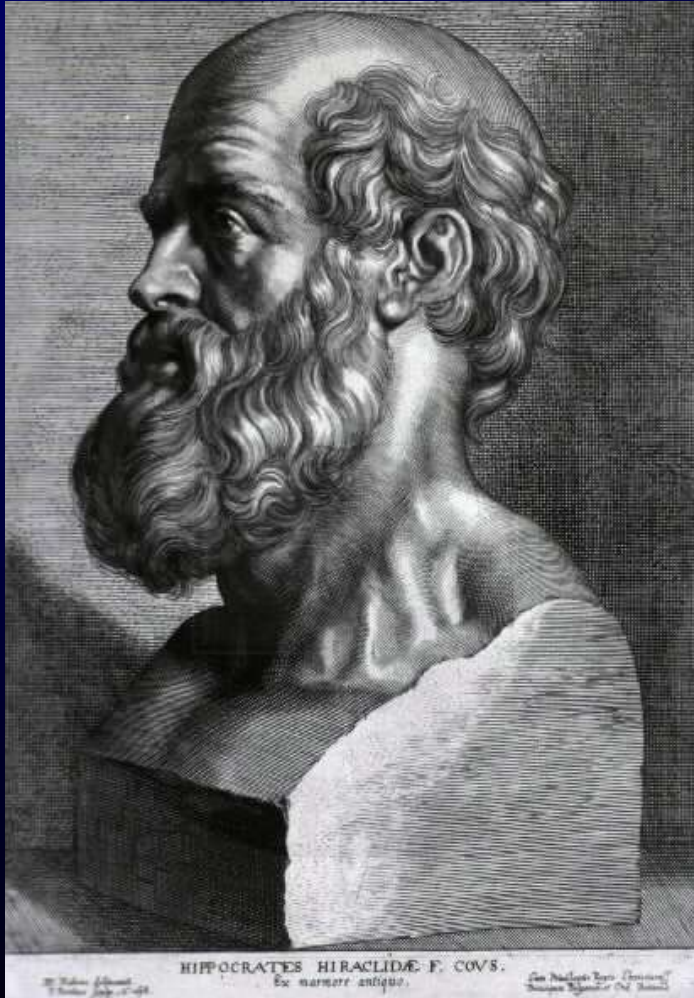
A nighttime photograph of a grand European square, likely Place Stanislas in Nancy, France. The buildings are illuminated with warm yellow and red lights. In the background, a church with a dome and spire is visible. The sky is dark with a single bright star or light source.

L'insuffisance cardiaque, fléau cardiovasculaire du XXI^{ème} siècle

Yves Juillière. Cardiologie, ILCV, CHU Nancy-Brabois

Hippocrate (460-370 av. JC)

Théorie des humeurs



- ✦ Maladie : déséquilibre interne de l'organisme entre 4 humeurs :
 - Sang, lymphe (ou phlegme), bile jaune, atrabile (ou bile noire)
 - Condition de la santé : juste tempérament
 - Maladie : 3 phases : dégénérescence des humeurs, coction (réaction par la fièvre), crise (évacuation de l'humeur en excès)
- ✦ Diététique : selon 4 éléments (Eau, Terre, Air, Feu) : 4 tempéraments selon la théorie des humeurs :
 - Phlegmatique, mélancolique, sanguin, colérique

Galien (129-201)

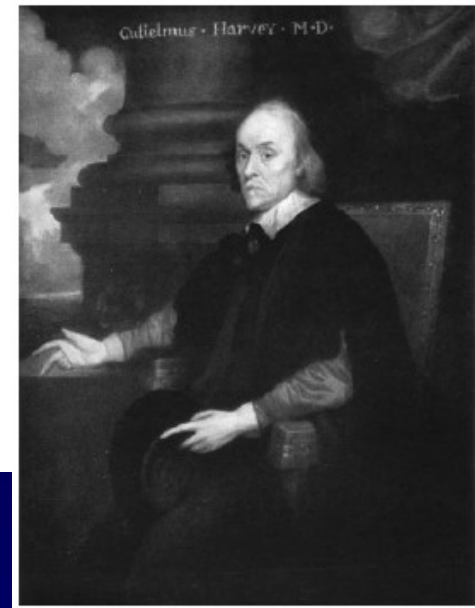
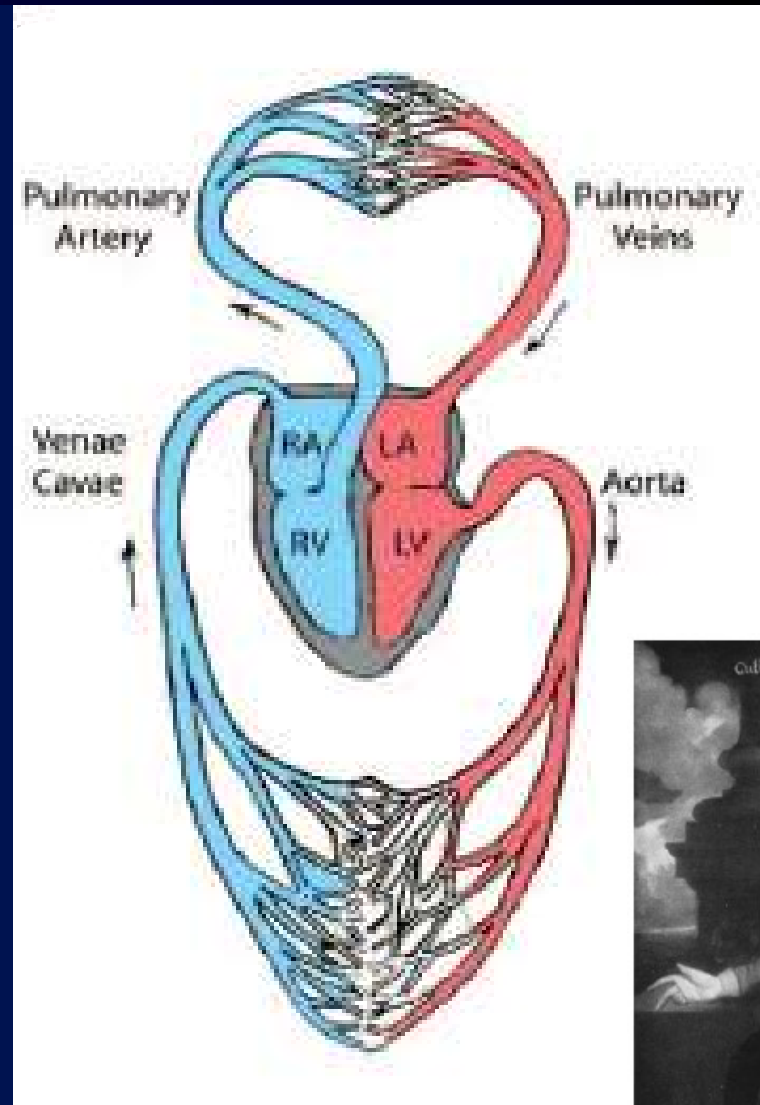
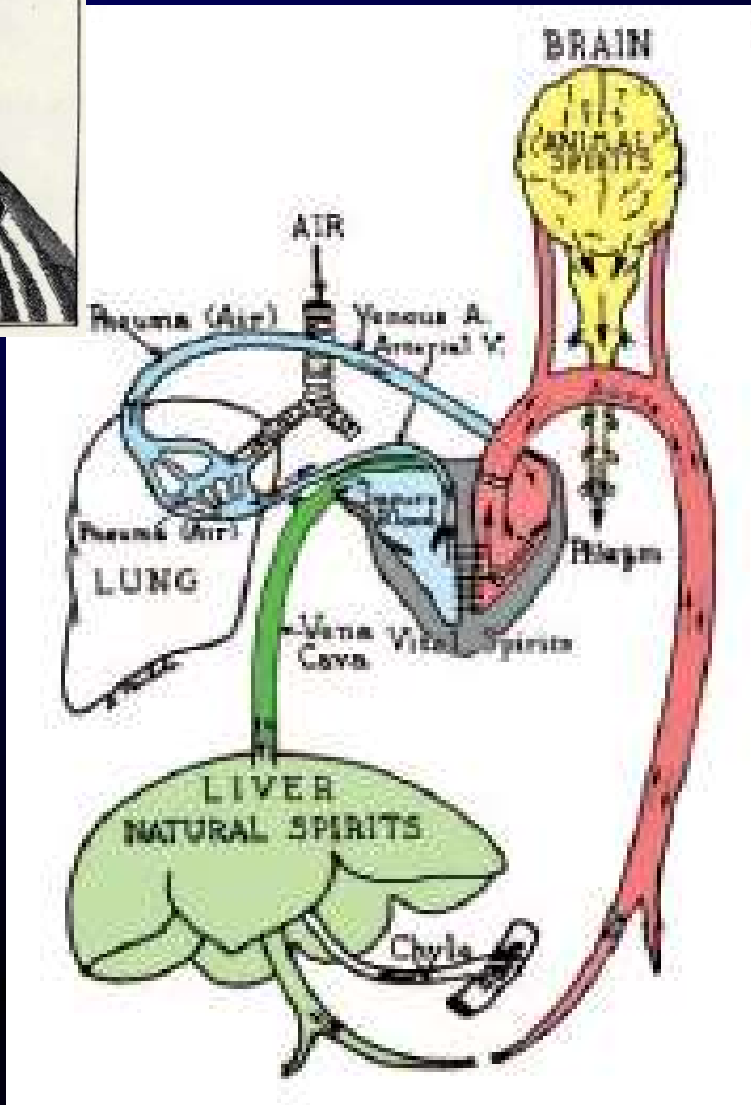


- ❖ Médecin grec
- ❖ Identifie le sang des veines et des artères
- ❖ Première description de la circulation sanguine
- ❖ Référence du cursus universitaire du médecin médiéval

Evolution de l'approche de la circulation sanguine



**Galien
(129-201)**



William Harvey (1578-1657)

DEFINITIONS DE L'INSUFFISANCE CARDIAQUE

Physiopathologique

- ✘ Etat physiopathologique où :
 - le cœur, en raison d'une anomalie de la fonction cardiaque, ne peut assurer un débit cardiaque suffisant pour répondre aux besoins métaboliques des tissus

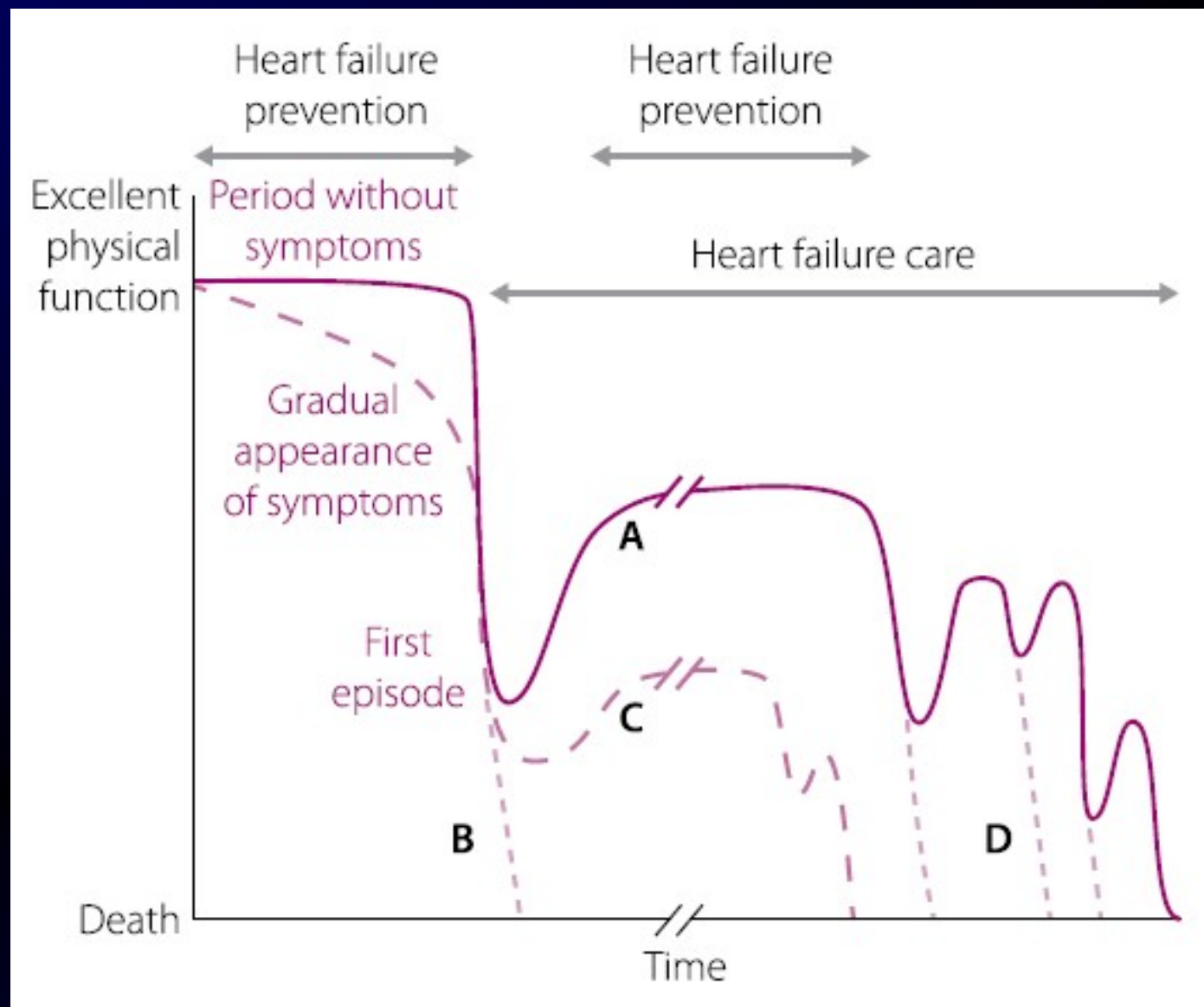
Clinique

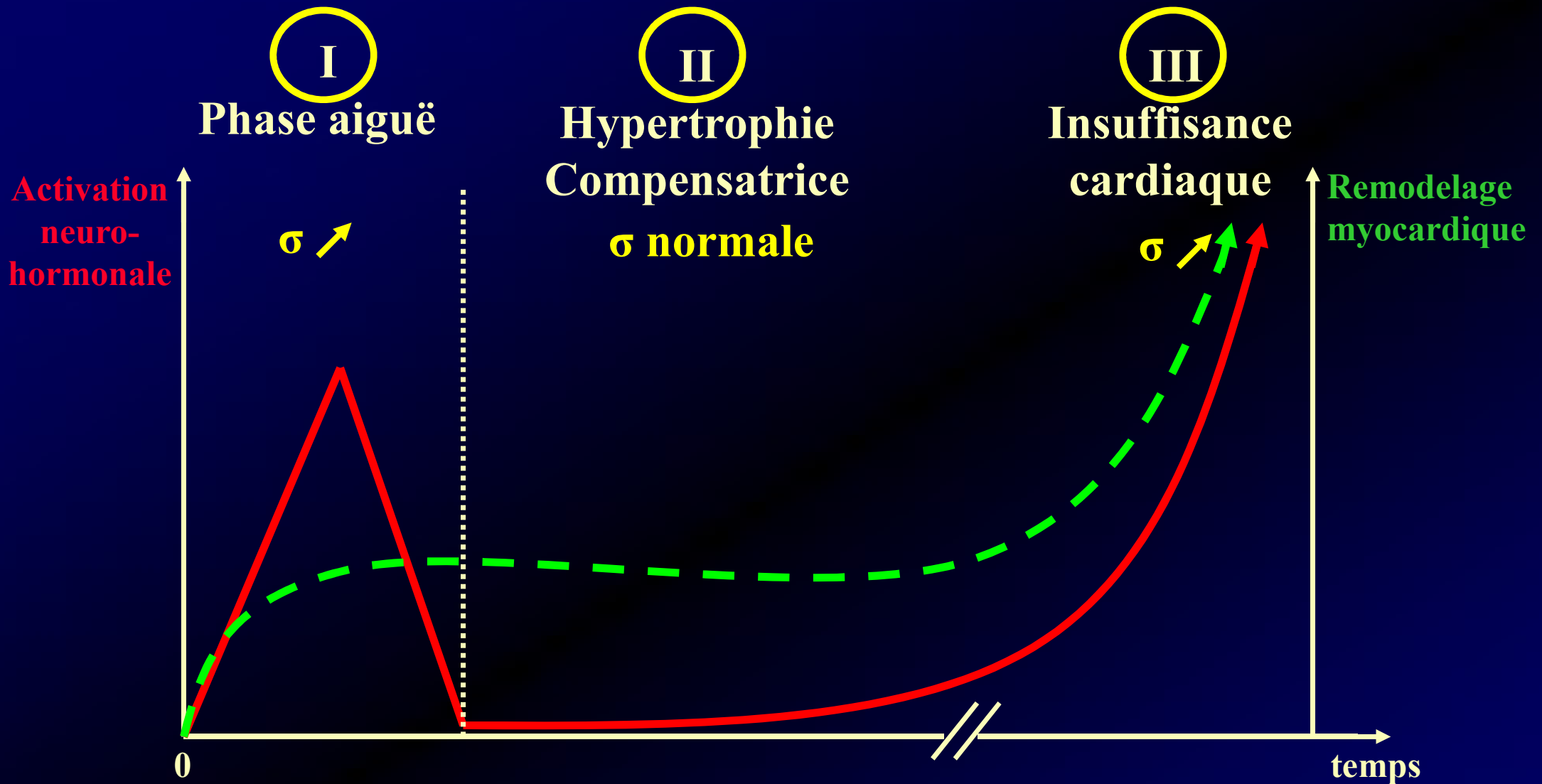
- ✘ Syndrome clinique avec :
 - symptômes typiques d'IC
 - signes typiques d'IC
 - preuve objective d'une anomalie structurale ou fonctionnelle du cœur au repos

La physiopathologie

Improving care for patients with acute heart failure: before, during and after hospitalization

COWIE MR et al. ESC HF 2014; 1: 110-145





Loi de Laplace : $\sigma = k \frac{Pr}{e}$

σ : contrainte sur les myocytes
 P : pression intra-VG
 r : rayon VG
 e : épaisseur du myocarde

Si $\sigma \nearrow$: IC
 ex: ballon

Systeme Sympathique

Baisse de la pression artérielle détectée par les barorécepteurs carotidiens (I cardiaque, diurétiques...)

