72)
Insufficient flow	3	No (27%)	Yes (0.19)
Premature Cycling	4	No (63%)	Yes (0.67)
Auto triggering	5	No (63%)	Yes (0.45)

2. For a patient after cardiothoracic surgery, who is waking up after sedation is stopped, please rank the PVAs from 1 (top of the hierarchy) to 5 (bottom of the hierarchy), in relation to one another, based on the assumed severity in relation to its potential association with hemodynamic instability, when the PVA is detected and resolved.



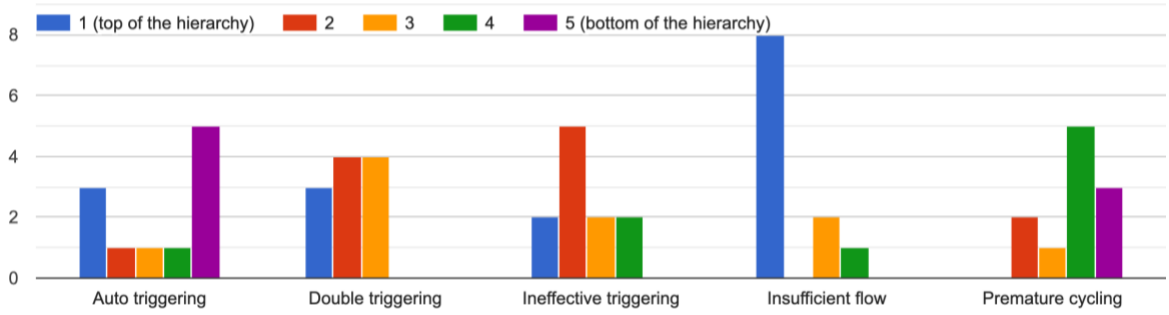
	Hierarchy (ranking)	Consensus	Stability (P-value)
Double Triggering	1	Yes (82%)	Yes (0.27)
Ineffective Triggering	2	No (45%)	Yes (0.72)
Insufficient flow	3	No (45%)	Yes (0.41)
Premature Cycling	4	No (63%)	Yes (0.77)
Auto triggering	5	No (63%)	Yes (0.55)

3. For a patient after cardiothoracic surgery, who is waking up after sedation is stopped, please rank the PVAs from 1 (top of the hierarchy) to 5 (bottom of the hierarchy), in relation to one another, based on the assumed severity in relation to its potential association with hemodynamic instability, when the PVA is persistent despite intervention.



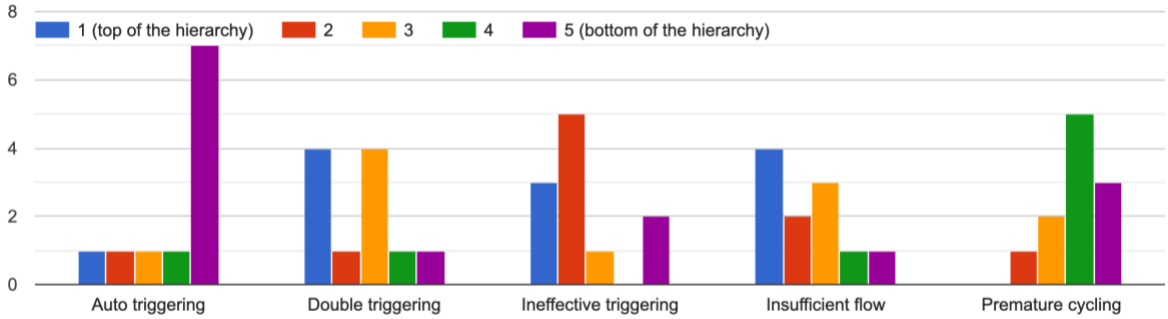
	Hierarchy (ranking)	Consensus	Stability (P-value)
Double Triggering	1	Yes (73%)	Yes (0.77)
Ineffective Triggering	2	No (45%)	Yes (0.86)
Insufficient flow	3	No (36%)	Yes (0.36)
Premature Cycling	4	No (63%)	Yes (0.9)
Auto triggering	5	No (63%)	Yes (0.24)

4. For a patient after cardiothoracic surgery, who is waking up after sedation is stopped, please rank the PVAs from 1 (top of the hierarchy) to 5 (bottom of the hierarchy), in relation to one another, based on the assumed severity in relation to its potential association with discomfort, when the PVA is undetected and unresolved.



