6th European Congress of Aerospace Medicine
PRAGUE 20-23th september 2018

Cardiovascular risk evaluation in aircrew members
Comparison between SCORE and empirical evaluation

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6th ECAM PRAGUE 20-23 September 2018

I have no financial relationships to disclose.

I will discuss the following off-label use and/or investigational use in my presentation.

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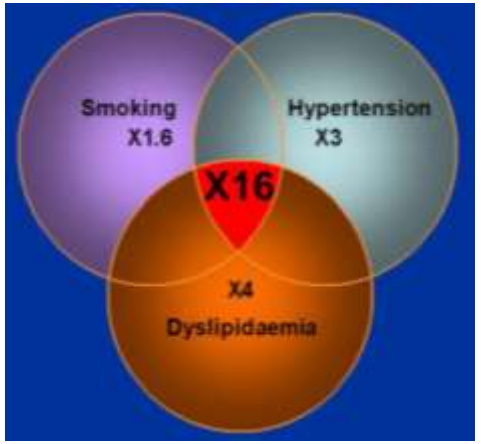
Service de santé des armées

- **Major impact of coronary disease :**
  - Major public health problem in the general/military population
  - Risk for sudden incapacitation in flight
  - Risk for the mission

- More than 200 cardiovascular risk factors or markers are described:
  - Modifiable / non-modifiable
  - Major / minor
  - Dependent / independent



- **Cumulative effect << they potentiate each other**

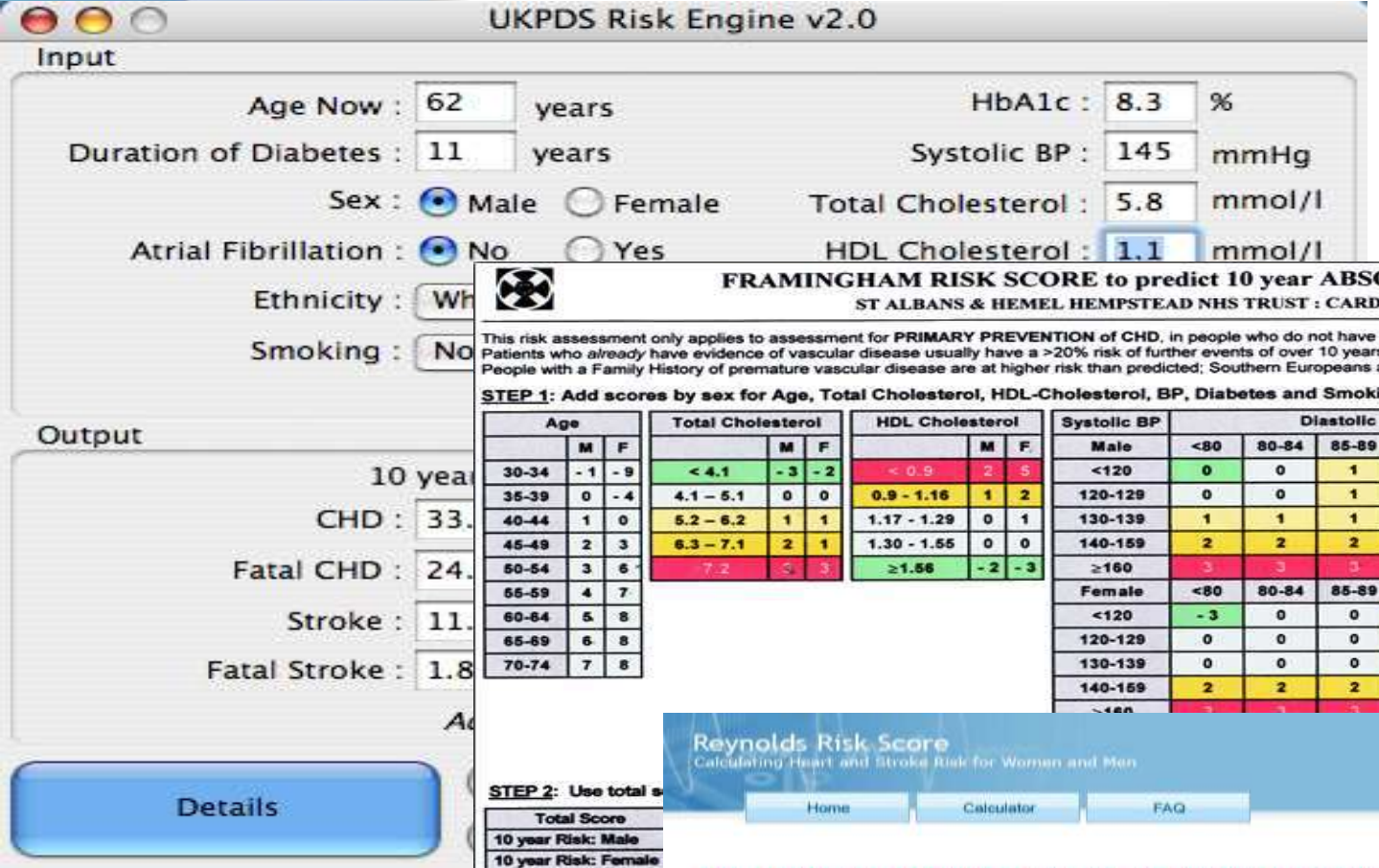
Cardiovascular risk assessment at each visit

