



# PulsioFlex Monitoring Platform

Flexible and patient-focused advanced hemodynamic monitoring







# Making therapeutic decisions is not easy

## Let us help

The PulsioFlex Platform for advanced hemodynamic patient monitoring is easily adaptable to your patient's individual needs and specific requirements.

- Adjustable to various clinical settings (OR, ER, ICU)
- Specific to the physicians need for information
- Easily scalable to patient's risk level

### Intelligent visualization for advanced patient monitoring

- Brilliant 8" LED color touch screen with high resolution
- Glass touch screen and intuitive user interface
- Space saving thanks to minimal dimensions and low weight
- Flexible mounting and installation possibilities
- Modular expandability with automatic module detection
- Network compatible e.g. print function via clinic network
- Information transfer to PDMS



# By your side

## Patient-centered flexibility

The PulsioFlex Monitoring Platform is a flexible, patient-focused hemodynamic monitoring device. This convenient and compact bedside monitor is easy to set up and assists users through smart and intuitive handling – to help guide the next therapeutic steps.



### Identify your patients' risk level continuously and intuitively

The PulsioFlex offers the possibility to choose between different pre-configured displays which can be individually adjusted. The special color concept provides a comprehensive picture of the measured parameters. An example is the dynamic 'Spider-Vision' feature which shows an overview of the most important parameters at a glance. Modifications of the patient's constitution are automatically represented graphically by the spider's net changes.

Stay continuously updated about any change in your patient's condition – enable immediate and purposeful adjustment of treatment.

#### Additional benefits:

- Expandable modular design
- Usable as stand-alone monitor
- Simple set-up through individually coded cables
- Intuitive menu guidance



