

Coding, aggregation and agreement

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Basically a Swedish PHC flavour

with a touch of measurement
not very far from clinical practice
certainly pragmatic elements
but the ideas can be generalised

Outline

Coding

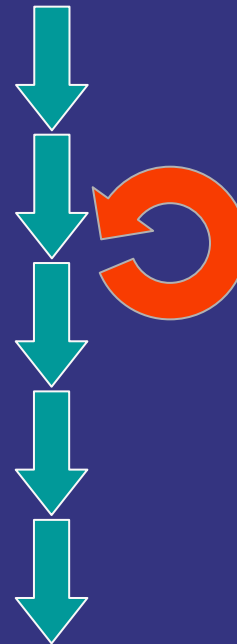
Aggregation

Agreement

Coding and agreement

Aggregation and agreement

Beyond agreement



Coding

in Primary Health Care

A Swedish Perspective

Almost 100 % computer-based patient records

Using the ICD for labelling in the CPR

Coding by GPs (n=184)*:

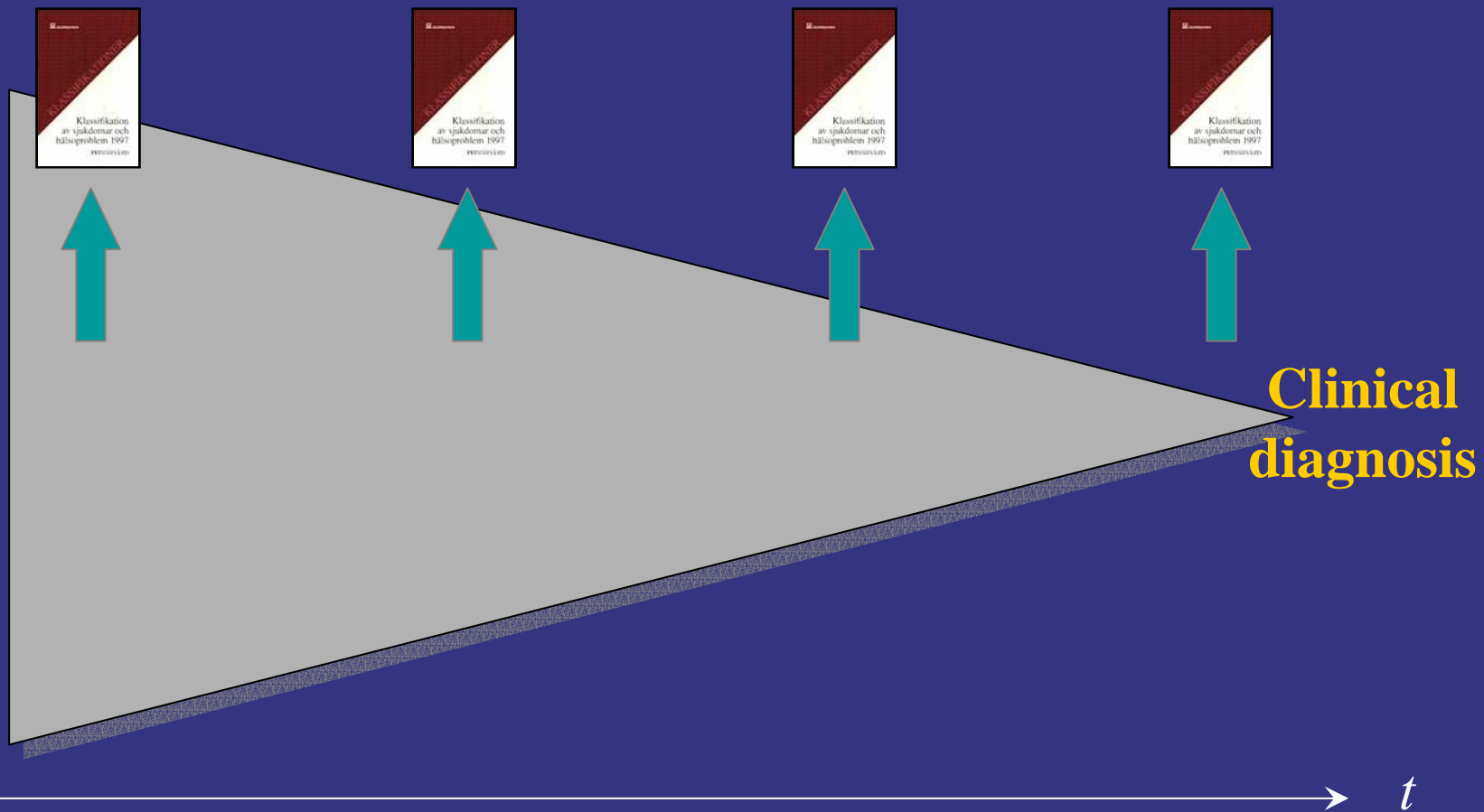
- 76 % “almost always”
- 12 % “mostly”
- 7 % “intermediate frequency”
- 5 % “never”

