

1<sup>ère</sup> Année de Médecine

Cas de liaison

# Athérosclérose #3

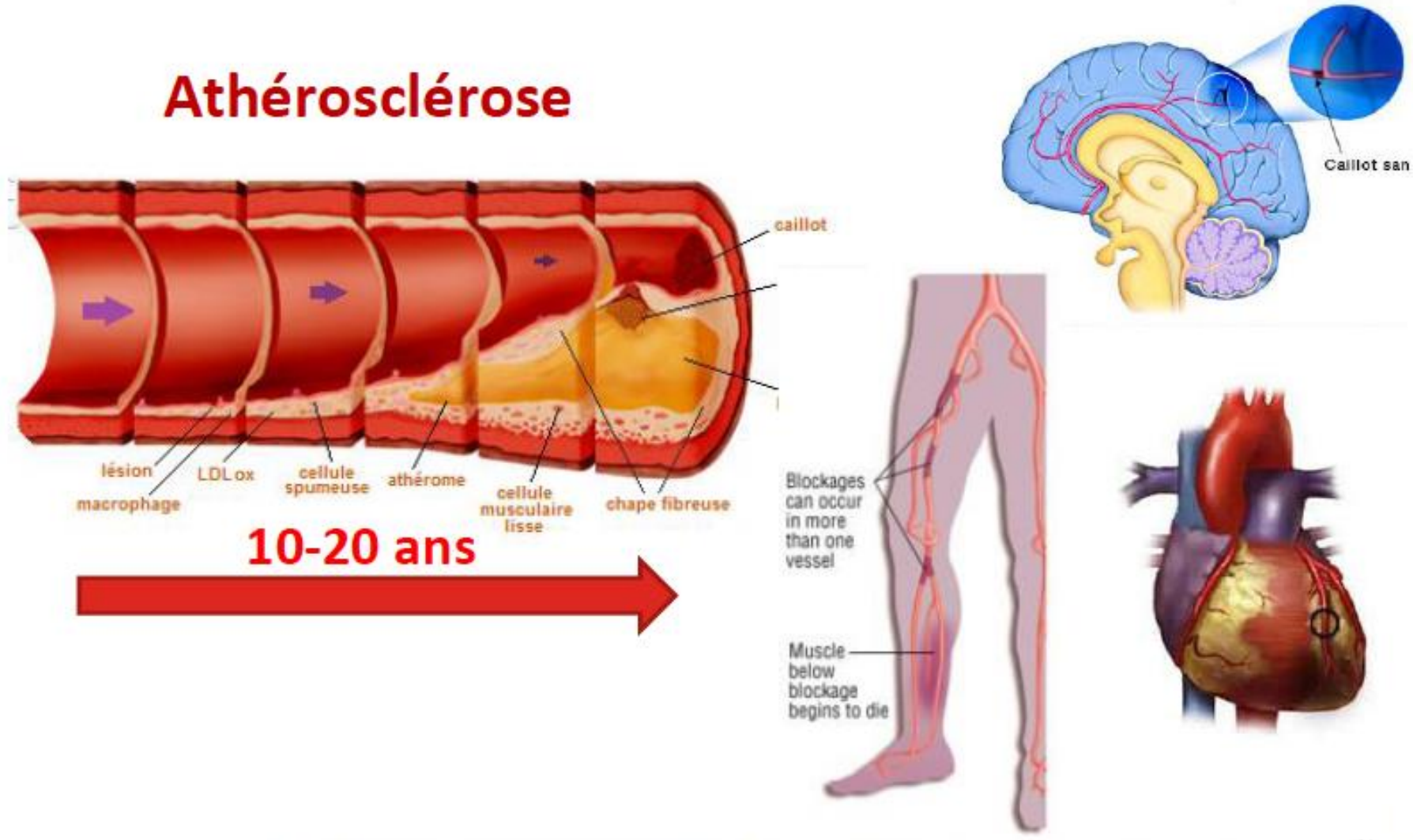
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Département de Médecine  
Hôpital Universitaire de Genève  
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[www.cardiology-geneva.ch](http://www.cardiology-geneva.ch)

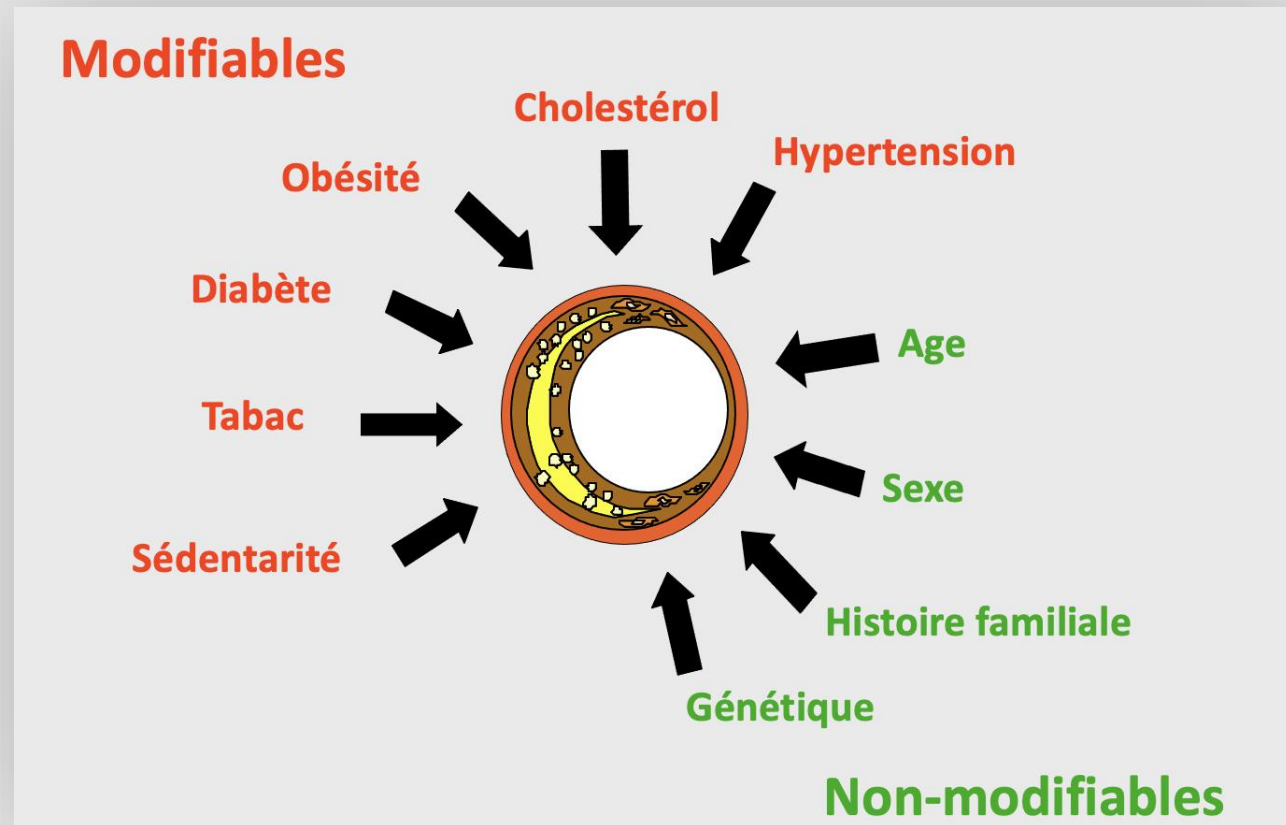
Genève, le 19 novembre 2025

# Prévention Cardiovasculaire

## Athérosclérose



## Facteurs de risque cardio-vasculaires



Mesurer vos facteurs de risque cardiovasculaires

# 4 types de prévention

**Prévention primordiale:** Eviter une maladie avant son apparition

- Conseils (alimentation, hygiène de vie, arrêt tabac)
- Vaccins
- Chimio-prophylaxie

**Prévention primaire:** Dépister tôt une maladie asymptomatique

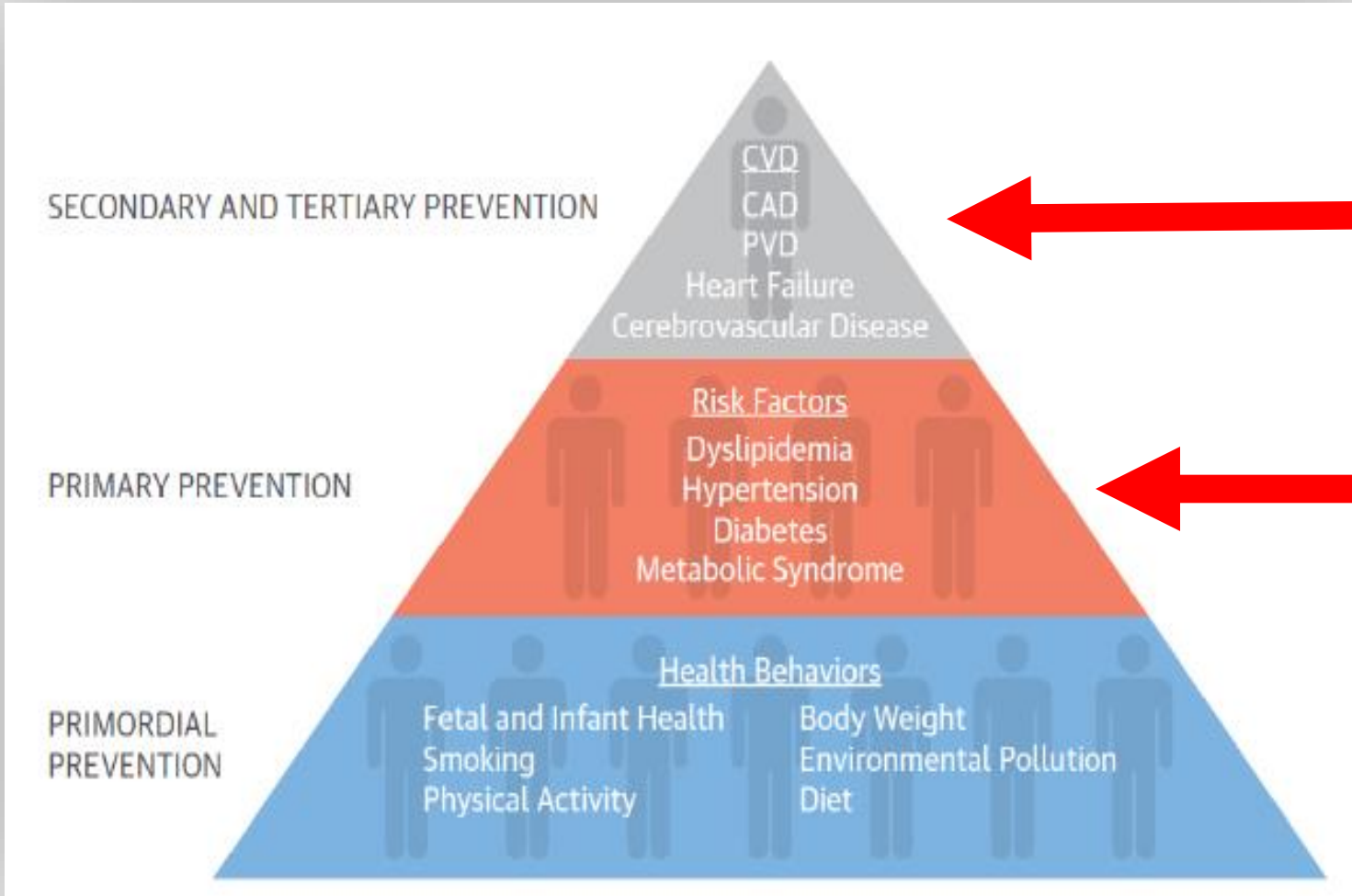
- Dépistages (coloscopie, mammographie, mesure cholestérol, TA)

**Prévention secondaire:** Eviter les complications d'une maladie établie

- Conseils
- Dépistage des complications
- Traitement

**Prévention tertiaire:** Eviter les complications d'actes médicaux

# Prévention cardiovasculaire



Patients known for cv disease (acute MI, stroke...) or atherosclerotic lesions documented by vascular imaging

Patients without CV event (acute MI, stroke,) and no atherosclerotic lesions documented by vascular imaging

# Prévention Cardiovasculaire

## Les recommandations de prévention cardiovasculaire : mise à jour 2017

	Américaines	Européennes ESC = European Society of Cardiology
<b>Hypertension</b>	<b>2014</b> JCN-8 = Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure	<b>2013</b> ESH = European Society of Hypertension
<b>Cholestérol</b>	<b>2013</b> AHA = American Heart Association ACC = American College of Cardiology	<b>2016</b> EAS = European Atherosclerosis Society
<b>Diabète</b>	<b>2017</b> <i>Standards of medical care</i> ADA= American Diabetes Association	<b>2013</b> EASD = European Association for the Study of Diabetes
<b>Prévention cardiovasculaire Aspirine en prévention primaire</b>	<b>2016</b> USPTF = US services preventive task force	<b>2016</b> <i>CVD prevention in clinical practice</i>

# Prévention Cardiovasculaire



European Society  
of Cardiology

European Heart Journal (2019) 00, 1–78  
doi:10.1093/eurheartj/ehz455

ESC/EAS GUIDELINES



## 2019 ESC/EAS Guidelines for the management of dyslipidaemias: lipid modification to reduce cardiovascular risk

The Task Force for the management of dyslipidaemias of the European Society of Cardiology (ESC) and European Atherosclerosis Society (EAS)

**Authors/Task Force Members:** François Mach\* (Chairperson) (Switzerland), Colin Baigent\* (Chairperson) (United Kingdom), Alberico L. Catapano<sup>1</sup>\* (Chairperson) (Italy), Konstantinos C. Koskinas (Switzerland), Manuela Casula<sup>1</sup> (Italy), Lina Badimon (Spain), M. John Chapman<sup>1</sup> (France), Guy G. De Backer (Belgium), Victoria Delgado (Netherlands), Brian A. Ference (United Kingdom), Ian M. Graham (Ireland), Alison Halliday (United Kingdom), Ulf Landmesser (Germany), Borislava Mihaylova (United Kingdom), Terje R. Pedersen (Norway), Gabriele Riccardi<sup>1</sup> (Italy), Dimitrios J. Richter (Greece), Marc S. Sabatine (United States of America), Marja-Riitta Taskinen<sup>1</sup> (Finland), Lale Tokgozoglul<sup>1</sup> (Turkey), Olov Wiklund<sup>1</sup> (Sweden)



European Society  
of Cardiology

European Heart Journal (2025) 00, 1–70  
<https://doi.org/10.1093/eurheartj/ehaf190>

ESC GUIDELINES

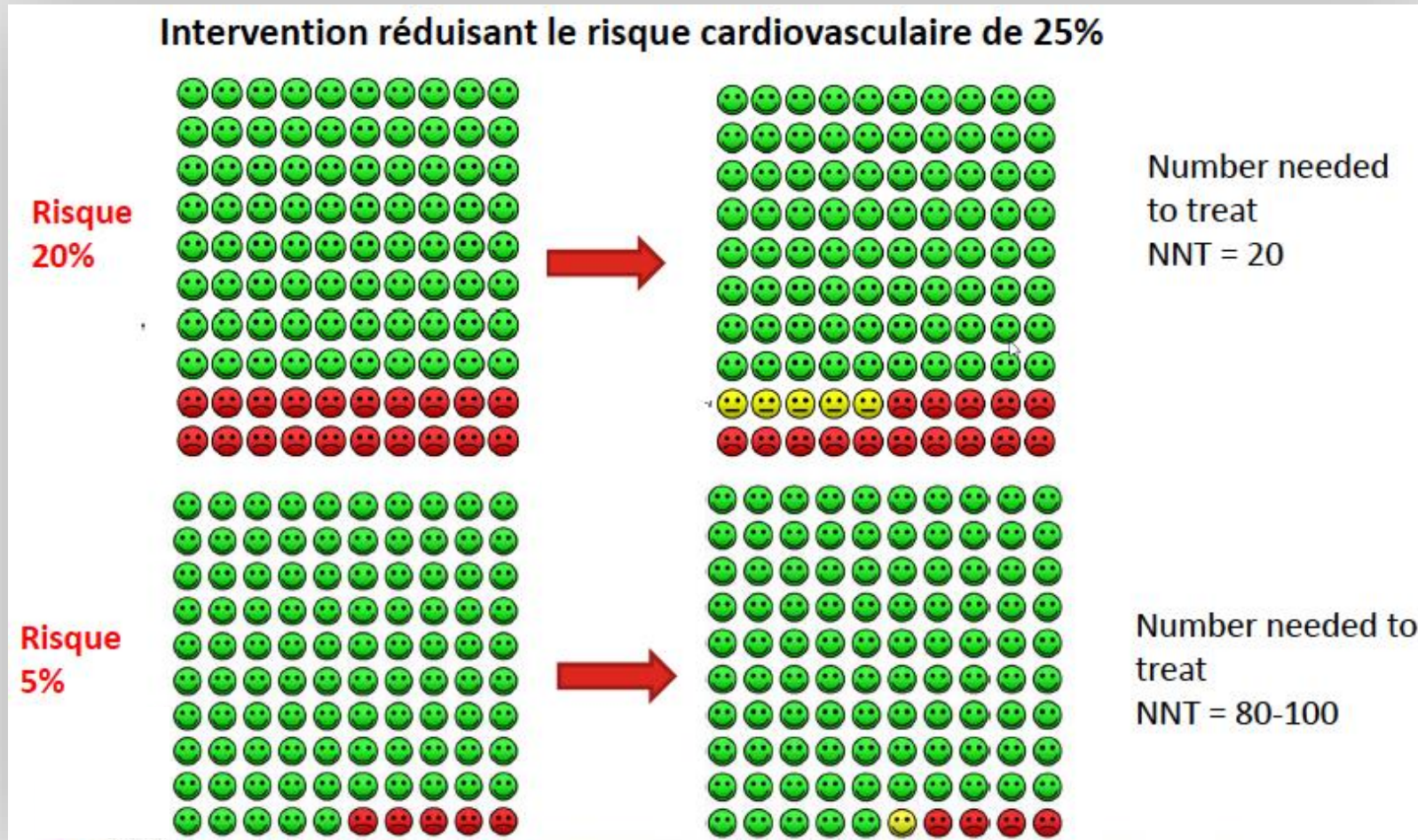
## 2025 Focused Update of the 2019 ESC/EAS Guidelines for the management of dyslipidaemias

Developed by the task force for the management of dyslipidaemias of the European Society of Cardiology (ESC) and the European Atherosclerosis Society (EAS)

**Authors/Task Force Members:** François Mach ●\*†, (ESC Chairperson) (Switzerland), Konstantinos C. Koskinas\*†, (ESC Chairperson) (Switzerland), Jeanine E. Roeters van Lennep ●\*†, (EAS Chairperson) (Netherlands), Lale Tokgozoglul ●, (Task Force Co-ordinator) (Türkiye), Lina Badimon ● (Spain), Colin Baigent ● (United Kingdom), Marianne Benn ● (Denmark), Christoph J. Binder ● (Austria), Alberico L. Catapano ● (Italy), Guy G. De Backer ● (Belgium), Victoria Delgado ● (Spain), Natalia Fabin ● (Italy), Brian Ference (United Kingdom), Ian M. Graham ● (Ireland), Ulf Landmesser (Germany), Ulrich Laufs ● (Germany), Borislava Mihaylova ● (United Kingdom), Børge Grønne Nordestgaard ● (Denmark), Dimitrios J. Richter ● (Greece), Marc S. Sabatine ● (United States of America), and ESC/EAS Scientific Document Group

# Prévention Cardiovasculaire

Le bénéfice du traitement dépend du **risque cardiovasculaire**



# Prévention Cardiovasculaire

## Dépistage cardiovasculaire systématique

### Dépistage tabac

A tous les âges dès 18 ans

Niveau de preuve A



### Dépistage de l'hypertension

Niveau de preuve A



### Dépistage du diabète

Dès 35-40 ou avant si facteurs de risque

Niveau de preuve A



### Dépistage du LDL-cholestérol

Niveau de preuve A



# Prévention Cardiovasculaire



**ESC**

European Society  
of Cardiology

European Heart Journal (2021) **42**, 3227–3337

doi:10.1093/eurheartj/ehab484

**ESC GUIDELINES**

## 2021 ESC Guidelines on cardiovascular disease prevention in clinical practice

**Developed by the Task Force for cardiovascular disease prevention in clinical practice with representatives of the European Society of Cardiology and 12 medical societies**

**With the special contribution of the European Association of Preventive Cardiology (EAPC)**

**Authors/Task Force Members: Frank L.J. Visseren\* (Chairperson) (Netherlands), François Mach\* (Chairperson) (Switzerland), Yvo M. Smulders<sup>†</sup> (Task Force Coordinator) (Netherlands), David Carballo<sup>†</sup> (Task Force Coordinator)**



EUROPEAN  
SOCIETY OF  
CARDIOLOGY\*

European Heart Journal (2016) **37**, 2315–2381

doi:10.1093/eurheartj/ehw106

**JOINT ESC GUIDELINES**

## 2016 European Guidelines on cardiovascular disease prevention in clinical practice

**The Sixth Joint Task Force of the European Society of Cardiology and Other Societies on Cardiovascular Disease Prevention in Clinical Practice (constituted by representatives of 10 societies and by invited experts)**

**Developed with the special contribution of the European Association for Cardiovascular Prevention & Rehabilitation (EACPR)**