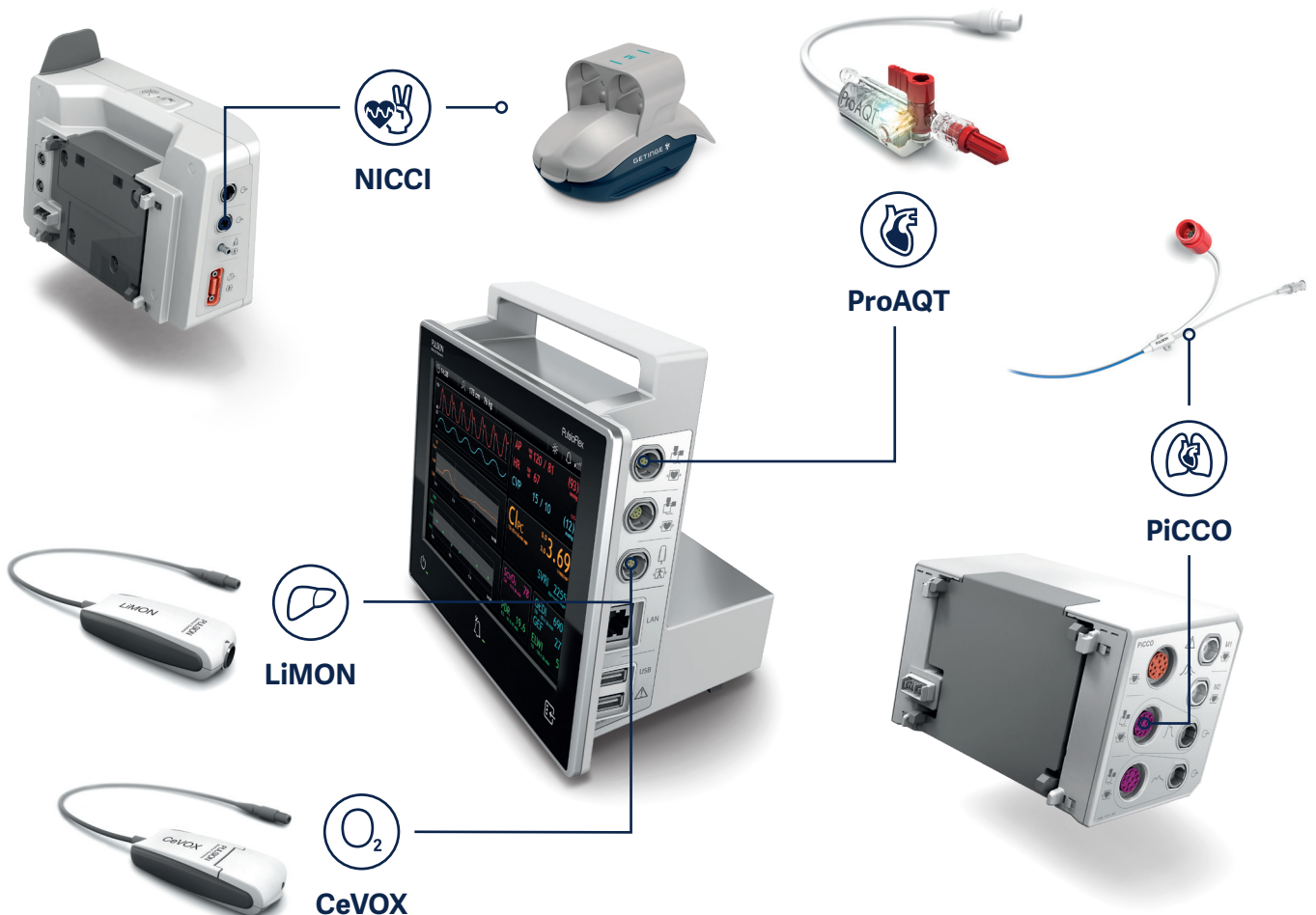
# PulsioFlex Monitor

## Platform setup

At a certain point you will need more information about your patient's hemodynamic condition.

### Get the complete picture with:

- Continuous, noninvasive blood pressure measurement with NICCI
- Minimally invasive perioperative cardiac output trend monitoring with ProAQT
- Volume management with PiCCO and ProAQT
- Determination of calibrated parameters like cardiac output and its determinants with PiCCO
- Lung edema diagnostic with PiCCO
- Continuous central venous oxygen saturation monitoring with CeVOX
- Noninvasive global liver function monitoring with LiMON





# NICCI Technology

Never miss a beat



reddot winner 2020

NICCI is the latest innovation in advanced hemodynamic monitoring, providing continuous and noninvasive parameters during surgeries. Now a broader range of patients in the OR can benefit from advanced hemodynamic insights. NICCI monitors the patients' hemodynamic status even before induction of anesthesia and after surgery. Therefore, an application is useful for rehabilitation and perioperative optimization.



NICCI provides the advantage of using continuous monitoring especially when an arterial line is not indicated and intermittent blood pressure (BP) measurement is not sufficient.

## NICCI Mouse & Sensor

- Designed for maximal patient comfort
- Ergonomic design, easy to clean
- Integrated double finger cuff for automatic finger change and uninterrupted measurement for up to 72h
- Three different finger sensor sizes to suit well on the patients' fingers to ensure the best measurement results
- For patients' fingerdiameters ranging from 13 to 28mm diameter (excluding children under the age of 4)

## NICCI Module

- The NICCI Module clicks easily on the back of the PulsioFlex Monitor
- Integrated storage and cable management solution
- Integrated and automatic upper arm cuff calibration
- Quick access keys on module allow easy access to most common use actions
- Indicator light on module allows easy identification of system status



# Hypotension

## – an unknown risk?

Nowadays, the question is not whether intraoperative hypotension is dangerous or not but rather how it can be prevented.



**72%**

of non-cardiac surgical patients experienced hypotension during their respective procedures.<sup>1</sup>



**82%**

of routine blood pressure monitoring during general anesthesia and surgical procedures rely on intermittent measurements<sup>2,3</sup>



**40%**

of hypotensive episodes during surgeries might be missed or overlooked by intermittent upper arm cuff readings.<sup>4</sup>

### Complications Associated with Intra-operative Hypotension

Hypotensive phases have a mean duration of around 3 minutes. Yet even 1 minute at a mean arterial pressure (MAP) of 50 mmHg, or accumulative effects over short periods, increases the risk of mortality by 5% and can result in organ failure or complications including:<sup>5,6</sup>



**7.4%**

increased risk of acute kidney injury when bloodpressure drops below 65 mmHg or 20% from baseline.<sup>7</sup>



**56%**

of cardiac arrests are preceded by pronounced hypotension.<sup>8</sup>



**2.3%**

of patients developed myocardial injury after non-cardiac surgery.<sup>7</sup>



**1.3%**

increased risk of a post-operative stroke for each minute of intra-operative hypotension (IOH).<sup>9</sup>