* Nilsson, Åhlfeldt and Strender (2002)

DATE	DIAG	PAT	CONT	DIA	CARE	AGE	Y	SEX	CODE
19970626	F439P	4805	31658	1	49	46	97	K	KSH97-P
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19970630	H660	10741	56403	1	49	6	97	K	KSH97-P
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19970701	I209P	657	5039	2	49	80	97	M	KSH97-P
19970701	I67-P	657	5039	1	49	80	97	M	KSH97-P
19970701	I739P	657	5039	3	49	80	97	M	KSH97-P
19970701	F51-	688	5290	2	34	79	97	K	KSH97-P
19970701	R35-	688	5290	1	34	79	97	K	KSH97-P
19970701	I74-	1293	10003	1	34	73	97	M	KSH97-P
19970701	M255	1365	10524	1	49	72	97	K	KSH97-P
19970701	N30-P	1365	10524	2	49	72	97	K	KSH97-P
19970701	N950	1430	10974	1	34	71	97	K	KSH97-P
19970701	M751	1463	11213	1	54	71	97	K	KSH97-P

Clinical and Statistical Diagnosis

Statistical diagnosis



Use and reuse of coded data

Two illustrations:
vision and reality

The vision

Registries *frequently* used for

- Providing quality patient management,
- Patient audit
- Quality assurance
- Practice management
- Management of specific groups of patients
- Research

Clinical, health services and health economics

Britt, Beaton and Miller (1995)

Reality

Registries *infrequently* used for

- Multipurpose (46 %)
- Annual reports (26 %)
- Quality assurance (20 %)
- Other purpose (4 %)
- Research (1 %)
- Did not know (2 %)

Nilsson, Åhlfeldt and Strender (2002)

Aggregation

in Primary Health Care

Dimensions for aggregation

Location

Blood
Circulatory organs
Digestive organs
Ear
Eye
Inner secretory organs
Mammary gland
Multiple organs/functions
Musculoskeletal system
Nervous system
Psychological functions
Respiratory organs
Sexual organs
Skin
Urinary tract organs

