



**ADVANCES IN CARDIAC
ARRHYTHMIAS**
and
**GREAT INNOVATIONS
IN CARDIOLOGY**
XXIX GIORNATE CARDIOLOGICHE TORINESI

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TURIN
OCTOBER
27-28,
2017
Centro Congressi
Unione Industriale
di Torino

Advanced Heart Failure and VAD

Prof Mauro Rinaldi

PROFILE-LEVEL	Official Shorthand	General time frame for support	Treatment
INTERMACS LEVEL 1	“Crash and burn”	Hours	•Short-term VAD
INTERMACS LEVEL 2	“Sliding fast”	Days to week	•Long-term LVAD
INTERMACS LEVEL 3	Stable but Dependent	Weeks	
INTERMACS LEVEL 4	“Frequent flyer”	Weeks to few months, if baseline restored	•Medical therapy •Conventional surgery •HTx waiting list • <i>Mitraclip??</i> • <i>Cardioband??</i>
INTERMACS LEVEL 5	“Housebound”	Weeks to months	
INTERMACS LEVEL 6	“Walking wounded”	Months, if nutrition and activity maintained	
INTERMACS LEVEL 7	Advanced Class III		

FOCUS on INTERMACS 1



The Journal of
Heart and Lung
Transplantation
<http://www.jhltonline.org>

The 2013 International Society for Heart and Lung
Transplantation Guidelines for Mechanical Circulatory
Support: Executive Summary

INTERMACS profile	Description	Time frame for intervention
Profile 1 Critical cardiogenic shock	Patients with life-threatening hypotension despite rapidly escalating inotropic support, critical organ hypoperfusion, often confirmed by worsening acidosis and/or lactate levels.	Definitive intervention needed within hours.

Recommendations for management of patients with decompensated heart failure:^{1,118-120}

Class I:

1. Short-term mechanical support, including extracorporeal membrane oxygenation, should be used in acutely decompensated patients who are failing maximal medical therapy.

Level of evidence: C.

Primary VAD screening

Pre-cardiotomy

Cardiogenic Shock

Post-cardiotomy

Inotrope + IABP

Secondary VAD screening

Short-term VAD

BRIDGE to BRIDGE

Recovery

Long-term VAD

**Emergency
Transplant**

Bridge To Transplant

Destination Therapy

Elective Transplant



“Hub and Spoke” model





Università degli Studi di Torino

DIVISIONE DI CARDIOCHIRURGIA

Direttore Prof. M. Rinaldi

28 MARZO 2008
Ore 9 -17

**L'ASSISTENZA
VENTRICOLARE
MECCANICA NELL'AREA
PIEMONTESE:
PROPOSTA DI CREAZIONE
DI UNA RETE
TERAPEUTICA**



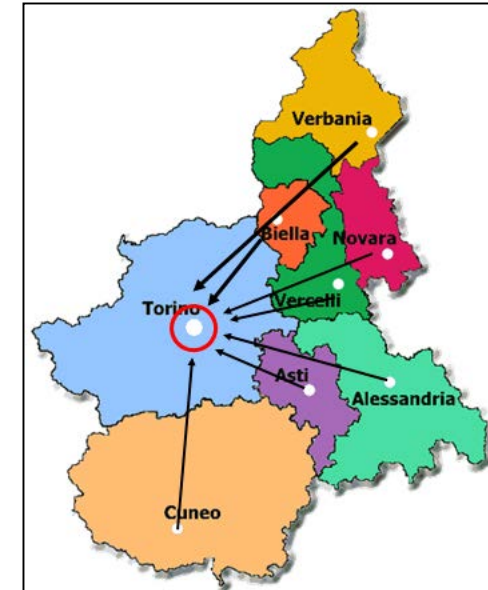


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M. Rinaldi

Pollenzo, 28 Marzo 2008

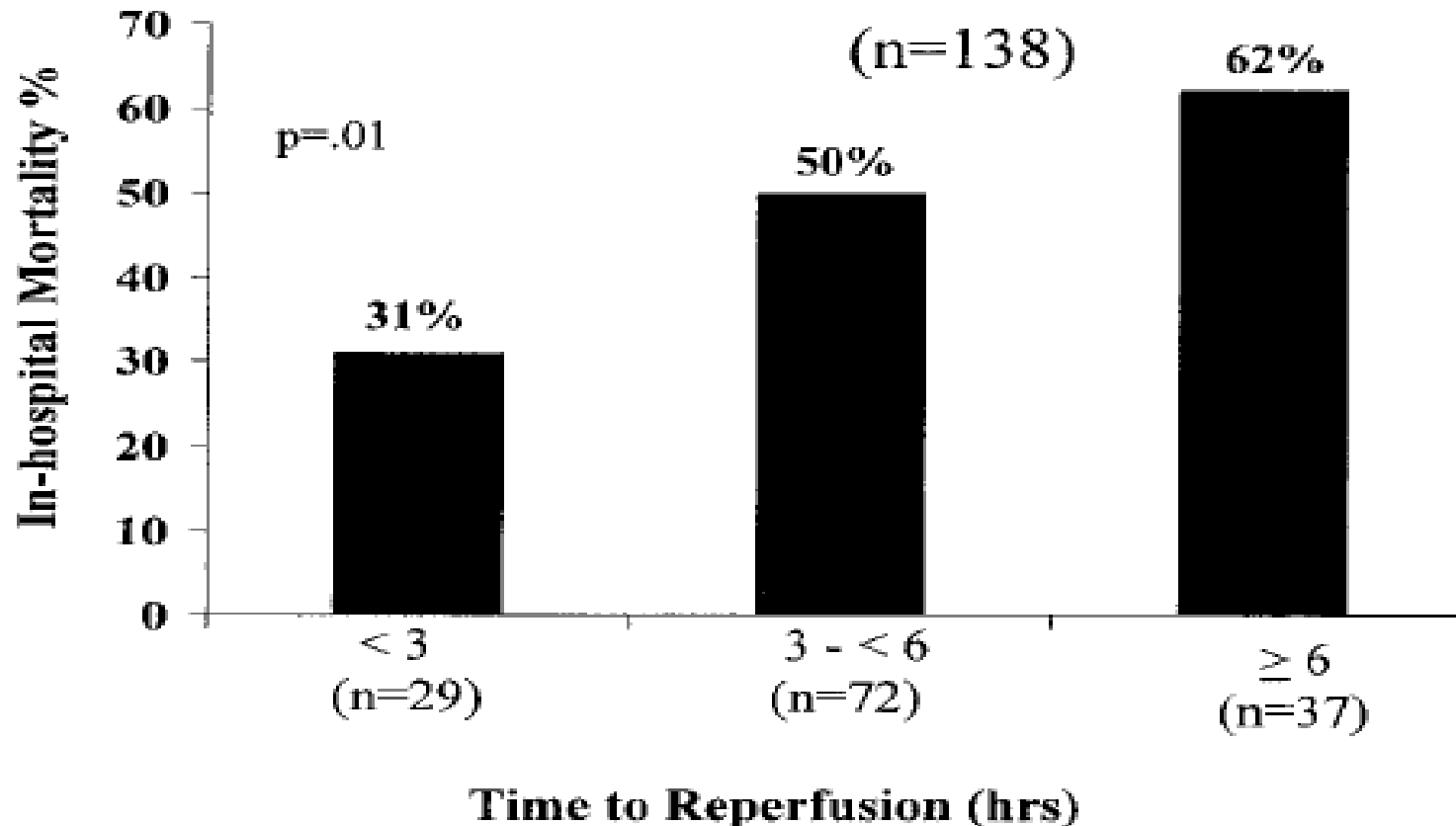


MCS Regional Network

Step 1: Cardiology – Cardiac Surgery (Spoke)

Acute Cardiogenic Shock

In-hospital mortality 30-60%



Inhospital mortality rate by time-to-reperfusion in patients with shock. The inhospital mortality rate increases progressively with increasing time-to-reperfusion.

Brodie Am Heart J 2003

Cardiogenic Shock: clinical definition

- **Unresponsive Hypotension**

- Prolonged MAP < 60 mmhg for > 30 min (or decrease in SBP more than 40 mmhg)
- CI < 1,8 l/min/m² or < 2,2 l/min/m² with **inotropic support**

- **High filling pressures**

- CVP > 14 mmhg
- Wedge pressure > 16 mmhg

- **Inadequate tissue perfusion**

- SVO₂ < 55; Lactate continuously increase (or > 3)
- Alteration in consciousness
- Urine output < 30 cc/h

MCS Regional Network

Step 1: Cardiology – Cardiac Surgery (Spoke)

Acute Cardiogenic Shock

Inhospital mortality 40-60%



Early revascularization

Inotropic drugs



IABP

LOS despite 2 high dose
inotropic drugs and
IABP

Refractory Cardiogenic Shock

In hospital mortality > 90%



Short-term VAD

As soon as possible
(<12 hours)

Get in touch with the hub centre activating
the Regional Network



Currently available percutaneous MCS



	iVAC 2L [®]	TandemHeart [™]	Impella [®] 5.0	Impella [®] 2.5	Impella [®] CP	ECLS (multiple systems)
Catheter size (F)	11 (expandable)	–	9	9	9	
Cannula size (F)	17	21 venous 12–19 arterial	21	12		17–21 venous 16–19 arterial
Flow (L/min)	Max 2.8	Max. 4.0	Max. 5.0	Max. 2.5	3.7–4.0	Max. 7.0
Pump speed (rpm)	Pulsatile, 40 mL/beat	Max. 7500	Max. 33 000	Max. 51 000	Max. 51 000	Max. 5000
Insertion/placement	Percutaneous (femoral artery)	Percutaneous (femoral artery + vein for left atrium)	Peripheral surgical (femoral artery)	Percutaneous (femoral artery)	Percutaneous (femoral artery)	Percutaneous (femoral artery + vein)
LV unloading	+	++	++	+	+	–
Anticoagulation	+	+	+	+	+	+
Recommended duration of use	–21 days	–14 days	10 days	10 days	10 days	–7 days
CE-certification	+	+	+	+	+	+
FDA	–	+	+	+	+	+
Relative costs	++	+++++	+++++	+++	+++++	+(+)

Reproduced from Ref. [57] with permission

Peripheral precutaneous ECMO

Distal perfusion

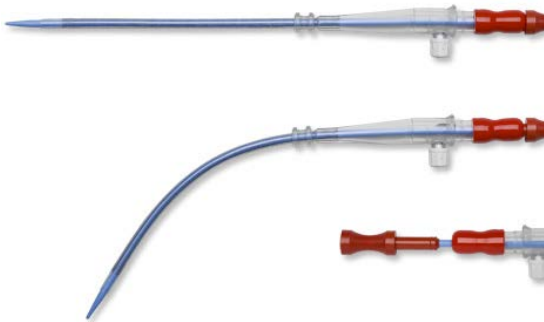
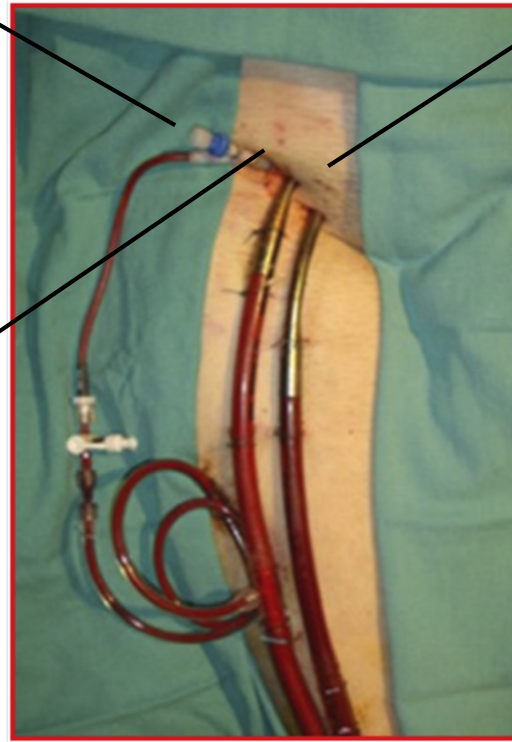
8- 10 fr
200 cc/min
Femoral artery

