Acumen Hypotension Prediction Index (HPI) software Frequently asked questions

Acumen HPI software

What is Acumen HPI software?
Acumen HPI software is a decision support tool that detects the likelihood of a patient trending towards a hypotensive event* and provides you with insights to understand the root cause and inform a potential course of action for your patient.

For which patient population is Acumen HPI software indicated?
Acumen HPI software is intended for use in surgical and non-surgical patients receiving advanced hemodynamic monitoring. The Acumen HPI feature is considered to be additional quantitative information regarding the patient's physiological condition for reference only and no therapeutic decisions should be made based solely on the Acumen HPI parameter.

How is monitoring hypotension with Acumen HPI software different than monitoring with standard hemodynamic variables?
Davies,[1] et al sought to compare the accuracy in predicting impending hypotension of Acumen HPI software versus that of the commonly used hemodynamic parameters via ROC curve analysis. This study found that Acumen HPI (at -5, -10, -15 min) was a superior predictor of hypotensive events.*

Additionally, two randomized controlled trials[2,3] suggest that the use of Acumen HPI software as an early indicator of hemodynamic instability may enable a longer reaction time to proactively evaluate the root cause of impending hypotension. These two clinical trials also showed that Acumen HPI software in combination with a therapeutic protocol reduced the incidence, duration and severity of hypotensive events in non-cardiac surgical patients.

Acumen HPI software algorithm

How was the Acumen HPI software algorithm developed?
Arterial waveform recordings from 130 million cardiac cycles were processed through machine learning techniques to identify 23 predictive features of impending hypotensive events. The algorithm includes these features and is proprietary to Edwards Lifesciences. At 10 minutes before an event, Acumen HPI software predicted arterial hypotension with a sensitivity and specificity of 89% (87 to 91%) and 90% (87 to 92%) respectively, and with an AUC of 0.95 [0.95 to 0.96].[4]

How does the Acumen HPI algorithm work?
The algorithm evaluates the peripheral arterial waveform from the Acumen IQ sensor and updates advanced hemodynamic parameters, including Acumen HPI parameter every 20 seconds. The HPI parameter displays a value ranging from 0 to 100 with higher values indicating a higher likelihood of a hypotensive event.* If the HPI parameter exceeds 85 for two consecutive 20-second updates or reaches 100 at any time, the Acumen HPI software high alert pop up window will appear, prompting you to review the patient hemodynamics using the Acumen HPI software secondary screen.
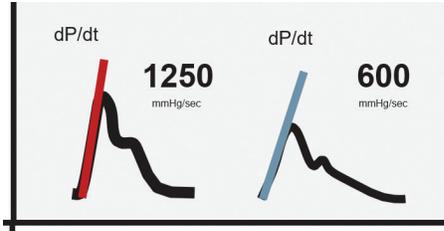
Systolic slope (dP/dt)

What is arterial dP/dt?
Systolic slope (dP/dt) is calculated as the maximum upslope of the arterial pressure waveform measured from a peripheral arterial line using Acumen IQ sensor. It measures the maximum rate of the arterial pressure rise during left ventricular contraction.[5] Even though arterial dP/dt will have lower absolute values than isovolumic LV pressure dP/dt, their trends correlate strongly.[6,7] Changes from baseline or trend values of arterial dP/dt are more useful than absolute values, and may be an indicator of increasing or decreasing contractility.[8]
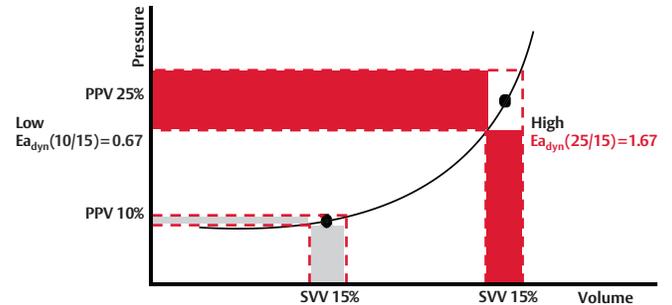
* A hypotensive event is defined as MAP <65 mmHg for a duration of at least one minute.

