



Questions & Answers

PiCCO Technology

This document is intended to provide information to an international audience outside of the US.

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i PiCCO stands for Pulse Contour Cardiac Output. The “i” in PiCCO was added to create a pronounceable word.

Patient target groups, recommended application areas and application limitations:

Recommended target patient groups and recommended application areas:

PiCCO is useful for all critically ill patients requiring hemodynamic monitoring. These may include intensive care patients from various departments, such as surgical, medical, cardiac, neurological, pediatric and burn units, as well as patients undergoing major surgical interventions. In general, PiCCO is recommended in cases of unstable hemodynamic situations, unclear volume status and in situations with therapeutic conflicts.

Those situations are usually present in:

- Septic shock
- ARDS (Acute Respiratory Distress Syndrome)
- Cardiogenic shock
- Severe burn injury
- Multiple trauma
- Hypovolemic shock
- Subarachnoid hemorrhage
- Pancreatitis
- High risk surgical procedures
- General pediatric intensive care

Application limitations:

Patients with arterial access restrictions due to femoral artery grafting or severe burns are usually not qualified for the placement of a PiCCO catheter into the femoral artery.

Note: The axillary or brachial artery can be used as an alternative site. Additionally, a long radial artery catheter may be placed for short term use.

PiCCO may give inaccurate thermodilution measurements in patients with certain medical conditions, e.g. intracardiac shunts, aortic aneurysm, aortic stenosis, mitral or tricuspid insufficiency, pneumectomy, large pulmonary embolism and extracorporeal circulation. Please refer to the section ‘Medical and Physiological Questions’ for more details.

How long can an arterial PiCCO catheter be left in place?

- The catheters for femoral, axillary and brachial arteries are intended for use of up to 10 days. In the case of complications, they have to be removed immediately. (exception: long radial artery catheter PV2014L50: max. 3 days)
- Exchange interval for PiCCO monitoring kits: every 4 days

The exchange interval can be shorter in case of detection of complications associated with the application of these disposable articles e.g. bleeding, hematoma, signs of infection, perfusion impairment, misplacement of the catheter or if local regulations or standard operating procedures overrule this recommendation.

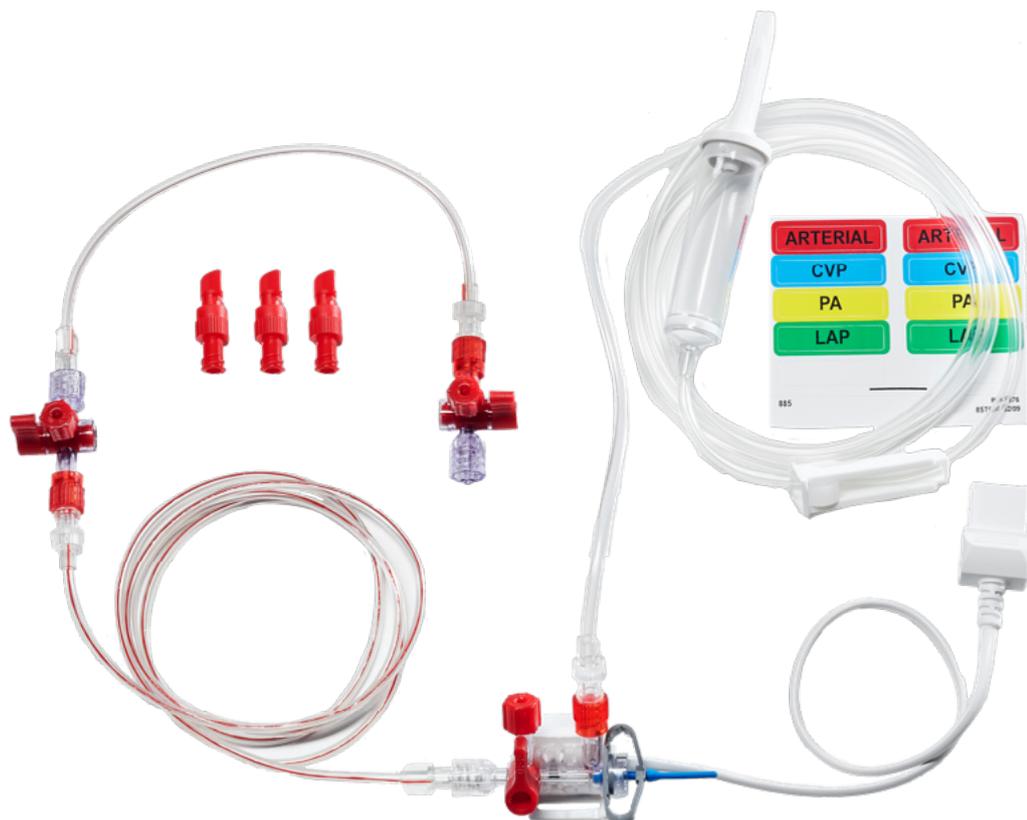
Can the PiCCO catheter stay in place during MRI?