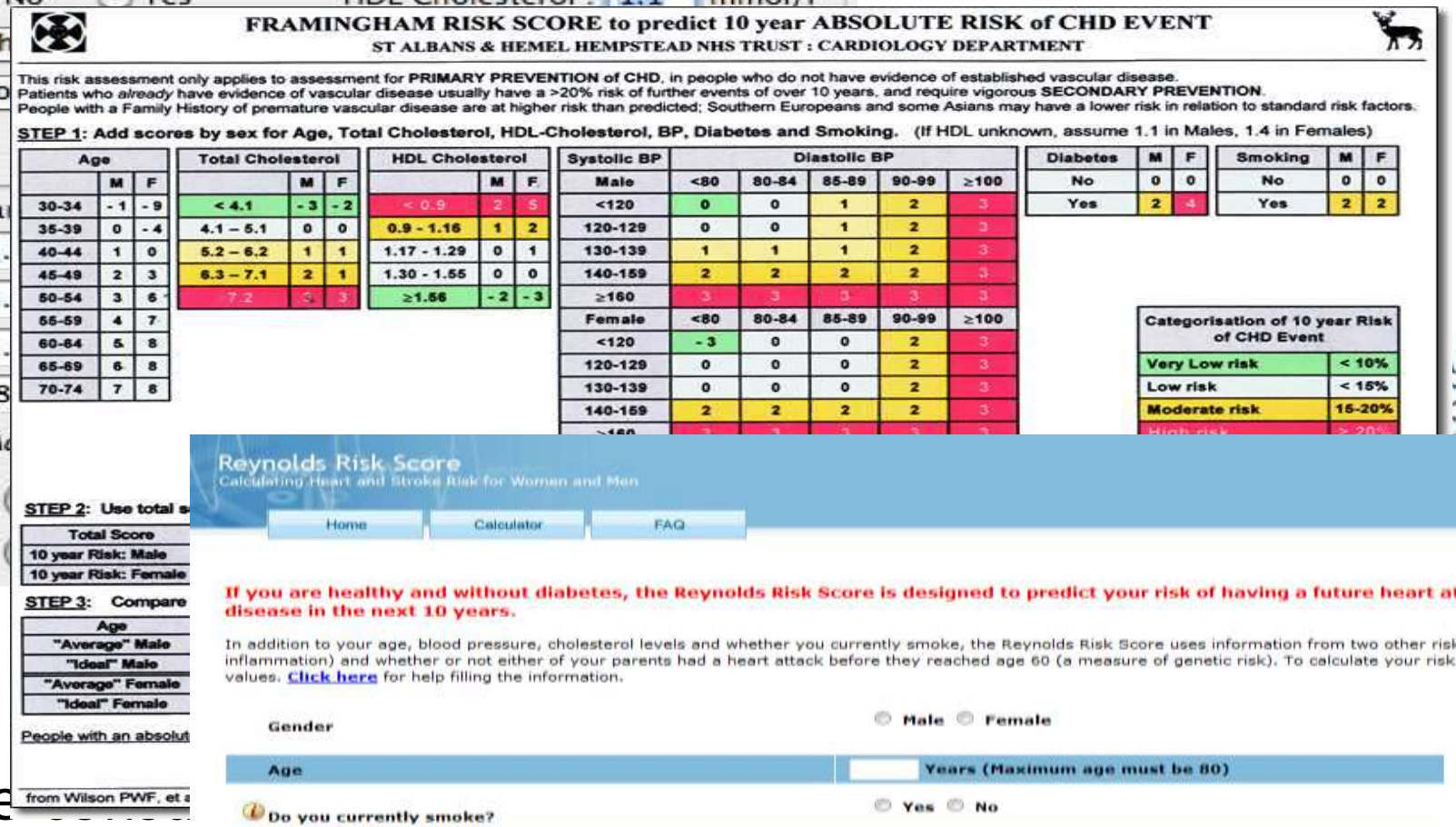
Service de santé des armées

→ Gold standard scores

- <u>Many scores are available:</u>

- But : time-consuming and sometimes complex, used lot of data


UKPDS Risk Engine v2.0
Input
Age Now : 62 years
Duration of Diabetes : 11 years
Sex : Male Female
Atrial Fibrillation : No Yes
Ethnicity :
Smoking :
HbA1c : 8.3 %
Systolic BP : 145 mmHg
Total Cholesterol : 5.8 mmol/l
HDL Cholesterol : 1.1 mmol/l
Output
CHD :
Fatal CHD :
Stroke :
Fatal Stroke :
Details