# New SCORE for CV risk classification



European Heart Journal (2021) **00**, 1–16  
doi:10.1093/eurheartj/ehab309

**CLINICAL RESEARCH**  
*Epidemiology and prevention*

## **SCORE2 risk prediction algorithms: new models to estimate 10-year risk of cardiovascular disease in Europe**

**SCORE2 working group and ESC Cardiovascular risk collaboration**

*Eur Heart J* June 13, 2021



European Heart Journal (2021) **00**, 1–13  
doi:10.1093/eurheartj/ehab312

**CLINICAL RESEARCH**  
*Epidemiology and prevention*

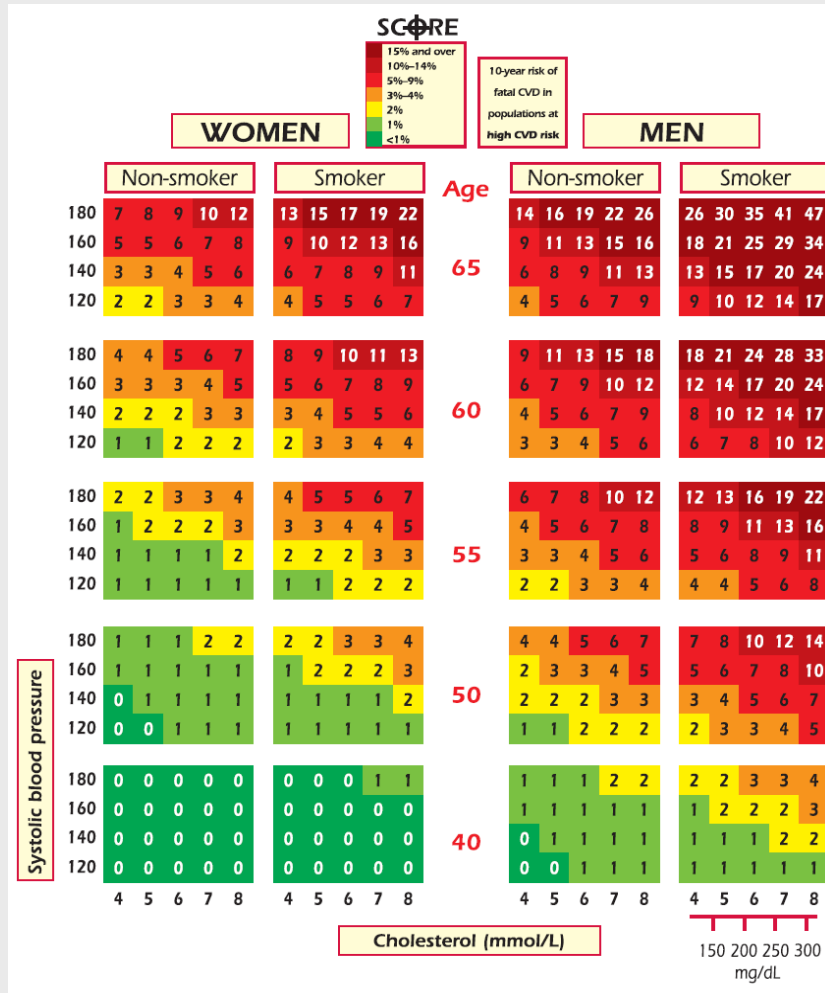
## **SCORE2-OP risk prediction algorithms: estimating incident cardiovascular event risk in older persons in four geographical risk regions**

**SCORE2-OP working group and ESC Cardiovascular risk collaboration**

*Eur Heart J* June 13, 2021

# SCORE

- Age 40-70 y
- 10-year risk of fatal CVD

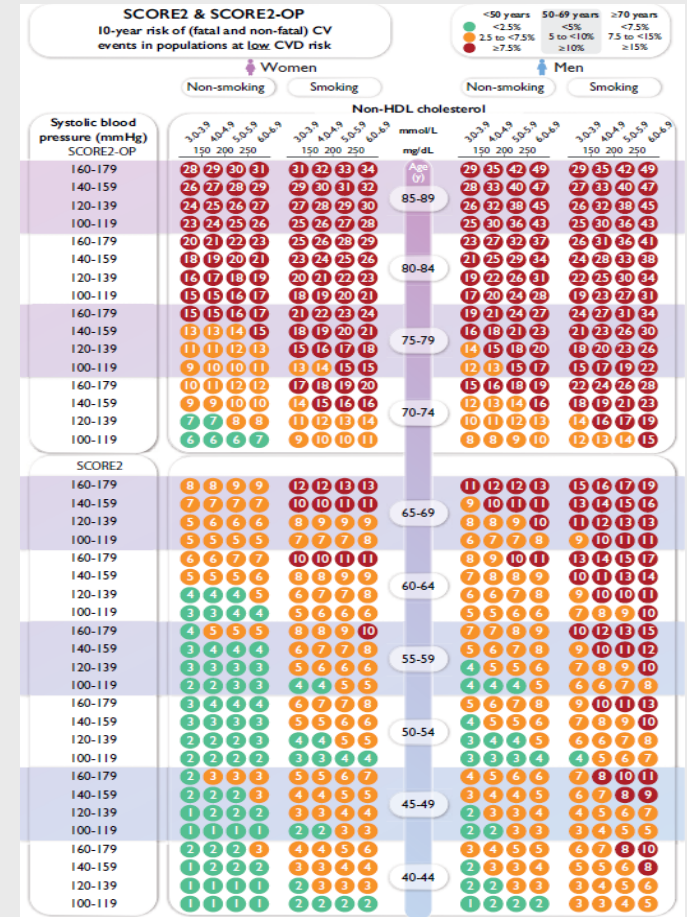


# SCORE2 / SCORE2-OP

- Age 40-89 y
- 10-year risk of fatal **and non-fatal** CVD

SCORE2  
≥ 70 yrs

SCORE2-OP  
< 70 yrs



# How is SCORE2 / SCORE2-OP calculated?



**1. Age**

**2. Sex**

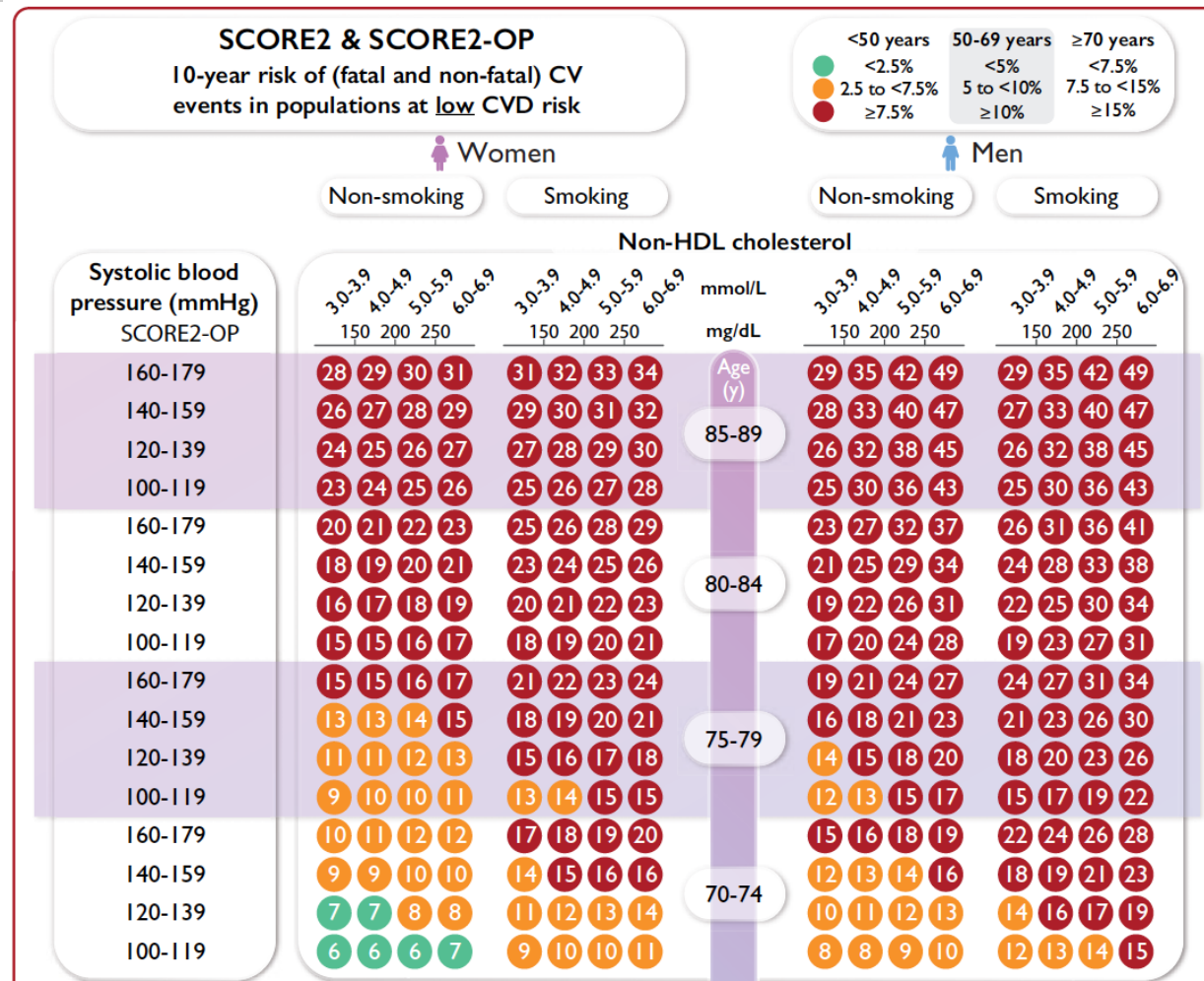
**3. Non-HDL-C (= total cholesterol – HDL-C)**

**4. Systolic blood pressure**

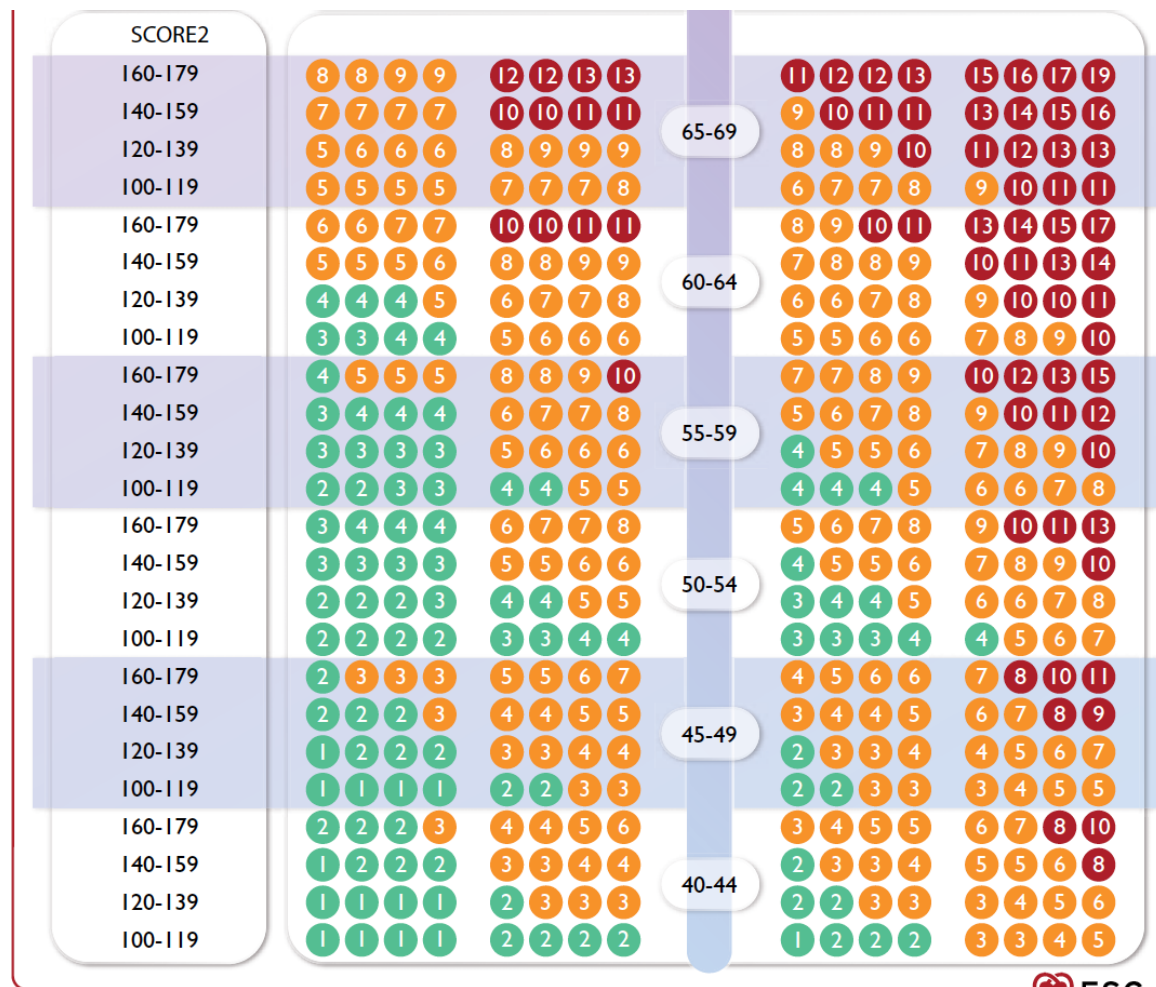
**5. Smoking status**

**6. Geographic region**

# SCORE2 and SCORE2-OP risk chart for fatal and non-fatal (MI, stroke) ASCVD



# SCORE2 and SCORE2-OP risk chart for fatal and non-fatal (MI, stroke) ASCVD



©ESC

# Cardiovascular risk assessment in diabetes

## Novel concept

For patients without ASCVD or severe target-organ damage, a novel T2DM-specific risk score (SCORE2-Diabetes) is introduced.

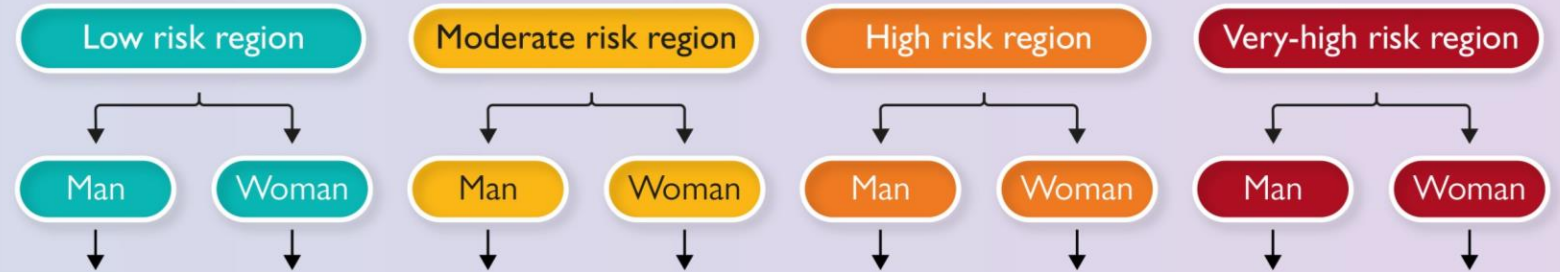
## SCORE2-Diabetes

### Key features

- Estimates 10-year risk of CVD events in individuals with type-2 diabetes
- Discriminates risk in individuals with type-2 diabetes using conventional CVD risk factors and those specifically related to diabetes
- Calibrated to predict CVD risk in: **low**, **moderate**, **high** and **very high** risk regions of Europe
- Aligned with SCORE2 risk predictions for individuals without diabetes
- Separate risk scores for men and women with type-2 diabetes

# SCORE2-Diabetes: example of risk estimation

Example: 60 year old non-smoking individual with diabetes, SBP = 140 mm Hg, total cholesterol = 5.5 mmol/L and HDL = 1.3 mmol/L



**10-year risk:**

**4.7 %**

# SCORE2-Diabetes: example of risk estimation

Example: 60 year old non-smoking individual with diabetes, SBP = 140 mm Hg, total cholesterol = 5.5 mmol/L and HDL = 1.3 mmol/L



Newly diagnosed diabetes (i.e. at age 60), HbA1c of 50 mmol/mol, eGFR of 90 ml/min/1.73m<sup>2</sup>

Diabetes diagnosed age 50, HbA1c of 70 mmol/mol, eGFR of 60 ml/min/1.73m<sup>2</sup>

	Low risk region		Moderate risk region		High risk region		Very-high risk region	
	Man	Woman	Man	Woman	Man	Woman	Man	Woman
Newly diagnosed diabetes (i.e. at age 60), HbA1c of 50 mmol/mol, eGFR of 90 ml/min/1.73m <sup>2</sup>	8.4%	6.1%	11.0%	7.6%	12.5%	11.1%	20.3%	20.6%
Diabetes diagnosed age 50, HbA1c of 70 mmol/mol, eGFR of 60 ml/min/1.73m <sup>2</sup>	12.9%	9.8%	17.2%	12.7%	21.0%	20.4%	31.2%	34.0%

# SCORE2-Diabetes: example of risk estimation

Example: 60 year old non-smoking individual with diabetes, SBP = 140 mm Hg, total cholesterol = 5.5 mmol/L and HDL = 1.3 mmol/L

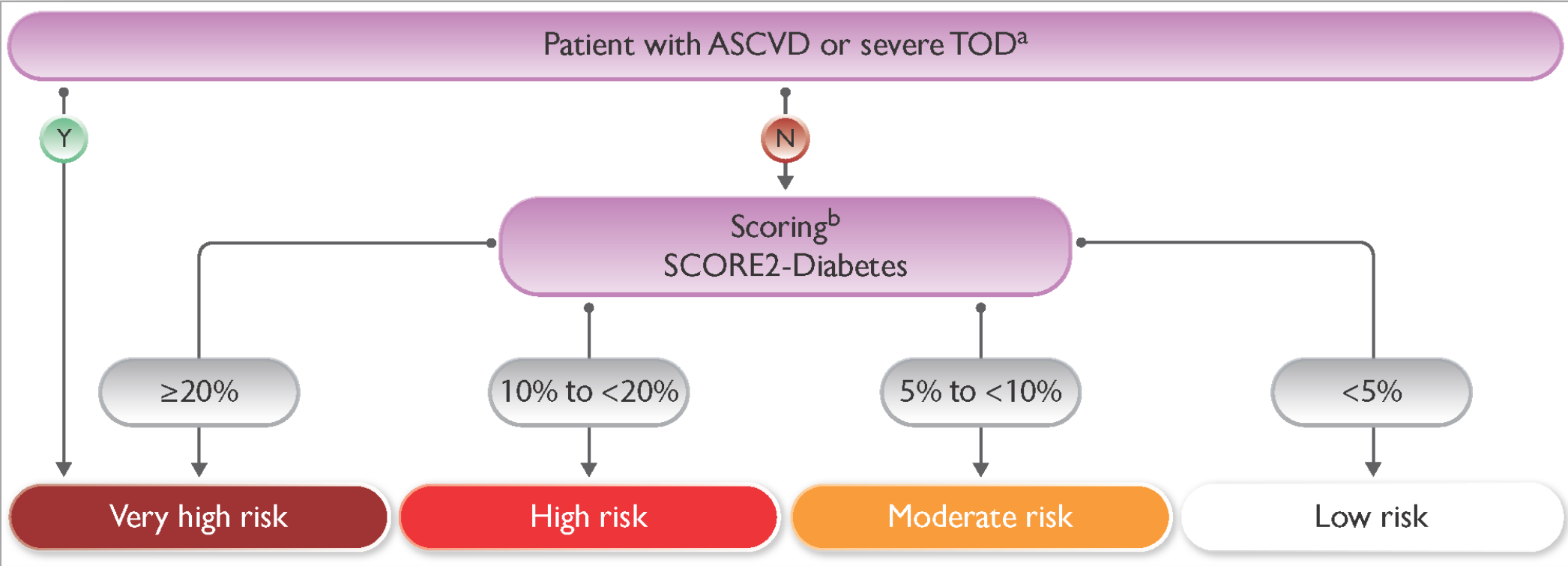


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# Cardiovascular risk categories in patients with type 2 diabetes