The effect of MRI on the PiCCO catheter has been investigated as observational study with survey analysis and in model experiments and published as congress poster abstracts (Huber et al., Intensive Care Medicine Experimental 2015, Kampen et al., Intensivmed Notfallmed 2002, Kampen et al. Anaesthesia 2004, Greco et al. AnnFAR 2011). These investigations (study and survey analysis) did not show any negative effects on the function of the PiCCO catheter during MRI.

However, there are currently no systematic tests for all available MRI systems under the various measurement conditions. Therefore, we cannot confirm the compatibility of the PiCCO catheter with MRI systems, in general and recommend removal prior to the MRI. It is the treating physician's full responsibility if the decision is made to leave the PiCCO catheter in place during the MRI.

Why is it recommended to use PiCCO monitoring kits?

The PiCCO Technology was validated with the original, unmodified PiCCO disposable pressure transducer systems (monitoring kits), which have been tested for frequency response and are matched to the algorithms used in the PiCCO Technology, in order to give maximum reliability. The most important factor to maintain reliability is the connection tubing used with the disposable pressure transducer. This tubing is very inelastic and has a certain length and inner diameter. The use of any other transducers, connection tubing or modification of the connection tubing (e.g. with a needleless blood sampling port) might impair the accuracy of pulse contour cardiac output (and dependent parameters).



Methodological questions

What external factors could cause the PiCCO parameters to become less accurate?

The PiCCO Technology is based on transpulmonary thermodilution and arterial pulse contour analysis. Thus, the thermodilution measurement needs to be performed correctly and the arterial pressure curve needs to be of a certain quality. For trouble shooting purposes please refer to the "Trouble-Shooting-Guide".



Medical and physiological questions

How can specific therapies influence the PiCCO measurement?

Hypothermia:

There is no influence on thermodilution measurements as long as the patient's temperature is stable. Cooled injectate should be used. Temperature fluctuations of the baseline are compensated for, by the device itself. However, a thermodilution measurement is not recommended when a stable baseline cannot be detected, as shown by the screen message 'Wait' (temperature change > 0.05°C /min).

Vasoconstrictors/inotropes/volume therapy:

All parameters are correctly calculated. In case of significant changes in the catecholamine requirements or volume therapy, recalibration of the pulse contour analysis is recommended. The changing values of the central venous pressure (CVP) should be updated regularly.

How can specific illnesses of the heart and lungs influence PiCCO measurements?

Heart

Cardiac arrhythmia:

The thermodilution parameters are still measured correctly. The pulse contour analysis is correct in mild to moderate arrhythmias (normal rate atrial flutter/fibrillation, bigeminal, trigeminal or occasional extra systoles). In severe cardiac rhythm disturbances (tachyarrhythmia, supraventricular tachycardia), pulse contour analysis may be inaccurate. Evaluate the quality of the pressure curve by checking for the white lines (PulsioFlex horizontal/PiCCO2 vertical) below the pressure curve whether the algorithm was able to detect the systolic portion. It is also recommended to recalibrate with 3–5 thermodilution measurements.

Intra-cardiac shunts:

Due to the marked alteration in the thermodilution curve, no valid values can be calculated. In less severe shunts, measurements may be possible. However, the occurrence of a premature hump in the thermodilution curve can lead to the detection of a previously unknown intra-cardiac shunt.