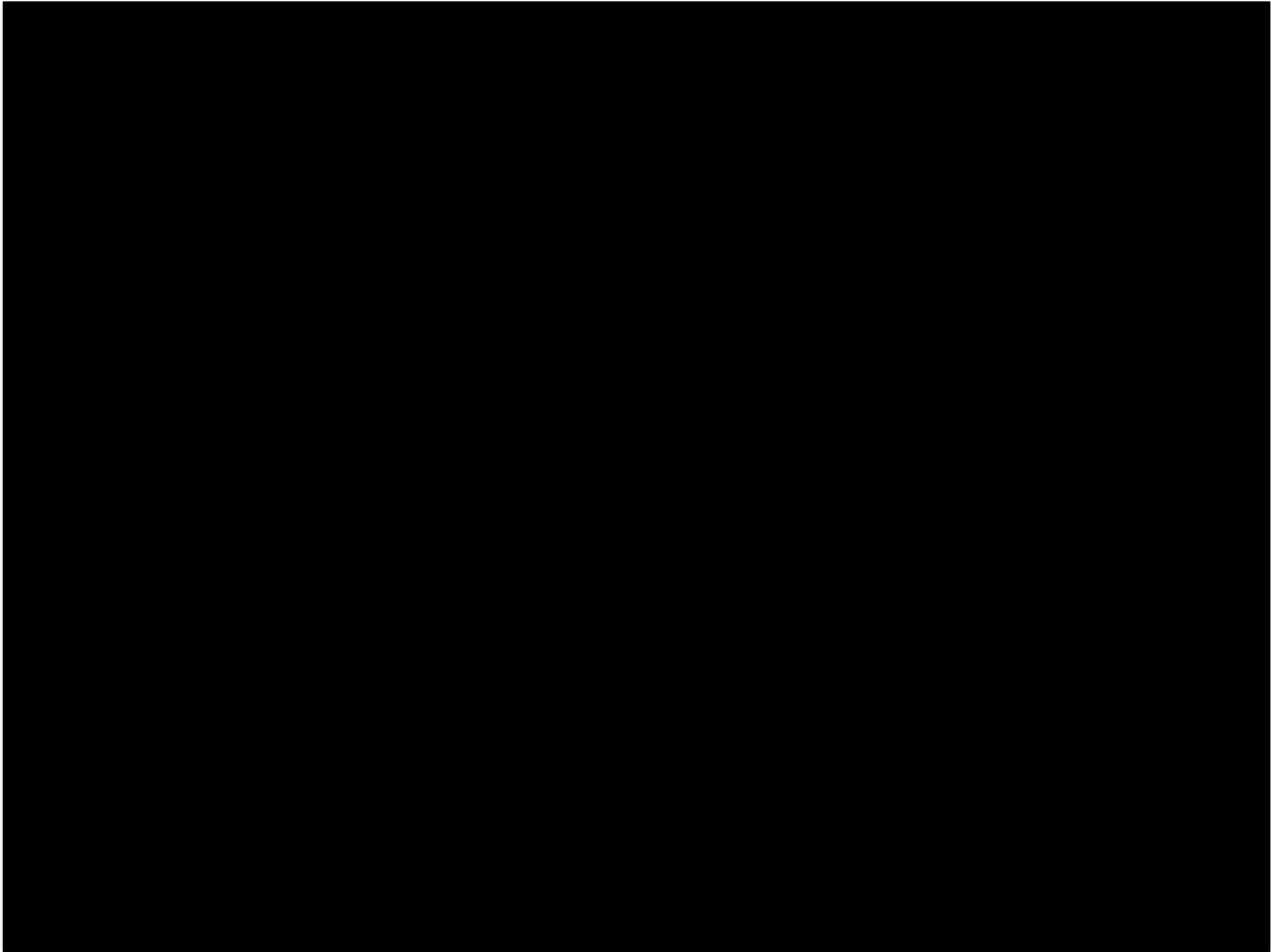
Arterial cannula

18-22 fr Edwards
High flow, multiperforated
flexible

Venous cannula

22- 24 fr Edwards
multiperforated

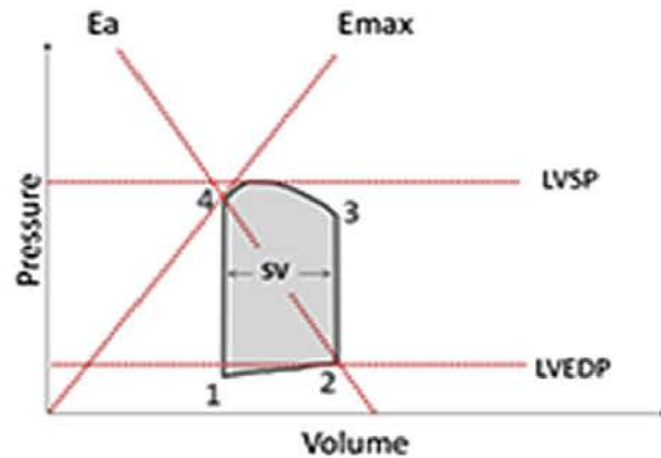




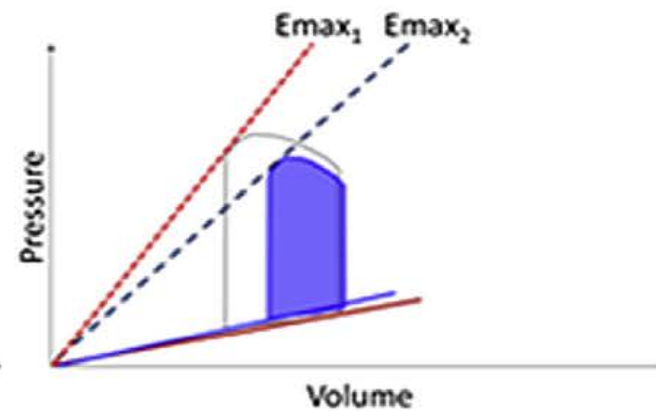
**2015 SCAI/ACC/HFSA/STS Clinical Expert Consensus
Statement on the Use of Percutaneous Mechanical Circulatory
Support Devices in Cardiovascular Care (Endorsed by the
American Heart Association, the Cardiological Society of India,
and Sociedad Latino Americana de Cardiologia Intervencion;
Affirmation of Value by the Canadian Association of
Interventional Cardiology—Association Canadienne de
Cardiologie d'intervention)***

