



Blood pressure and cardiovascular management for anesthesia professionals



DS Aware™ point of care clinical decision support software with integrated cloud-based analytics for quality improvement & research

DS Aware™ - Cardiovascular Decision Support

DS Aware™ has been developed with and for anesthesiologists to assist in monitoring blood pressure and cardiovascular stability at the point of care during surgery when an arterial line is in place and arterial pressure is continuously measured.

Point-of-Care Software (Medical Device)

Our point-of-care software is a medical device pre-installed on a lightweight, medical-grade 10" tablet. It connects directly to patient monitors via serial or network connections and streams invasive arterial blood pressure (ABP) waveforms through our proprietary algorithms to provide:

- Real-time visualization of blood pressure, cardiac output (CO), and systemic vascular resistance (SVR)
- Trends and cumulative time at mean arterial pressure (MAP) thresholds, including hypotension
- Case review and end-of-surgery summaries
- Easy-to-read visualizations of cardiovascular parameters throughout the procedure

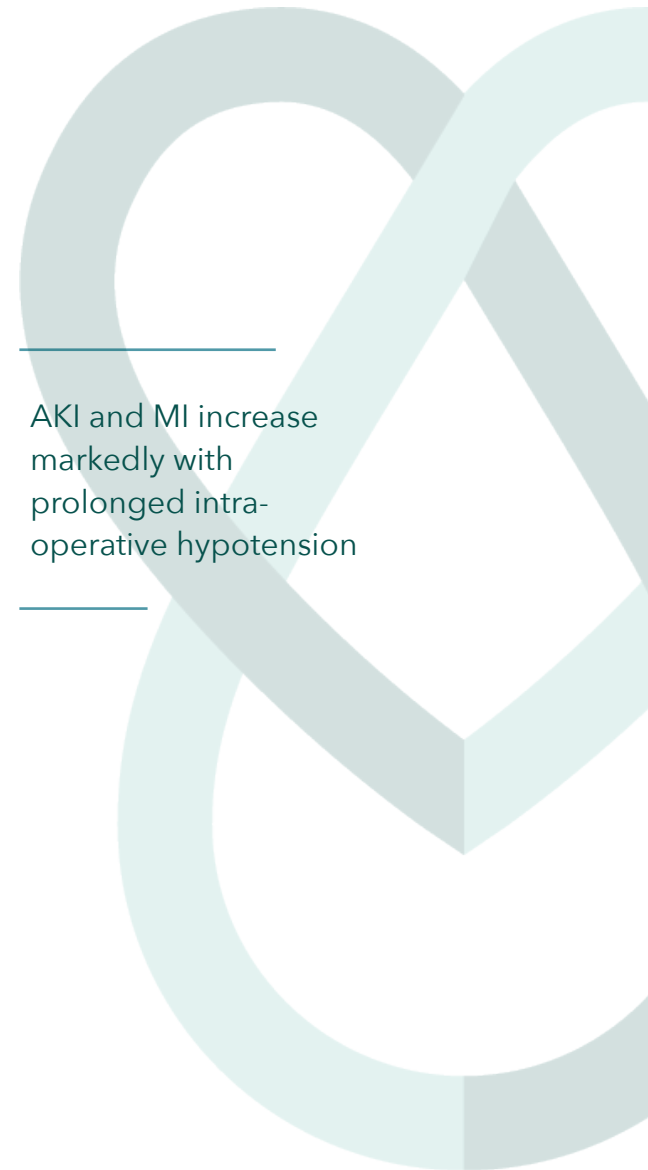
Key Features

- Intuitive visualization designed for anesthesiologists
- No additional calibration or sensors required
- Pre-installed and ready to use on a medical-grade tablet
- Connects digitally to patient monitors for seamless data capture
- Displays cumulative metrics and trends to support intra-operative decision-making

Expected Benefits

- Supports anesthesiologists in monitoring and managing intra-operative cardiovascular changes
- Low ongoing cost of ownership - no additional disposables or sensors required
- May contribute to reducing hospital resource usage and costs in non-cardiac surgical patients¹⁴