# Prévention Cardiovasculaire

## Score de risque de l'AGLA ([www.gsla.ch](http://www.gsla.ch))

Période de risque: 10 ans

### Quel risque ?

Risque de faire un événement coronarien mortel ou non-mortel

= **Risque absolu**

Jusqu'à 10 % = **risque faible**

10- 20% = **risque intermédiaire**

20% ou plus = **risque élevé**

30% ou plus = **risque très élevé**

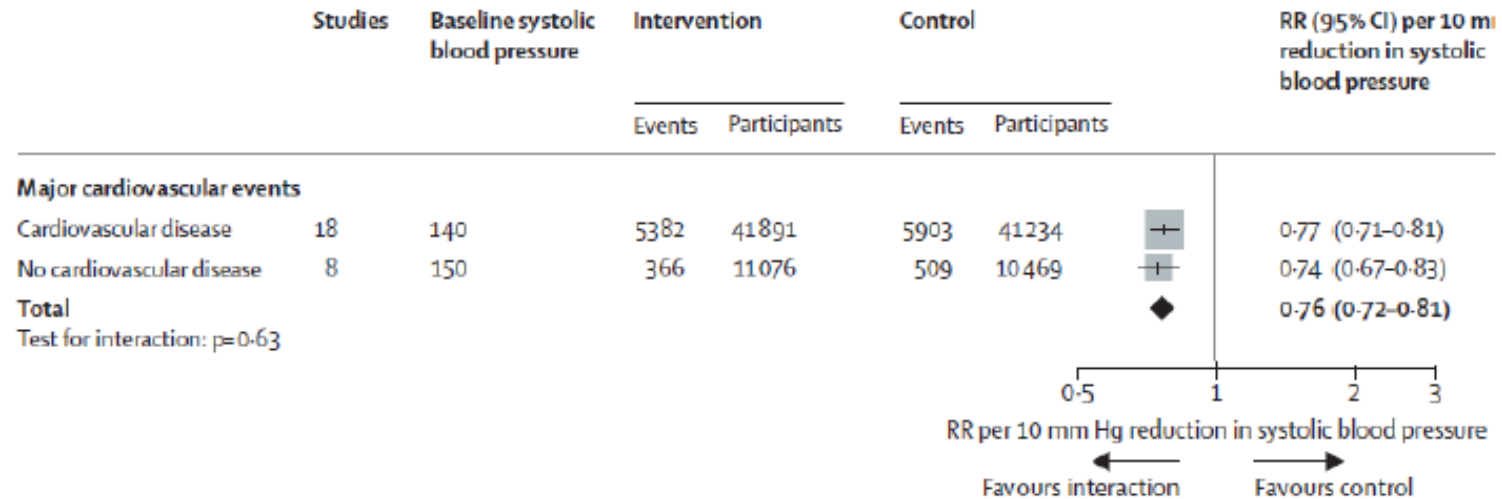
### Score de risque du GSLA

Estimation du risque cardio-vasculaire global

Score de risque du GSLA						
1) Nombre de points par facteur de risque, en fonction du degré de sévérité	▶ Fumeur	▶ LDL-cholestérol (mmol/l)	2) Addition des points de tous les facteurs de risque			
	■ Non 0	■ < 2,59 0				
▶ Âge (ans)	▶ Pression artérielle systolique (mm Hg)	■ 2,59–3,36 5	3) Risque absolu d'événement coronarien aigu en l'espace de 10 ans, compte tenu du nombre total de points			
		■ 3,37–4,13 10				
■ 4,14–4,91 14						
■ 35–39 0	■ < 120 0	■ ≥ 4,91 20	▶ Risque sur 10 ans pour la Suisse, en pourcentage			
■ 40–44 6	■ 120–129 2	▶ Triglycérides (mmol/l)				
■ 45–49 11	■ 130–139 3		■ < 1,14 0			
■ 50–54 16	■ 140–159 5	■ 1,14–1,70 2	■ 0–24 points < 1			
■ 55–59 21	■ ≥ 160 8	■ 1,71–2,27 3	■ 25–31 points 1–2			
■ 60–65 26	▶ Antécédents familiaux	▶ HDL-cholestérol (mmol/l)	■ 32–41 points 2–5			
▶ Non 0			■ < 0,91 11	■ ≥ 2,28 4	■ 42–49 points 5–10	
					■ 0,91–1,16 8	■ 50–58 points 10–20
					■ 1,17–1,41 5	■ > 58 points > 20
	■ ≥ 1,42 0					

# Hypertension artérielle

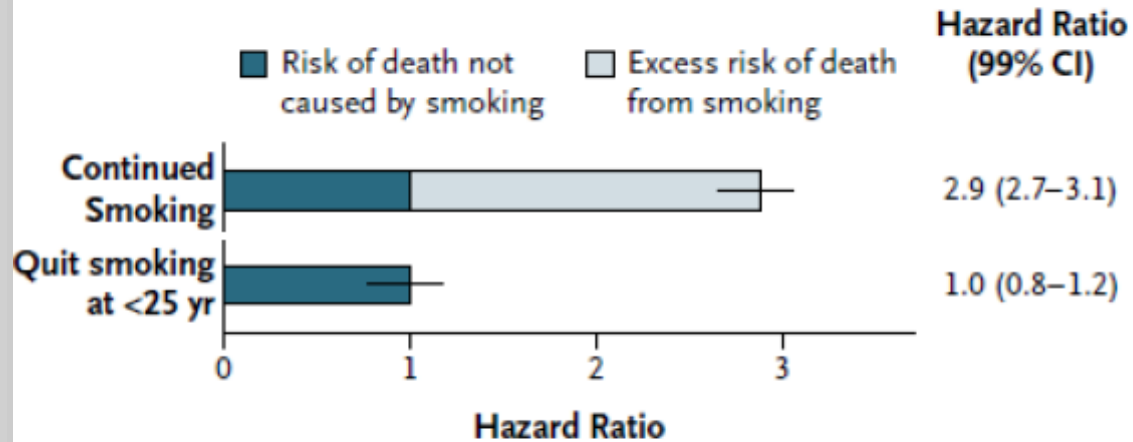
## Bénéfices en prévention primaire et secondaire



Pour une diminution de 10 mmHg, le risque cardiovasculaire est abaissé de 20-25 %

# Tabagisme

## Bénéfices de l'arrêt du tabac

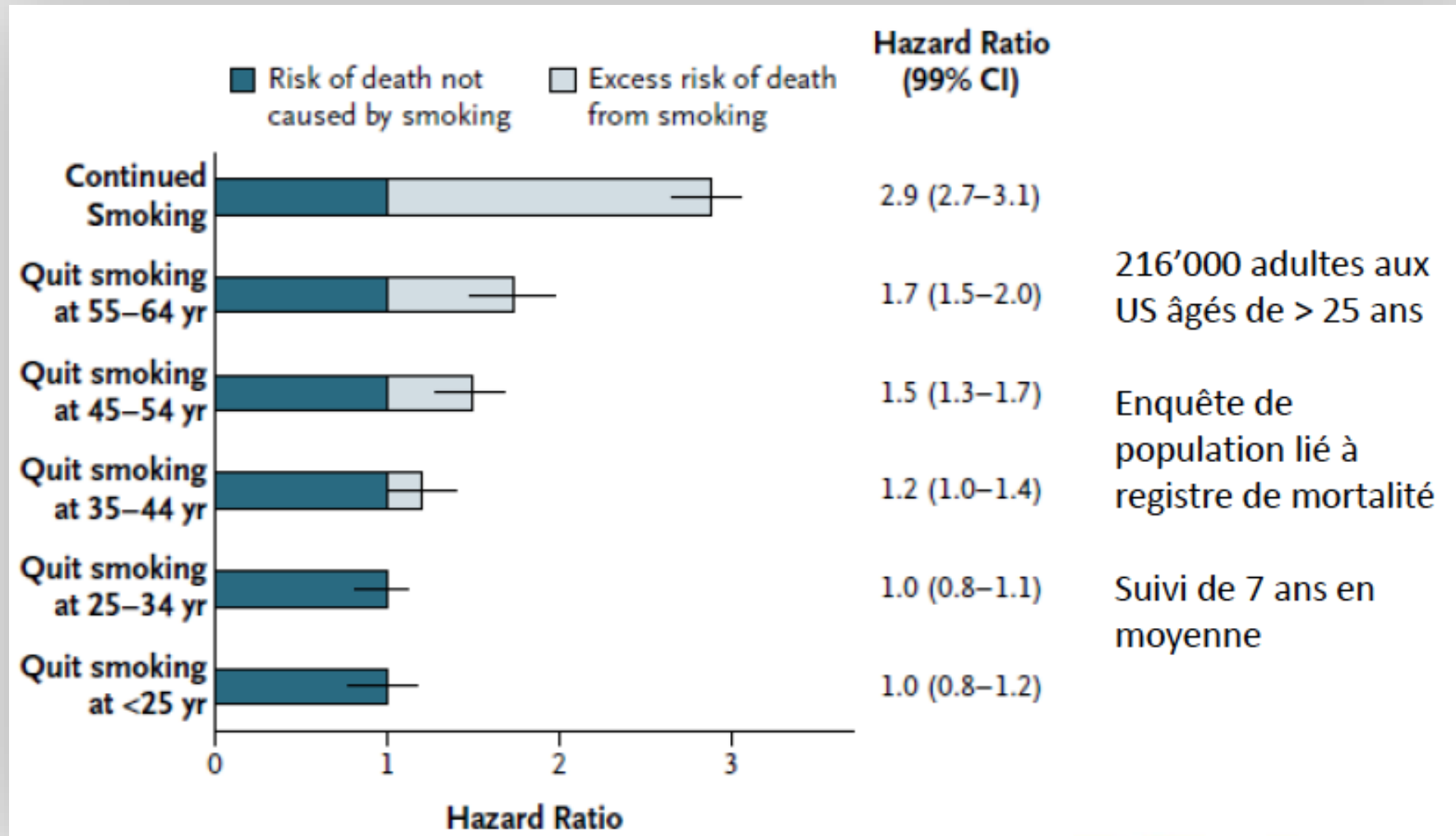


216'000 adultes aux US âgés de > 25 ans

Enquête de population lié à registre de mortalité

Suivi de 7 ans en moyenne

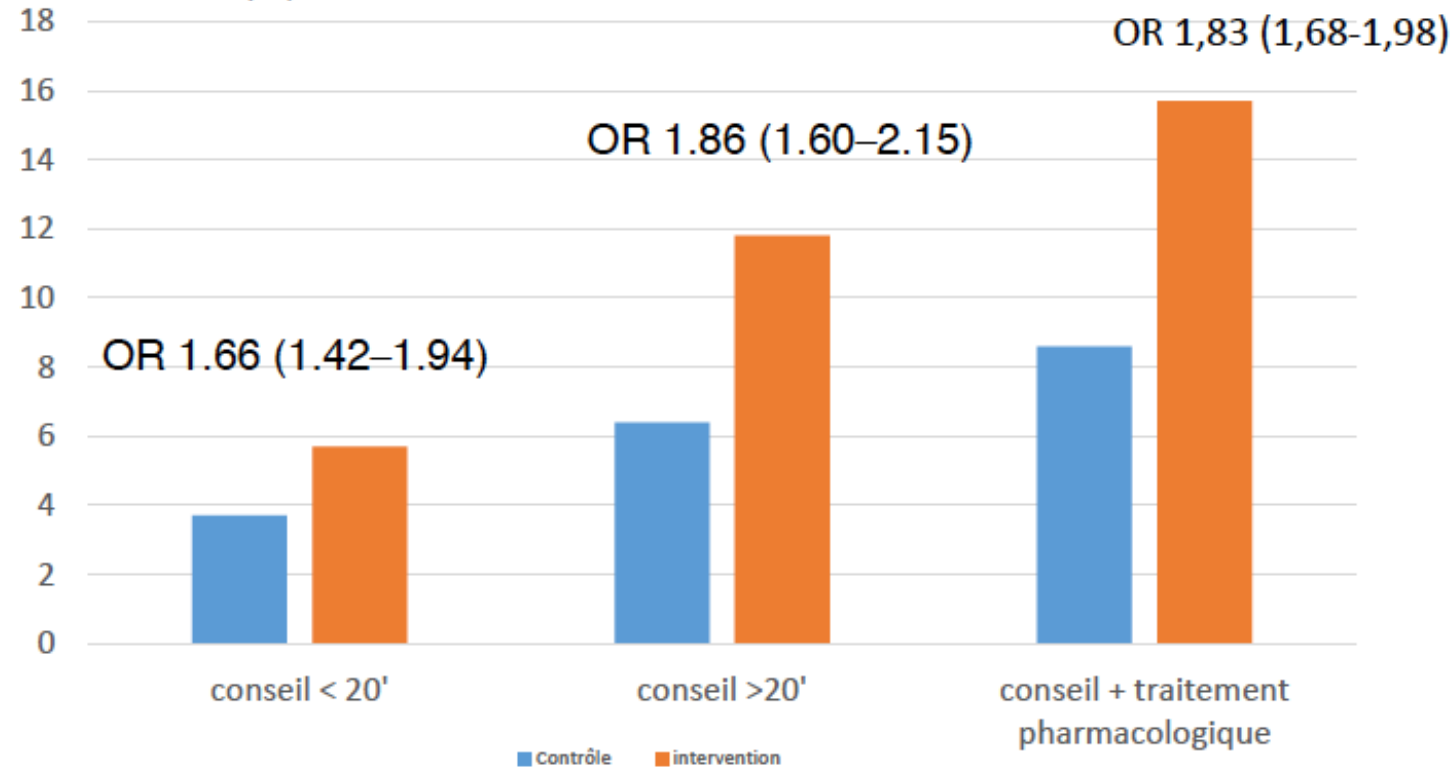
# Tabagisme



# Tabagisme

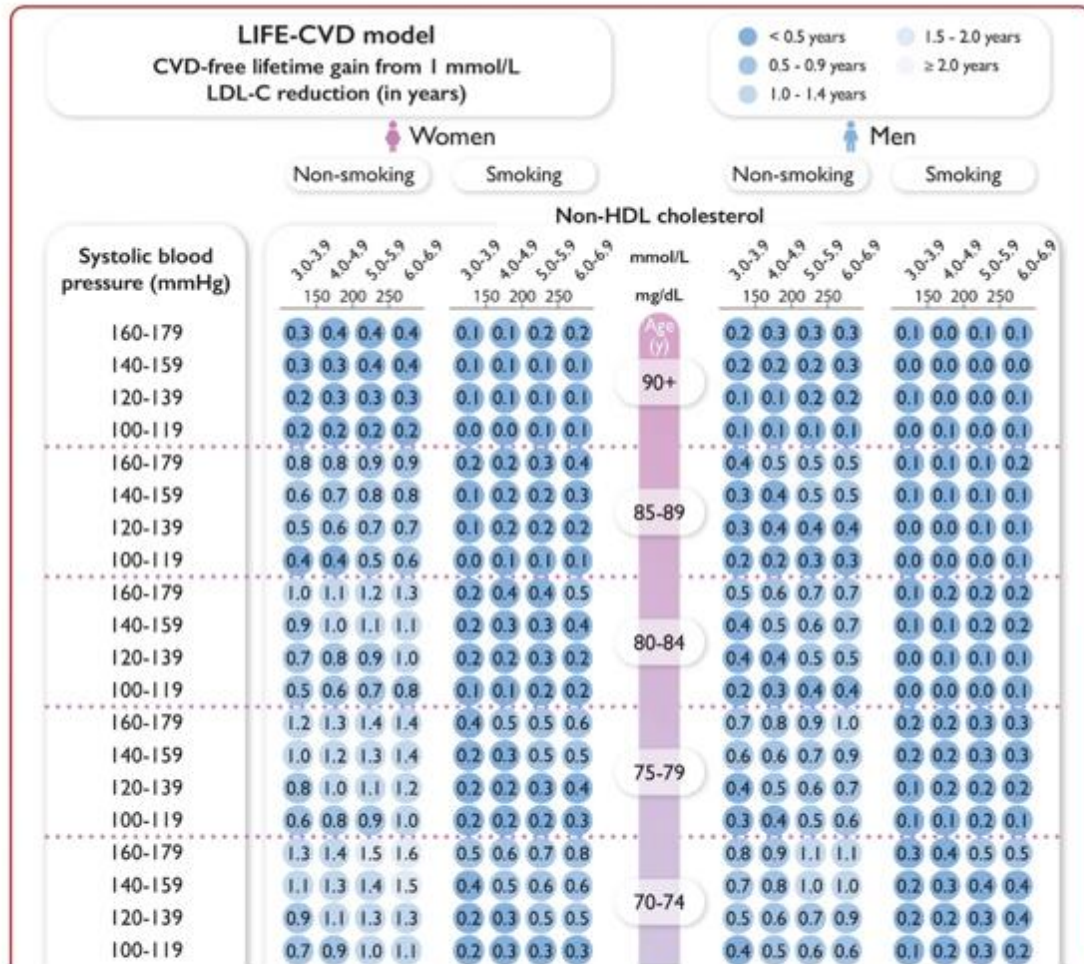
## Efficacité du conseil médical

Taux arrêt  $\geq$  6 mois (%)



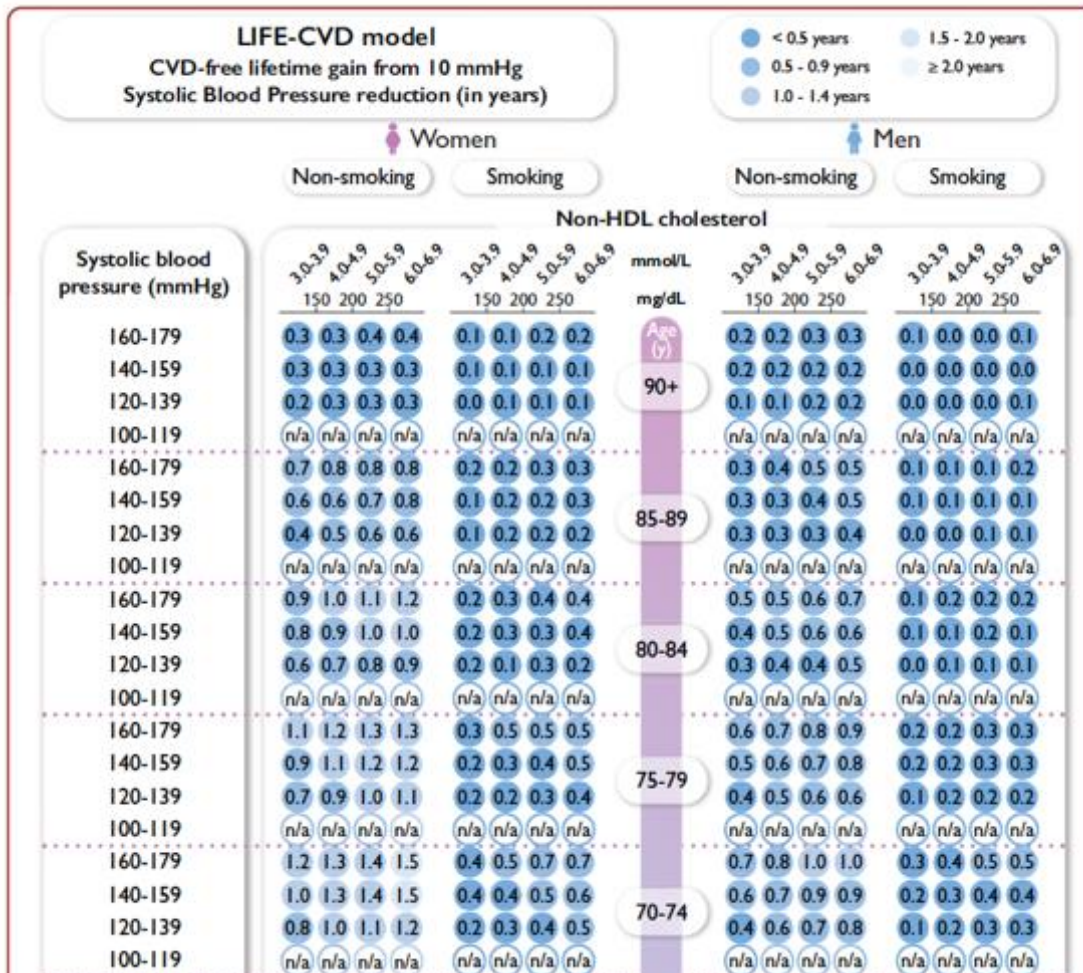
49 essais cliniques, 19'000 participants, population mixte

# CVD-free lifetime gain



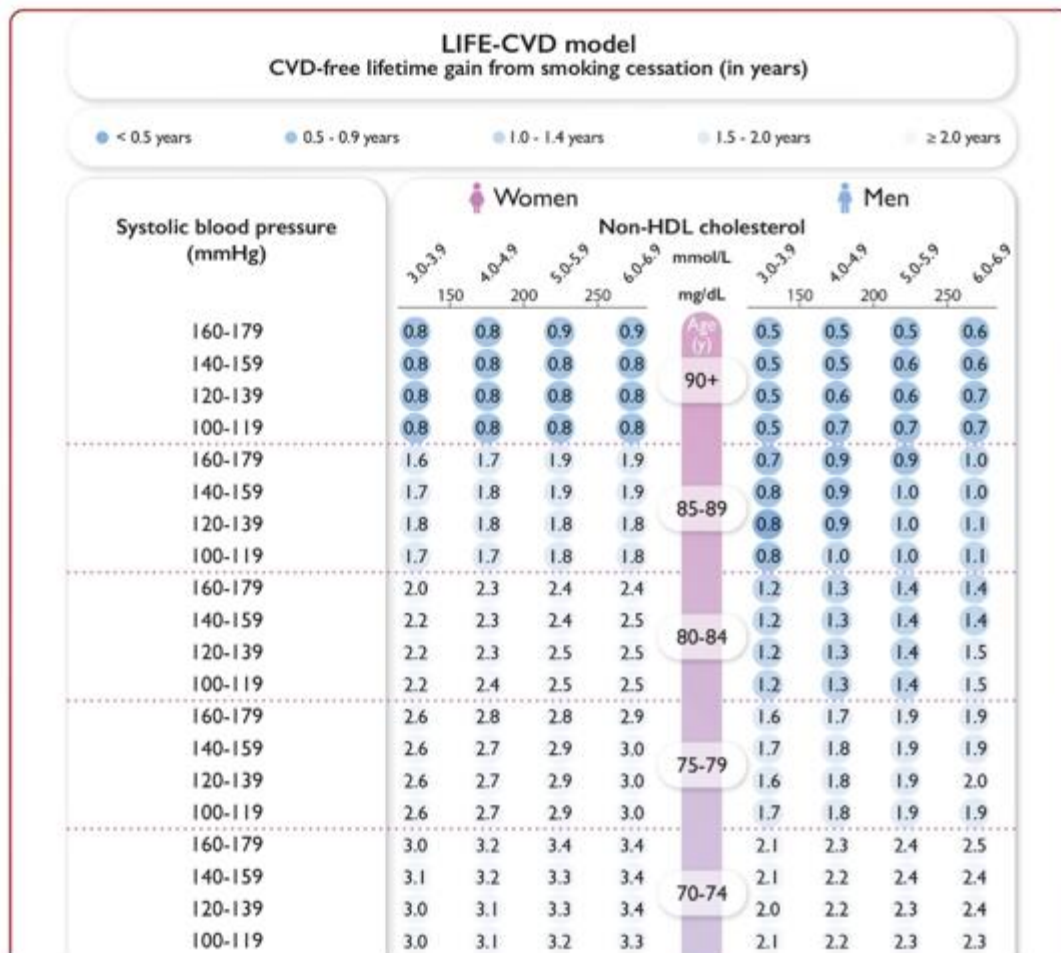
**Average years-free-of-cardiovascular disease gained per 1 mmol/L (40 mg/dL) LDL-C reduction in apparently healthy persons (1)**