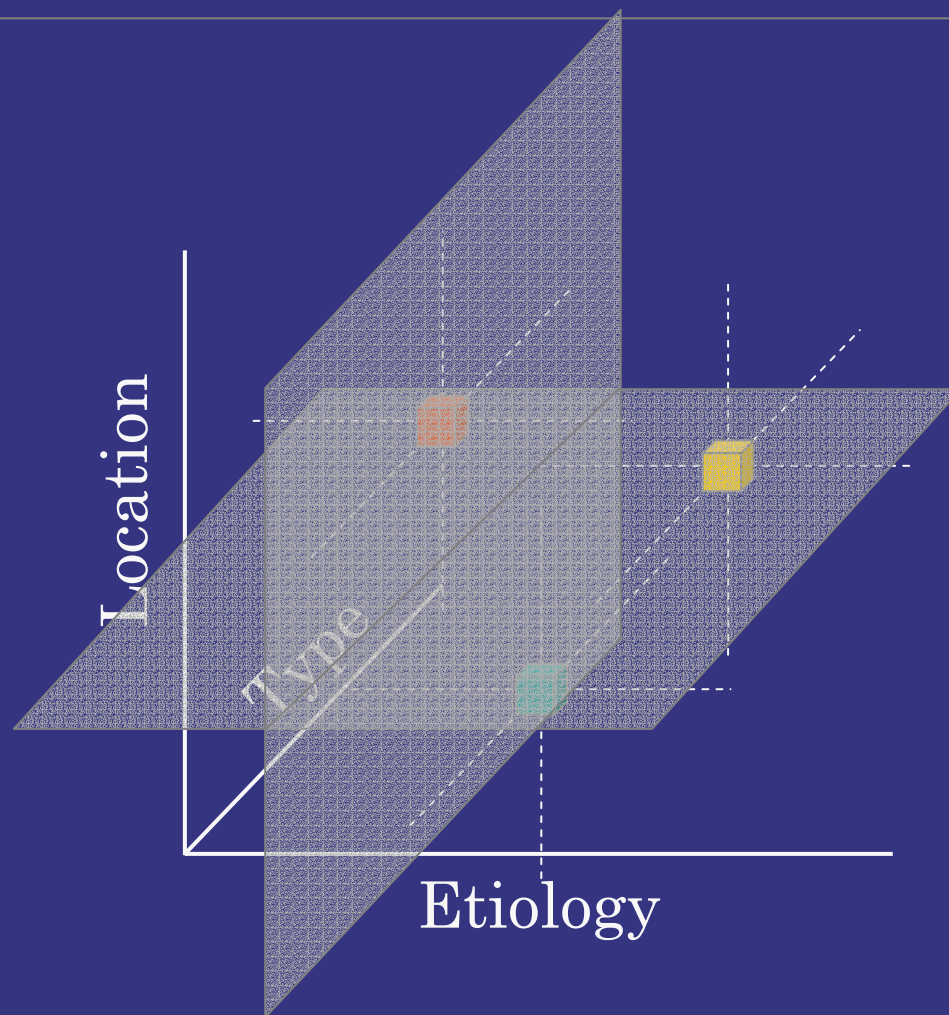
Etiology

Circumstances
Deficiency
Endogenous
Infection
Injury
Mixed etiology
Poisoning

Type

Disease
Healthy
Risk
Symptom

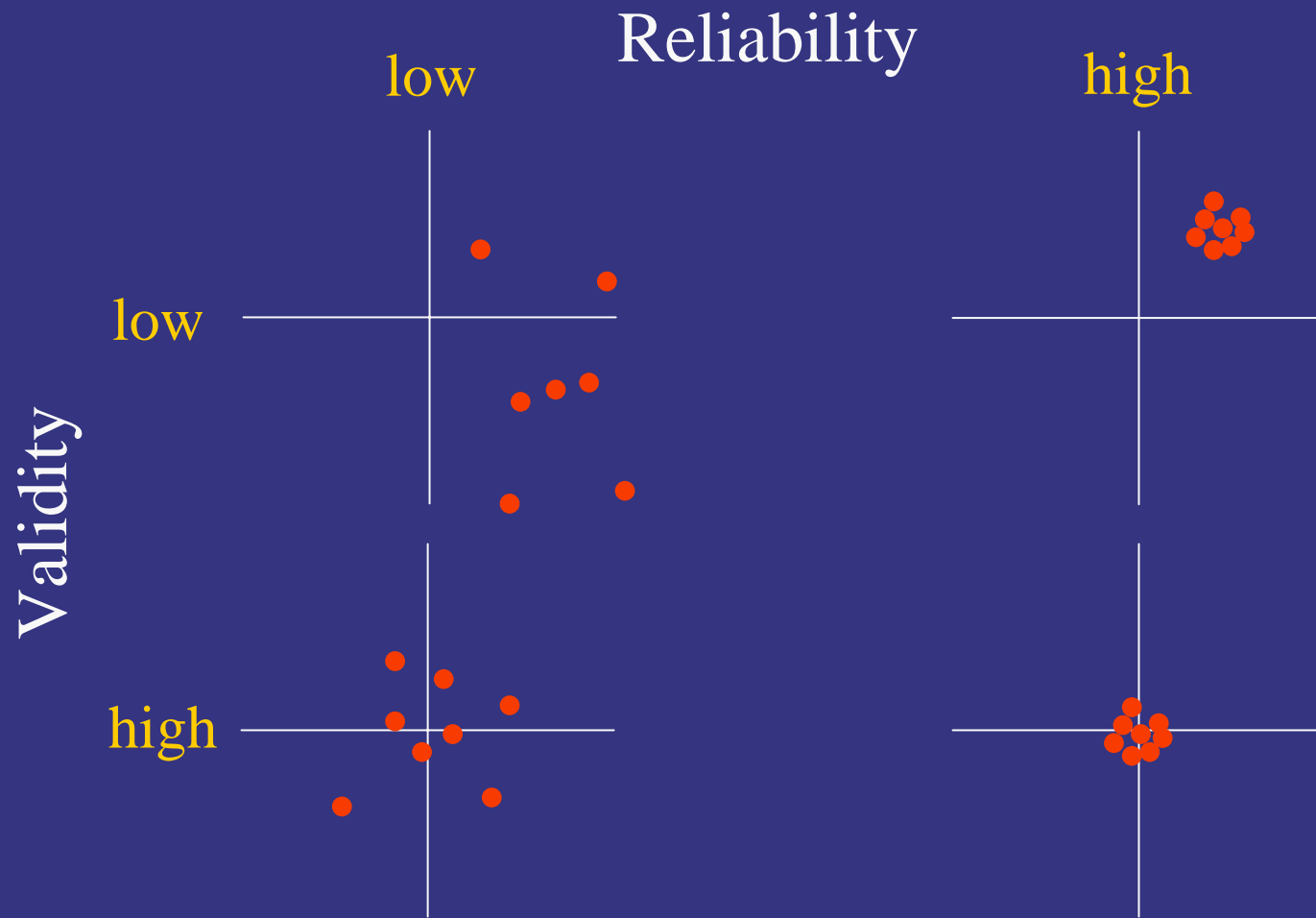
Aggregation in Primary Health Care



What about agreement?

the detour

Healthiness of measurement



Reliability

Reliability = Reproducibility

$$\textit{Reliability} = \frac{\textit{Subject Variability}}{\textit{Subject Variability} + \textit{Measurement error}}$$

$$\textit{Reliability} = \frac{\sigma_s^2}{\sigma_s^2 + \sigma_e^2} = \textit{Intraclass Correlation Coefficient, ICC}$$

Agreement in Primary Health Care

Categorical data

- Nominal or ordinal
- Reproducibility = Agreement

Is agreement influenced by coding tools?

Coding tool based on the aggregation scheme?

100 cases classified by two “judges”

Category		Judge A			f _{iB}
		1	2	3	
Judge B	1	25	13	12	50
	2	12	2	16	30
	3	3	15	2	20
f _{iA}		40	30	30	∑ f _i = 100

42 %

$$\chi^2 \approx 32,30$$

$$P = 1.66E-06 \text{ (4 d.f.)}$$

$$C \approx .49$$

A Coefficient of Agreement for Nominal Scales

$$\kappa = \frac{p_o - p_c}{1 - p_c}$$

Cohen (1960)

Cohen's Example

		Judge A			
Category		1	2	3	p_{iB}
Judge B	1	.25 (.20)	.13 (.15)	.12 (.15)	.50
	2	.12 (.12)	.02 (.09)	.16 (.09)	.30
	3	.03 (.08)	.15 (.06)	.02 (.06)	.20
p_{iA}		.40	.30	.30	$\sum p_i = 1$

$$p_o = .25 + .02 + .02 = .29$$

$$p_c = .20 + .09 + .06 = .35$$

$$\kappa = -.06 / .65 \approx -.09$$

Interpretation of Cohen's κ

Less than straightforward

– LARGE-sample characteristics

$n \geq 16k^2$ for symmetric two-sided confidence intervals
21 ICD chapters thus require 7,056 cases ...