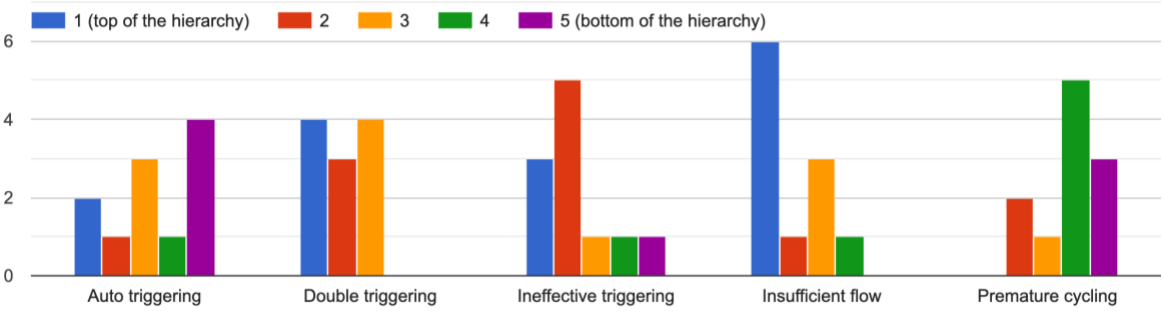
	Hierarchy (ranking)	Consensus	Stability (P-value)
Insufficient flow	1	Yes (73%)	Yes (0.60)
Ineffective Triggering	2	No (45%)	Yes (0.69)
Double Triggering	3	No (36%)	Yes (0.76)
Premature Cycling	4	No (45%)	Yes (0.72)
Auto triggering	5	No (45%)	Yes (0.60)

5. For a patient after cardiothoracic surgery, who is waking up after sedation is stopped, please rank the PVAs from 1 (top of the hierarchy) to 5 (bottom of the hierarchy), in relation to one another, based on the assumed severity in relation to its potential association with discomfort, when the PVA is detected and resolved.



	Hierarchy (ranking)	Consensus	Stability (P-value)
Double Triggering	1	No (36%)	Yes (0.60)
Ineffective Triggering	2	No (36%)	Yes (0.41)
Insufficient flow	3	No (45%)	Yes (0.22)
Premature Cycling	4	No (45%)	Yes (0.79)
Auto triggering	5	No (63%)	Yes (0.55)

6. For a patient after cardiothoracic surgery, who is waking up after sedation is stopped, please rank the PVAs from 1 (top of the hierarchy) to 5 (bottom of the hierarchy), in relation to one another, based on the assumed severity in relation to its potential association with discomfort, when the PVA is persistent despite intervention**.**



	Hierarchy (ranking)	Consensus	Stability (P-value)
Insufficient flow	1	No (45%)	Yes (0.55)
Ineffective Triggering	2	No (45%)	Yes (0.69)
Double Triggering	3	No (36%)	Yes (0.65)
Premature Cycling	4	No (45%)	Yes (0.92)
Auto triggering	5	No (36%)	Yes (0.41)

Any other comments related to this survey?

Ineffective triggering is a particularly challenging asynchrony, because it can occur in very different context, and thus have variable impact on patient's perception and impact on outcome.

Final Round PVA Delphi

11 antwoorden

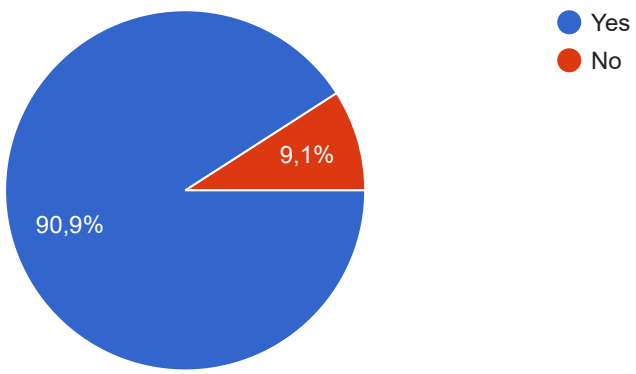
Analyse publiceren

Kopiëren

Statement 1

A strategy that uses a hierarchy with composite PVAs is preferred over one that uses individual PVAs.