Journal of Cardiac Failure Vol. 21 No. 6 2015

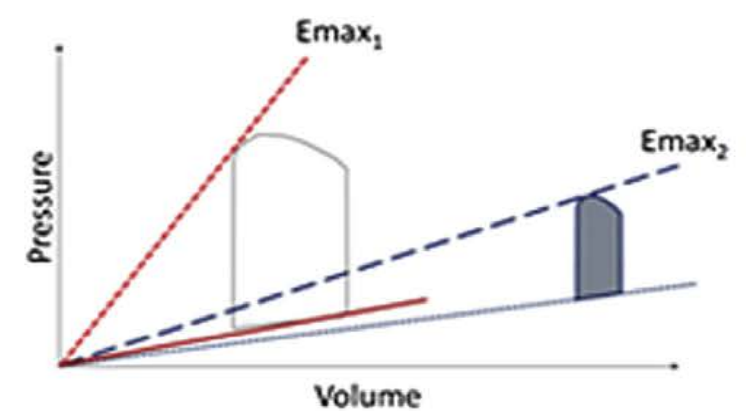
A Steady State



B Acute Myocardial Infarction



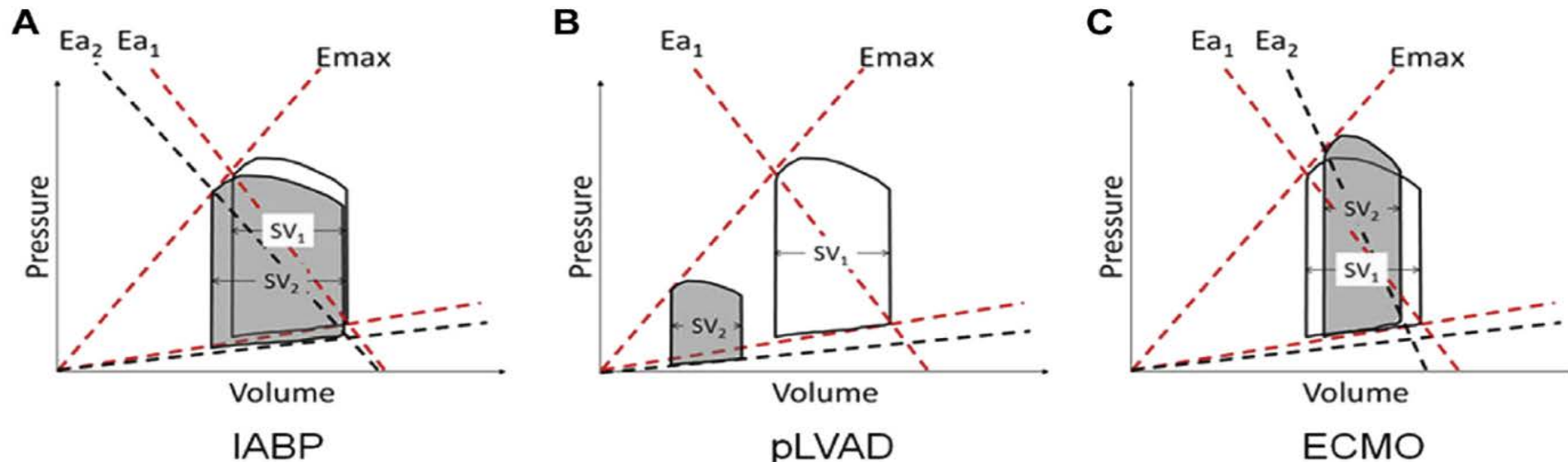
C Cardiogenic Shock



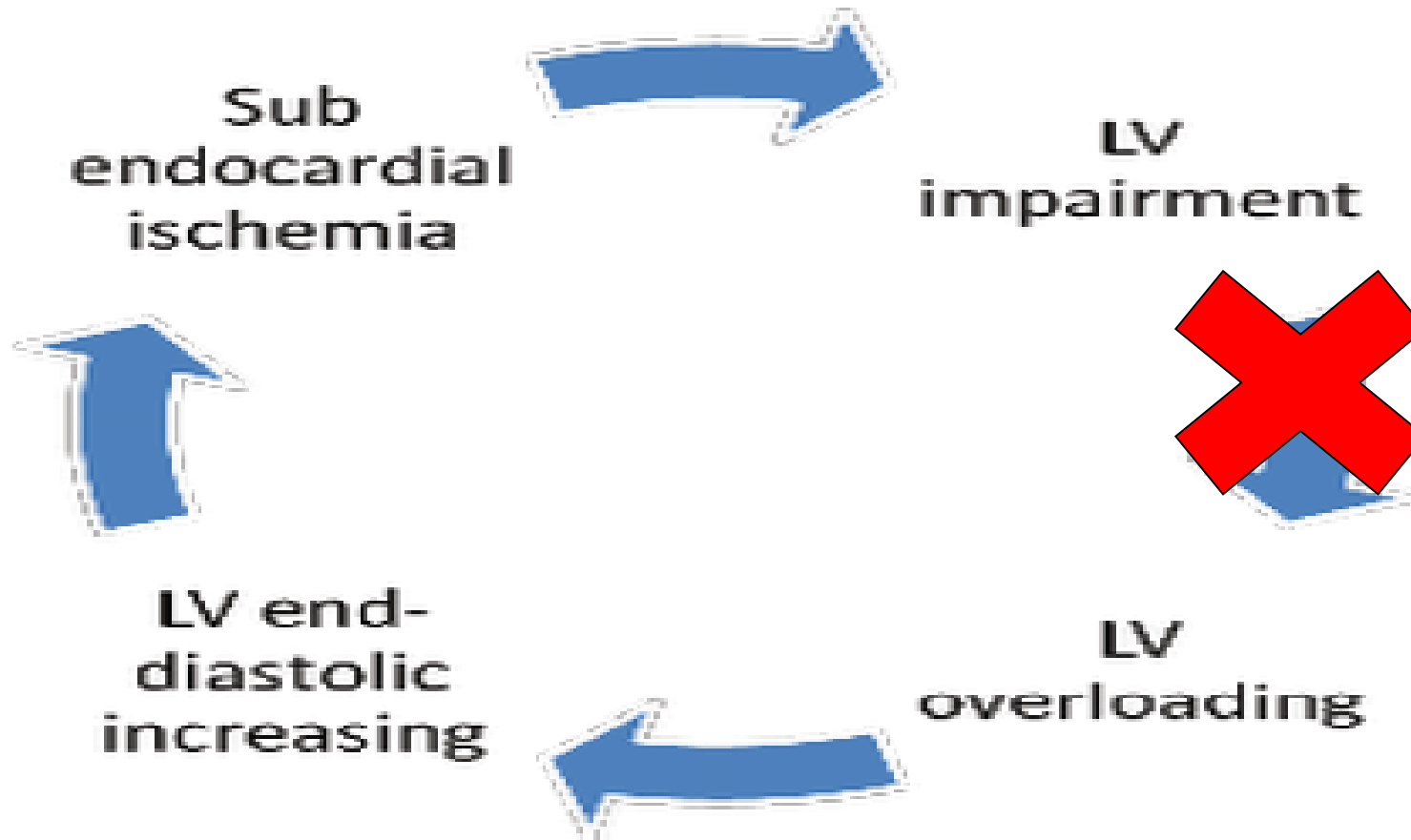
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Left ventricular overload on ECMO



Left ventricular unloading





THE INTERNATIONAL SOCIETY FOR HEART & LUNG TRANSPLANTATION

A Society That Includes Basic Science, the Failing Heart, and Advanced Lung Disease.

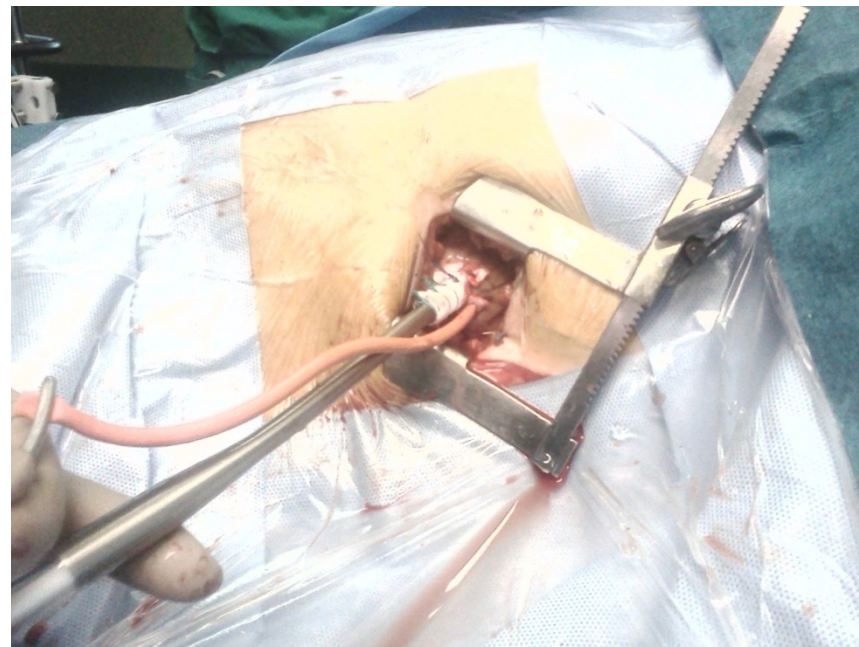


TRANSAPICAL LEFT VENTRICULAR INFLOW CANNULA (TLVIC) DURING VENO-ARTERIAL ECMO SUPPORT: A BRIDGE TO SOLUTION IN ACUTE CARDIOGENIC SHOCK



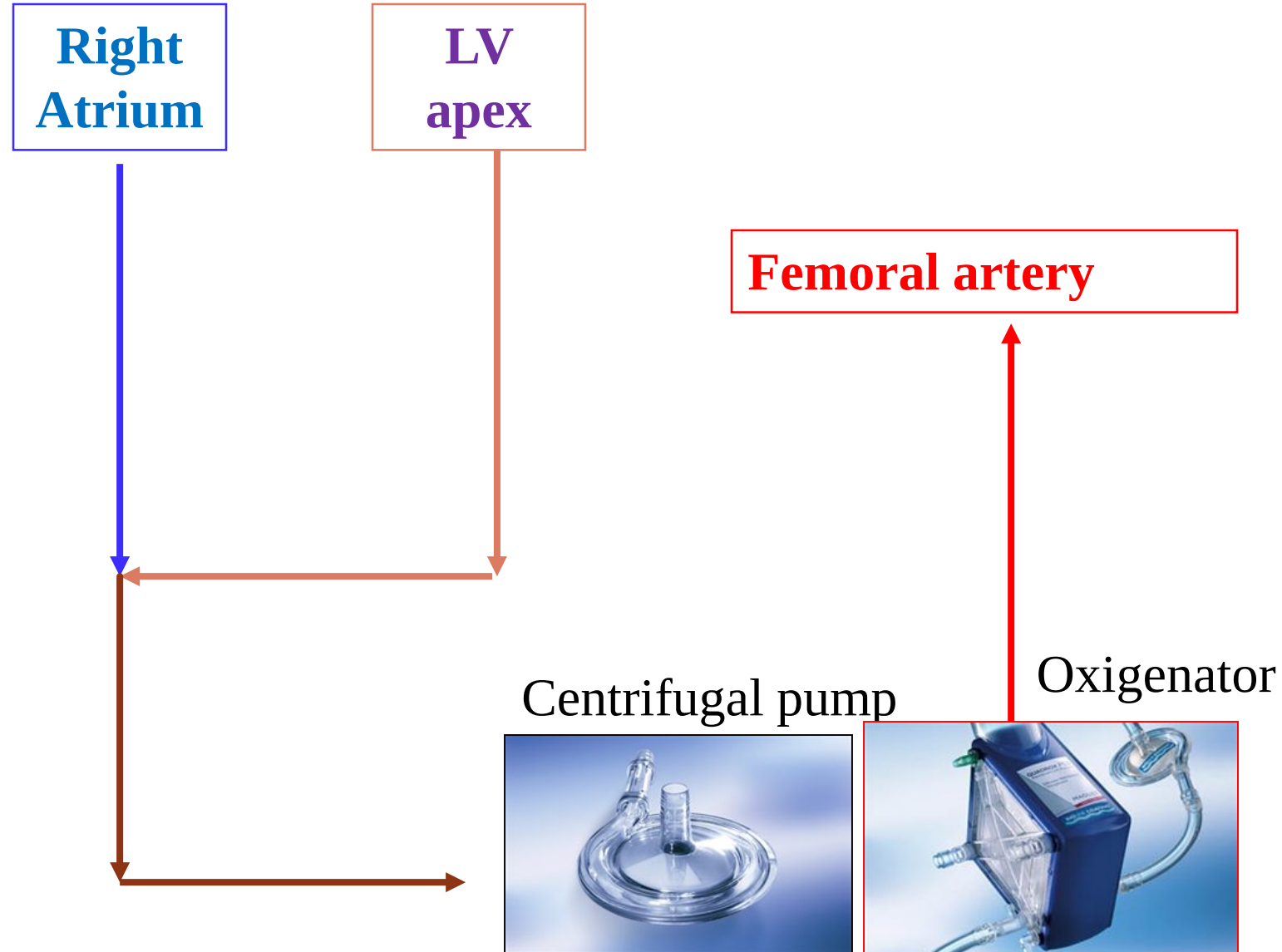
Centofanti P., Attisani M., La Torre M., Boffini M., Ricci D., Ribezzo M., Simonato E., Baronetto A., Rinaldi M.
Division of Cardiac Surgery, San Giovanni Battista Hospital 'Molinette', University of Turin, Turin, Italy

Anterolateral Mini left thoracotomy



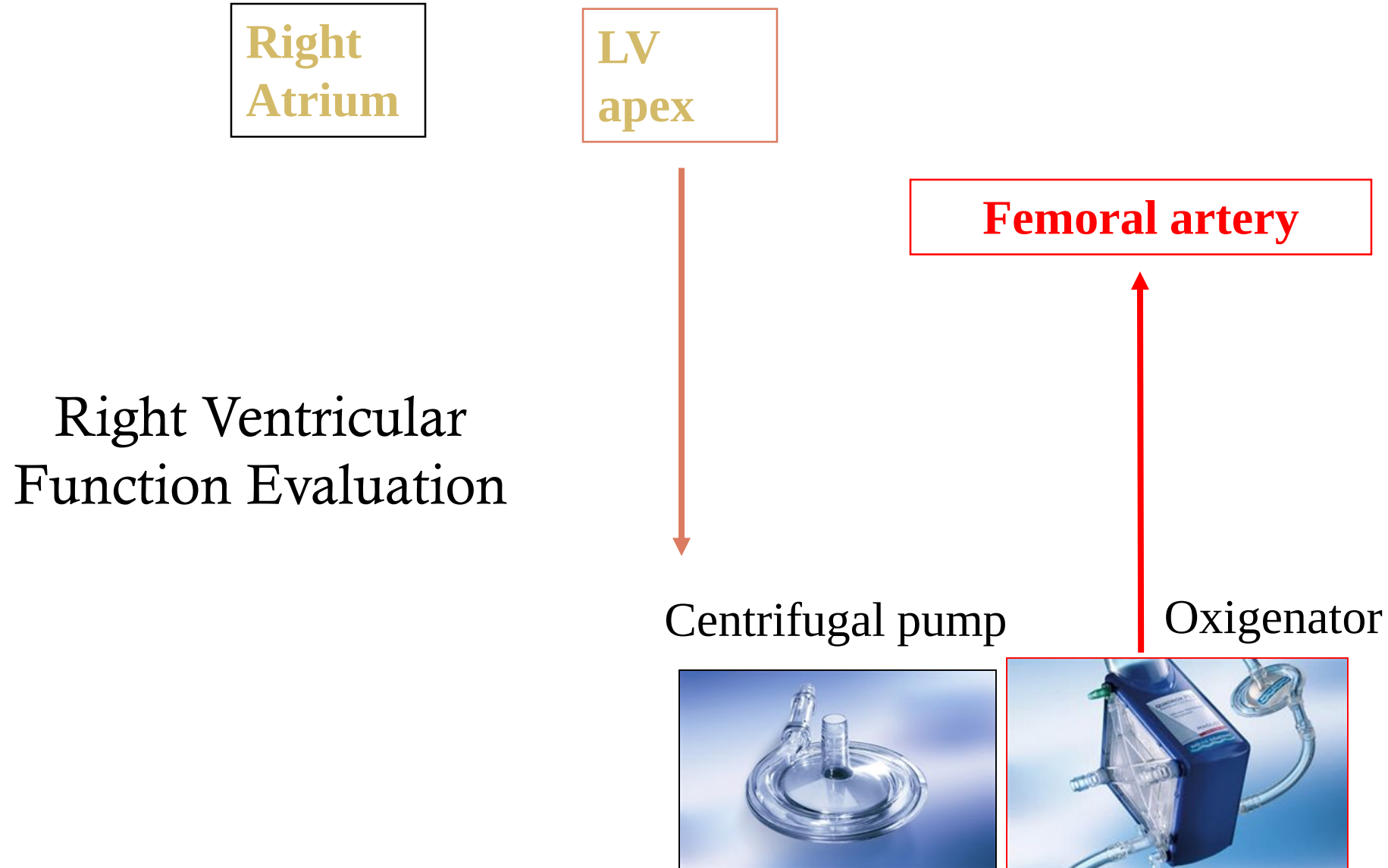
Right Ventricular and Pulmonary Function Evaluation