ACTIVATION Σ

Augmentation des catécholamines

β bloquants

↗ Inotropisme

↗ FC

Vasoconstriction

A court terme:
 β bloquants néfastes
Risque de décompensation
cardiaque

A court terme:
Effet hémodynamique positif

↗ Dépenses énergétiques

↗ Ischémie

↗ Troubles du rythme

↗

↗ Postcharge

↗

Stimulation

SRAA

↗

Hypertrophie

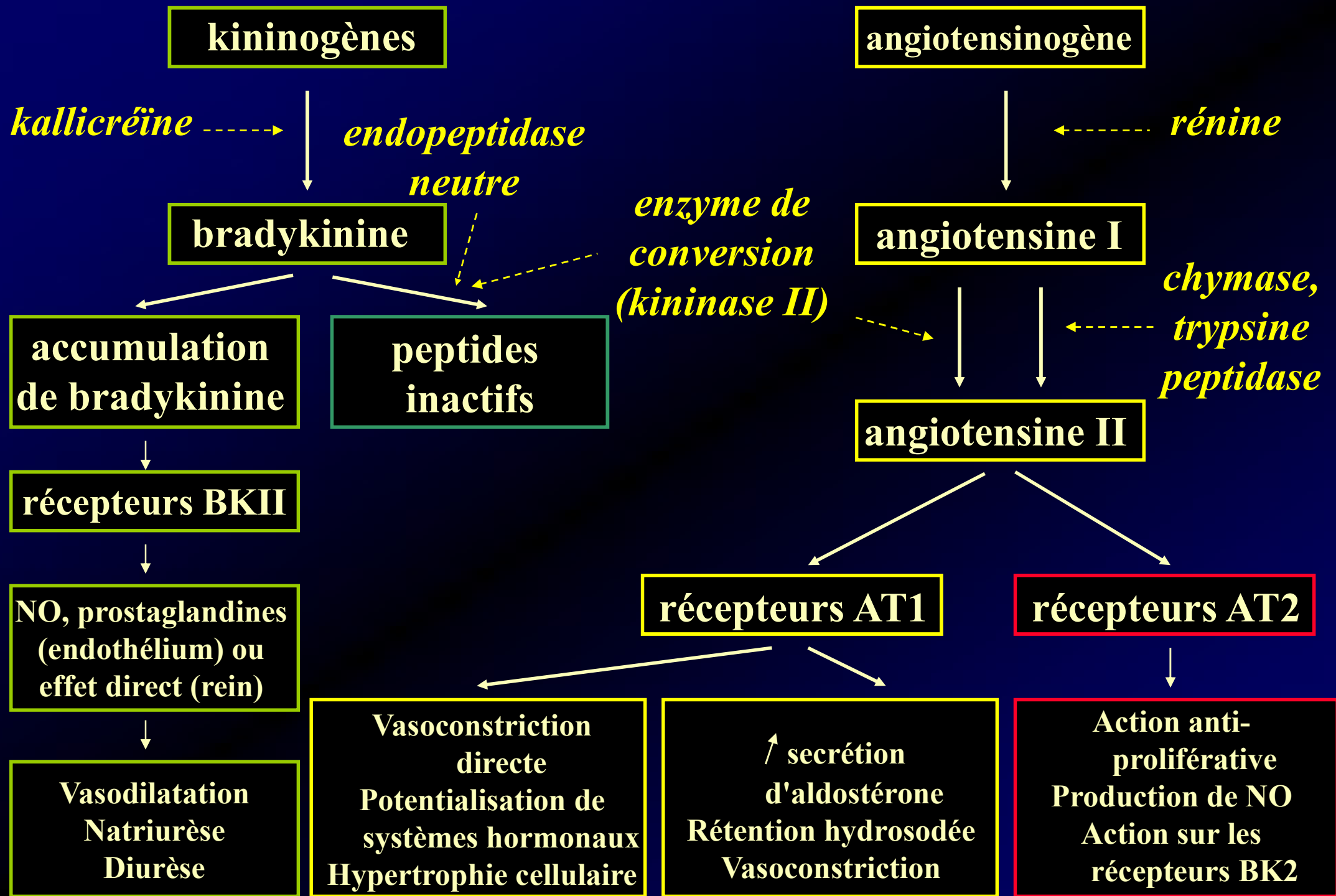
myocytaire

Cytotoxicité

A long terme (> 3 mois):
 β bloquants bénéfiques

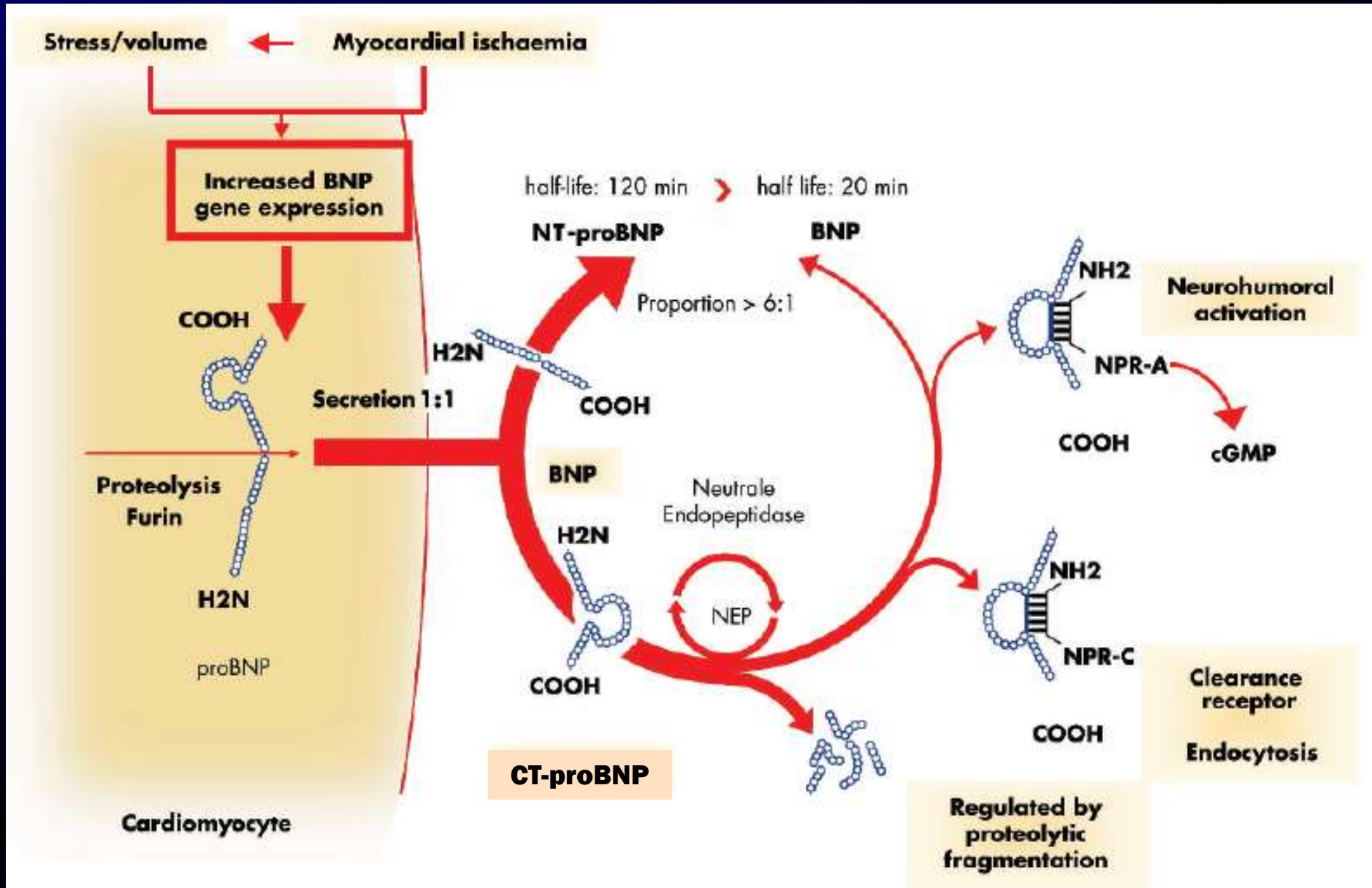
A long terme:
Aggravation ICC Chronique

CEI

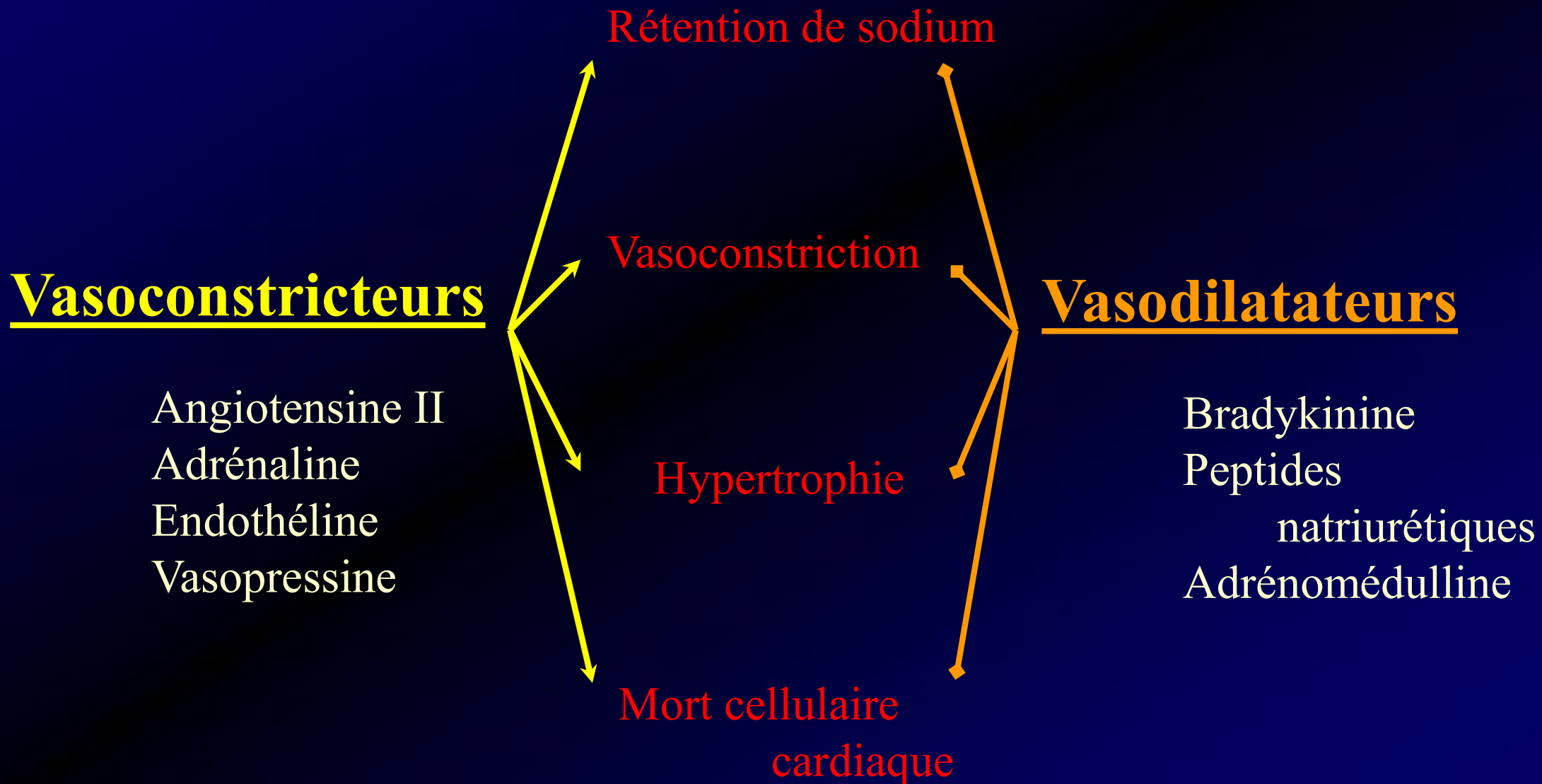


Role of BNP and NTproBNP in clinical routine

WEBER M, HAMM C, Heart 2006; 92; 843-849

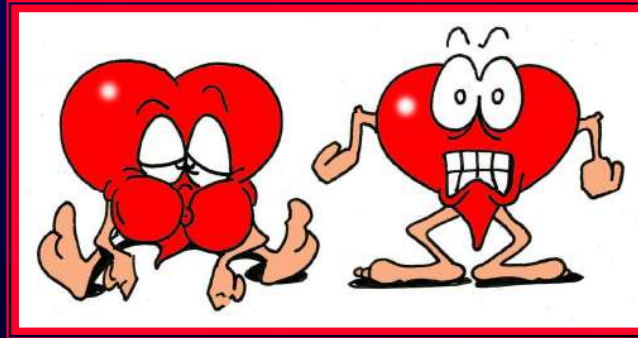


Interaction des systèmes neuro-hormonaux endogènes



COUPES ANATOMIQUES DU COEUR

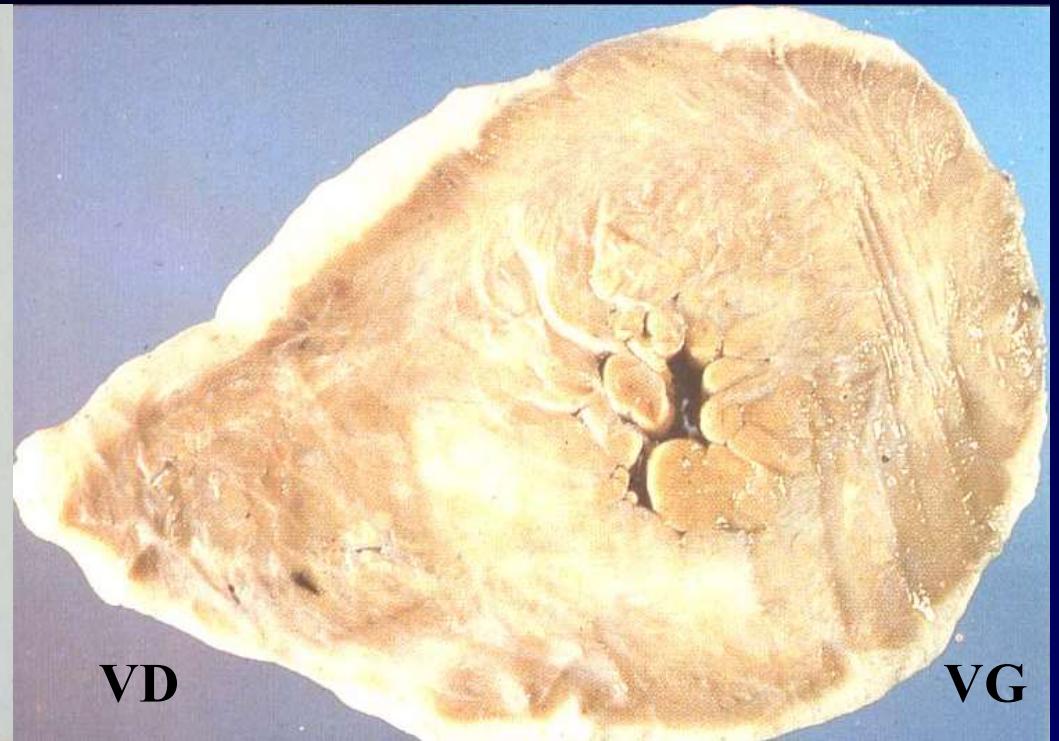
IC
Systolique



IC à
FEVG Préservée



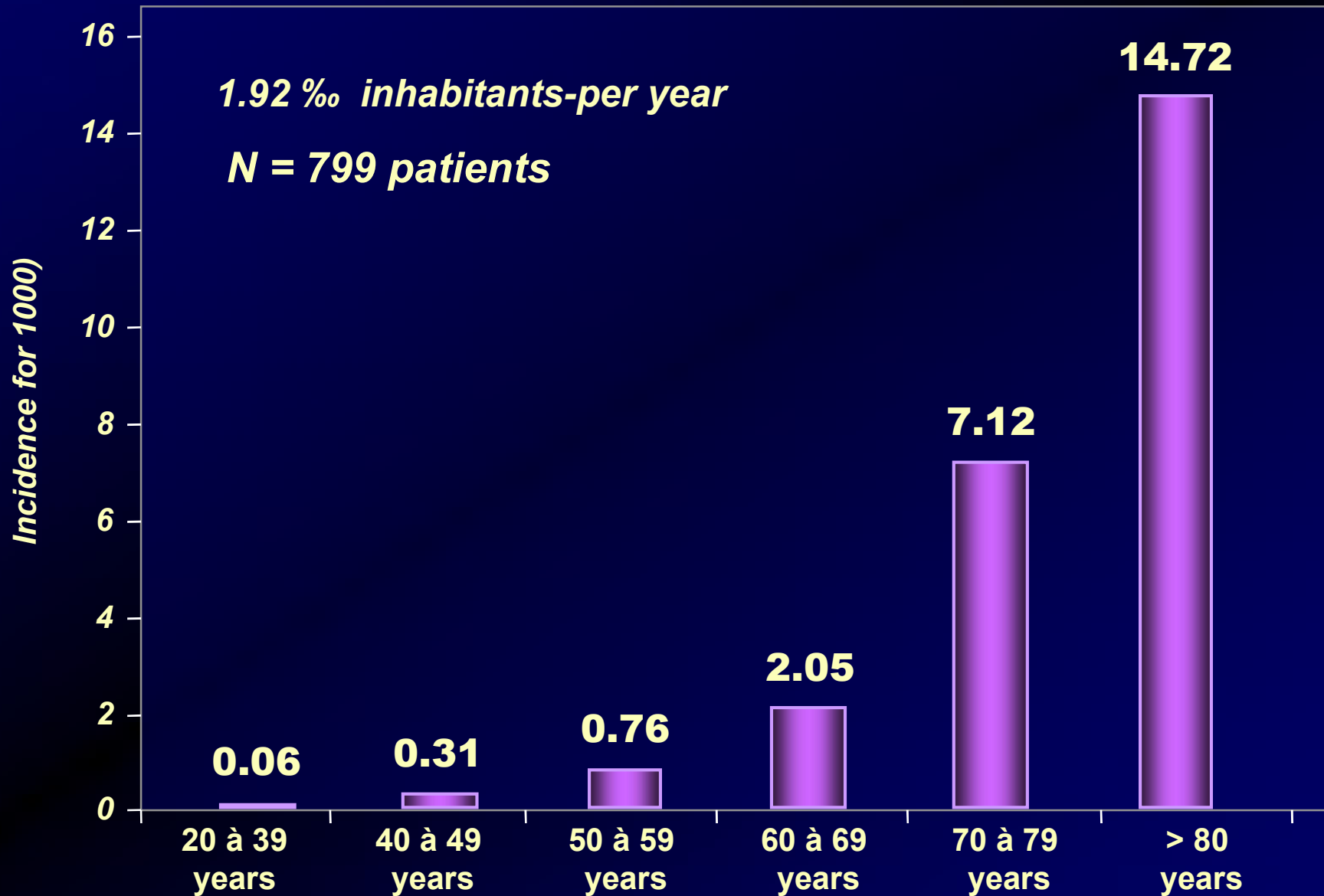
Dilatation des ventricules
Parois fines



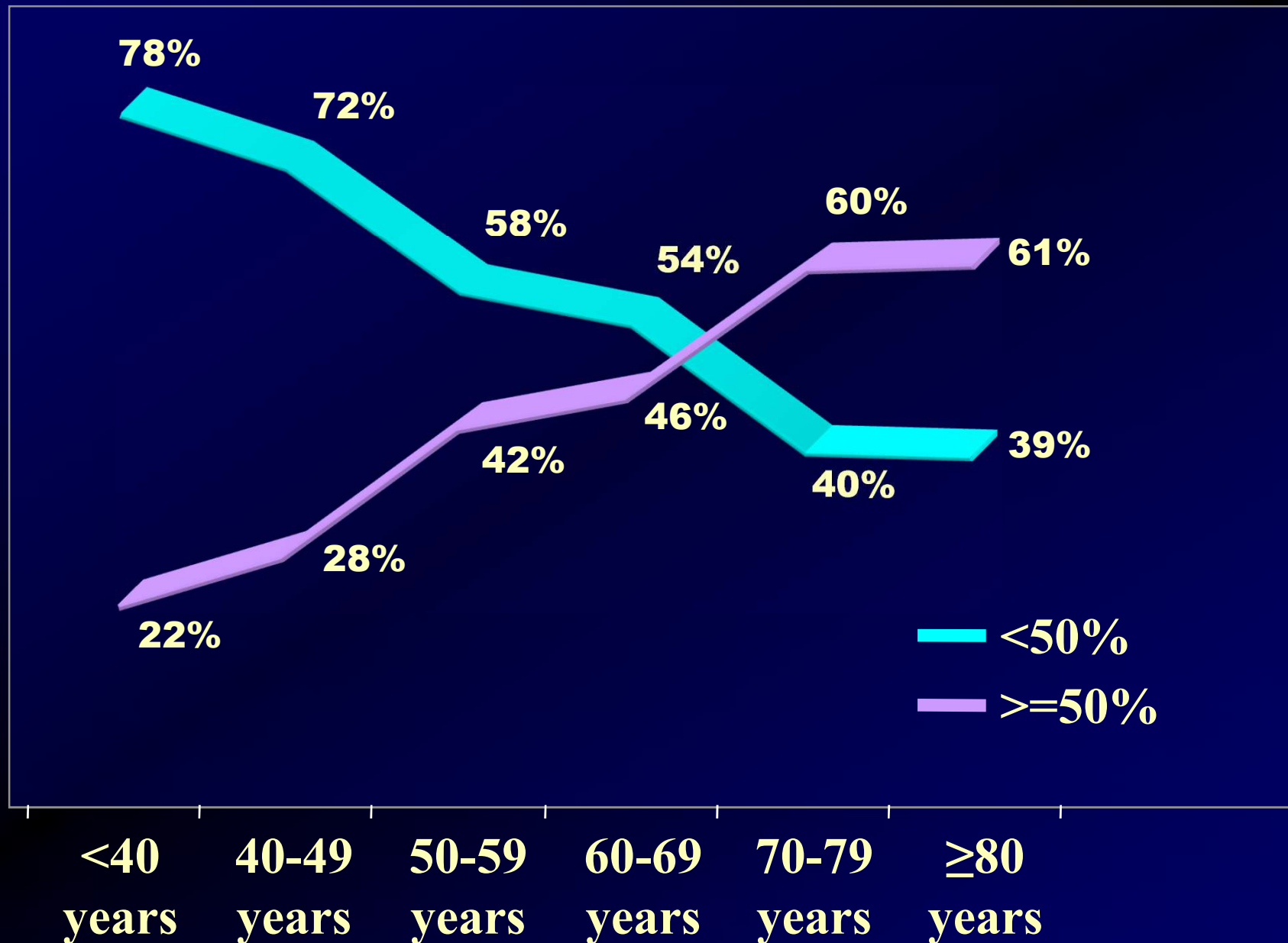
Petite cavité ventriculaire
Parois épaissies

ETICS

Epidémiologie et Thérapeutique de l'Insuffisance Cardiaque dans la Somme Incidence of HF



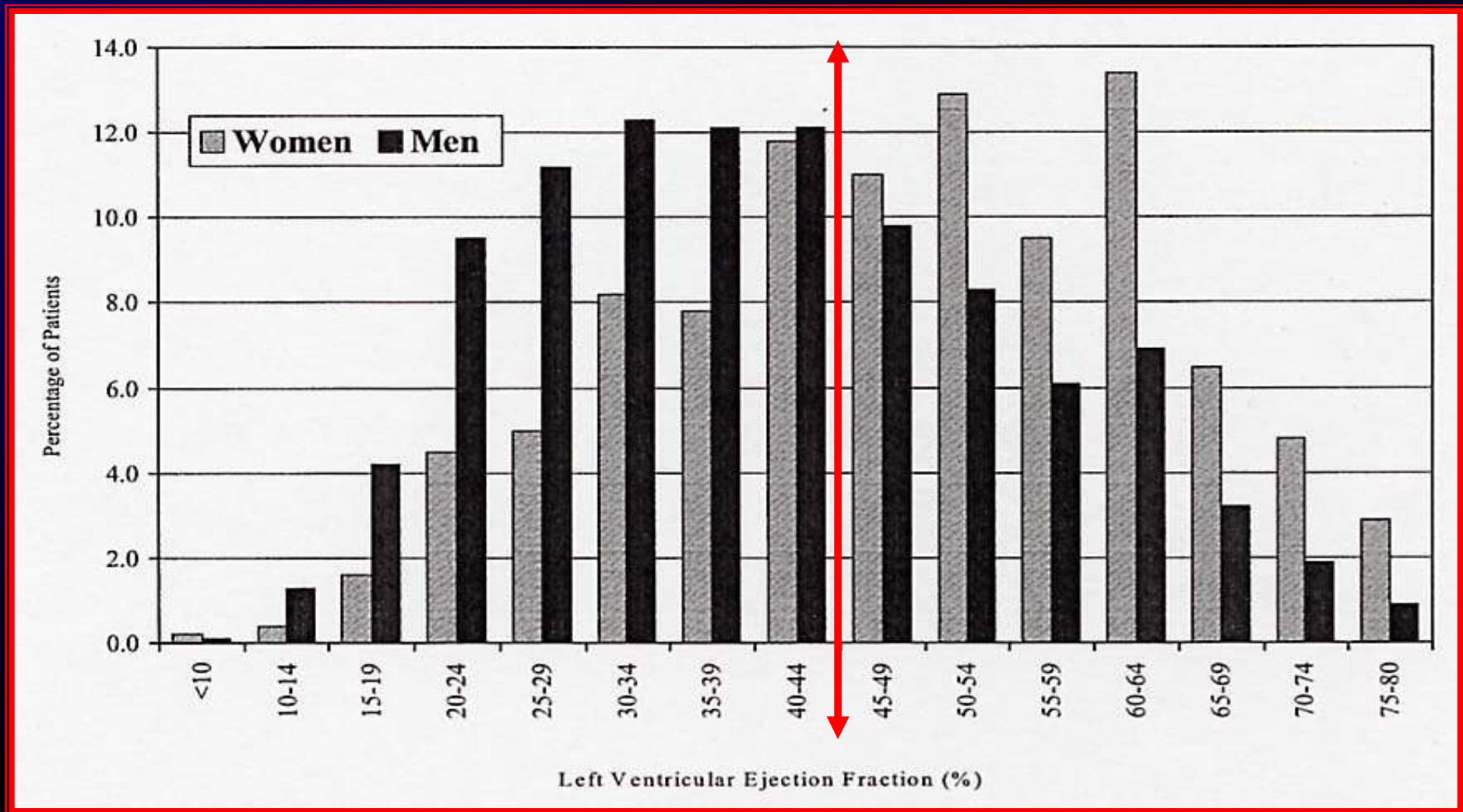
ETICS : LVEF according to age



THE EUROHEART FAILURE SURVEY PROGRAMME

Part 1: patient characteristics and diagnosis

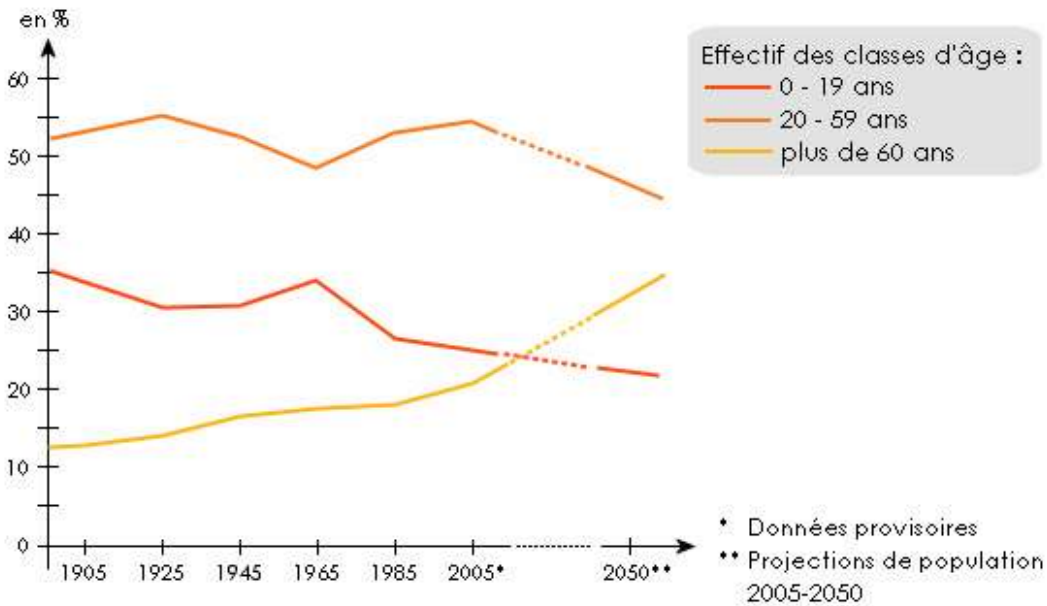
Cleland JGF et al, Eur Heart J 2003; 24: 442-463



Le contexte sociétal

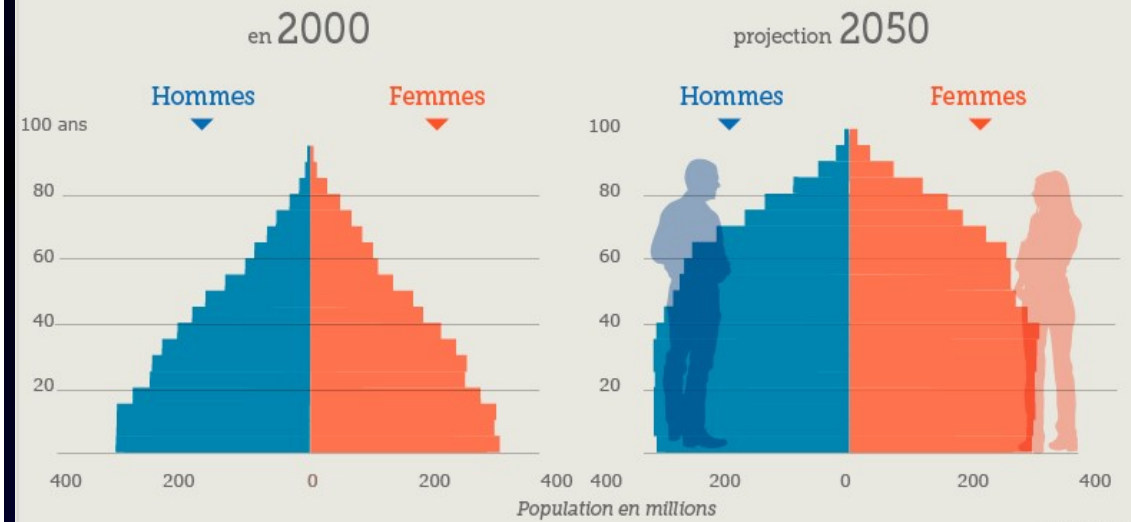
Age de la population

Evolution de la population par groupe d'âge et projections pour 2050



Vieillessement de la population à l'horizon 2050

PYRAMIDE MONDIALE DES ÂGES

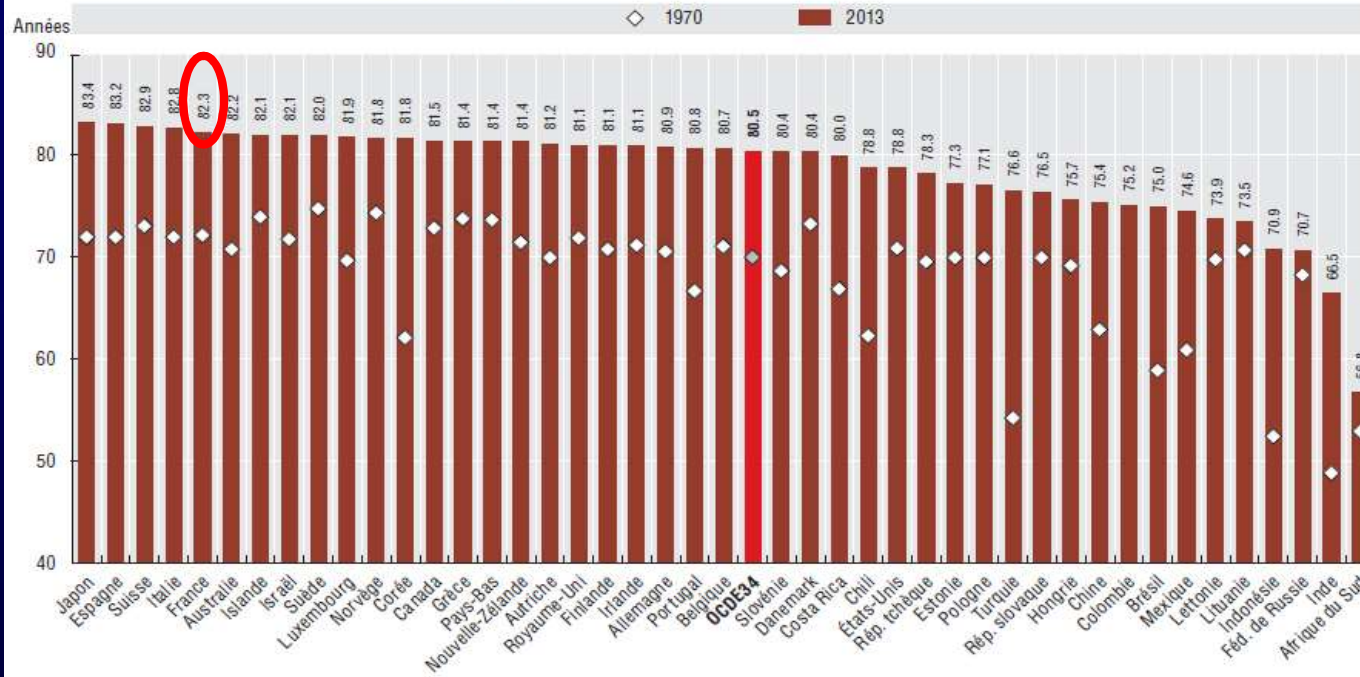


Source : Nations Unis

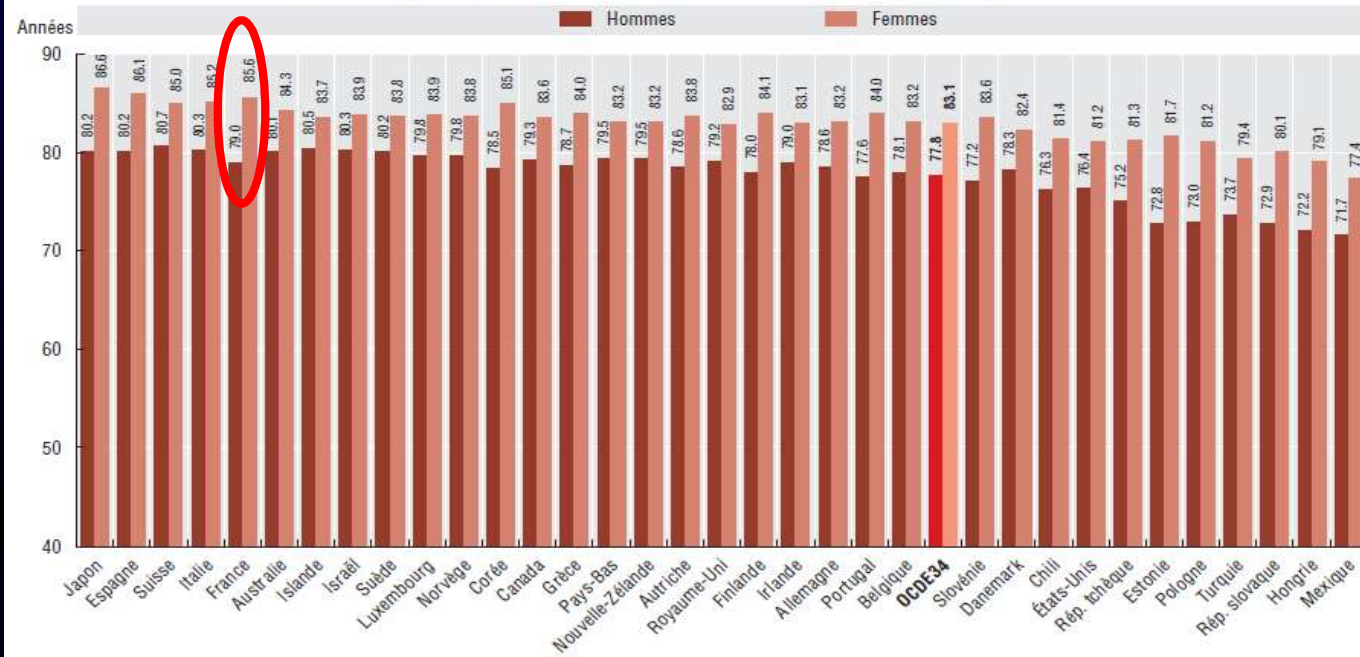
07/08/2014

Infographie LE FIGARO

3.1. Espérance de vie à la naissance, 1970 et 2013 (ou années les plus proches)



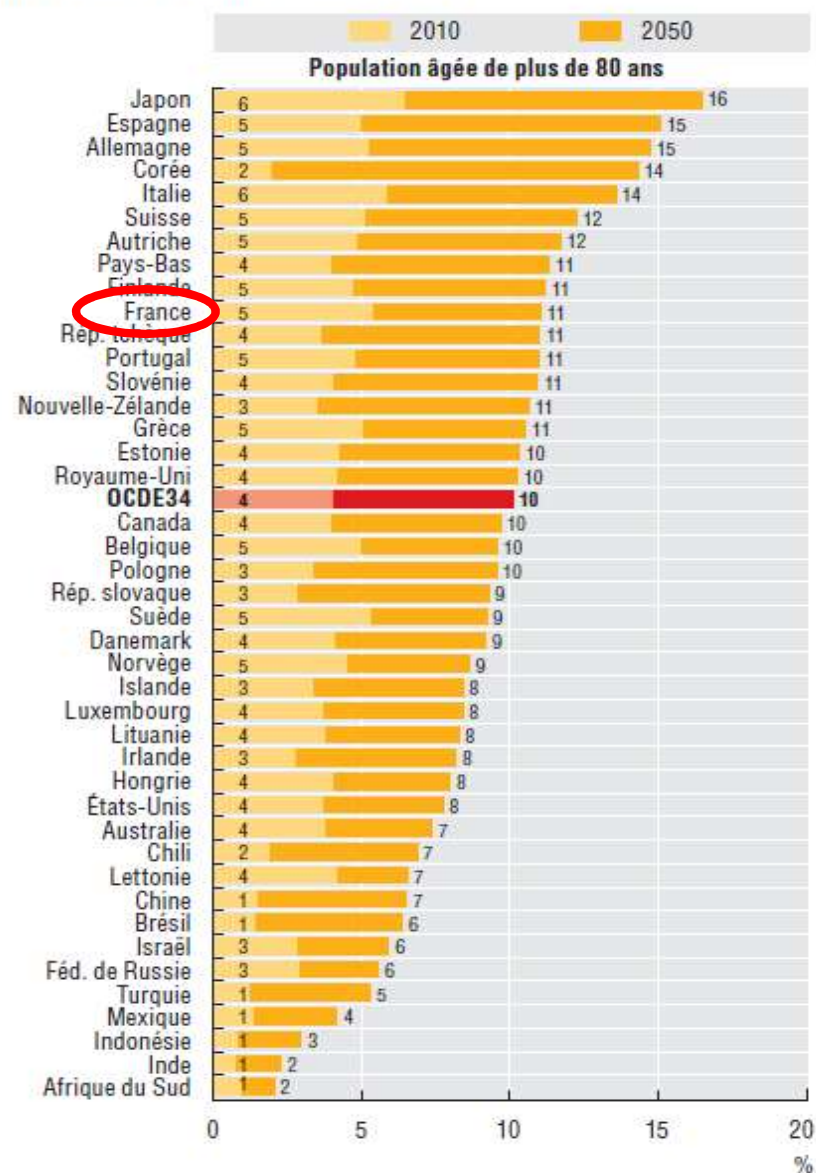
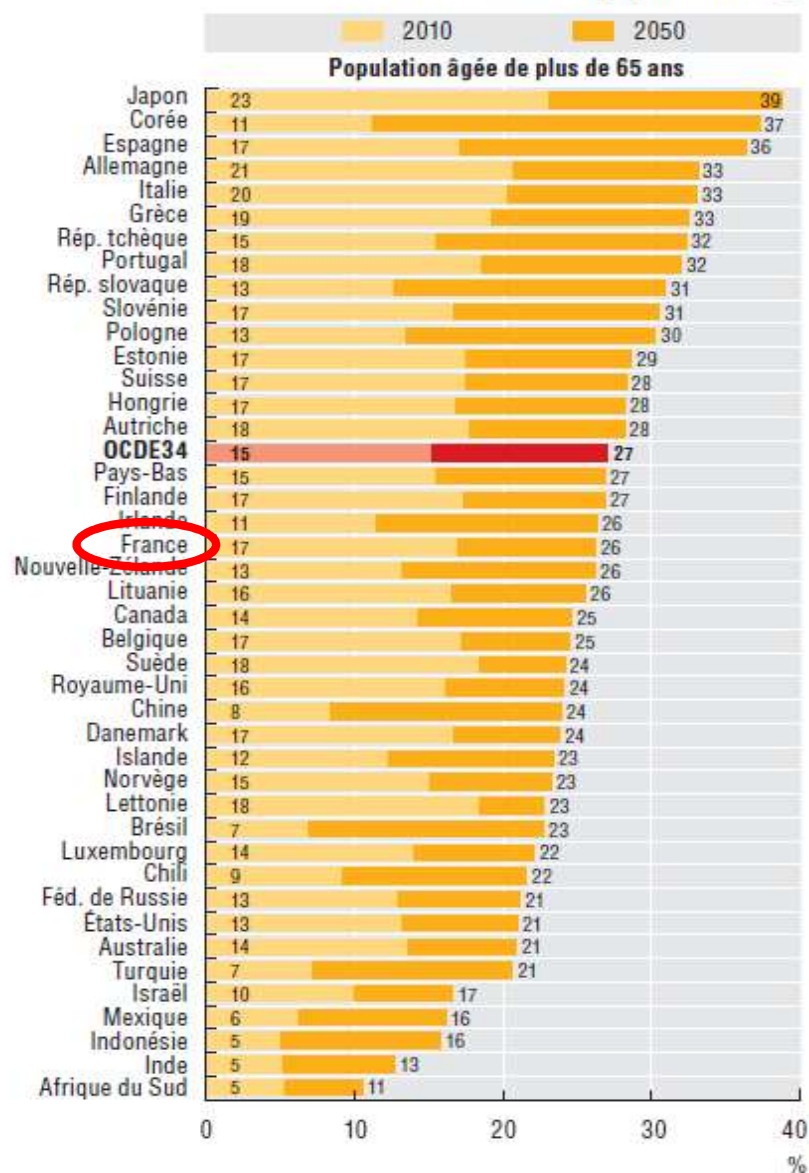
3.4. Espérance de vie à la naissance par sexe, 2013 (ou année la plus proche)



