

**NON-INVASIVE
& CONTINUOUS
CARDIAC
HEMODYNAMIC
MONITORING**

UPDATED SEPTEMBER 2019



Mespere LifeSciences is a high tech medical company located in Waterloo, Ontario, Canada. Mespere is devoted to developing non-invasive solutions to reduce invasive clinical procedures. The company has successfully developed a number of breakthrough products in the field of cardiac and cerebral hemodynamic monitoring such as, the world's first non-invasive and continuous central venous pressure (VENUS 2000 CVP), jugular venous oximetry (VO 100), and cerebral oximetry with blood volume (NeurOs Cerebral Oximetry) monitoring systems. Currently, these measurements can only be obtained through highly invasive catheters. Other products that Mespere has developed include cardiac output, stroke volume, cerebral perfusion, muscle oxygenation, brain imaging etc.

Mespere's products have significant advantages over the traditional invasive methods in that they are; non-invasive, infection free, easy to use, lower cost etc. Mespere LifeSciences products have a wide range of clinical applications in hospital and at-home settings. The products can be applied to patients with chronic diseases such as congestive heart failure and early stage renal failure to help improve the quality of life and reduce the cost of medical care.

Mespere is ISO 13485 certified, with more than 30 US and international patents. The products have obtained CE mark, FDA, and Health Canada approval. The company is at the early stage of market development and has established distribution and clinical partnerships in over 20 countries. Mespere's key team consists of entrepreneurs with successful track records, world renowned doctors and research scientists.



Central Venous Pressure Monitoring System

- High accuracy and precision of ± 2.94 cmH₂O or ± 2.16 mmHg
- Efficient: Measurements achieved in minutes versus hours
- Completely Non-Invasive: Infection Free
- Operates on either tablet, laptop, computer, or any third-party monitors of the customers choice

Key Clinical Applications



Heart Failure Management - Early Venous Congestion Detection

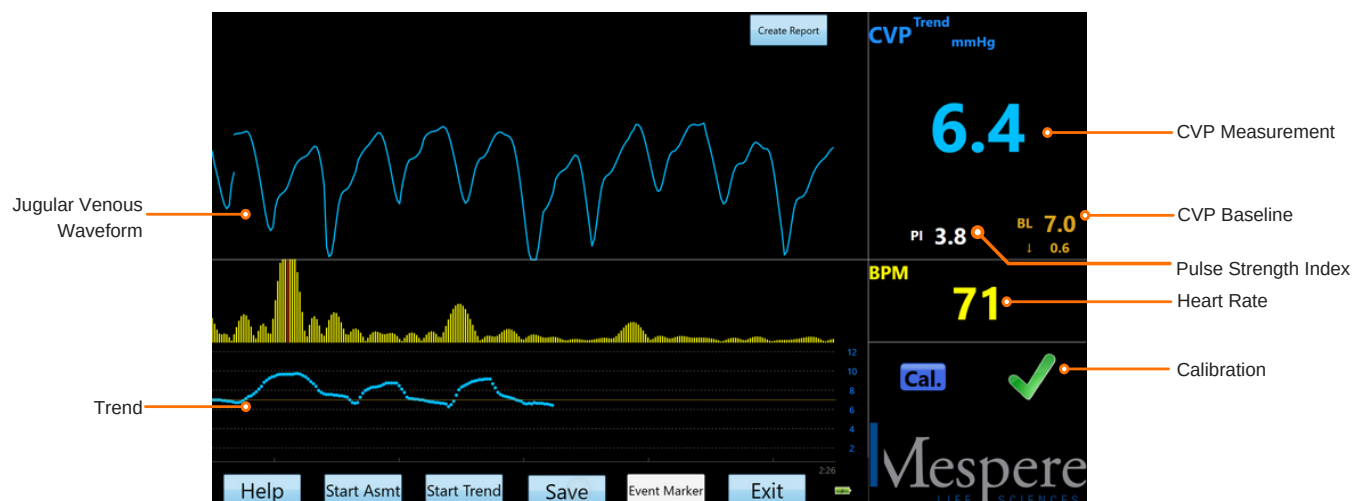
Heart Clinics, LTC, ED, and
ICU



Sepsis Management - Fluid Overload and Tissue Reperfusion

LTC, ED, and ICU

VENUS 2000 Display

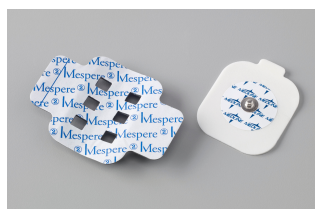


VENUS 2000 Sensor

Reusable Sensor



Single-Use Adhesive



MESPERE VO 100 JUGULAR VENOUS OXIMETRY



Jugular Venous Oximetry Monitoring System

- High accuracy and precision of $\pm 2\%$
- Completely Non-Invasive: Infection Free
- Efficient: Measurements achieved in minutes versus hours
- Operates on either tablet, laptop, computer, or any third-party monitors of the customers choice
- Placement: Right or left, internal or external jugular vein