FRAMINGHAM RISK SCORE to predict 10 year ABSOLUTE RISK of CHD EVENT
ST ALBANS & HEMEL HEMPSTEAD NHS TRUST : CARDIOLOGY DEPARTMENT
This risk assessment only applies to assessment for PRIMARY PREVENTION of CHD, in people who do not have evidence of established vascular disease.
Patients who already have evidence of vascular disease usually have a >20% risk of further events of over 10 years, and require vigorous SECONDARY PREVENTION.
People with a Family History of premature vascular disease are at higher risk than predicted; Southern Europeans and some Asians may have a lower risk in relation to standard risk factors.
STEP 1: Add scores by sex for Age, Total Cholesterol, HDL-Cholesterol, BP, Diabetes and Smoking. (If HDL unknown, assume 1.1 in Males, 1.4 in Females)
Age
30-34 -1 -9
35-39 0 -4
40-44 1 0
45-49 2 3
50-54 3 6
55-59 4 7
60-64 5 8
65-69 6 8
70-74 7 8
Total Cholesterol
< 4.1 -3 -2
4.1 – 5.1 0 0
5.2 – 6.2 1 1
6.3 – 7.1 2 1
≥7.2 3 3
HDL Cholesterol
< 0.9 2 5
0.9 - 1.16 1 2
1.17 - 1.29 0 1
1.30 - 1.55 0 0
≥1.56 -2 -3
Systolic BP
Diastolic BP
Male <80 80-84 85-89 90-99 ≥100
<120 0 0 1 2 3
120-129 0 0 1 2 3
130-139 1 1 1 2 3
140-159 2 2 2 2 3
≥160 3 3 3 3 3
Female <80 80-84 85-89 90-99 ≥100
<120 -3 0 0 2 3
120-129 0 0 0 2 3
130-139 0 0 0 2 3
140-159 2 2 2 2 3
Diabetes M F
No 0 0
Yes 2 4
Smoking M F
No 0 0
Yes 2 2
Categorisation of 10 year Risk of CHD Event
Very Low risk < 10%
Low risk < 15%
Moderate risk 15-20%
STEP 2: Use total s
Total Score
10 year Risk: Male
10 year Risk: Female
STEP 3: Compare
Age
"Average" Male
"Ideal" Male
"Average" Female
"Ideal" Female
People with an absolut
from Wilson PWF, et a


Reynolds Risk Score
Calculating Heart and Stroke Risk for Woman and Men
Home
Calculator
FAQ
If you are healthy and without diabetes, the Reynolds Risk Score is designed to predict your risk of having a future heart attack, stroke, or other major heart disease in the next 10 years.
In addition to your age, blood pressure, cholesterol levels and whether you currently smoke, the Reynolds Risk Score uses information from two other risk factors, a blood test called hsCRP (a measure of inflammation) and whether or not either of your parents had a heart attack before they reached age 60 (a measure of genetic risk). To calculate your risk, fill in the information below with your most recent values. Click here for help filling the information.
Gender Male Female
Age Years (Maximum age must be 80)
Do you currently smoke? Yes No
Systolic Blood Pressure (SBP) mm/Hg
Total Cholesterol mg/DL (or) mmol/L
HDL or "Good" Cholesterol mg/DL (or) mmol/L
High Sensitivity C-Reactive Protein (hsCRP) mg/L
Did your Mother or Father have a heart attack before age 60 ? Yes No
Calculate 10 year risk

- But : time

→ Gold standard scores

- <u>Many scores are available:</u>

HAS
HAUTE AUTORITÉ DE SANTÉ

Société Française de Cardiologie

EUROPEAN SOCIETY OF CARDIOLOGY®

American Heart Association.

