MPIDR-NES Training Programme

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Population and Health

Lecture 14. Medical causes of death: Collection, Classification, Comparability

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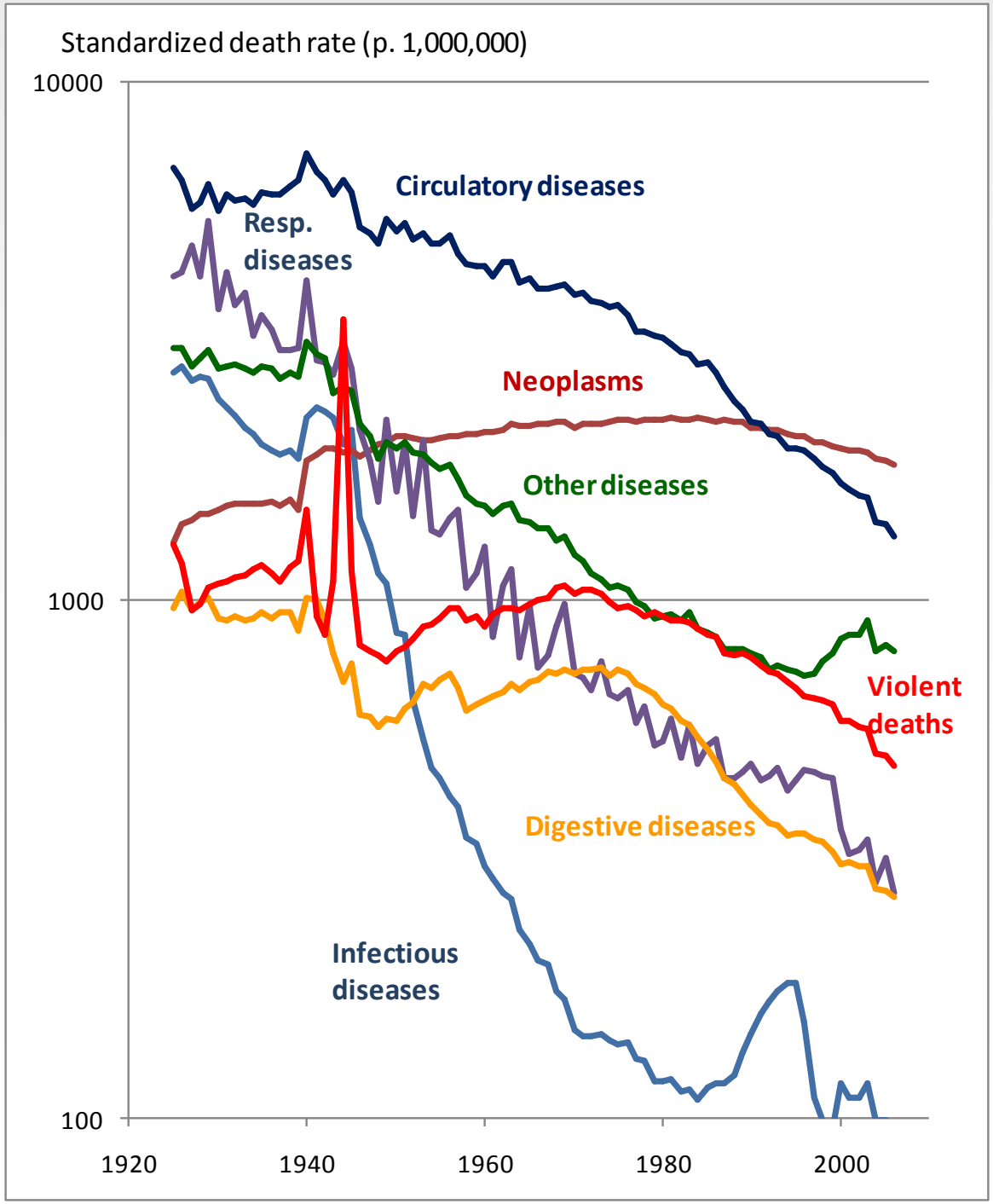
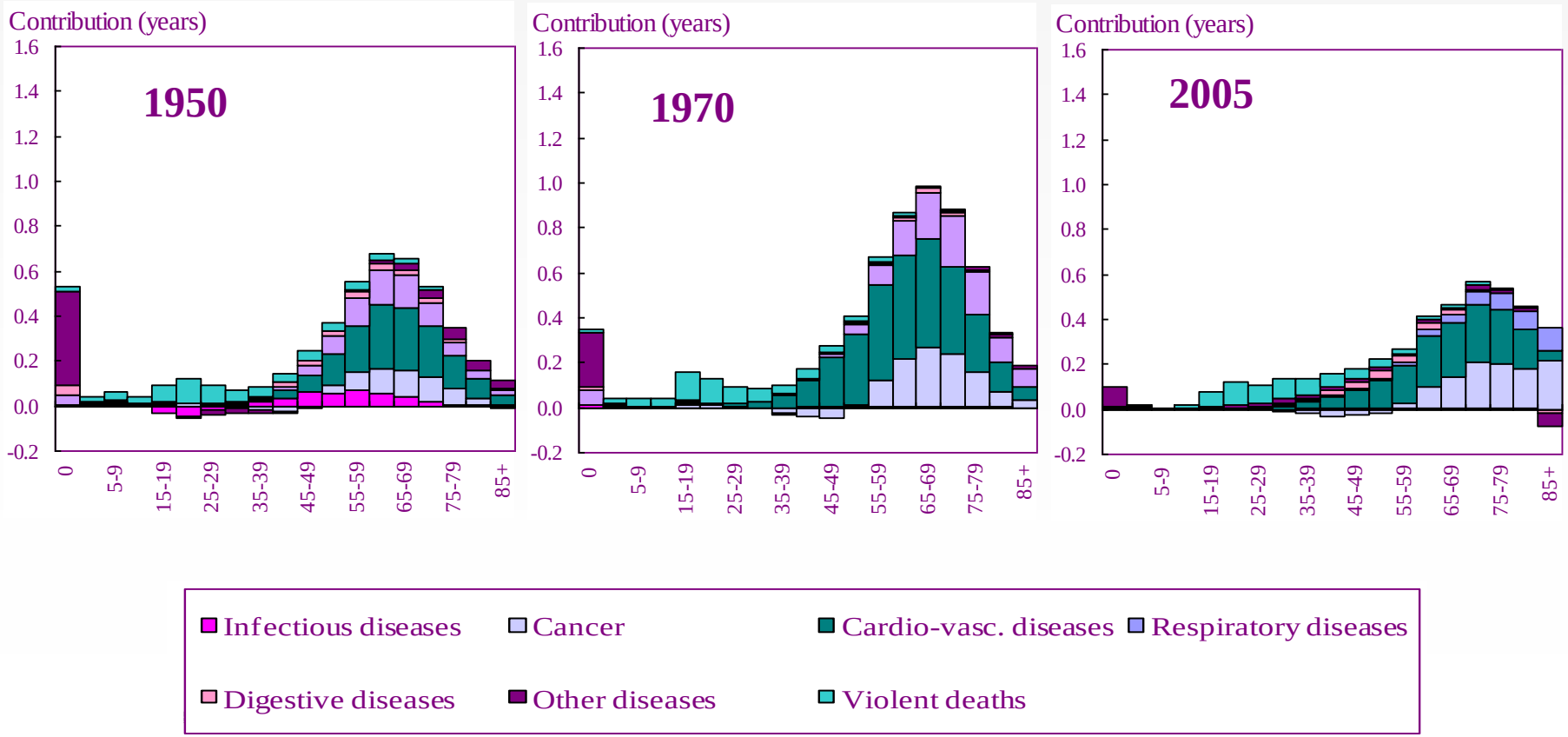
РЭШ Российская экономическая школа



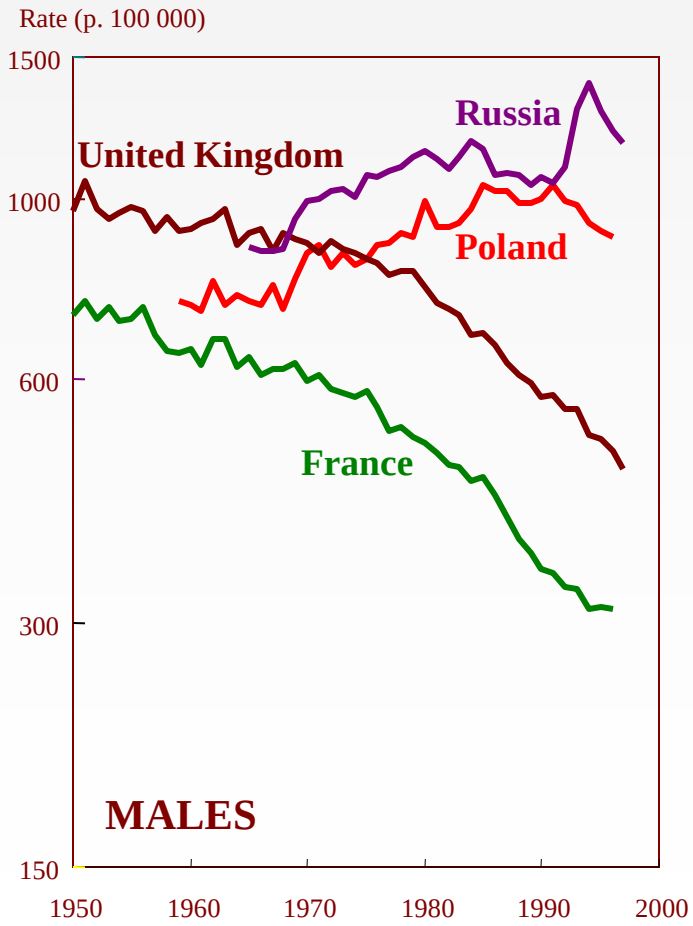
Trends in main causes of death in France, since 1925

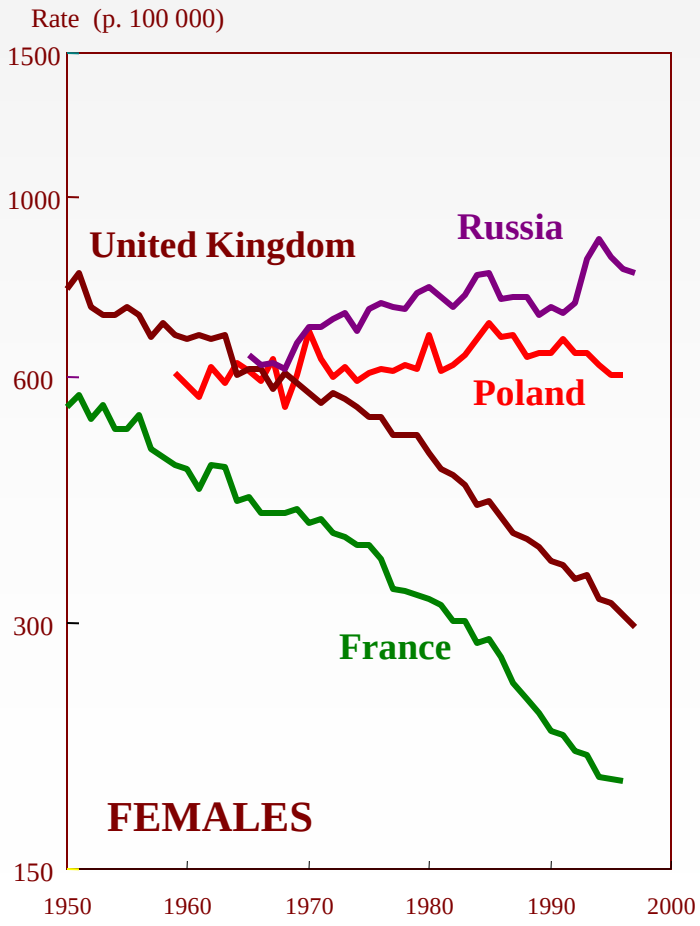
Causes of death and sex differentials in life expectancy

England & Wales



Comparative trends in cardiovascular mortality





What did he (she) die of ?