# CVD-free lifetime gain



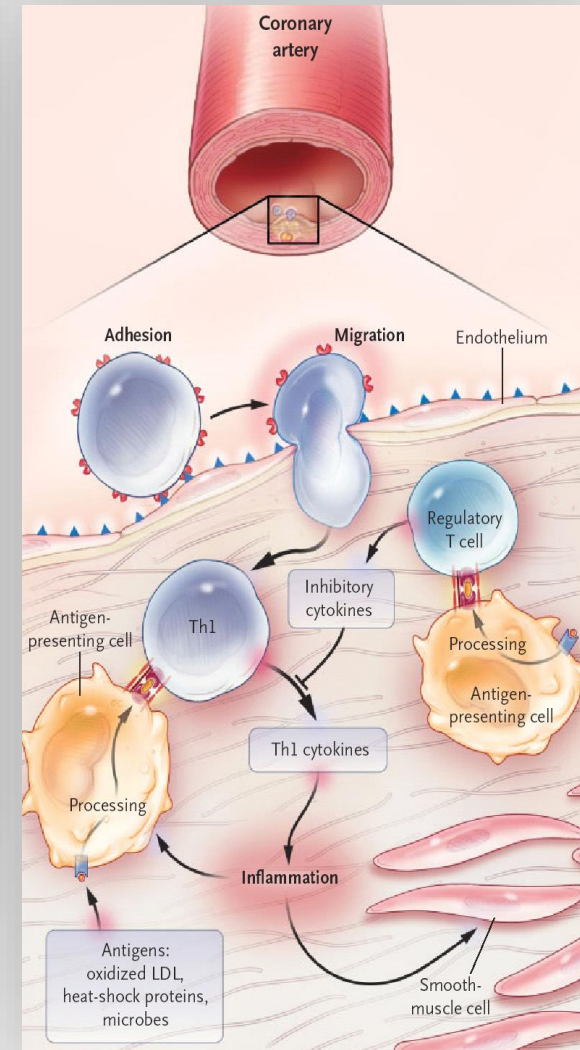
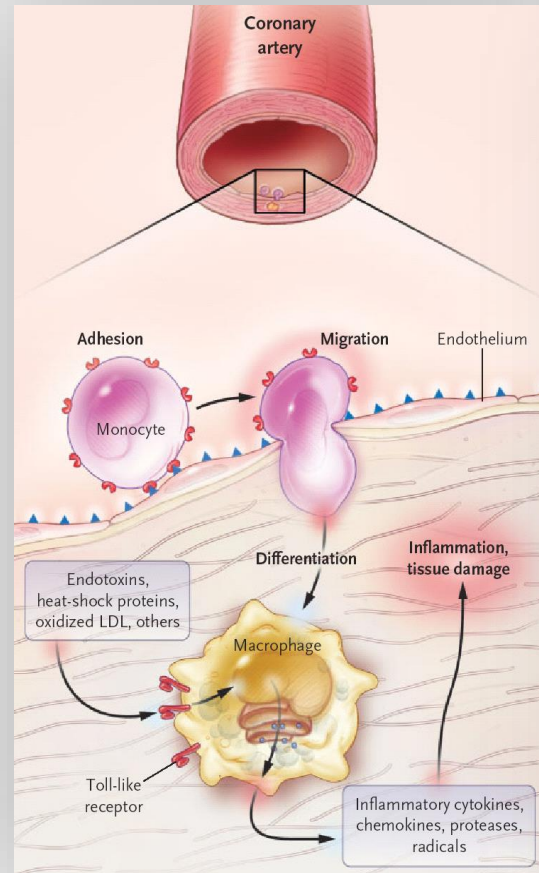
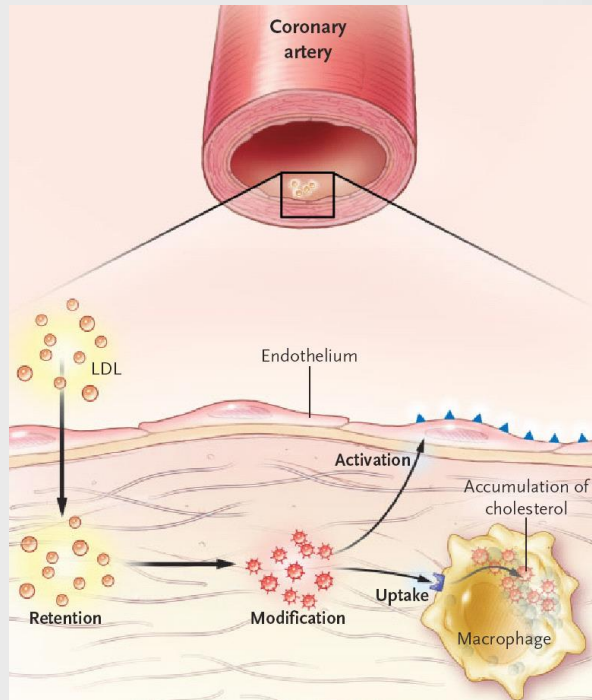
**Lifetime benefit from lowering systolic blood pressure by 10 mmHg for apparently healthy persons (1)**

# CVD-free lifetime gain



**Lifetime ASCVD benefit from smoking cessation for apparently healthy persons (1)**

# Pathophysiologie de l'athérosclérose



# Cholestérol & Athérosclérose

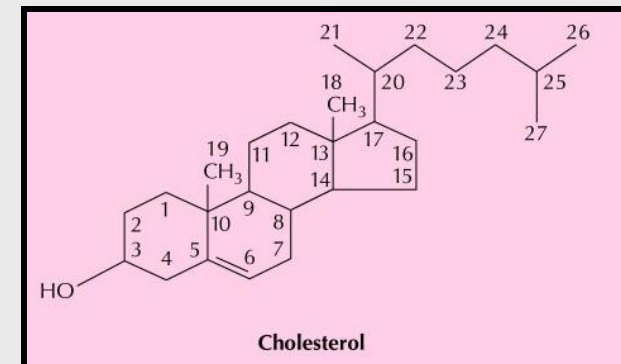
## Cholestérol

*Chole:* bile      *Stereos:* solide

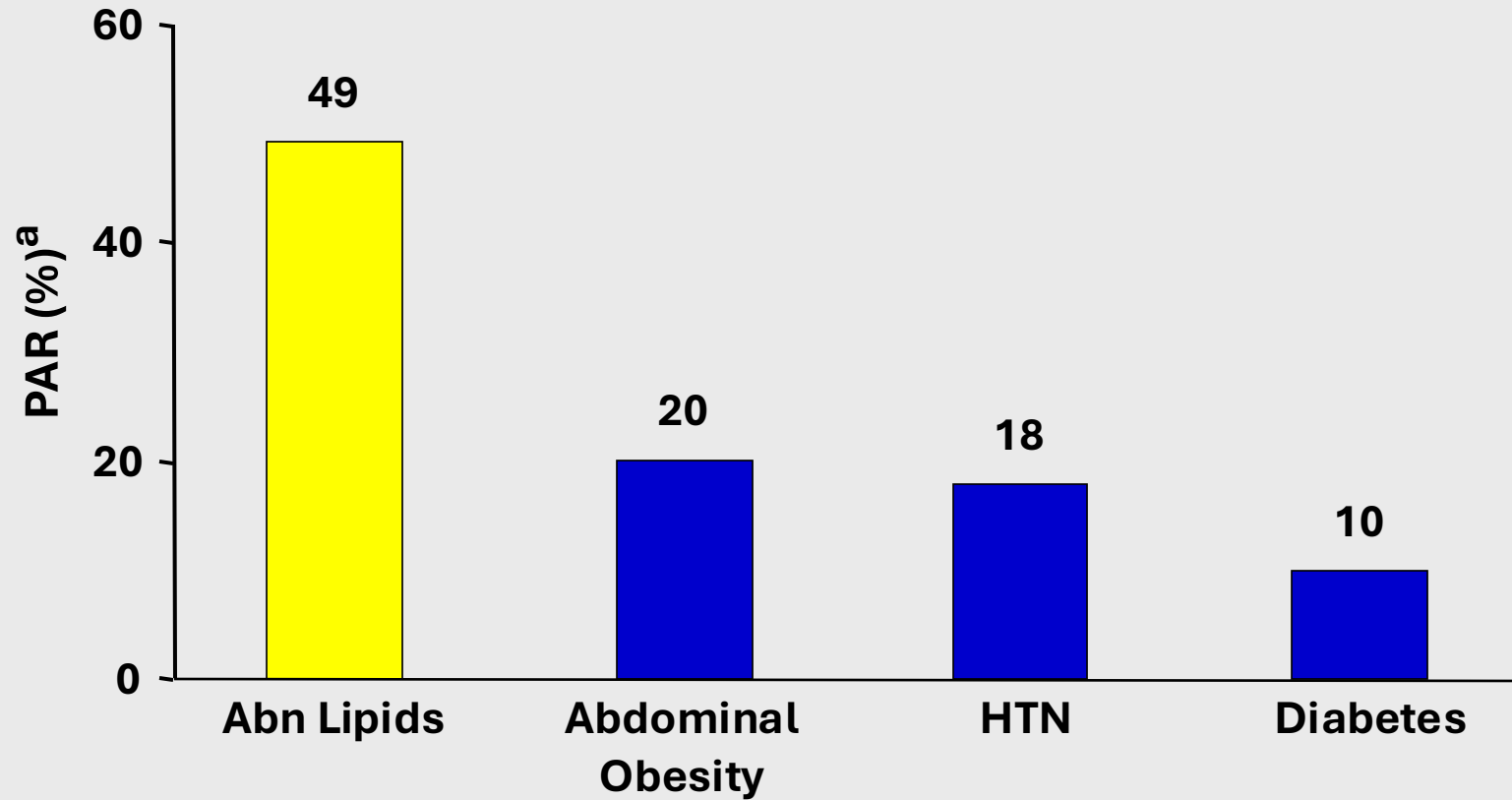
Fait partie des substances fondamentales de l'organisme et c'est un composant de tous les tissus.

Le cholestérol est important en tant que:

- Élément de la membrane cellulaire
- Substance de base pour:
  - les acides biliaires (digestion de certains aliments)
  - vitamine D (formation des os)
  - hormones (oestrogènes et testostérone)



# Principales causes d'infarctus aigu du myocarde



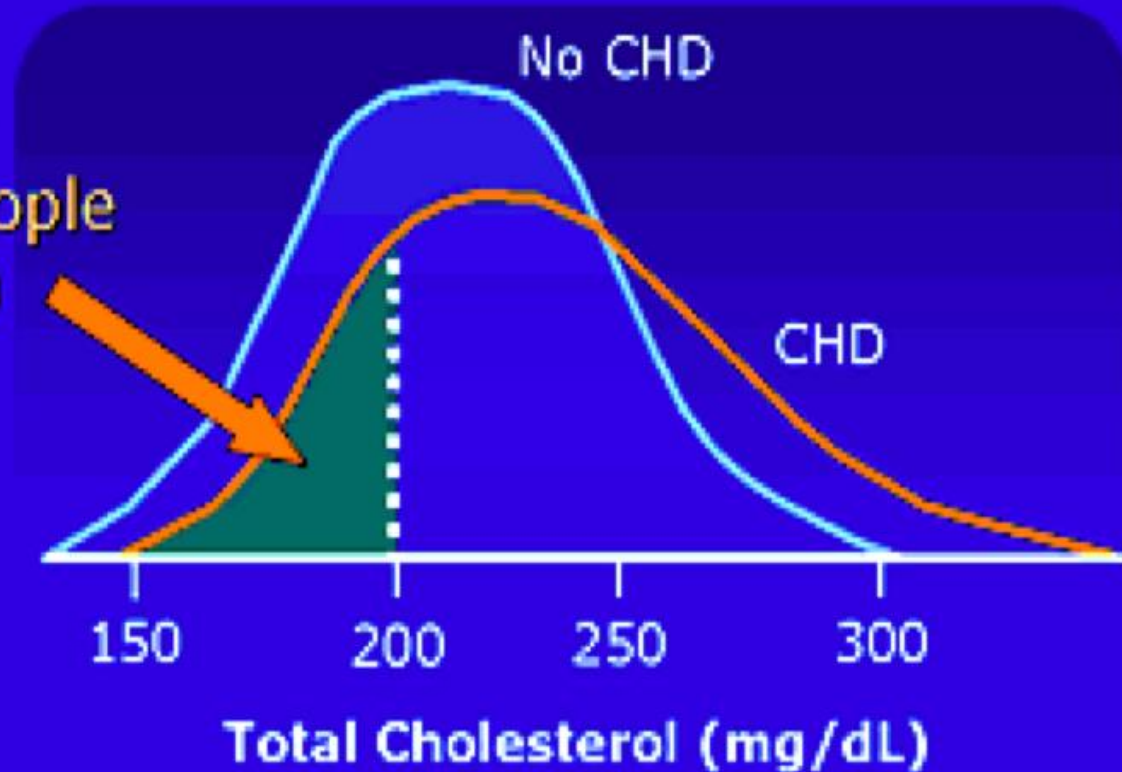
<sup>a</sup>Proportion of MI in the total population attributable to a specific risk factor

# Cholest rol et risque CV

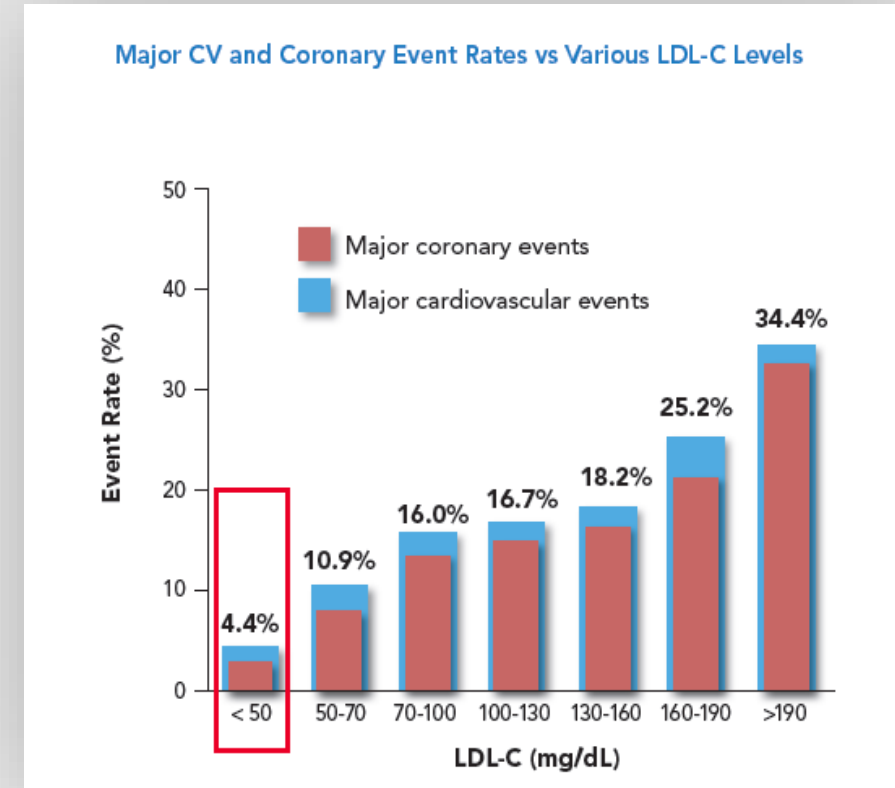
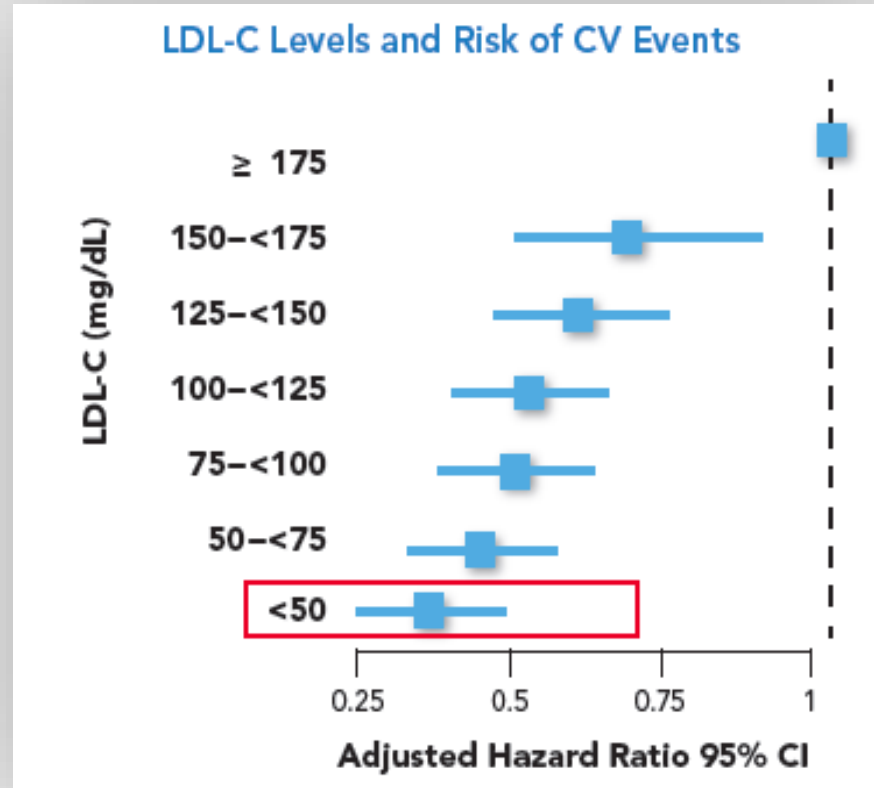
## Total Cholesterol Distribution: *CHD vs Non-CHD Population*

Framingham Heart Study—26-Year Follow-up

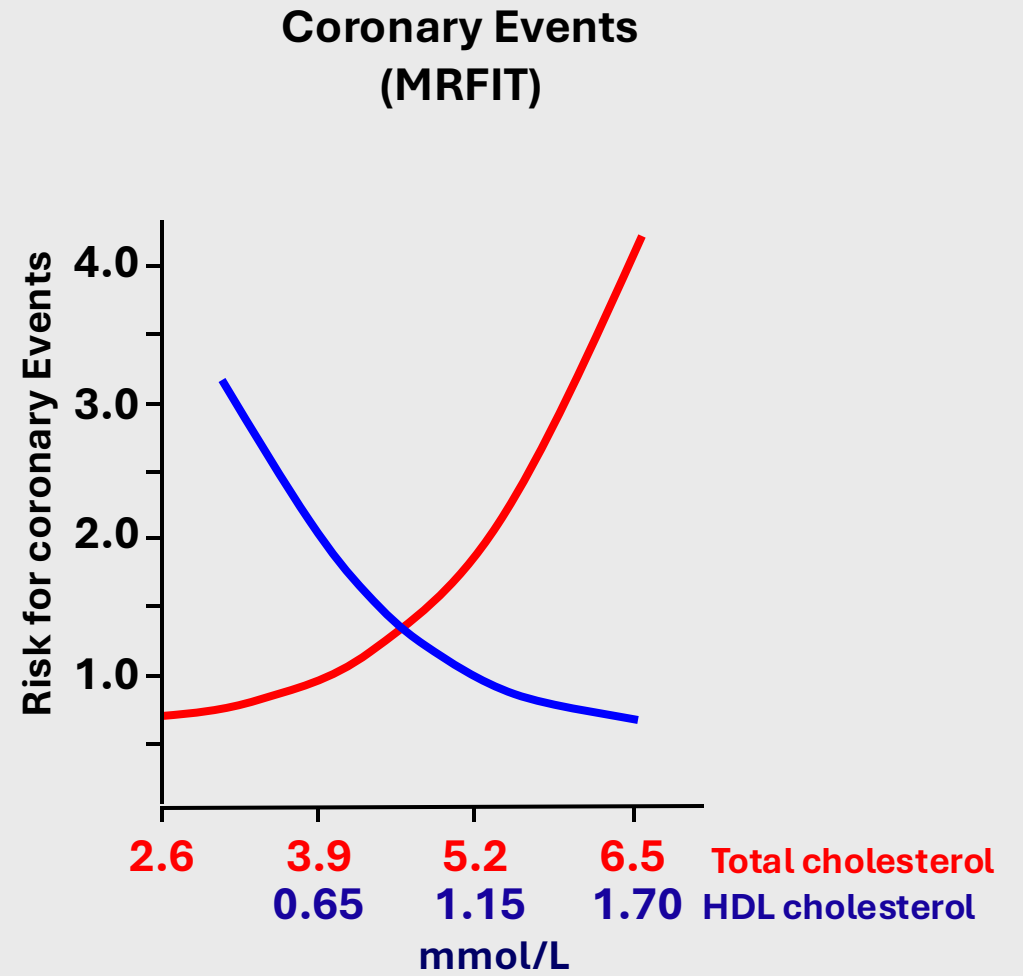
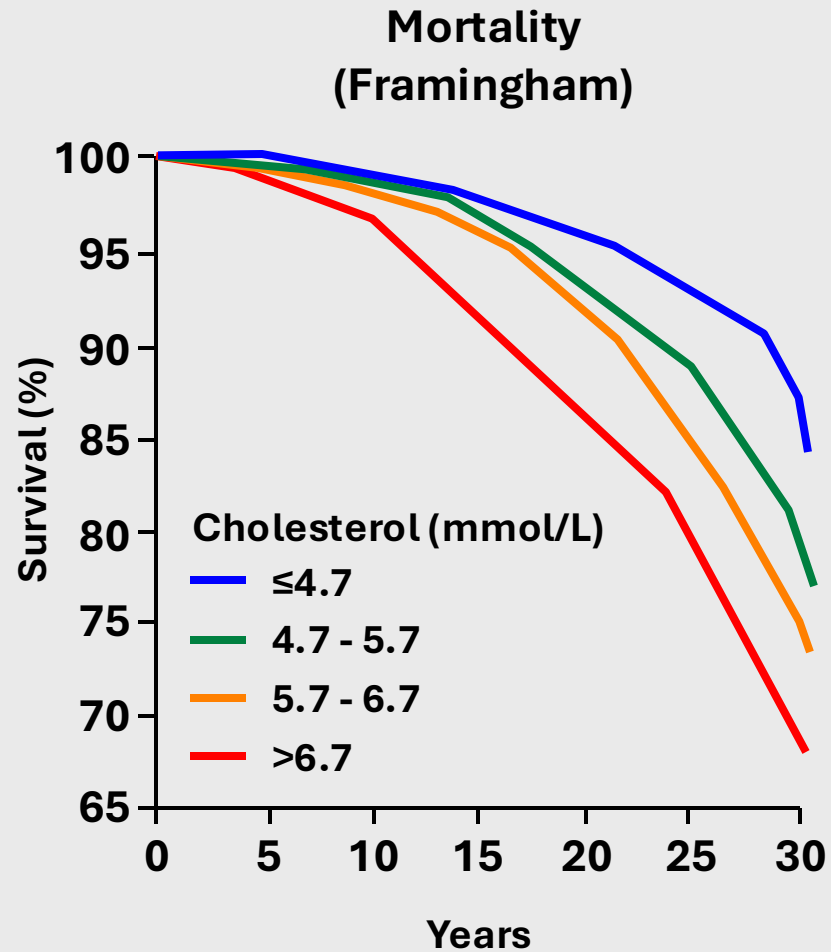
35% of CHD  
Occurs in People  
with TC < 200  
mg/dL