Although predominantly determined by LV contractility, dP/dt may be impacted by afterload during periods of vasoplegic states. Additionally, exercise caution when using dP/dt in patients with severe aortic stenosis, since the stenosis may reduce the coupling between the left ventricle and the afterload.

Dynamic arterial elastance (Ea$_{dyn}$)

What is Ea$_{dyn}$?

Ea$_{dyn}$ is the ratio of pulse pressure variation (PPV) to stroke volume variation (SVV). Ea$_{dyn}$ has been shown to provide indication of potential afterload responsiveness to increase blood pressure by giving fluids in preload responsive mechanically ventilated and spontaneously

breathing patients.[9,10] In other words, it may be used as a predictor to determine when a preload responsive patient may also be pressure responsive. Ea$_{dyn}$ greater than 1.0 may suggest that preload responsive patients will increase their mean arterial pressure in response to a fluid bolus. A gray zone may exist between Ea$_{dyn}$ values of 0.8 and 1.2.[11]

Can Ea$_{dyn}$ be used in spontaneously breathing patients?

Yes, Ea$_{dyn}$ can be used with spontaneously breathing patients as the impact of irregular variations in intrathoracic pressure influences both PPV and SVV in the same magnitude, maintaining the validity of the ratio.[9]

References

1. Davies et al. Ability of an arterial waveform analysis-derived hypotension prediction index to predict future hypotensive events in surgical patients. *Anesthesia & Analgesia 2019*; 130(2): 352-359.
2. Wijnberge et al. Effect of a machine learning-derived early warning system for intraoperative hypotension vs standard care on depth and duration of intraoperative hypotension during elective noncardiac surgery: *The HYPE Randomized Clinical Trial. JAMA 2020*.
3. *Schneck et al. Hypotension prediction index based protocolized haemodynamic managementreduces the incidence and duration of intraoperative hypotension in primary total hip arthroplasty: a single center feasibility randomized blinded prospective interventional trial. J Clin Monit Comput 2020.*
4. Hatib et al. Machine-learning algorithm to predict hypotension based on high-fidelity arterial pressure waveform analysis. *Anesthesiology 2018*; 129: 663-674.
5. Ostadal et al. Continual measurement of arterial dP/dt$_{max}$ enables minimally invasive monitoring of left ventricular contractility in patients with acute heart failure. *Crit Care 2019*; 23:364
6. De Hert et al, Evaluation of Left Ventricular Function in Anesthetized Patients Uding Femoral Artery dP/dtmax. *Journal of Cardiothoracic and Vascular Anesthesia* 2006; 20(3): 325-330.
7. Tartiere et al, Non-invasive radial pulse wave assessment for the evaluation of left ventricular systolic performance in heart failure. *Eur Journal of Heart Failure 2007*; 9: 477-483.
8. Garcia Monge et al. Performance comparison of ventricular and arterial dP/dtmax for assessing left ventricular systolic function during different experimental loading and contractile conditions. *Crit Care 2018*.
9. Garcia Monge et al. Dynamic arterial elastance as a predictor of arterial pressure response to fluid administration: a validation study. *Crit Care 2014*; 18: 626-637.
10. Cecconi et al. The use of Pulse Pressure Variation and Stroke Volume Variation in spontaneously breathing patients in spontaneously breathing patients to assess dynamic arterial elastance and to predict arterial pressure response to fluid administration. *Anest & Anealg 2015*; 120: 76-84.
11. Garcia Monge et al. Dynamic arterial elastance to predict arterial pressure response to volume loading in preload-dependent patients. *Crit Care 2011*; 15: R15

For professional use. For a listing of indications, contraindications, precautions, warnings, and potential adverse events, please refer to the Instructions for Use (consult eifu.edwards.com where applicable).

Edwards devices placed on the European market meeting the essential requirements referred to in Article 3 of the Medical Device Directive 93/42/EEC bear the CE marking of conformity

Edwards Lifesciences • Route de L'Etraz 70, 1260 Nyon, Switzerland • edwards.com

Edwards