AMERICAN COLLEGE of CARDIOLOGY

- But : time-consuming and sometimes complex, used lot of data

→ often replaced with an empirical evaluation (EE)

(only in primary prevention)

Service de santé des armées

Different scores

- European scores : **SCORE**
  - Laurier
- German score : PROCAM
- American scores: Framingham – ASCVD – Reynolds

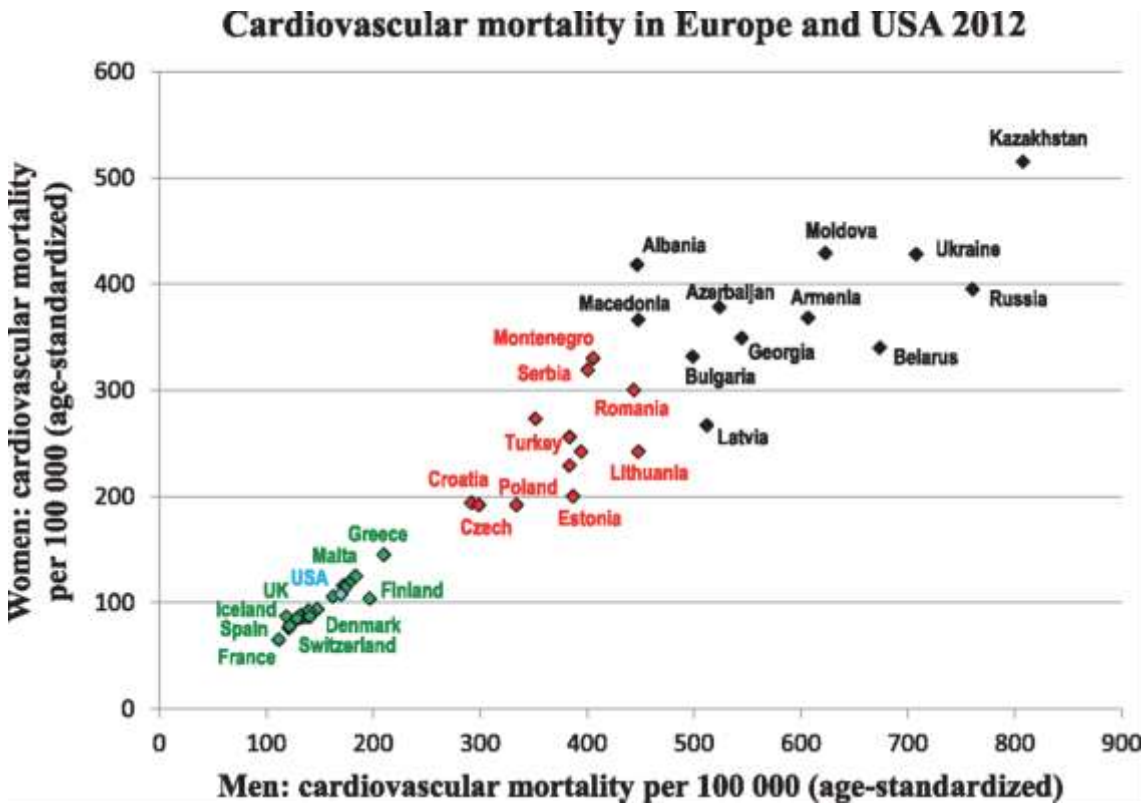
Score (Systematic Coronary Risk Evaluation)

- **European model :**
  - 12 European cohort studies
  - 250,000 patients data collected
  - 3 million person-years
  - 7,000 fatal CV events recorded.

- **Establish the total 10 year risk of Cardiovascular death**

- based on **gender, age, total cholesterol, systolic blood pressure and smoking status**

- according to the **risk level of the country**



Mortensen and Falk. Eur Heart J. 2016;38(29):2259-2263.