Lungs

Partial lung resection:

Lung resection procedures (lobectomy, bilobectomy, pneumectomy) theoretically reduce the pulmonary blood volume (PBV) and may lead to an underestimation of the extravascular lung water (EVLW). To evaluate this theoretical assumption, a double indicator dilution technique is required to determine the PBV before and after lung resection. Published clinical data on this topic is very limited. Clinical studies using this approach show that:

 Find more information here:
PiCCO Technology. Clinical Evidence.

- The amount of extracted lung tissue and pulmonary blood volume do not correlate
- Clear correction factors for PBV calculation cannot be determined
- An initial effect on PBV is generally physiologically compensated latest two days post-operatively

Thus, it is not recommended to correct the measured values for PBV and EVLW with fixed calculation factors. Clinical evidence is not available and such corrections may lead to unexpected and unpredictable errors in the calculation of EVLW in patients after lung resection.

Pulmonary perfusion disturbances

(e.g. pulmonary embolism):

In pulmonary embolisms, the pulmonary vasculature is partly obstructed and the thermodilution bolus does not reach the complete lung tissue. Depending on the amount of lung tissue without adequate perfusion, extravascular lung water (EVLW) might be underestimated. Nevertheless, in this case the cardiac output and the global end-diastolic volume (GEDV) are measured correctly.

Pleural effusion:

Pleural fluid is not influencing the measurement of extravascular lung water. The capillary surface of the lung parenchyma that is in contact with the pleural fluid is very small in comparison to the pulmonary capillary network. An appropriate analogy is, the relation of the size of a tennis court to the surface area of two hands. Thus, the temperature loss to the pleural fluid is negligible.

Are there special recommendations regarding PiCCO in open-heart surgery?

On pump (with extracorporeal circulation – heart-lung-machine):

The initial PiCCO calibration should be done after anesthesia but before opening the chest. When performing pulse contour calibration by thermodilution measurements, the patient should be hemodynamically stable without significant changes in body temperature. Another thermodilution measurement can be conducted immediately before cardiopulmonary bypass (CPB). During extracorporeal circulation the PiCCO is not able to give valid results due to the lack of an existing arterial pressure curve. Therefore, thermodilution measurements are of no use during extracorporeal circulation. As soon as the heart starts pumping again and the patient is weaned from the heart-lung-machine, PiCCO will display the cardiac output derived from the pulse contour analysis. Recalibration of the pulse contour should be performed as soon as possible. This comes along with an update on the volume status (GEDI), which is usually of interest immediately after bypass and after closing of the chest.

Off pump:

Initial calibration is done after induction of anesthesia. During the entire procedure, continuous cardiac output can be followed on a beat to beat basis. Recalibration during the procedure is only possible when the patient is in sufficiently stable condition. During the procedure, the index of left ventricular contractility (dPmx) gives additional information on contractility, and can serve as an early warning indicator for ischemic events. Stroke volume variation (SVV) and pulse pressure variation (PPV) serve as indicators of volume responsiveness, even under open chest conditions. However, patients must be ventilated with a tidal volume >8ml/kg, and have a sufficient sinus rhythm.

What needs to be considered when using PiCCO in pediatrics?

The clinical usefulness and relevance as well as the validity of PiCCO in pediatric intensive care has been confirmed in several studies.  Read more here: PiCCO Technology. Clinical Evidence.

The minimum body weight of the patients within these studies was 3 kg, but normal ranges for adults are only applicable in patients who are at least 5 years of age. Furthermore, pulse contour analysis has not yet been sufficiently validated. General recommendations for PiCCO use in pediatric patients are:

- PiCCO can be used in a broad range of indications (acute respiratory failure, shock, head trauma, sepsis, cardiac surgery, severe burn injury, liver transplantation)
- PiCCO catheter (3F 7cm) should be placed into the femoral artery
- PiCCO is recommended in patients of at least 10kg body weight and up.