**17%**

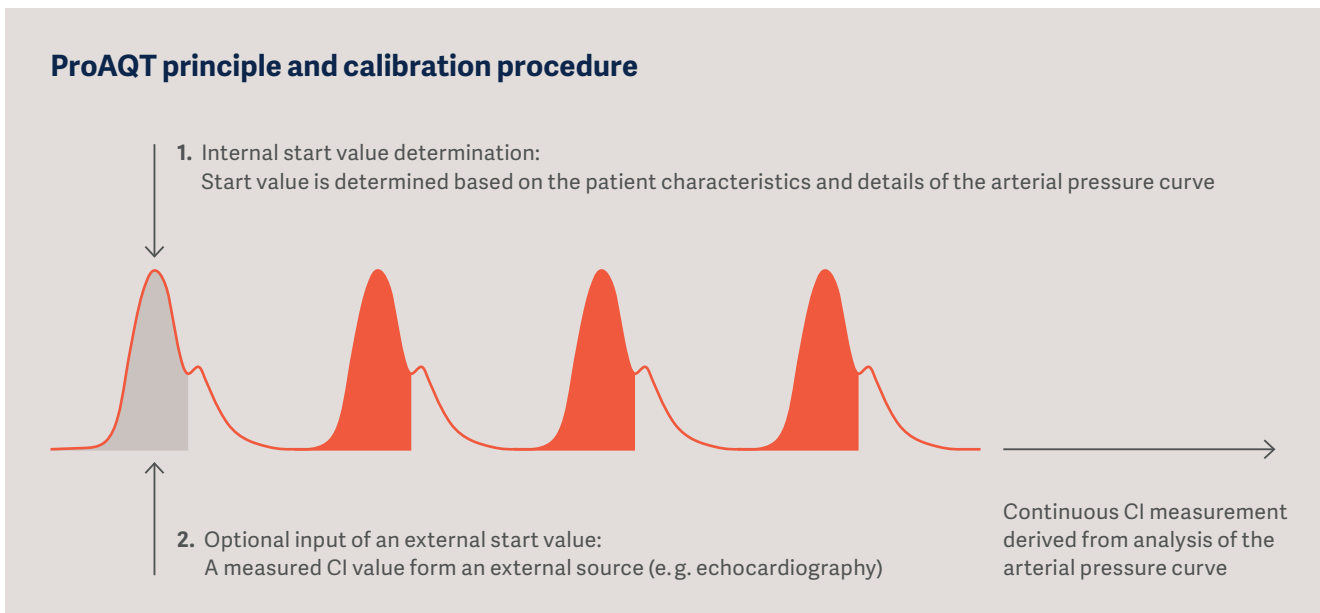
of non-ambulatory patients suffer complications within 30 days following surgery.<sup>10,11</sup>



# ProAQT Technology

## Peri-operative fluid optimization

Cardiac output and volume responsiveness based on arterial pulse contour analysis with ProAQT.