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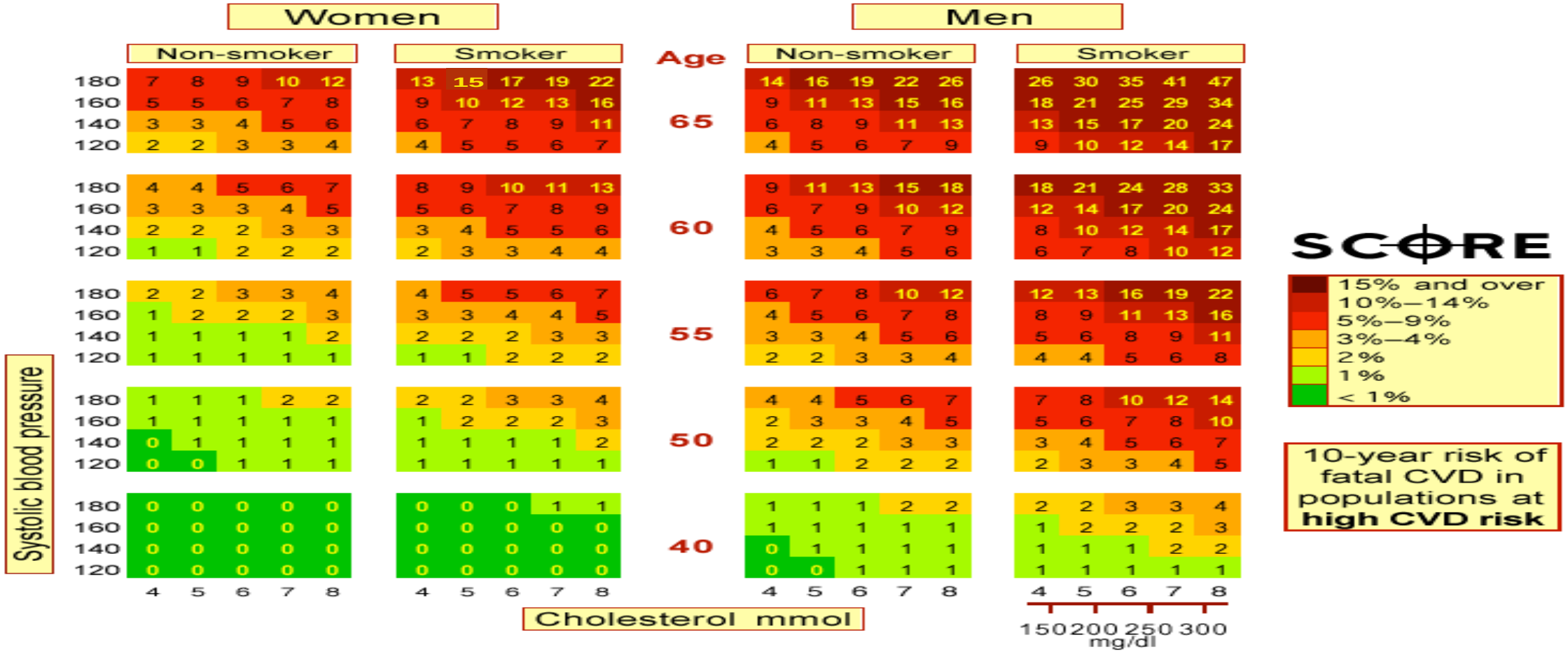
SCORE des armées



High Risk

Armenia, Azerbaijan, Belarus, Bulgaria, Georgia, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Macedonia FYR, Moldova, Russia, Ukraine and Uzbekistan.

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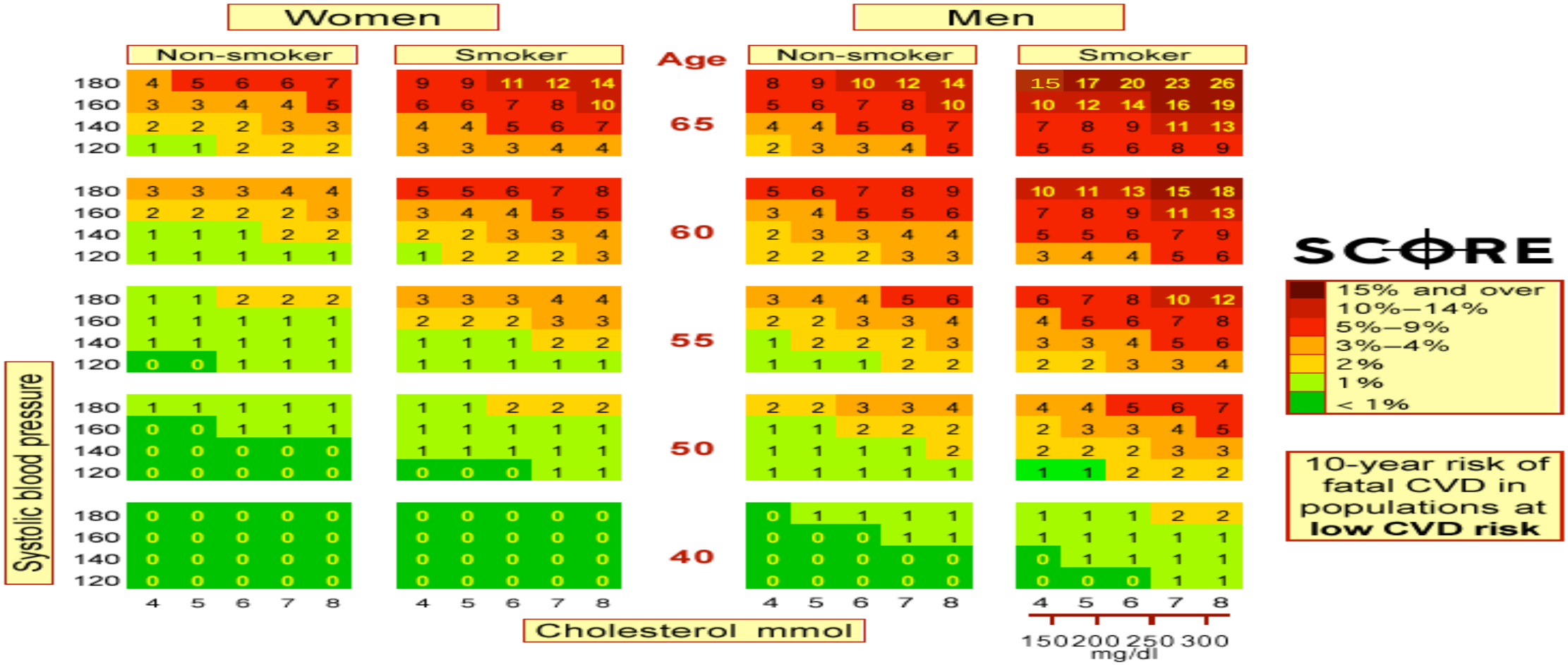
SCORE