- Perfusion of the limb where the PiCCO catheter is placed should be monitored closely to avoid ischemia
- Injectate volume for the thermodilution measurement should be adjusted to body weight (minimum 2 ml)
- Only thermodilution measurement parameters should be interpreted as pulse contour analysis is not yet sufficiently validated
- In children of less than 5 years of age, the normal range of values is different to those for adults (GEDI tends to be lower, ELWI tends to be higher). This effect is significant in neonates (< 1 year of age). In young children GEDI and ELWI should be used mainly as trend information.
- The presence of an intracardiac shunt interferes with the thermodilution measurement, possibly leading to measurement inability. On the other hand the thermodilution signal allows easy shunt detection.

Does the respiratory cycle influence the PiCCO thermodilution cardiac output measurement?

No, the respiratory cycle does not influence the PiCCO thermodilution cardiac output measurements, as the thermodilution curve is approximately 20 seconds long, including approximately 3 respiratory cycles. Thus, the PiCCO values represent an average of several respiratory cycles and have a much lower coefficient of variation than cardiac output from pulmonary artery thermodilution.

Is PiCCO cardiac output more accurate than a right heart catheter?

In terms of accuracy the two methods are equivalent. However, the PiCCO method has a much lower coefficient of variation. In other words, the PiCCO method is much less user dependent and gives more stable measurements. When compared to the gold standard (Fick method), PiCCO shows excellent correlation. PiCCO pulse contour cardiac output shows a high correlation and low bias to the PiCCO arterial thermodilution cardiac output.

Pulse contour cardiac output deviates from transpulmonary thermodilution cardiac output. What could be the possible reasons?

The thermodilution CO will only change when a new set of thermodilution measurements is performed. The pulse contour CO is updated beat by beat based on the systolic part of the arterial curve. In case of hemodynamically unstable patients, differences between the pulse contour and thermodilution cardiac output may occur. In such cases frequent recalibration (via thermodilution) is recommended. Other causes include errors in the detection of the arterial wave form and therefore errors in the wave form analysis and extreme arrhythmias or frequent extra systoles.

Cardiac preload volume is not equivalent to global end-diastolic volume Index (GEDI). How can this clearly indicate cardiac preload?

Strictly defined, cardiac preload is the myocardial fiber stretch at the end of ventricular diastole. A parameter that accurately reflects preload in clinical practice is not yet available. However, studies have demonstrated that GEDI (or ITBI) is a reproducible and sensitive parameter and serves as a good approximation of preload.

 Read more here: PiCCO Technology. Clinical Evidence.

In contrast, it has been repeatedly shown that the central venous pressure, pulmonary artery occlusion pressure, and right ventricular end-diastolic volume index do not reflect cardiac preload.

Why is the GEDI value larger than physiologically expected?

GEDI is a theoretical volume, an indicator of the total end-diastolic volume of all four heart chambers: the right atrium, right ventricle, left atrium, and left ventricle. Furthermore, a small volume must be added; these include volumes from the aorta and a small amount just prior to the right atrium. Additionally, GEDI it is not a value displaying the volume of the heart during a single cardiac cycle: it is a sum of several cardiac cycles.

Why are stroke volume variation (SVV) and pulse pressure variation (PPV) of clinical relevance only when the patient is under mechanical ventilation?

In all devices, that are using pulse contour analysis, the interpretation of SVV and PPV requires the following conditions:

- Fully controlled positive pressure ventilation with a tidal volume $\geq 8\text{ml/kg}$ (no spontaneous breathing or assisted breaths) and
- Sufficient sinus rhythm with no artefacts

Under these conditions the relative difference between maximum and minimum stroke volume or pulse pressure over a time span of 30 seconds will indicate how volume responsive a patient is. An SVV or PPV above 13% indicates that a patient will react to administered volume, whereas a SVV or PPV below 10% usually represents sufficient volume status. Values between 10 and 13% require further interpretation as they may depend on the individual patient's clinical picture. When using lower tidal volumes ($<8\text{ml/kg}$) SVV and PPV have been shown to become less accurate and are not recommended. Under open chest conditions, SVV and PPV are dependent on cardiac filling, thus cardiac preload (GEDI) can be used for volume management.