11 antwoorden

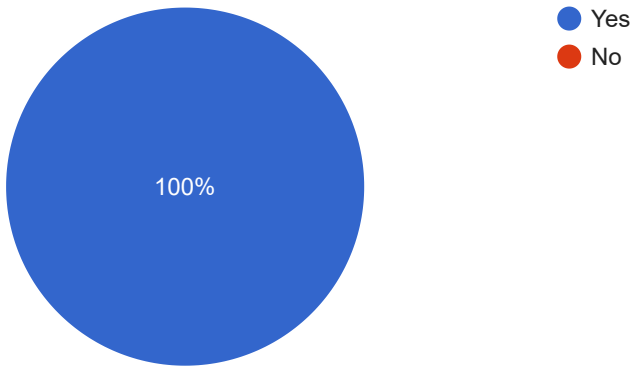


Kopiëren

Statement 2

Do you agree with using this composite of severe and mild PVAs for patients without ARDS regarding duration of mechanical ventilation:

11 antwoorden

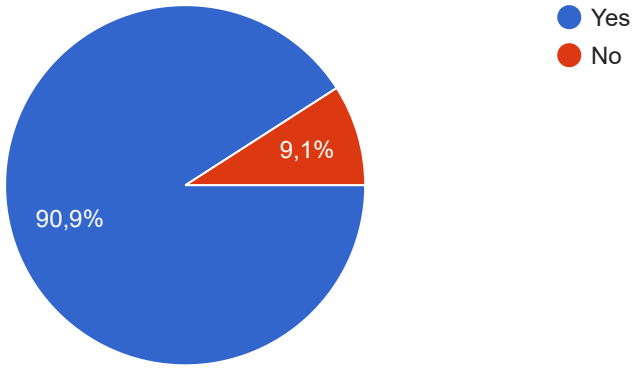


Statement 3

Kopiëren

Do you agree with using this composite of severe and mild PVAs for patients without ARDS regarding discomfort:

11 antwoorden

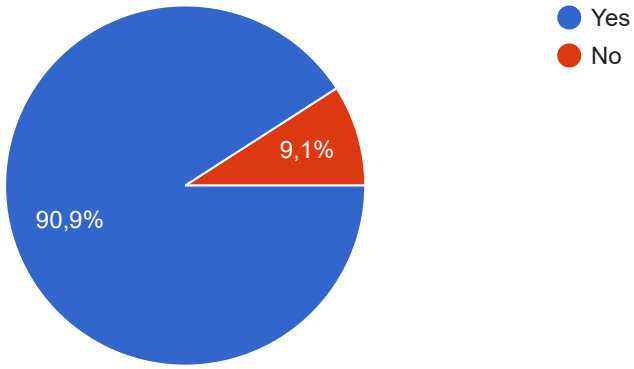


Statement 4

Kopiëren

Do you agree with using this composite of severe and mild PVAs for patients after cardiothoracic surgery regarding hemodynamic instability:

11 antwoorden

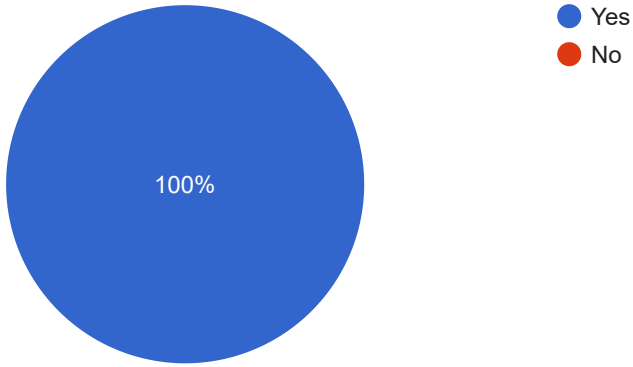


Statement 5

Kopiëren

Do you agree with using this composite of severe and mild PVAs for patients after cardiothoracic surgery regarding discomfort:

11 antwoorden



Question 1

Can you identify **three** research or knowledge gaps related to PVA, ordered from most to least important?