Low Risk

Andorra, Austria, Belgium, Cyprus, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Luxembourg, Malta, Monaco, The Netherlands, Norway, Portugal, San Marino, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

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SCORE

Advantages

- European population
- Easy to use, visual results with color code
- Frequent updates

Disadvantages

- Not really adapted for diabetes
- some cardiovascular risk factors not taken into account:
  - Family history of cardiac disease
  - Obesity
  - Obstructive sleep apnea syndrome …
- Smoking : simple evaluation by smoker /non smoker
- only mortality and not all CV events

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SCORE

Empirical evaluation

Age

- >50 yo for male
- > 60 yo for female

Smoking

- Cigarettes/day
- Duration +++

Diabetes

- Equilibration
- Duration +++

High Blood Pressure

- > 140/90 mmHg
- Stress during visit

Family History

- > 55 yo for male
- > 65 yo for female

Obesity

- BMI > 30 kg/m²

- **Empirical but also global evaluation**

- **Gradual et progressive**

- <u>Evaluation of other cardiac risk factors :</u>
  - Obstructive Sleep Apnea Syndrome,
  - Physical activity
  - Diet, Alcohol …
  - Chronic inflammation
  - Stress …

Service de santé des armées

Aims

- Comparison of global cardiac risk between ESC SCORE and empirical evaluation

in aircrew member (AM) population

- Specific analysis of under-estimated and over-estimated population

Service de santé des armées

Methods

- Population
  - Civilian and military aircrew members
  - Aeromedical center of Bordeaux military hospital
  - During 1 year (between 04/01/2017 and 03/31/2018)
  - Age > 40 yo
  - Systematic blood test during the visit

- Exclusion Criteria
  - Coronary artery or vascular disease
  - Age > 75 yo

- Analysed data
  - Empirical evaluation by AME
  - SCORE calculated in a second time