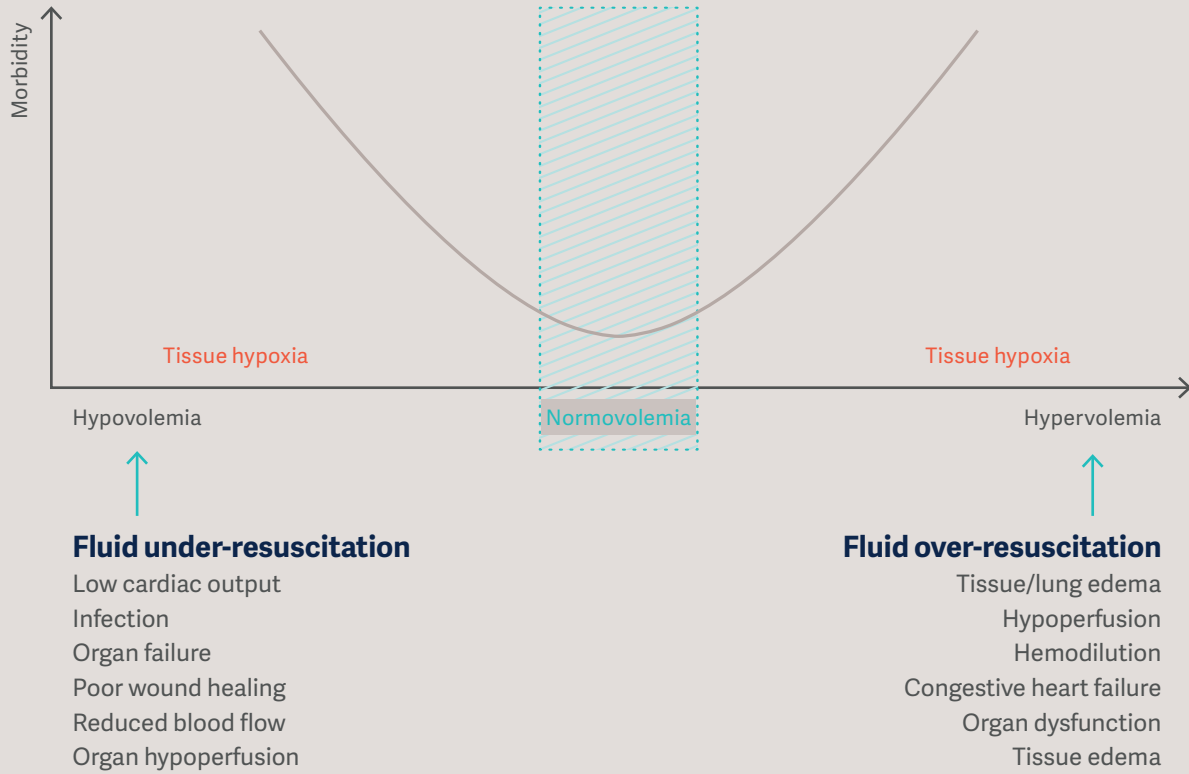
### ProAQT is applicable for:

- Complex procedures with high-risk of intra- and postoperative complications
- Anticipated high blood loss (> 20%) and volume shifts during procedure which can result in hypo- or hypervolemia
- Protracted surgery time (> 120 min)

»...hemodynamic goal-directed therapy using pulse pressure variation, cardiac index trending and mean arterial pressure as the key parameters leads to a decrease in postoperative complications in patients undergoing major abdominal surgery«<sup>13</sup>



## Individualized fluid therapy helps avoid hypervolemia or hypovolemia (and) related complications<sup>12</sup>



## Significant difference of infectious complications

The Swalzwedet et. al. study shows the evidence of the beneficial effects of perioperative GDFT with ProAQT (in abdominal surgery).<sup>13</sup>



### Control Group:

Number of Patients: 81

Patients with infectious complications: 21



### Study Group:

Number of Patients: 79

Patients with infectious complications: 9



# PiCCO Technology

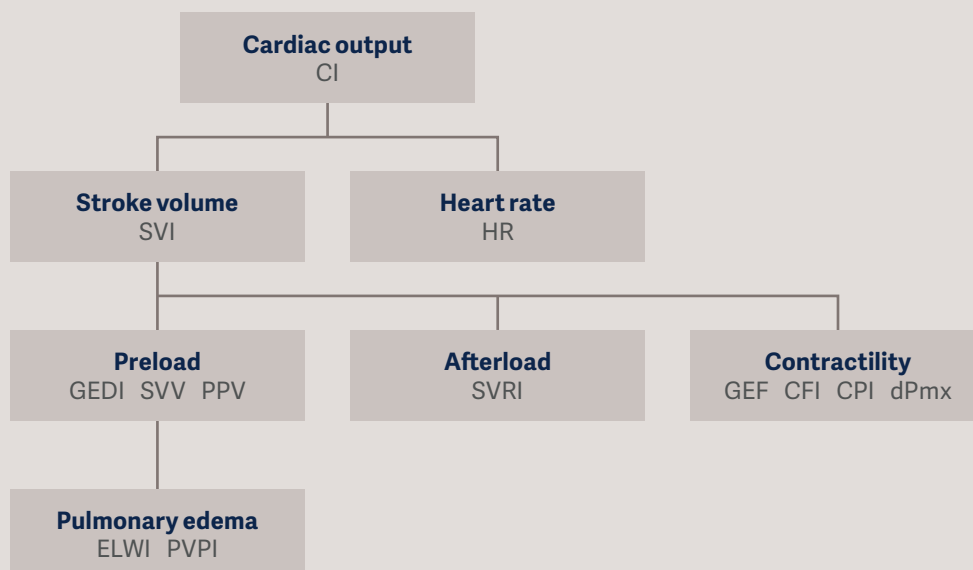
Get the complete picture of the hemodynamic situation in critically ill patients

