Exploring adherence to clinical guidelines: application of regression tree analysis in diabetes care

Carinci F, Pellegrini F, Nicolucci A

Monash Institute of Health Services Research, Australia
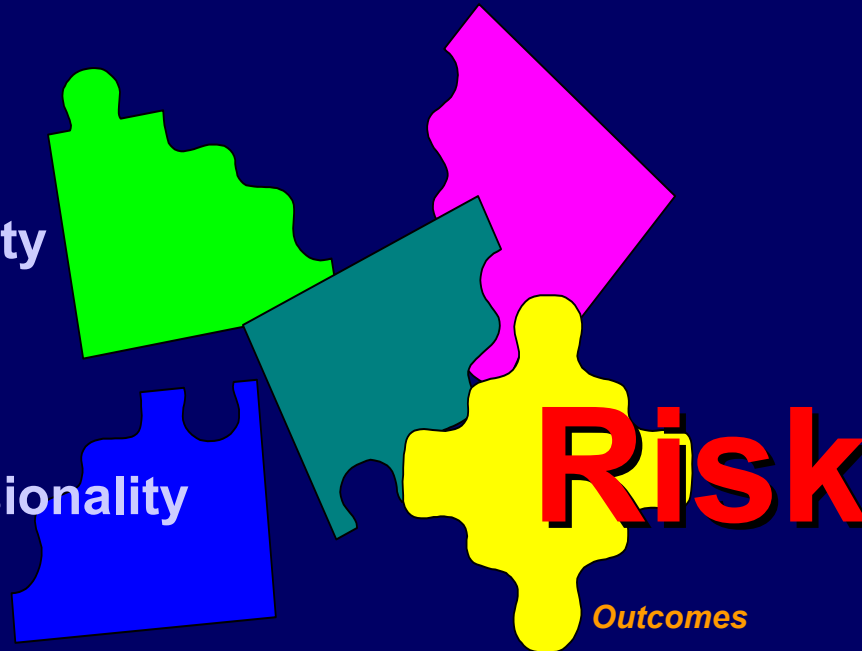_Consorzio Mario Negri Sud, Italy_

Evidence-based Practice

- ☑ **Heterogeneity**
- ☑ **Accuracy**
- ☑ **Multidimensionality**

Risk

Outcomes

Mortality
Hospital length of stay
Chronic disease/morbidity
Physical functional status
Psychosocial functioning
Quality of life
Resource utilization
Disease and medical care complications
Cost of care

Predictive model building

Outcome definition

Mortality
- Hospital length of stay
- Chronic disease/morbidity
- Physical functional status
- Psychosocial functioning
- Quality of life
- Resource utilization
- Disease and medical care complications
- Cost of care

Predictive model building

Diabetic Complications Study

OUTCOME FOR THE ORIGINAL STUDY DESIGN

Cases: *DIABETIC PATIENTS EXPERIENCING COMPLICATIONS*

- **first amputation in the past 12 months or foot complications**
- **dialysis initiated within the previous 12 months or serum creatinine levels of 3 mg/dl or more**
- **blindness developed within the previous 12 months or proliferative retinopathy/diabetic maculopathy**

Controls: *DIABETIC PATIENTS WITHOUT COMPLICATIONS*

- **patients without any of the previous complications**

Case - Control rate 1:2

Nicolucci A et al.   A comprehensive assessment of the avoidability of long term complications of diabetes   mellitus: a case-control study, *Diabetes Care*, 1996; 19 (9): 927-933

National Italian Sample

Population

	Total	Cases	Controls
• N (Subjects)	2774	886	1888
Type 1:	379	185	194
Type 2:	1390	212	1178
Type 2/IT:	1005	489	516

• N (Care centers)

