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Letter to the Editor – Author response

"Less usual ventilatory modes II: BIPAP and Automode"

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Disclaimer: The opinions shared in this letter to the editor are entirely my own and do not represent the views, policies, or positions of my employer, any associated organizations, or past co-authors.

I read with great interest the recent article by Perez and Pasco [1] addressing BiPAP and Automode, where they employed and discussed the Taxonomy of the Modes concepts necessary for concisely describing and classifying BiPAP and Automode. Unfortunately, the authors did not clarify that Automode is a distinct version of IMV(2), where an algorithm automatically determines the Apnea Time Limit to guide when mandatory breaths are reintroduced. [2] Because of this uncommon function, under certain circumstances Automode may allow spontaneous respiratory rates that fall below the mandatory set rate (Figure 1). This is a potential safety risk when the operator is not aware of it.

Figure 1: A simulation using Automode VC-VS (PC-IMV(2)s,a) with mandatory respiratory rate set at 20 breaths/min and tidal volume (VT) set at 400ml, which should yield a minute ventilation of 8L/min. However, the ventilator displays a spontaneous rate of 5 and a minute ventilation of 2L/min, with no mandatory breaths delivered

The authors based their description of the Apnea Time Limit of Automode on the Servo-U users' manual: (https://www.getinge.com/us/products/servo-u-mechanical-ventilator/), which provides only a brief and insufficient explanation of this unusual functionality. Furthermore, it does not include the algorithm used to calculate the Apnea Time Limit or a visual tool to help users in understanding when mandatory breaths are reintroduced. The lack of comprehensive guidance observed in the Servo-U users' manual can result in users experiencing uncertainty regarding the operation of Automode, which may negatively affect its utilization. [3] Additionally, it does not notify the user of the potential for an unanticipated decrease in spontaneous respiratory rate.

Up until January 2024, neither the Servo-U user manual nor any published literature had documented this unexpected behavior of Automode. Working in collaboration with Robert L Chatburn, we examined Automode and published our findings in an article titled "The automatic apnea time adjustments during ventilation with Automode". [2] This publication explains how Automode functions, offering more detail than the overview provided in the Servo-U user manual. It also introduced the guiding Algorithm behind Automode, presented a nomogram to visually guide the bedside clinician in understanding and estimating the calculated Apnea Time Limit and supplied a spreadsheet Microsoft Excel (Microsoft, Redmond, WA) to exactly calculate the Apnea Time Limit values (https://1drv.ms/x/s!AuFakBJODC3DhaUGJSOD3RlCSf6zLg?e=ida1Tz).

Finally, Garnero and Chatburn used algorithmic analysis to identify the factors that may lead Automode to permit a lower spontaneous rate, and they emphasized the importance of appropriately setting the minimum respiratory rate and minimum minute-ventilation alarms to alert the clinician.
In their publication1, Perez and Pasco described only three Taxonomic Attribute Groups (TAGs) for Automode, but a fourth one also applies. When the square flow waveform is selected in Volume Control (VC), the "Flow Adaptation" option becomes available, and therefore appears in Automode VC-VS (Figure 2).