Key Clinical Applications

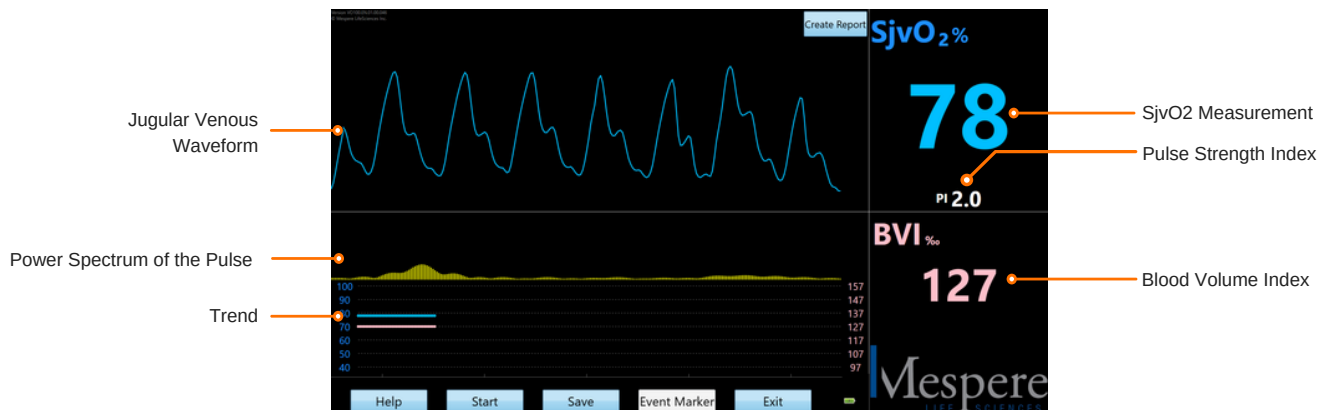


**Post Cardiac Surgery
Management - Cardiac
Hemodynamics**
ICU



**Sepsis Management - Fluid
Overload and Tissue
Reperfusion**
LTC, ED, and ICU

VO 100 Display



VO 100 Sensor

Reusable Sensor



Single-Use Adhesive



MESPERE VENART DUAL PULSE OXIMETRY



Arterial and Venous Oximetry with Cardiac Index and Stroke Volume

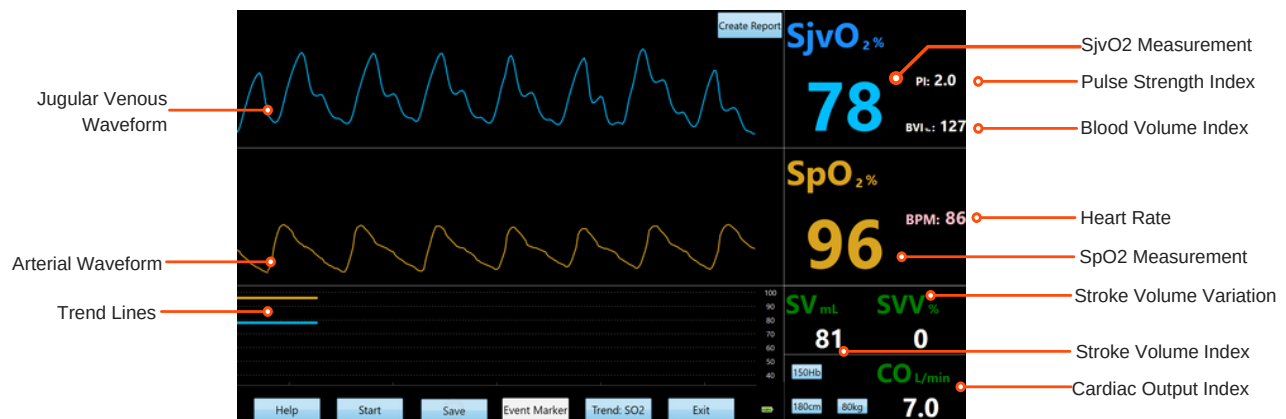
- Beat by Beat Fick's Principle Calculation of Cardiac Output & Stroke Volume
- Completely Non-Invasive: Infection Free
- Placement: VO100 sensor on jugular vein and pulse oximeter on index finger