Diabetic Outpatient Clinics: 35
General Practitioners: 49

Potential Correlates

PREDICTORS

- Age*
- Diabetes duration*

- Sex
- Occupation
- Marital status
- Hypertension
- History of myocardial infarction and/or stroke
- Co-morbidity
- Need for help to reach the health facility
- Regular attendance to visits
- Compliance with dietary recommendations
- Self-adjustment of insulin dose
- Self-monitoring
- Frequency of educational interventions
- Smoke
- Alcohol consumption in the past five years

*global adjustment terms and tree predictors

Identifying New Outcomes

Outcome: quality of care (process)

- **expressed as the rate of execution of the following procedures in the past 12 months (based on the expected number from the application of St. Vincent Decl.'s guidelines):**

  - *use of glycated haemoglobin*

  - *monitoring of cardiovascular risk factors*
    (blood pressure, blood lipids)

  - *monitoring of renal function*
    (microalbuminuria,macroalbuminuria, serum creatinine)

  - *eye examination*

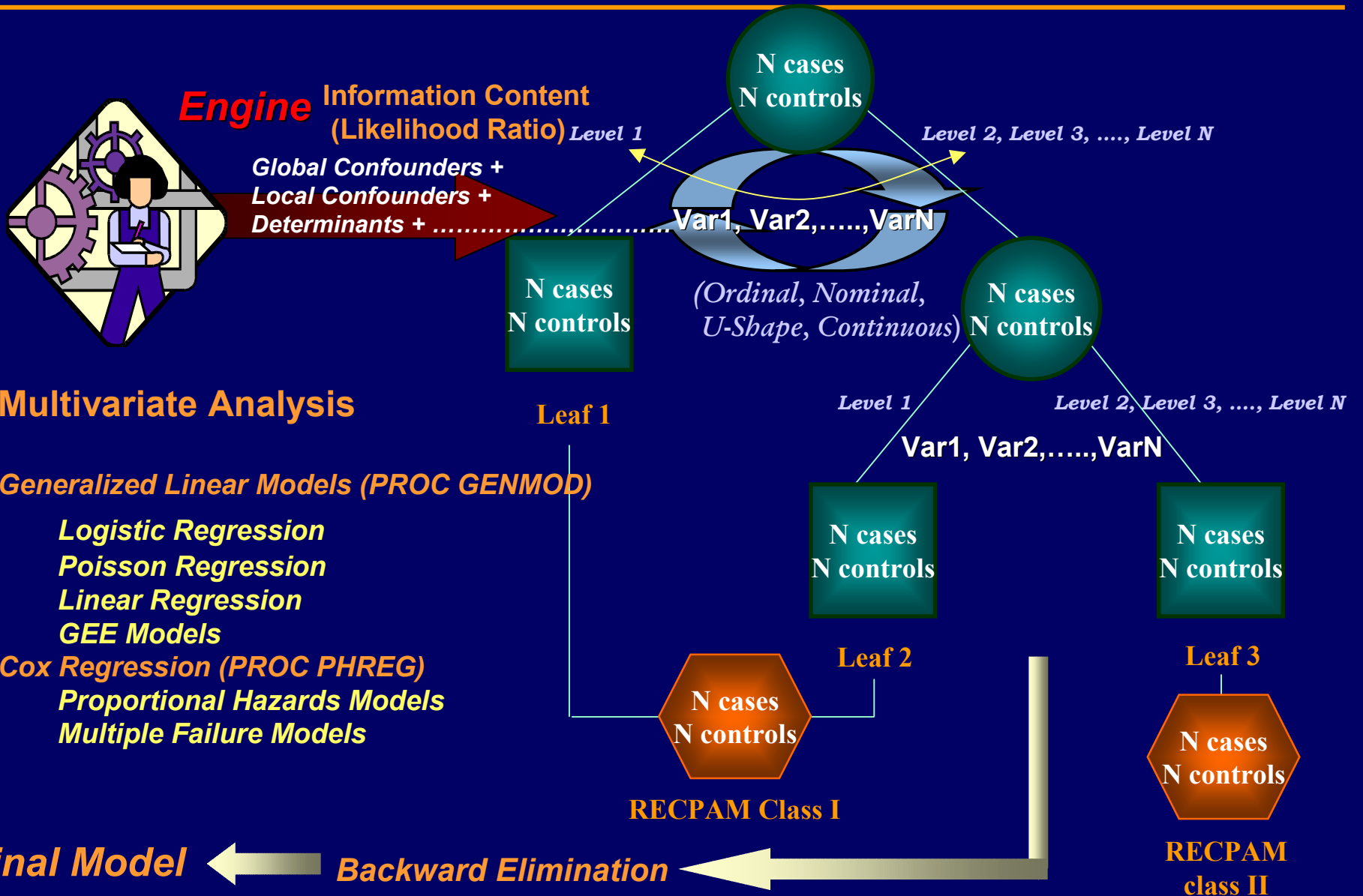 - *educational interventions on selected aspects of care*
    (diet, self-monitoring of blood glucose, insulin therapy self-management, hypoglycemic emergencies, foot care, physical activity)