– Dependencies

Prevalence

Number of categories in the scheme

– What about $\kappa \neq 0$

Interesting at all?

How much agreement do we need?

Interpretation of Cohen's κ

Landis och Koch (1977)

<0.00	Poor
0.00-0.20	Slight
0.21-0.40	Fair
0.41-0.60	Moderate
0.61-0.80	Substantial
0.81-1.00	Almost perfect

Fleiss (1981)

<0.40	Poor
0.40-0.75	Fair to good
>0.75	Excellent

Altman (1991)

<0.20	Poor
0.21-0.40	Fair
0.41-0.60	Moderate
0.61-0.80	Good
0.81-1.00	Very good

Byrt (1996)

<0.00	No
0.01-0.20	Poor
0.21-0.40	Slight
0.41-0.60	Fair
0.61-0.80	Good
0.81-0.92	Very good
0.93-1.00	Excellent

Agreement

in Primary Health Care

The Classification Browser

Coding and agreement

Three coding tools

- Printed version
- ICD chapters
- Aggregation model

152 cases

Two coders per case & tool

No difference between the tools

Aggregation and agreement

No difference → Combine the code sets

152 cases

Six coders per case

Find a new statistic

Subject	Category						Category					Quantity		
	1	2	3	4	5		1	2	3	4	5	Po _i	Pe	K _i
1				6		6				30		1.000	0.220	1.000
2		3			3	6		6		6		0.400	0.220	0.231
3		1	4		1	6		0	12	0		0.400	0.220	0.231
4					6	6				30		1.000	0.220	1.000
5		3		3		6		6		6		0.400	0.220	0.231
6	2		4			6	2		12			0.467	0.220	0.316
7			4		2	6			12	2		0.467	0.220	0.316
8	2		3	1		6	2		6	0		0.267	0.220	0.060
9	2			4		6	2			12		0.467	0.220	0.316
10					6	6				30		1.000	0.220	1.000
⋮						⋮						⋮	⋮	⋮
25	1			4	1	6	0			12	0	0.400	0.220	0.231
		5		1		6		20		0		0.667	0.220	0.573
27	4				2	6	12				2	0.467	0.220	0.316
28		2		4		6		2		12		0.467	0.220	0.316
29	1		5			6	0		20			0.667	0.220	0.573
30					6	6				30		1.000	0.220	1.000
Total	26	26	30	55	43	180						0.556	0.220	0.430
p_j	0.144	0.144	0.167	0.306	0.239	1								

Aggregation and agreement

Categorization scheme	Number of classes	p_o	p_e	κ_G
The chapter structure	17	0.83	0.11	0.81
The compositional structure				
Location	15	0.88	0.12	0.86
Etiology	7	0.83	0.34	0.74
Type	3	0.84	0.53	0.67
Location and etiology	38	0.77	0.06	0.76
Location and type	27	0.79	0.08	0.77
Etiology and type	12	0.78	0.21	0.72
Location, etiology and type	53	0.74	0.05	0.72

Aggregation and agreement

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 Etiology and type	12	0.78	0.21	0.72
 Location, etiology and type	53	0.74	0.05	0.72