Espérance de vie
OCDE 2015

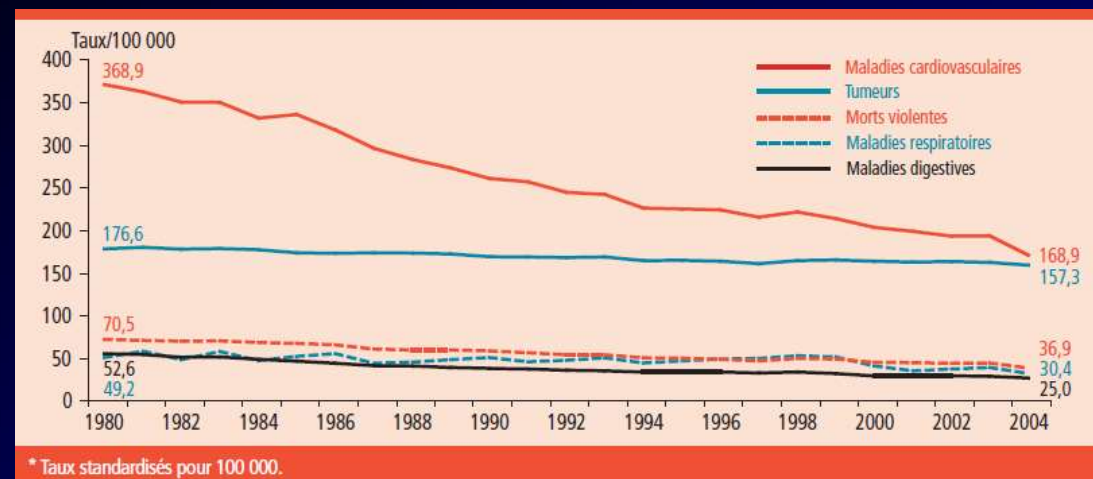
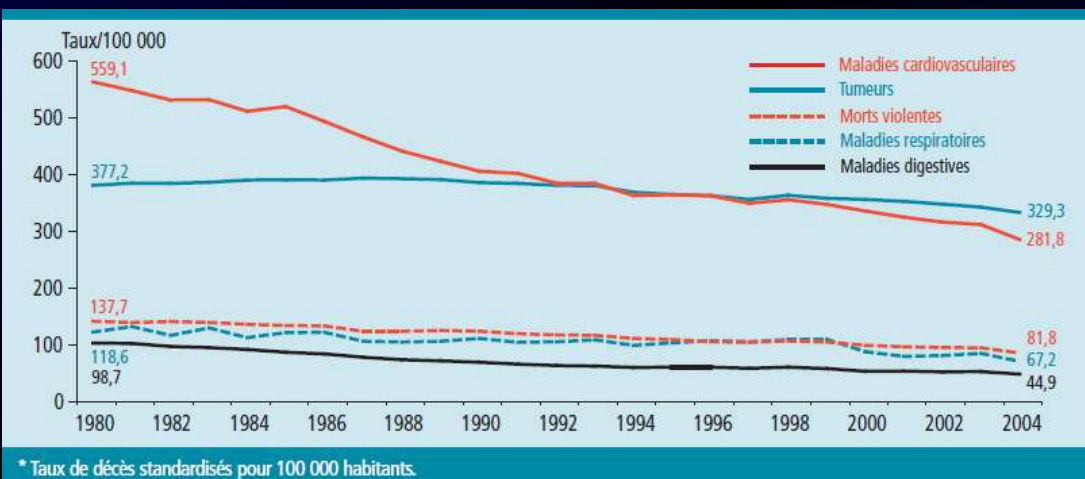
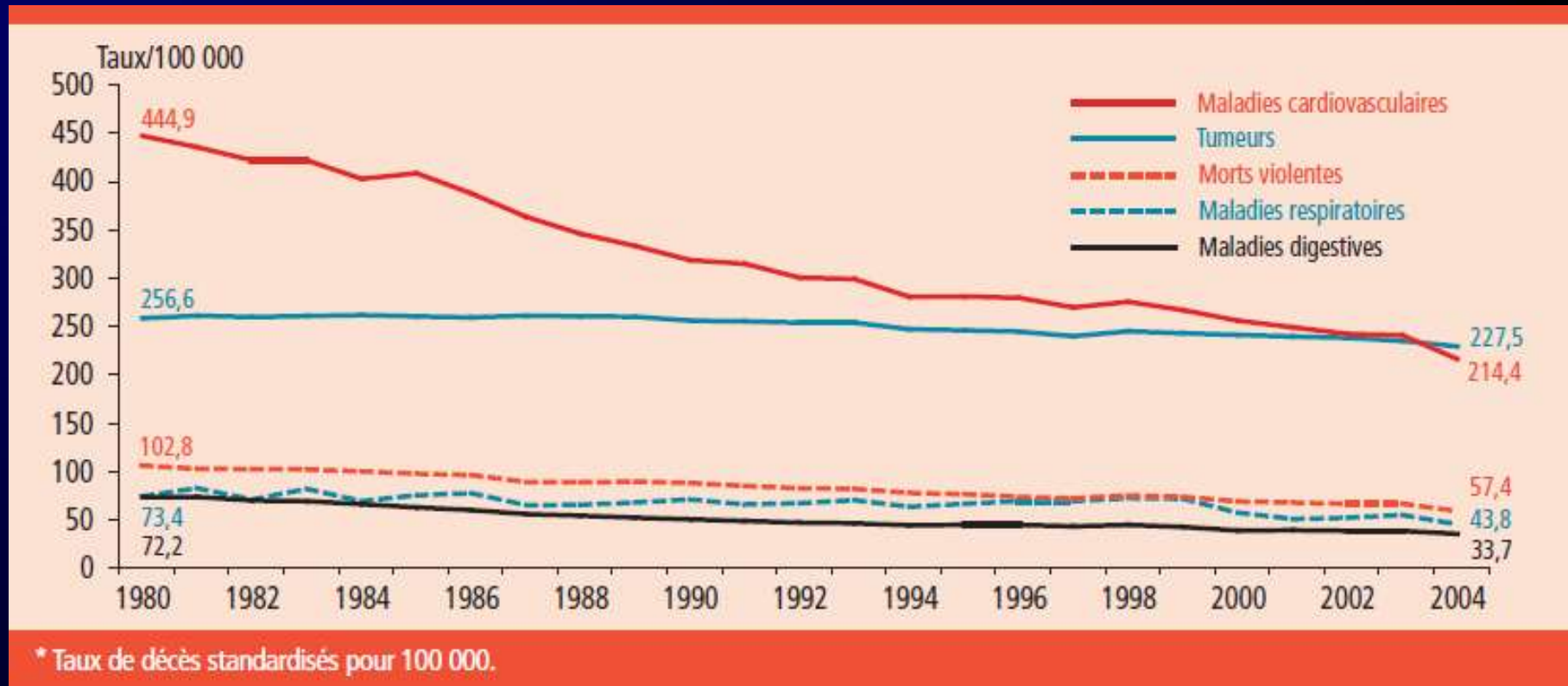
Espérance de vie OCDE 2015

11.1. Part de la population âgée de plus de 65 et 80 ans, 2010 et 2050



Les causes médicales de décès en France en 2004 et leur évolution 1980-2004

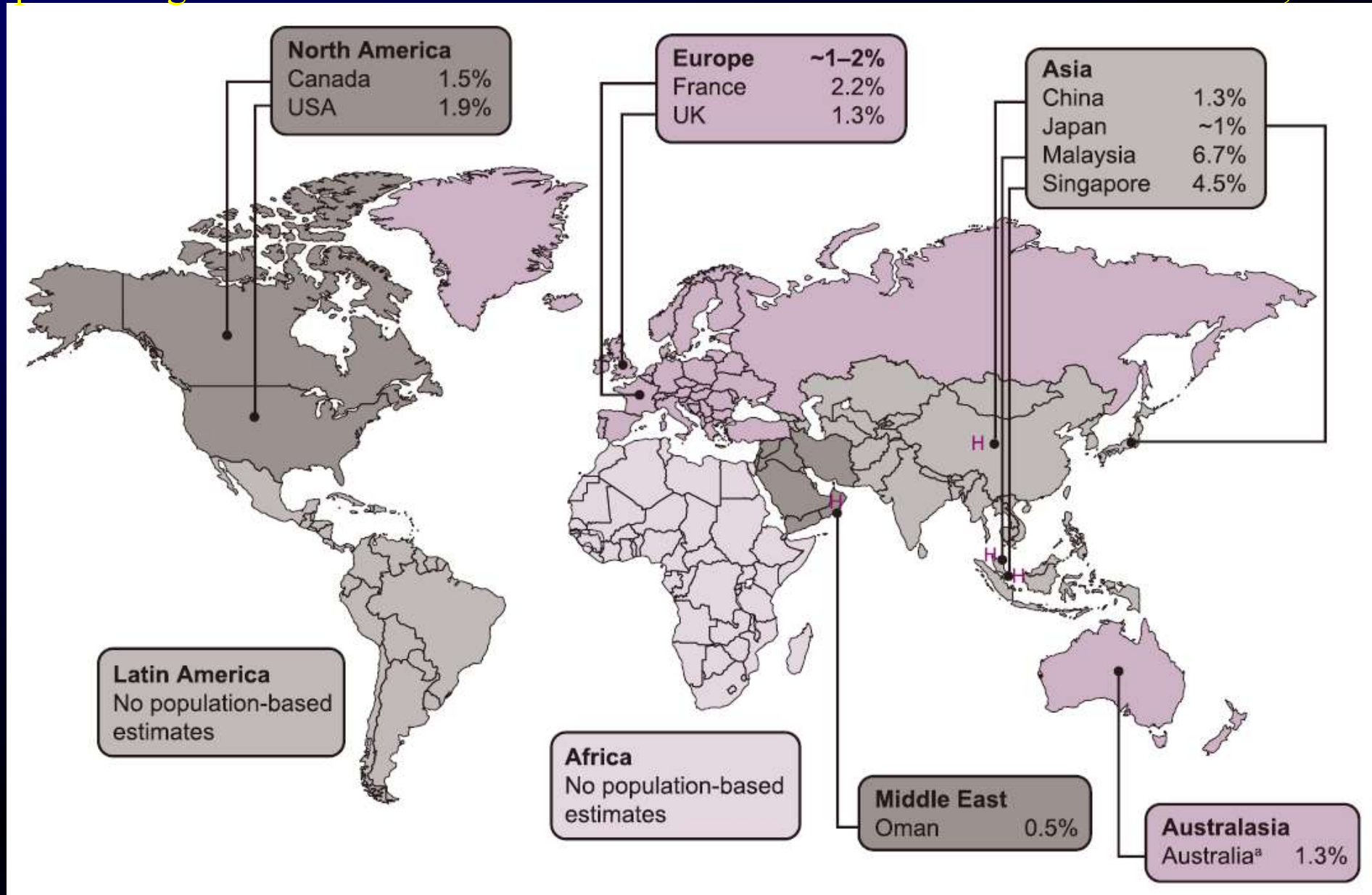
AOUBA A et al. BEH thématique 35-36, 18 septembre 2007 (InVS)



Le contexte épidémiologique

Proportion of population living with heart failure in individual countries across the globe

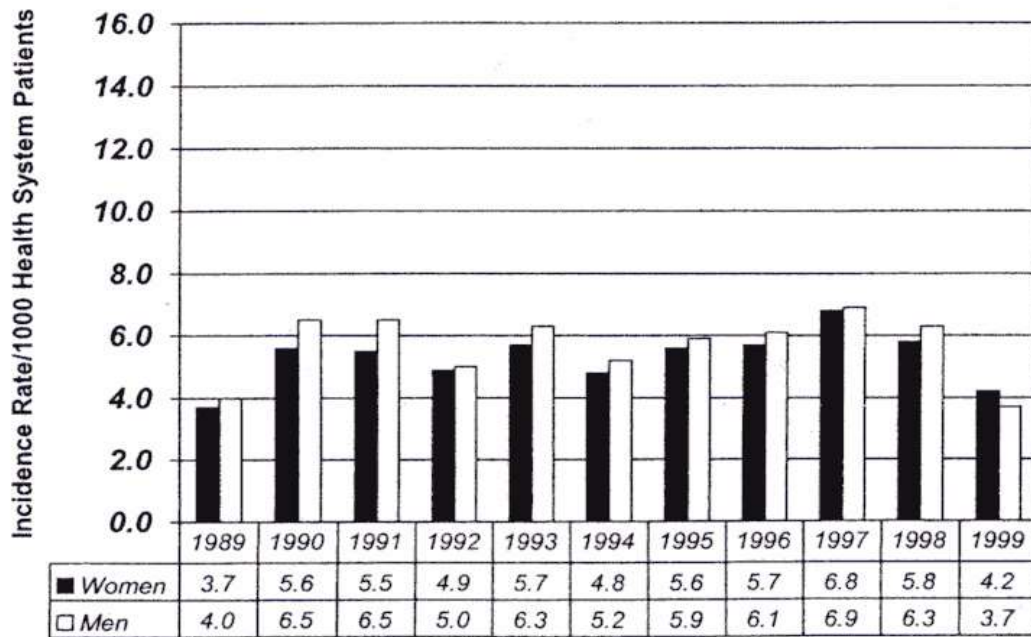
HF: preventing disease and death worldwide. PONIKOWSKI P et al. ESC HF2014; 1: 4-25



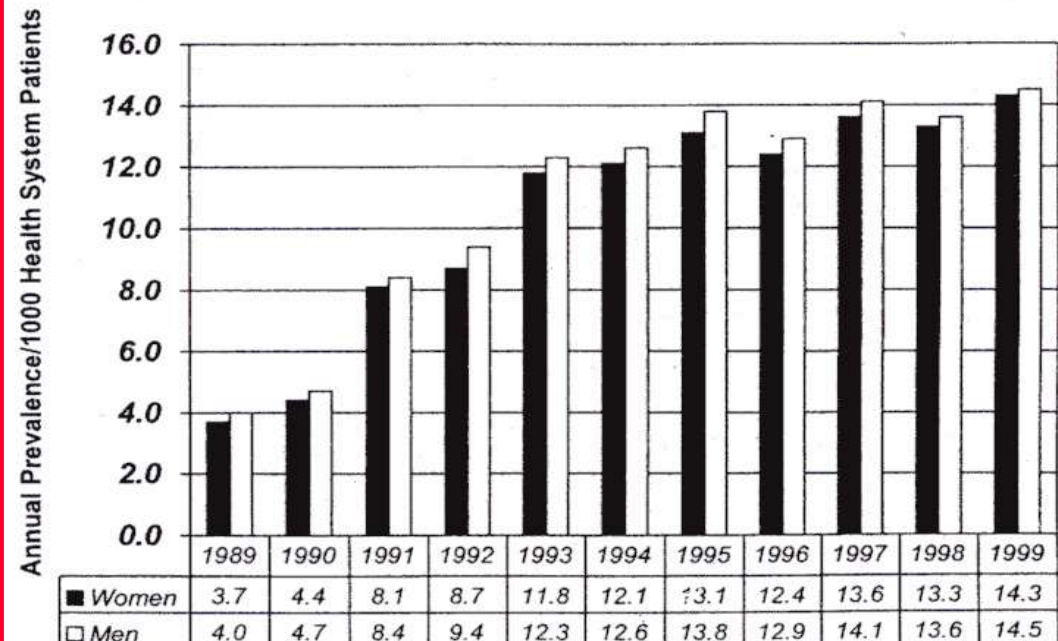
HEART FAILURE EPIDEMIC

Resource Utilization Among Congestive Heart Failure (REACH) Study

McCullough PA et al, J Am Coll Cardiol 2002; 39: 60-69



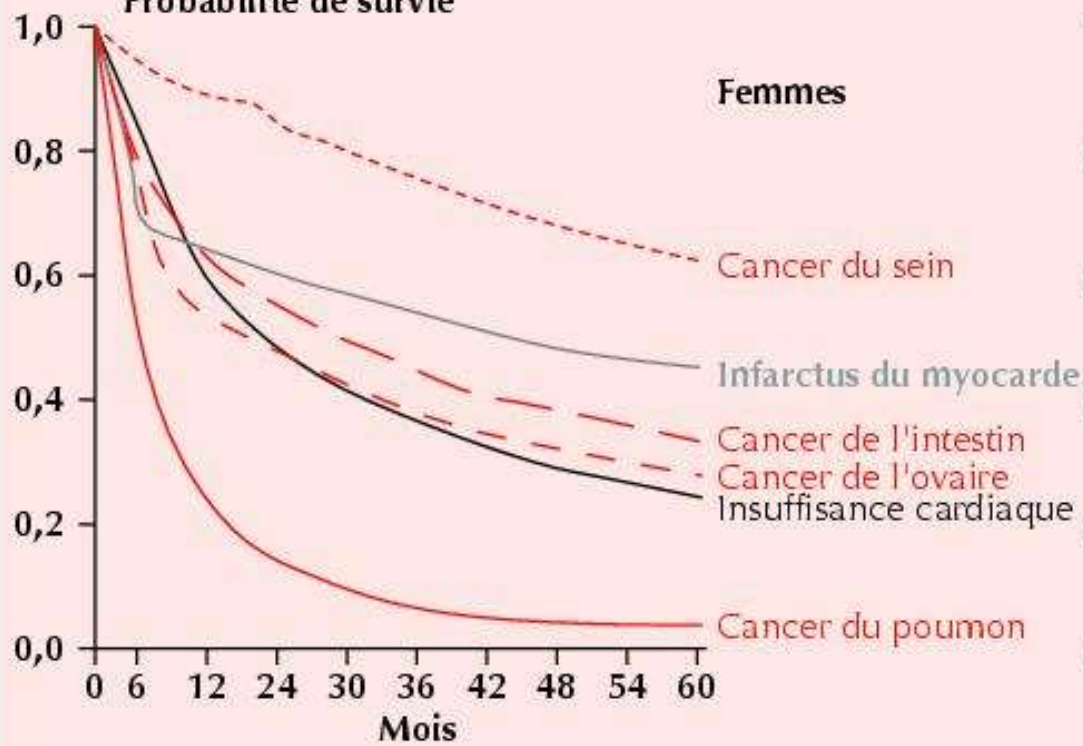
Age- and gender-adjusted incidence of CHF



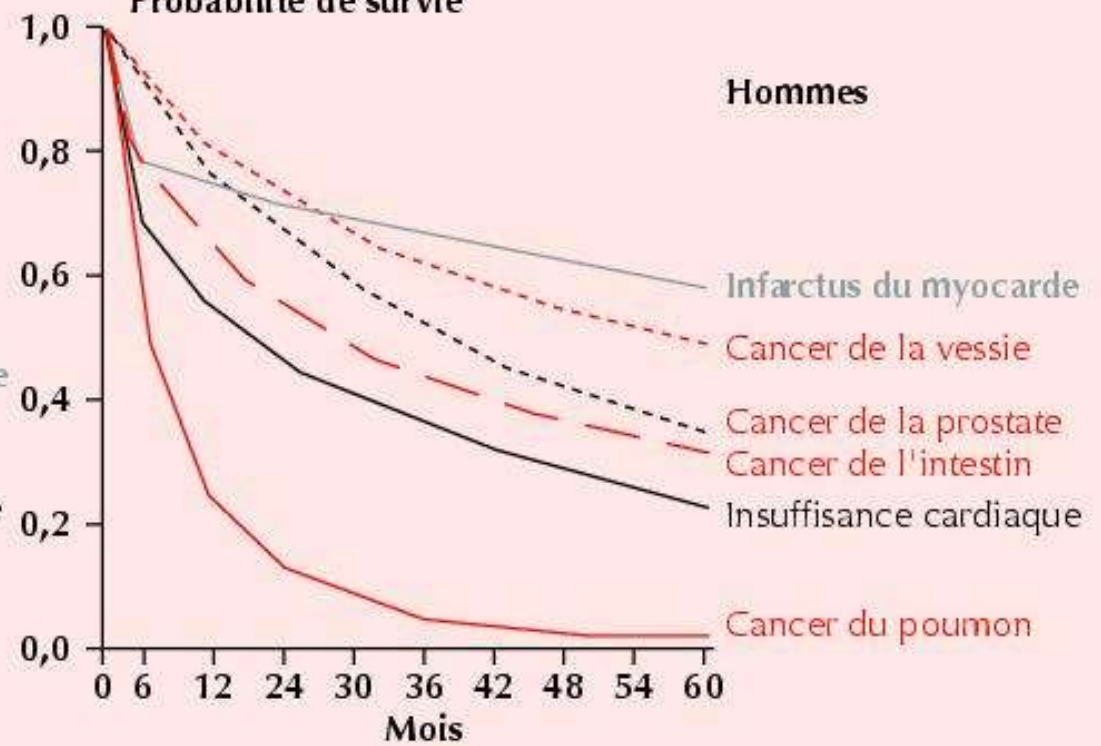
Age- and gender-adjusted prevalence of CHF

PATIENTS HOSPITALISÉS

Probabilité de survie

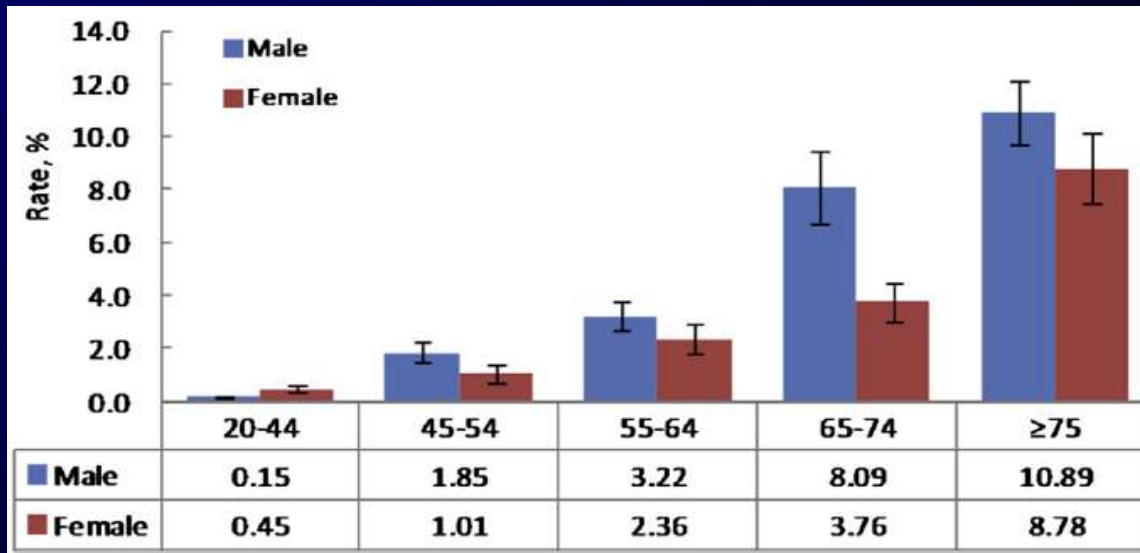


Probabilité de survie



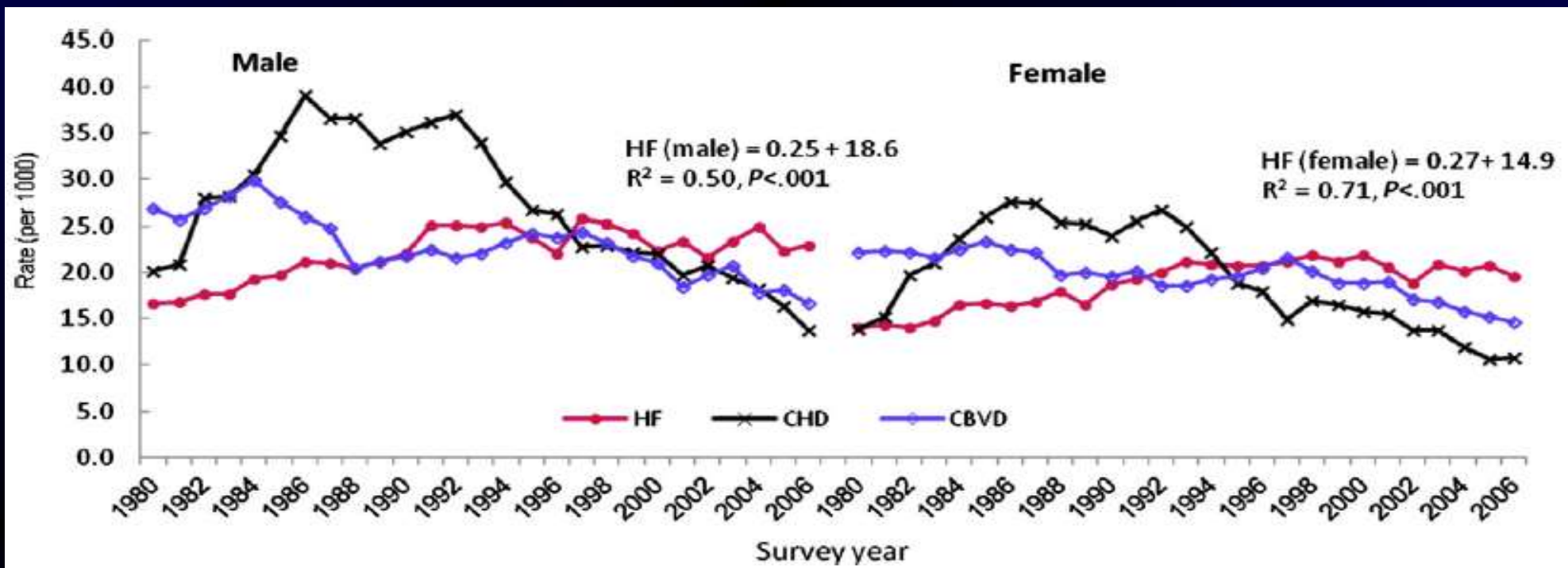
Epidemiology of HF and scope of the problem