→ Low, moderate and high risk

Service de santé des armées

Results

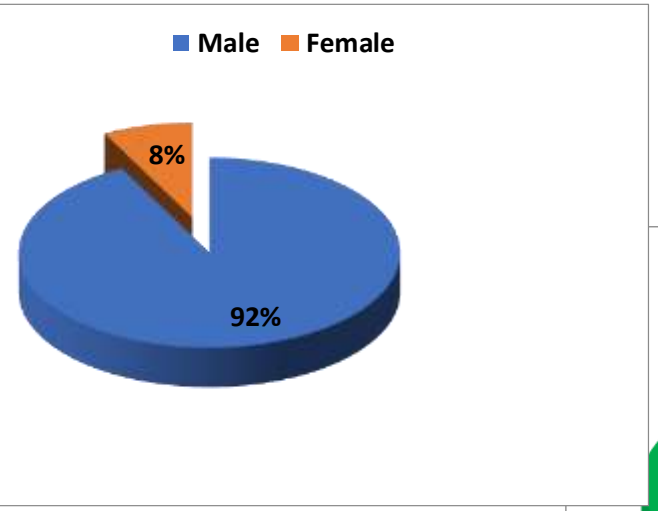
n= 564

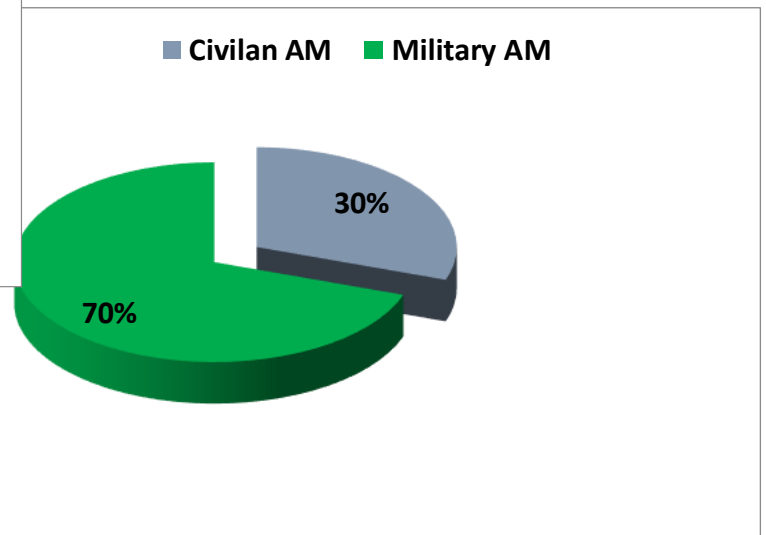
Exclusion: 16

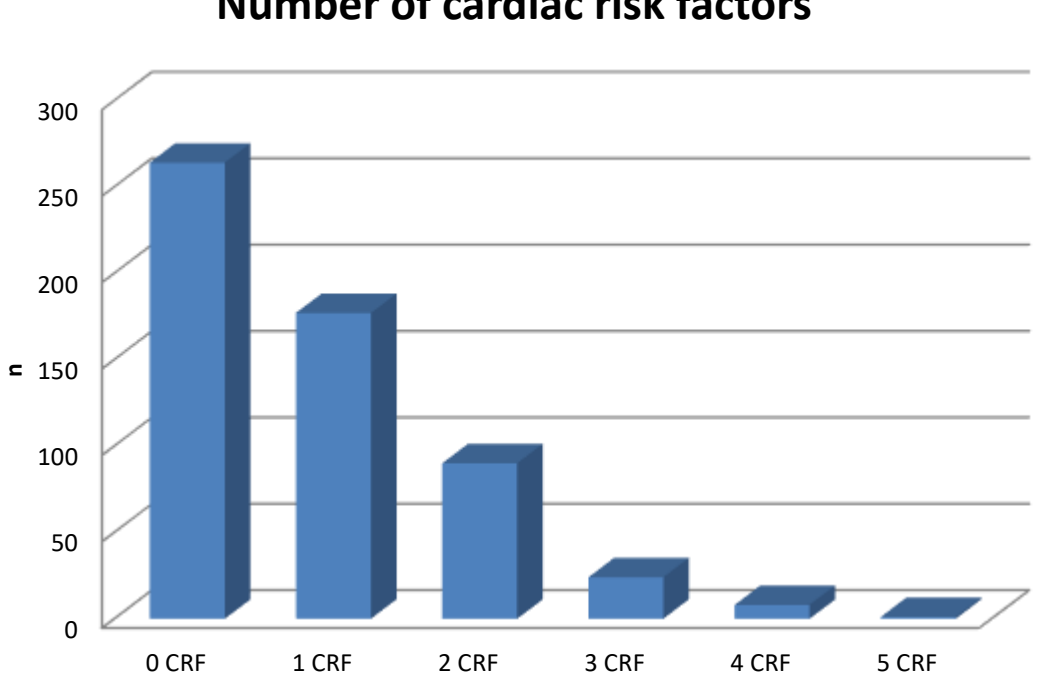
7 strokes, 6 CAD, 3 > 75 yo

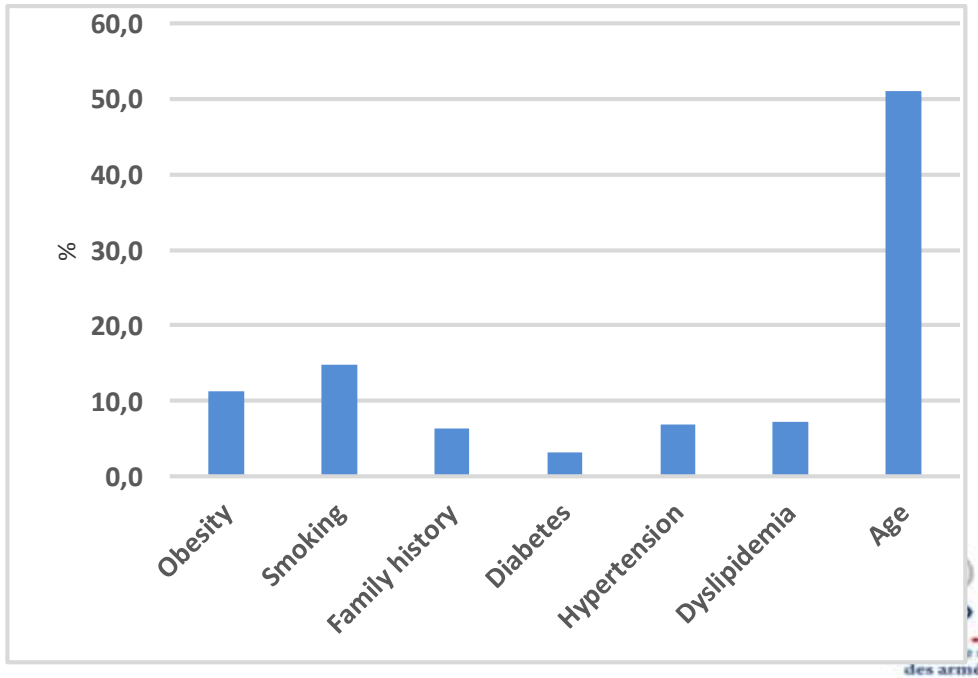
Mean age: 48.6 yo +/- 6

40 to 75 yo









Empirical evaluation vs SCORE

SCORE

EE / SCORE	Low risk	Moderate risk	High risk	
Low risk				
Moderate risk				
High risk				

Good correlation : 75.5% → p < 0.001%

(same results with Framingham and ASCVD)

Service de santé des armées

Results : under-estimated population

EE / SCORE	Low risk	Moderate risk	High risk	
Low risk	**252**	**62**	**1**	315
Moderate risk	**66**	**78**	**5**	149
High risk	**9**	**77**	**14**	100
	327	217	20	564

	Under- E pop	Reference	
	n=75	n=489	
Age	51.5	48.16	*p<0.01*
Male	97.30%	92.30%	*ns*
BMI (kg/m²)	25	26	*ns*
Systolic blood pressure (mmHg)	131	128,7	*ns*
Smoker	9.0%	15.50%	*ns*
Diabetes	1.30%	3.50%	*ns*
treated Dyslipidémia	4%	7.80%	*ns*
Total cholesterol (mmol/l)	6	5.5	*ns*
Treated hypertension	1.30%	7.80%	*p<0.01*

	Under- E pop	Reference
no CRF (*excluded age*)	**64** (85%)	**200** (41%)
More than 1 CRF	**11** (15%)	**289** (59%)
	75	489
		p<0.001

CRF: family history, smoking, treated hypertension, diabetes or dyslipidemia, BMI > 30 kg/m²

Majority of AM
few CRF by empirical evaluation
but high/moderate risk by SCORE

- Age between 40-50 yo
- Caution in case of high systolic blood pressure during visit / stress
- Moderation factor for EE:
taking into account the intensity of smoking intoxication

Service de santé des armées

Results : over-estimated population