switch from V-A ECMO to A-A Centrifugal Pump



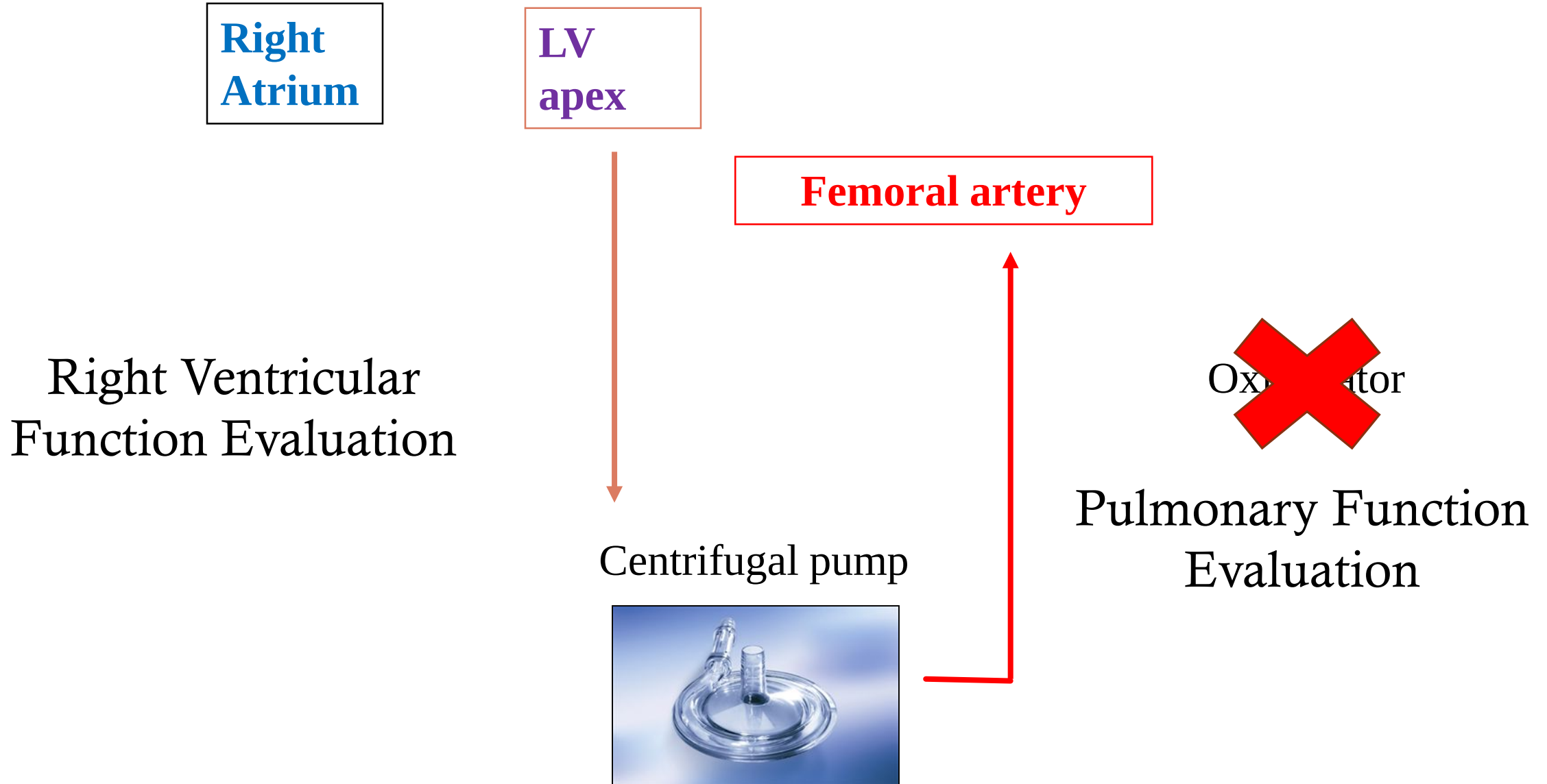
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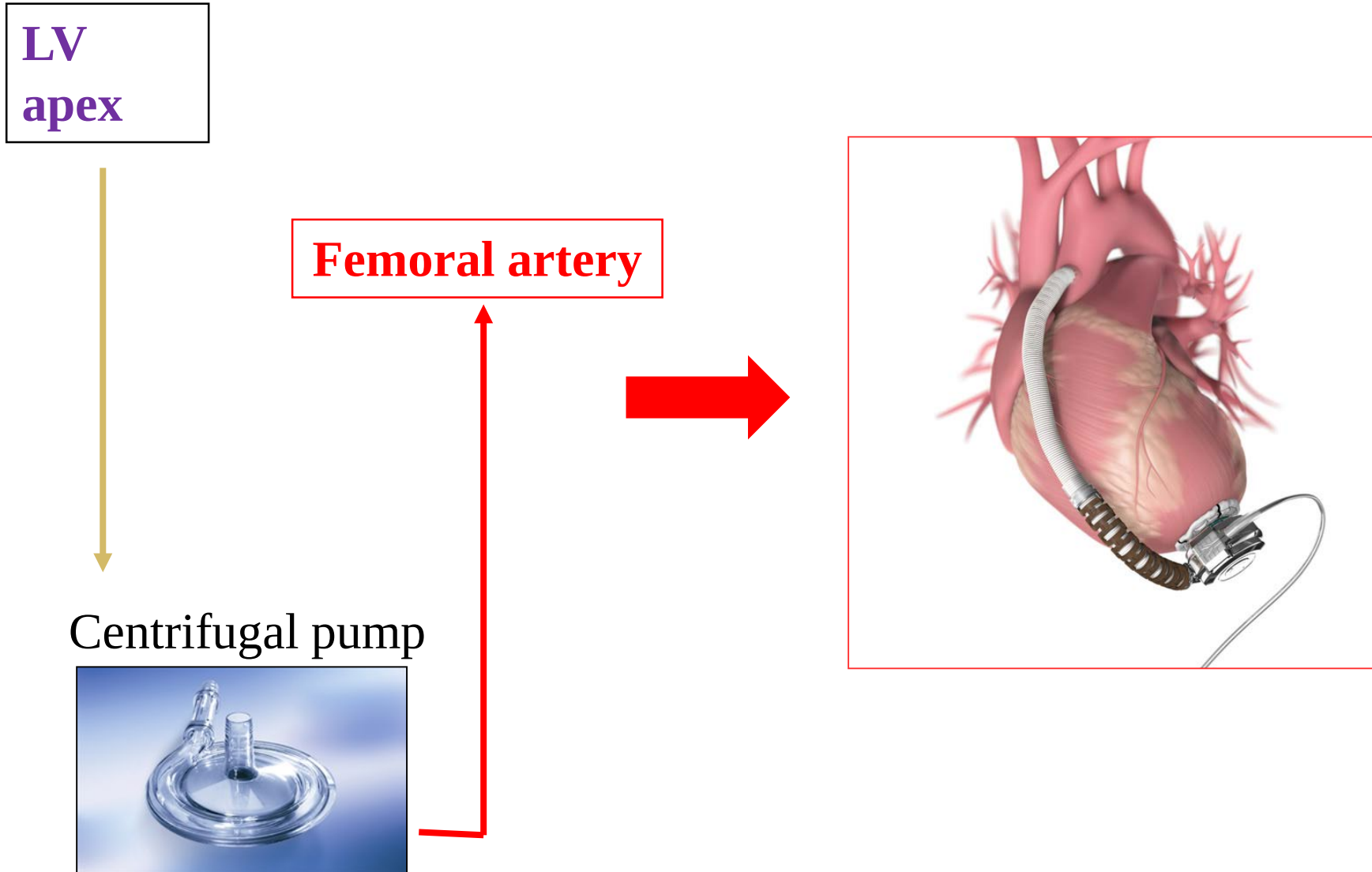
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Right Ventricular and Pulmonary Function Evaluation