# Clear relationship between LDL-C and risk of CV events



# Cholestérol et risque CV



# Time-exposure to LDL-c

JACC CV HEALTH PROMOTION SERIES

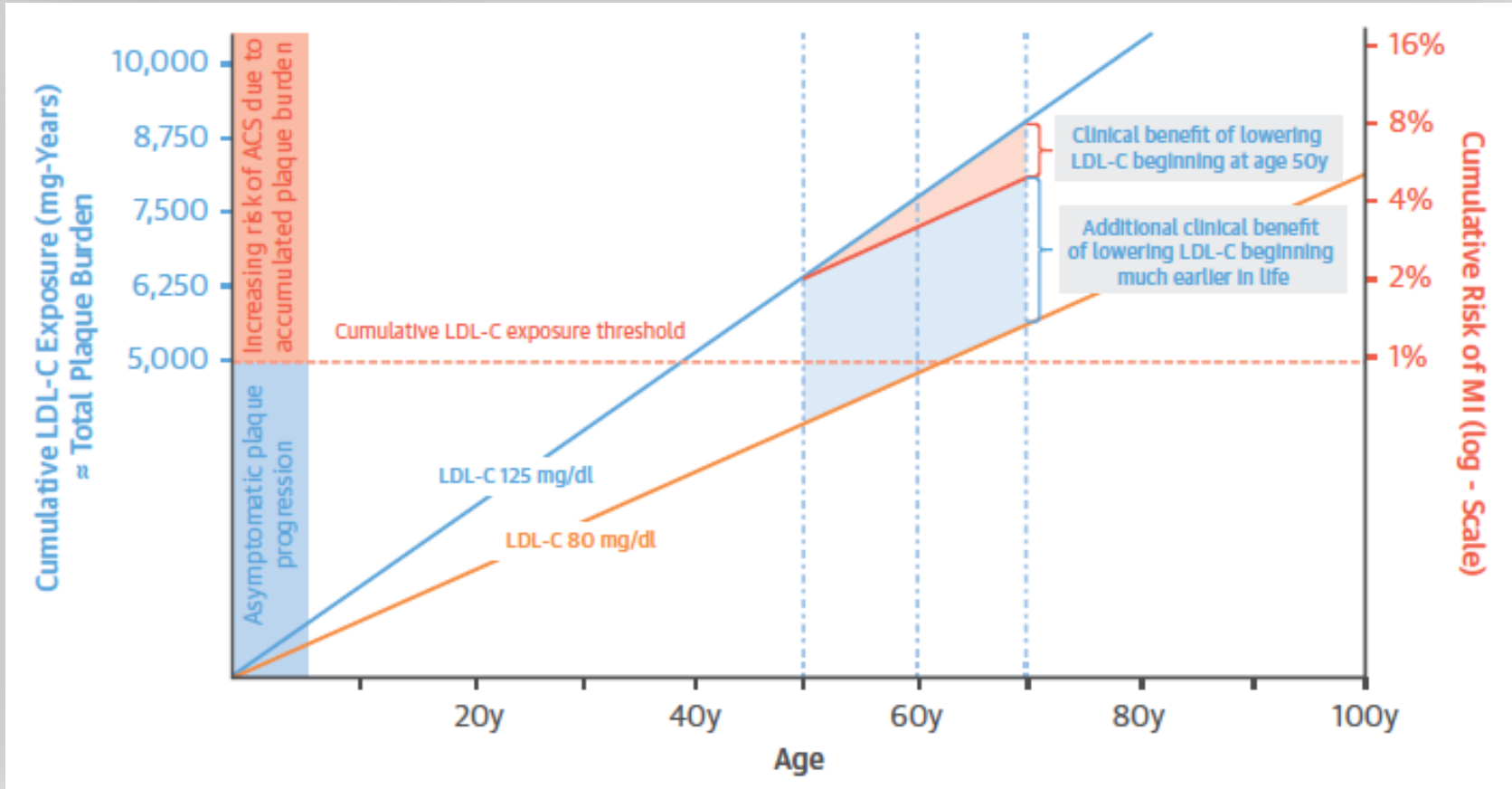
JACC FOCUS SEMINAR

## Reprint of: Impact of Lipids on Cardiovascular Health

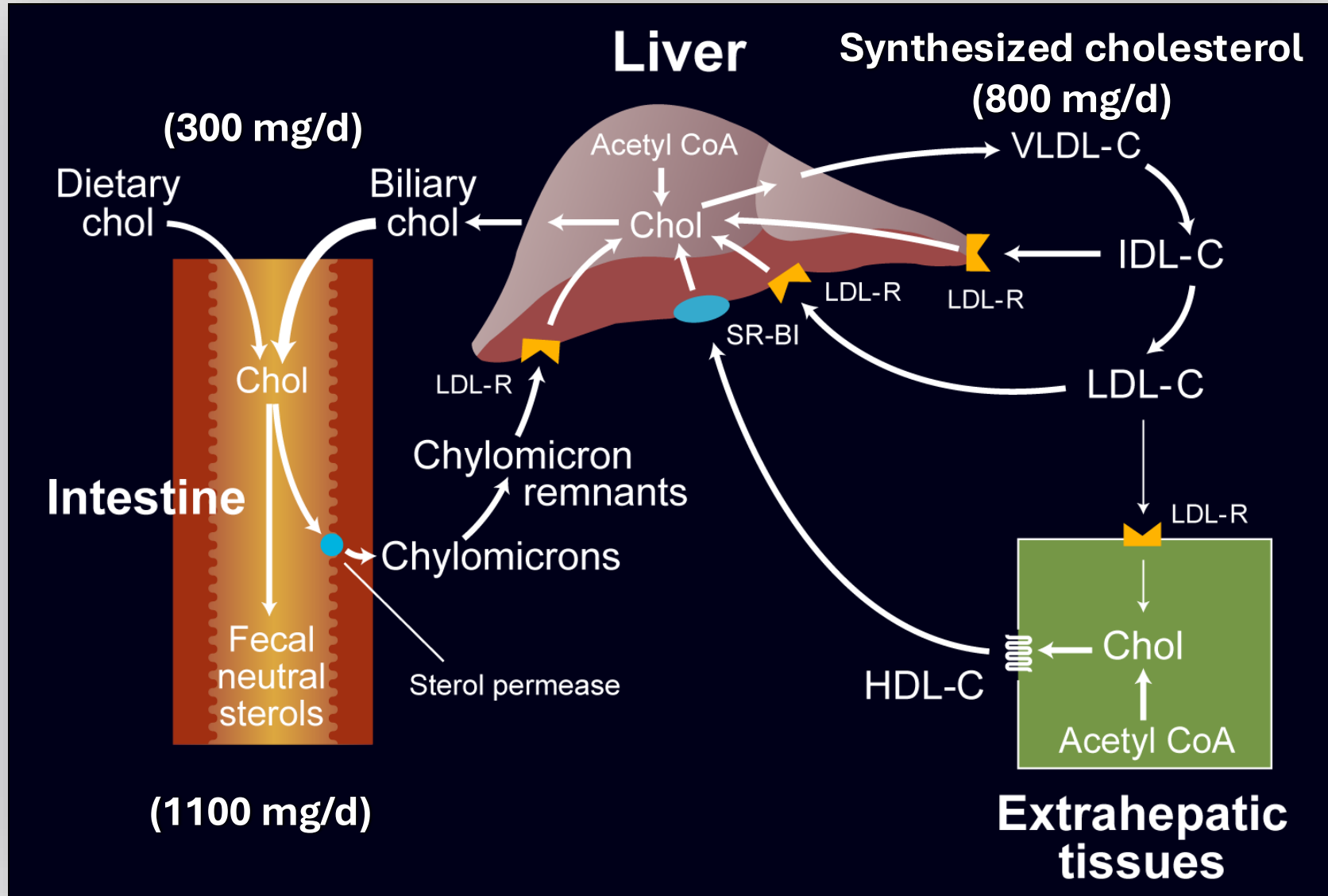
JACC Health Promotion Series

Brian A. Ference, MD, MPH, MSc,<sup>a</sup> Ian Graham, MD,<sup>b</sup> Lale Tokgozoglou, MD,<sup>c</sup> Alberico L. Catapano, PhD<sup>d,e</sup>

JACC 2018;72:2890



# Transport du cholestérol



# **Cholestérol & Athérosclérose**

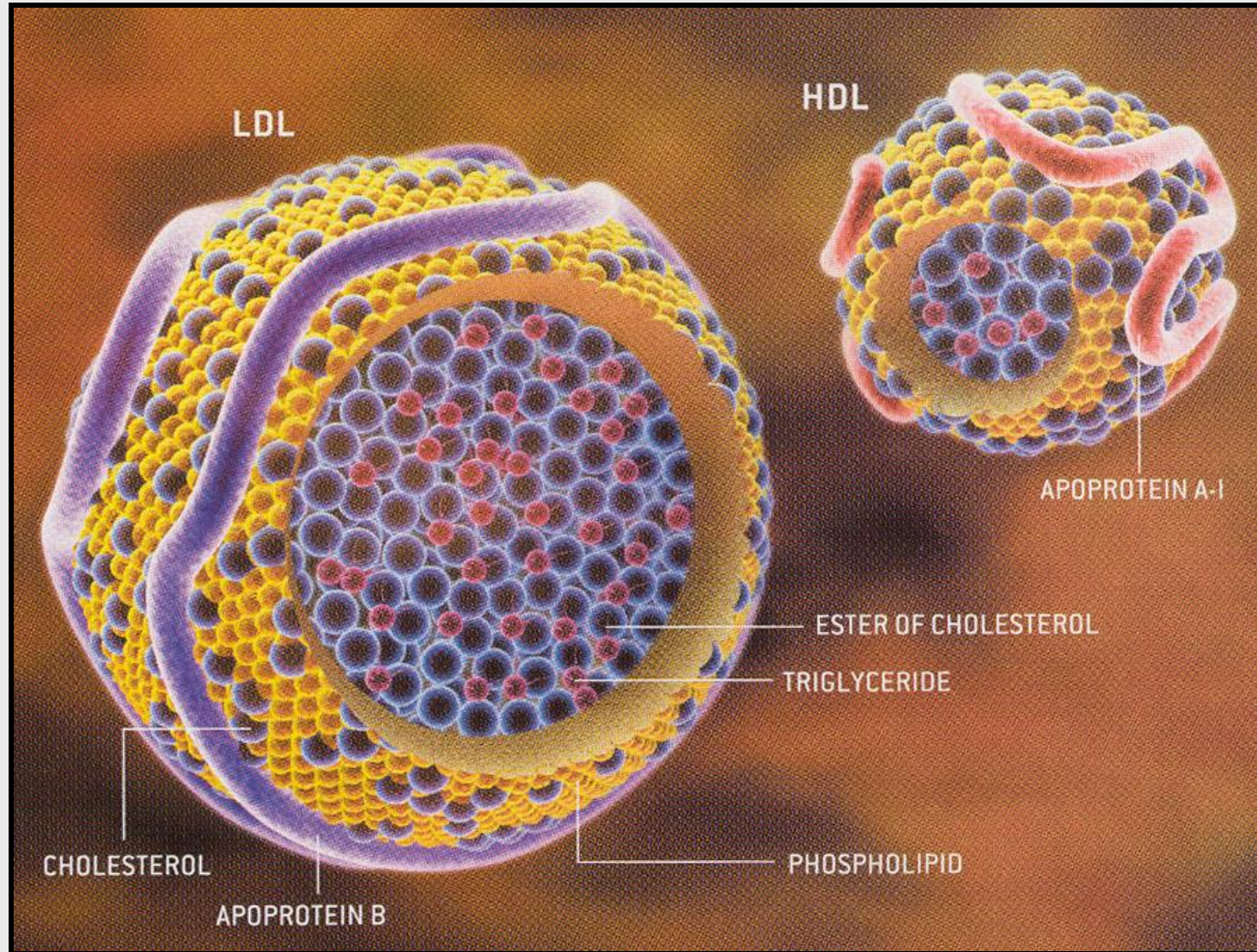
**Le cholestérol est une substance adipeuse, insoluble dans le sang.**

**Le cholestérol a besoin de se lier à une substance qui assure son transport sanguin vers les cellules qui vont le transformer.**

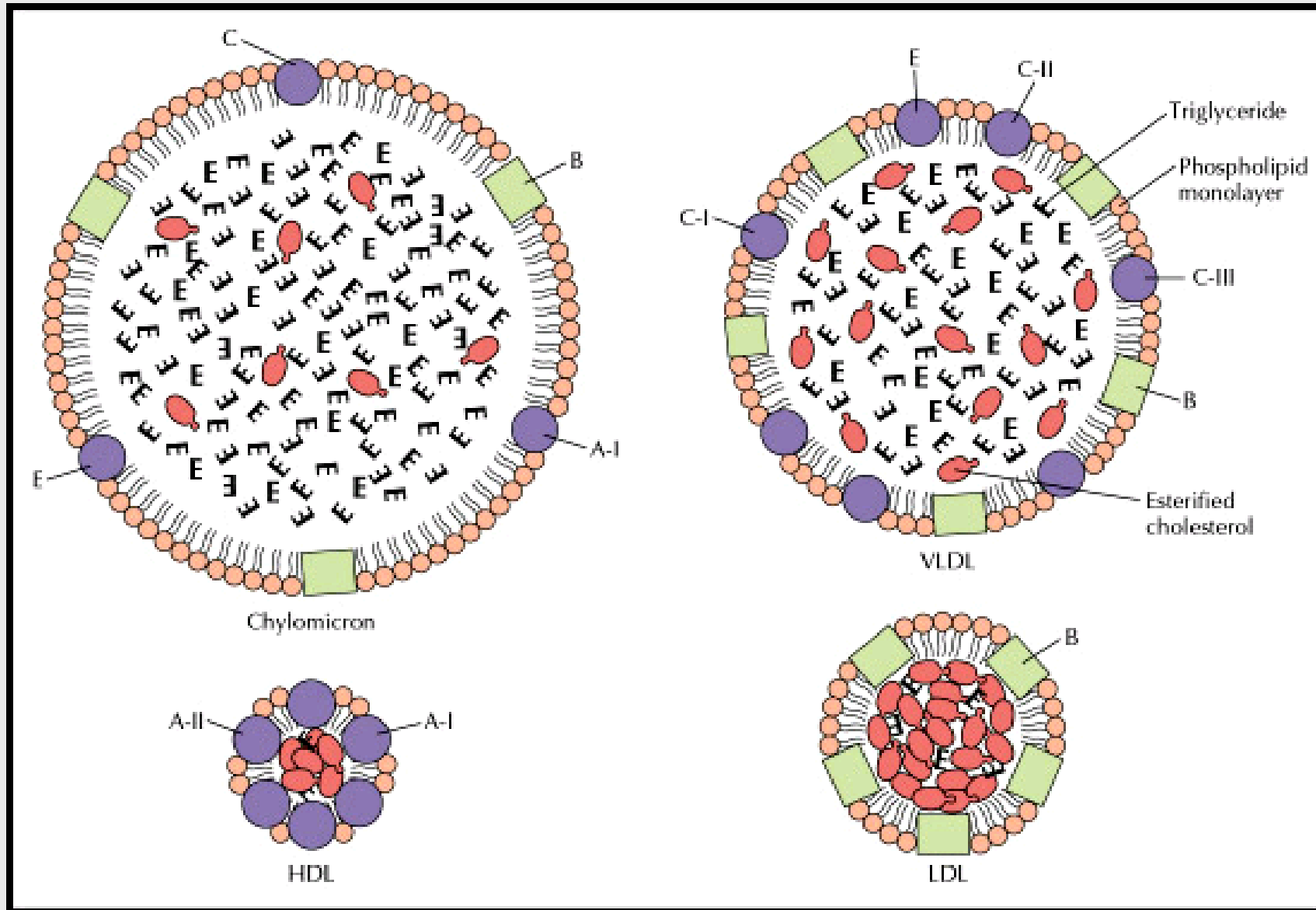
**Le cholestérol est entouré par une « enveloppe » de protéines hydrosolubles: apoprotéines.**