Key Clinical Applications



**Cardiac Function Management -
Fluid Optimization during surgery and critical care
ICU and OR**

VenArt Display



VenArt Sensors

Reusable Sensors



Single-Use Adhesive





Facts about Heart Failure¹

- There are approximately 600,000 Canadians living with heart failure and 50,000 new cases diagnosed every year.
- Upon diagnosis, 50% will die within 5 years and the remaining 50% will die within 10 years.
- Heart Failure is the third most common reason for hospitalization in Canada.
- 25% of patients will be readmitted within 30 days of discharge.
- Heart Failure patients cost \$2.8 billion annually

What is Heart Failure?

Heart Failure is a very complex and incurable disease that causes patients to frequently visit the Emergency Department requiring urgent medical care. Heart Failure is a disease that develops after the heart has been damaged or weakened. It occurs when the pumping action of their heart is not strong enough to move blood around to fulfill the body's needs. The damage of the heart function can cause fluid to back up into the patient's lungs or in other parts of the body. The congestion of fluid will cause a lack of oxygen and will cause the patient to have a shortness of breath and feel tired much quicker.

Patients with congestive heart failure typically present with fluid overload and require diuresis or other measures to reduce the pulmonary congestion that results from increased preload. For heart failure patients, venous congestion is the primary reason for hospital readmission. Venous congestion is apparent 1-2 weeks prior to decompensation occurring.²

Current Common Practice

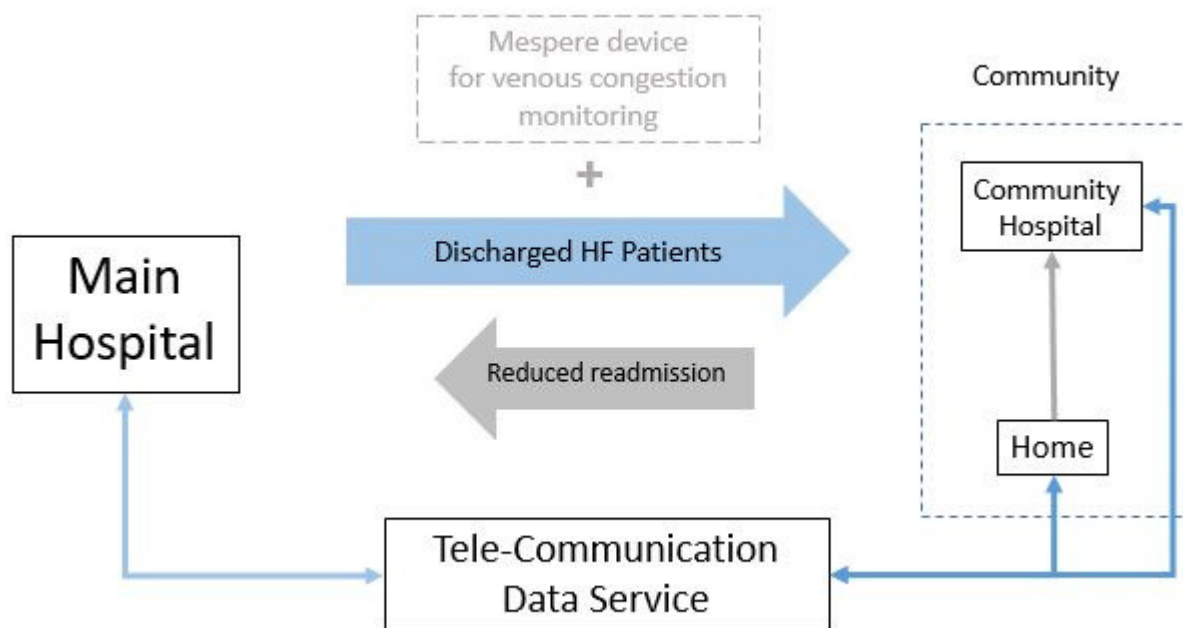
Following heart failure hospitalization, patients are in a vulnerable state. Heart disease management programs have been established which provide some form of nursing-intensive interventions that are focusing on ensuring the delivery of guideline-based medical therapy (therapeutic modification), enhancing patient self-efficacy through education regarding adherence and self-management (education), and regular surveillance for early signs of clinical deterioration (monitoring).³ Patients will need to adjust their lifestyle, monitor their weight daily, and record how they are feeling.