What is the difference between CFI and GEF?

Cardiac function index is calculated as the cardiac output divided by the global end-diastolic volume. Global ejection fraction is calculated as stroke volume multiplied by four and divided by global end-diastolic volume. As Cardiac index is calculated by multiplying stroke volume with heart rate the difference between the two parameters is that CFI includes heart rate in its calculation. Thus, interpretation of GEF for cardiac contractility might be advantageous, as low stroke volume (due to low contractility) can be compensated by a high heart rate.

How is lung water measured by the PiCCO thermodilution and how accurate is it?

Sakka et al. (Intensive Care Med 2000) investigated the ability to measure extravascular lung water (EVLW) with thermodilution. In 57 intensive care patients, they used the double indicator dilution technique (using thermodilution with indocyanine green, ICG) allowing them to measure intrathoracic blood volume (ITBV) and extravascular lung water (EVLW). Results showed that there is a need to include a calculation factor of 1.25 when calculating ITBV from the thermodilution derived global end-diastolic volume (GEDV). In another 209 intensive care patients, this calculation factor was used to calculate ITBV and EVLW, and when comparing those calculated values to the simultaneously real measured values (with double indicator dilution technique based on ICG), very close correlations were found. This approach of measuring EVLW with the arterial thermodilution by PiCCO was later validated in several experimental and clinical studies, confirming high accuracy.  Read more here: PiCCO Technology. Clinical Evidence.

How is the measurement of the extravascular lung water index (ELWI) influenced by obesity?

The extravascular lung water index (ELWI) in ml/kg is calculated from the absolute volume of extravascular lung water in milliliters divided by the body weight in kilograms. This causes an underestimation (in obese patients) or an overestimation (in underweight patients) of ELWI, if the actual body weight is used for indexing. As lung size does not change with the body weight, the correct way of ELWI calculation is to use an idealized body weight, or predicted body weight (PBW). PBW is calculated from the height of the patient and includes other specifics such as age and gender. The PiCCO devices have been using PBW for the calculation of ELWI since 2007, making it accurate even in severely obese patients. In the PiCCO Technology integrations in patient monitors (Philips, Draeger, Mindray, GE and Nihon Kohden) only the latest software versions provide the ELWI calculation related to PBW. In older software versions it is recommended to enter an estimated ideal body weight which is calculated by the simplified formula: estimated Ideal Body Weight = Height (cm)/ 100 minus 10% for males, and minus 15% for females.

What is the effect of injecting the indicator bolus for PiCCO into the femoral vein instead of the superior vena cava/right atrium?

If both the central venous catheter and PiCCO arterial catheter are placed on the same side (e.g. right femoral groin) a double hump indicator curve with resulting measurement errors may occur because of a disturbed temperature signal from the 'cross talk' between the venous and arterial blood streams. In other words, the cold temperature can pass across to the arterial thermistor without passing through the cardiopulmonary system i.e. directly from vein to artery. This is more common in pediatric patients.

Even when using long femoral venous catheters, there is a small effect from cross talk caused by thermal migration from the catheter into the vessel. Cross talk can be avoided if the PiCCO arterial catheter is either placed in the opposite femoral artery or in the brachial/axillary artery.

If cross talk is avoided, thermodilution measurement is possible, but the PiCCO readings for GEDI will be slightly higher than the actual volumes. This is caused by the additional volume from the point of injection to the point of detection, because the catheter for indicator injection is not placed directly before or in the right atrium. The value for ELWI will be correct, as it is calculated from the difference of two overestimated volumes. The PulsioFlex and PiCCO₂ from software version V3.1. the PiCCO function requires adjustment and confirmation where both, the central venous and arterial catheters are placed to ensure accurate calculation of GEDI.

Can I perform a thermodilution measurement with a peripherally inserted central catheter (PICC) rather than a centrally inserted venous catheter?

In order to get an adequate thermodilution curve for accurate parameter calculation, the injectate bolus must be injected in under 7 seconds, and remain cool enough for the PiCCO catheter to detect a difference between the patient's blood and the bolus. It may be that these conditions cannot be fulfilled and thus this approach is generally not recommended.