switch from V-A ECMO to A-A Centrifugal Pump

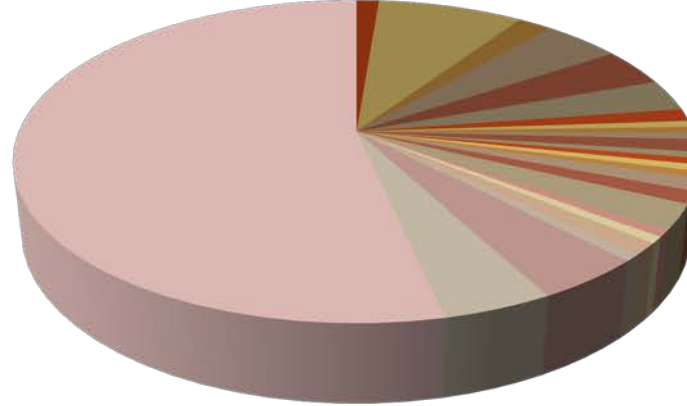


Piemonte Regional Network

2008 – 2017

192 pazienti

25 centri afferenti: 7 fuori regione



■ Ospedale di Alessandria

■ Ospedale di Novara

■ Ospedale di Cuneo

■ Ospedale di Rivoli

■ Ospedale di Moncalieri

■ Ospedale di Aosta

■ Ospedale di Perugia

■ Ospedale di Asti

■ Ospedale di Alba

■ Ospedale di Potenza

■ Ospedale di Biella

■ Ospedale San Luigi

■ Ospedale di Pinerolo

■ Ospedale di Cosenza

■ Ospedale di Ciriè

■ Ospedale di Chieri

■ Ospedale di Genova

■ Fondazione Maugeri di Veruno/Torino

■ Centro Cardiologico Monzino

■ Policlinico di Bari

■ Torino - Ospedale Maria Vittoria

■ Torino - Ospedale Sant'Anna

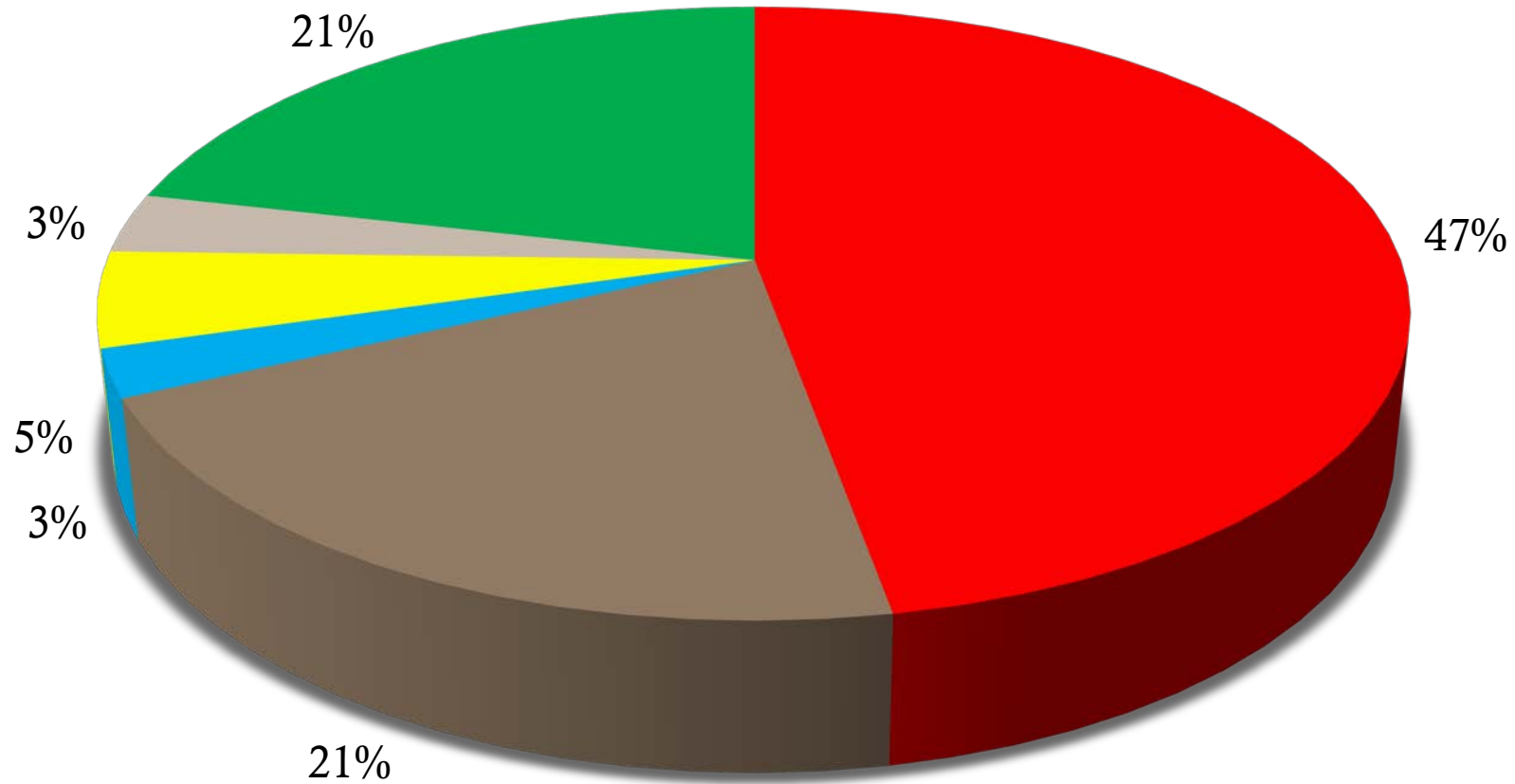
■ Torino - Ospedale San Giovanni Bosco

■ Torino - Ospedale Mauriziano

■ Torino - Molinette

Piemonte Regional Network

Etiologia



■ Post-ischemica

■ CMPD a coronarie sane

■ Valvolare

■ Post-miocardite

■ Altro

■ Postcardiotomica

VA ECMO in Cardiogenic shock

MCS Piemonte Regional Network

n= 146 patients INTERMACS level 1 2008-2017

Results

Death	52 /146	36%
Recovery	50 /146	34%
Bridge to emergency transplant	32 /146	22%
Bridge to long term LVAD	12 /146	8%

Survival to discharge

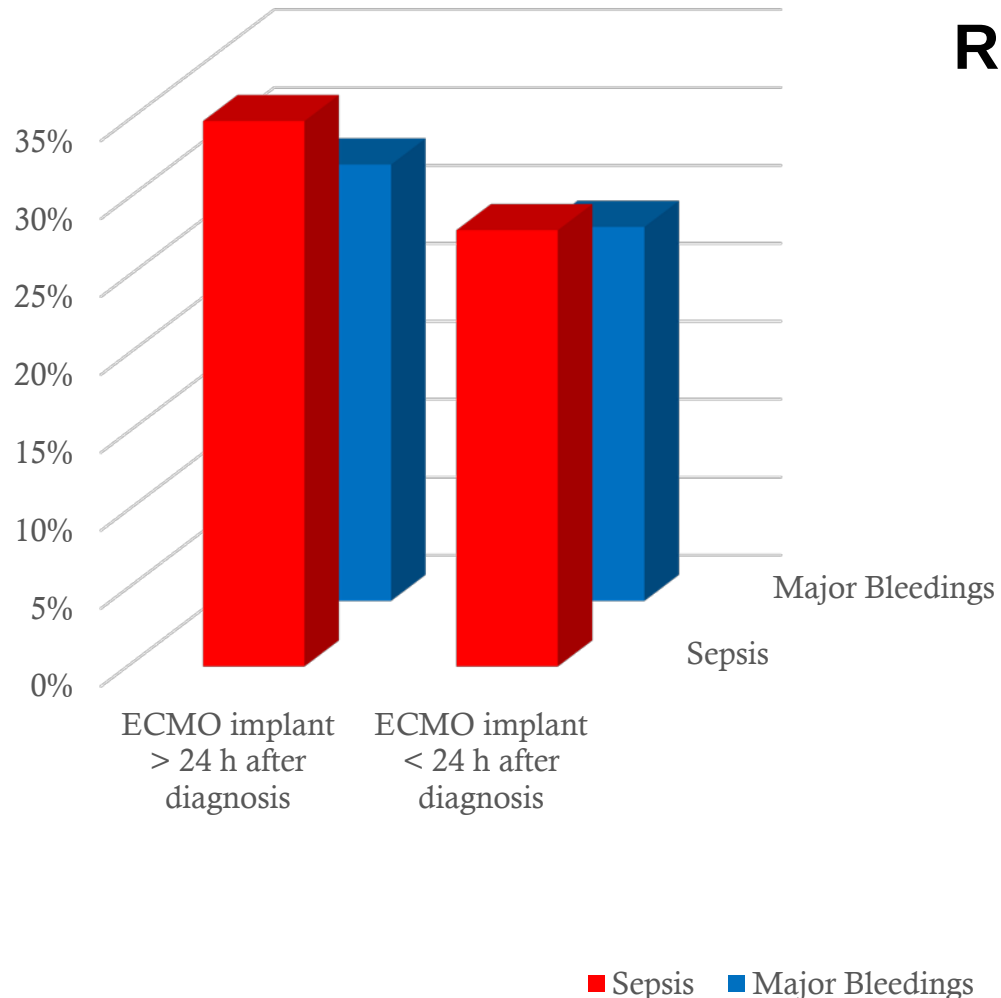
84 /146

57%

VA ECMO in Cardiogenic shock MCS Piemonte Regional Network

n= 146 patients INTERMACS level 1

Results



Sepsis

Positive blood cultures and
Clinical signs of infection

Major bleedings

Surgical revision or evidence
of
bleeding > 4 blood units
transfusion

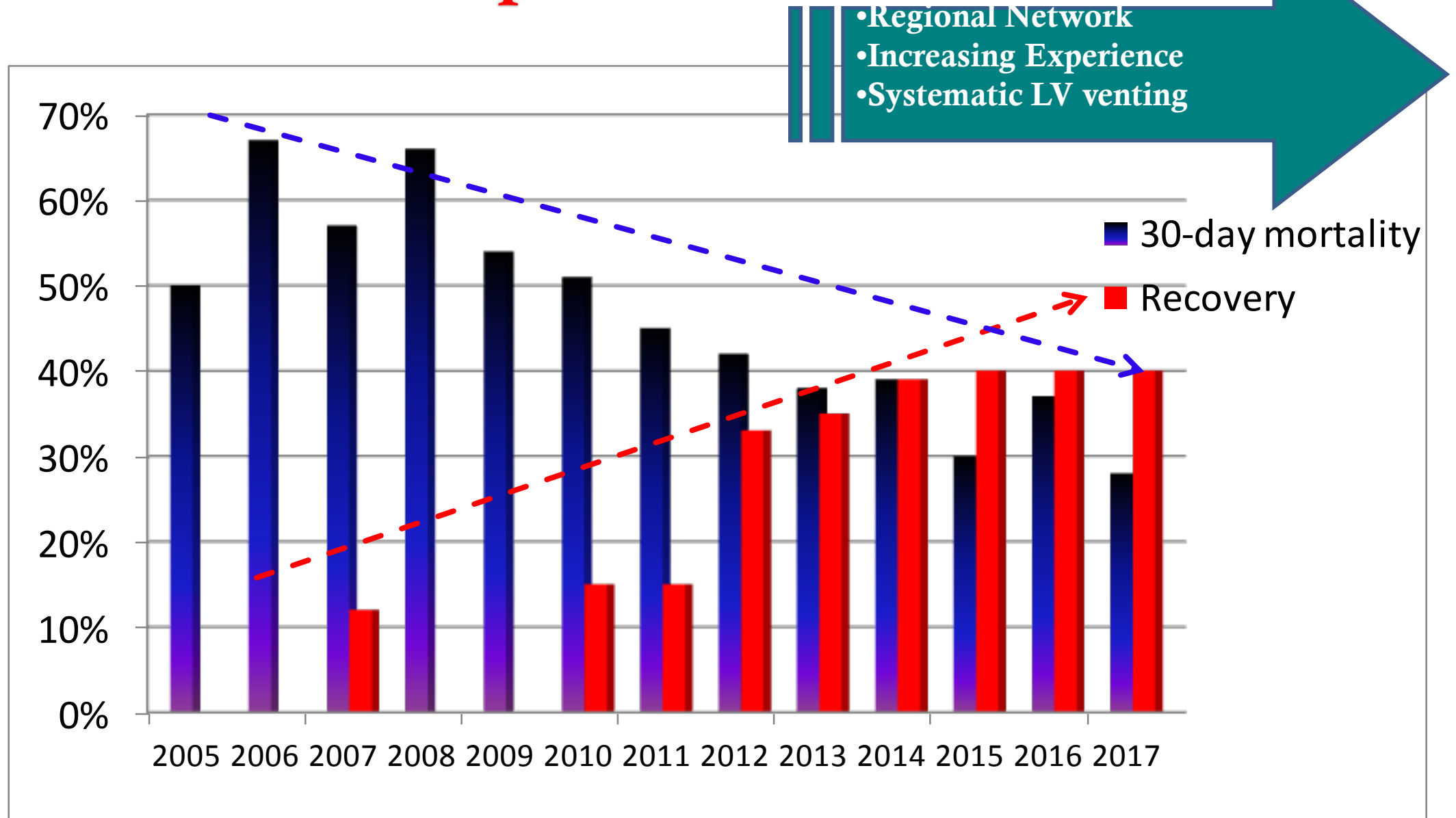
VAD/ECMO Risk factors for death

Multivariate analysis

Postcardiotomic	p 0,003
No left ventricular venting	p 0,01
Central approach	p 0,01
External ECMO	p0,22
Instable ECMO	p 0,02
Previous cardiac arrest (CPR)	p 0,15
Miocardial infarction	p 0,32
Previous MOF	p 0,04