- Heart failure
- Myocardial infarction
- Angina pectoris
- Hypertension

Medical causes of death

- Smoking
- Working conditions
- Diet
- Stress

Mortality determinants

Collection of causes of death. A short history

- John Graunt (1662) *Natural and Political Observations Made Upon the Bills of Mortality*
- First death tables : Copenhagen, 1707; Berlin, 1737; Nîmes, 1767
- England and Wales, the *1837 Registration Act* introduces the registration of the cause of death in addition to the registration of vital events
- By the early XXth century, the principle of a national registration of the causes of death was established in many European countries.

Improvement of the quality

- Medical certification of the cause of death
- Confidentiality
- Standardized certificate
- Multiple causes of death

⇨ ***Completeness and reliability in industrialized countries,***

But still lacking in most developing countries

How to classify ?

- Alphabetical order used in the *Bills of mortality*
- Several dozens of classifications published between 1718 and 1855
- International Statistical Congress of 1853: William Farr and Marc d'Espine were entrusted with *"establishing a uniform nomenclature of the causes of death applicable to all countries"*

A controversy which is still current

- D'Espine tries to define a coherent classification according to the *"nature of the diseases"*.
- Farr, more pragmatic, isolated the best-known diseases of the time, such as *smallpox*, *scarlet fever* and *tuberculosis* and classified the others according to their *anatomical location*.

⇨ ***A compromise adopted in 1853 but never used***

1893 : ICD-0

- Bertillon's nomenclature, already in use for Paris statistics of causes of death, is adopted as the *1st International Classification of Diseases*.
- The nomenclature is rapidly used by many cities and countries
- Since its adoption, it was revised 10 times :

1900, 1909, 1920, 1929, 1938,

1948, 1955, 1965, 1975, 1989

The same structure but a complete upheaval inside

ICD-0	→	ICD-10
14 divisions	→	21 chapters
203 items	→	> 10,000 items

-The structure lies essentially on the anatomic localisation of diseases and was not fundamentally changed

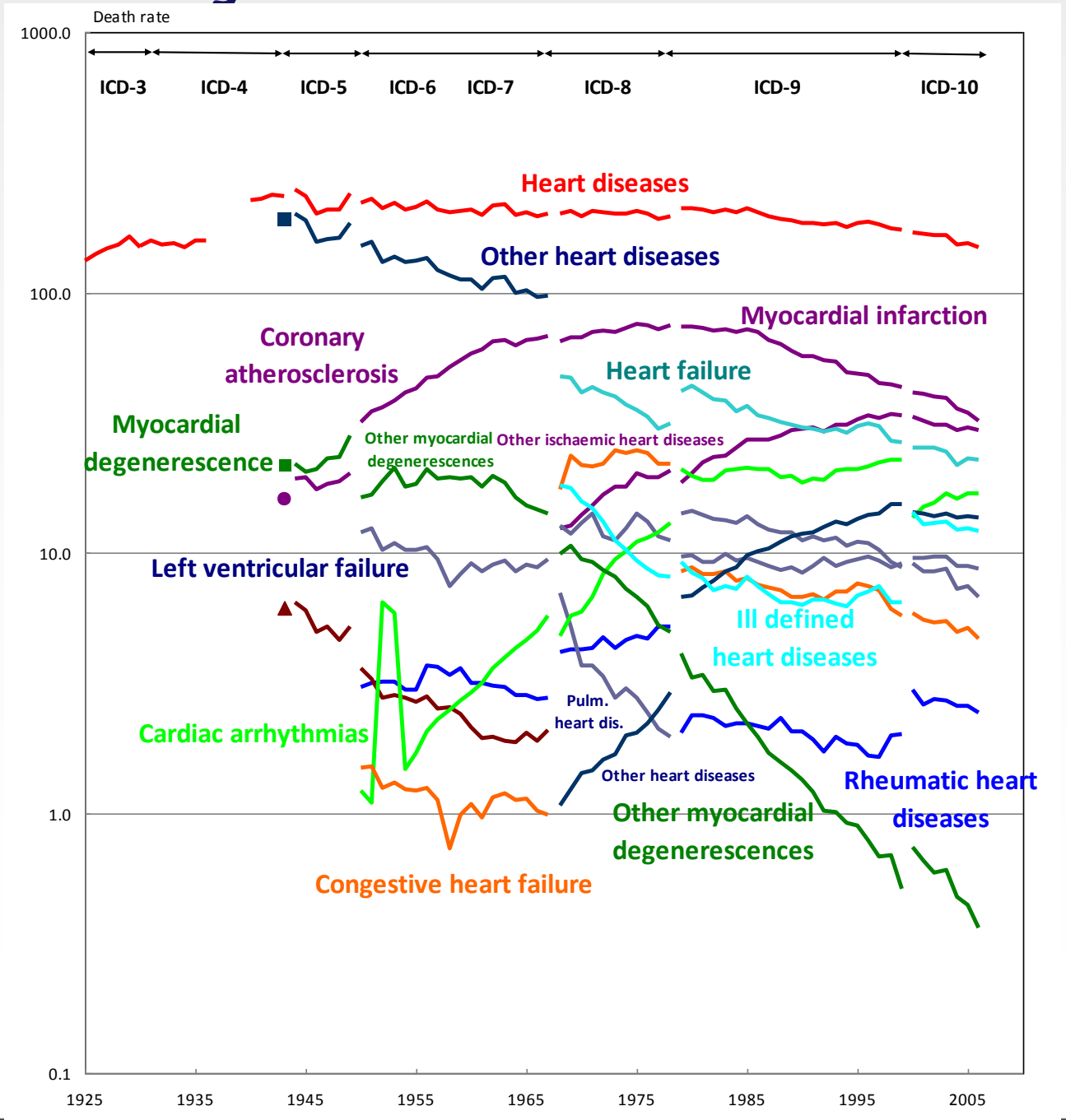
- but at each revision items contents were deeply updated,

- new items created for taking in account the medical progress or the extension of the fields of utilisation of the Classification

Revisions make impossible to follow trends in specific causes of death

- Exchanges between the items are very complex.
- After World War 2, no explanation is given by WHO about the reasons of the changes
- Some statistical offices perform a double classification for the first year of implementation of the new revision, but this is very rare
- One possibility : the *a posteriori* double classification

Following heart diseases over 8 revisions



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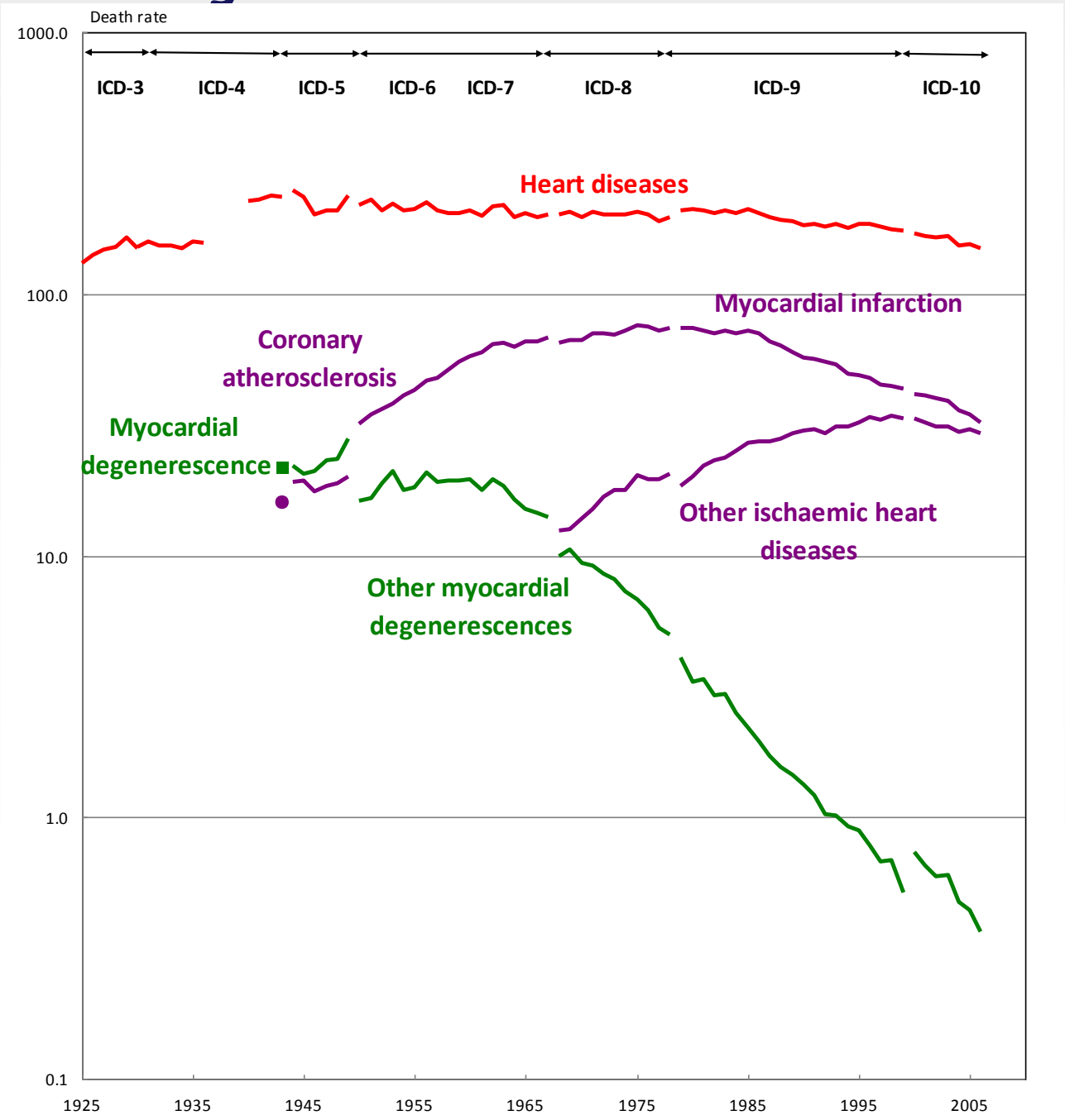

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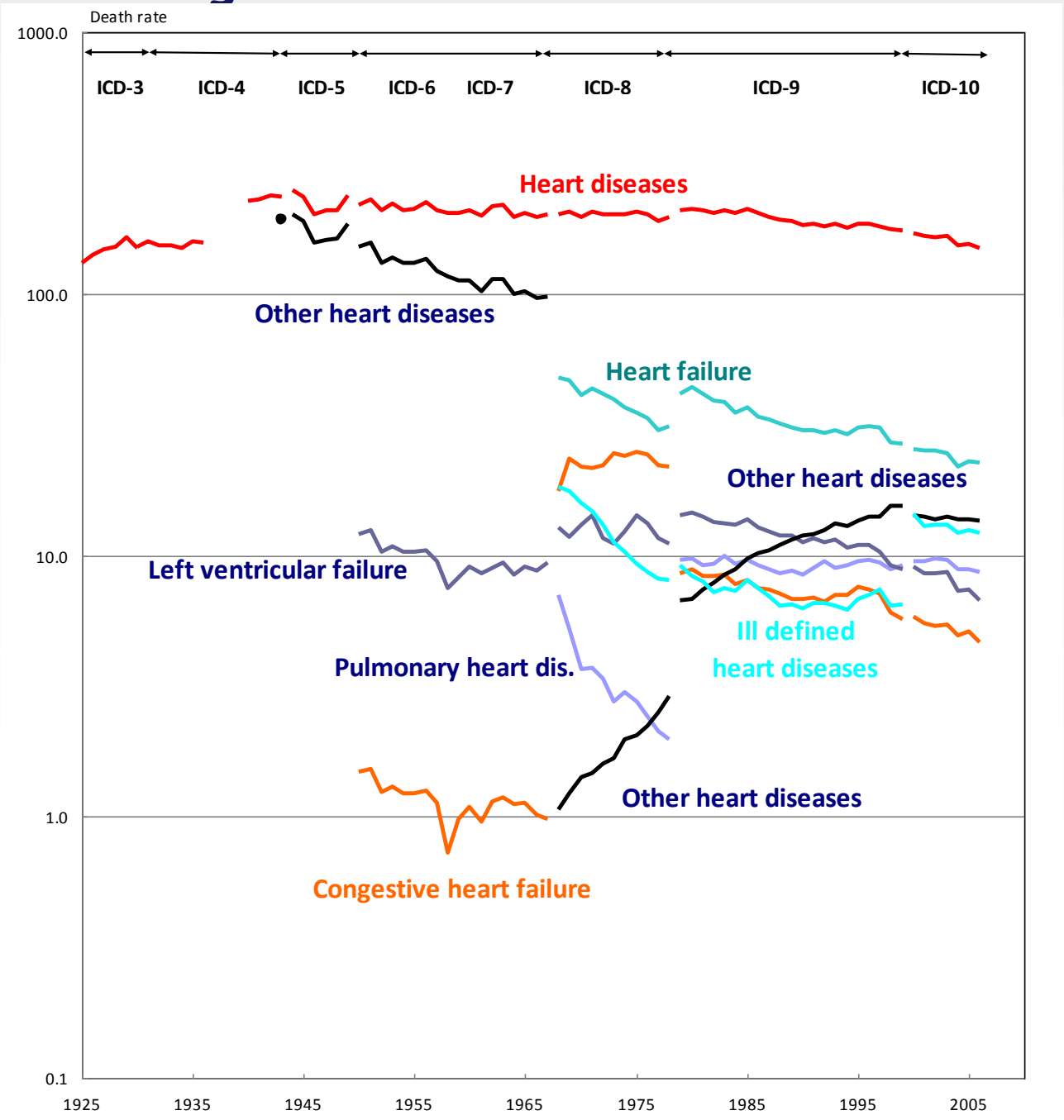