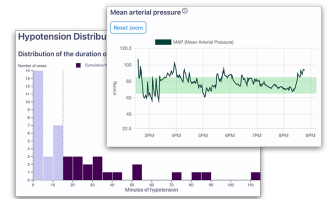
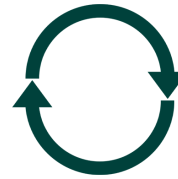
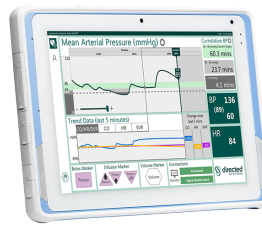
AKI and MI increase markedly with prolonged intra-operative hypotension



Cloud Analytics Platform (Not a Medical Device)

DS Aware™ also includes a secure, cloud-based analytics platform. This component is not a medical device and is intended for research, quality improvement, and internal review purposes. It enables:

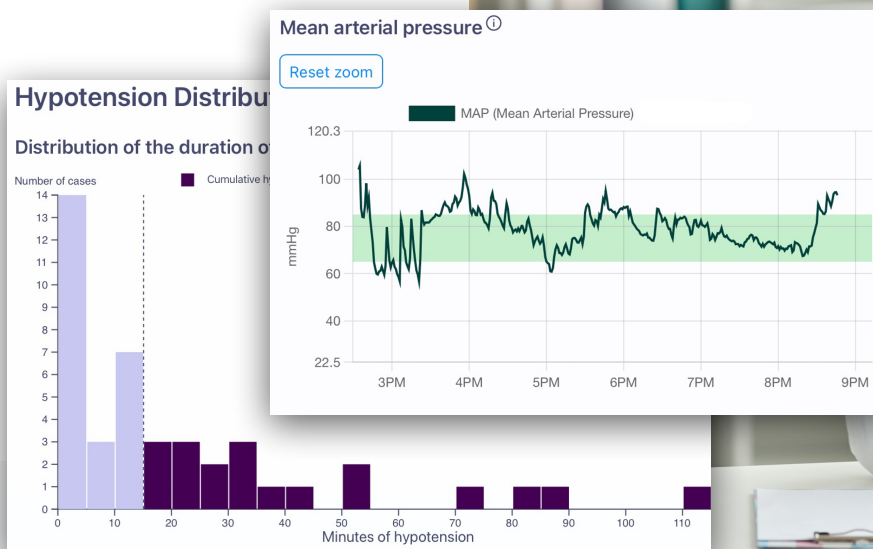
- Secure cloud storage of data collected by all DS Aware™ installations at your facility
- Visualization of trends over time, comparison across surgical types, and analysis by patient demographics
- Access to high-resolution intra-operative data from each procedure when required
- Remote software updates and maintenance for DS Aware™ point-of-



Fully integrated solution

“There does not appear to be any safe duration of a MAP less than 55 mmHg”

Walsh, 2013



The problem of intra-operative hypotension

Intra-operative hypotension (IOH) is a common and frequent occurrence in patients undergoing general anesthesia for non-cardiac surgery.

A 2014 study of almost 17,000 anesthetic records revealed that 26% of the surgical patients involved had a peri-operative systolic blood pressure of <80 mmHg for >5 minutes¹.

Intra-operative hypotension has long been associated with:

- Post-operative mortality².
- Acute kidney injury (AKI)
- Myocardial injury (MI)^{3,4,5}

Benefits of preventing intra-operative hypotension

The prevention of IOH by tailoring management of blood pressure to individual patient physiology, may improve post-operative outcomes⁶.