LIU L and EISEN HJ. *Cardiol Clin* 2014; 32: 1-8



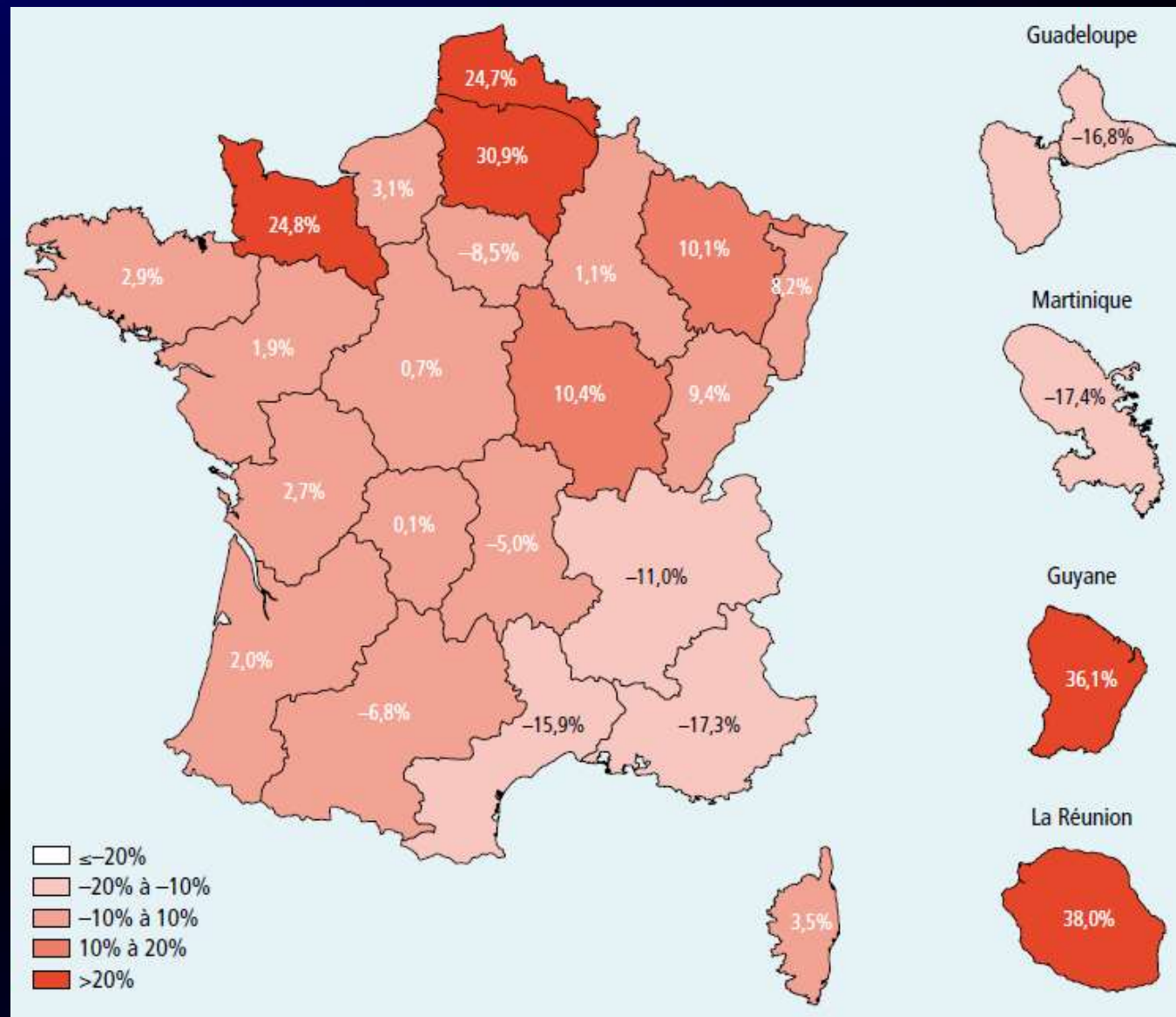
Prevalence (%) of HF in adults ≥ 20 yrs

Age-adjusted hospitalization rates (per 1000) in pts ≥ 65 yrs

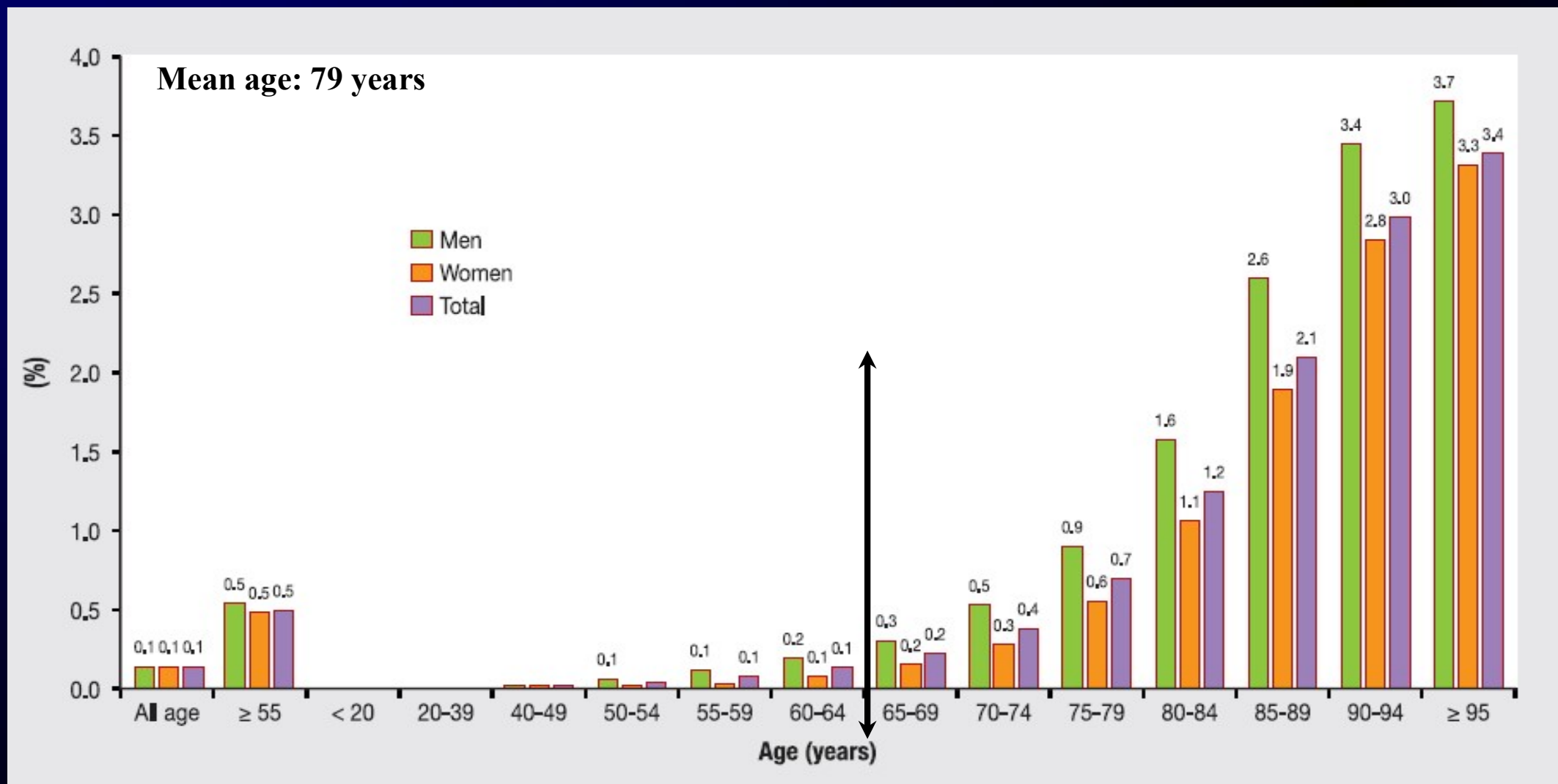


Taux de pts hospitalisés pour IC en 2008 et évolutions en 2002-2008, France

PEREL C et al. BEH 2012; 41: 466-470



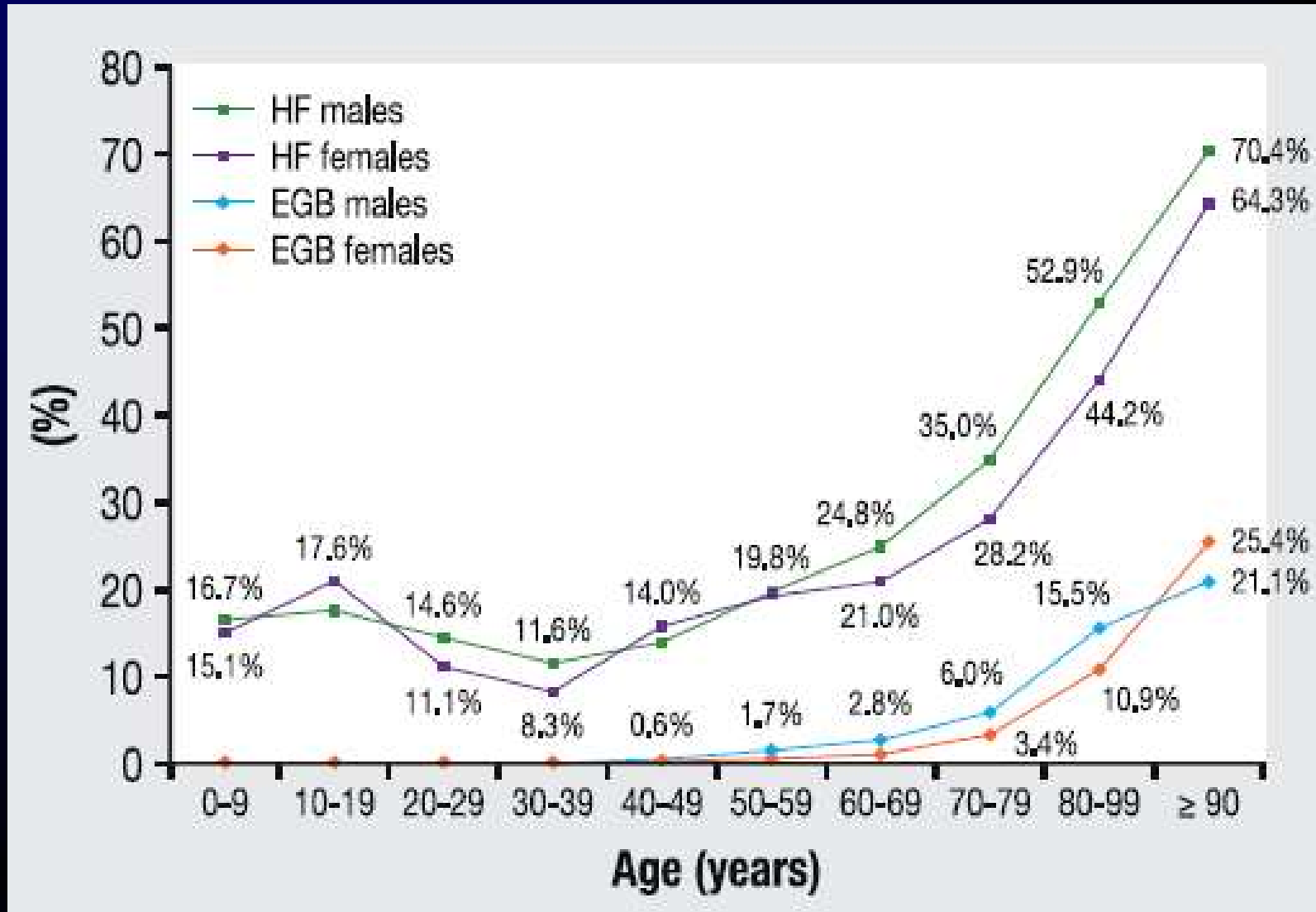
Incidence rate of a first hospitalization for HF by age and sex among subjects covered by the general scheme in France in 2009 (n=69.958)



First hospitalization for HF in France in 2009: Pt characteristics and 30-day F/U

TUPPIN P et al. Arch Cardiovasc Dis 2013; 106: 570-585

Age- and gender-adjusted 2-year mortality rates of patients with a first hospitalization for HF in 2009, compared with those of a random sample of national health insurance beneficiaries (EGB)



Two-year outcome of pts after a first hospitalization for HF in France in 2009
 TUPPIN P et al. Arch Cardiovasc Dis 2014; 107: 158-168

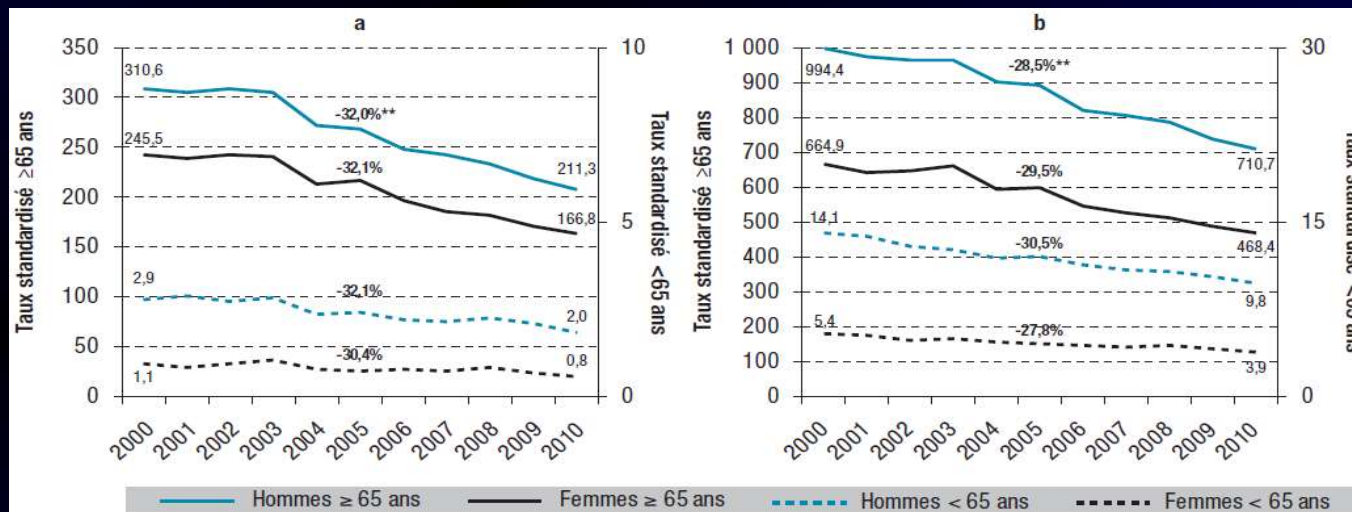
Évolution des taux de mortalité par IC en France (a : en cause initiale ; b : en causes multiples)

GABET A et al. BEH 2014; 21-22: 386-394

Années	Cause initiale			Causes multiples		
	Total ^b	Hommes	Femmes	Total ^b	Hommes	Femmes
2000	46,0	53,5	41,3	137,5	175,1	113,7
2001	45,1	52,7	40,5	133,3	171,4	109,6
2002	45,7	53,2	41,1	132,5	168,8	109,9
2003	45,5	52,7	41,1	133,9	168,5	112,5
2004	40,3	47,0	36,3	122,7	158,0	101,2
2005	40,6	46,5	36,9	123,1	156,6	102,4
2006	37,1	43,0	33,6	112,5	144,0	93,3
2007	35,8	42,3	31,9	109,4	141,4	90,2
2008	34,7	40,8	31,1	106,2	137,6	87,4
2009	32,7	38,3	29,4	101,0	129,6	83,8
2010	31,1	36,4	28,0	96,8	124,9	80,2
Variation 2000-2010	-32,4%	-32,0%	-32,2%	-29,6%	-28,7%	-29,5%

^a Nombre de décès pour 100 000 habitants, standardisé sur l'âge selon la population française de 2006.

^b Taux global standardisé sur l'âge et le sexe selon la population française de 2006.

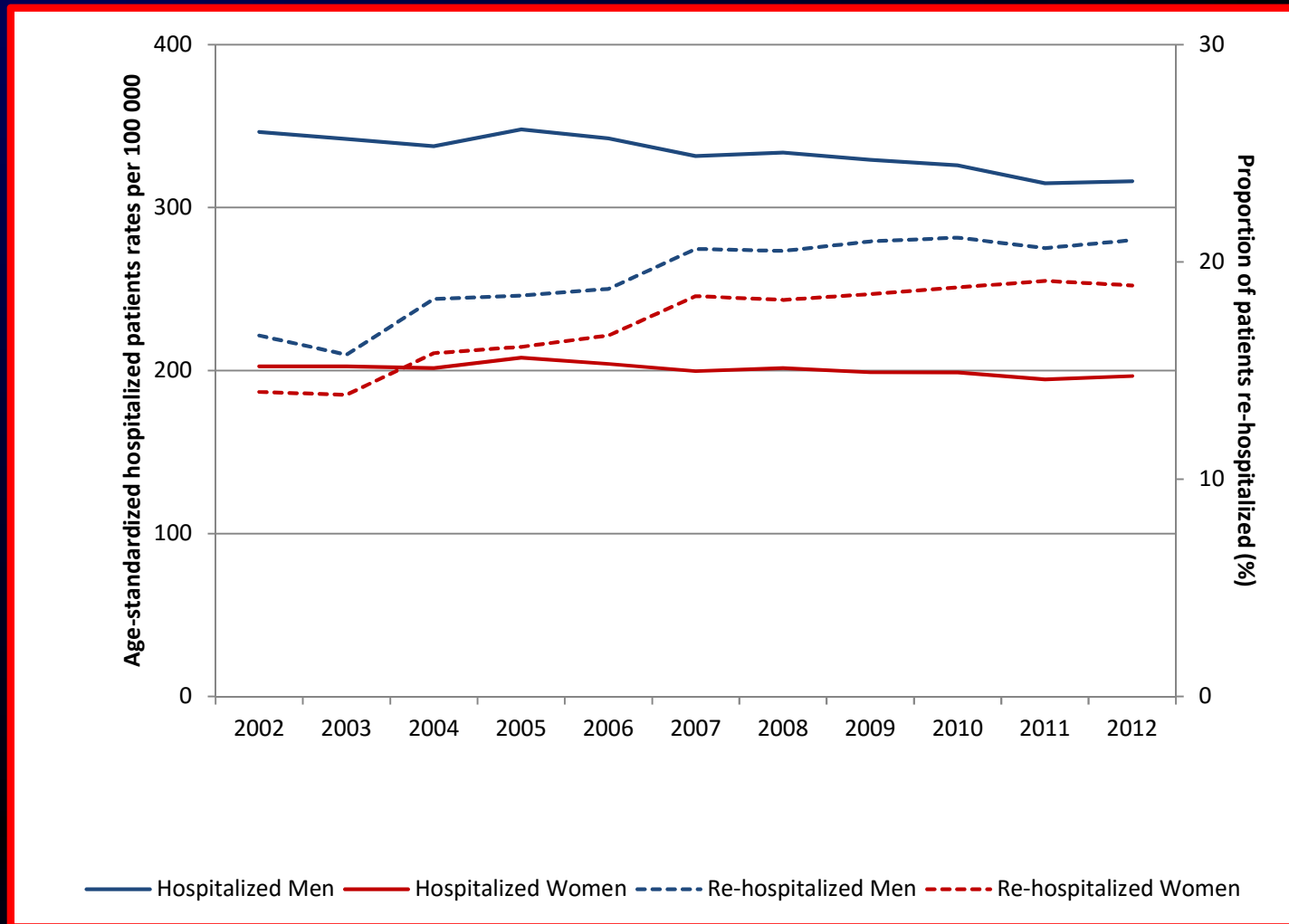


* Taux de mortalité pour 100 000 habitants, standardisé sur l'âge selon la population française de 2006.

** Pourcentage de variation du taux de mortalité standardisé entre les années 2000 et 2010.

National trends in rate of patients hospitalized for heart failure and heart failure mortality in France, 2000-2012

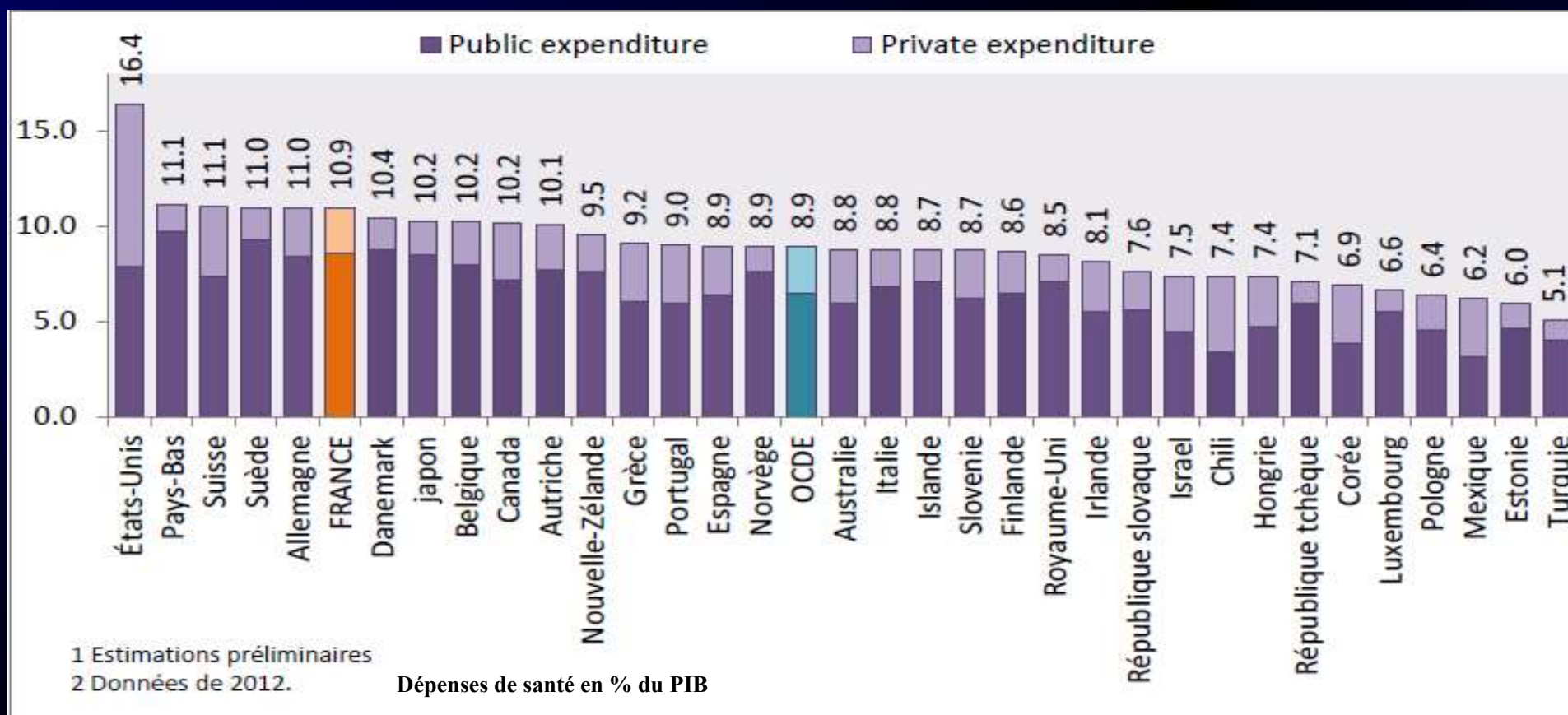
GABET A et al. Eur J Heart Fail 2015; 17: 583-590



Trends in age-standardized rates (per 100,000 inhabitants and standardized to the 2010 European census population) of patients hospitalized for HF and re-hospitalized for HF between 2002 and 2012, by sex, France

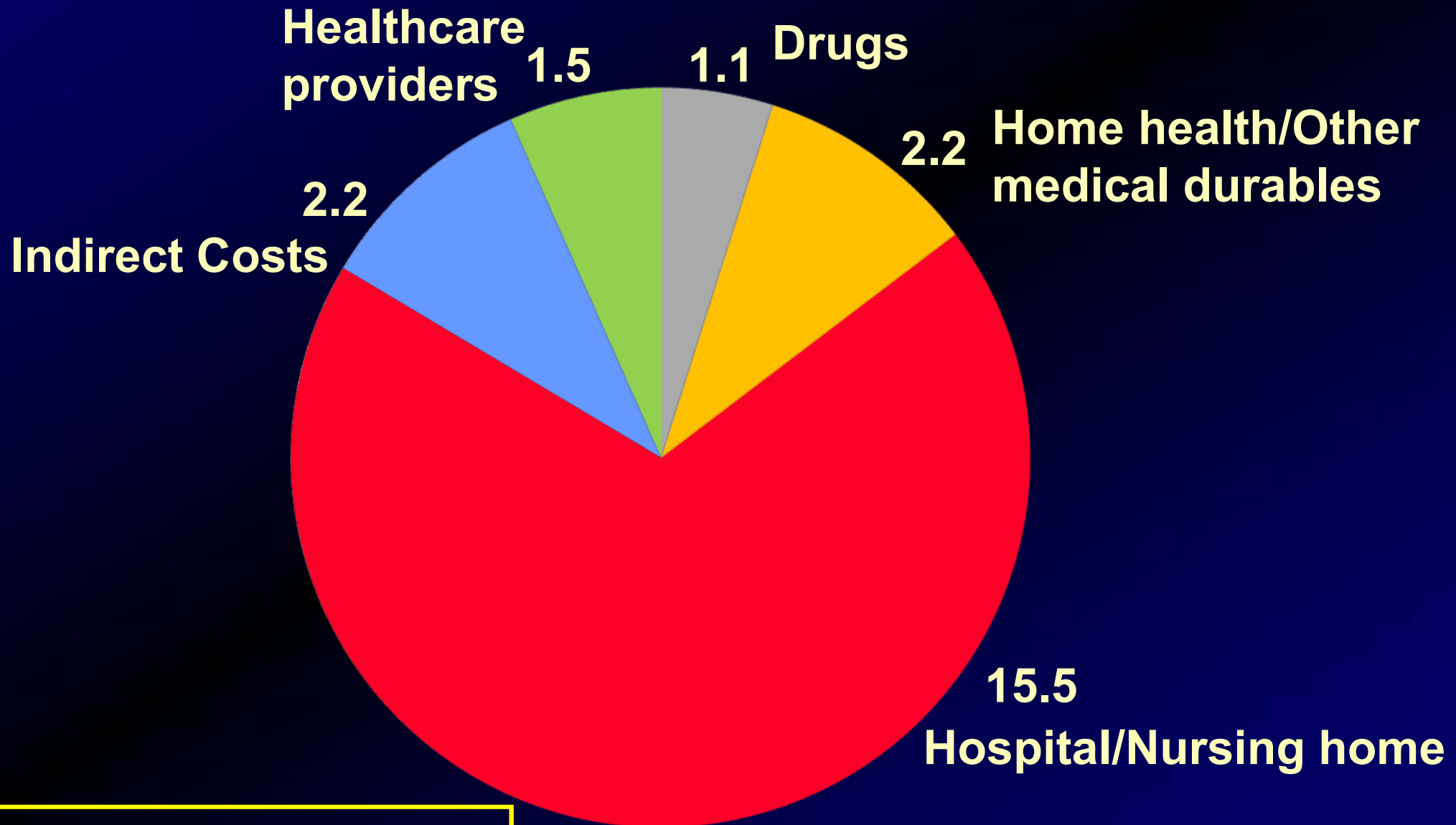
Le contexte économique

Dépenses de santé OCDE 2015



ANNUAL COST OF HF ESTIMATED TO BE \$22.5 BILLION (USA)

(American Heart Association 2000 Heart and Stroke Statistical Update)



Costs in billions of dollars

Prevalence and economic burden of CVDs in France in 2013 according to the national health insurance scheme database

TUPPIN P et al. Arch Cardiovasc Dis 2016; 109: 399-411

	Outpatient care (%)							Total
	Physicians	Nurses and physiotherapists	Other health care professionals	Clinical pathology	Drugs	Other health products (LPP)	Transport	
<i>Heart failure</i>	2.7	21.7	2.7	2.1	11.7	6.4	2.9	48.8
Acute	1.5	9.6	0.0	0.9	3.5	3.1	2.5	21.1
Chronic	6.1	35.2	0.1	3.4	20.8	10.2	3.3	79.4
<i>All cardiovascular diseases</i>	5.9	11.5	0.5	1.8	15.1	4.1	3.3	42.9

	Hospital care (%)				Cash payments (%)	Total (million €s)
	DRG hospitalization stays	Additional payment for expensive drugs	Post-acute care, rehabilitation	Total		
<i>Heart failure</i>	30.4	1.5	16.0	48.9	2.4	2500
Acute	57.1	2.8	18.1	78.5	0.4	1314
Chronic	0.9	0.1	13.8	16.1	4.5	1186
<i>All cardiovascular diseases</i>	30.4	3.9	14.5	50.3	6.8	15,090

17%

DRG: diagnosis-related group; LPP: *liste des produits et prestations*. The shares of total outpatient care or hospital stays are higher than the sum of the shares of the various types of expenditure included in the table because only the main expenditures were reported.