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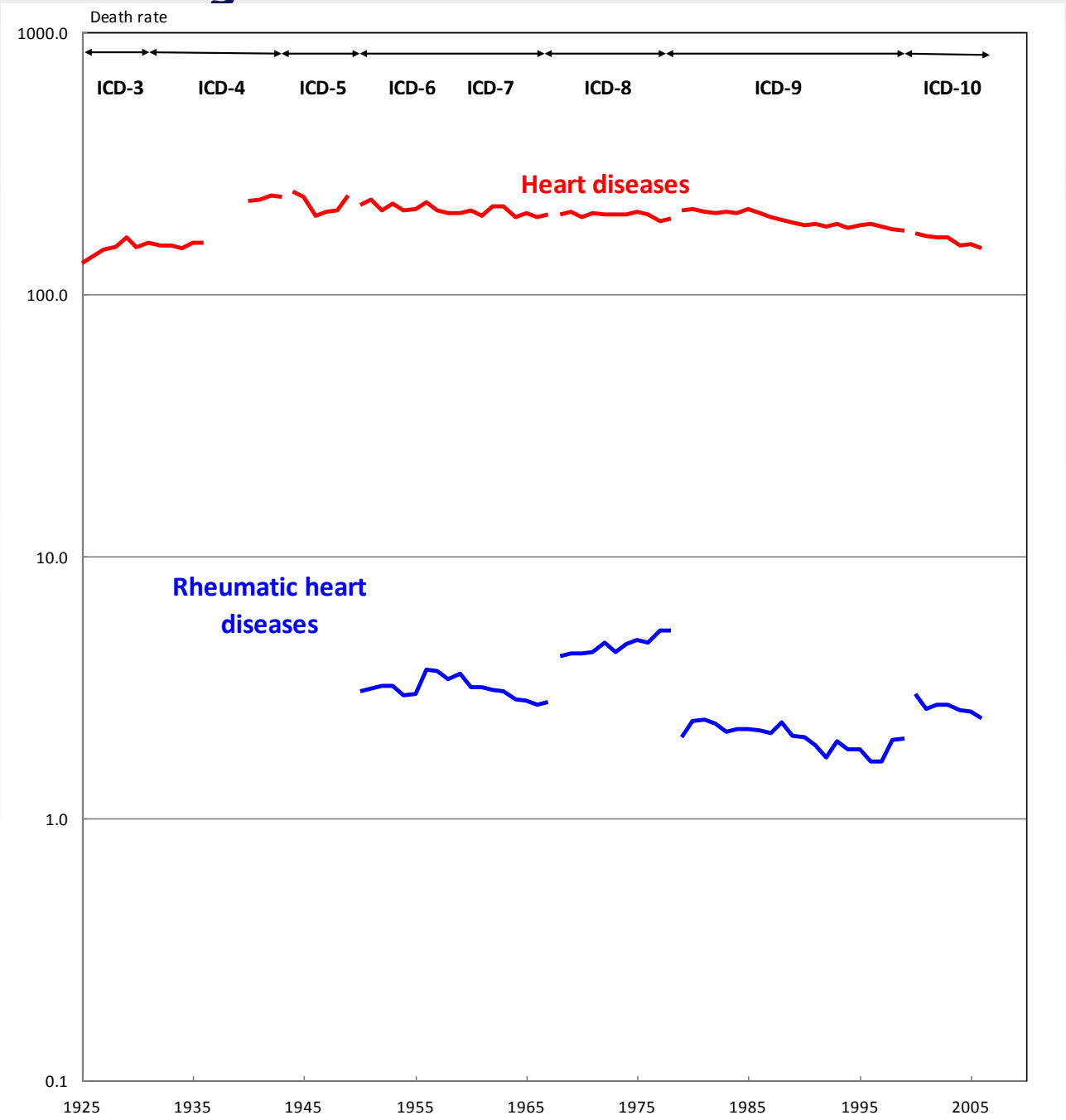
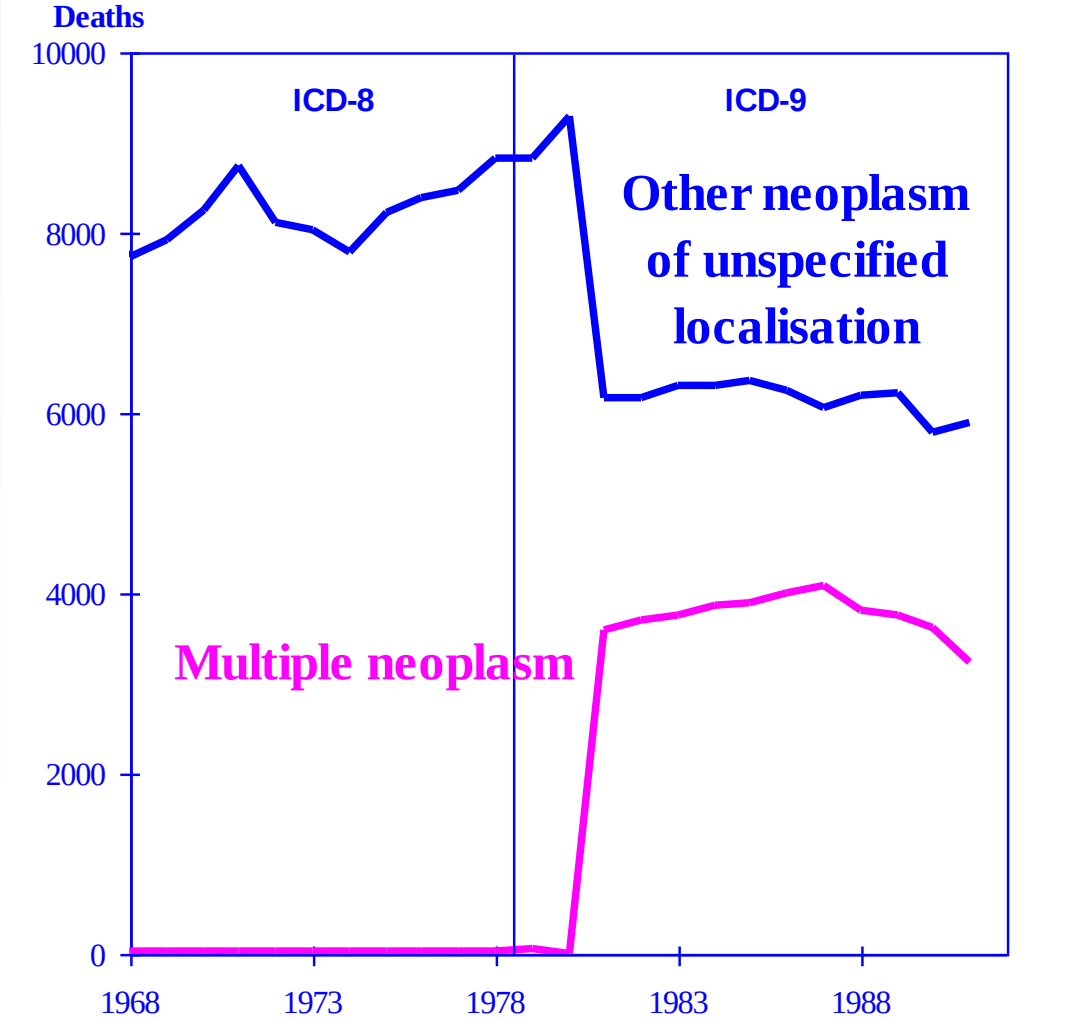


Disruptions independant from ICD revisions



Comparability in space

Table 2 : Standardised mortality rate (p. 100,000) due to pneumonia in the European countries in 1983 and 1984. Males

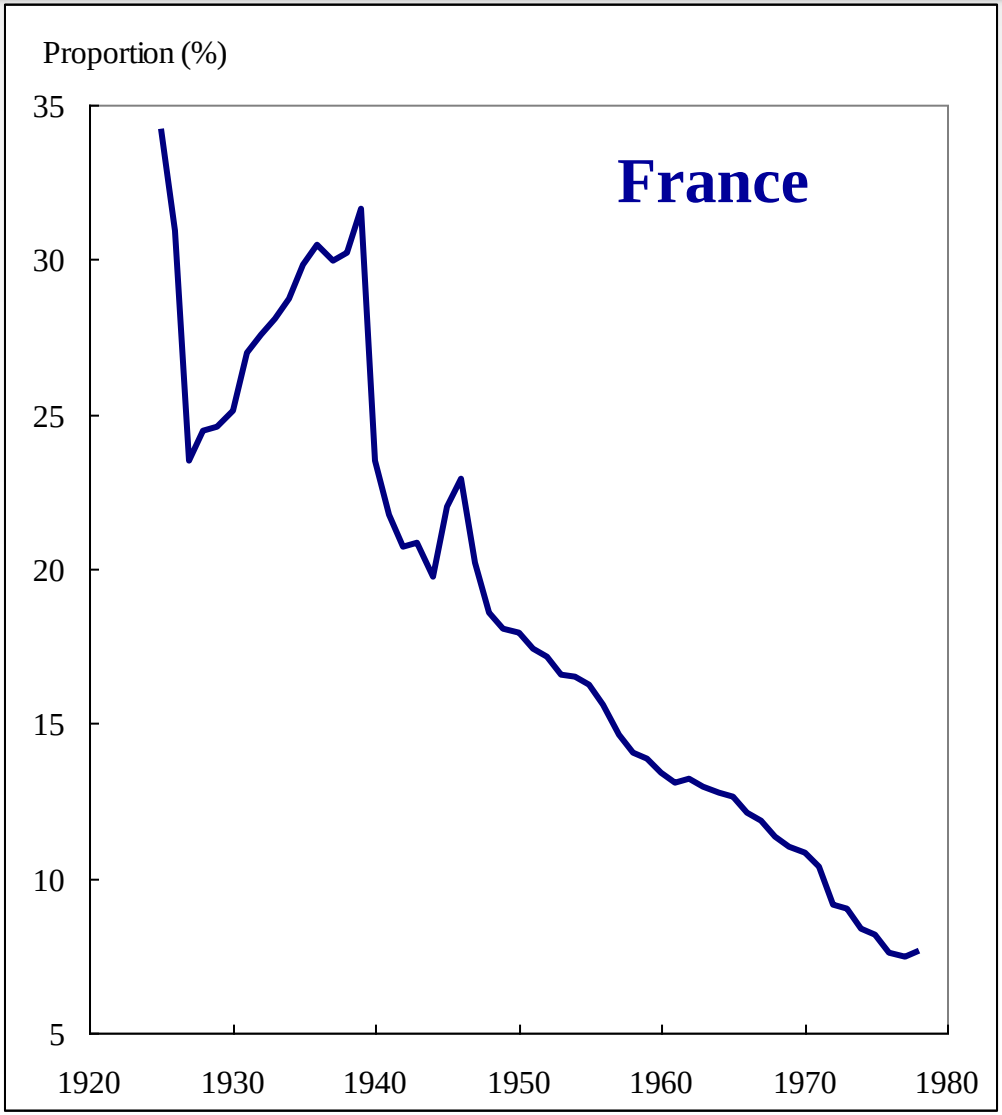
1983			1984		
	Country	Rate		Country	Rate
1	Northern Ireland	104	1	Northern Ireland	88
2	**England and Wales**	**102**	2	Scotland	78
3	Ireland	82	3	Ireland	76
4	Scotland	81	4	Bulgaria	59
5	Bulgaria	66	5	Romania	57
6	Romania	64	6	Czechoslovakia	55
7	Czechoslovakia	60	7	Iceland	51
8	Iceland	50	8	**England and Wales**	**45**
9	Yugoslavia	44	9	Yugoslavia	40
10	Belgium	34	10	Portugal	34
11	Portugal	33	11	Belgium	31
12	FRG	29	12	Luxembourg	28
13	Poland	28	13	Poland	27
14	Spain	28	14	FRG	27
15	GDR	27	15	Spain	25
16	Italy	24	16	Netherlands	25
17	Netherlands	24	17	GDR	24
18	Luxembourg	24	18	Italy	20
19	Austria	23	19	Austria	20
20	Malta	20	20	Hungary	14
21	Hungary	17	21	France	13
22	Greece	15	22	Greece	12
23	France	13	23	Malta	5