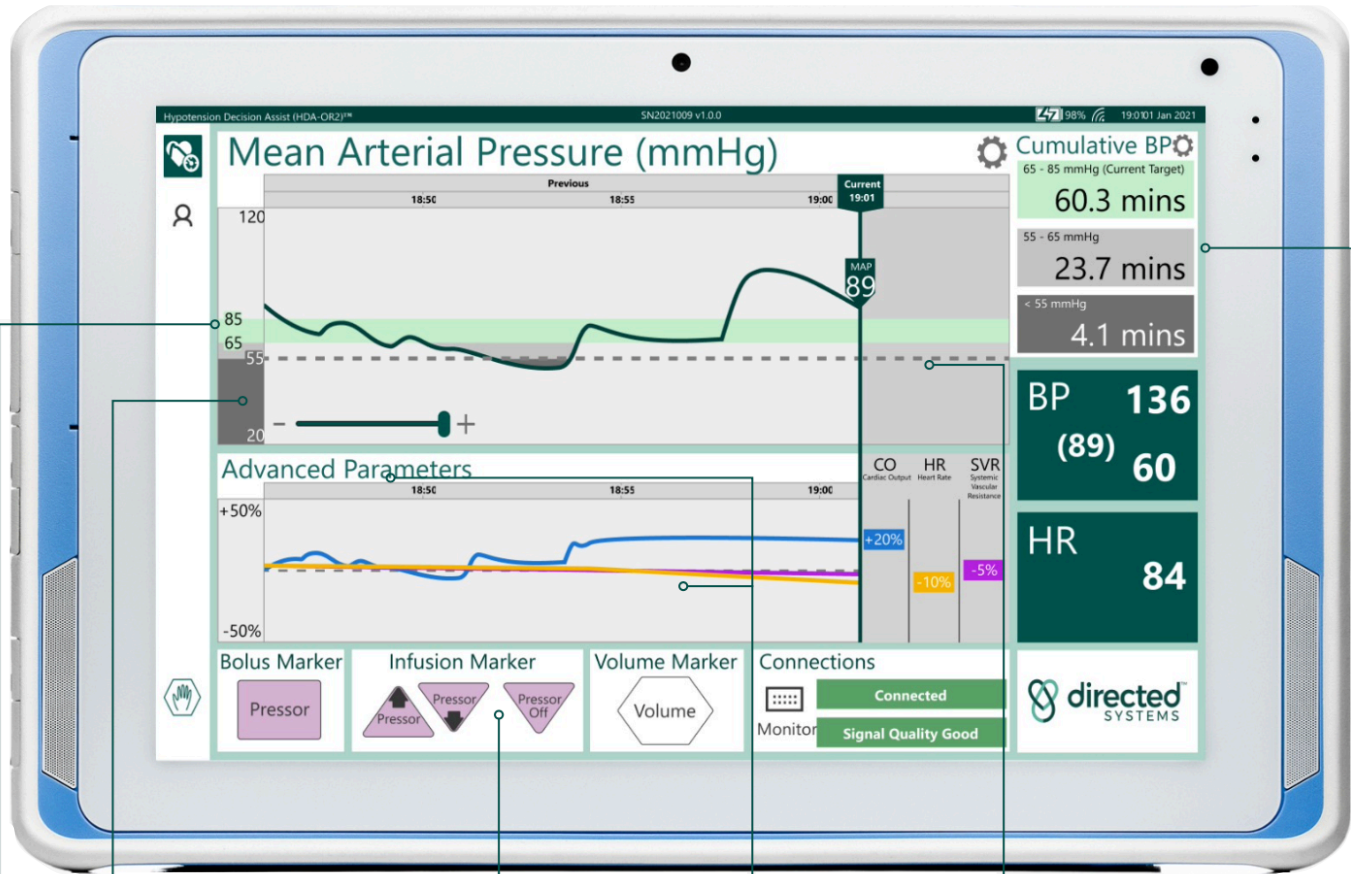
Intra-operative hypotension if not optimally controlled, may contribute to poor outcomes, even death in post-operative high-risk patients. Even short periods of hypotension can increase the risk of organ injury⁷

Cumulative total time of IOH matters

- MAP below 60-70 mmHg among adults is associated with increased risk of acute kidney injury (AKI), myocardial injury (MI), and mortality, and the risk is a function of both hypotension severity and duration⁸.
- Patients are at increased risk of AKI when their cumulative time below a MAP of 65 mmHg reaches or exceeds 13 minutes⁹.
- When patients fall even further below this threshold (for example, MAP below 55 mmHg), even short durations are associated with increased risk of AKI. A MAP of 50 mmHg can significantly increase the risk of AKI and MI even after just 1 minute¹⁰.