L'approche thérapeutique et son évolution

Facteurs de risque cardiovasculaire

Maladie
coronaire

HTA
Valvulopathies

Cardiomyo-
pathies

Maladies
cardiaques rares

Co-morbidités

**INSUFFISANCE
CARDIAQUE**

Systolique / Diastolique
Chronique / Aiguë
Gauche / Droite

Complications

Thrombo-
embolies
AVC

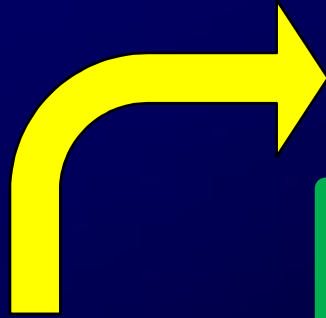
Dépression
Défaillance
cognitive

Arythmies

Œdème
Capacité à
l'effort réduite

Activation
neuro-
endocrine

Soins de fin de vie ?



Facteurs de risque comportementaux

Mauvaise alimentation
Tabagisme
Manque d'activité physique
Usage nocif de l'alcool

Mondialisation
Urbanisation
Vieillesse
Revenu
Education
Logement

Déterminants et facteurs sociaux

Facteurs de risque métaboliques



Insuffisance rénale

Infarctus myocardique
AVC
Insuffisance cardiaque

Maladies cardiovasculaires



Élévation PA
Obésité
Diabète
Hyperlipidémie

Saignées

120 à 1950



- ❖ Préconisées par Hippocrate et Galien :
théorie des humeurs
- ❖ Surtout à partir de la Renaissance
jusqu'au XVIIIème siècle (panacée
universelle)
- ❖ XIXème siècle : encore utilisée assez
largement
- ❖ Milieu du XXème siècle :
essoufflement
- ❖ Actuellement : rares indications
(hémochromatose, polycythémie vraie)

1750 à 1990



William Whitering - 1785



Digitale pourpre

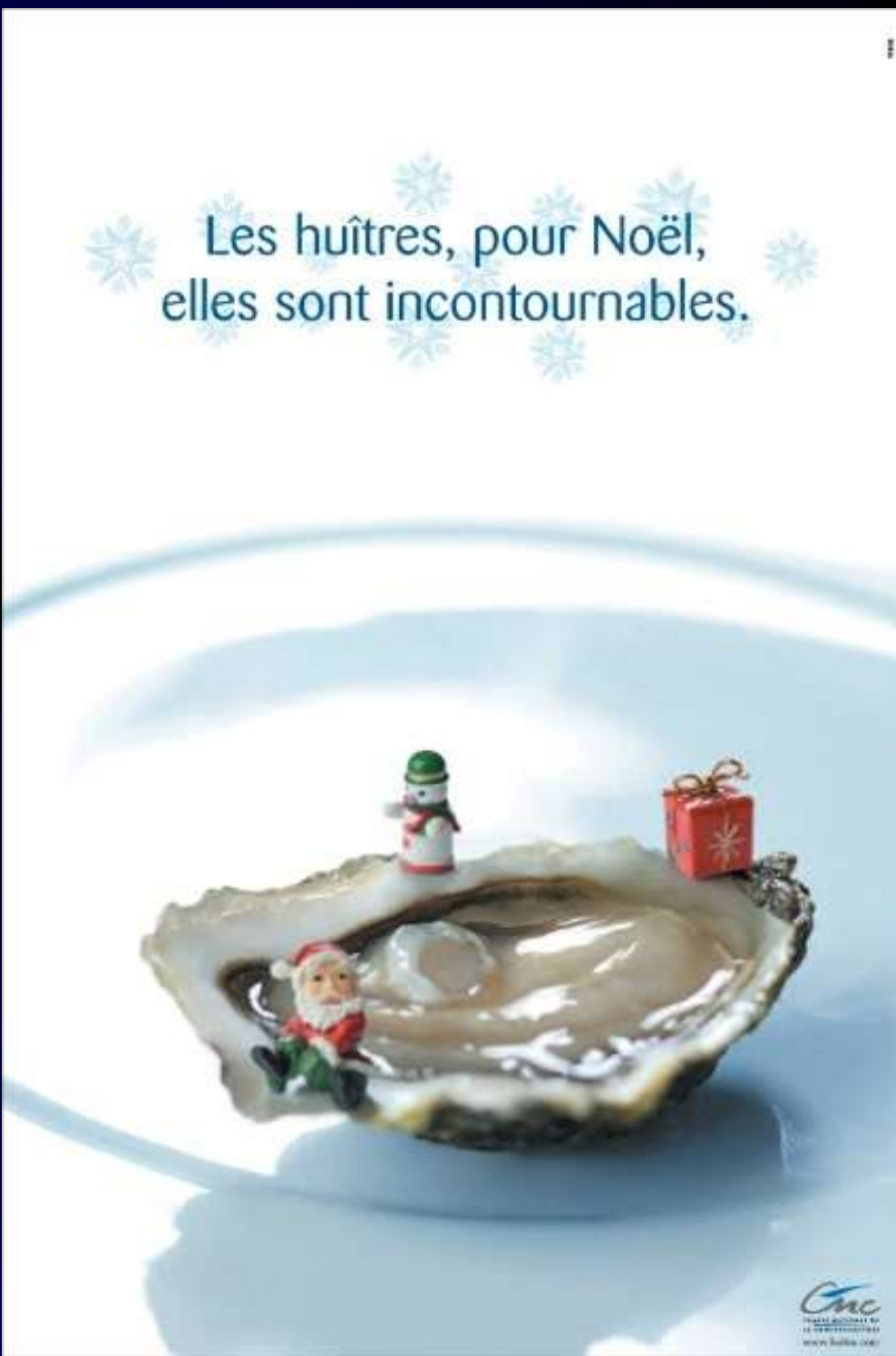
REGLES HYGIENO-DIETETIQUES

- ❖ IC = important dérèglement neuro-hormonal
- ❖ Apports sodés : modérés.
 - 6 g de sel/jour
- ❖ Apports hydriques :
 - < 1,5 l/jour
 - Eviter l'alcool
- ❖ Réentraînement à l'effort +++





ittel
**Buvez.
Eliminez.**



Les huîtres, pour Noël,
elles sont incontournables.

CONSENSUS

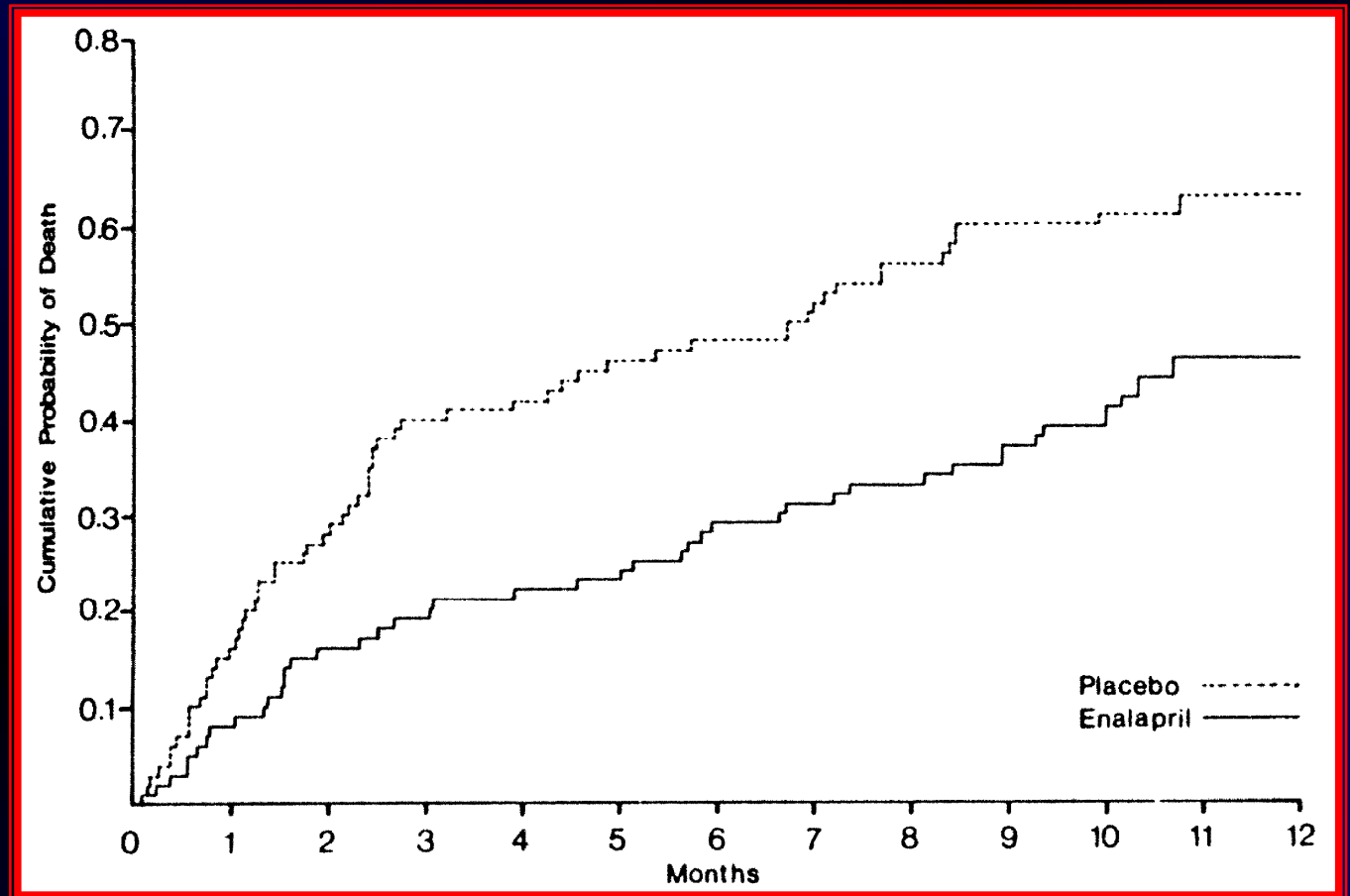
NYHA IV
Enalapril
18 mg/d

6-mth mortality:

P 44%

E 26%

RRR: 40%



CONSENSUS group. N Engl J Med 1987; 316: 1429-35

1950s - 1980s

Modèle hémodynamique

Contractilité réduite

Dysfonction de la pompe

Traitement :

Drogues inotropes positives pour
stimuler la contractilité

Vasodilatateurs pour « décharger »
le coeur

Drogues conventionnelles

Diurétiques

Digitaliques

1980s - 2000

Modèle neurohormonal

Remodelage progressif avec altération de la
performance myocardique

Traitement :

Prévention de la progression avec
des bloqueurs neurohormonaux

Drogues conventionnelles

Diurétiques

Digitaliques

Thérapies émergentes

Bloqueurs de l'endothéline

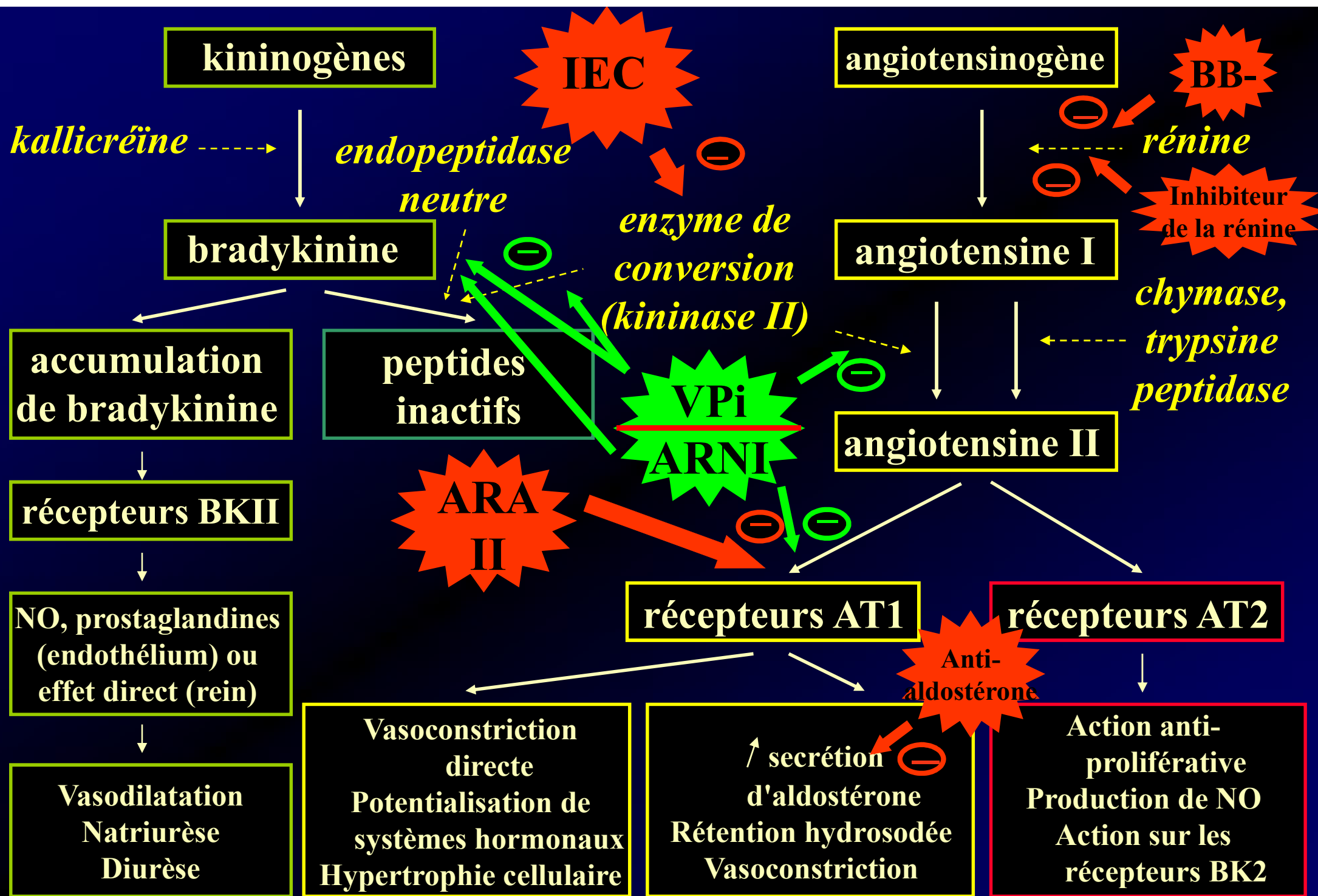
Peptides atriaux chimériques

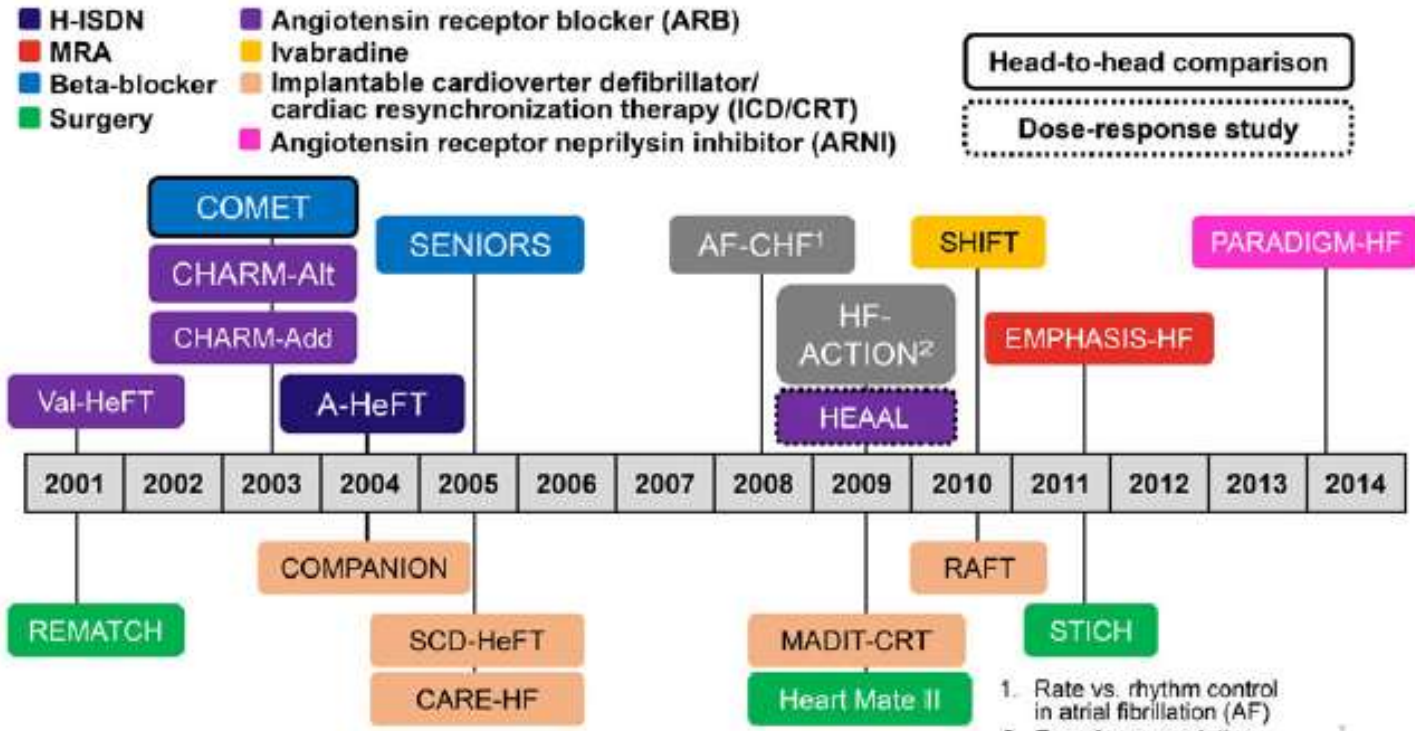
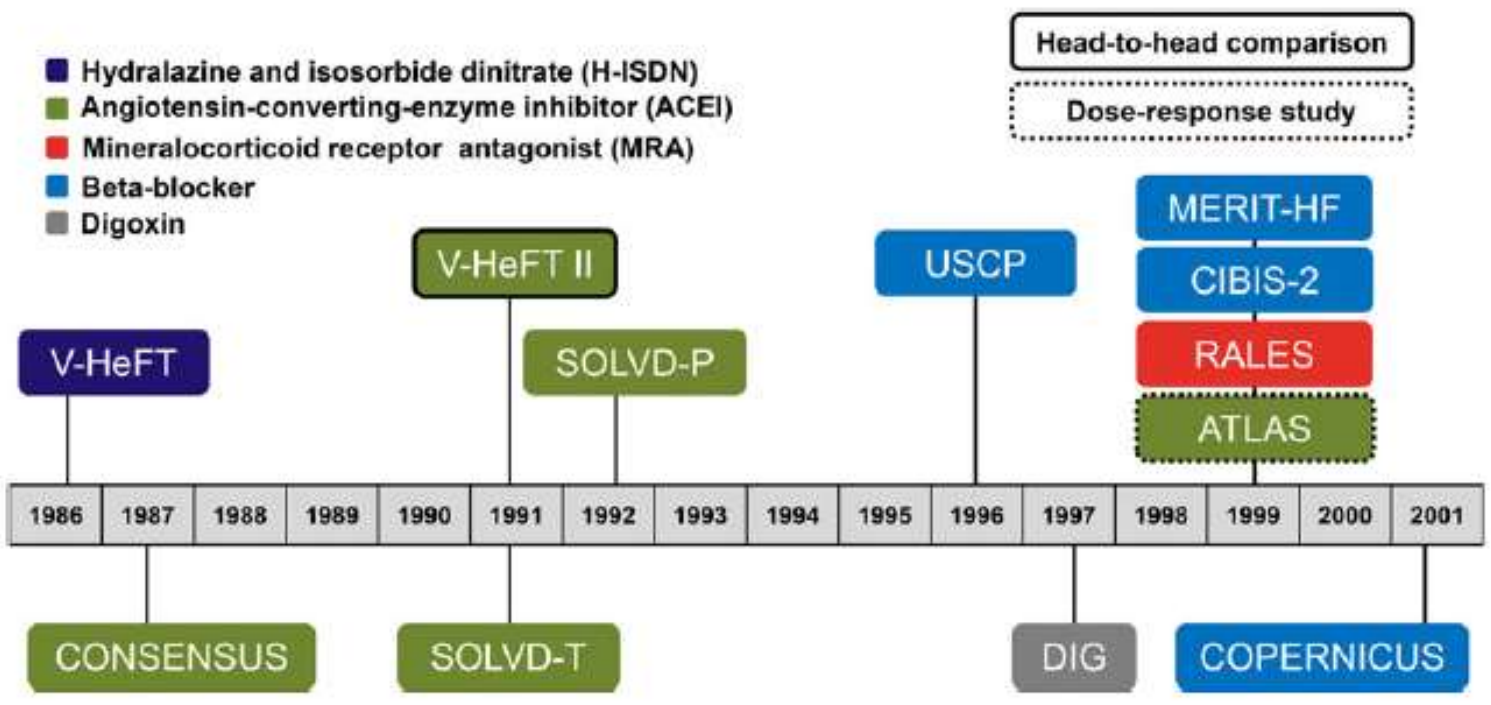
Inhibiteurs des cytokines

Inhibiteurs des métalloproteinases
matricielles

Heart Failure: a changing paradigm

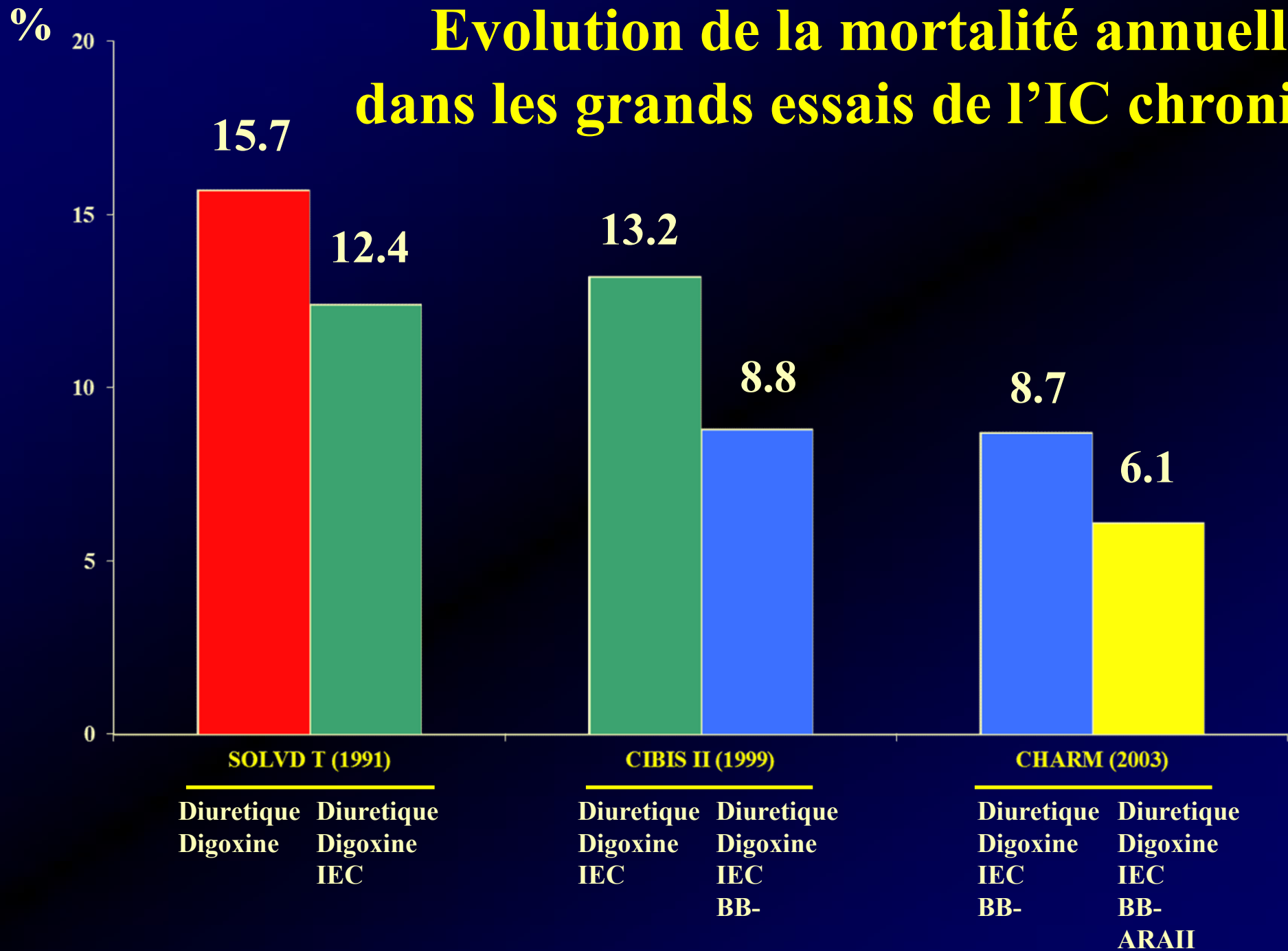
Francis GS, Am J Med 2001; 110(7A): 37S-46S





1. Rate vs. rhythm control in atrial fibrillation (AF)
 2. Exercise prescription

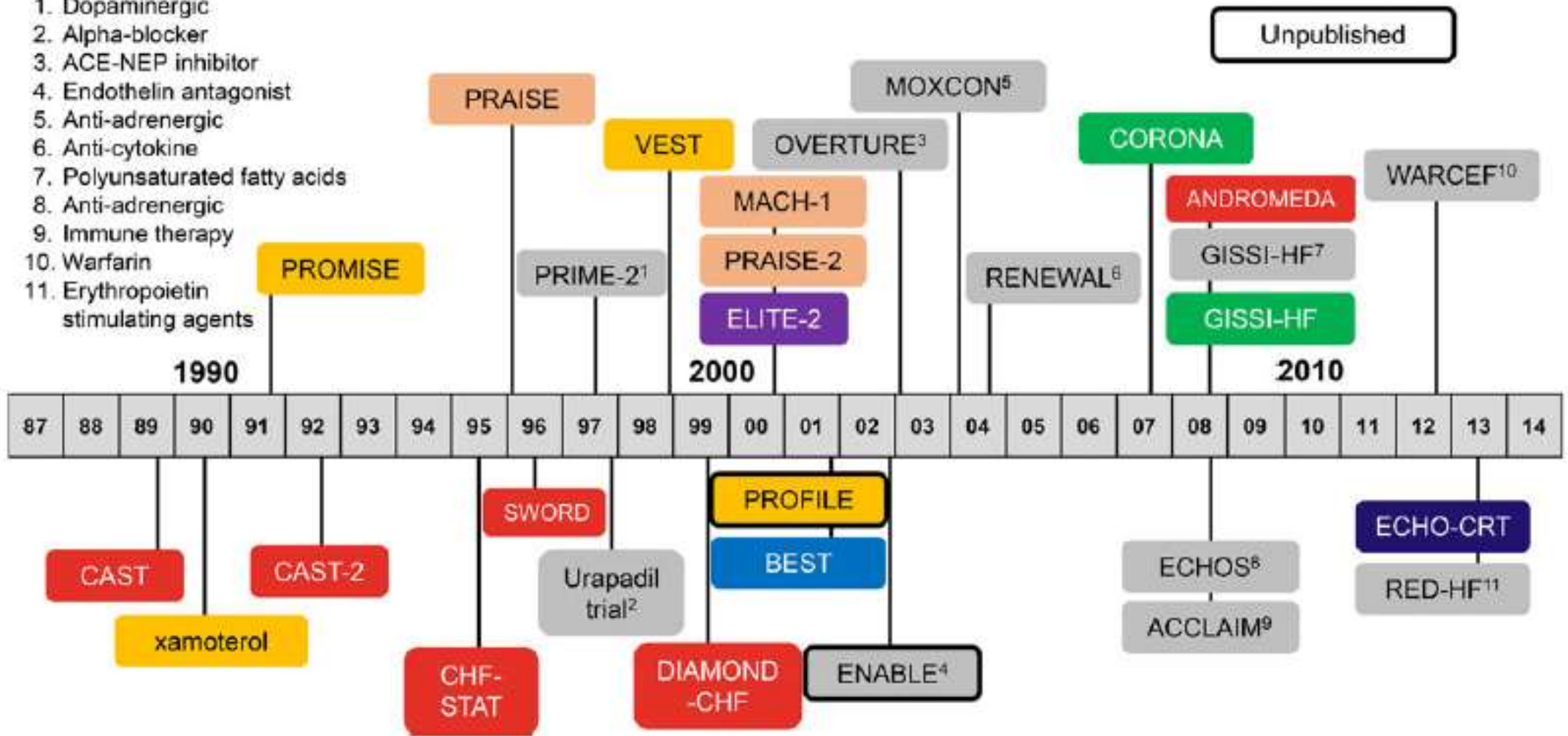
Evolution de la mortalité annuelle dans les grands essais de l'IC chronique