  - *frequency of the educational interventions*
    (regular vs. not regular)

cut-off: 50% (lower quartile)

low quality ≤50%	*N =*	*689*
good quality >50%	*N =*	*2085*

RECPAM/SAS *(F.Carinci, A.Ciampi)*

Engine **Information Content (Likelihood Ratio)** *Level 1*

Level 2, Level 3, ..., Level N

N cases N controls

Global Confounders + Local Confounders + Determinants + ... **Var1, Var2,.....,VarN**

N cases N controls

(Ordinal, Nominal, U-Shape, Continuous)

N cases N controls

Leaf 1

Multivariate Analysis

Level 1

Level 2, Level 3, ..., Level N

Var1, Var2,.....,VarN

Generalized Linear Models (PROC GENMOD)

Logistic Regression
Poisson Regression
Linear Regression
GEE Models

Cox Regression (PROC PHREG)
Proportional Hazards Models
Multiple Failure Models

N cases N controls

N cases N controls

Leaf 2

Leaf 3

N cases N controls

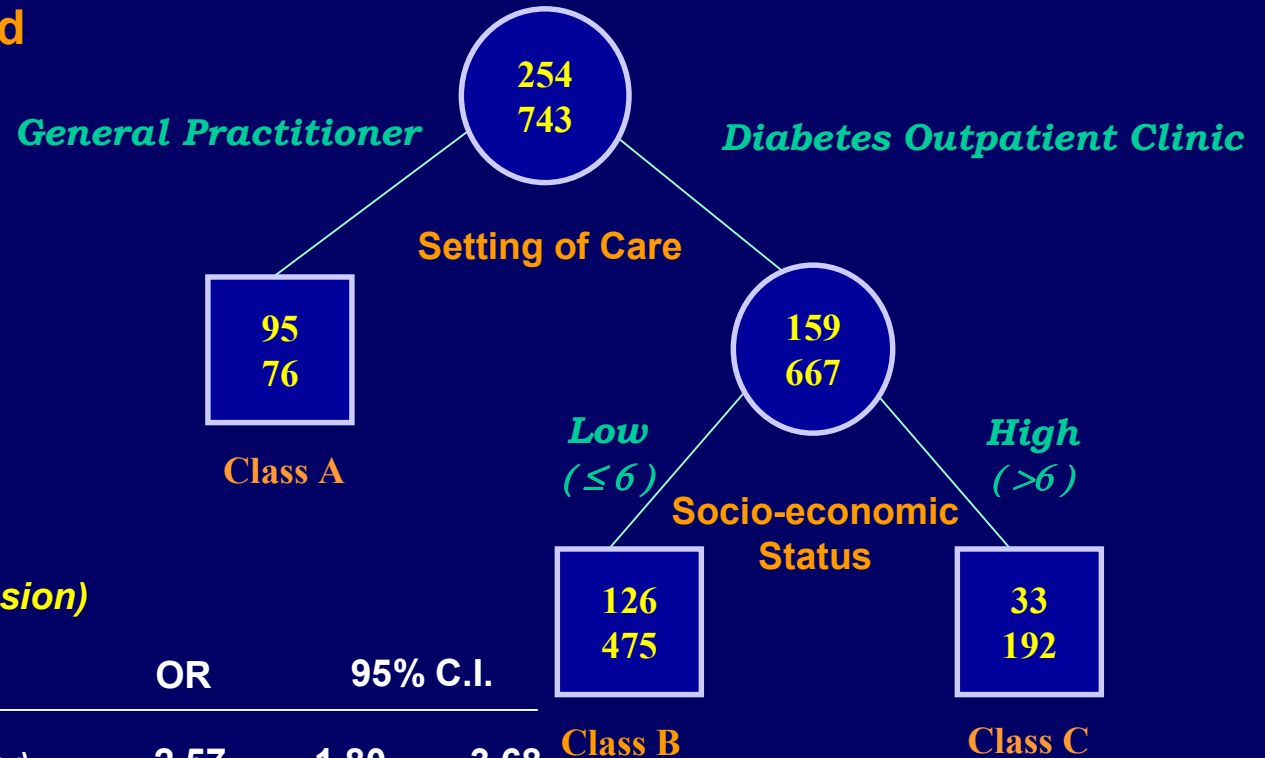**RECPAM Class I**

N cases N controls

RECPAM class II

Final Model ← *Backward Elimination*

Quality-based stratification tree + statistical model

Type 2 Insulin-Treated Diabetes Mellitus (N=997)

General Practitioner   *Diabetes Outpatient Clinic*

254
743

Setting of Care

95
76

Class A

159
667

Low (≤6)   *High (>6)*

Socio-economic Status

126
475

33
192