There is a need for new technologies to reduce the number of costly hospitalization and improve the quality of life of these patients.



Mespere LifeSciences Solution

The Mespere monitoring system has the best of all features given it is non-invasive application, continuous monitoring capabilities, and tele-monitoring feature. The Mespere monitoring system can monitor venous congestion in a home setting. However, to have meaningful impact on patient care, the information provided by the device has to be monitored by physicians. Heart failure patients will conduct daily monitoring, and physicians can utilize the information provided by a non-invasive venous congestion monitoring device to assist in the management of their heart failure patients.





Facts about Sepsis

- Worldwide incidence of sepsis is estimated to be 19 million cases per year.¹
- Between 28-50% of people diagnosed with sepsis die.²
- Most expensive condition treated in U.S. hospitals, costing \$20 billion in 2011 and increase on average annually by 11.9%.³
- Mortality from sepsis increases 8% for every hour that treatment is delayed. As many as 80% of sepsis deaths could be prevented with rapid diagnosis and treatment.⁴
- 80% of patients diagnosed with sepsis developed the condition outside the hospital.⁵

What is Sepsis?

Sepsis is a life-threatening illness caused when the body's response to an infection damages its own tissues and organs. Sepsis can be broken down into three core stages:

- 1. Sepsis:** chemicals of the immune system reach the bloodstream and cause inflammation throughout the body
- 2. Severe Sepsis:** infection disrupts blood flow to the brain or kidneys, leading to organ failure
- 3. Septic Shock:** patient's blood pressure drops significantly causing respiratory, heart, or organ failure which could result in mortality⁶

Current Common Practice

Sepsis must be treated as an emergency. Aggressive fluid resuscitation must be performed to restore tissue perfusion in order to prevent organ dysfunction.

- **Within 3 Hours:** aggressive fluid resuscitation by administering antibiotics and intravenous fluids to the patient, approximately 30mL/kg
- **Within 6 Hours:** In the case of blood pressure remaining low despite initial fluid resuscitation, central venous pressure and central venous oxygen saturation should be measured
- **Within 12 Hours:** essential to diagnose or exclude any source of infection



Fluid Overload

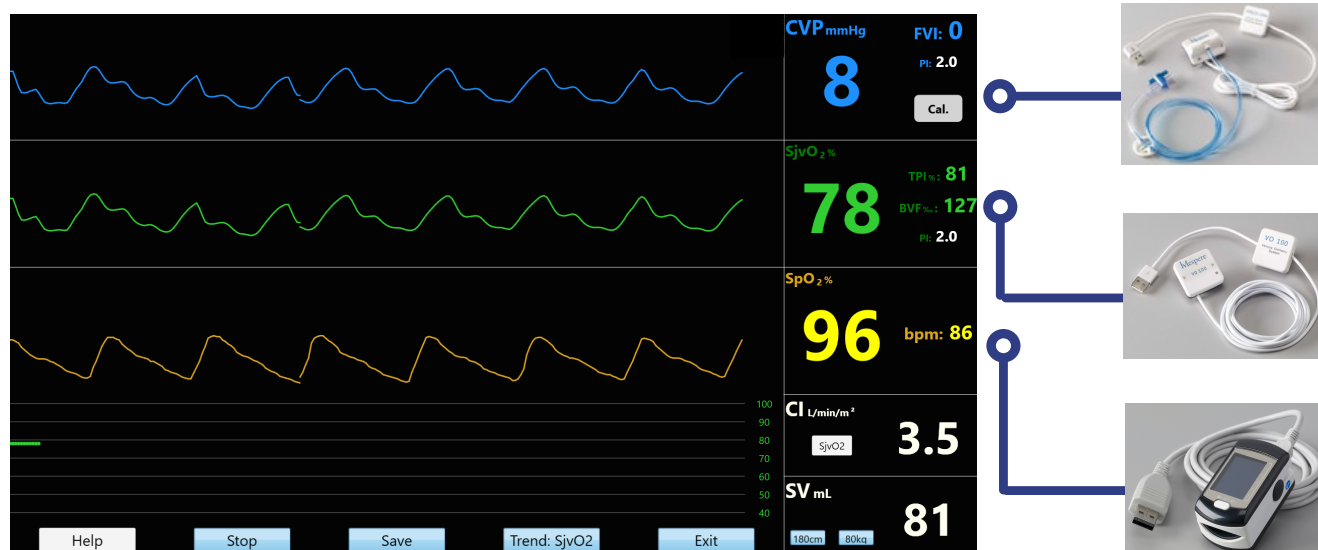
If too much fluid is administered, then fluid overload can occur and cause further complications. Clinical studies have shown that fluid overload can lead to hypertension, peripheral edema, pulmonary edema, respiratory failure, and increased cardiac demand.