11 antwoorden

Impact of PVA on outcome (other that an association)
Impact of PVA on dyspnea, P0.1 and dynamic lung stress
Impact of using closed loop systems for ventilator settings on PVA

1. Further subdivide patient groups 2. Look at more/different clinical outcomes specific for particular patient groups 3. Look at PVA's in relation to interventions

Yes. 1)Real-Time Detection and Quantification Tools are a problem. Many asynchronies happen and are no diagnosticated. Maybe AI can help this. 2) There is insufficient high-quality evidence linking specific types or durations of PVA to long-term outcomes such as mortality, weaning failure, disconfourt or ICU length of stay. Large-scale prospective trials are needed to define thresholds of clinically significant PVA and correlate them with patient-centered outcomes, mostly in ARDS patients. 3) There is limited evidence guiding personalized ventilator settings based on patient-specific respiratory drive, effort, and mechanics to minimize asynchrony. 4) There is a difficult to teach and learn asyunchronies by the healthcare staff in daily basis. Perhaps what is proposed here in this paper can help to mitigate or facilitate this issue.

1. impact on outcome of patients suffering prolonged PVAs
2. fighting the ventilator (was never mentioned in the PVA delphi, but is of immediate danger for the patient: patient is exhaling forcefully and prolonged against an inspiration effort of the ventilator with circulatory collapse)
3. automated detection of PVAs from the ventilator (most important, because it guarantees for timely reaction and helps the nursing staff)

1) visualization at the bedside, will this reduce asynchronies 2) can interventions be standardized and will this be standardized and 3) which PVAs does truly affect outcomes?

1. Does using a protocolized strategy to minimize PVA by adjusting the ventilator impact patient outcomes, for patients with a high burden of PVAs?
2. Does a strategy of active (or automated) monitoring of the ocurrence of PVAs impact patient outcomes?
3. For patients with ARF and difficult to abolish PVAs, is a watchful waiting strategy (tolerate) superior to neuro muscular blokade and controlled ventilation?

1) Evidence on general causality between PVA and complications and/or outcomes is still really weak and currently based on either retrospective clinical studies or a few prospective experimental studies.
2) Association of different PVAs with different outcomes are complicated to study.

3) Simulation studies using AI, big data, and maybe digital twins may help to foster research on PVAs.

1. The true impact of severe versus mild patient–ventilator asynchronies on outcomes, both in previous and future studies.
2. Whether interventions that reduce the incidence of one type of patient–ventilator asynchrony inadvertently increase the incidence of others—does reducing one come at the cost of another?
3. The findings observed here may need to be confirmed in other patient populations, such as those with COPD or patients receiving ECMO.

1. Lack of well powered studies linking asynchronies to outcomes
2. Studies investigating real-time asynchrony detection tool
3. Studies investigating optimal ventlation strategies to minimize asynchronies

1. An RCT is needed to show the impact of synchronous ventilation strategy compared to asynchronous ventilation on different outomes including physiological and patient centered
2. Consensus is needed in terms of nomenclature
3. automatization analysis is requiered to better undertamd the incidence and impact of asynchrony during the whole ICU stay
3. Clinical and preclinical studies need to be designed to understand the consequences of different types of assynchronies.

1. impact of PVAs on outcome adjusted for underlying cause of high/low drive and impairement of respiratory system mechanics - are different types of PVAs biomarkers or do they actually impact outcomes
2. discrimination between specific PVAs and specific patient populations particularly at risk for adverse outcome related to PVAs
3. impact of automated modes of ventilation or recognition of PVAs on outcomes

Anything else you would like to mention related to this final round?

7 antwoorden

No, thanks

Thank you for your patience, Laura!

no

Thanks for the excellent, comprehensive work!

Thanks for your efforts, Laura!

nope

No.