Permutation results

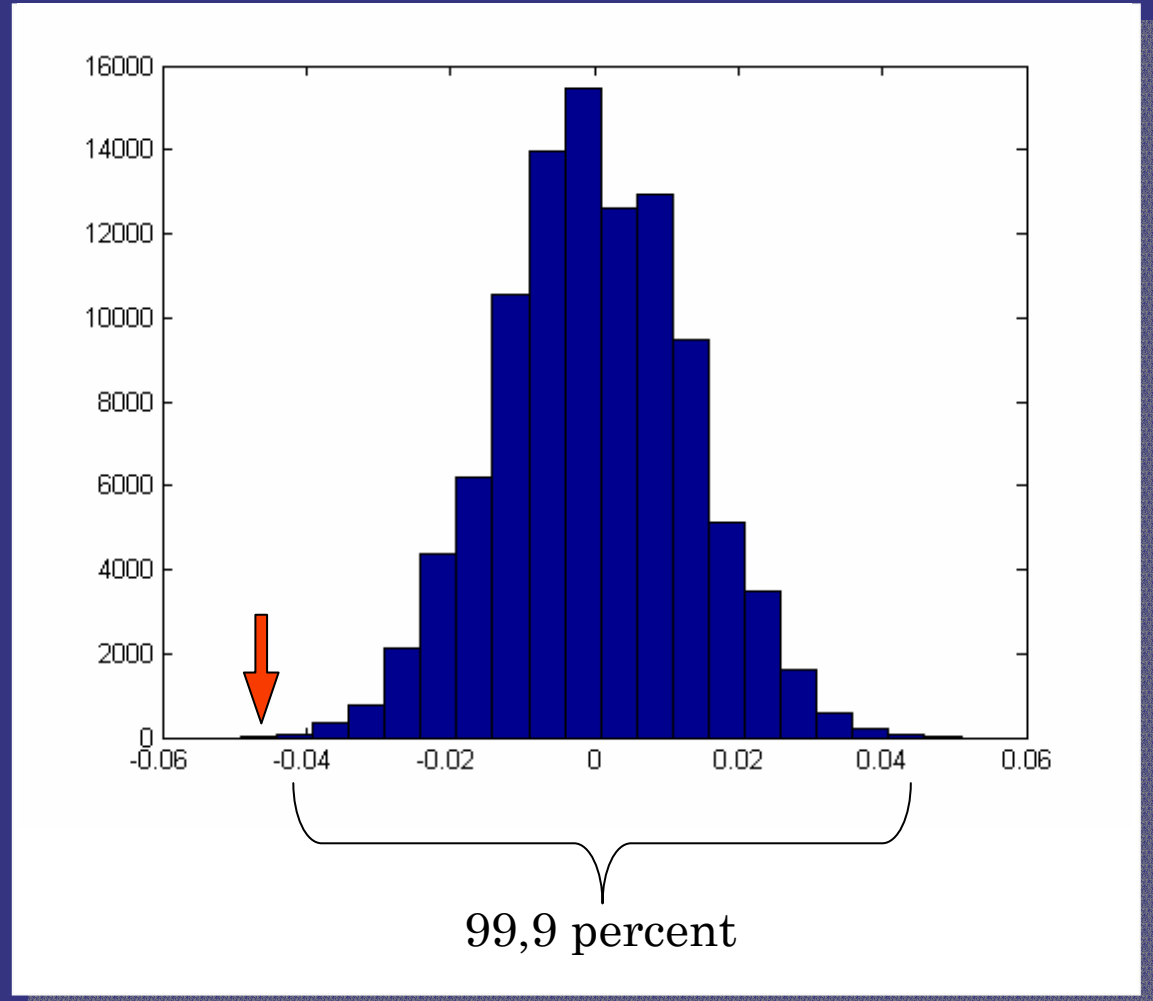
The chapter structure is okay

- One single dimension is better (Location)
- The best way to include more than one dimension
- Location and type may be an alternative