PiCCO Technology is based on two physical principles: transpulmonary thermodilution and pulse contour analysis. Both principles allow the calculation of advanced hemodynamic parameters and have been clinically tested and established for more than 20 years.<sup>14,15</sup>

## PiCCO helps you to answer these questions:

- What is the current cardiovascular situation?
- What is the cardiac preload and afterload?
- Is the patient fluid responsive?
- Is the patient developing lung edema?

### Hemodynamic parameters





## Simplify hemodynamics

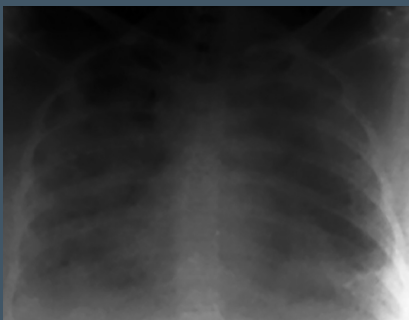
- Clinically proven and widely accepted minimally-invasive alternative to the pulmonary artery catheter
- The precise PiCCO parameters allow physicians to perform patient-individualized therapy with optimal use of volume, inotropes and vasopressors
- PiCCO enables the measurement of extravascular lung water for pulmonary edema assessment

»PiCCO provides a comprehensive picture of the hemodynamic condition through relevant information on preload responsiveness indexes, cardiac output and extravascular lung water. In critically ill patients and particularly in those with both cardiovascular and respiratory disorders, PiCCO thus allows clinicians to take rapidly appropriate decisions on when to start, to continue and to stop fluid administration.«

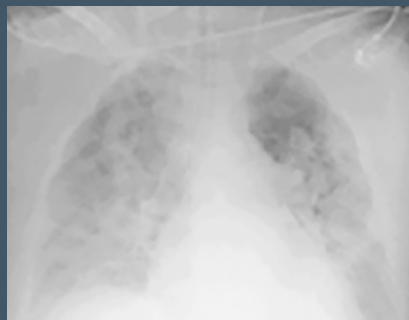
Jean-Louis Teboul, MD, Professor Service de Réanimation médicale, Centre Hospitalier Universitaire de Bicêtre, Paris, France

PiCCO Technology offers direct and accurate bedside quantification of pulmonary edema by measuring extravascular lung water index (ELWI). This enables sensitive and early detection of the development of pulmonary edema and allows early therapeutic intervention before the pulmonary edema can cause alveolar damage or complications. The ELWI measurement is significantly more accurate than pulmonary edema estimation from chest X-rays.<sup>16,17,18</sup>

Examples of chest X-rays that do not reflect the level of pulmonary edema



**ELWI = 21 ml/kg**  
Severe pulmonary edema



**ELWI = 14 ml/kg**  
Moderate pulmonary edema



**ELWI = 8 ml/kg**  
No pulmonary edema

Pulmonary edema is not easily detected by chest X-rays as shown above. For pulmonary edema diagnosis ELWI is more sensitive than chest X-ray.<sup>19</sup>

# CeVOX Technology

Sensitive continuous measurement of oxygen balance for early detection of tissue hypoxia<sup>20</sup>

CeVOX Technology is based on spectrophotometry.

Infrared light of specific wave lengths is emitted by LEDs and transmitted through a fiber optic into the vessel.