Identification of Patient–Ventilator Asynchronies and their Impact on Patient Outcomes: A Delphi Study

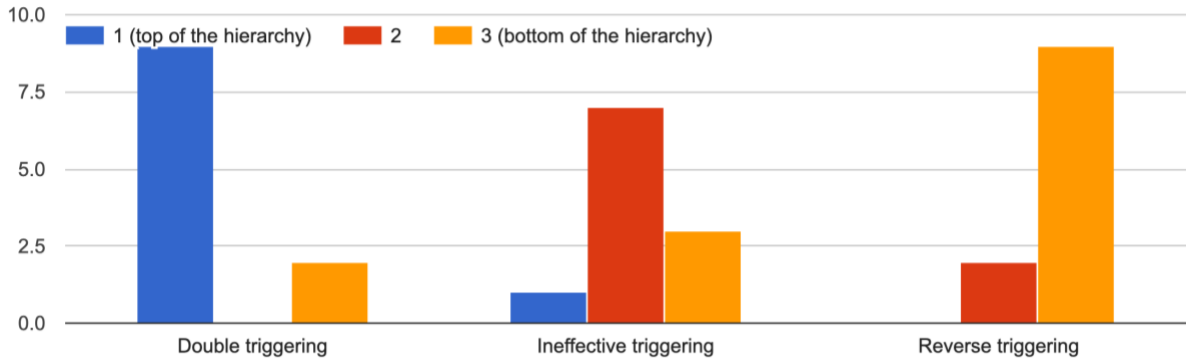
Round Eight Survey Report

The Round eight survey was run on an email round. The stability is reached for the remaining two statements.

Consensus	≥ 70% in favour of agree/disagree in Likert–scale, or any option in MCQ	Aim for stability
Stability	Chi-square or Kruskal-Wallis test for analysis, p-value <0.05 is significant (not applicable for round 1)	To analyse and aim for stable consensus or dissensus. If stable, the question is dropped from the next round.

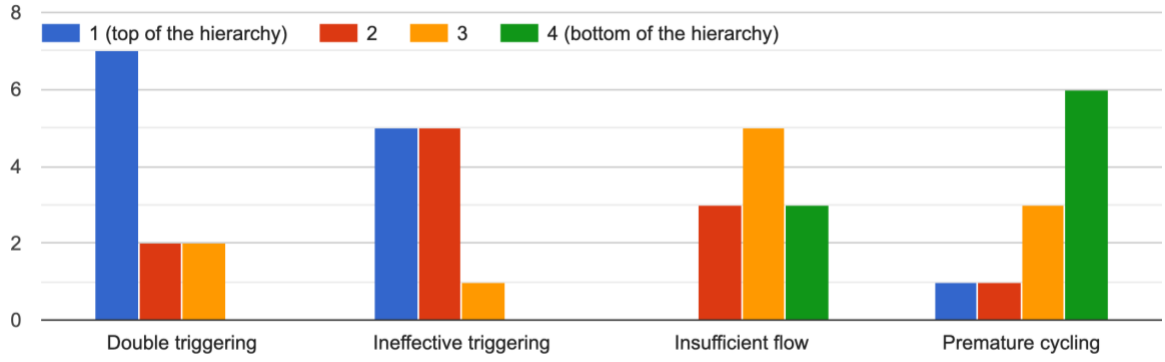
Hierarchy of PVAs: Patients with ARDS

5. For a patient with ARDS, transitioning from controlled to support ventilation, please rank the PVAs from 1 (top of the hierarchy) to 3 (bottom of the hierarchy), in relation to one another, based on the assumed severity in relation to its potential association with mortality, when the PVA is detected and resolved.



	Hierarchy (ranking)	Consensus	Stability (P-value)
Double Triggering	1	Yes (82%)	Yes (1.0)
Ineffective Triggering	2	No (63%)	
Reverse Triggering	3	Yes (82%)	

1. For a patient without ARDS, transitioning from controlled to support ventilation, please rank the PVAs from 1 (top of the hierarchy) to 3 (bottom of the hierarchy), in relation to one another, based on the assumed severity in relation to its potential association with duration of ventilation, when the PVA is undetected and unresolved.



	Hierarchy (ranking)	Consensus	Stability (P-value)
Double Triggering	1	No (63%)	Yes (1.0)
Ineffective Triggering	2	No (45%)	
Insufficient flow	3	No (45%)	
Premature Cycling	4	No (55%)	