■ CRT
 ■ ARB
 ■ Statin
 ■ Anti-arrhythmic
 ■ Inotrope
 ■ Beta-blocker
 ■ CCB

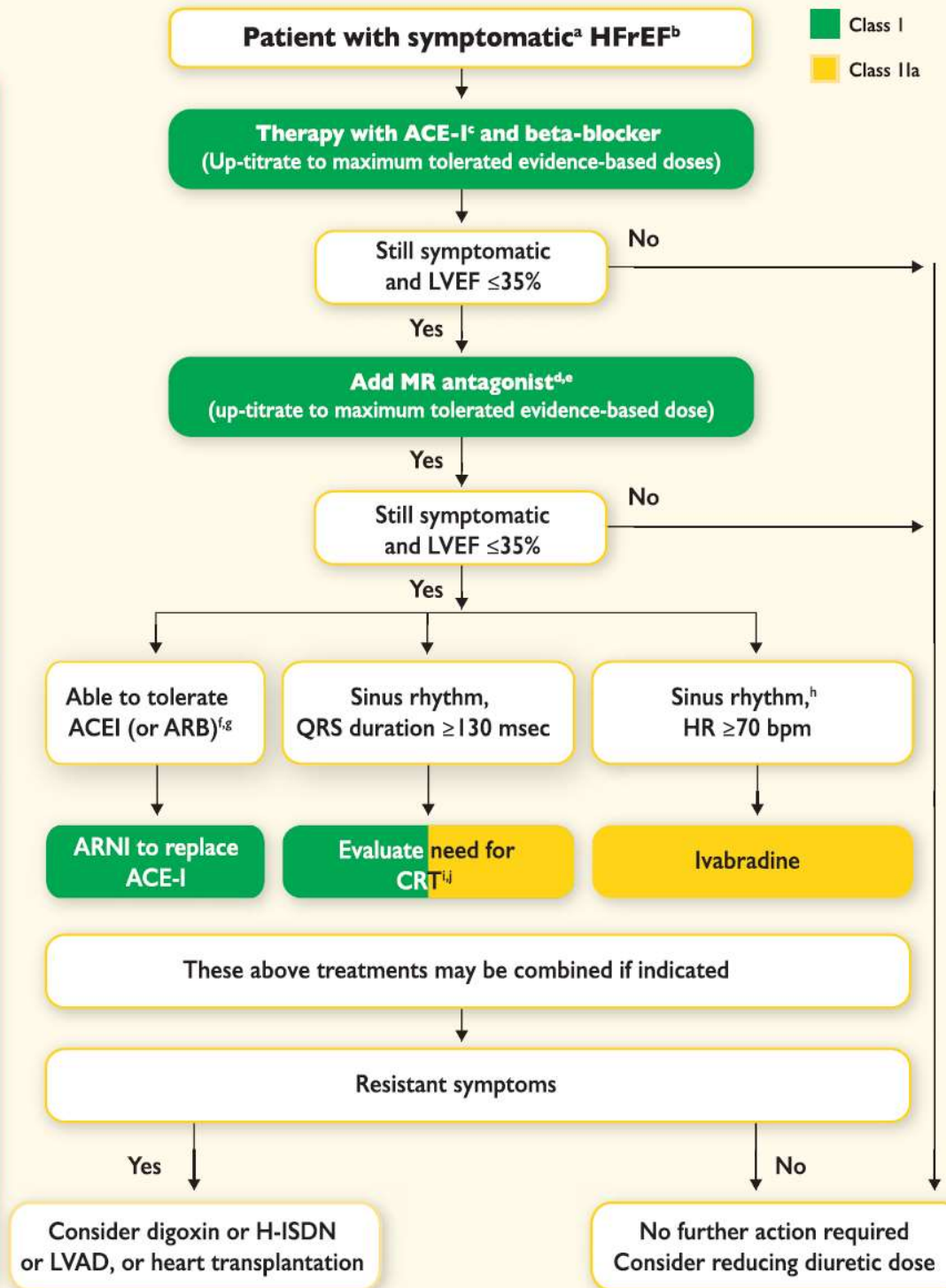
1. Dopaminergic
2. Alpha-blocker
3. ACE-NEP inhibitor
4. Endothelin antagonist
5. Anti-adrenergic
6. Anti-cytokine
7. Polyunsaturated fatty acids
8. Anti-adrenergic
9. Immune therapy
10. Warfarin
11. Erythropoietin stimulating agents

Unpublished

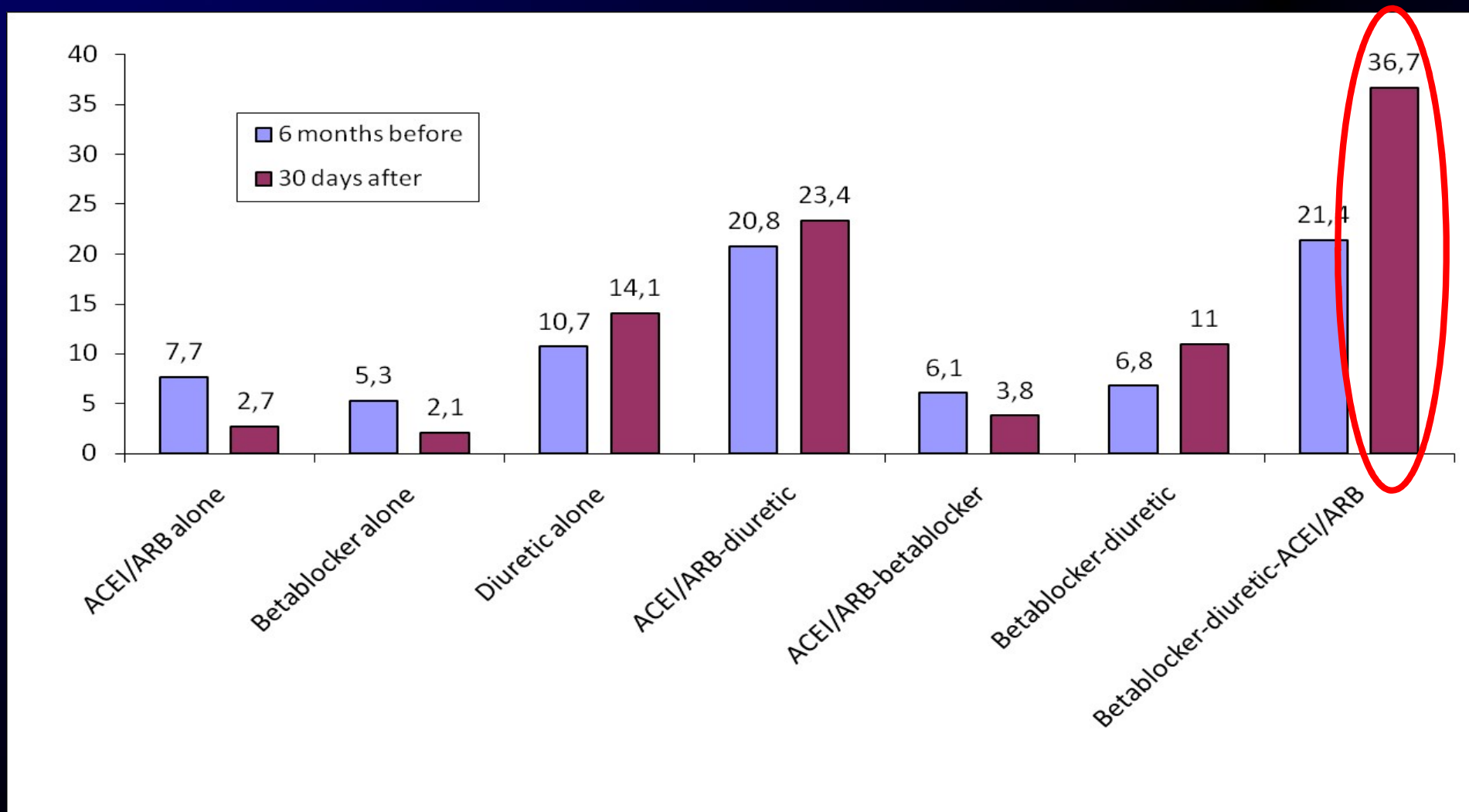


Diuretics to relieve symptoms and signs of congestion

If LVEF $\leq 35\%$ despite OMT
or a history of symptomatic VT/VF, implant ICD



Treatments, 6 months before index hospitalization (2009) and for patients surviving at least 30 days after discharge, with at least one drug reimbursement during these two periods

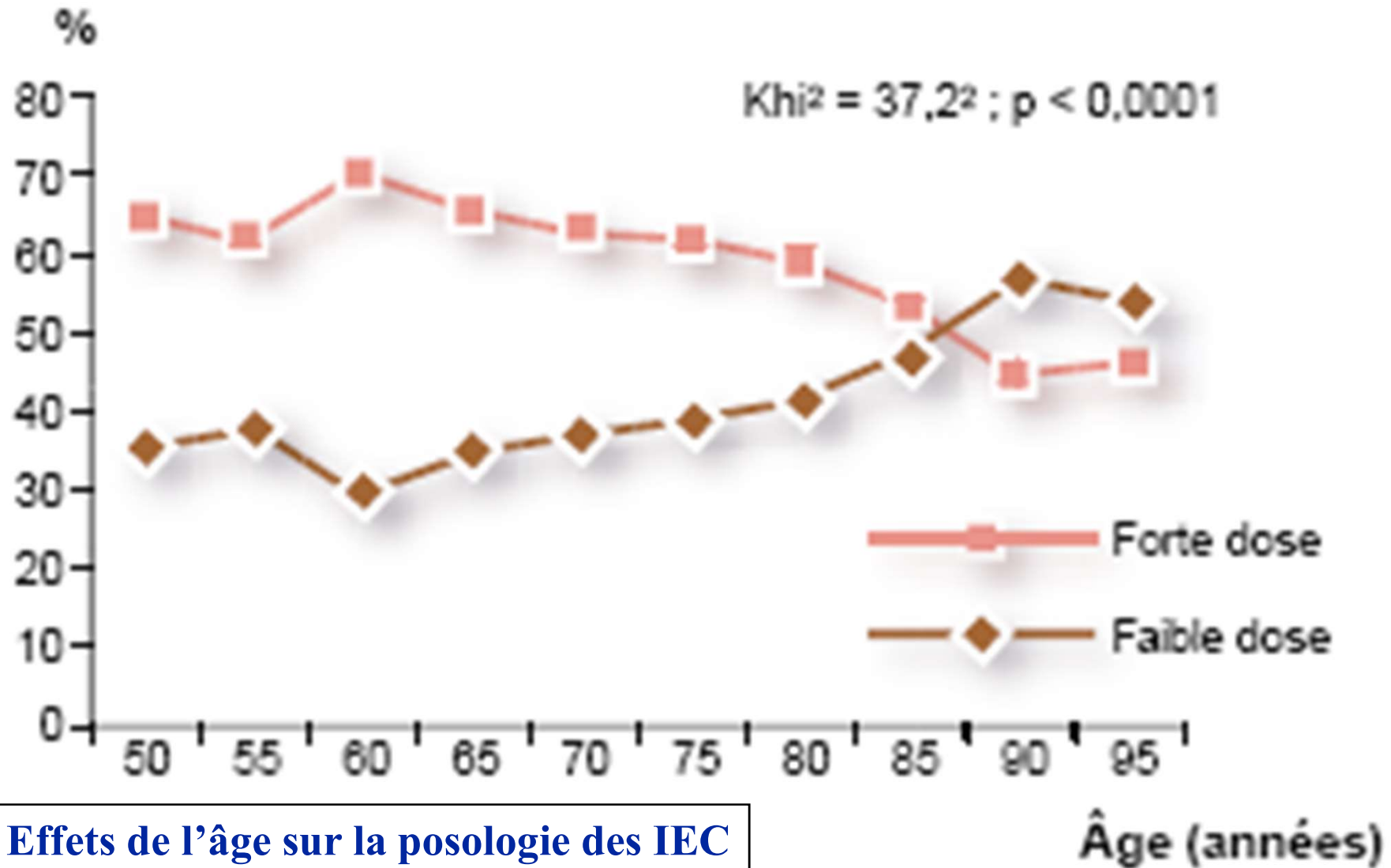


Two-year outcome of pts after a first hospitalization for HF in France in 2009

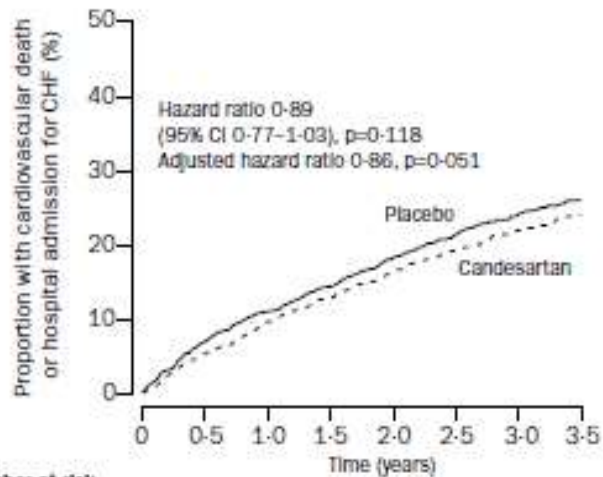
TUPPIN P et al. Arch Cardiovasc Dis 2014; 107: in press

Prise en charge des pts IC par les MG français en 2003

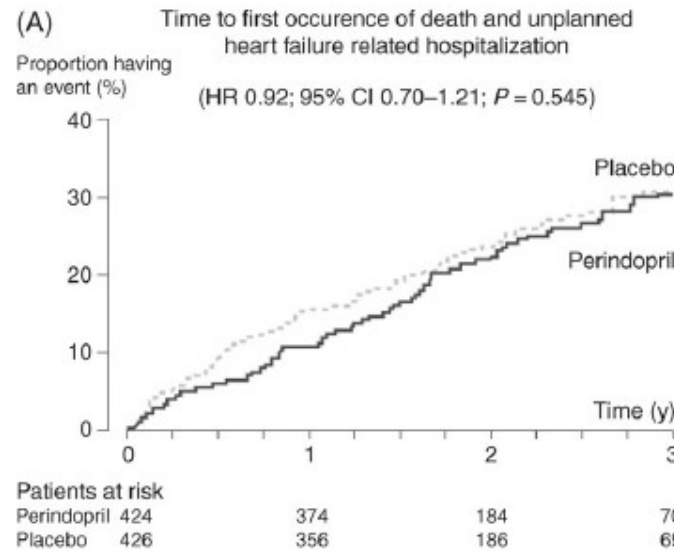
Jondeau G et al, Arch Mal Cœur 2004; 97: 833-839



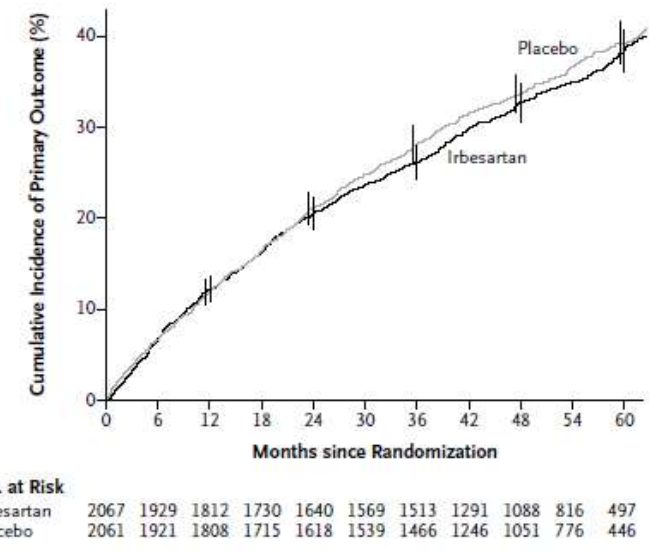
GRANDS ESSAIS DANS L'IC-FEP



CHARM Preserved

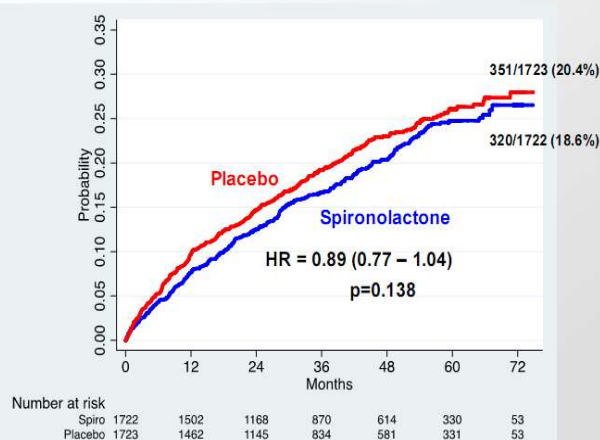


PEP-CHF



I-PRESERVE

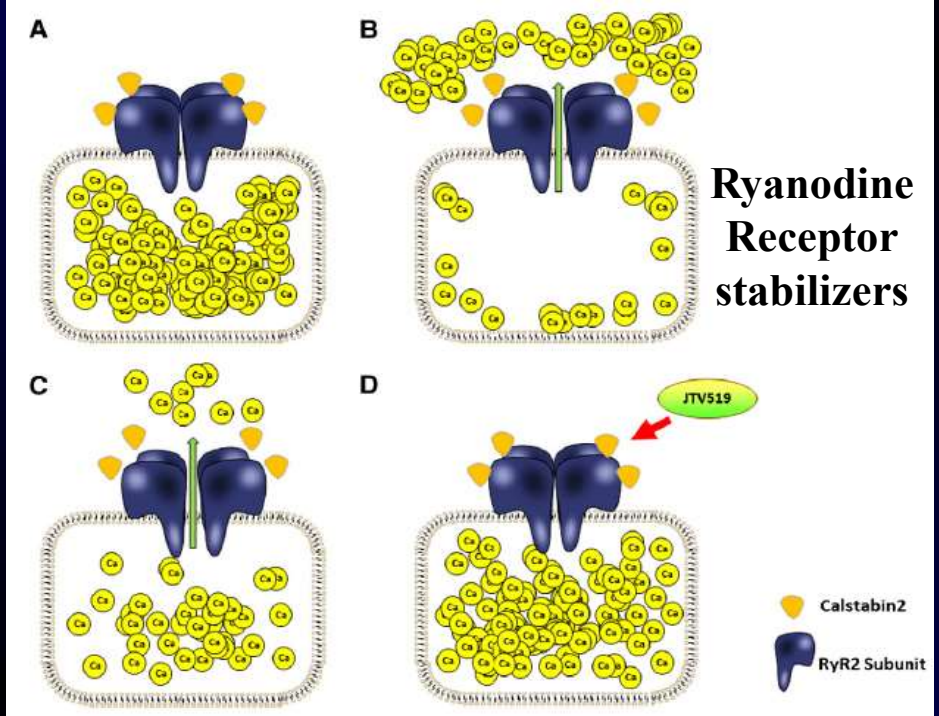
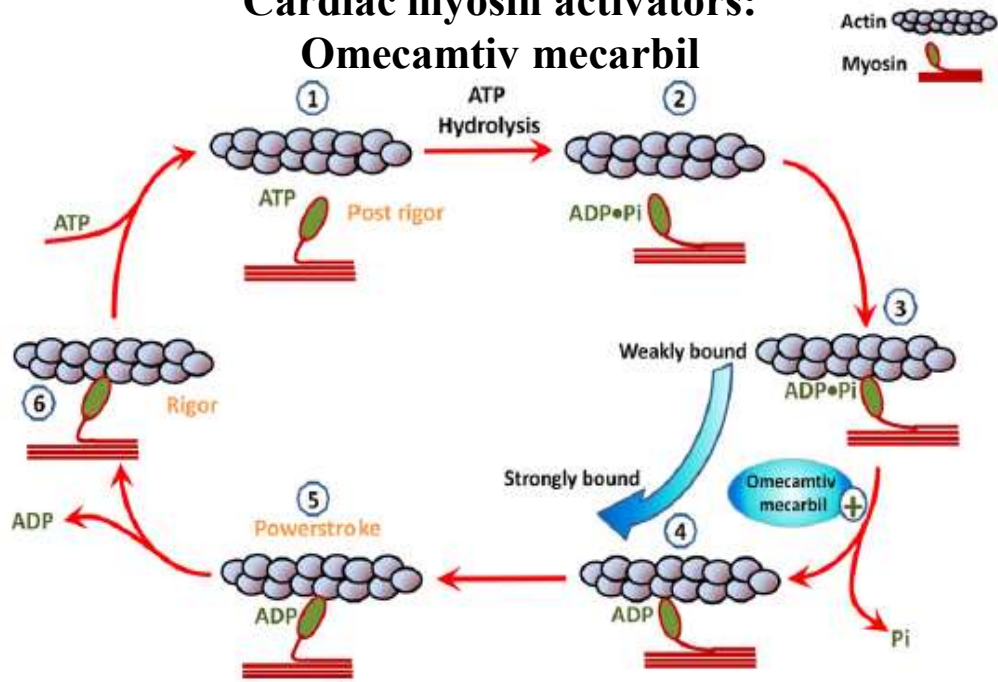
1° Outcome
(CV Death, HF Hosp, or Resuscitated Cardiac Arrest)



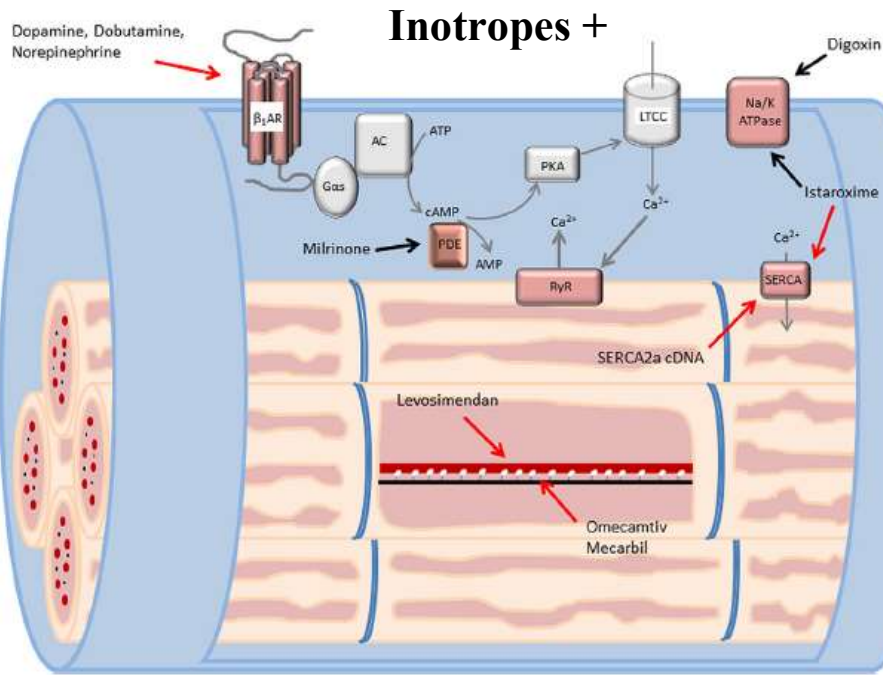
TOPCAT

Traitement de l'IC avec FEVG préservée : ce que l'on veut !

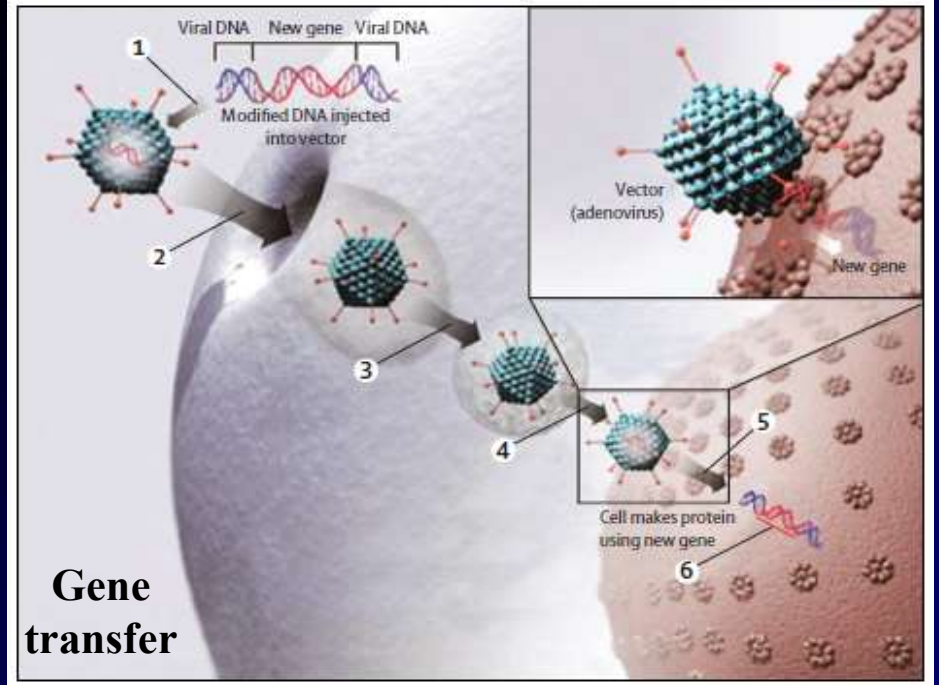
Cardiac myosin activators: Omecamtiv mecarbil



Ryanodine Receptor stabilizers

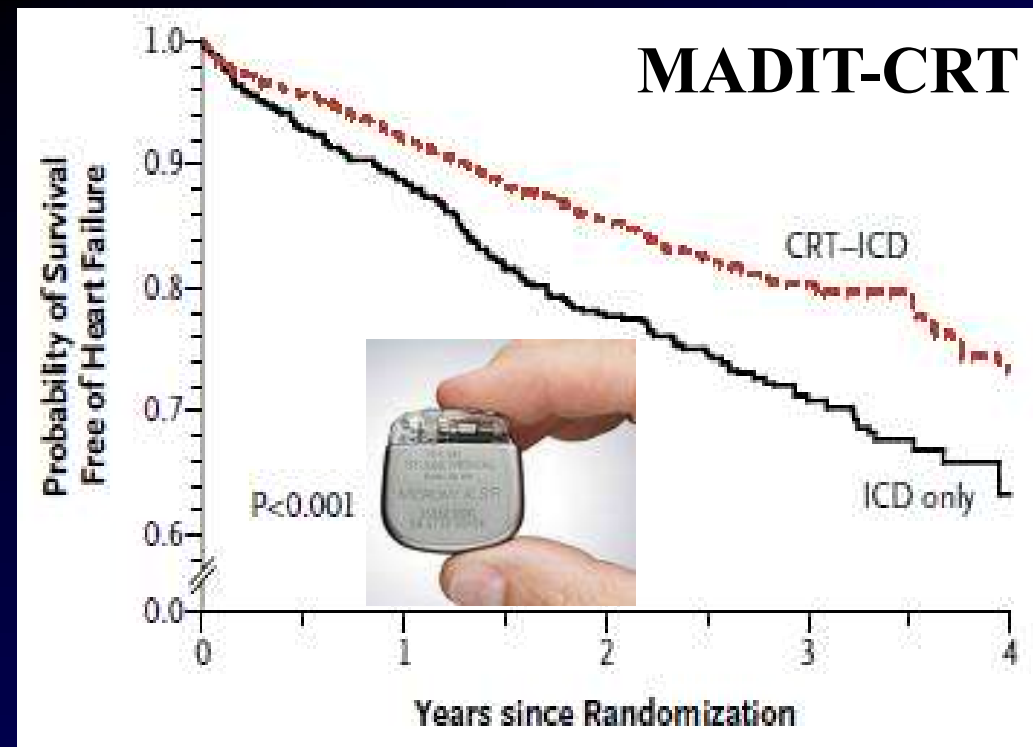
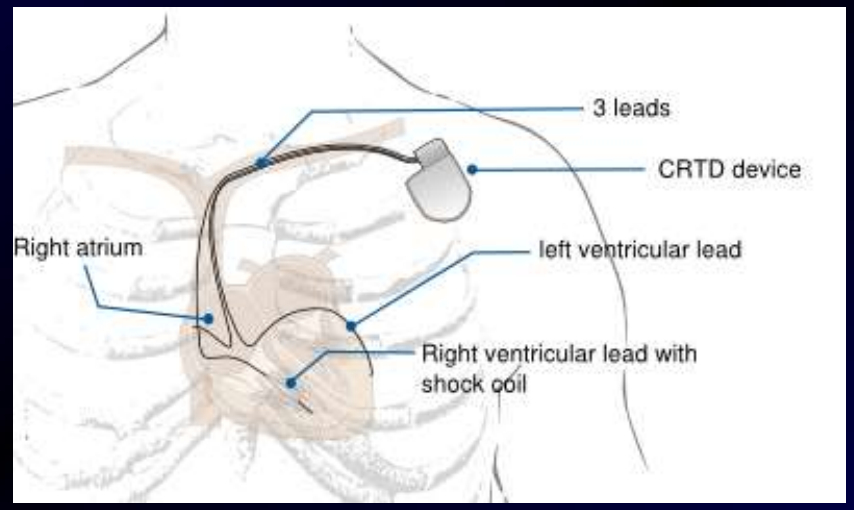
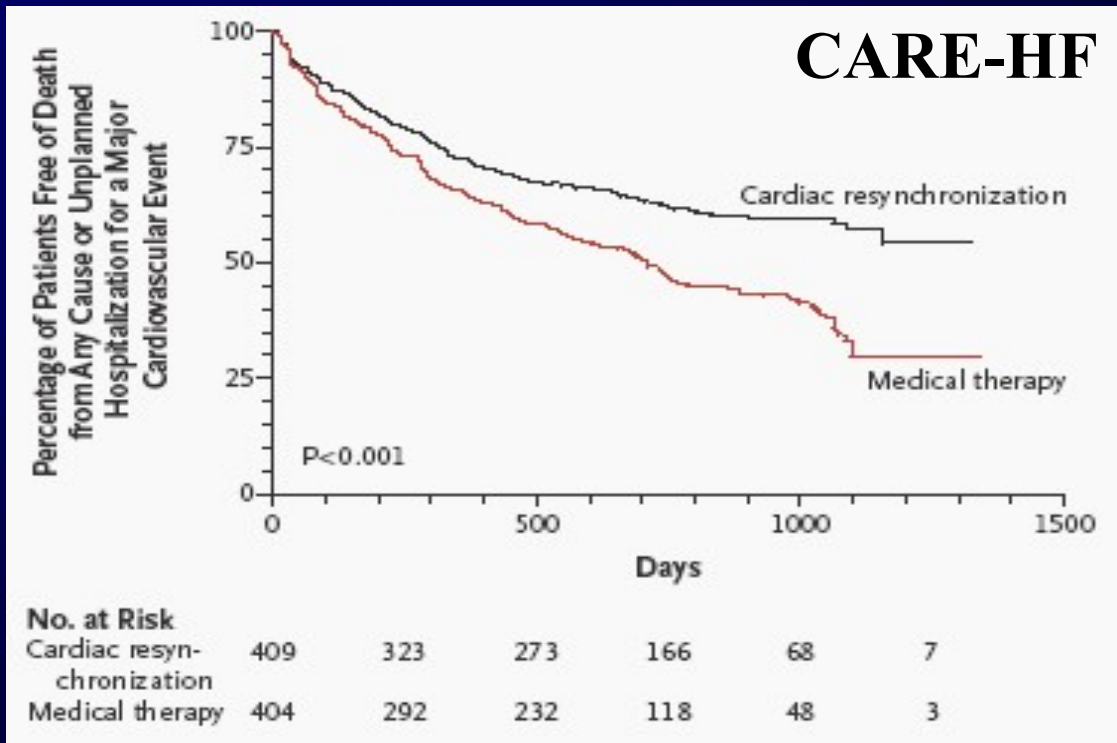