What are the recommended volumes of injectate required for arterial thermodilution measurement?

The injectate volume is dependent on the patient's body weight. If the patient has an increased amount of extravascular lung water (i.e. ELWI is more than 10 ml/kg body weight), the volume to be injected must be increased. In clinical practice, most people use a standard volume of 15ml of cold saline solution in adults. This standard works in most patients and avoids confusion and mistakes. However, the injectate volume has to be adapted for patients with very low or very high body weight. A recommendation of the most appropriate injectate volume is given on the PiCCO measurement screen.

How many thermodilution measurements are recommended in a new patient?

It is recommended that three consecutive measurements, with less than 15% (\pm) variation compared to the mean value are performed within a 5 minute time frame. If the patient has elevated ELWI, the first measurement may not be accurate and more or cooler injectate may be required (e.g. if you are using room temperature injectate initially and ELWI reading is > 10ml/kg).

What kind of injectate can be used with the PiCCO Technology?

It is recommended to use a saline solution. The use of glucose, may cause the small piston inside the injectate temperature sensor to stick to the housing, and impede movement during injection.

Can PiCCO detect an abnormally shaped thermodilution curve?

Yes, the PiCCO Technology monitors and analyzes the shape of the thermodilution curve for plausibility. On the display screen a status line will give an error code or error message if an abnormal curve is detected. In addition, the thermodilution curve is also displayed on the screen and can be examined by the user.

What are the time intervals or under which circumstances is it recommended that new thermodilution measurements be performed, so that results from the pulse contour analysis are updated and accurately reflect the patient status?

In general PiCCO should be calibrated every 8 hours by thermodilution; however, individual patient needs vary greatly. For example, if your patient is in shock you may have to determine GEDI and ELWI hourly and confirm/recalibrate pulse contour cardiac output. Once the patient is stabilized you may be able to decrease the frequency of measurements to once every 2 hours and then, if the patient remains stable decrease to every 4–6 hours. Another strategy could be to perform a thermodilution measurement if the continuous cardiac output has trended consistently in the same direction for 15 minutes or if there are large and/or sudden changes in the patient's clinical status requiring changes to their vasopressors, inotropes or fluid requirements.

How does PiCCO calculate the BSA to get the indexed values?

Different BSA calculation formulas have been used since the PiCCOplus software V7.1 and included in PiCCO₂ and PulsioFlex as well as in the latest software versions of monitors of Philips, Draeger, Mindray, GE and Nihon Kohden.

(BSA) Body surface area (m²)

Patients with BW < 15kg

$BSA = (\text{weight}^{0.5378} \times \text{height}^{0.3964}) \times 0.024265$
(Haycock et al., J Pediatrics 1978)

Patients with BW >= 15kg

$BSA = (\text{weight}^{0.425} \times \text{height}^{0.725}) \times 0.007184$
(Du Bois & Du Bois, Arch Int Med 1916)

Predicted body weight (PBW)

Calculation	Category	Gender
$PBW \text{ (Kg)} = 50 + 0.91 (\text{height (cm)} - 152.4)$	Adult	Male
$PBW \text{ (Kg)} = 45.5 + 0.91 (\text{height (cm)} - 152.4)$	Adult	Female
$PBW \text{ (Kg)} = 39 + 0.91 (\text{height (cm)} - 152.4)$	Pediatric > 152.4cm	Male
$PBW \text{ (Kg)} = 42.2 + 0.91 (\text{height (cm)} - 152.4)$	Pediatric > 152.4cm	Female
$PBW \text{ (Kg)} = ((\text{height (cm)})^2 / 1.65 / 1000)$	Pediatric < 152.4cm	Both

(PBSA) Predicted body surface area (m²)

Calculated with PBW instead of actual body weight (BW)

How is the mean transit time (MTt) detected and what does it represent?

The concentration of the indicator is distributed over time because of the volume in the system, i.e. there is a given time for each particle of the indicator to travel between the point of injection and point of detection. This time is called the transit time and each particle has its own transit time. The MTt is the mean value of all these transit times. The MTt multiplied with the cardiac output gives the whole thermal volume (Intrathoracic Thermal Volume, ITTV) that the indicator has to go through.