Source : WHO

Ill defined and unknown causes of death

- If their proportion varies in time or space, they have to be taken in account to avoid bias.
- Example of France : the proportion of ill defined and unknown causes dropped from around 35% in 1925 to 5% in recent years

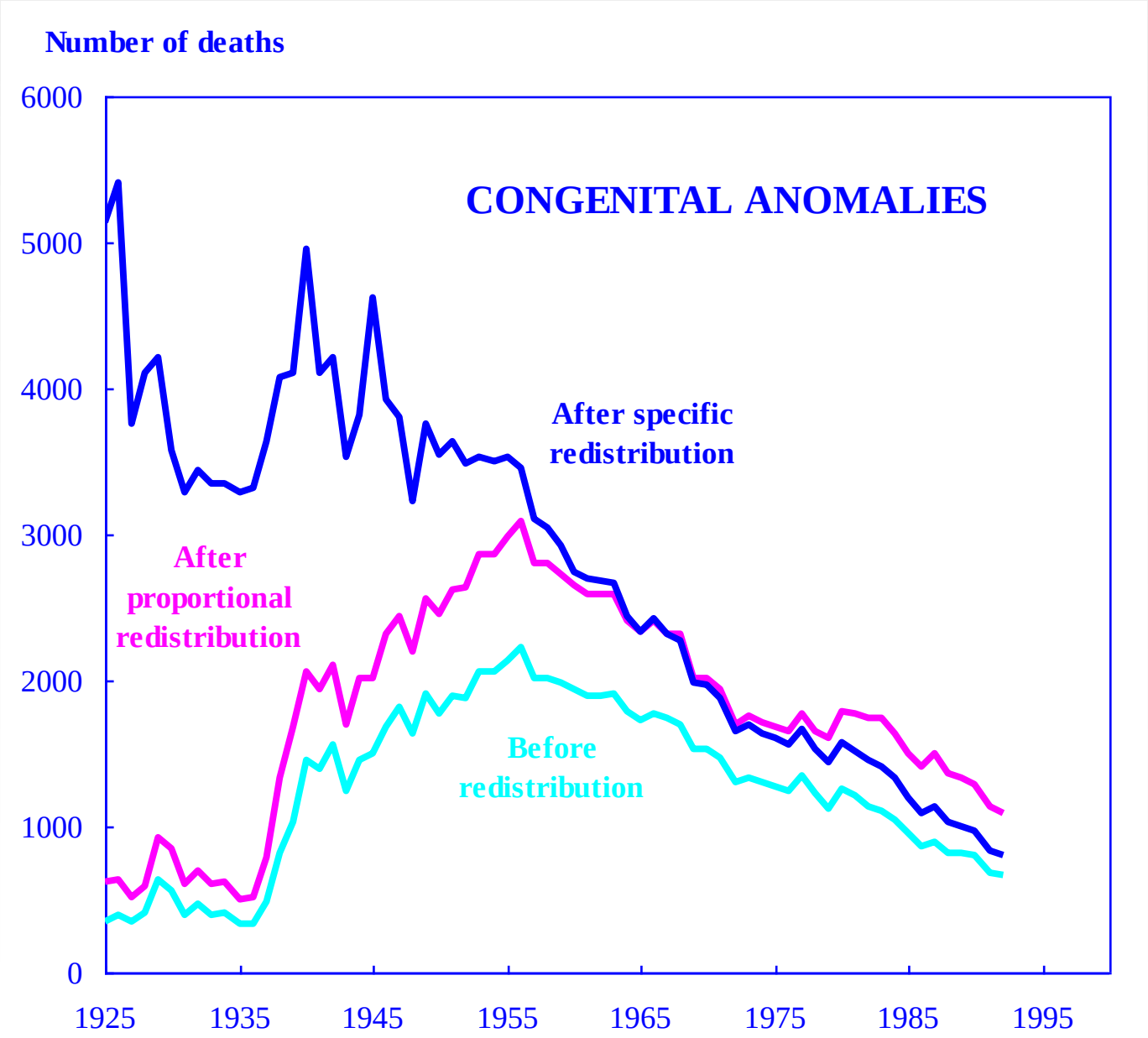
Trends in deaths of ill-defined or unknown cause



Vallin Jacques and Meslé France, 1988. – *Les causes de décès en France de 1925 à 1978* . – Paris, INED,PUF, 608 p. (Travaux et Documents, Cahier 115).

How to deal with ill defined causes ?

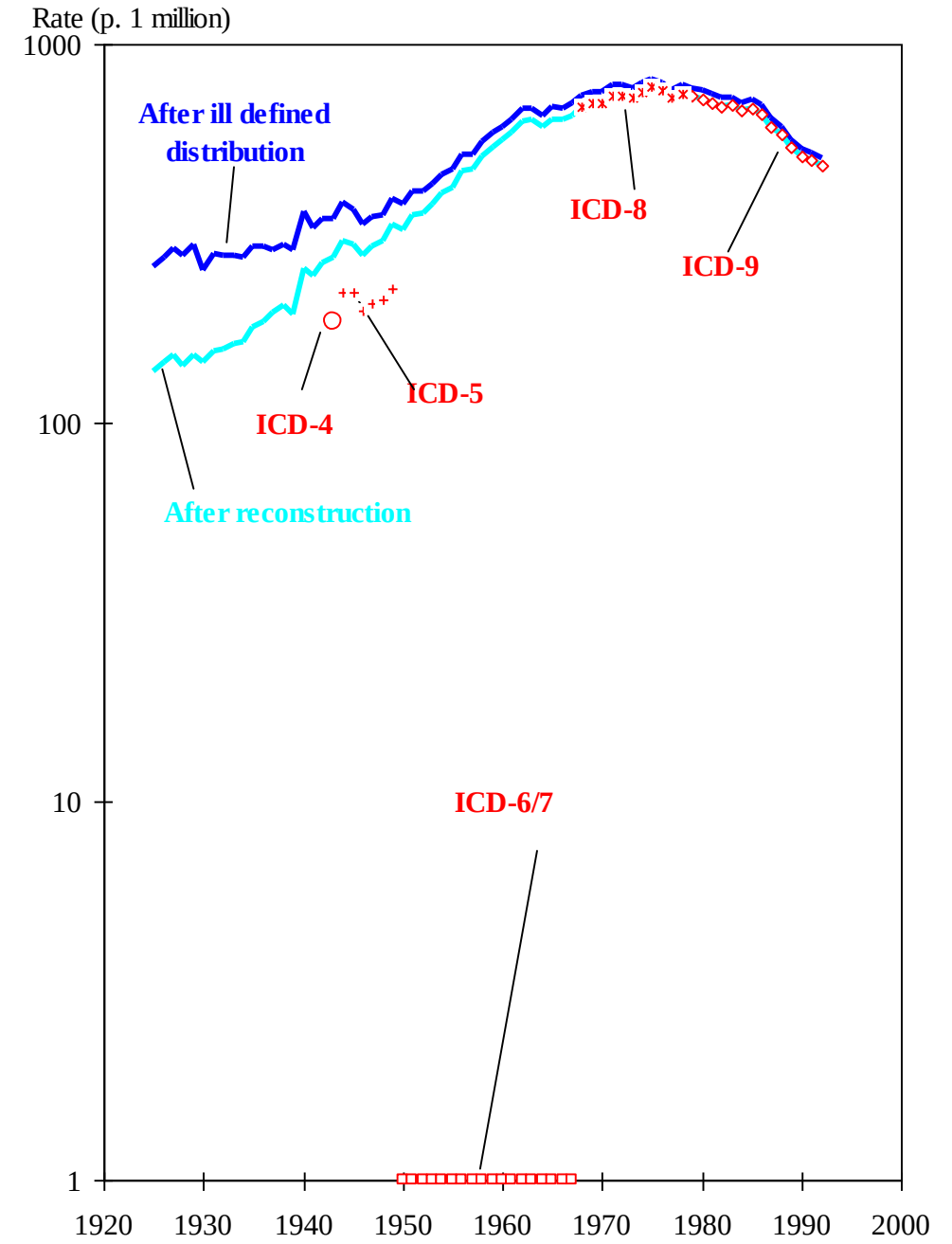
- Under the assumption of independence between the actual cause of death and the probability to be declared as ill defined, a simple proportional repartition is enough and this solution is adopted very often.
- The assumption is however clearly false. Some diseases are more susceptible to be hidden or incorrectly registered.
- Other methods are possible. Sully Ledermann proposed to study spatial correlations between proportion of ill defined and proportion in each specific cause of death. This method was adapted for the French case taking in account temporal correlations.


Number of deaths
6000
5000
4000
3000
2000
1000
0
1925
1935
1945
1955
1965
1975
1985
1995
CONGENITAL ANOMALIES
After specific redistribution
After proportional redistribution
Before redistribution

Proportion (%) of deaths from ill defined cause in some European countries

	1955	1970	1985	2000
France	17.5	10.4	6.4	6.1
Portugal	16.5	15.3	11.4	12.4
Spain	15.9	8.1	3.1	2.7
Hungary	10.8	0.4	0.1	0.1
Norway	7.5	5.0	3.4	4.5
Italy	6.7	3.3	2.7	1.3
Netherlands	5.1	3.5	3.0	5.5
Finland	4.9	0.4	0.6	0.4
Sweden	4.3	0.6	0.8	2.7
England & Wales	1.8	0.6	0.5	2.6

Myocardial infarction



The different lines of classification

- ICD itself is traversed by different lines of classification: anatomical, aetiological, time axis…
- Researchers are looking for more systematic classification :
  - Avoidable mortality
    - Endogenous/exogenous (Bourgeois-Pichat, 1951)
    - avoidable within the framework of current medical knowledge (Holland, 1988).
    - Amenable mortality (Nolte *et al.*, 2004)
  - Aetiological (according to the nature)
    - D'Espine's initial idea
    - Systematic reclassification (Vallin and Nizard, 1978; Vallin and Meslé, 1988; Meslé, 1999)