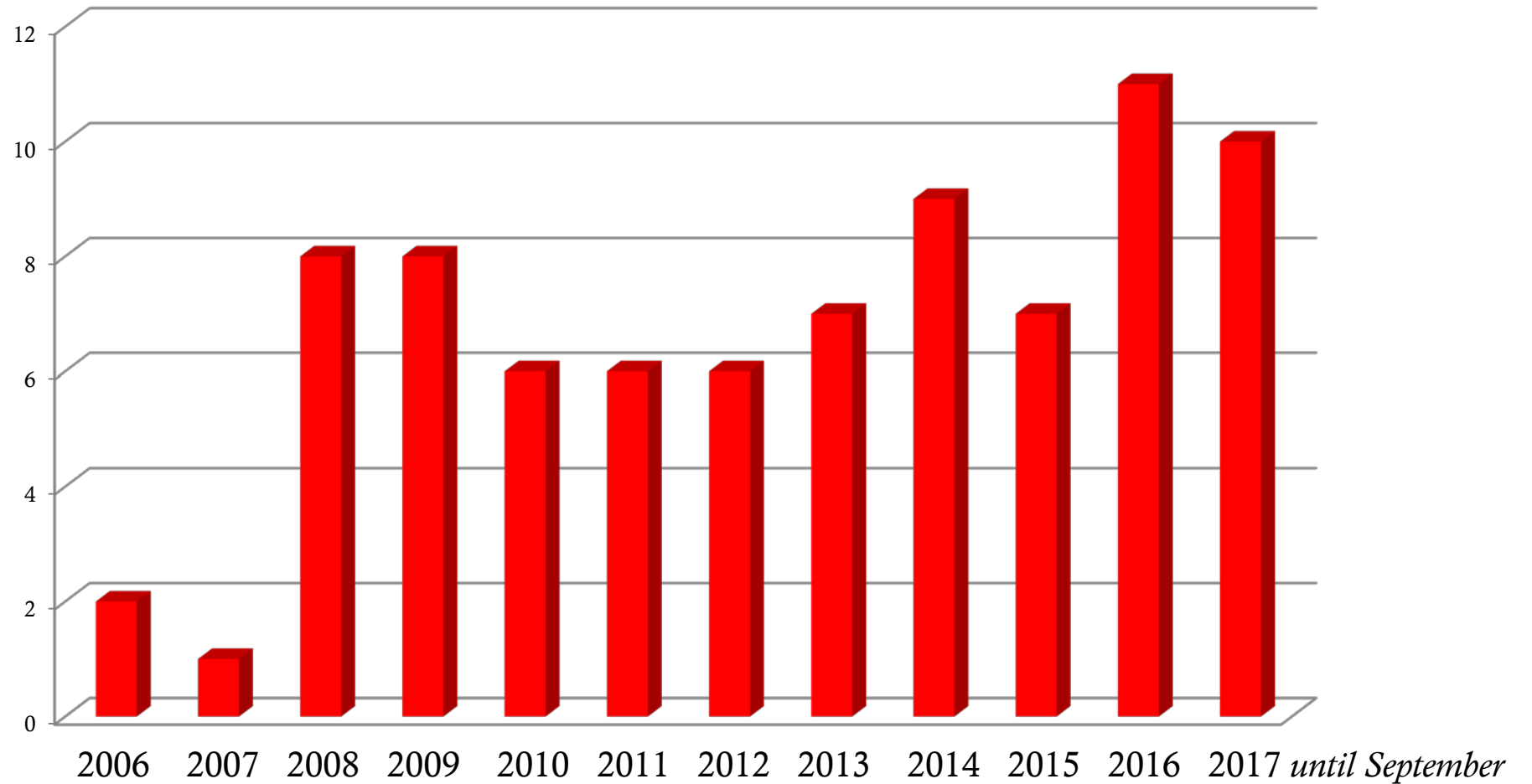
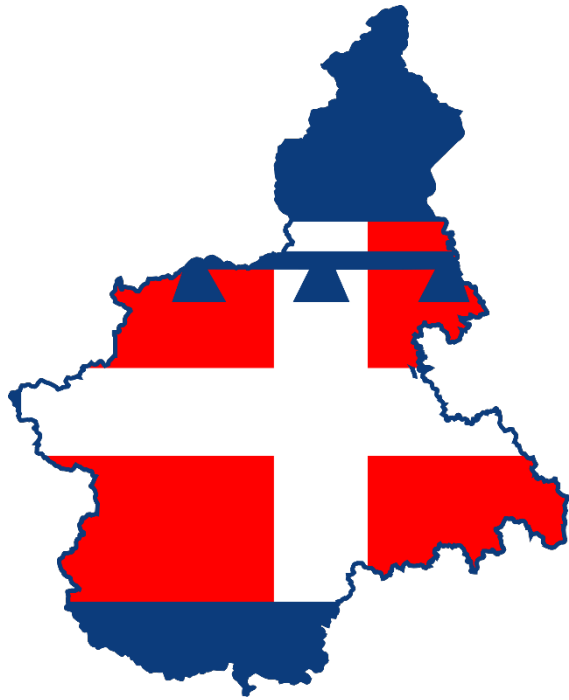
VADs/ECMO changing outcomes