In 2020, the Anesthesia Quality Institute (AQI) published a quality metric for hypotension⁹. This measure (IIM025: ePreop 31) evaluates the proportion of cases in which the patient's MAP is below 65 mmHg for 15 minutes or more, cumulatively over the course of the surgery.

Main Screen



Slider allows MAP timescale to be zoomed in and out so that changes over time can be seen macroscopically and in detail.

Cardiovascular treatments can be indicated by pressing these "marker" buttons.

A marker will appear on the main MAP chart and on the CO, HR and SVR trends.

These allow the patient's responsiveness to different treatments to be assessed.

They can also act as an aide-memoire for recording on the main medication chart.

Main chart shows mean arterial pressure (MAP) trend and its current numeric value. With user defined hypotension warning limits and defined severe hypotension range. To assist the user to maintain MAP within acceptable limits.

Trend data for cardiac output (CO), heart rate (HR) and systemic vascular resistance (SVR).

Values are calibrated using their values 5 minutes ago as baseline and expressed as % change.

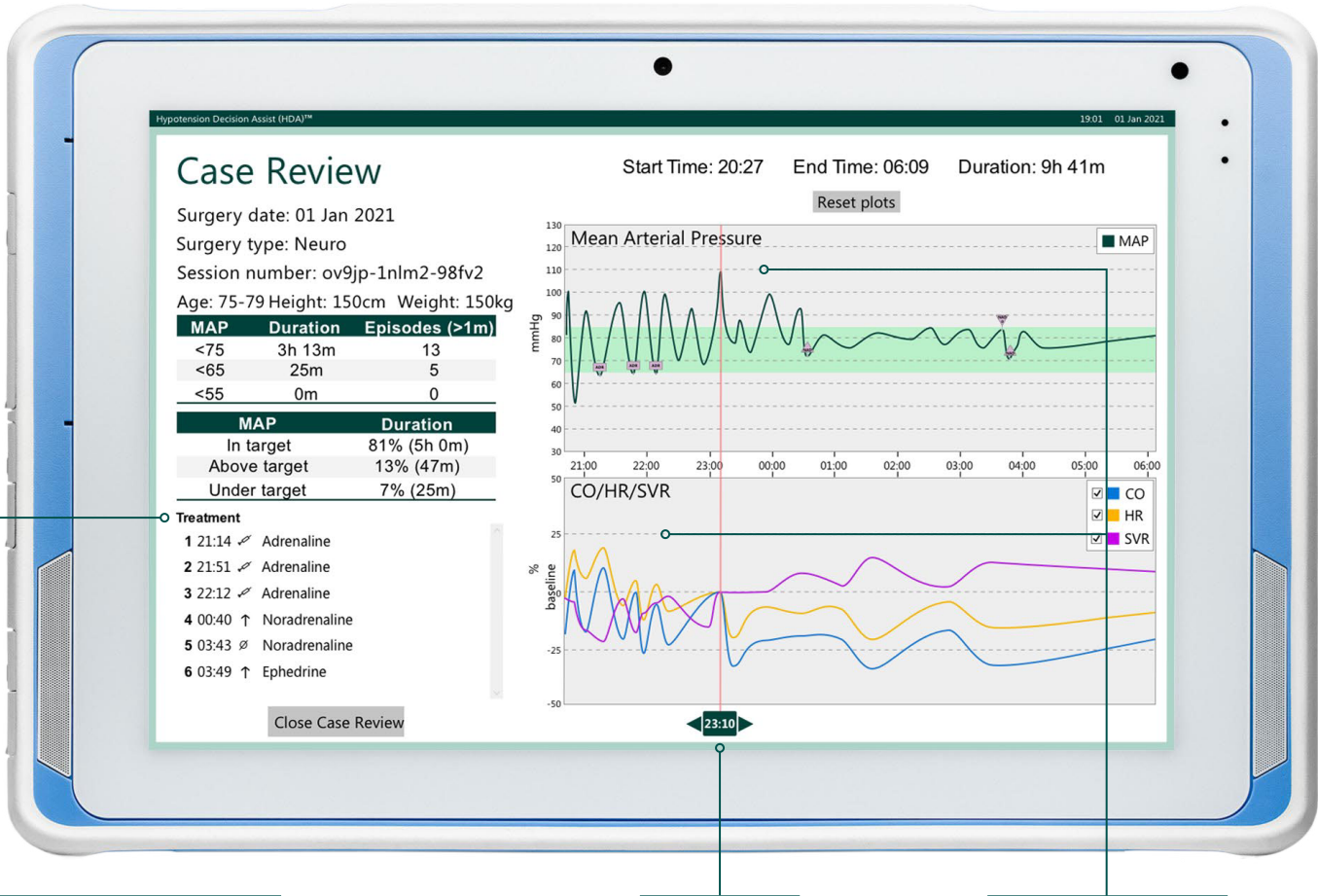
The pattern of changes allows the user to assess cardiovascular status and helps them decide appropriate treatment.