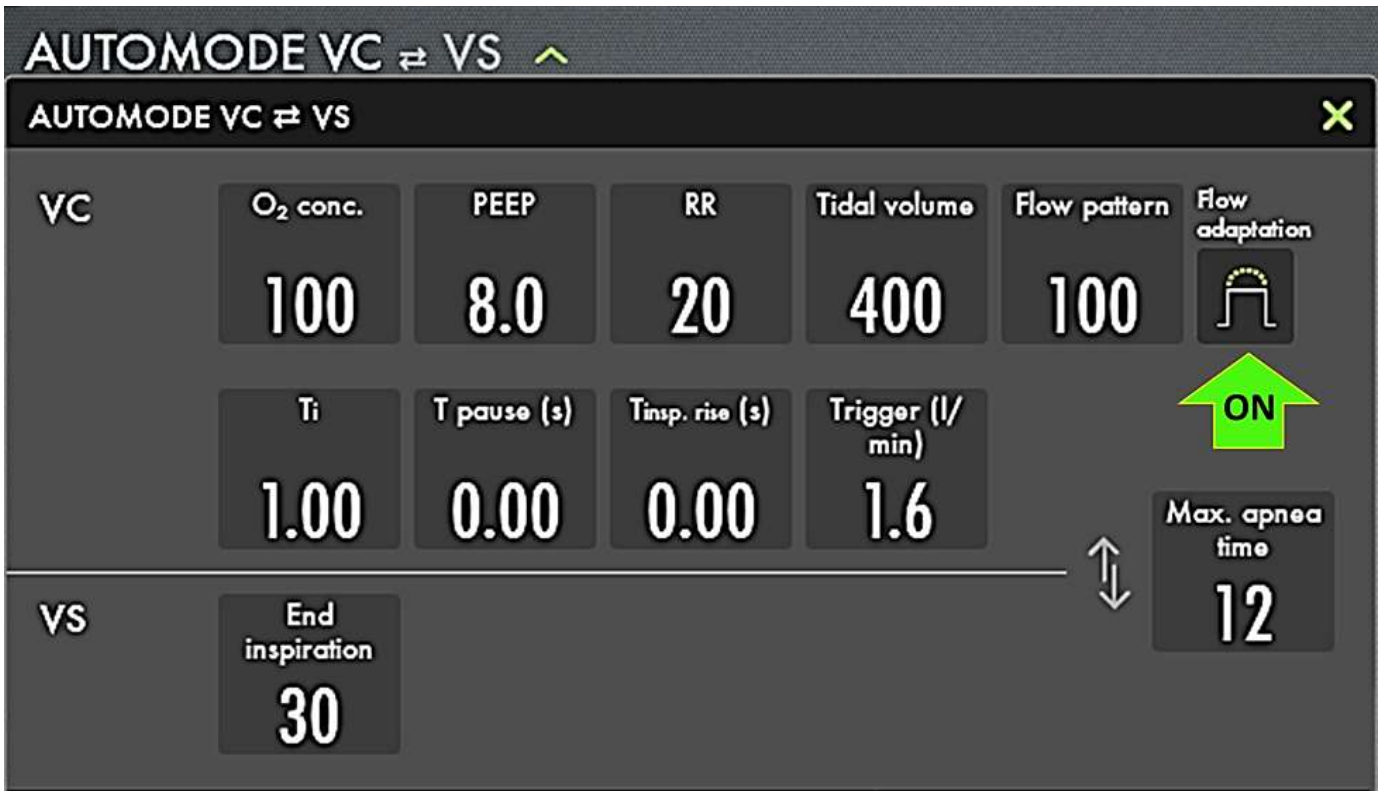

Figure 2: Screenshot displaying Automode VC-VS when the operator activates Flow Adaptation. The activation is displayed by the green dotted lines.

When Flow Adaptation is ON, if the patient needs more flow than the preset in Volume Control, the machine will provide it by switching the control variable from volume to pressure. This capacity is described in the Taxonomy of the Modes publications under the "Dual Targeting Scheme (d)." [4] In Automode, any patient's triggered breath switches the CMV mode (PC, PRVC or VC) mode to the associated CSV mode (PS or VS). "CMV modes" is a generic description for modes composed of mandatory breaths, while "CSV modes" is for modes composed of spontaneous breaths. Consequently, the "duality" in Automode VC-VS (Flow Adaptation is ON) could only be seen when the inspiratory effort is produced after the machine has triggered the mandatory breath (Figure 3)

Figure 3. Displays a simulated scenario using Automode VC-VS (Flow Adaptation ON) to evaluate its behavior. The two breaths on the left are machine triggered breaths in a fully passive scenario. The two middle breaths are triggered by the machine, and a simulated inspiratory effort is produced after, which activates the switch in the control variable from volume to pressure. The two breaths on the right are triggered by a simulated inspiratory effort, which switches the mode from VC to VS. VS is highlighted in the "AUTOMODE VC-VS" name confirming the switch of mode.

Consequently, Automode VC-VS (Flow Adaptation ON) is classified as: VC-IMV(2)d,a .
All the possible TAGs for Automode are displayed in Table 1.

Perez and Pasco noted in the abstract that "knowledge of each mode is prudent for safe utilization", a principle that shapes the purpose of this letter. My aim is to complement their work by offering additional references and clarifying key operational features to support end users in applying Automode safely and effectively.

Finally, I would like to commend the authors for the thoughtful effort and dedication reflected in this valuable publication

Table 1: All the possible TAGs for Automode

AUTOMODE			
PC-PS	PRVC-VS	VC-VS (Flow Adapt OFF)	VC-VS (Flow Adapt ON)
PC-IMV(2)s,s	PC-IMV(2)a,a	VC-IMV(2)s,a	VC-IMV(2)d,a

References

1. Perez V, Pasco J. Less usual ventilatory modes II: BIPAP and Automode. J Mech Vent 2025; 6(4):209-214.

2. Garnero AJ, Chatburn RL. Automatic apnea time adjustments during ventilation with Automode. Respir Care 2024; 69(1):24-31.

3. Understanding ventilator operation: Importance of the respiratory therapist at the bedside. Respir Care 2023; 6 9(1):154-155.

4. Chatburn RL, El-Khatib M, Mireles-Cabodevila E. A taxonomy for mechanical ventilation: 10 fundamental maxims. Respir Care 2014; 59(11):1747-1763.

Author's reply

We have read the letter to the editor [1] submitted in relation to our recent article on the taxonomy and functioning of less commonly used modes in routine clinical practice, such as BIPAP and Automode. [2] First, we would like to thank the author for their comments.

In that article, [2] our aim was to review the IMV (intermittent mandatory ventilation) sequence, types 1 and 2, through the aforementioned "modes" available on some of the mechanical ventilators in our Units, with the intention of providing a brief aid for clinical use.