Different definitions for “avoidable” deaths

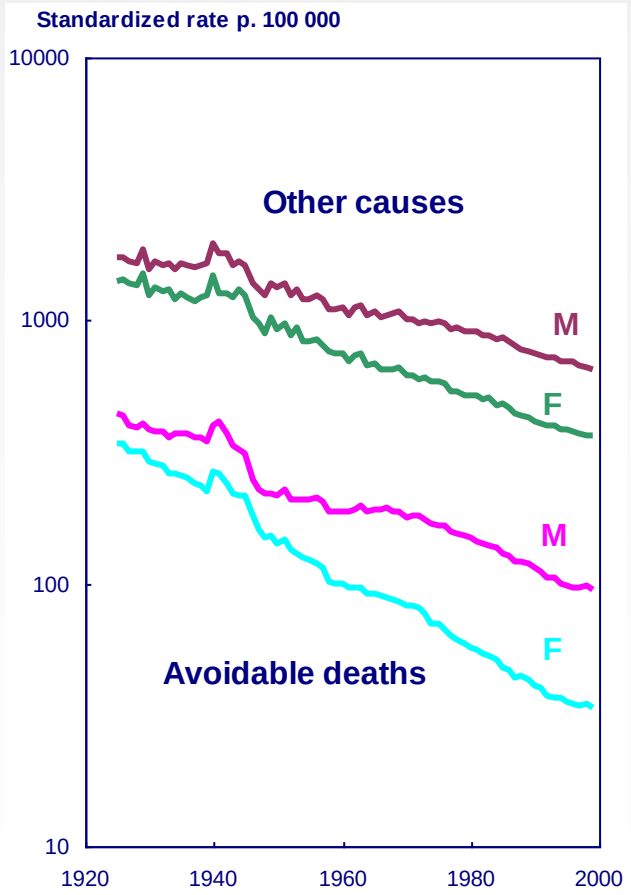
- « **Avoidable death** » (Holland, 1988)
  Premature mortality for causes amenable to medical care and health promotion

- **Mortality amenable to health care (**Nolte and McKee, 2003)

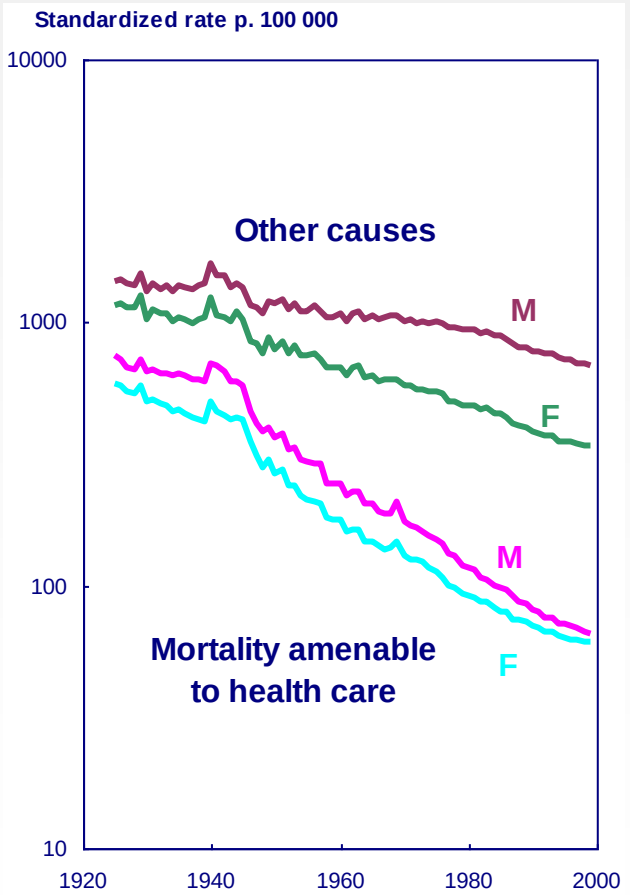
- **Mortalité prématurée/Mortalité évitable** (Jougla, 2003)

  Causes of death which should be avoided or at least decreased before age 65, specially linked to risky behaviors

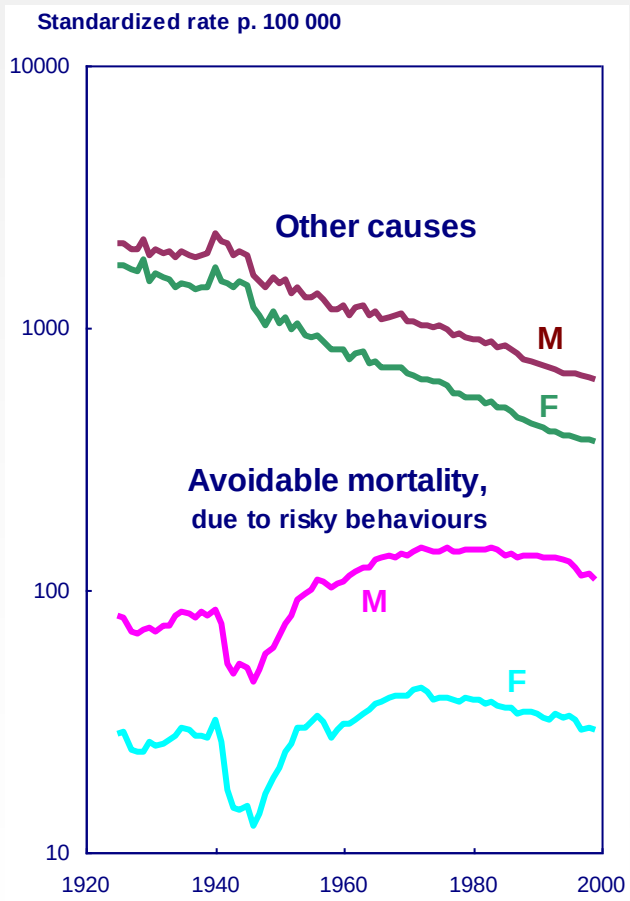
Different definitions for “avoidable” deaths



Holland Walter W., 1998. – *European Community atlas of "avoidable death"*. – Oxford, New York et Tokyo, Oxford University Press, 356 p.



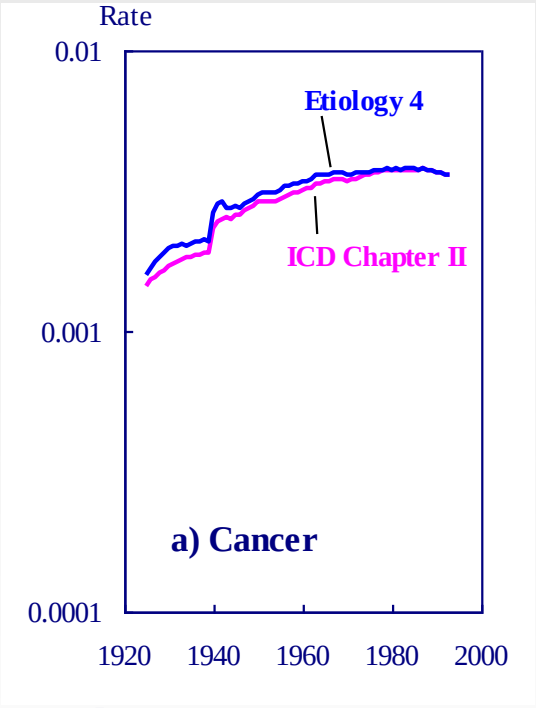
Nolte Ellen et McKee Martin, 2003. – *British medical Journal*, vol. 327, n° 1129

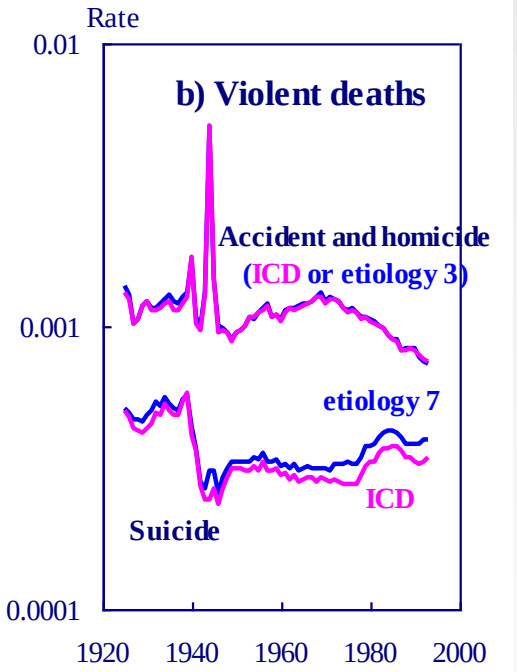


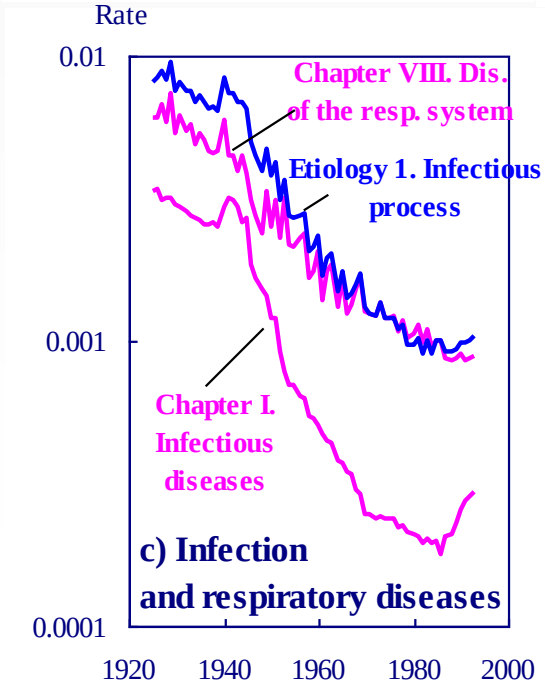
Jougla Éric (éd.), 2003. – La mortalité prématurée en France, *BEH*, n° 30-31, p. 133-152.

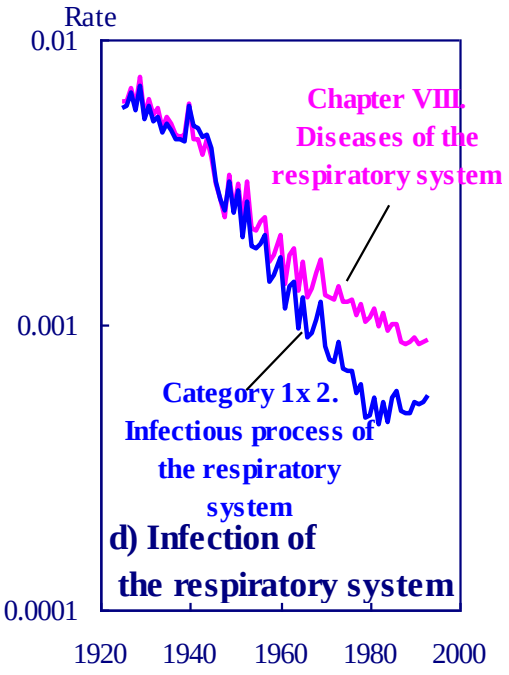
An etiological classification
(Vallin and Nizard, 1978)

- Infectious process
- Immunological process
- Accidents
- Cancer
- Hereditary process
- Degenerative process
- Suicide
- Ill-defined and unknown