The "green zone" shows the target range for mean arterial pressure (MAP) set by the user for the patient.

This allows rapid visualization of how the MAP is changing and enables the user to decide whether intervention is needed.

Amount of time in target MAP range and in user defined and severe hypotension ranges.

Hypotension Case Review - HCR™



Treatment marker record showing time and type of marker placement.

Baseline slider.

MAP & CO/HR/SVR trend data screen

The charts can be zoomed with a pinch-zoom and scrolled.

Data Extraction via USB and networking

All case files can now be automatically uploaded to DS Aware™ analytics and reporting (see DS Aware™ brochure) via networking, to enable further off line analysis of patient cases postoperatively.

References

- 1 Nair et al., Anesthesia information management system-based near real-time decision support to manage intraoperative hypotension and hypertension. *Anesth Analg* 2014; 118: 206-214.
- 2 Monk TG, Saini V, Weldon BC, Sigl JC. Anesthetic management and one-year mortality after noncardiac surgery. *Anesth Analg* 2005; 100: 4-10.
- 3 Wesselink EM, Kappen TH, Torn HM, Slooter AJC, van Klei WA. Intraoperative hypotension and the risk of postoperative adverse outcomes: a systematic review. *BJA* 2018; 121: 706-721.
- 4 Sun LY, Wijeyesundera DN, Tait GA, Beattie WS. Association of intraoperative hypotension with acute kidney injury after elective noncardiac surgery. *Anesthesiol* 2015; 123: 515-515.
- 5 Walsh M, Devereaux PJ, Garg AX, Kurz A, Turan A, Rodseth RN, Cywinski J, Thabane L, Sessler DI. Relationship between intraoperative mean arterial pressure and clinical outcomes after noncardiac surgery: toward an empirical
- 6 Futier et al., Effect of Individualized vs Standard Blood Pressure Management Strategies on Postoperative Organ Dysfunction Among High-Risk Patients Undergoing Major Surgery: A Randomized Clinical Trial. *JAMA* 2017; 318: 1346-1357.
- 7 Godet T, Grobost R, Futier E. Personalization of arterial pressure in the perioperative period. *Curr Opin Crit Care* 2018; 24: 554-559.
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- 9 Anesthesia Quality Institute, Internal Improvement Measures, IIM025: ePreop 31: Intraoperative Hypotension among Non- Emergent Noncardiac Surgical Cases, 2020.
- 10 Salmasi, V., Maheshwari, K., Yang, D., Mascha, E. J., Singh, A., Sessler, D.I., & Kurz, A. Relationship between Intraoperative Hypotension, Defined by Either Reduction from Baseline or Absolute Thresholds, and



Who we are

Directed Systems is a fast-moving medical software and data analytics company based in Cambridge, UK and Austin, USA. Our target customers for DS Aware are the anesthesiologists and hospitals who are concerned about the incidence and cost of post-operative complications of intra-operative hypotension. We develop software that incorporates smart proprietary algorithms to analyze, visualize, predict and interpret real-time physiological signals.

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