Inotropes +

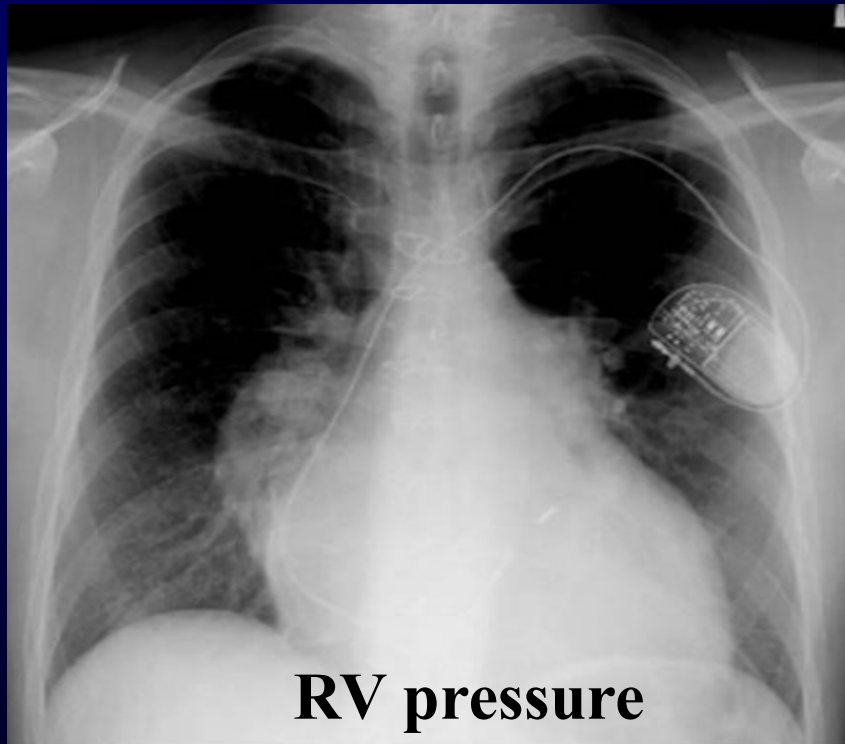


Gene transfer

DISPOSITIFS MEDICAUX ELECTRIQUES



Implantable haemodynamic monitoring Chronicle (Medtronic)



COMPASS-HF study
274 patients in NYHA class III or IV
6-month event rate
HF hospitalisation or
emergency room visit

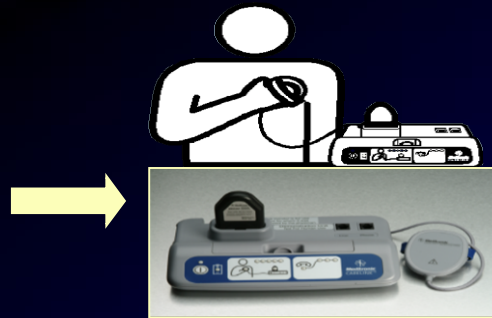
Chronicle	0.70
Control	0.89

$p = 0.33$

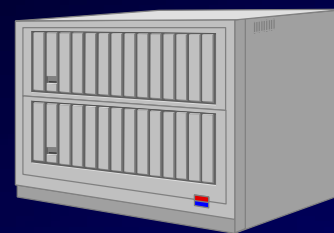
Bourke J Am Coll Cardiol 2008;51: 1073-9



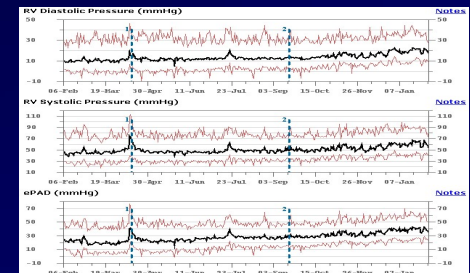
Chronicle® IHM



Home Monitor



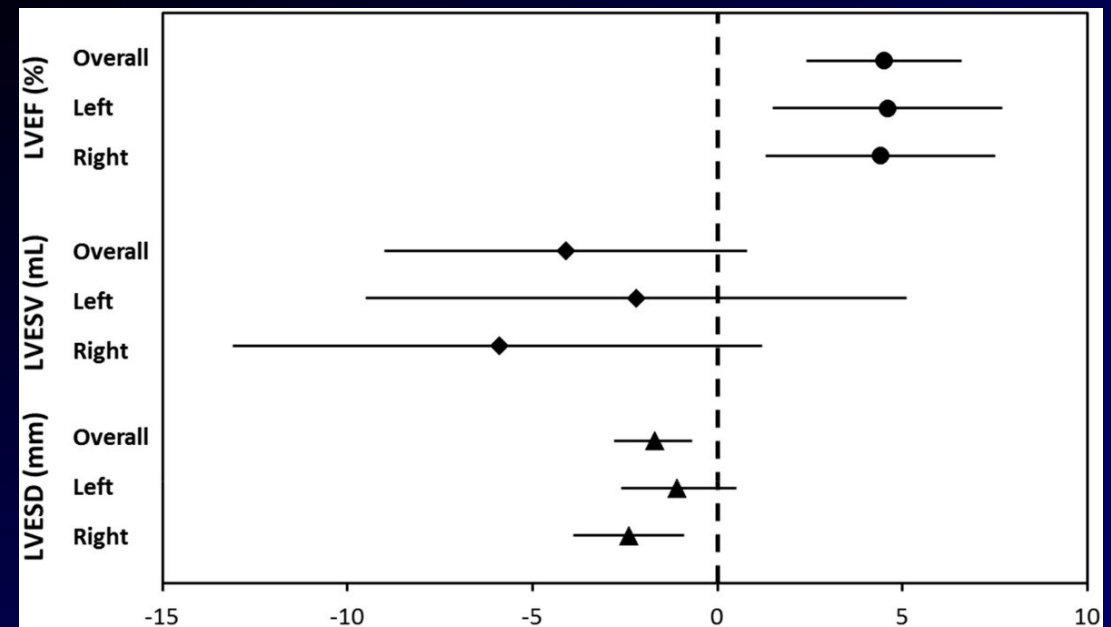
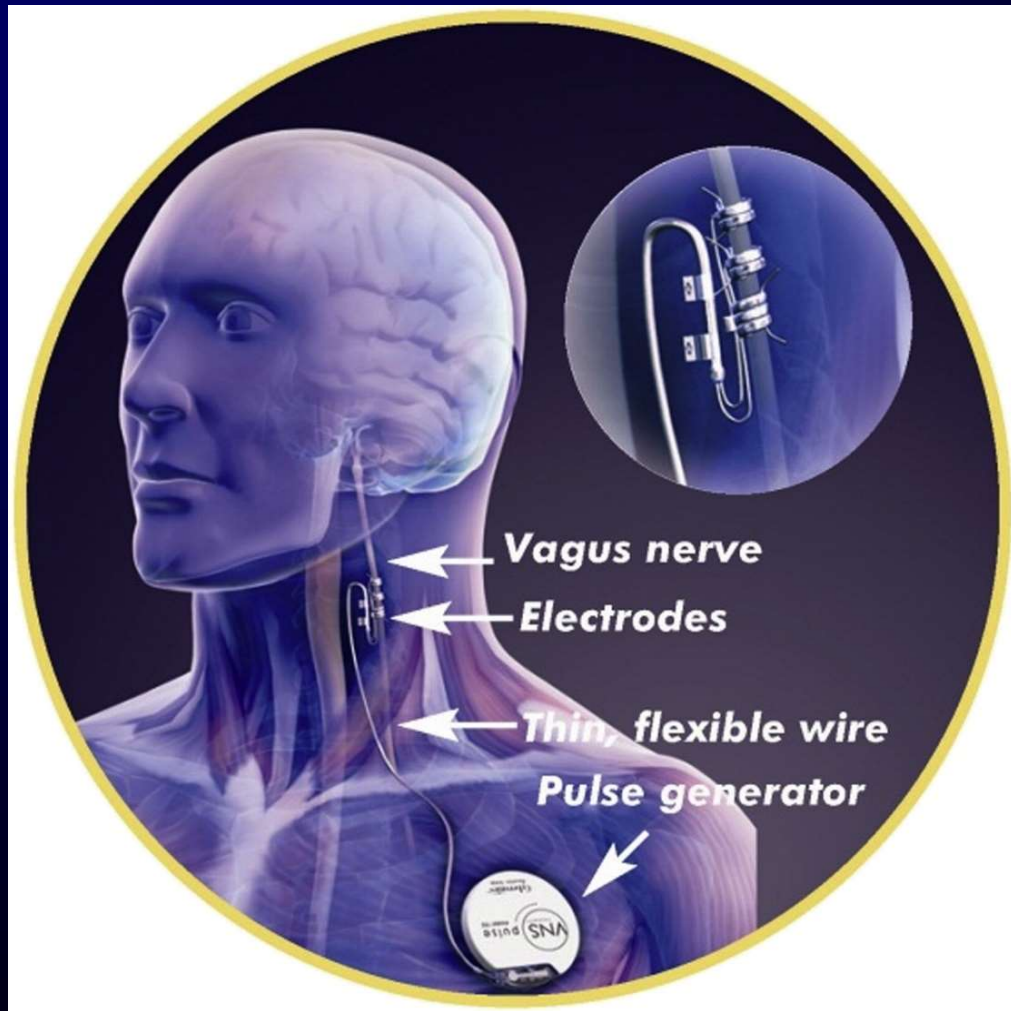
Secure Network



Clinician access

Autonomic regulation therapy via left or right cervical vagus nerve stimulation in pts with CHF: the ANTHEM-HF trial

PREMCHAND RK et al. J Card Fail 2014; 808-816



HEART TRANSPLANTATION

FRENCH BIOMEDICINE AGENCY 2013

Figure C1. Durée d'attente selon la période d'inscription (1995-2013)

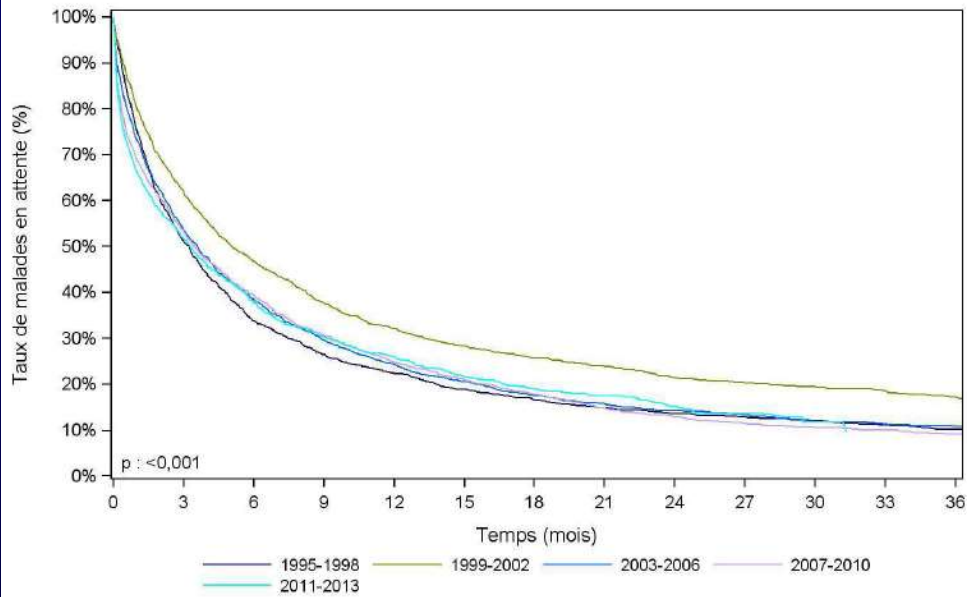


Figure C4. Survie globale du receveur après greffe cardiaque (1993-2012)

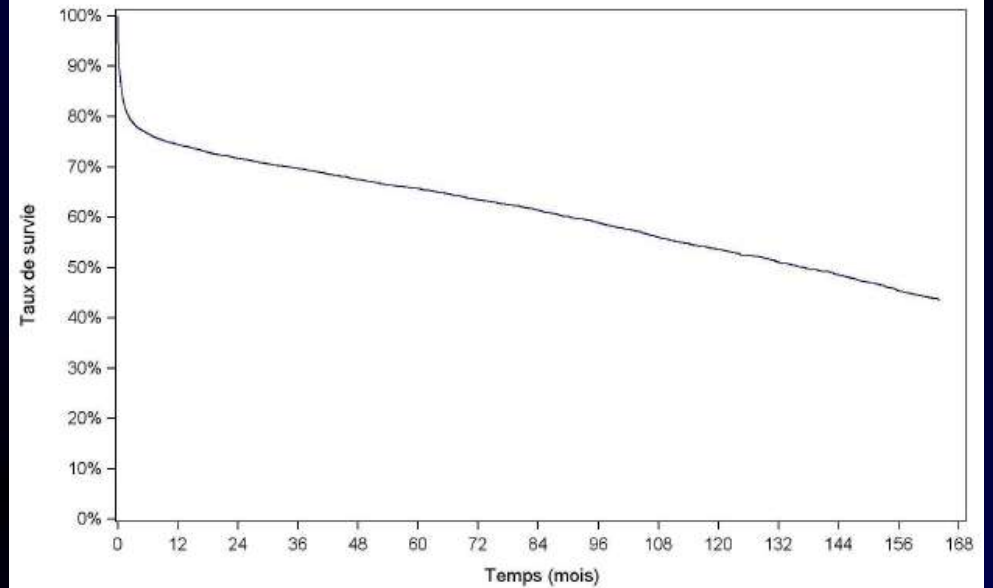


Figure C5. Courbe de survie du receveur cardiaque selon la période de greffe

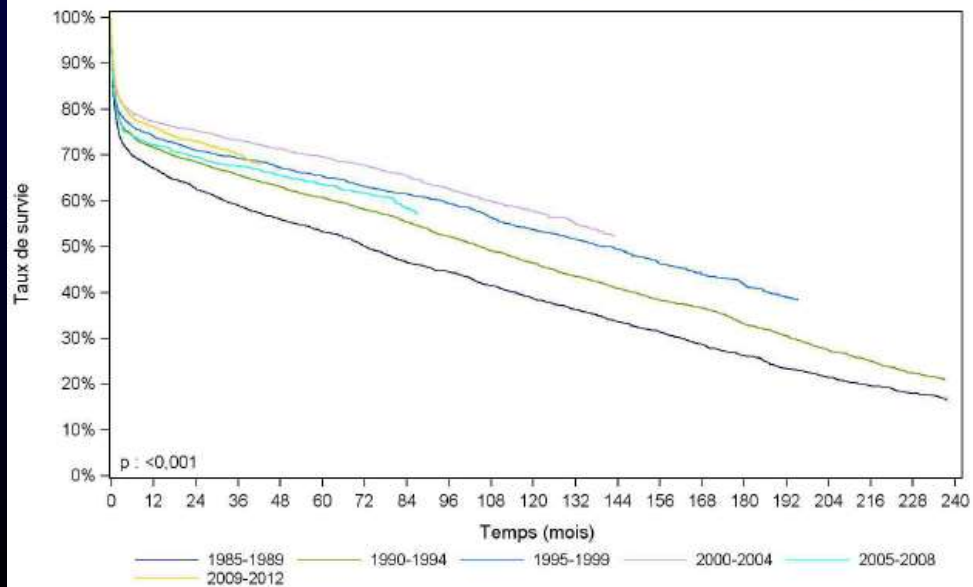
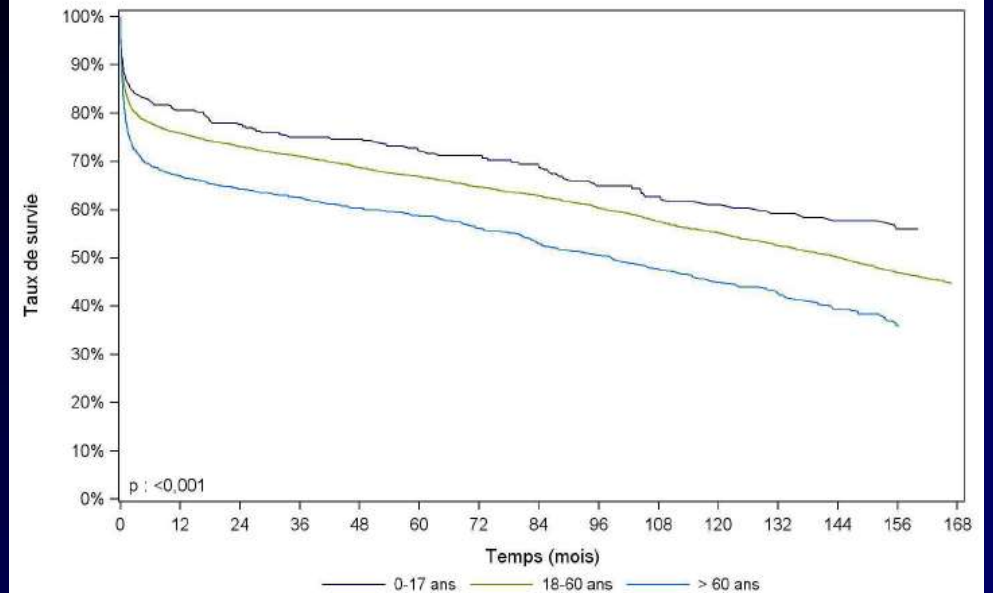


Figure C6. Survie du receveur après greffe cardiaque selon l'âge du receveur (1993-2012)



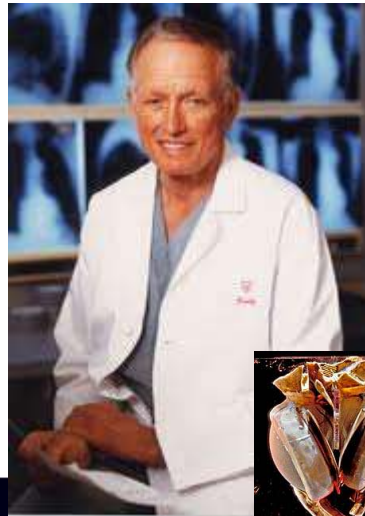
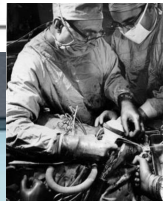
Mechanical circulatory support for advanced HF

STEWART GC and GIVERTZ MM. Circulation 2012; 125: 1304-1315

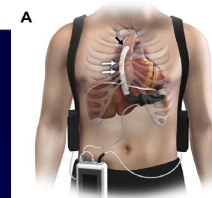
1960	1970	1980	1990	2000	2010
<p>1963: First report of implantable artificial ventricle by Liotta</p> <p>1964: NIH forms Artificial Heart Program</p> <p>1966: First successful pneumatic LVAD implanted by DeBakey for post-cardiotomy wean and bridge to recovery</p> <p>1969: Denton Cooley uses first TAH as bridge to transplant for postcardiotomy shock</p>	<p>1970: NIH forms working group to explore VADs</p> <p>1977: NIH request for proposals for components of long-term implantable pumps</p> <p>1978: Norman et al. report first use of LVAD as bridge to transplant for postcardiotomy stone heart syndrome</p>	<p>1980: NIH second request for proposals for long-term implantable LVAD</p> <p>1982: Implant of first total artificial heart (Jarvik-7) intended for permanent support</p> <p>1984: First successful implant of electrically-driven Novacor LVAD as bridge to transplant for chronic heart failure.</p> <p>1984: CMS defines strategies for LVAD support</p>	<p>1992: FDA approves Abiomed 5000 as bridge to transplant</p> <p>1994: FDA approves pneumatic LVAD (Thermo Cardiosystems) as bridge to transplant</p> <p>1995: FDA approves electrical LVAD (Thoratec XVE) as bridge to transplant</p> <p>1998: FDA approves Novacor and Thermo Cardiosystems LVADs as bridge to transplant</p>	<p>2001: REMATCH shows HeartMate XVE superior to optimal medical therapy for transplant-ineligible patients with advanced heart failure</p> <p>2003: Landmark FDA approval of Thoratec HeartMate XVE for destination therapy</p> <p>2004: Reports of SynCardia total artificial heart success as in-hospital bridge to transplant for biventricular failure leads to FDA approval</p> <p>2006: Interagency Registry of Mechanically Assisted Circulatory Support (INTERMACS) established</p> <p>2007: First report of continuous flow LVAD (Thoratec HeartMate II) as bridge to transplant</p> <p>2008: FDA approves continuous flow LVAD (HeartMate II) for bridge to transplant</p> <p>2009: Thoratec HeartMate II superior to HeartMate XVE as destination therapy</p>	<p>2010: FDA approves Thoratec HeartMate II for destination therapy</p> <p>2010: Preliminary results of HeartWare intra-pericardial continuous flow VAD as bridge to transplant (ADVANCE study)</p> <p>2011: NHLBI-sponsored REVIVE-IT study to compare LVAD with medical therapy in stable NYHA III patients</p>



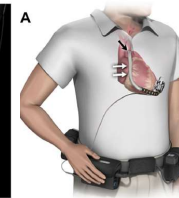
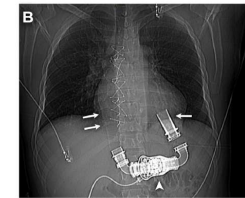
Mickael DEBAKEY



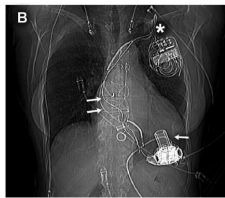
Denton COOLEY



HeartMate II

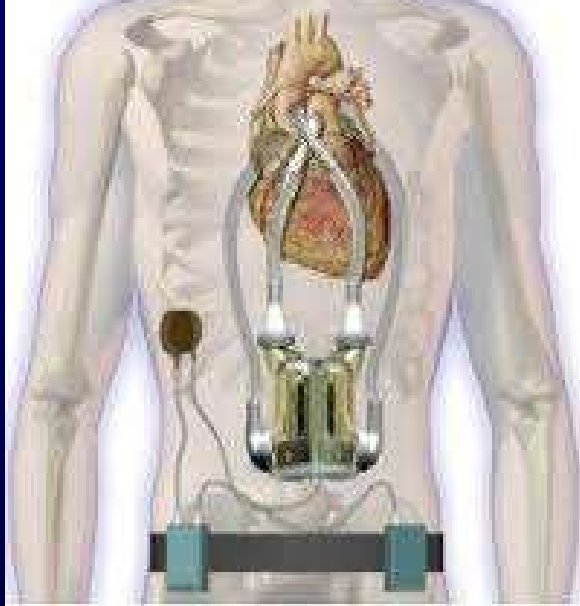


HeartWare



Différents types de cœur artificiel

AnyHeart



Thoratec



Incor



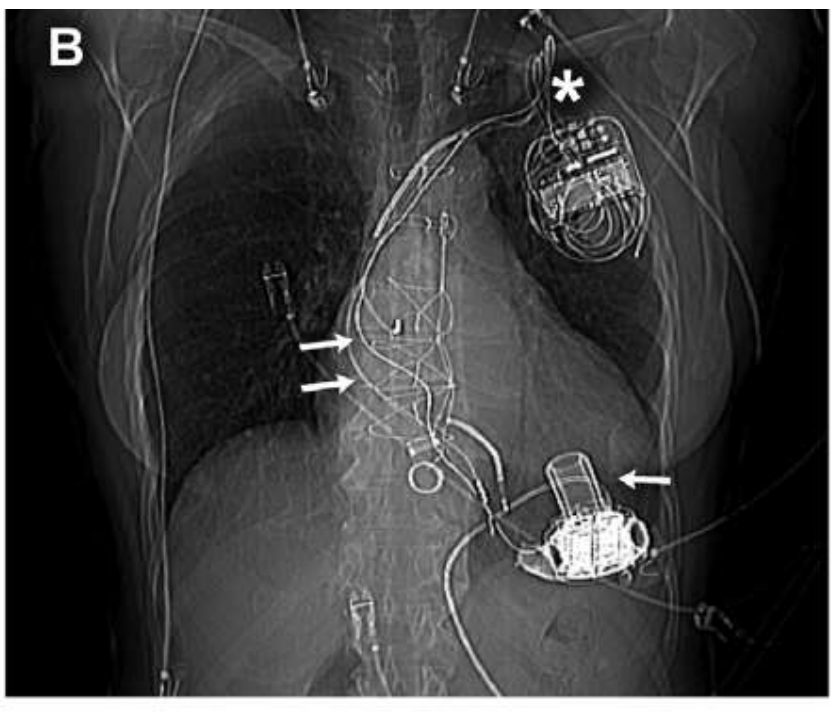
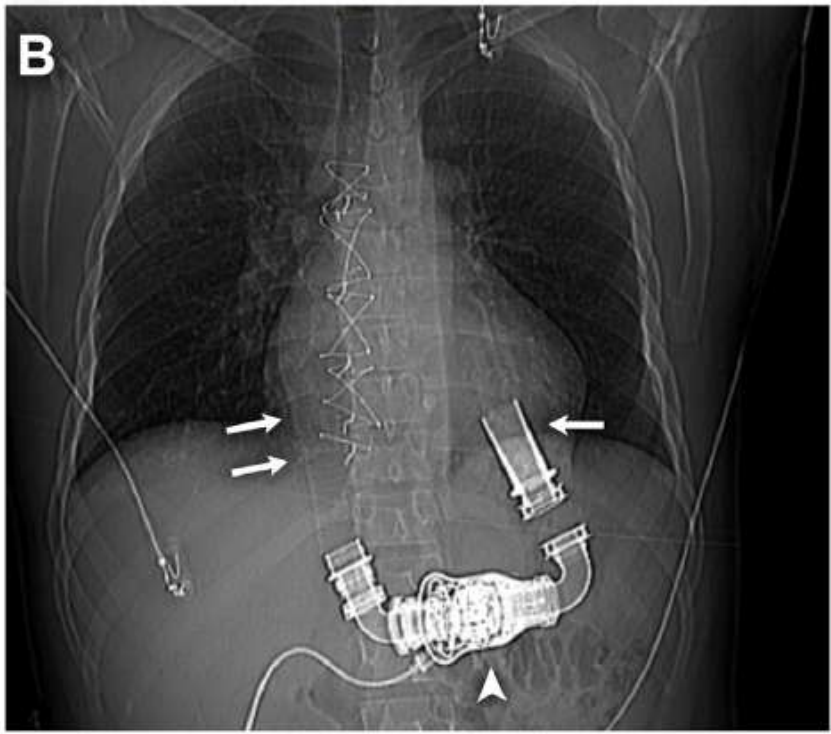
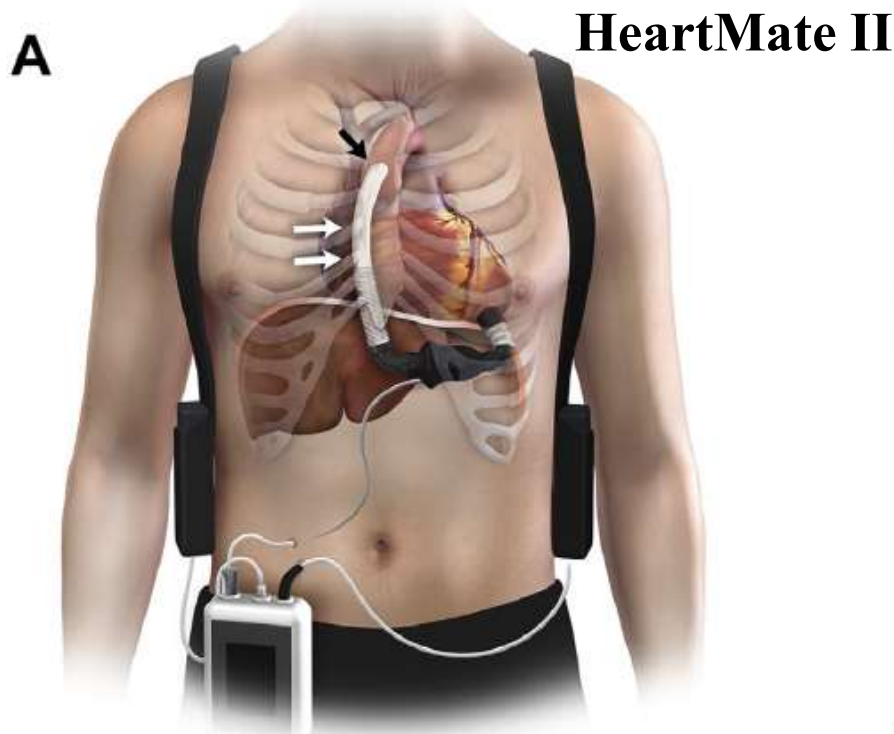
Novacor