**cholestérol + apoprotéines = lipoprotéines hydrosolubles**

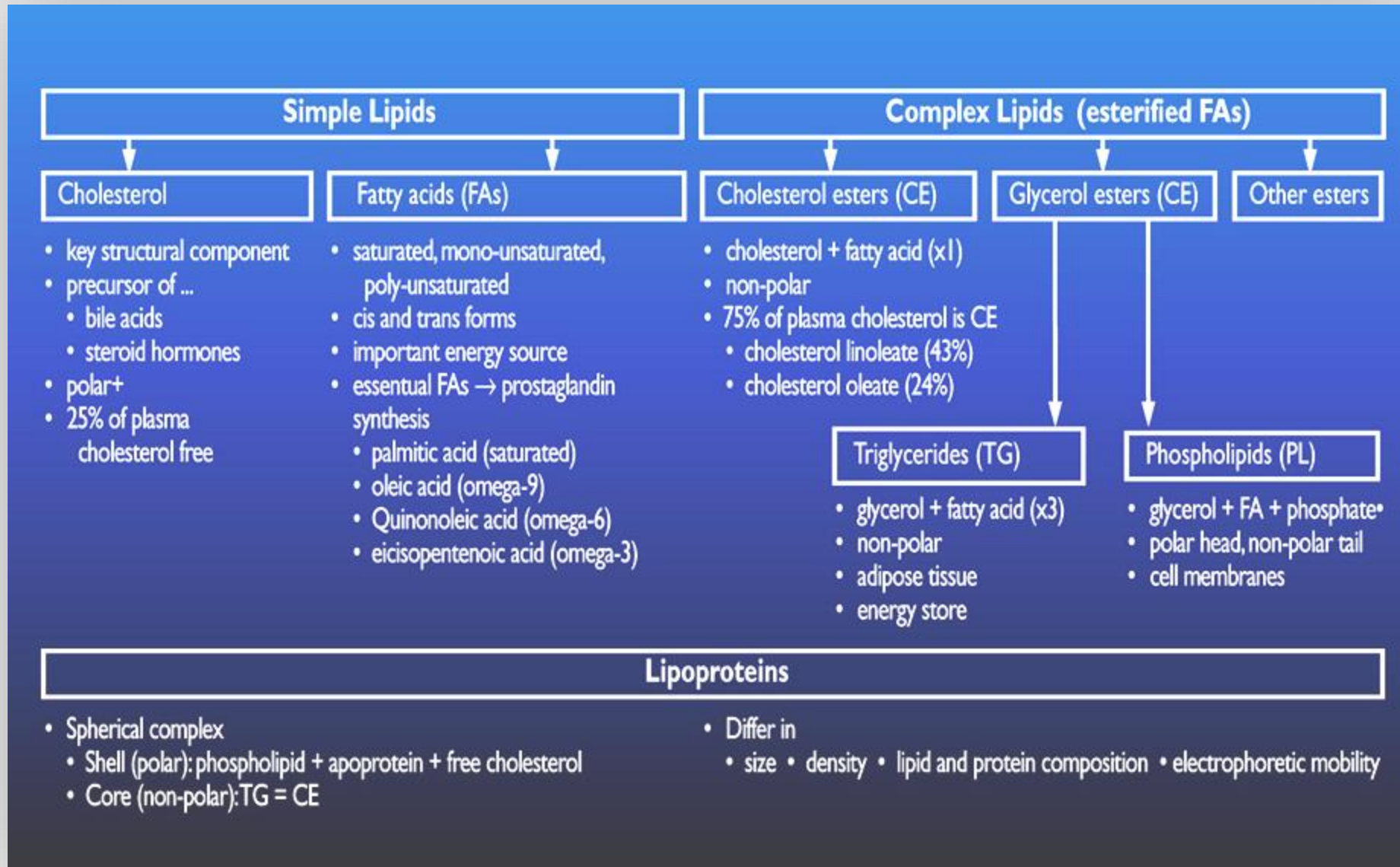
# Structure des lipoprotéines



# Structure des lipoprotéines



# Classification des lipides et des lipoprotéines



# Caractéristiques des lipoprotéines

**VLDL: Very Low Density Lipoprotein**

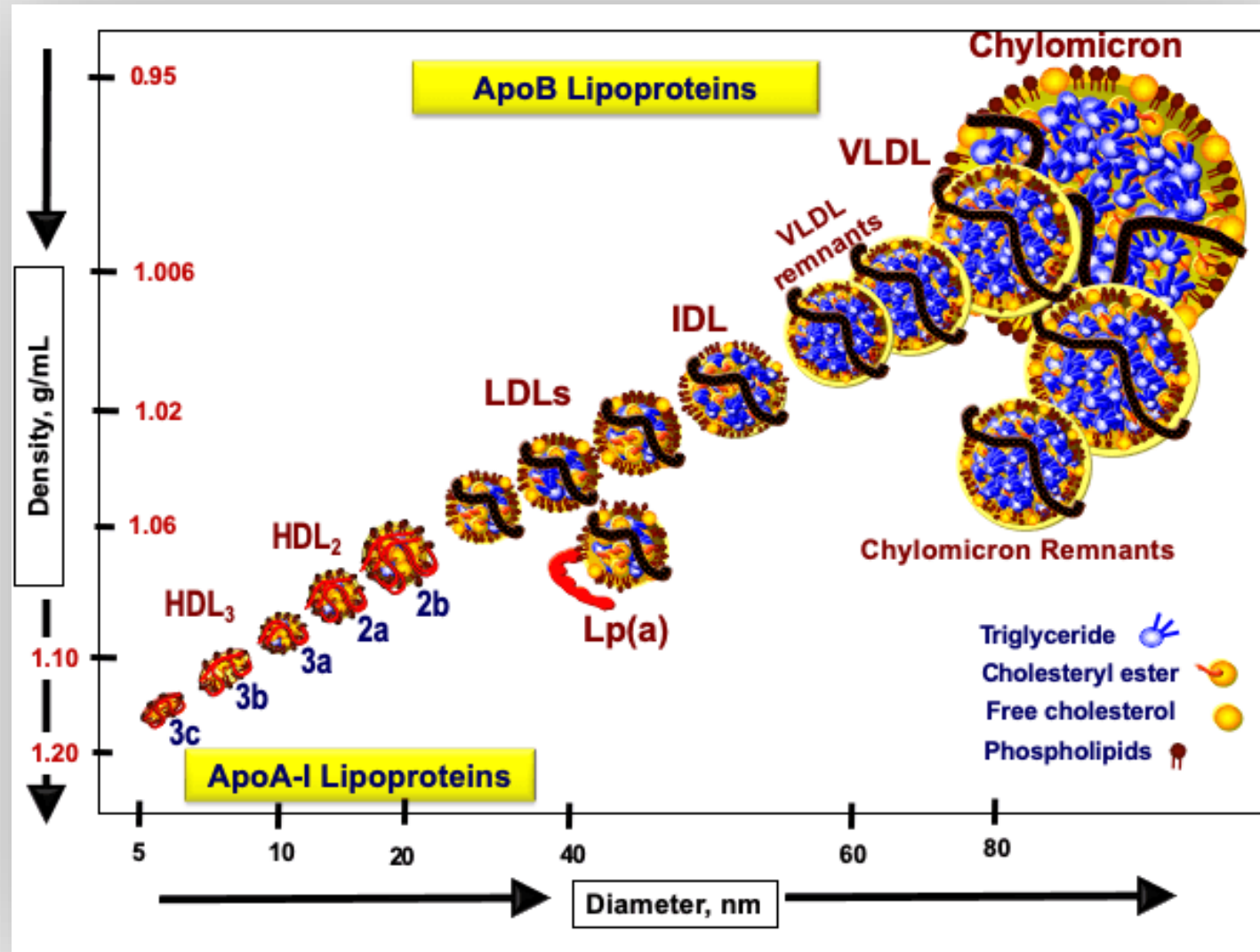
**IDL: Intermediate Density Lipoprotein**

**LDL: Low Density Lipoprotein**

**HDL: High Density Lipoprotein**

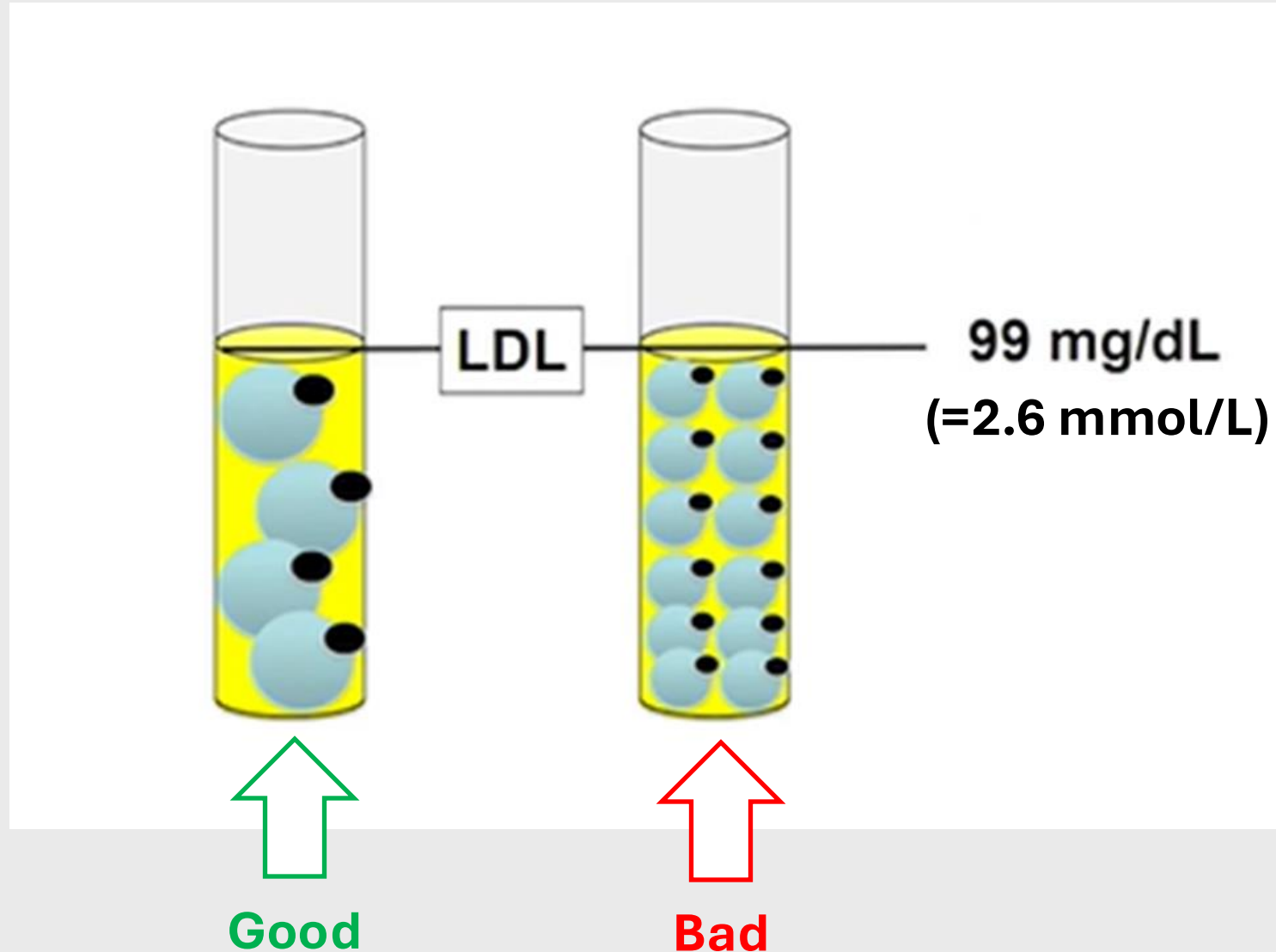
	chylomicrons	VLDL	IDL	LDL	HDL
Subtypes				1, 2, 3	2, 3
Diameter (nm)	500	43	27	27, 26.6, 26	9.5, 6.5
Composition (% total mass)					
protein	2%	10%	18%	25%	55%
TG	85%	50%	26%	10%	4%
C	1%	7%	12%	8%	2%
CE	3%	13%	22%	37%	15%
PL	9%	20%	22%	20%	24%
Apoprotein content	C-III, C-II, C-I, B-48, E, A-I, A-II	B-100, C-III, E, C-II, C-I, A-I, A-II	B-100, B-48, E	B-100	A-I, A-II, D, C-III, C-I, E

# Structure des lipoprotéines



# 2 patients with moderated CV risk in primary prevention

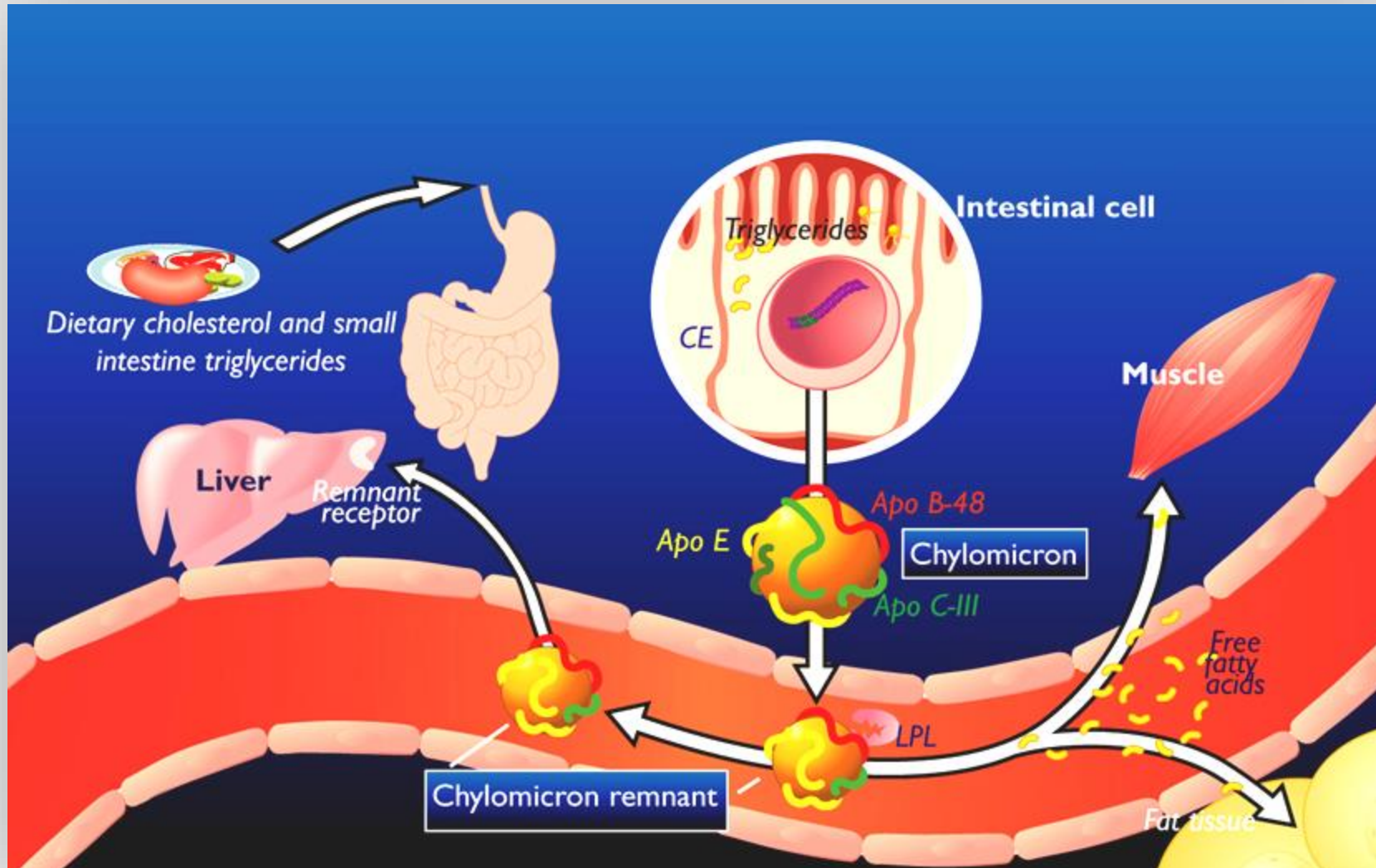
Same LDL-C level



# Apolipoprotéines

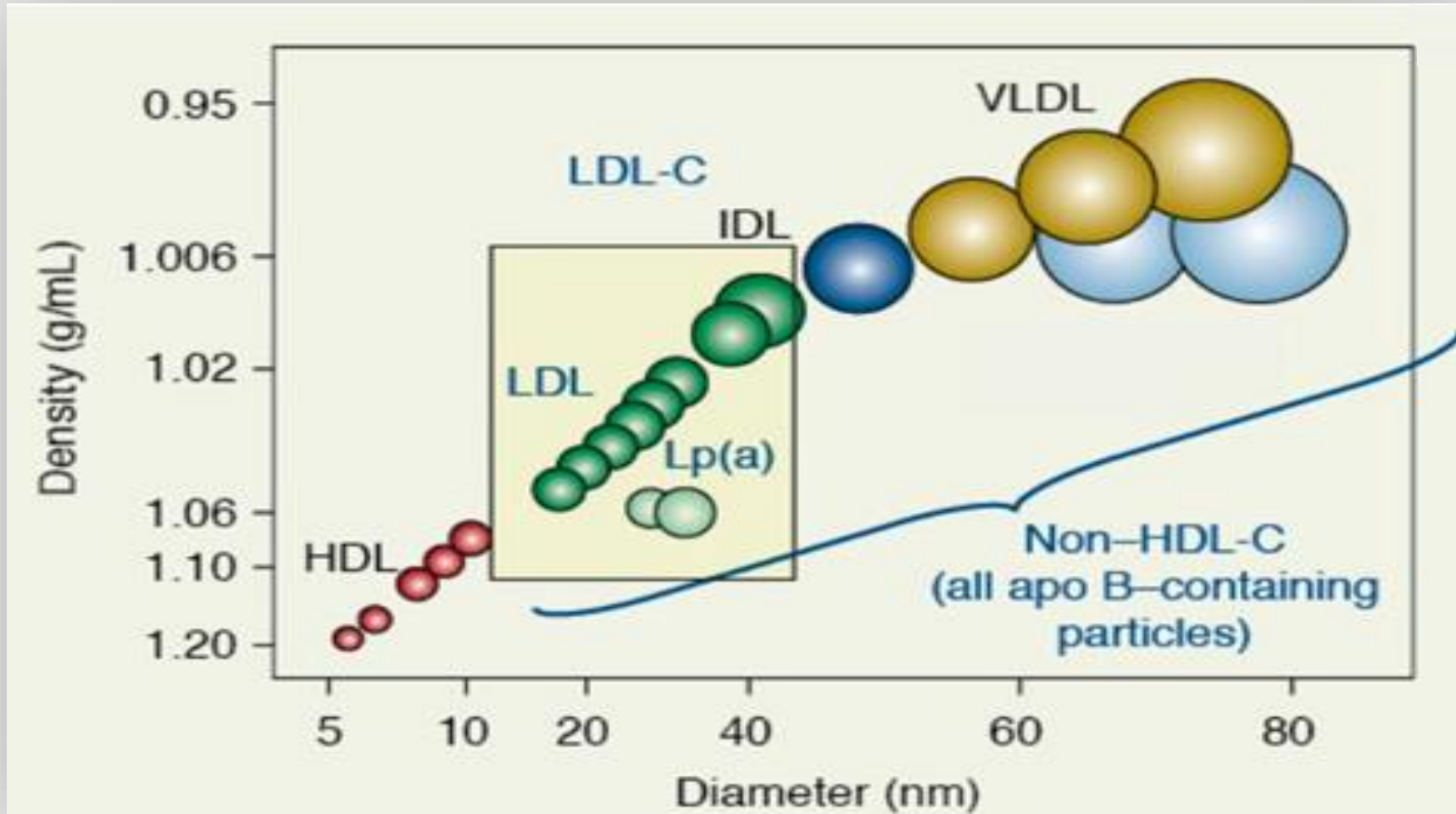
- **Principales protéines des lipoprotéines**
- **Fonctions:**
  - **activation d'enzymes du métabolisme des lipides**
  - **facilitation le transport des lipides**
    - **lecithin cholesterol acyltransferase (LCAT)**
    - **lipoprotein lipase (LPL)**
    - **hepatic triglyceride lipase (HTGL)**
  - **attachement à la surface cellulaire (récepteurs)**

# Digestion et métabolisme du cholestérol



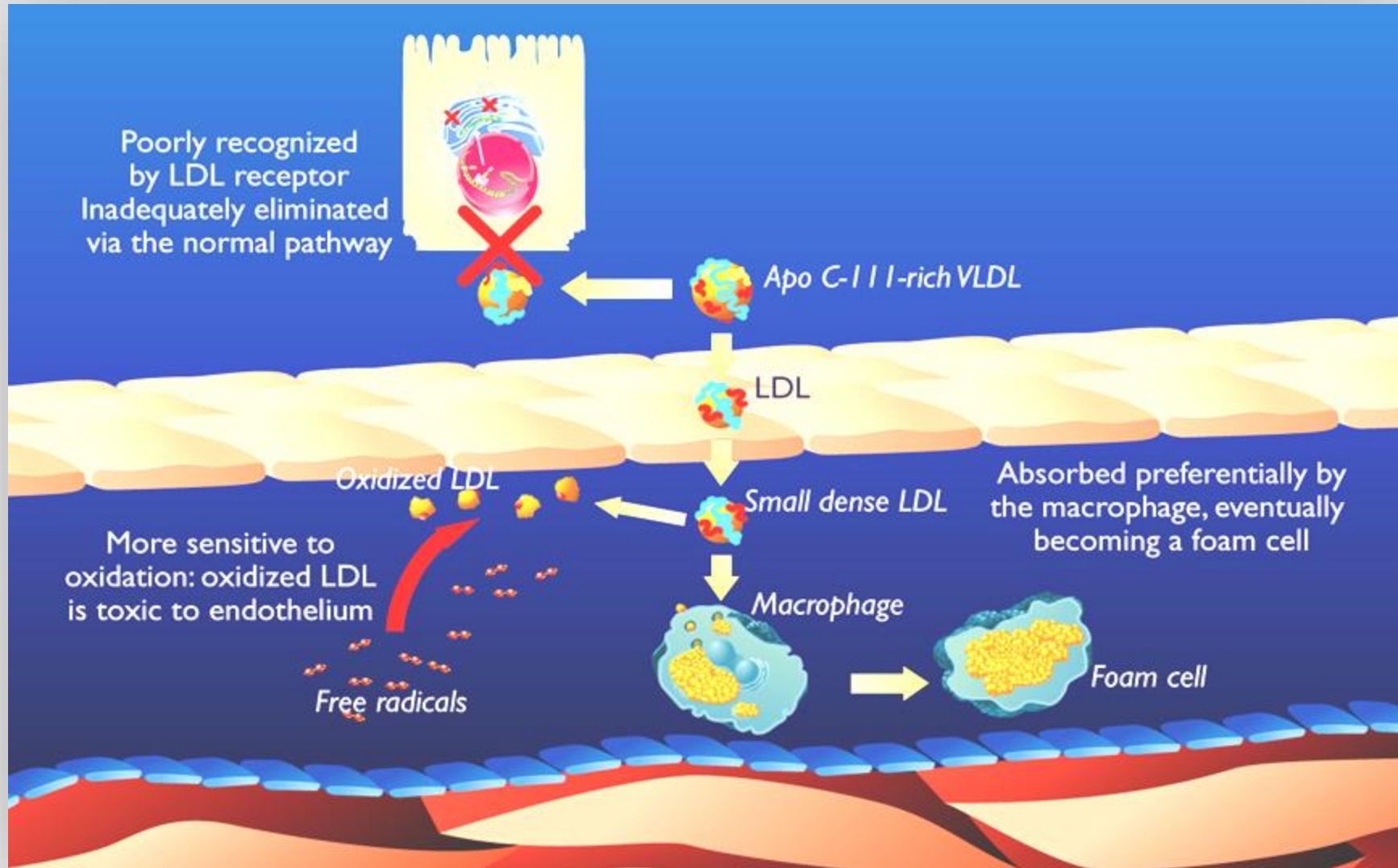


# Caractéristiques des lipoprotéines

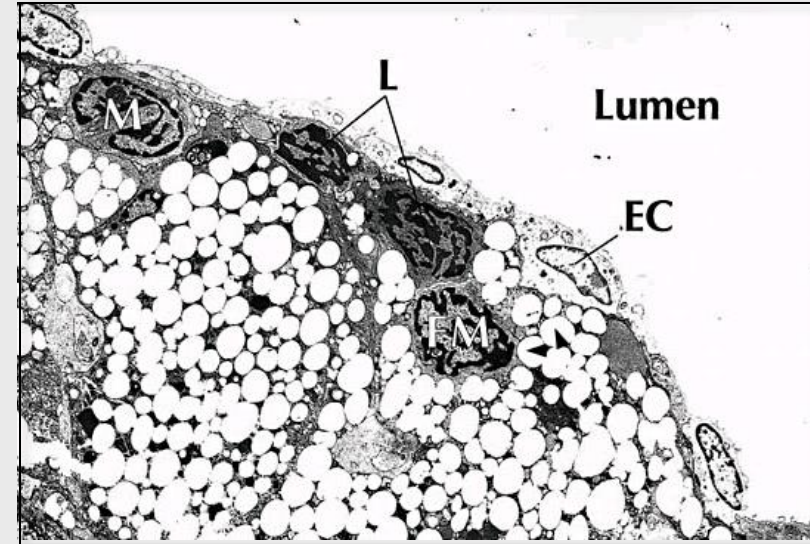
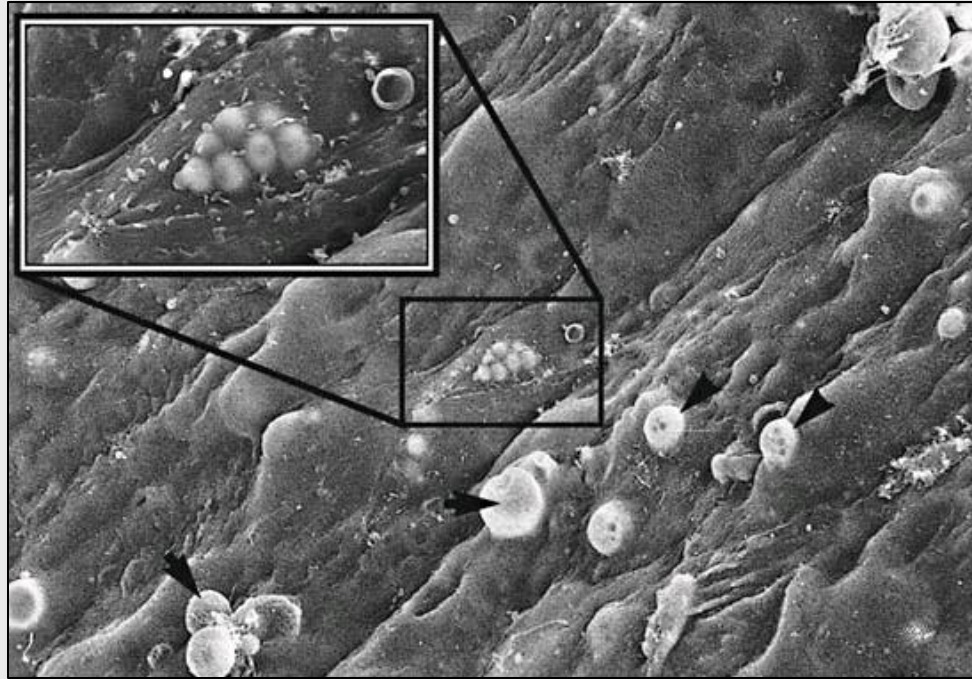