Turin Experience 2005-2017



Piemonte Regional Network Experience

Durable LVAD (81 pts) - Implants per year





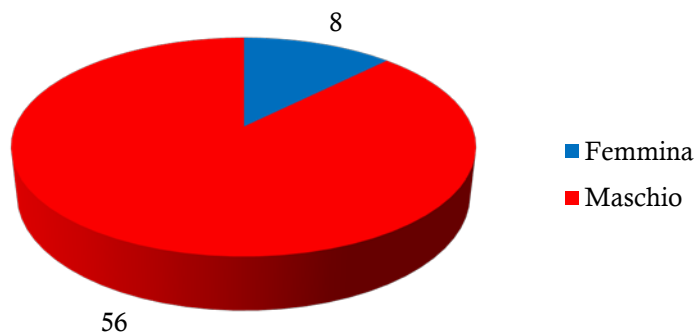




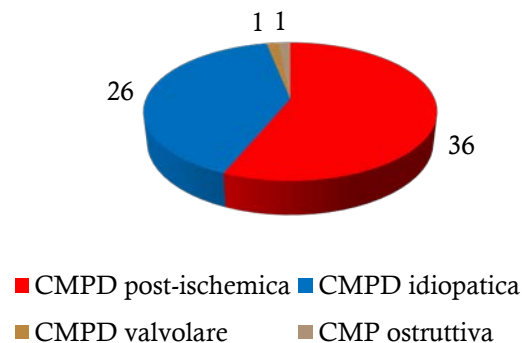
Piemonte Regional Network Experience

Long term LVAD

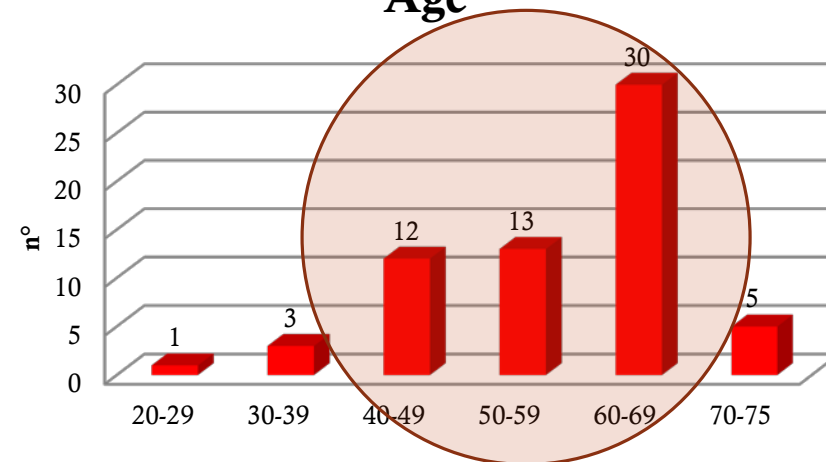
Gender



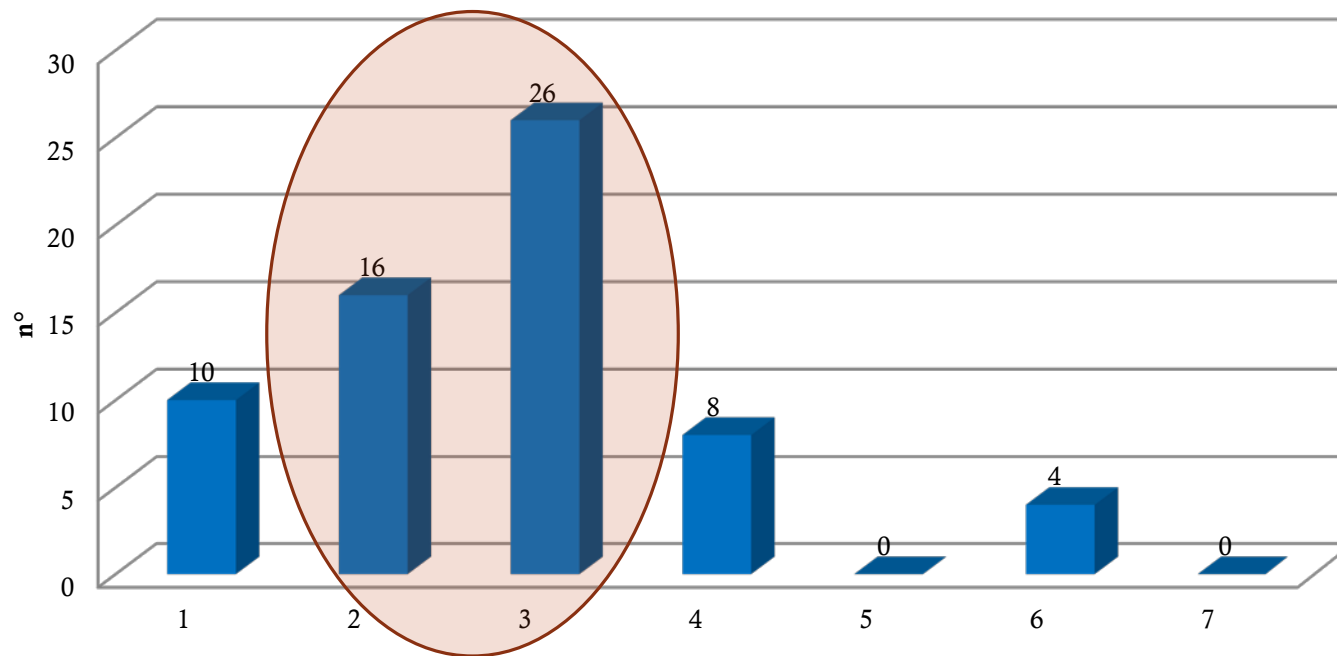
Etiology



Age

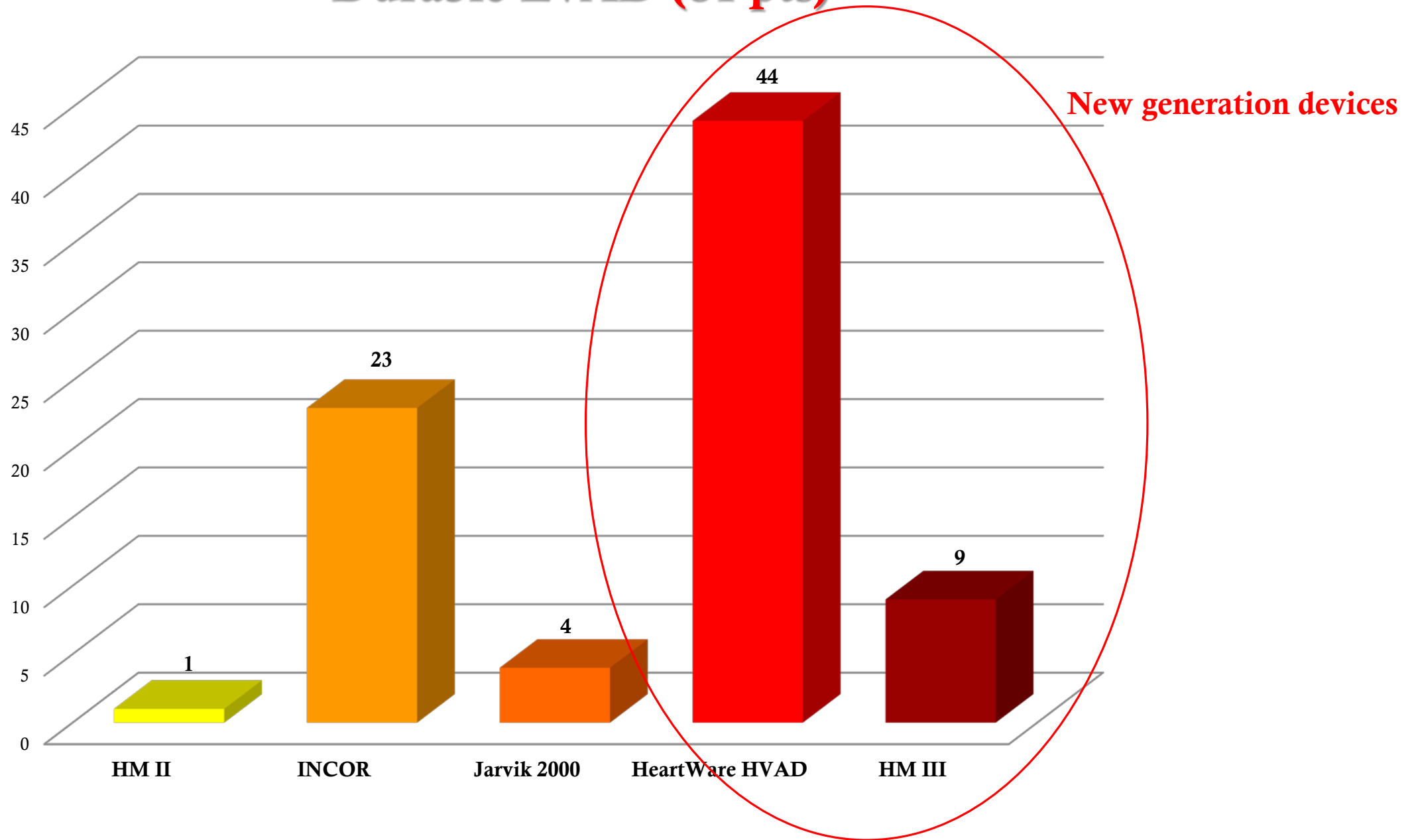


INTERMACS profile



Piemonte Regional Network Experience

Durable LVAD (81 pts)



Piemonte Regional Network Experience

Long term LVAD

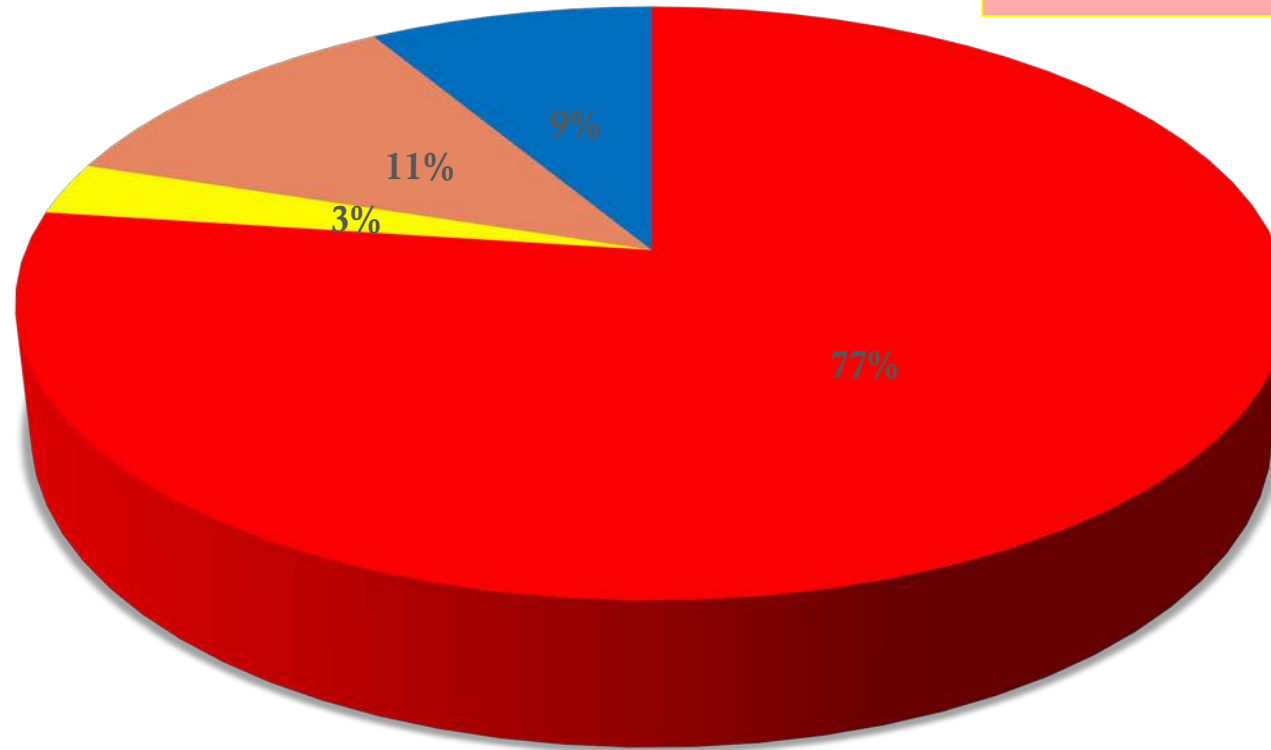
In hospital mortality		
Others LVAD	3/28	11%
HVAD + HM III	2/53	3 %
Total Mortality	5/81	6.0%