How is the exponential down slope time (DSt) detected?

The down slope time is detected by plotting the thermodilution curve and the temperature change (indicator concentration) on a logarithmic scale (ln) and time change on a linear scale (lin). When plotting the thermodilution curve as a linear-ln graph, the indicator decay approximates a linear function. Two points, a starting point located at 85% of the maximum temperature response, and an end point defined as 45% of the maximum temperature response, are identified. The time difference between them is determined and labelled as the down slope time (DSt). DSt multiplied with cardiac output gives the pulmonary thermal volume (PTV) which is the largest single volume in the series of "mixing chambers" of the cardiopulmonary system. PTV consists of Pulmonary Blood Volume (PBV) and Extravascular Lung Water (EVLW).

Technical Questions

How can electrical interference be eliminated?

In general PiCCO devices are protected against interference with diathermy devices for electrical surgical procedures and coagulation. Interference may occur when PiCCO is sending the arterial pressure signal to a patient monitor via the pressure transfer cable connected to the AUX port of the PiCCO, meaning when a direct cable connection between the PiCCO device and the bedside monitor is established. In cases where interference is reported, the following remedies may help:

1. Ensure that the green/yellow potential equalization cable (earthing cable) is connected between the PiCCO device and the related socket in the operating room (for PiCCO₂ only).
2. Connect the power cables from the PiCCO device and the patient monitor to different power circuits.
3. If these electrical connection solutions do not solve the problem, the connection between the PiCCO device and the patient monitor needs to be terminated. So the arterial pressure signal needs to be measured independently with a second pressure transducer which transfers the signal directly to the patient monitor.



How can the PiCCO measurement results be documented by printout or data download?

Printing:

Depending on the PiCCO device being used different print options are available

PiCCO₂ offers a printout by pushing the printer button on the front of the device. The design of the printout depends on the screen content at the moment the print button is pushed.

- Spider or Profile screen: all measurement values and the pressure curve(s)
- Trend screen: all measurement values, the pressure curve(s) and graphical trend
- Thermodilution measurement screen: all measurement values, the pressure curve(s) and the last six thermodilution measurement curves with result table

Before a printout can be obtained, it is necessary to connect a standard printer (HP LaserJet 1200 series driver compatible) to one of the USB ports on the back of the device for a direct printout. Alternatively, a download of the printout (PDF file plus a screenshot in JPG format) can be downloaded to a USB storage device for printing later at any computer with a connected printer. When connecting a USB device a message will appear on screen giving further information on the device status. Printing is begun only after the USB device is detected. The USB device should only be disconnected once the device confirms completion of the print process. If the PiCCO₂ is connected to a local area network (LAN) and configured correctly, sending the print to a printer integrated into the LAN is also possible.

PulsioFlex offers the print function through the printer button located within the main menu of the software. The screen will offer the print target (network, USB stick or local). The time span of data to be printed can also be adjusted. Before the print is begun, it is necessary to connect either a standard printer (HP Universal Printing PCL5 driver compatible) to one of the USB ports on the back of the device for direct print (local). Alternatively, a USB data storage device (USB stick) can be used for download of the printout (PDF file) and to print later on any computer with a connected printer.

When connecting a USB device a message will appear on the screen giving further information on the device status. Printing can only be begun after the USB device is detected. The USB device should only be disconnected once the device confirms completion of the print process. When the PulsioFlex is connected to a local area network (LAN) and configured correctly, sending the print to a printer integrated into the LAN is also possible.

Data download

PiCCO₂ (from software version 3.1 in Europe and 9.1 in the USA) allows patient monitoring data capture (data acquisition function). Continuous data is recorded every 12 seconds and thermodilution data is recorded every time a thermodilution is performed. Additionally, certain events (e.g. intubation, volume challenge, drug infusion) can be named and will be listed with the corresponding time. Data is stored in a CSV (comma separated value) format and can be downloaded onto a USB stick for further analysis. Please contact your local Sales Representative to activate the data acquisition function.