# Métabolisme du cholestérol

## Pouvoir athérogènes du LDL cholestérol

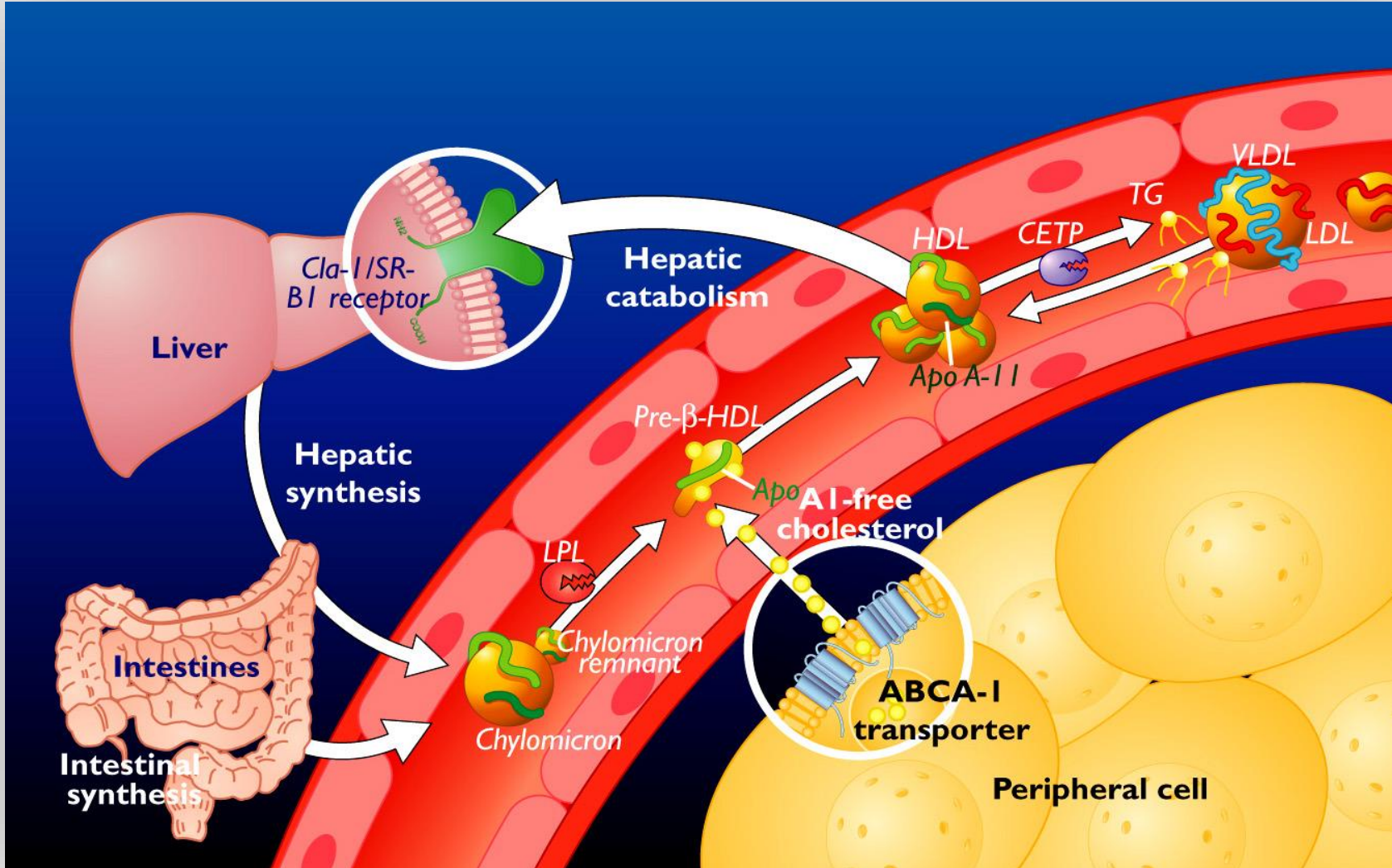


# Cholestérol & Athérosclérose



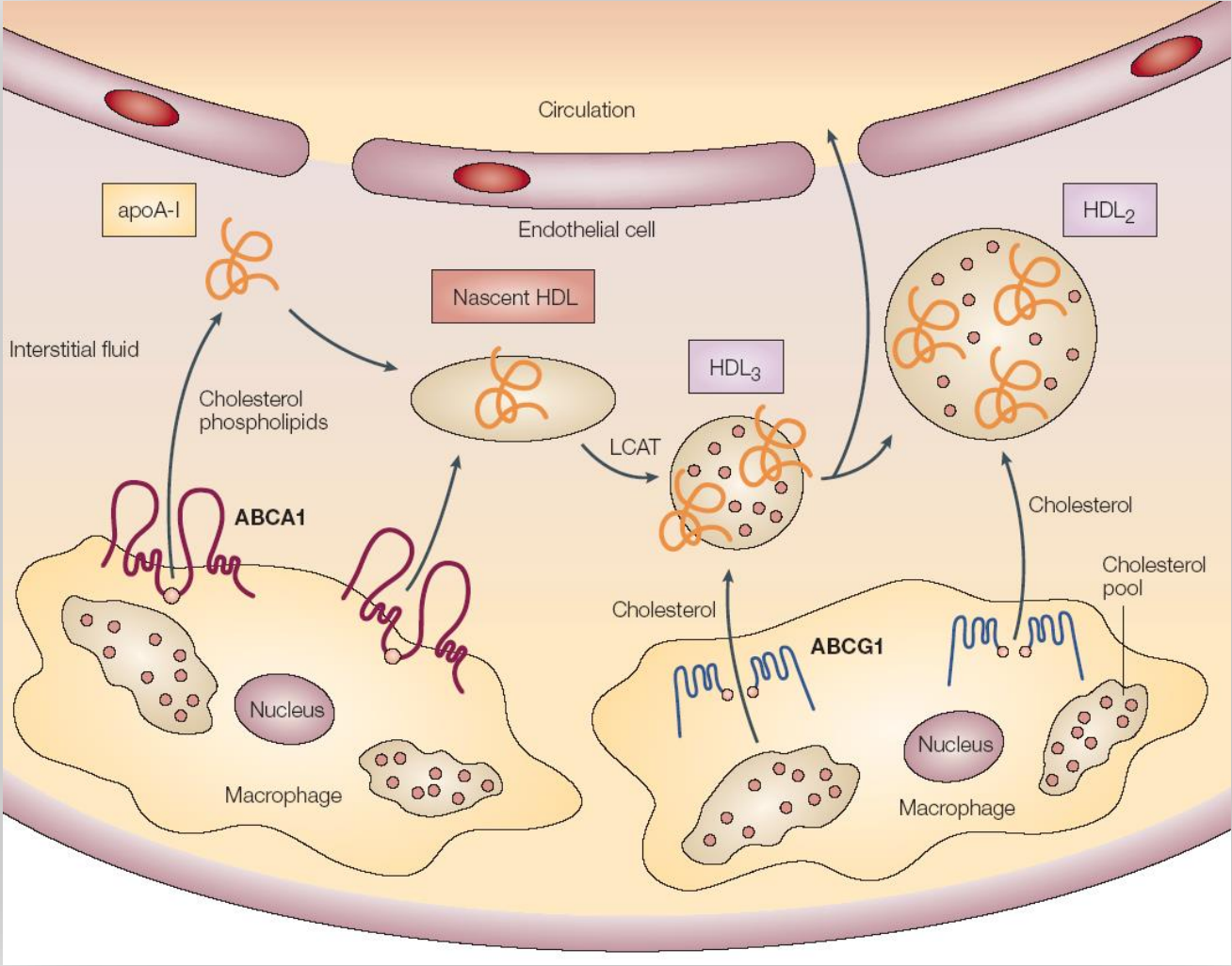
# HDL Cholestérol

## Reverse cholesterol transport



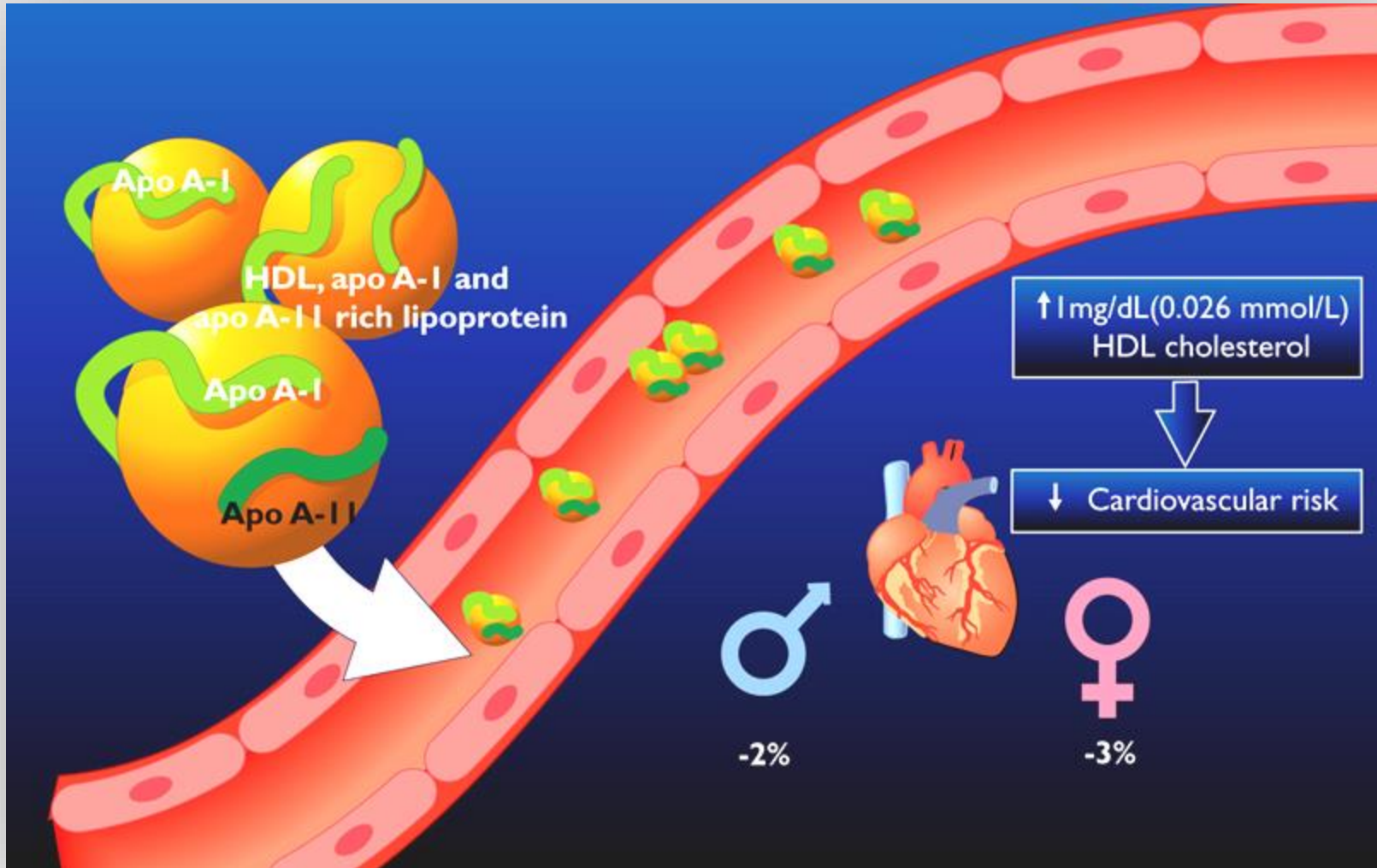
# Métabolisme du HDL-cholestérol

## Reverse cholesterol transport

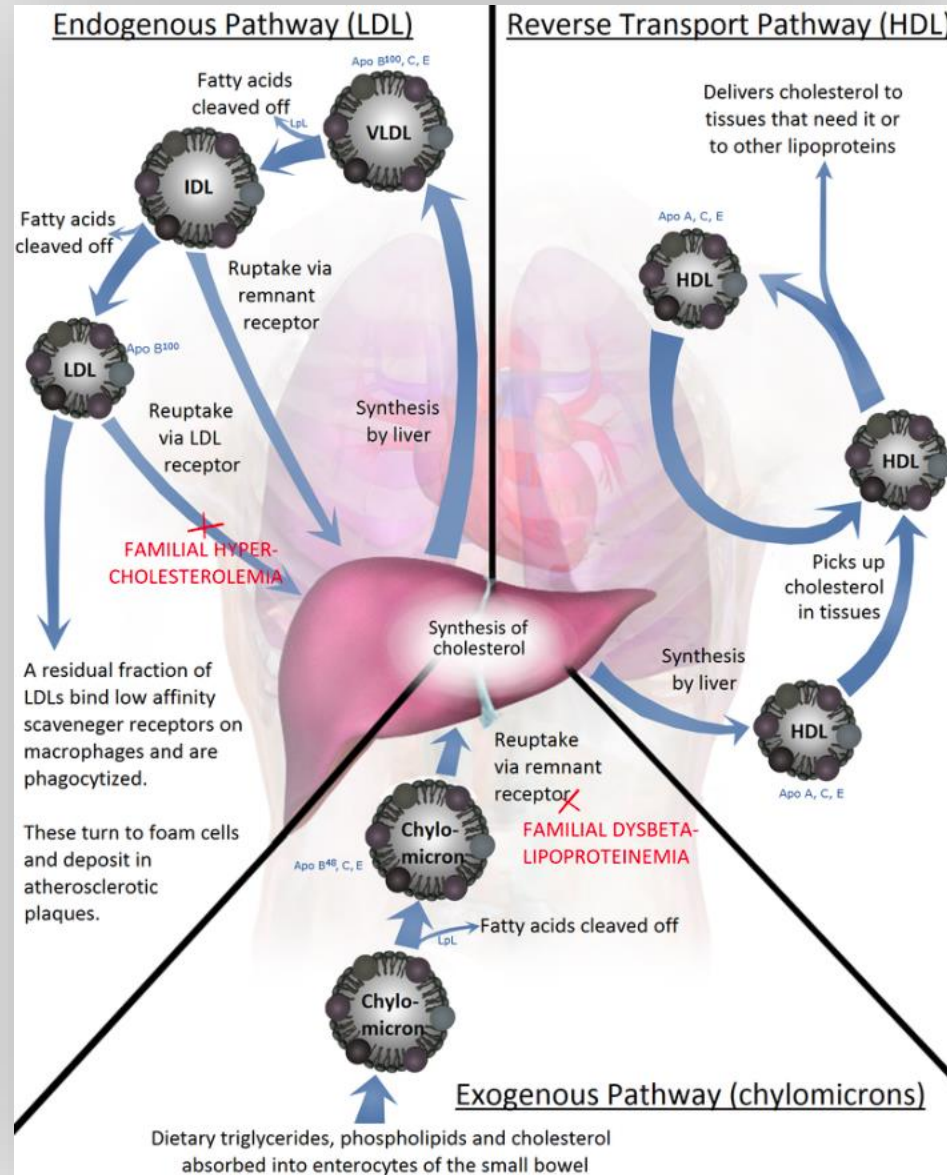


# HDL Cholestérol

## Rôle anti-athérosclérose



# Métabolisme du cholestérol



# LDL Cholestérol

- **Fortement associé à l'athérogenèse et aux événements (infarctus, attaques cérébrales)**
- **Elévation de 10% augmente de 20% le risque d'événements liés à l'athérosclérose (infarctus)**
- **Modifié par d'autres facteurs de risques**
  - HDL cholestérol bas
  - tabac
  - hypertension
  - diabète

# Triglycérides

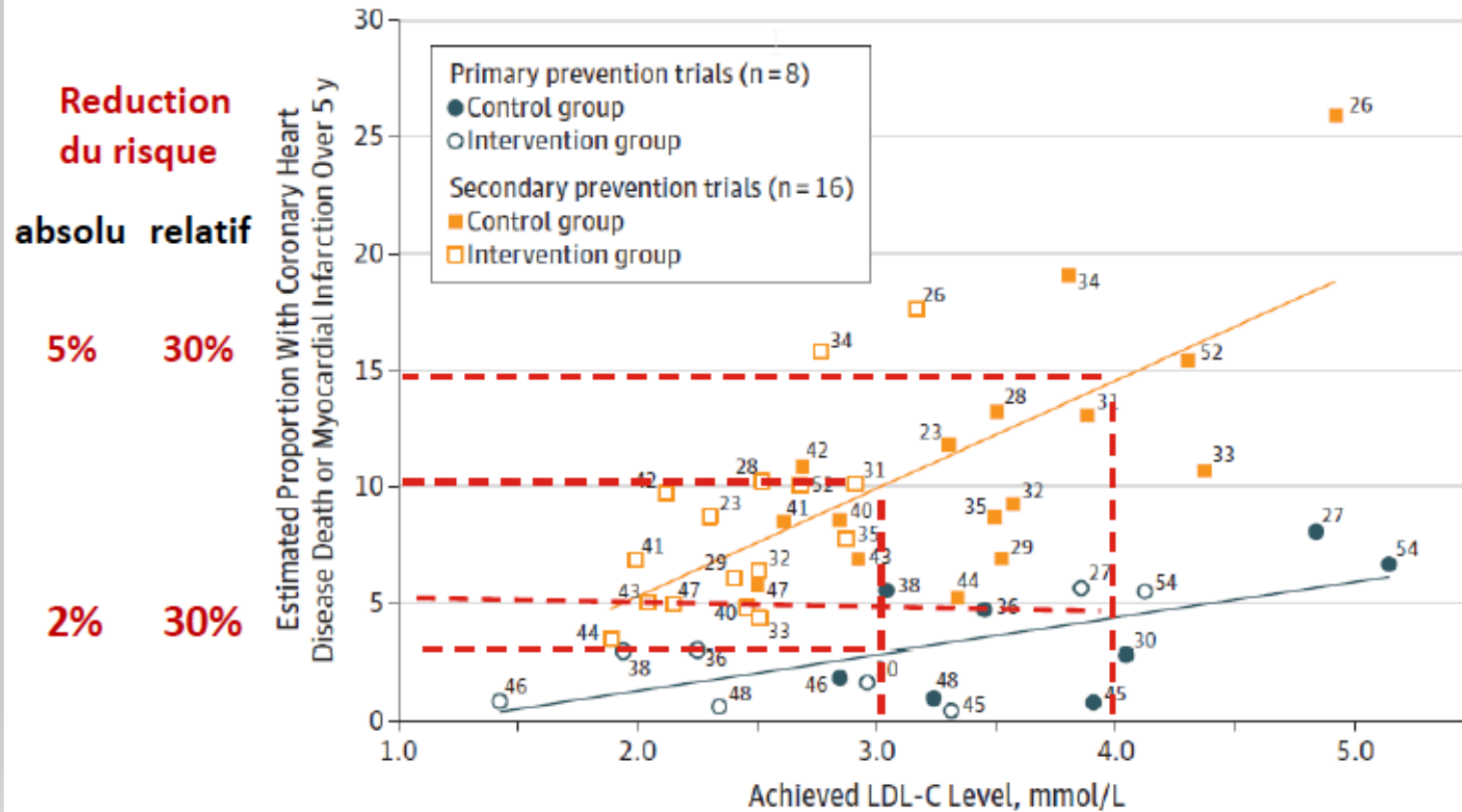
- **Augmente le risque d'athérosclérose**
- **Relation avec l'athérosclérose est complexe**
  - **Souvent lié à un cholestérol total assez bas et une augmentation des formes athérogéniques du LDL cholestérol**
- **Souvent associé à d'autres dyslipidémies**
- **Elévation (>10 mmol/L) augmente le risque de pancréatite**