Combining dimensions makes things worse

Subject	System 1			System 2			Difference	
	P _{0i}	Pe	K _i	P _{0i}	Pe	K _i	P _{0i}	K _i
1	0.667	0.215	0.576	1	0.116	1	-0.333	-0.425
2	0.2	0.215	-0.019	0.133	0.116	0.020	0.067	-0.039
3	1	0.215	1	1	0.116	1	0	0
4	0.667	0.215	0.576	0.267	0.116	0.171	0.4	0.405
5	1	0.215	1	1	0.116	1	0	0
6	1	0.215	1	0.667	0.116	0.623	0.333	0.377
7	1	0.215	1	1	0.116	1	0	0
8	0.4	0.215	0.236	1	0.116	1	-0.6	-0.764
9	0.667	0.215	0.576	0.667	0.116	0.623	0	-0.048
10	1	0.215	1	1	0.116	1	0	0
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
148	0.667	0.215	0.576	0.667	0.116	0.623	0	-0.048
149	1	0.215	1	1	0.116	1	0	0
150	0.467	0.215	0.321	1	0.116	1	-0.533	-0.679
151	0.133	0.215	-0.104	0.667	0.116	0.623	-0.533	-0.727
152	1	0.215	1	1	0.116	1	0	0
Average	0.776		0.715	0.878		0.862	0.101	0.147

Subject	System 1			System 2			Difference	
	P _{0i}	P _e	K _i	P _{0i}	P _e	K _i	P _{0i}	K _i
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⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
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149	1	0.215	1	1	0.116	1	0	0
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19970701	I74-	1293	10003	1	34	73	97	M	KSH97-P
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19970701	N950	1430	10974	1	34	71	97	K	KSH97-P
19970701	M751	1463	11213	1	54	71	97	K	KSH97-P

Small Area Analysis?