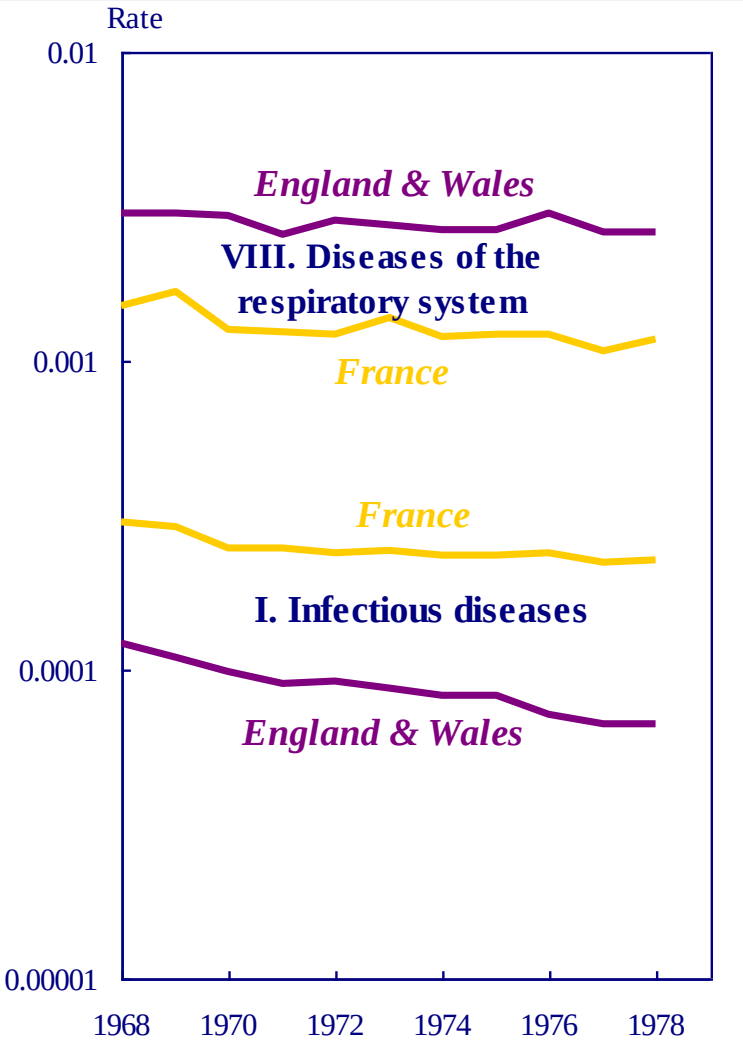


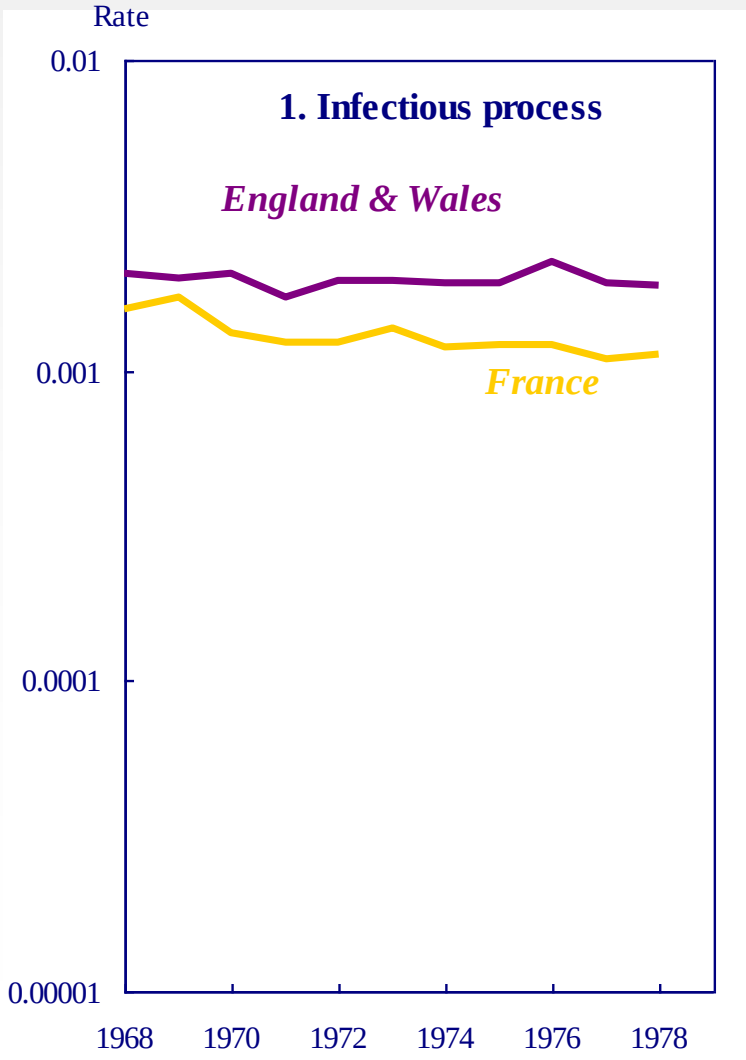




An etiological classification

A better estimate of the infectious process





The choice of the cause

- A standardized certificate
- Precise rules established by WHO
- Automated Cause Of Death Coding
- More attention devoted to multiple causes of death

A model recommended by WHO

CAUSE OF DEATH		Approximate interval between onset and death
I		
Disease or condition	(a)	.....
*Directly leading to death**	due to (or as a consequence of)	
Antecedent causes	(b)	.....
Morbid conditions, if any,	due to (or as a consequence of)	
giving rise to the above cause,		
stating the underlying	(c)	.....
condition last	due to (or as a consequence of)	
	(d)	.....
II		
Other significant conditions	.....	.....
contributing to the death, but		
not related to the disease or	.....	.....
condition causing it		

* This means the disease, injury or complication which caused death NOT ONLY, for example, the mode of dying, such as "heart failure, asthenia", etc.

Multiple causes

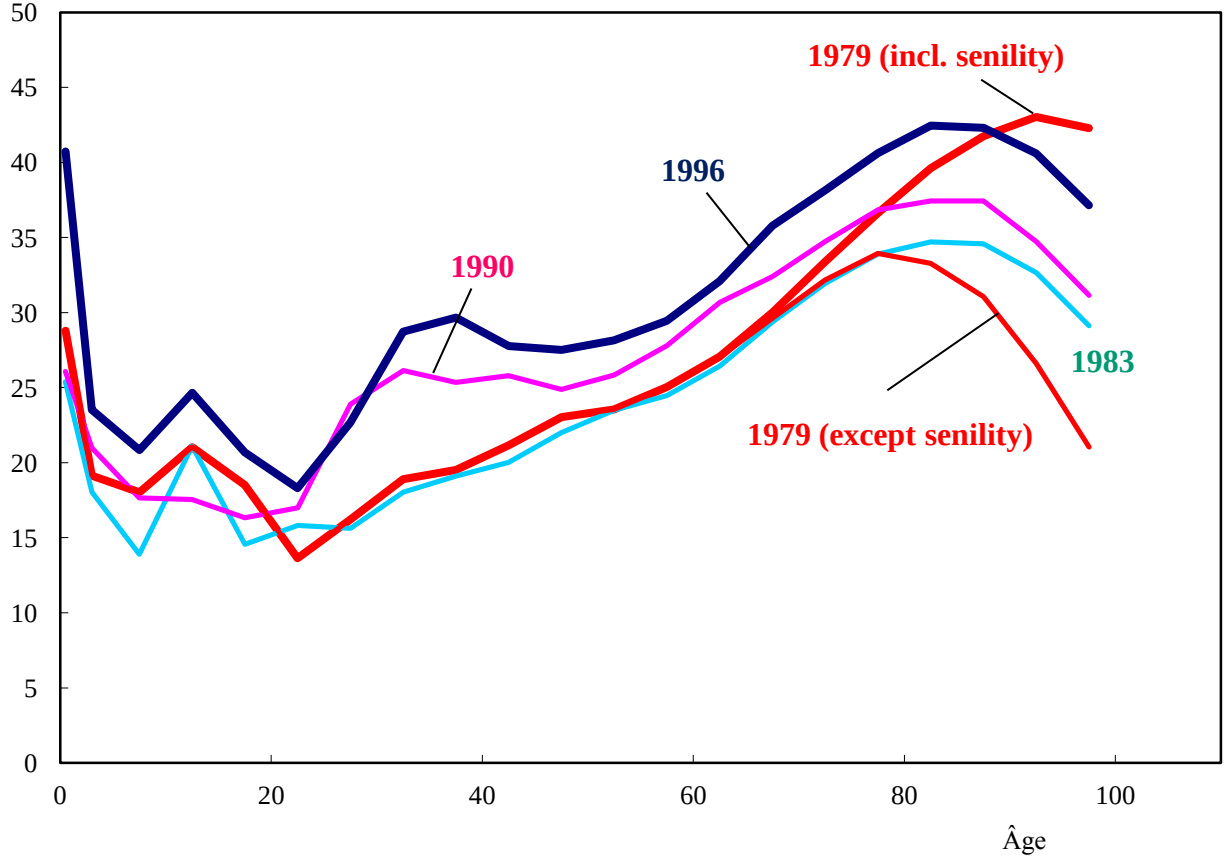
- With the concentration of deaths at old ages, the process leading to death is more and more complex and cannot be summarized with a single cause of death
- Few countries, however, are publishing multiple-cause data
- Moreover, rules and available data are very different from one country to another

Two main paths of analysis

- Total of mentions : highlights the role played in mortality by certain pathologies (alcoholism, diabetes) that appear more rarely as initial cause.
- Associations of causes: attempt to identify the sequences of typical diseases in certain pathological processes.

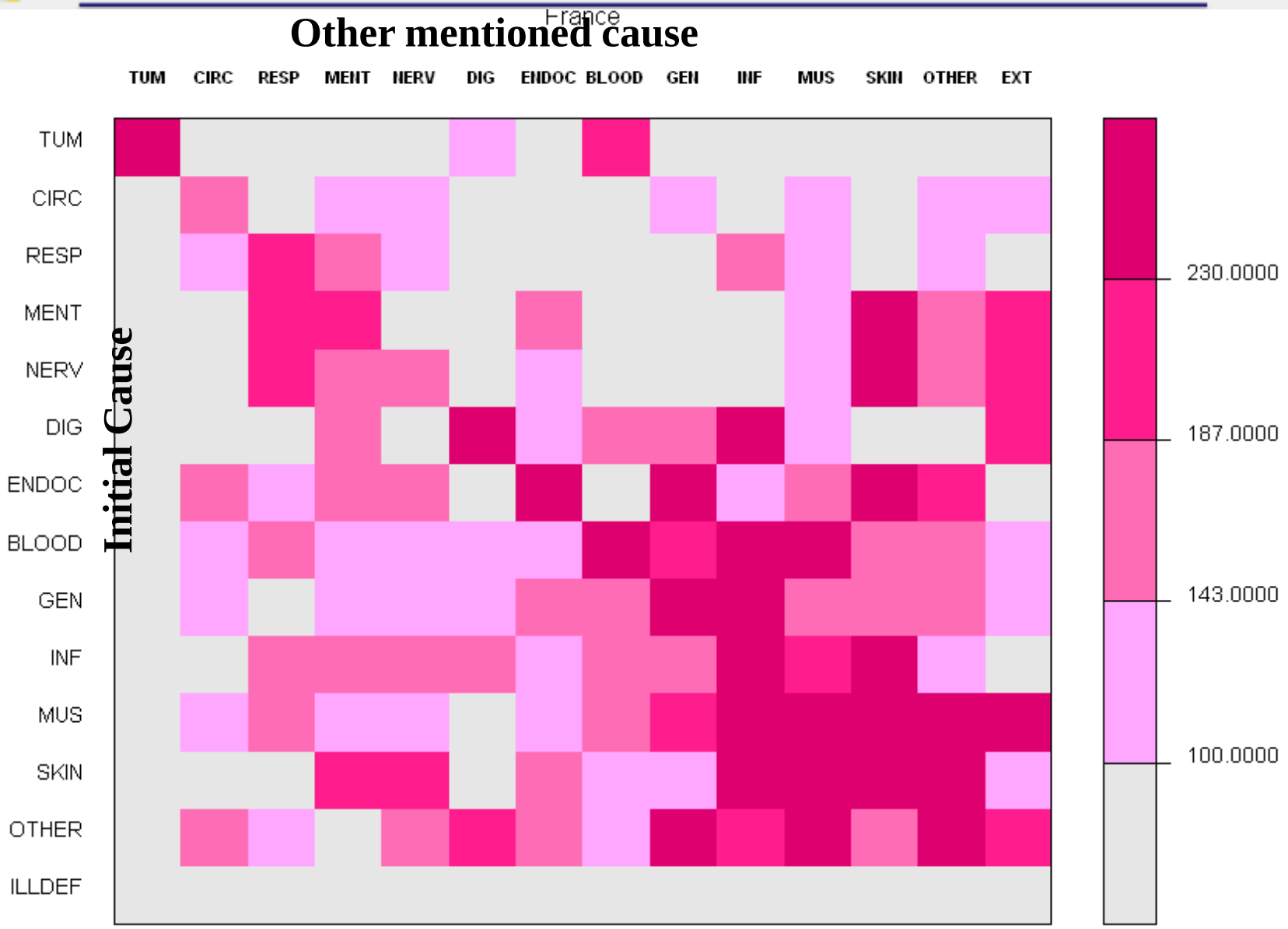
⇨ ***A promising research field but which remains largely unexplored***

Proportion of deaths with multiple causes



Aline Désesquelles, France Meslé (2004). « Intérêt de l'analyse des causes multiples dans l'étude de la mortalité aux grands âges : l'exemple français», *Cahier québécois de démographie*, 33 (1): 83-116.