# HDL Cholestérol

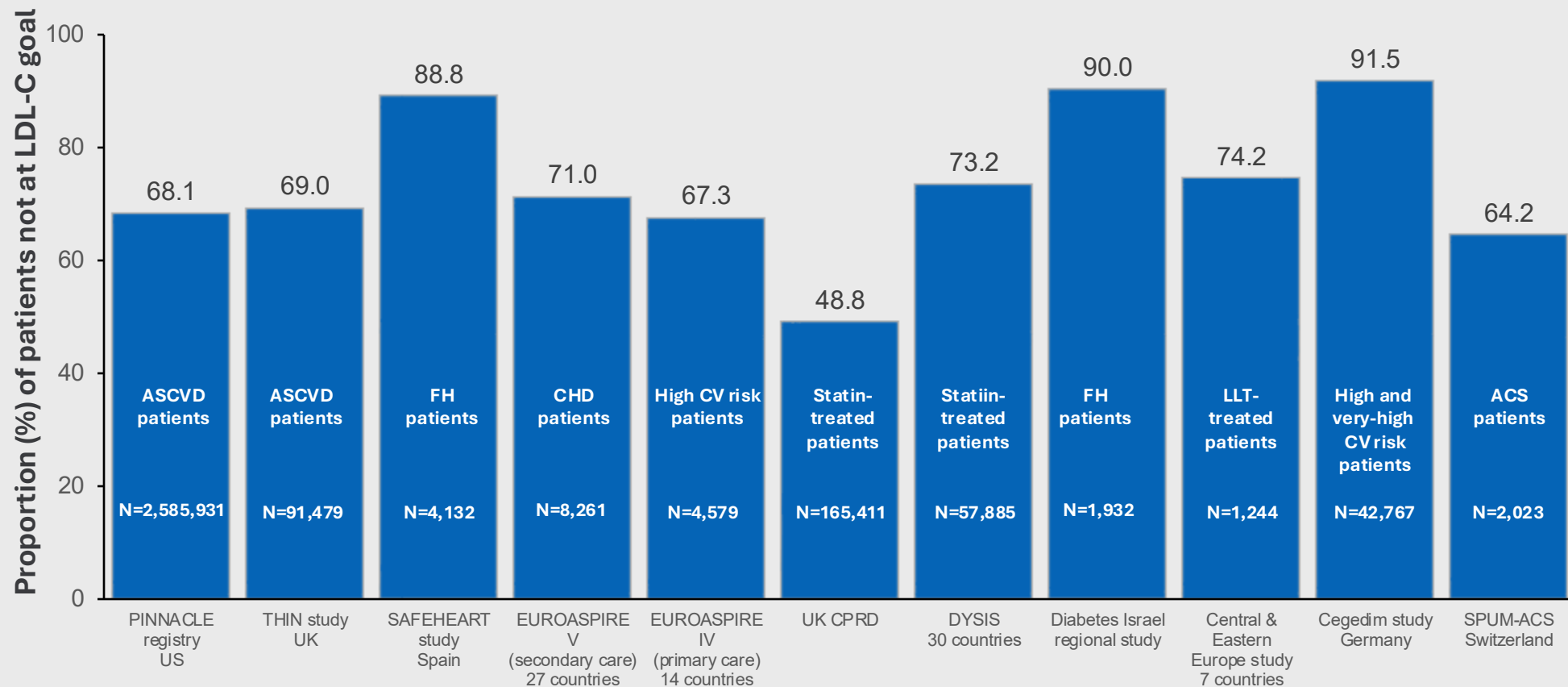
- **HDL cholestérol haut a un effet protecteur et diminue le risque d'athérosclérose**
- **Plus le HDL cholestérol est bas, plus le risque d'athérosclérose est élevé**
  - HDL cholestérol (<1.0/mmol/L) augmente le risque
- **HDL cholestérol bas souvent avec triglycérides élevés**
- **HDL cholestérol est diminué par le tabac, la surcharge pondérale et l'inactivité physique**

# LDL-C - Risque cardiovasculaire

## Bénéfices à 5 ans de baisser le LDL-cholestérol

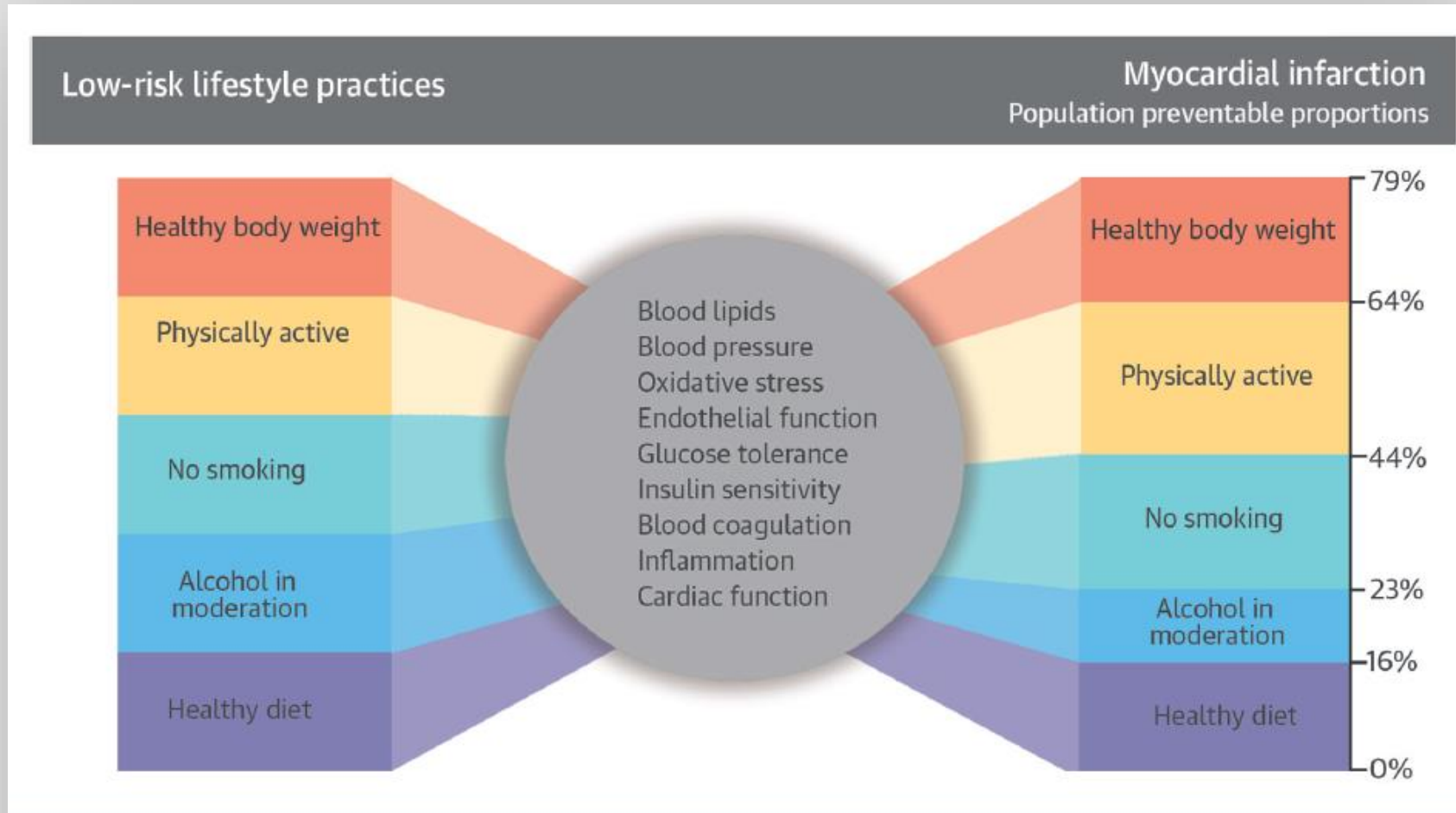


# Despite efficacious LDL-C lowering therapies. High and very high-risk patients are failing to achieve LDL-C goals



*Circulation.* [2019;140\(S1\):A12904](#); *BMJ Open.* [2017;7:e013255](#); *JACC.* [2016;67:1278–85](#); *Atherosclerosis.* [2019;285:135–146](#); *Eur J Prev Cardiol.* [2016;23:2007–2011](#); *Heart.* [2019;117:1–7](#); *Atherosclerosis.* [2016;255:200–09](#); *Eur J Prev Cardiol.* [2017;24:867–875](#); *Adv Ther.* [2019;36:608–20](#); *Atherosclerosis.* [2018;268:99–107](#); *J Am Heart Assoc.* [2017;6:e006537](#).

# CV Risk Factors & lifestyle



**CENTRAL ILLUSTRATION** 5 Combined Low-Risk Behaviors and the Population Preventable Proportions of MI

The combination of the 5 low-risk dietary and lifestyle factors, the proposed intermediate biological factors, and the population preventable proportions of myocardial infarction.

# Conclusions/Messages

Athérosclérose 19-11-2025

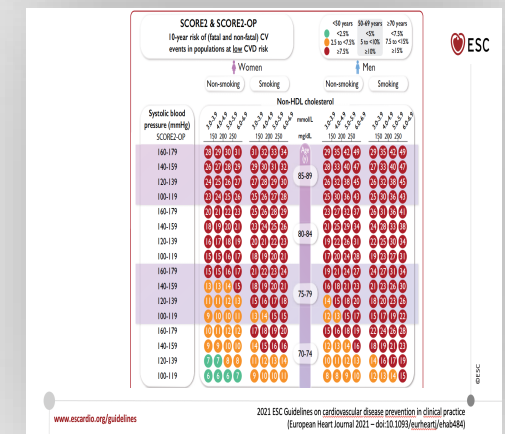
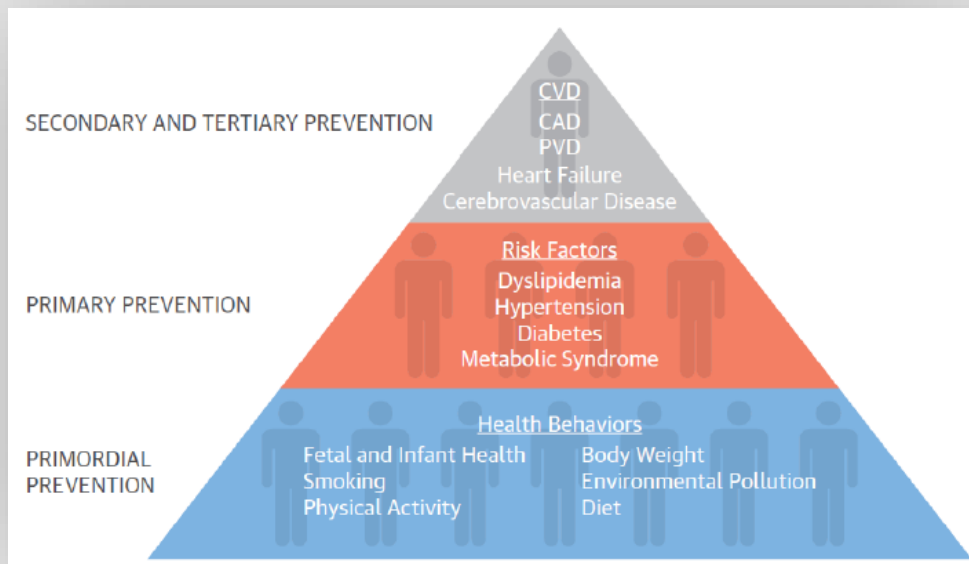
La prévention joue un rôle fondamentale, pas assez utilisée, dans la diminution des maladies CV.

Les scores de risque permettent de mieux définir les individus et patients qui doivent être traités le plus agressivement.

Les interventions médicamenteuses se basent sur l'estimation du risque cardiovasculaire.

**Score du GSLA**  
Estimation du risque cardio-vasculaire global

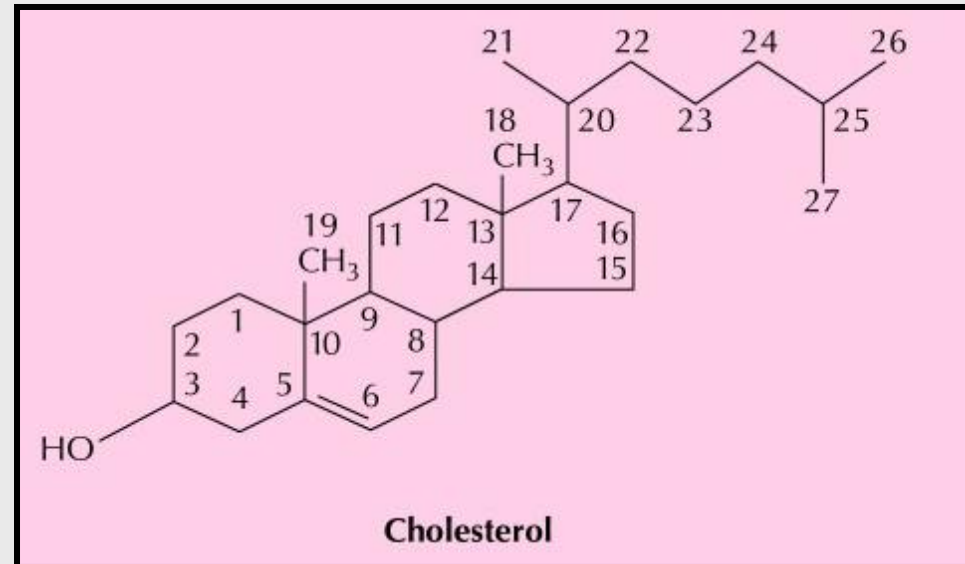
1) Nombre de points par facteur de risque, en fonction du degré de sévérité		2) Addition des points de tous les facteurs de risque	
▶ Fumeur	▶ LDL-cholestérol (mmol/L)	▶ Risque absolu d'événement coronarien aigu en l'absence de 10 ans, compte tenu du nombre total de points	
▶ Non	0	▶ Risque sur 10 ans pour la Suisse, en pourcentage	
▶ Oui	8	▶ 0-24 points < 1	
▶ < 2,58	0	▶ 25-31 points 1-2	
▶ 2,58-3,36	5	▶ 32-41 points 2-5	
▶ 3,37-4,13	10	▶ 42-49 points 5-10	
▶ 4,14-4,91	14	▶ 50-58 points 10-20	
▶ ≥ 4,91	20	▶ ≥ 59 points > 20	
▶ Age (ans)	▶ Pression artérielle systolique (mm Hg)	▶ Antécédents familiaux	
▶ 35-39	0	▶ Non	
▶ 40-44	6	▶ < 0,81	
▶ 45-49	11	▶ 0,81-1,16	
▶ 50-54	16	▶ 1,17-1,41	
▶ 55-59	21	▶ ≥ 1,42	
▶ 60-65	26	▶ < 100	
▶ < 120	0	▶ 100-159	
▶ 120-129	2	▶ ≥ 160	
▶ ≥ 130	3	▶ < 1,14	
▶ 130-139	5	▶ 1,14-1,70	
▶ ≥ 140	5	▶ 1,71-2,27	
▶ < 1,14	0	▶ ≥ 2,28	
▶ < 1,14	0	▶ < 0,81	
▶ 1,14-1,70	2	▶ 0,81-1,16	
▶ 1,71-2,27	3	▶ 1,17-1,41	
▶ ≥ 2,28	4	▶ ≥ 1,42	
▶ 0-24 points	< 1	▶ 25-31 points	
▶ 25-31 points	1-2	▶ 32-41 points	
▶ 32-41 points	2-5	▶ 42-49 points	
▶ 42-49 points	5-10	▶ 50-58 points	
▶ 50-58 points	10-20	▶ ≥ 59 points	
▶ ≥ 59 points	> 20		



# Conclusions/Messages

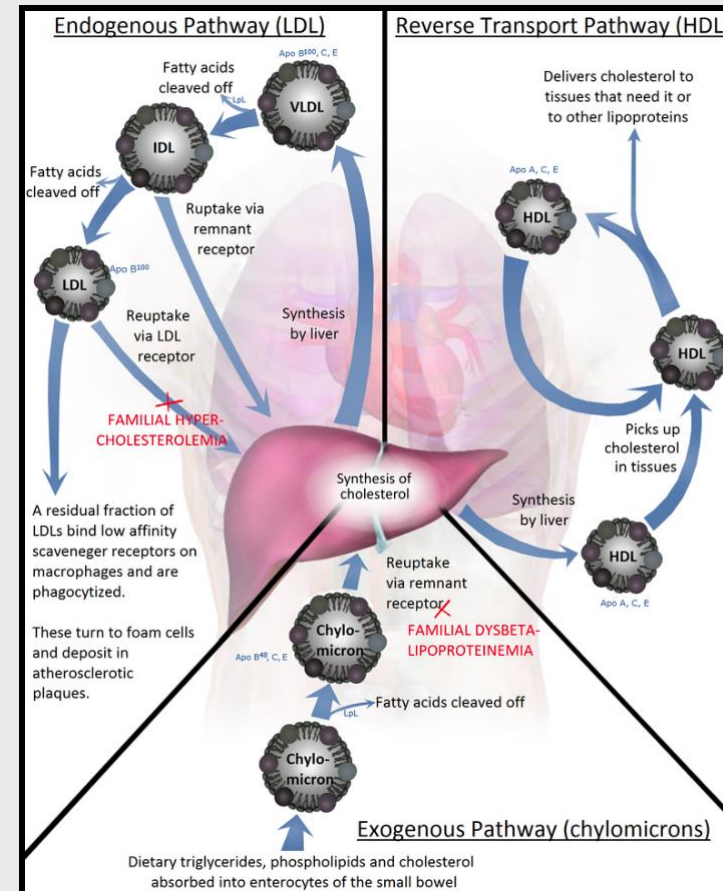
Athérosclérose 19-11-2025

**Le cholestérol n'est pas un poison, mais une substance vitale pour toutes les cellules de l'organisme.**

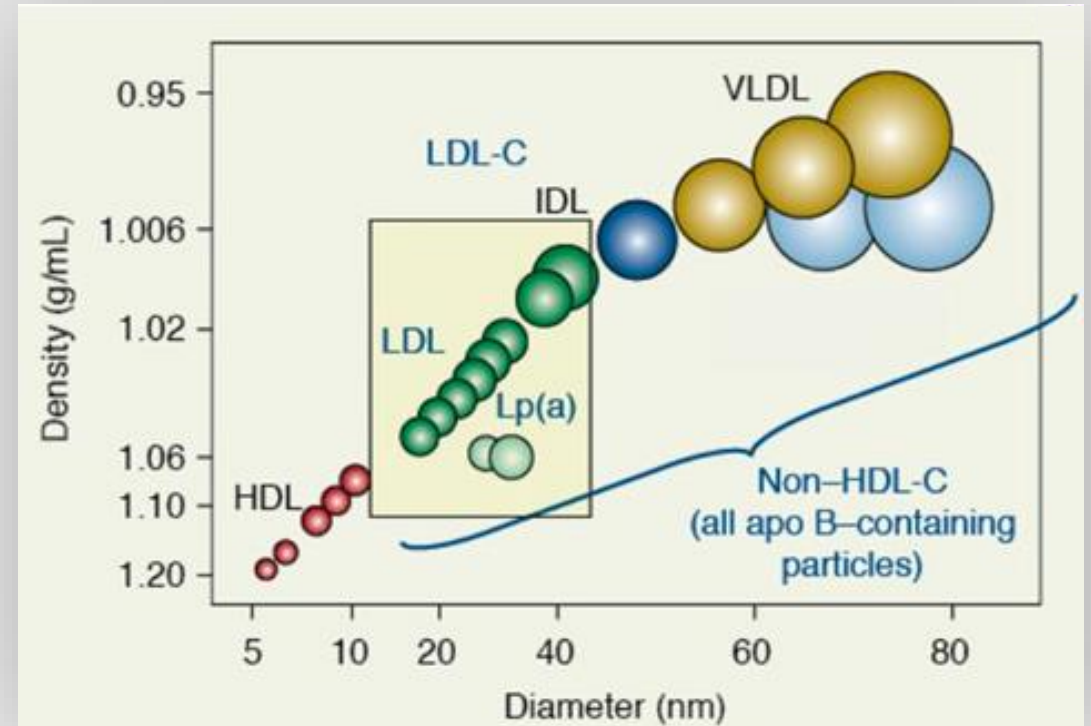
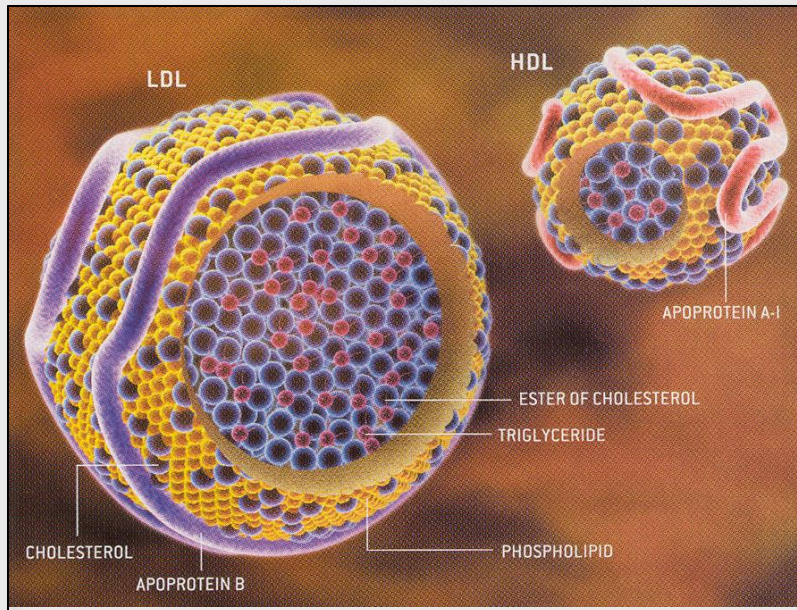


### Plusieurs voies métaboliques du cholestérol:

- Exogène
- Endogène
- Reverse transport



Le cholestérol est transporté dans la sang sous forme de lipoprotéines



**HDL cholestérol = le bon**

**LDL cholestérol = le mauvais**