Piemonte Regional Network Experience HeartWare – HVAD and Heartmate III

Surgical approaches

53 LVAD implantations

Thoracotomy 100% redo
DoubleMini-Thorac 75% redo

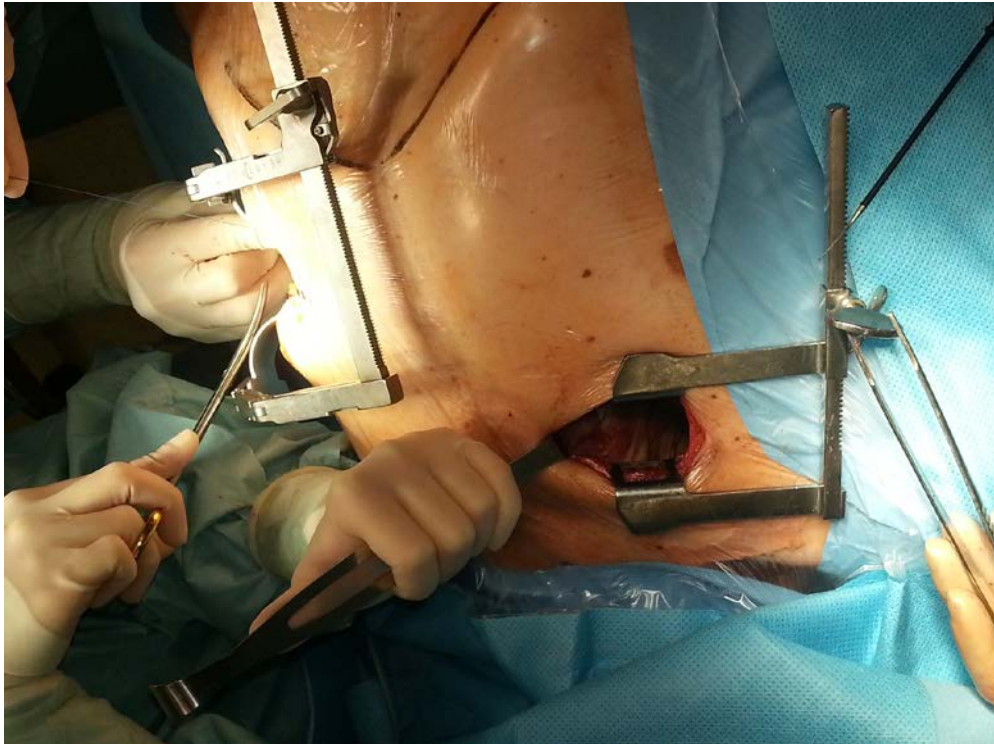


■ Sternotomy ■ Minist/MiniThorac ■ MiniThorac/MiniThorac ■ Thoracotomy

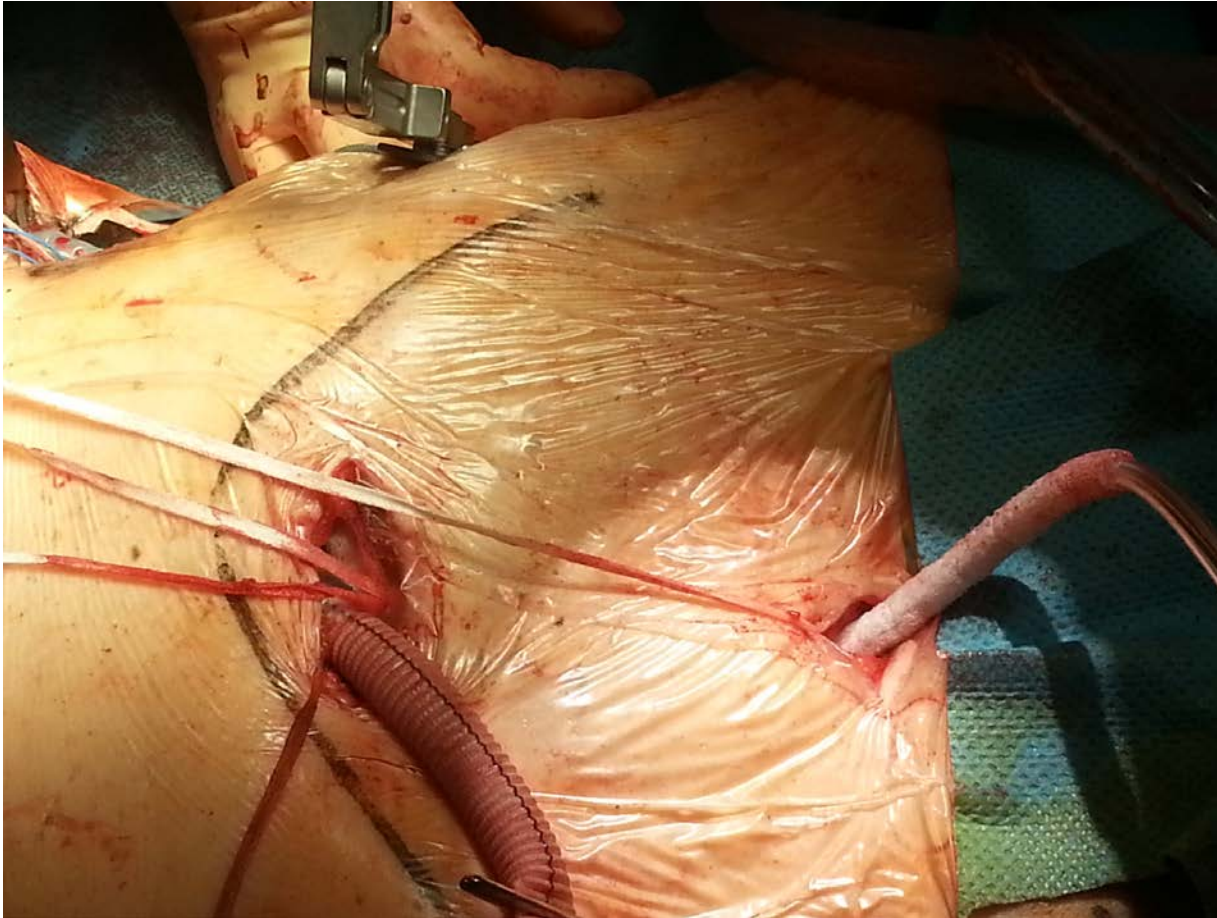
Minimally invasive LVAD implantation

Bridge to transplant
Complex redo surgery

Double minithoracotomy and subcostal approach



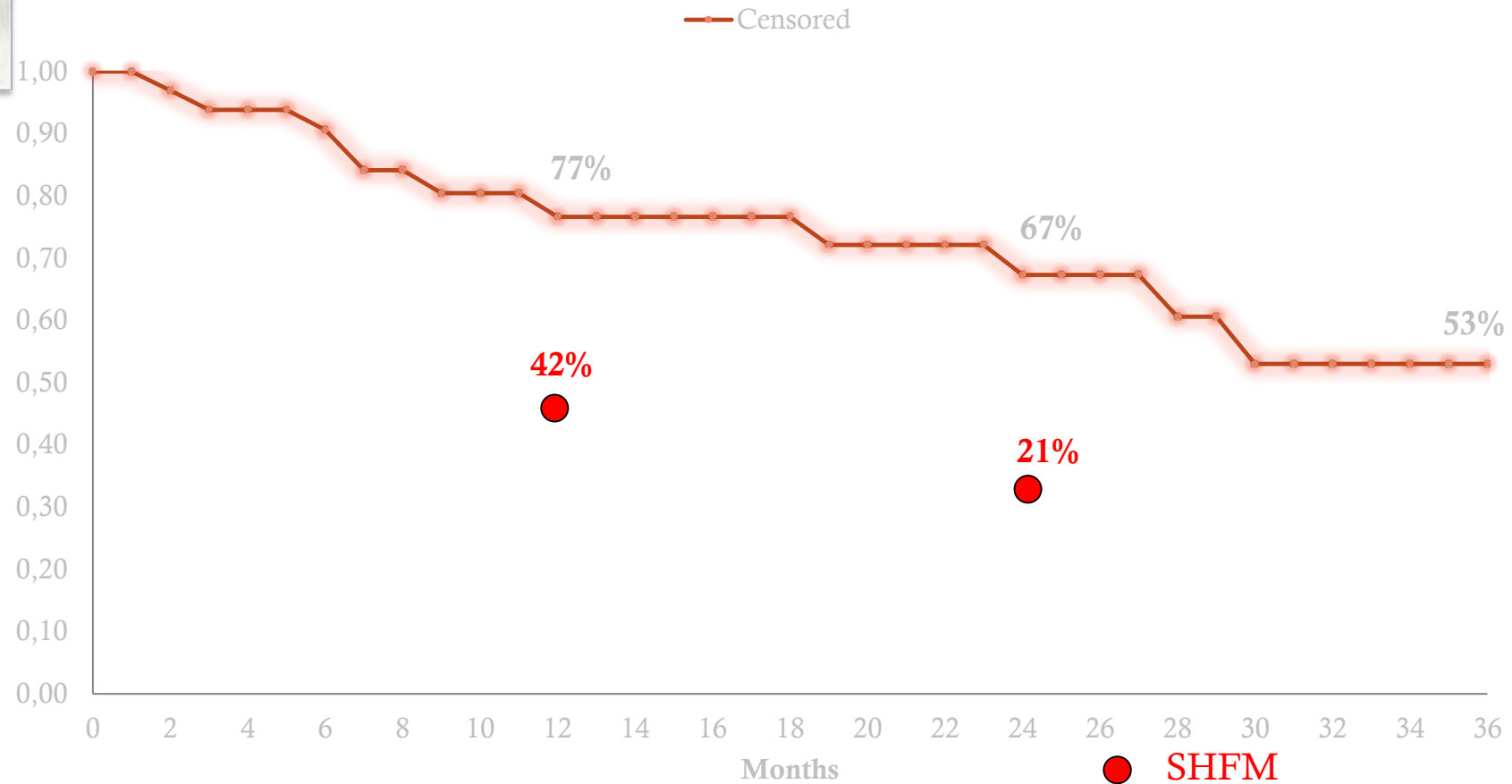
Minimally invasive LVAD implantation





Piemonte Regional Network Experience HeartWare – HVAD (44 patients)

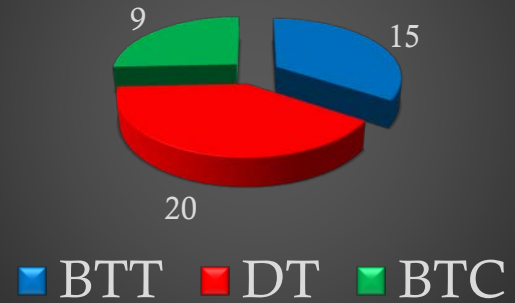
KM - HVAD Censored (HTx/Recovery)



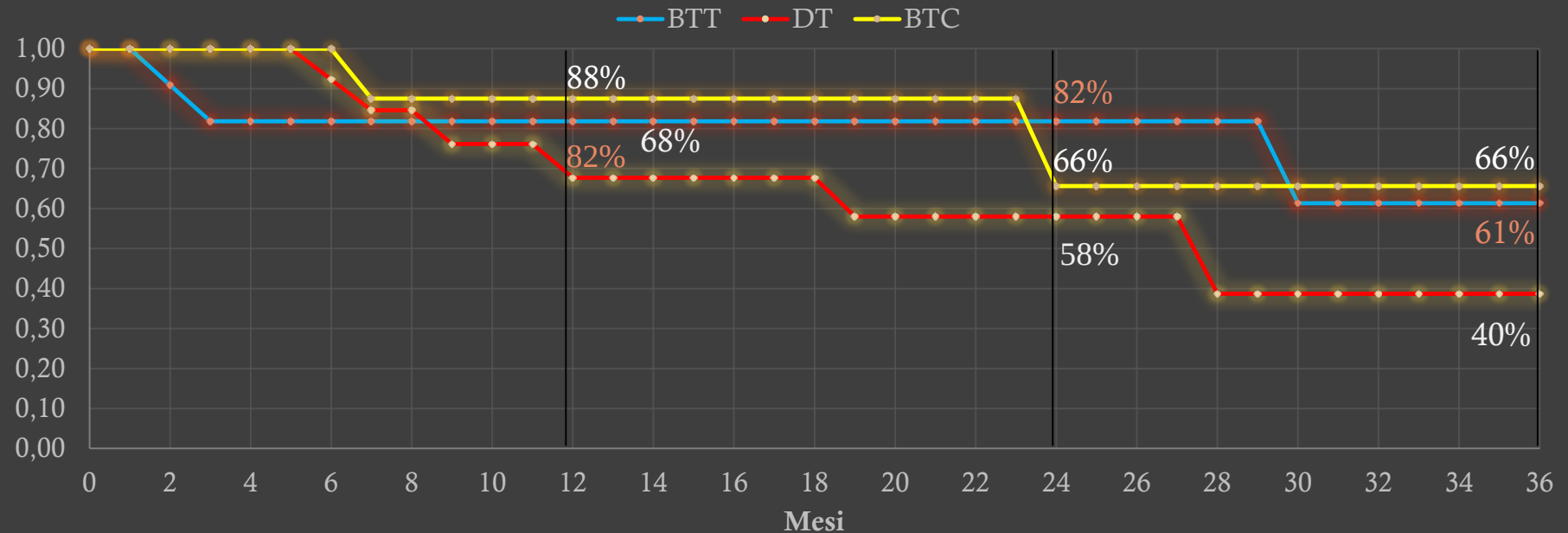
Piemonte Regional Network Experience

HeartWare - HVAD

ITT HVAD (44 pts)



KM - HVAD ITT Censored



Piemonte Regional Network Experience

HeartWare - HVAD

HVAD Implants n = 44, deaths = 13

Primary cause/mode of death	n	%	Mean time (months)
Neurologic event	5	11.4	14.4
Right Heart Failure	2	4.5	39
Major infection	1	2.3	2
Respiratory failure	1	2.3	12
Thrombosis	1	2.3	8
Multisystem Organ Failure	1	2.3	47
Other	2	4.5	15.5

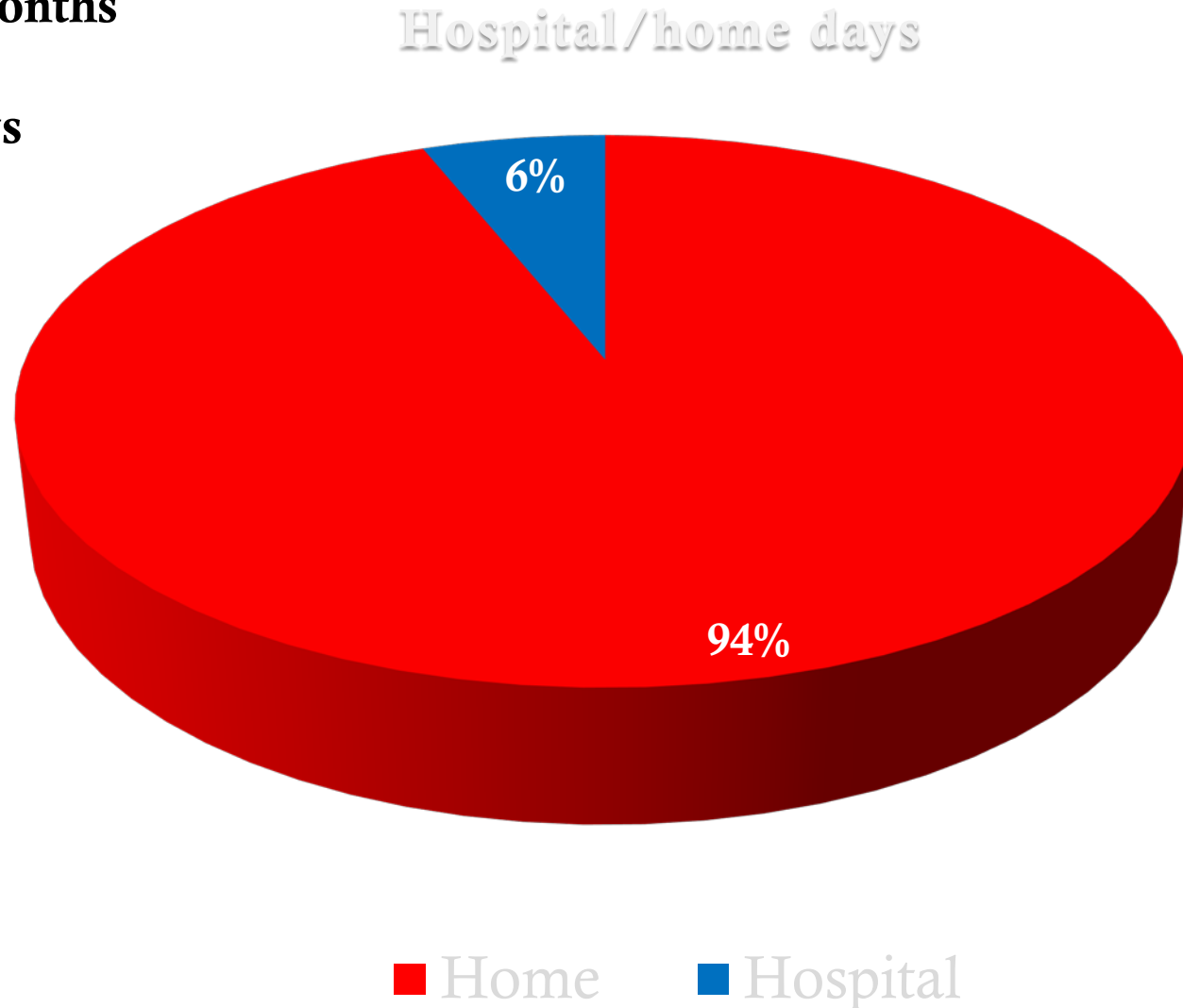
Long term LVAD Follow-up

81 implants

Mean Follow-up 22.68 ± 14.48 months

Mean Follow-up 681 days

Mean Hospital Stay 40,3 days



IDEAL VAD

- ◇ **Biocompatible**
- ◇ **Reduced dimension**
- ◇ **Reliable (10 million beats/years o 4 billion cycles/years)**
- ◇ **Low energy requirements**
- ◇ **Easy to implant and.....to explant**
- ◇ **Allowing the discharge of the patient**
- ◇ **Cheap.....**