Mespere LifeSciences Solution

Mespere LifeSciences introduces the first-ever monitoring systems that use near infrared spectroscopy to accurately measure venous hemodynamics without the need for invasive catheterization. Our innovative and cost-effective solutions can be used to ensure that patients are receiving the appropriate fluids in a timely manner.

VENUS 2000 CVP - Mespere LifeSciences VENUS 2000 CVP is a non-invasive and continuous central venous pressure (CVP) monitoring system. With the use of our product, healthcare professionals can now easily and efficiently monitor fluid levels during resuscitation to avoid overload.

VO 100 Jugular Venous Oximetry - Mespere LifeSciences VO 100 Jugular Venous Oximetry is a non-invasive and continuous monitoring system for jugular venous oxygen saturation (SjvO₂). Our product allows healthcare workers to monitor the effectiveness of fluid resuscitation for tissue re-perfusion and make sure that the appropriate treatment is being provided to the patient.



- Adhikari NK, Fowler RA, Bhagwanjee S, Rubenfeld GD. Critical care and the global burden of critical illness in adults. *Lancet* 2010;376:1339-46.
- Wood KA, Angus DC. Pharmacoeconomic implications of new therapies in sepsis. *Pharmacoeconomics*. 2004;22(14):895-906.
- Torio CM, Andrews RM. National Inpatient Hospital Costs: The Most Expensive Conditions by Payer, 2011: Statistical Brief #160. In: *Healthcare Cost and Utilization Project (HCUP) Statistical Briefs* [Internet]. Rockville (MD): Agency for Health Care Policy and Research (US) 2006-2013
- Kumar A, Roberts D, Wood KE, Light B, Parrillo JE, Sharma S, Suppes R, Feinstein D, Zanotti S, Taiberg L, Gurka D, Kumar A, Cheang M.: Duration of hypotension before initiation of effective antimicrobial therapy is the critical determinant of survival in human septic shock. *Crit Care Med*. 2006 Jun;34(6):1589-96.
- Making Health Care Safer. *CDC Vital Signs*. Aug 2016
- Fitch, S.J., & Gossage, J.R.: Optimal Management of Septic Shock. *PostGraduate Medicine* 2002;111(3). Retrieved June 29, 2016, from <http://healthline.com/health/septic-shock#Overview1>
- Alsous F, Khamiees M, DeGirolamo A, Amoateng-Adjepong Y, Manthous C. *Chest*. (2000) Negative fluid balance predicts survival in patients with septic shock: a retrospective pilot study. *Jun*; 117(6):1749-54.
- Marik, P.E., Linde-Zwirble, W.T., Bittner, E.A. et al. *Intensive Care Med* (2017). doi:10.1007/s00134-016-4675-y

Mespere LifeSciences

Non-Invasive Hemodynamic Monitoring Infection Rate Analysis

SCENARIO 1

Number of Cases Per Year: 500

Cost of ICU Stay Per Day: \$3,592

SAVINGS

TOTAL

Number of Cases per year:	500
Number of Cases at risk of infection (5%):	25

Decrease in ICU days using Mespere system per patient:	-
Total Decrease in ICU days using Mespere System per year:	-
Cost of ICU stay per day:	\$3,592
Total Savings - ICU Stay:	\$89,800

Cost of Mespere sensors per patient:	\$50
Cost per year	\$25,000

Net Savings to hospital \$64,800

SCENARIO 2

Number of Cases Per Year: 1,000

Cost of ICU Stay Per Day: \$3,592

SAVINGS

TOTAL

Number of Cases per year:	1,000
Number of Cases at risk of infection (5%):	50

Decrease in ICU days using Mespere system per patient:	-
Total Decrease in ICU days using Mespere System per year:	-
Cost of ICU stay per day:	\$3,592
Total Savings - ICU Stay:	\$179,600

Cost of Mespere sensors per patient:	\$50
Cost per year	\$50,000

Net Savings to hospital \$129,600

Note: Assuming that saving one day in the ICU however, publications show that infection can lead to longer hospital stays (1-3weeks)