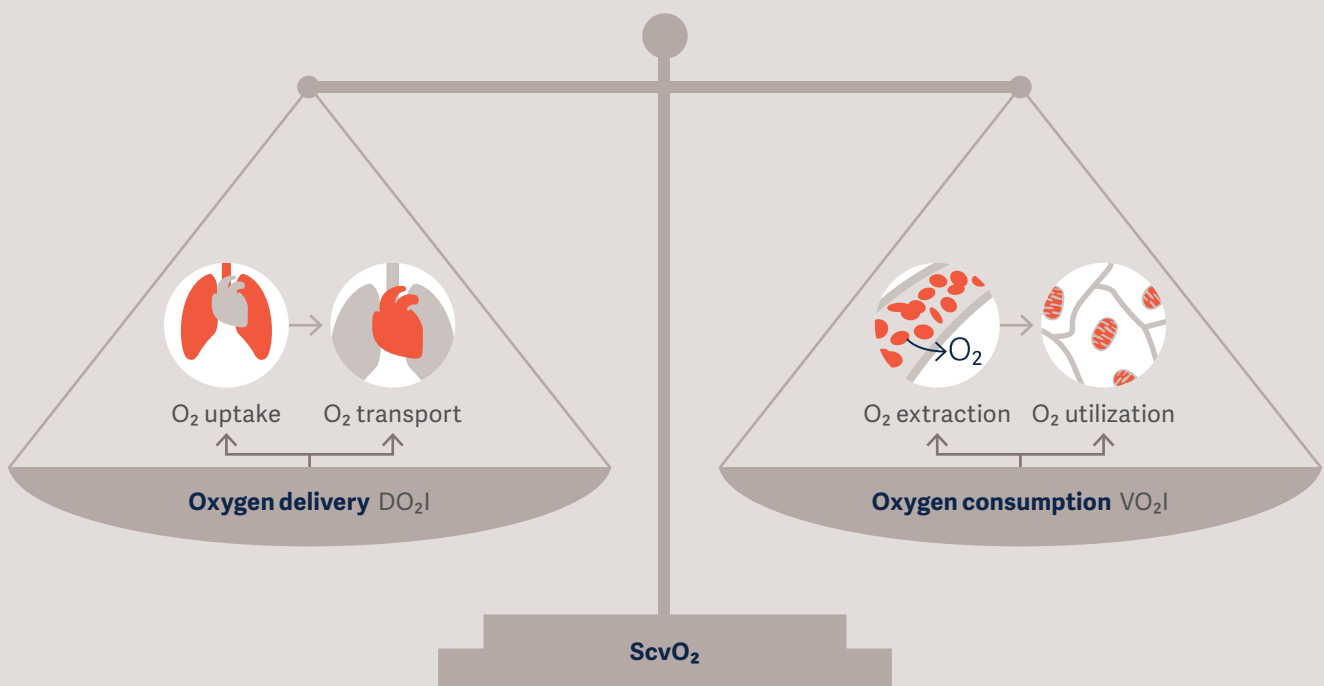
The light is then reflected by the red blood cells and transmitted back through a separate fiber optic to the optical module.

## Enables early intervention

- Traditional vital signs may be late indicators of inadequate oxygen delivery to tissue<sup>21</sup>
- Detects acute changes in systemic balance between oxygen delivery and consumption<sup>22</sup>
- Tracks therapeutic effects immediately and continuously<sup>23</sup>

## Reduces complications and mortality

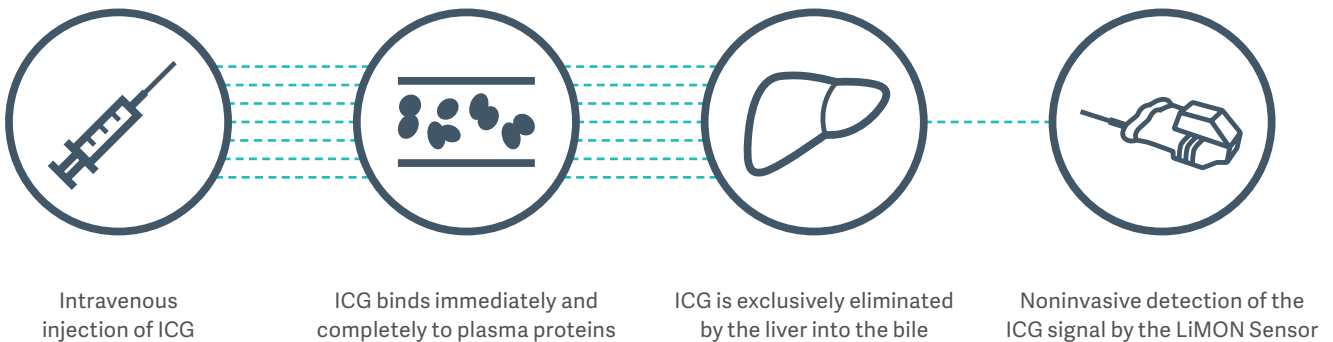
- Low ScvO<sub>2</sub> is related to an increased risk of post-operative complications in high-risk surgery<sup>23</sup>
- Decreases risk of infection by reducing frequency of blood gas analysis (BGA) sampling<sup>24</sup>
- Identifies early life-threatening drop in systemic oxygen delivery<sup>25</sup>