Main associations - France, 2003



Source: Désesquelles Aline, Salvatore Michele Antonio, Frova Luisa, Pace Monica, Pappagallo Marilena, Meslé France, Egidi Viviana. 2010. Revisiting the mortality of France and Italy with the multiple-cause-of-death approach. *Demographic Research, 23 (28), p. 771-806.*

Problems of discontinuity: the recent example of ICD-10

Source: Meslé France and Vallin Jacques, 2008. – The impact of ICD-10 on continuity in cause-of-death statistics. The example of France, Population-E, vol. 63, n° 2, p. 347-360.

ICD revisions

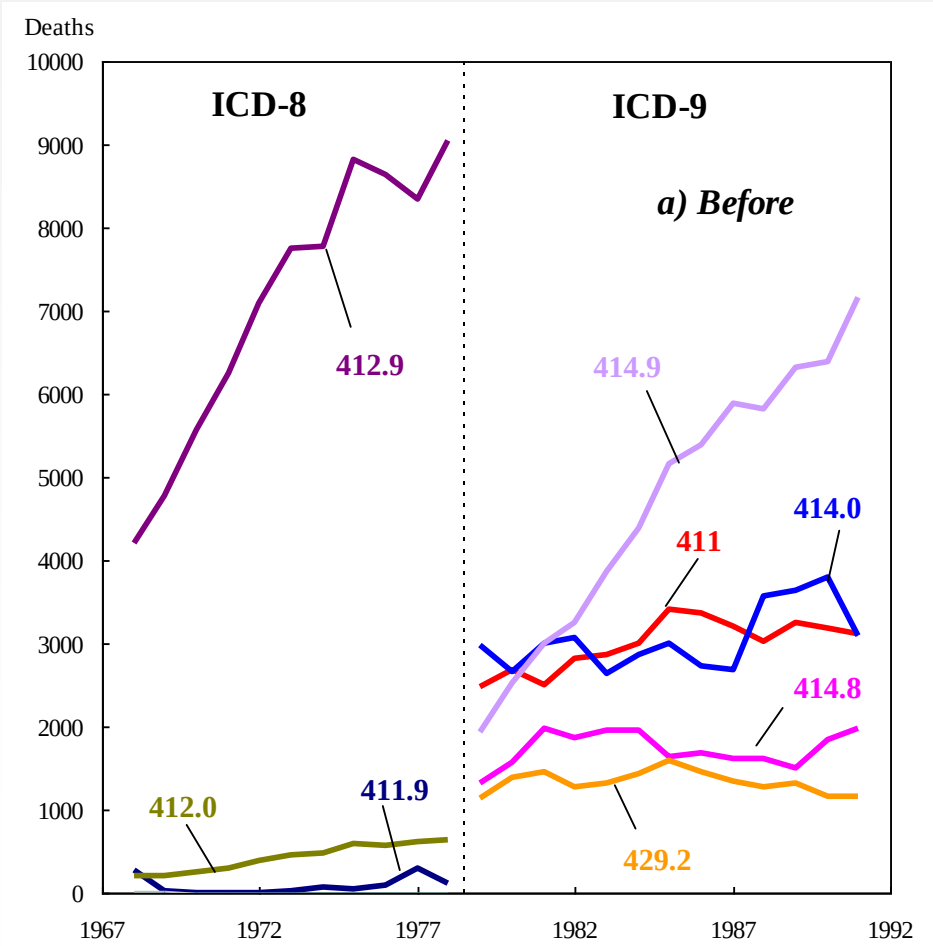
- 1893 : adoption of the 1st International Classification of Diseases
- Then, ten times revised

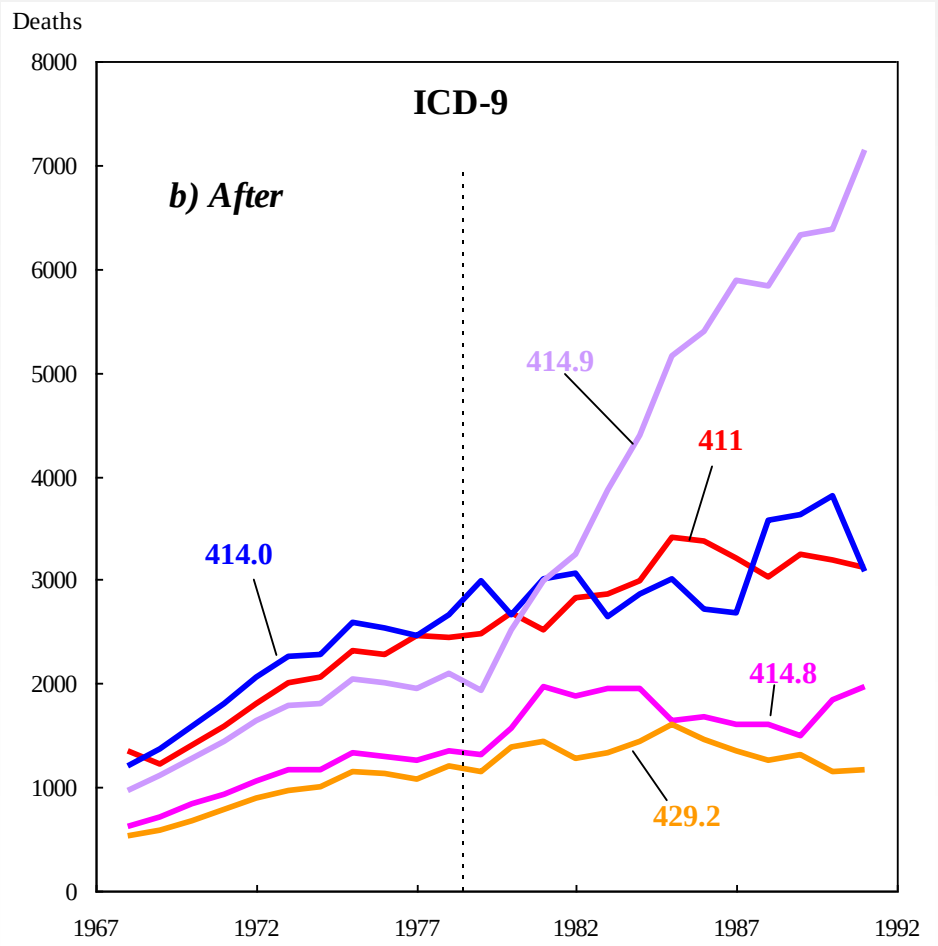
  ruptures in statistical series

  continuity can be restored from a double classification managed for the transition year

  or rebuilt *a posteriori*.

An example of reconstructed series for France (transition from ICD-8 to ICD-9)



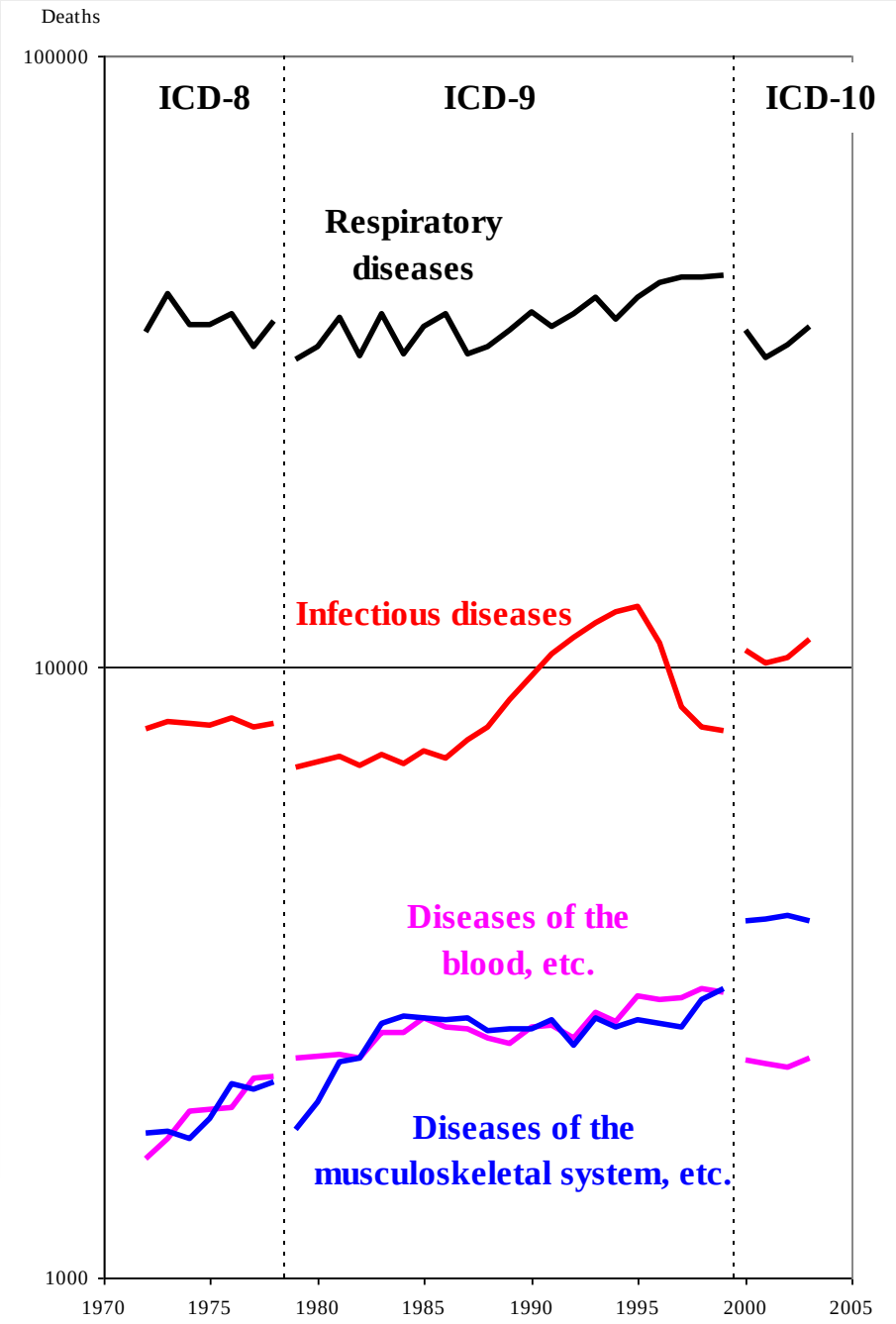


Move to ICD-10: a New Challenge

- Adopted in 1989, to enter in use in 1993.
- In fact implementation lasted : 1999 in the USA and in the UK, 2000 in France
- It resulted in ruptures potentially more important than ICD-8 or ICD-9 since not only the number of items increased at lot (up to more than 10 000) but slight changes occurred in the rules to select underlying causes

The case of France

- One more problem occurred in France : coding system changed in the same time as ICD-10 was adopted
- However, a bridge coding was performed on a death sample of the year 1999, what was not done for the previous transitions



Ruptures were particularly important, even at the rough level of entire ICD chapters

Possibles solutions ?