**Jarvik-7
modern version**

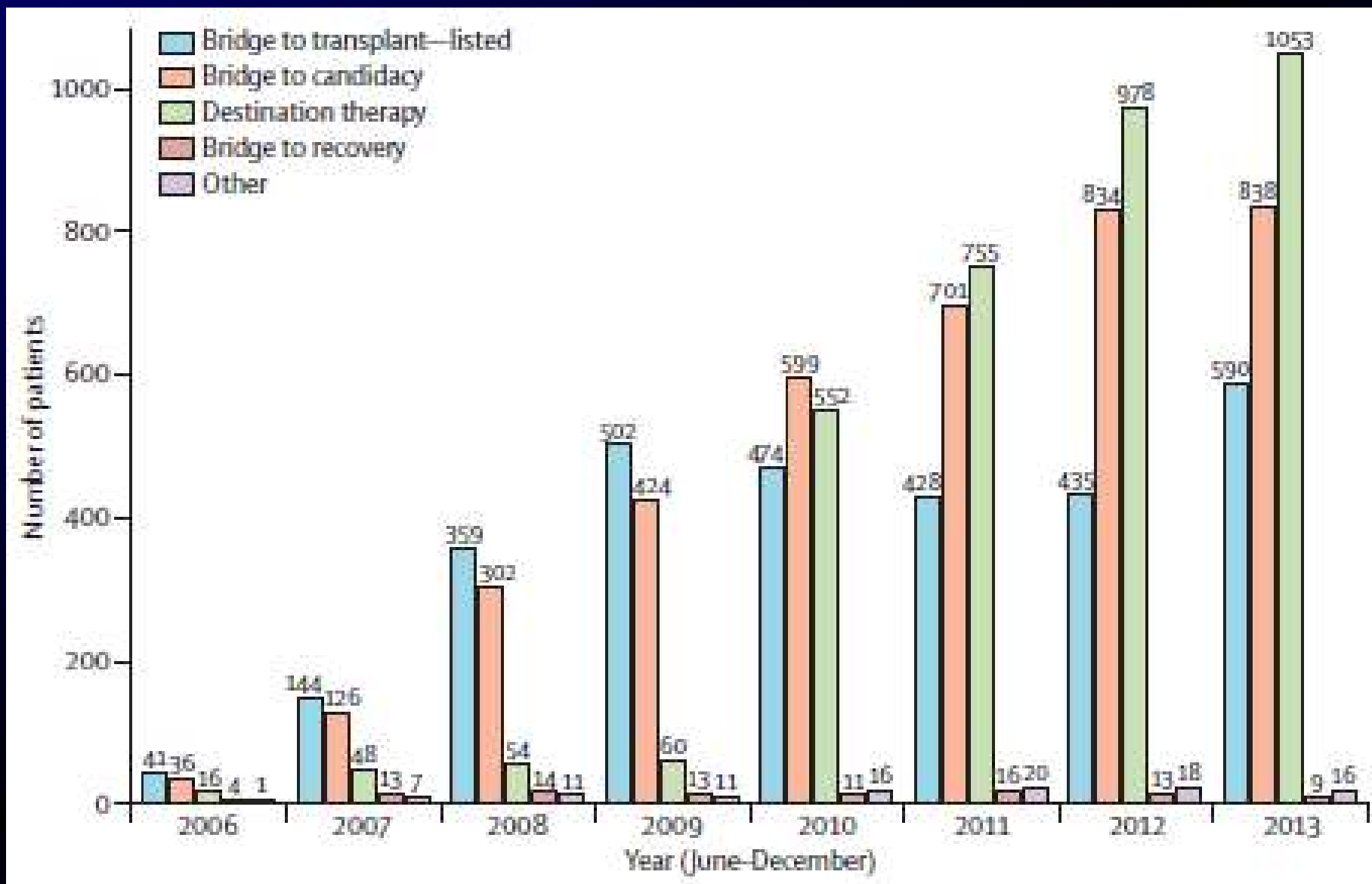


Continuous Flow LVAD



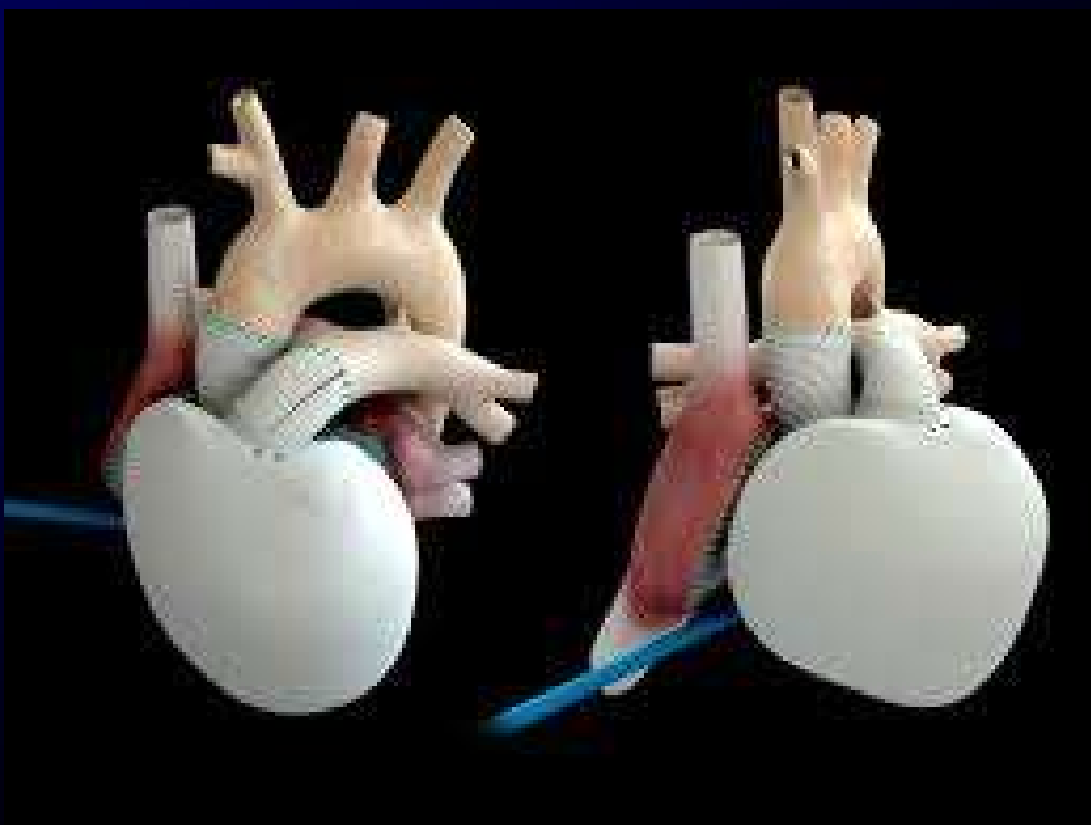
Ventricular implants for prolonged support per year in the USA by device strategy

BRAUNWALD E. Lancet 2015; 385: 812-824

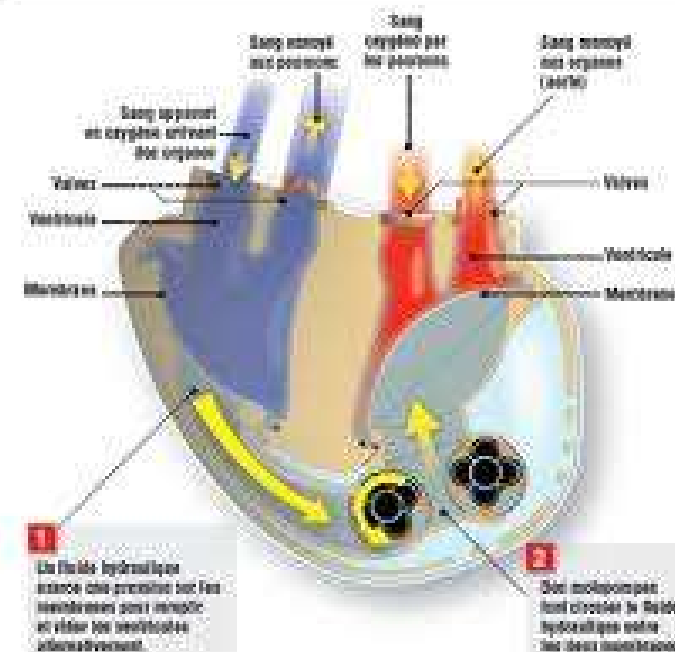


Cœur artificiel totalement implantable CARMAT

Alain CARPENTIER



Le fonctionnement du cœur artificiel





Transplantation cellulaire

Philippe MENASCHE

Etude ESCORT

Myoblast transplantation for heart failure

THE LANCET • Vol 357 • January 27, 2001

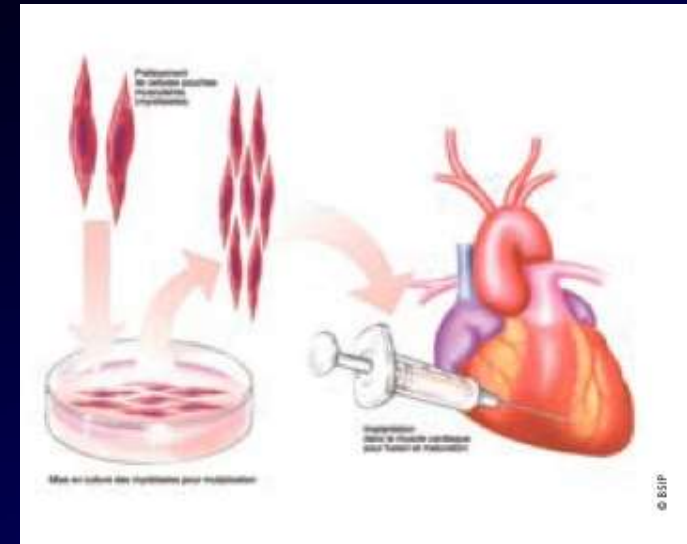
Philippe Menasché, Albert A Hagège, Marcio Scorsin, Bruno Pouzet, Michel Desnos, Denis Duboc, Ketty Schwartz, Jean-Thomas Vilquin, Jean-Pierre Marolleau

(Circulation. 2008;117:1189-1200.)

The Myoblast Autologous Grafting in Ischemic Cardiomyopathy (MAGIC) Trial

First Randomized Placebo-Controlled Study of Myoblast Transplantation

Philippe Menasché, MD, PhD; Ottavio Alfieri, MD; Stefan Janssens, MD, PhD;
William McKenna, MD; Hermann Reichenspurner, MD; Ludovic Trinquart, MSc;
Jean-Thomas Vilquin, PhD; Jean-Pierre Marolleau, MD; Barbara Seymour, BS;
Jérôme Larghero, PharmD, PhD; Stephen Lake, ScD; Gilles Chatellier, MD, PhD;
Scott Solomon, MD; Michel Desnos, MD; Albert A. Hagège, MD, PhD



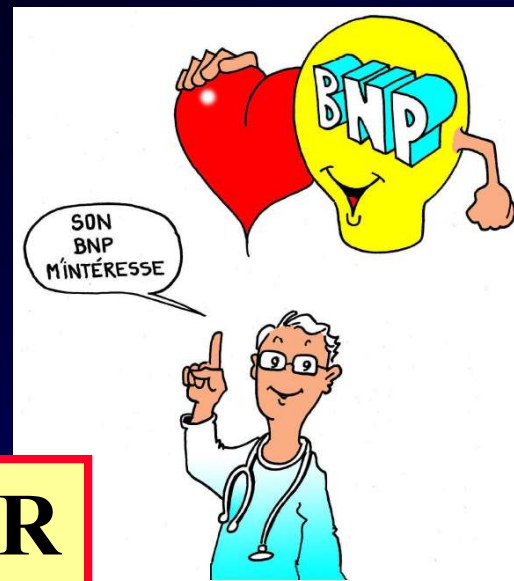
RÉADAPTER



EVITER



CONTRÔLER

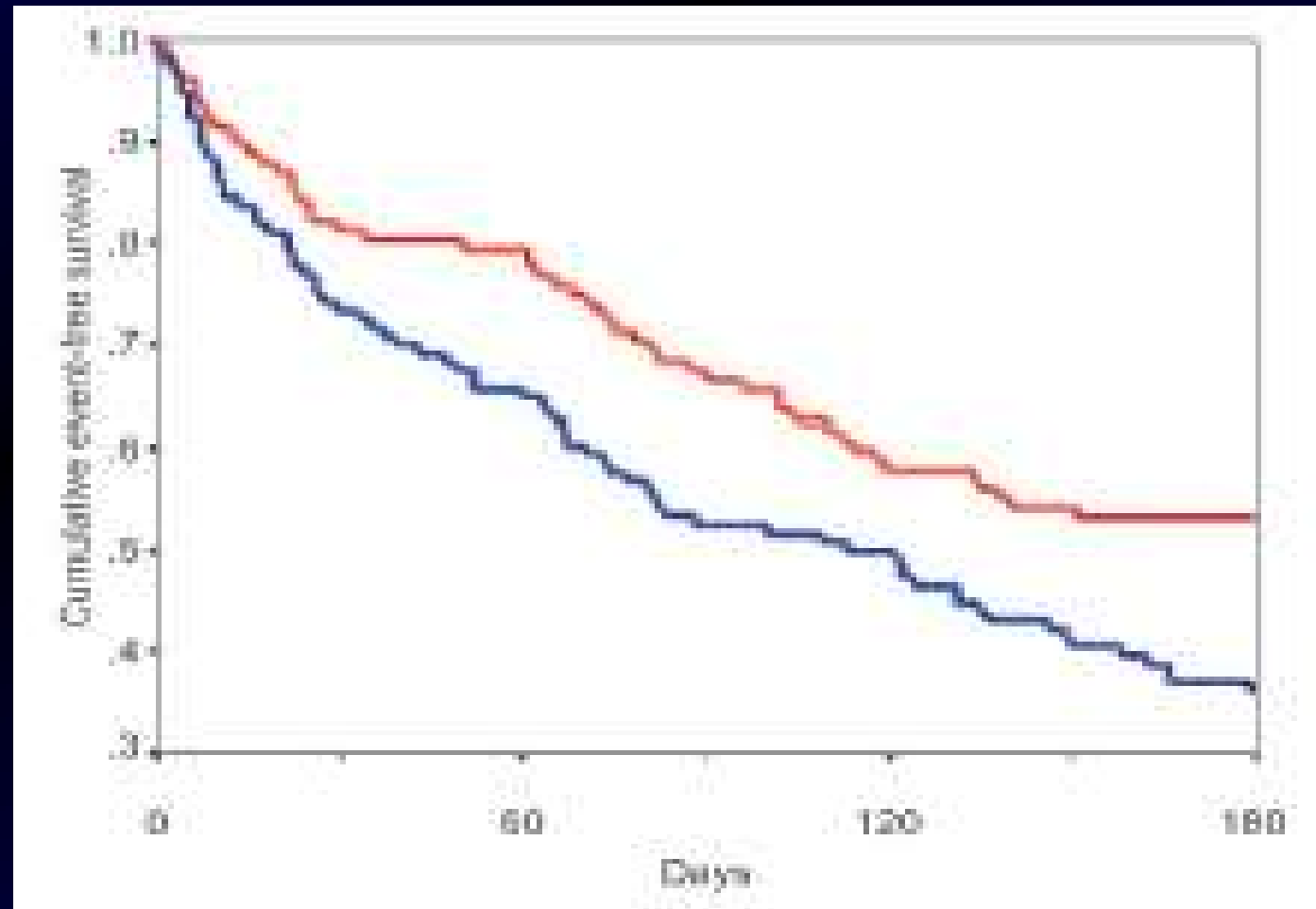


Discharge education improves clinical outcomes in pts with CHF

KOELLING TM et al. *Circulation* 2005; 111: 179-185

223 systolic CHF pts

1-hr
one-to-one teaching session
with an education nurse
at discharge



Non-invasive home telemonitoring for pts with HF at high risk of recurrent admission and death

The Trans-European Network – Home-care Management System study (TEN-HMS)

CLELAND JGF et al. J Am Coll Cardiol 2005; 45: 1654-1664

VITAL SIGNS MEASUREMENT

AUTOMATIC DATA COLLECTION
AND TRANSMISSION

DATA PRESENTATION AND REVIEW

Member

Care Team

Weight

Phone Call

Provider intervention
as necessary

ECG/Rhythm
Strip
Recorder

Blood
Pressure
and Pulse

Phone Call

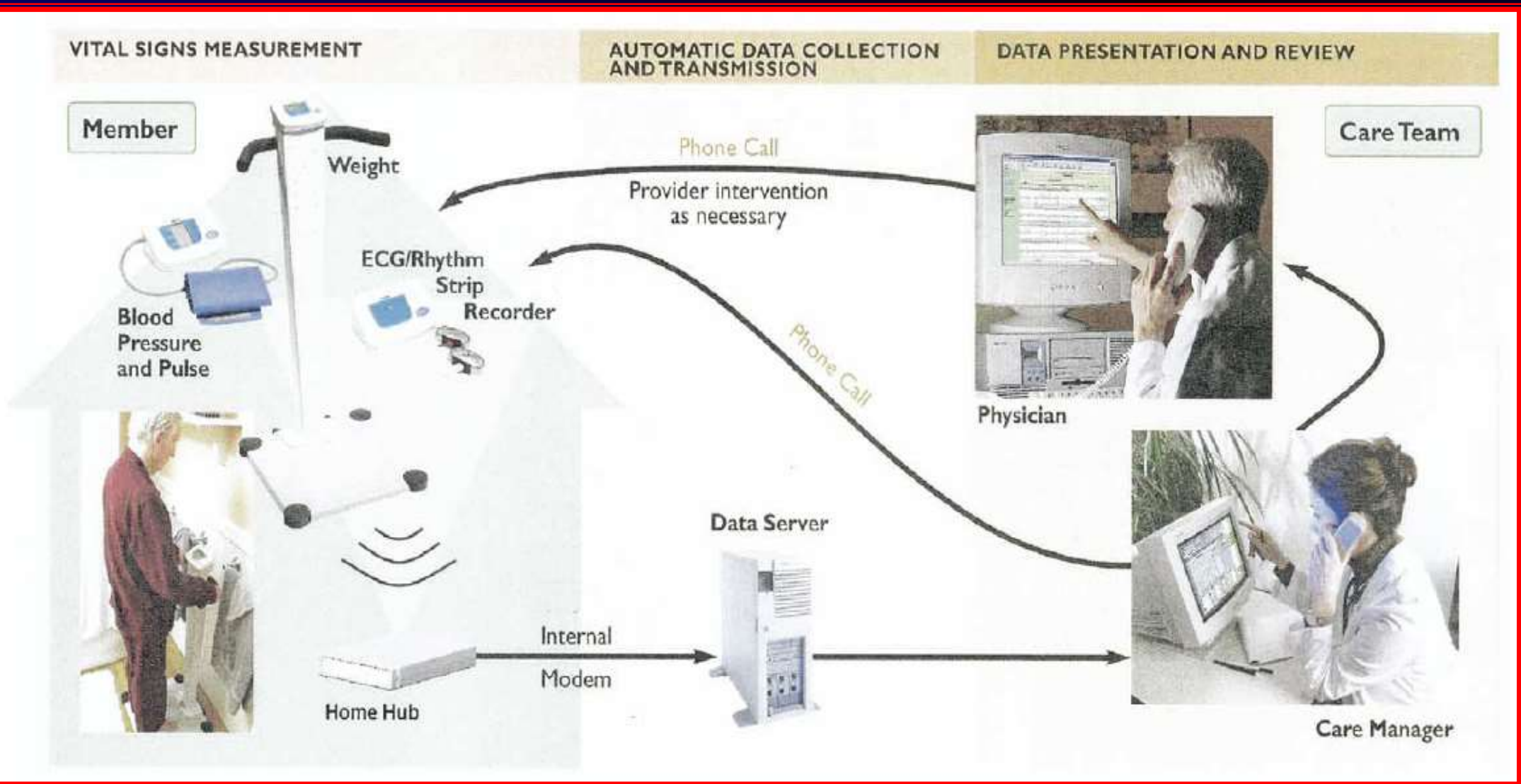
Physician

Data Server

Internal
Modem

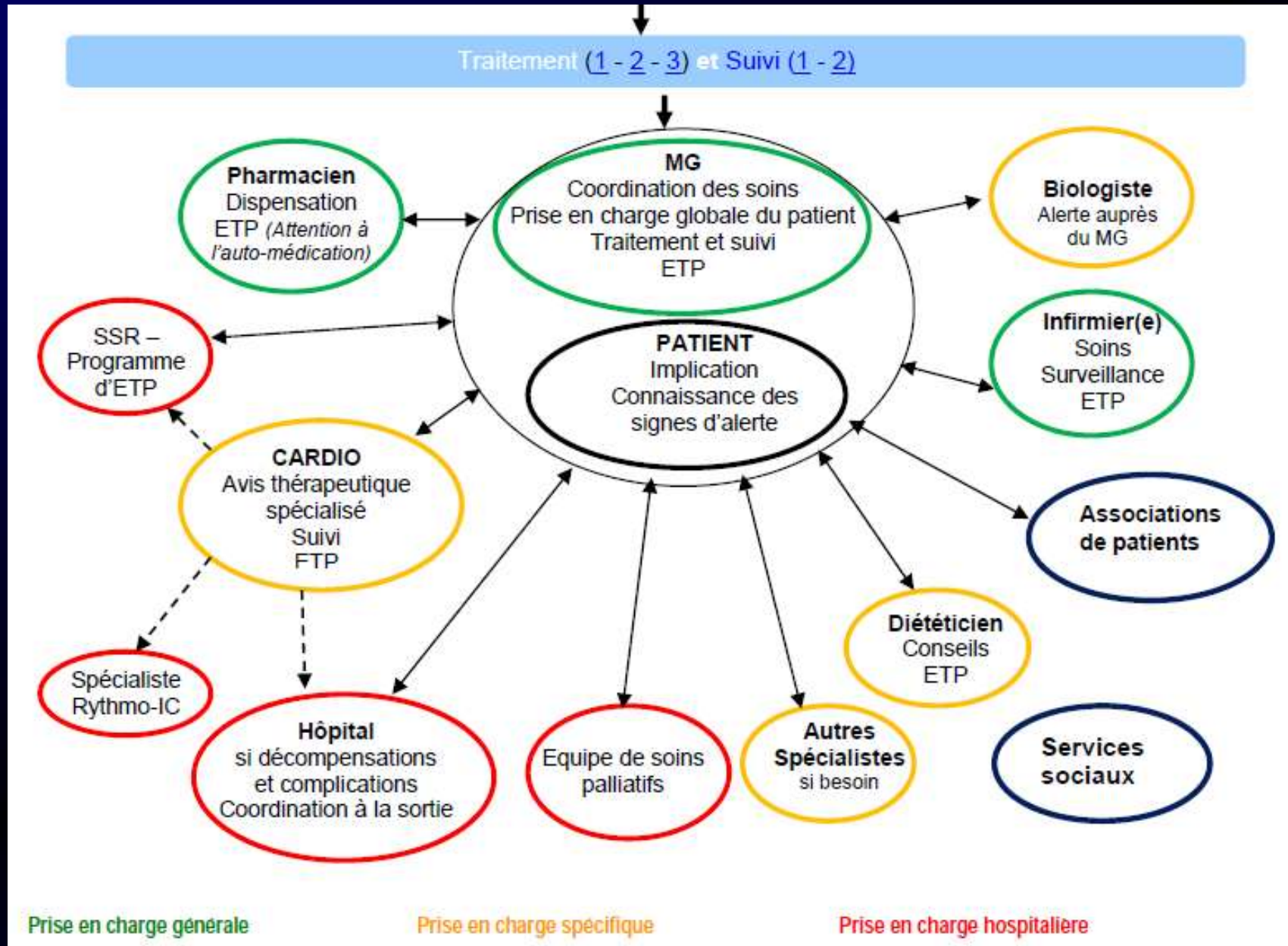
Home Hub

Care Manager

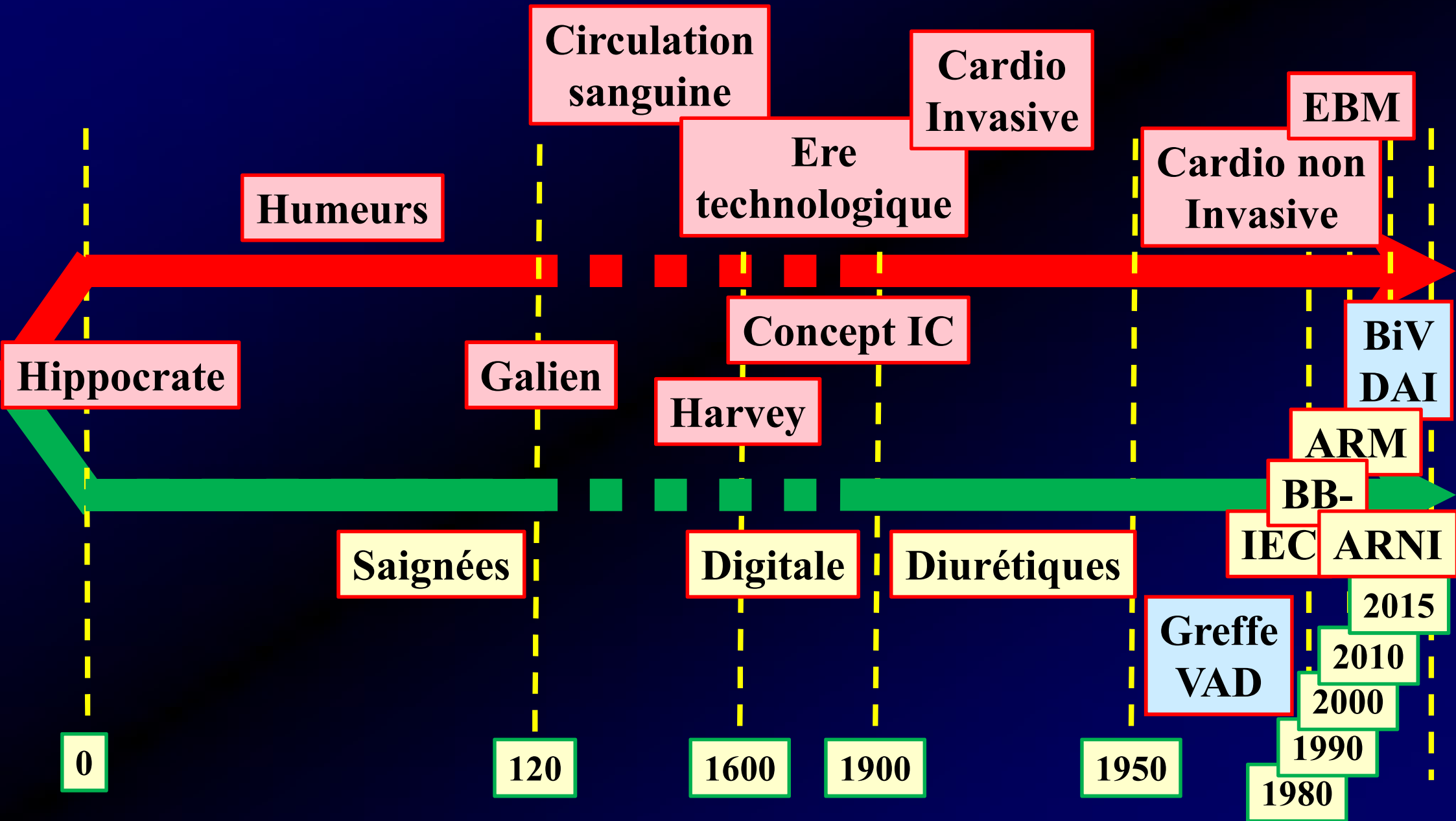


GUIDE DU PARCOURS DE SOINS – HAS 2012

Parcours de soins de l'IC




Evolution des progrès dans l'IC



Pour le XXIème siècle :



**Fléau
sociétal**



**Fléau
épidémiolo-
gique**



**Fléau
économique**