# **LiMON Technology**

## Non-invasive global liver function assessment at the bedside

LiMON Technology detects the elimination of diagnostic dye indocyanine green (ICG) by modified pulse oximetry.



### LiMON supports physicians in various applications

- Significantly better specificity and sensitivity than standard liver function tests<sup>26</sup>
- Quantification of remaining liver function before liver resection<sup>27,28</sup>
- Early identification of post-operative liver dysfunction in liver resection and transplantation<sup>29,30,31</sup>
- Identification of postoperative complications in liver surgery<sup>32</sup>

# Advanced patient monitoring platform

The PulsioFlex Monitoring Platform combines different technologies.

You can easily extend the hemodynamic scope with modules featuring NICCI, ProAQT, PiCCO, CeVOX, and LiMON. This will give you the information you need to help assess the hemodynamic status for a broad range of patients, on-site.

The following table lists the parameters available with the current technologies:



	NICCI	ProAQT	PiCCO	CeVOX	LiMON
<b>Invasiveness</b>	Noninvasive	Minimally invasive arterial line	Less invasive arterial catheter	Less invasive	noninvasive
<b>Pulse contour analysis (continuous)</b>					
<b>Chronotropy</b>	PR	HR	HR		
<b>Blood Pressure</b>	AP <sub>sys</sub> , AP <sub>dia</sub> , MAP	AP <sub>sys</sub> , AP <sub>dia</sub> , MAP	AP <sub>sys</sub> , AP <sub>dia</sub> , MAP		
<b>Flow</b>	CI <sub>Trend/Cal</sub> , SVI	CI <sub>Trend/Cal</sub> , SVI	CI <sub>PC</sub> , SVI		
<b>Contractility</b>	dPmx, CPI	dPmx, CPI	dPmx, CPI		
<b>Afterload</b>	SVRI	SVRI	SVRI		
<b>Volume responsiveness</b>	SVV, PPV	SVV, PPV	SVV, PPV		
<b>Thermodilution (discontinuous)</b>					
<b>Flow</b>			CI <sub>TD</sub>		
<b>Preload</b>			GEDI, ITBI		
<b>Contractility</b>			CFI, GEF		
<b>Pulmonary edema</b>			ELWI, PVPI		
<b>Oxymetry</b>					
<b>Oxygen saturation</b>				ScvO <sub>2</sub>	
<b>ICG elimination</b>					
<b>Liver function</b>					PDR, R15

Besides the PulsioFlex, the Advanced Patient Monitoring Technologies are integrated into the following OEM platforms:

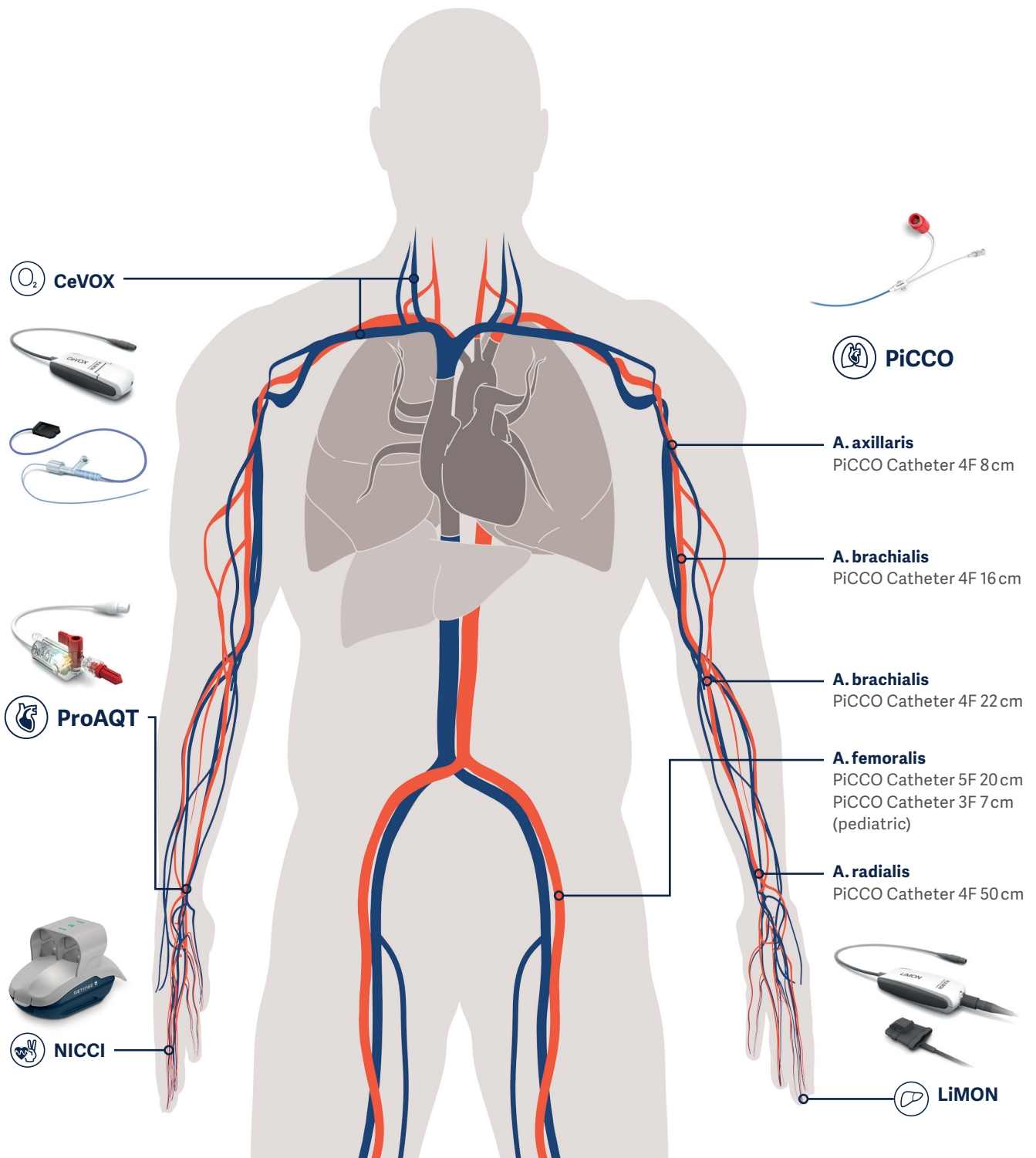
Nihon Kohden	Philips, Mindray, Drager Medical, General Electric, Nihon Kohden	Philips, Mindray, Nihon Kohden
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\* Cardiac index derived from pulse contour \*\* Calibrated from internal or external reference value \*\*\* Cardiac index derived from thermodilution



# Recommended application sites

of advanced hemodynamic monitoring technologies



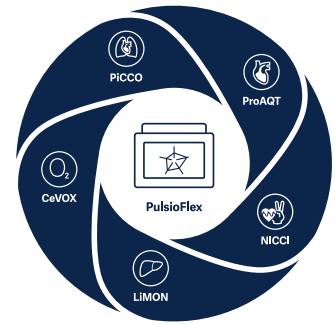






# Passion for life

## Improving outcomes for critically ill patients



Advanced hemodynamic monitoring helps physicians understand complex conditions of patients in intensive care units and during high-risk surgeries and helps to optimize their hemodynamic condition.<sup>13</sup>

Pulsion's core competence is the development and production of medical devices for monitoring critically ill patients. Pulsion Medical Systems SE was founded in 1990 and is located in Feldkirchen, Greater Munich. Since 2014, Pulsion is wholly-owned by, and fully-integrated with, Getinge.

Getinge is a global provider of innovative solutions for operating rooms, intensive care units, sterilization departments and life science companies and institutions.

Based on our firsthand experience and close partnerships with clinical experts, healthcare professionals and medtech specialists, we are improving everyday life for people – today and tomorrow.



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