Health care consumption in different areas

Treatment policy/practice

Single diagnosis or procedure

Based on variation in admission rate

- “What is too much variation?”
- Random and systematic variation

Retrospective studies

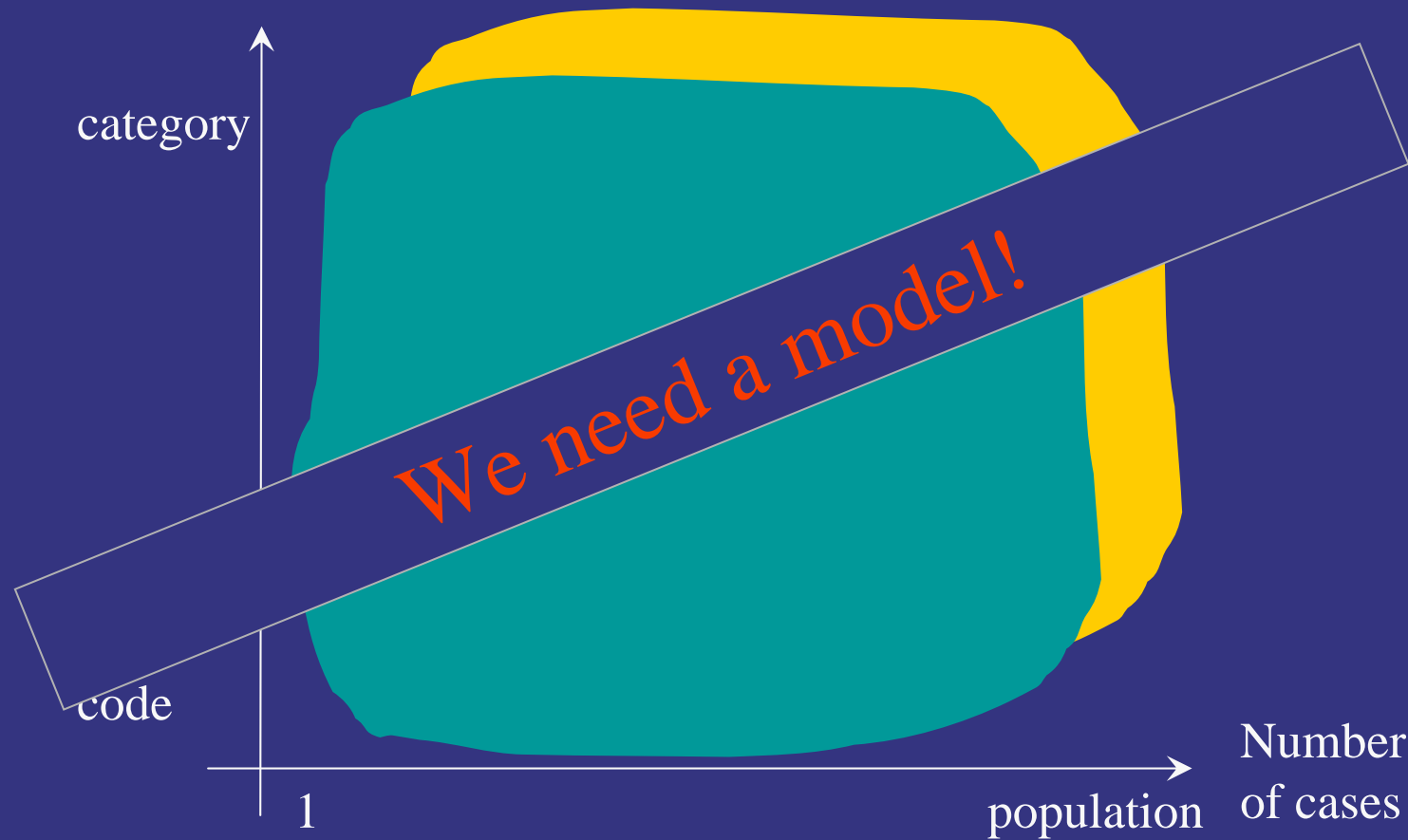
Causes of death

Swedish men, 1997-1999

Disease Category	CV	Södermanland	Östergötland	Jönköping	Kronoberg	Kalmar	Blekinge
01 Infectious and Parasitic Diseases	18.0	0.6	0.9	1.0	1.1	0.9	1.0
06 Neoplasms	5.4	25.4	24.6	24.2	26.2	22.4	23.8
25 Diseases of the Blood (-forming) Organs, Immunological Disorders	40.0	0.2	0.2	0.2	0.1	0.2	0.4
26 Endocrine, Nutritional and Metabolic Diseases	16.0	1.9	2.2	2.1	1.4	2.2	1.7
28 Mental and Behavioural Disorders	10.6	2.7	2.6	2.6	3.0	2.1	2.7
31 Diseases of the Nervous System and the Sense Organs	16.8	1.4	1.3	1.4	1.4	1.6	2.0
33 Diseases of the Circulatory System	2.1	48.7	48.0	48.7	46.9	50.0	48.8
37 Diseases of the Respiratory System	5.2	7.6	7.2	7.3	8.3	7.7	7.4
42 Diseases of the Digestive System	5.7	3.1	2.8	2.9	2.6	2.6	2.9
45 Diseases of the Skin and Subcutaneous Tissue	33.0	0.2	0.1	0.2	0.2	0.1	0.1
46 Diseases of the Musculoskeletal System and Connective Tissue	28.4	0.3	0.4	0.2	0.4	0.4	0.4
48 Diseases of the Genitourinary System	14.6	1.5	1.6	1.8	1.5	1.4	1.2
51 Certain Conditions Originating in the Perinatal Period	56.5	0.2	0.1	0.2	0.3	0.2	0
52 Congenital Malformations and Chromosomal Abnormalities	31.0	0.2	0.4	0.3	0.4	0.5	0.2
55 Symptoms, Signs, Abnormal Findings and Ill-defined Causes	39.3	1.3	1.5	1.4	0.7	1.8	2.5
58 External Causes of Injury and Poisoning	10.1	4.8	6.2	5.6	5.3	5.8	4.8

From infrequent, homogeneous to frequent, heterogeneous

Level of aggregation



Thank you!