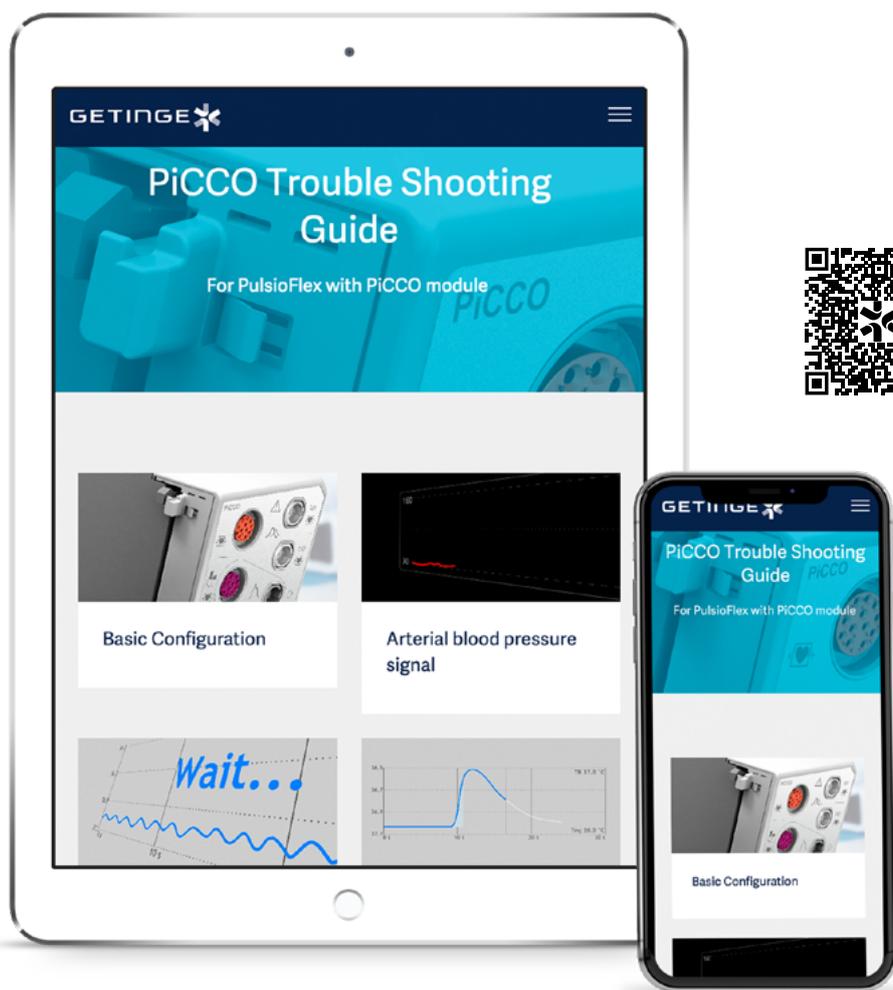
PulsioFlex has a data acquisition option in the main menu. Continuous data is recorded every 12 seconds and thermodilution data is recorded every time a thermodilution is performed. Additionally, certain events (e.g. intubation, volume challenge, drug infusion) can be named and will be listed with the corresponding time. Data is stored in a CSV (comma separated value) format and can be downloaded onto a USB stick for further analysis. From software version V5 also raw data acquisition (pressure and temperature signals) is possible. Please contact your local Sales Representative to activate the raw data acquisition function.

Can I link the PiCCO device into a Patient Data Management System (PDMS)?

All PULSION advanced hemodynamic monitoring devices continuously send all data to the serial RS232 port (PiCCO₂ directly, PulsioFlex via a defined USB-to-RS232 adapter). The data is available in a proprietary and documented format. With this information, data can easily be integrated into any kind of PDMS. The necessary drivers are already available for a broad range of PDMS and patient monitors. Please contact your local Sales Representative or Product Specialist for more information.

PiCCO practical help

Find out how to optimize PiCCO thermodilution measurements in your daily use. Containing comprehensive practical support, the PiCCO Trouble Shooting Guide assists clinicians and technicians when in need for handling information.



Scan the QR-Code
and visit the
PiCCO Trouble
Shooting Guide



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