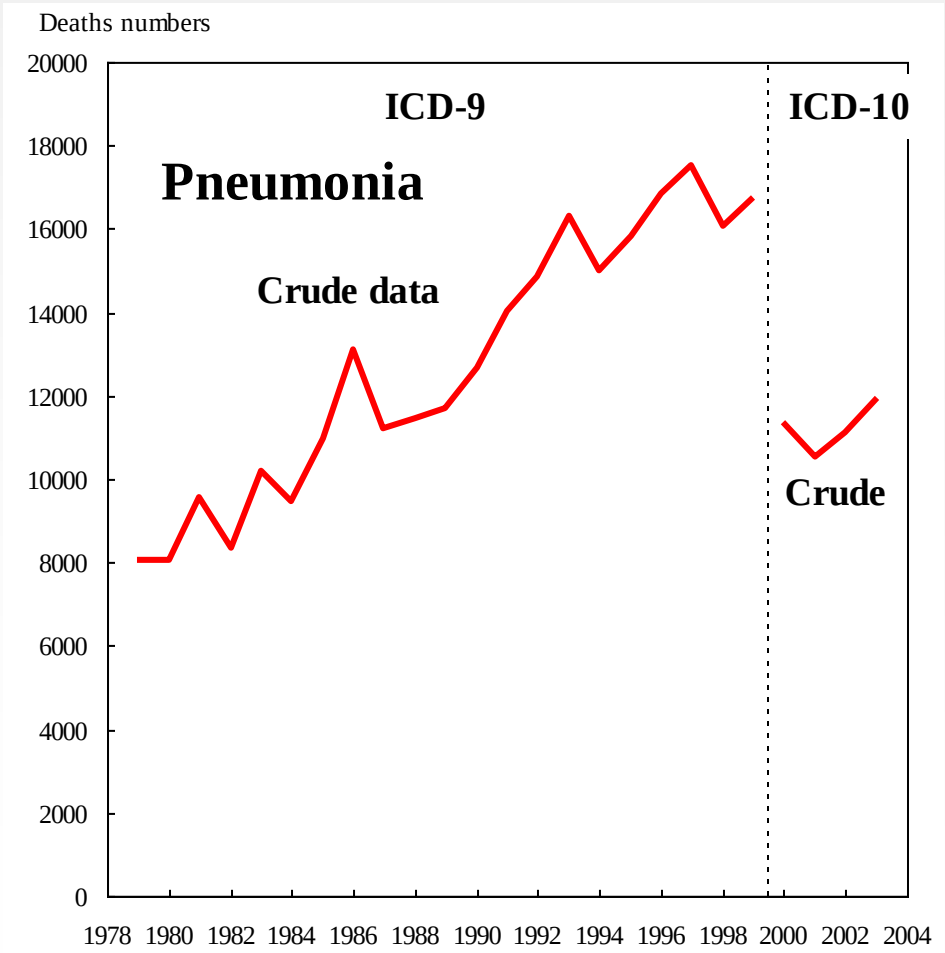
- To use French bridge coding?
- To rely on English or American bridge coding?
- To take benefit from multiple cause registration ?

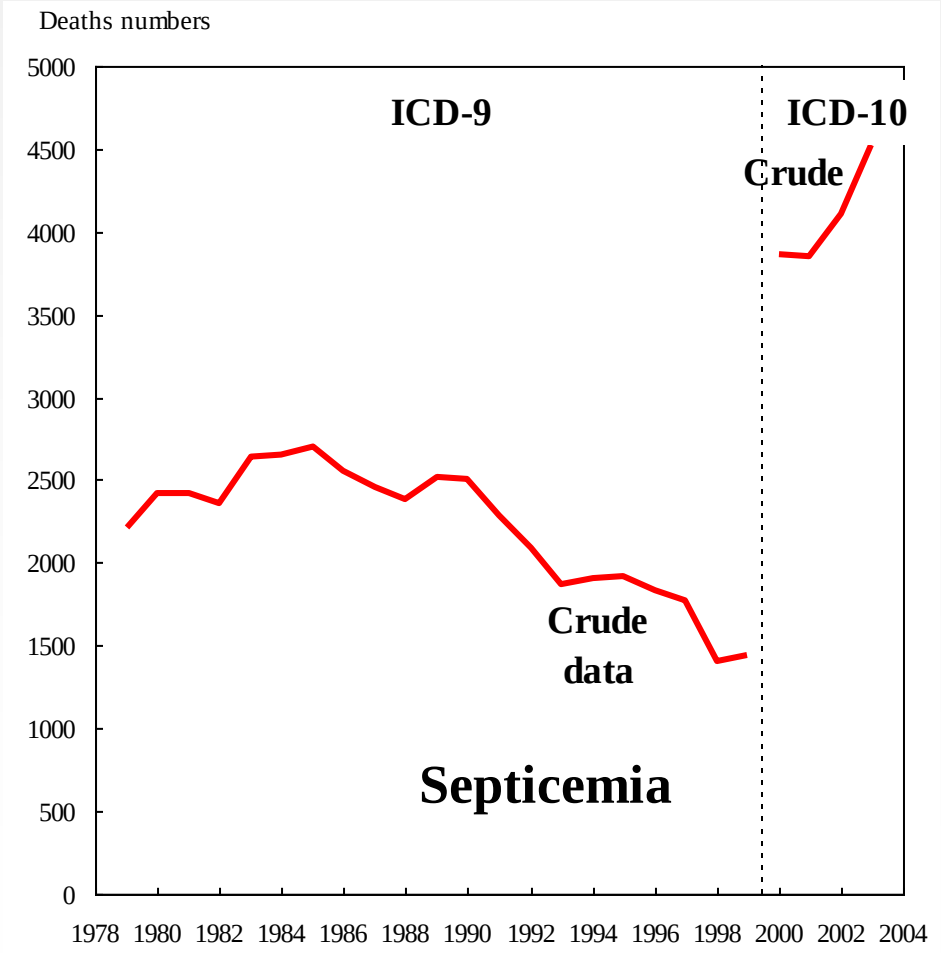
Pneumonia and septicemia as examples

French bridge coding

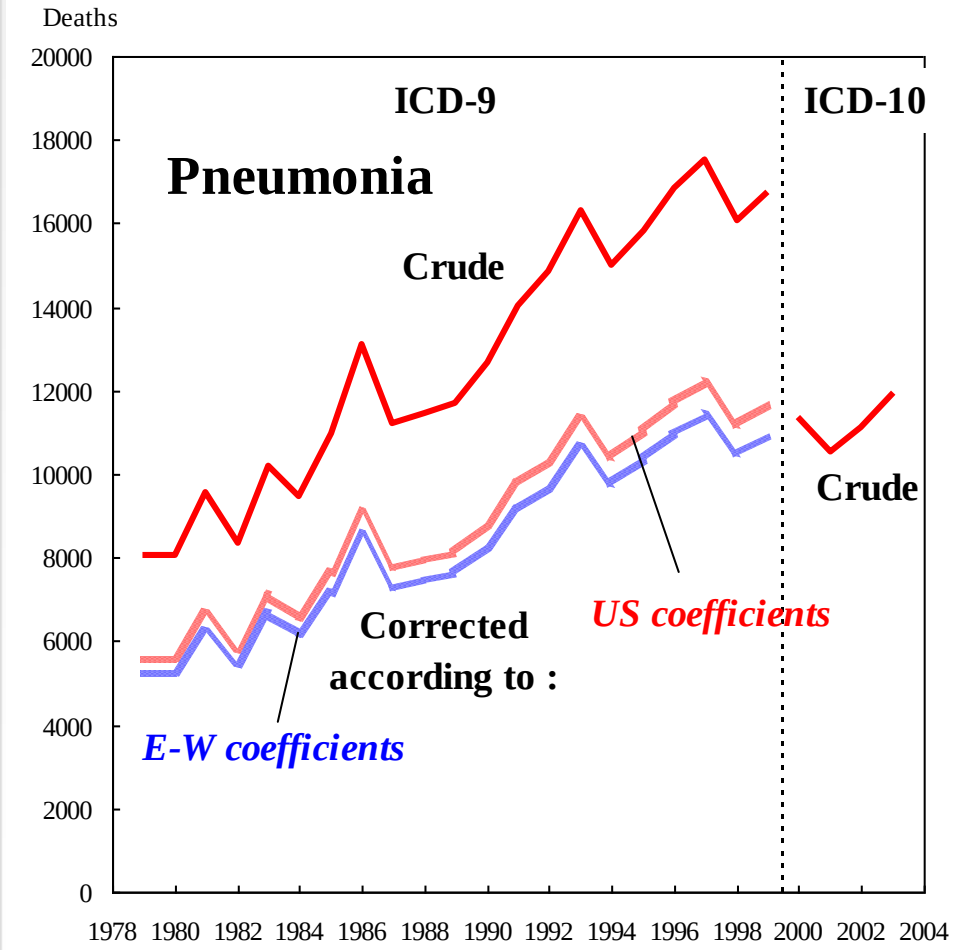
- Not very efficient. Too small sample (10% of 1999 deaths) does not allow working at an enough detailed level
- It can only serves as a safeguard to check the results obtained by other means

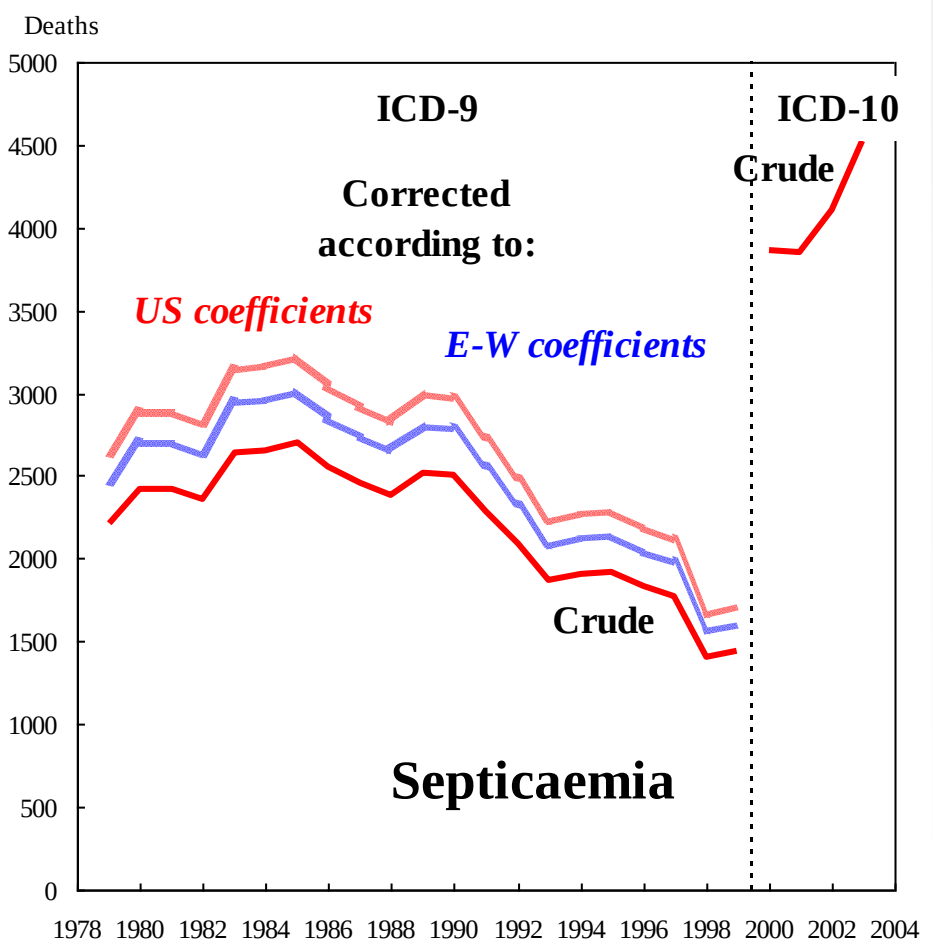
Applying coefficients resulting from English or American bridge coding





Applying coefficients resulting from English or American bridge coding





Taking benefit from multiple cause data

- A large part of the problem comes from changes in the rules for selecting the underlying cause from the various conditions mentioned on the death certificate
- If there is a break for a given cause selected as underlying cause, it could be expected that a reverse break occurs for the same cause identified as either direct cause or contributing cause, and assumed that the first gap could be filled on the basis of the second one.

Taking benefit from multiple cause data

- The problem with French data is that while a maximum of four causes were manually coded under ICD-9 (direct, underlying, contributing-1 and -2), since 2000, INSERM has automatically coded all the conditions mentioned on the certificate according to ICD-10.
- To try to put 2000 data in the same shape as those of 1999, the first condition mentioned on the first line of the death certificate was taken as the direct cause (except if is was the same as the selected underlying cause), then, the first two conditions mentioned in part two of the certificate were considered as contributing causes 1 and 2
- The results are surprisingly different from what was expected

Taking benefit from multiple cause data

Type of cause	Pneumonia		Septicemia	
	1999	2000	1999	2000
Underlying c.	16726	11342	1441	3857
Direct cause	12807	9037	5100	12823
Contributing causes 1 or 2	3373	2006	751	649
Total	32906	22385	7292	17329

Conclusion

In the case of France, neither bridge coding nor multiple cause analysis can be a main basis for reconstructing coherent time series. They appear to be no more than useful safeguards but do not dispense with the need for a patient comparative analysis of the actual medical and statistical contents of every item of both ICD-9 and ICD-10, to establish ex-post transition coefficients not given in enough detail by double classification