We consider the letter [1] to be a valuable contribution, as it expands upon what was described regarding the operation of Automode, specifically concerning the Apnea Time Limit algorithm[3]. However, it should be noted that the explanations provided in the letter [1] and article [3] constitute a theoretical framework based on laboratory simulation, not on real patients, and are limited to specific simulation parameters (severe ARDS with constant spontaneous respiratory rate), which may differ in actual patients with irregular breathing patterns, as the authors themselves point out.

Nevertheless, we believe this theoretical clarification is important, as it could occur in routine clinical practice with the associated risk of hypoventilation; therefore, clinicians using this "mode" should be aware. We suggest that it would be an interesting topic for review to determine whether what is described in theory actually occurs in clinical practice, how frequently, and whether it has any impact on patient outcomes.

Finally, the letter [1] mentions a fourth TAG (Taxonomic Attribute Groups) for Automode: [VC-IMV(2)d,a], which is correct. However, as indicated in our article. [2] we described only the TAGs available on our Servo-U ventilators, which do not have the "flow adaptation" function; thus, we only mentioned those with which we are familiar.

References

1. Gamero AJ. Letter to the Editor "Less usual ventilatory modes II: BIPAP and Automode". J Mech Vent 2026; 7(1):39-45.

2. Perez V, Pasco J. Less usual ventilatory modes II: BIPAP and Automode. J Mech Vent 2025; 6(4):209-214.

3. Garnero AJ, Chatburn RL. Automatic apnea time adjustments during ventilation with Automode. Respir Care 2024;69(1):24-31.

Response to author reply

After reviewing Perez and Pasco's response to my letter regarding their publication1, I believe it's important to provide readers with evidence demonstrating actual cases in which Automode permits a spontaneous respiratory rate that is lower than the set mandatory respiratory rate, as shown in Figures 1 and 2.

Over the years that I have used Automode, first with the Servo-I and now with the Servo-U—I have witnessed an unexpected lower spontaneous respiratory rate than the set mandatory rate, which was highlighted and explained by first time in our publication2. The bench test aimed to validate the algorithm, and a short time constant model was employed solely to ensure that every simulated inspiratory effort triggered a breath, allowing the algorithm to count each event. Figure 1 shows an actual patient with short time constants, while Figure 2 illustrates a patient with longer time constants. In both scenarios, Automode enabled lower spontaneous respiratory rates than the mandatory set respiratory rate. These observations underscore the safety concerns of Automode, regardless of the system's time constants. In other IMV(2) modes, such as BiPAP S/T (PC-IMV(2)s,s), AVAPS (PC-IMV(2)a,a; V60-Phillips Respironics), PSIMV+ with PSync ON (PC-IMV(2)s,s; C6-Hamilton Medical), safety is maintained because the set mandatory rate always serves as the minimum possible.

Given that the number of ventilated patients can be quite high, as seen during the Covid-19 pandemic, professionals working in busy ICUs may only notice an unexpectedly low respiratory rate when alarms for low respiratory rate or low minute ventilation are triggered (see Fig 1 and Fig 2). This situation presents a safety risk if it remains undetected for a prolonged period. For this reason, it is crucial to properly adjust alarms—especially the low respiratory rate alarm, which I suggest setting equal to the mandatory rate minus two, as illustrated in Fig 1 and Fig 2.

In conclusion, I concur with the authors that additional research is necessary to achieve a comprehensive understanding of Automode's functionality, especially in patients exhibiting irregular breathing patterns—a topic briefly discussed by Le Thorneau and Oeckler in their editorial. 3

Figure 1: In Automode PC-PS (PC-IMV(2)s,s), a mandatory respiratory rate of 10 is set for a patient with low compliance (short time constants). The mode allows a spontaneous rate of 9 breaths per minute, which is lower than the set mandatory rate; this situation is not allowed in other IMV(2) modes. In this scenario, the operator received a timely warning about potential safety concerns thanks to the low minute ventilation alarm. Additionally, the low respiratory rate alarm is configured to trigger when the rate drops to 2 breaths below the set mandatory rate, as shown in the upper right corner of the observed RR in the screen's reported values section.

Figure 2: shows Automode PRVC-VS (PC-IMV(2)a,a) configured with a mandatory respiratory rate of 12 for a patient with high lung compliance (long time constants). Here, the spontaneous breathing rate is observed at 9, which is below the set mandatory rate of 12. The low respiratory rate alarm provided timely warning to the operator about a possible safety concern, as it was programmed to trigger when the rate dropped 2 breaths below the mandatory rate.

References

1. Perez V, Pasco J. Less usual ventilatory modes II: BIPAP and Automode. J Mech Vent 2025; 6(4):209-214.

2. Garnero AJ, Chatburn RL. automatic apnea time adjustments during ventilation with Automode. Respir Care 2024;69(1):24-31.

3. Understanding ventilator operation: Importance of the respiratory therapist at the bedside. Respir Care 2023;6 9(1):154-155.