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High risk	**9**	**77**	**14**	100
	327	217	20	564

	Over- E pop	Reference	
	n=63	**n=501**	
Age	46	50.9	P<0.01
Male	92.10%	92.40%	ns
BMI (kg/m²)	27.5	25.7	p<0.01
Systolic blood pressure (mmHg)	128	128.9	ns
Smoker	23.80%	13.60%	p<0.01
Diabetes	3.20%	3.20%	ns
treated Dyslipidemia	17%	6.00%	p<0.01
Total cholesterol (mmol/l)	5.3	5.9	P<0.01
Treated hypertension	4.80%	7.20%	ns

	Over- E pop	Reference
no CRF (*excluded age*)	**19** (30%)	**245** (49%)
More than 1 CRF	**44** (70%)	**256** (30%)
	63	501
		p<0.001

CRF: family history, smoking, treated hypertension, diabetes or dyslipidemia, BMI > 30 kg/m²

Elements not taken into account by SCORE:

- Family history : 11 (17.5%)
- Diabetes : 2 (3.2%)
- Obstructive sleep apnea syndrome : 2 (3%)
- BMI > 30 kg/m²: 15 (25.4%)
  - ↳ 7 with normal cholesterol
- Treated hypertension : 3 (5%)
  - ↳ 2 with a normal SBP

Service de santé des armées

Conclusion

VS

SCORE

High correlation

Where is really the real global cardiac risk ?

Service de santé des armées

Conclusion

VS

SCORE

High correlation

Where is really the real global cardiac risk ?

Each has their own limits

It’s a case by case evaluation

For flight safety, priority to detect ischemic heart disease

Cumulated cardiovascular over-risk at the limit of the disease diagnosis

- Not taken into account all major cardiac risk factors
- Distorted estimation in case of treated hypertension or dislipidemia
- No progressive risk in case of smoking

Service de santé des armées

« Predictions are difficult, especially when they relate to the future »

Pierre Dac

Thank you for your attention