Class B   **Class C**

Final Model (Logistic Regression)

Variable	OR	95% C.I.	
Not regular visits (R.C.= regular)	2.57	1.80	3.68
Age	1.01	0.99	1.02
Diabetes Duration	0.99	0.97	1.01
Cardiovascular Risk (R.C. = no)	1.49	1.02	2.17
Class A (R.C.= Class C)	5.05	3.05	8.36
Class B (R.C. = Class C)	1.59	1.04	2.45

Disease Management Systems Analysis

Variable	TYPE 1 (N=376) OR	95% C.I.		Bootstrap % OR	95% C.I.		TYPE 2/IT (N=997) OR	95% C.I.		Bootstrap % OR	95% C.I.		TYPE 2/NIT (N=1371) OR	95% C.I.		Bootstrap % OR	95% C.I.	
Regular attend. visits (R.C.=Y)	2.75	1.08	7.01	2.80	1.06	7.30	2.57	1.80	3.68	2.58	1.78	3.73	1.69	1.25	2.29	1.69	1.24	2.29
Age	1.07	1.03	1.10	1.07	1.03	1.11	1.01	0.99	1.02	1.01	0.99	1.02	1.03	1.02	1.05	1.03	1.02	1.05
Diabetes Duration	0.96	0.92	1.00	0.95	0.90	1.00	0.99	0.97	1.01	0.99	0.97	1.00	0.99	0.97	1.01	0.99	0.97	1.01
Previous Cardiov. Dis, (R.C.= N)	-	-	-	-	-	-	1.49	1.02	2.17	1.49	1.01	2.14	-	-	-	-	-	-
Gender (R.C.= female)	-	-	-	-	-	-	-	-	-	-	-	-	1.39	1.08	1.79	1.39	1.07	1.81
Class A	14.81	4.20	52.28	16.58	4.45	79.84	5.05	3.05	8.36	5.14	3.08	8.76	5.49	3.33	9.05	5.60	3.41	9.64
Class B	3.95	1.37	11.43	4.20	1.33	15.41	1.59	1.04	2.45	1.60	1.06	2.53	1.89	1.19	3.01	1.92	1.23	3.21
Class C	1.00	-	-	-	-	-	1.59	1.00	-	-	-	-	1.00	-	-	-	-	-
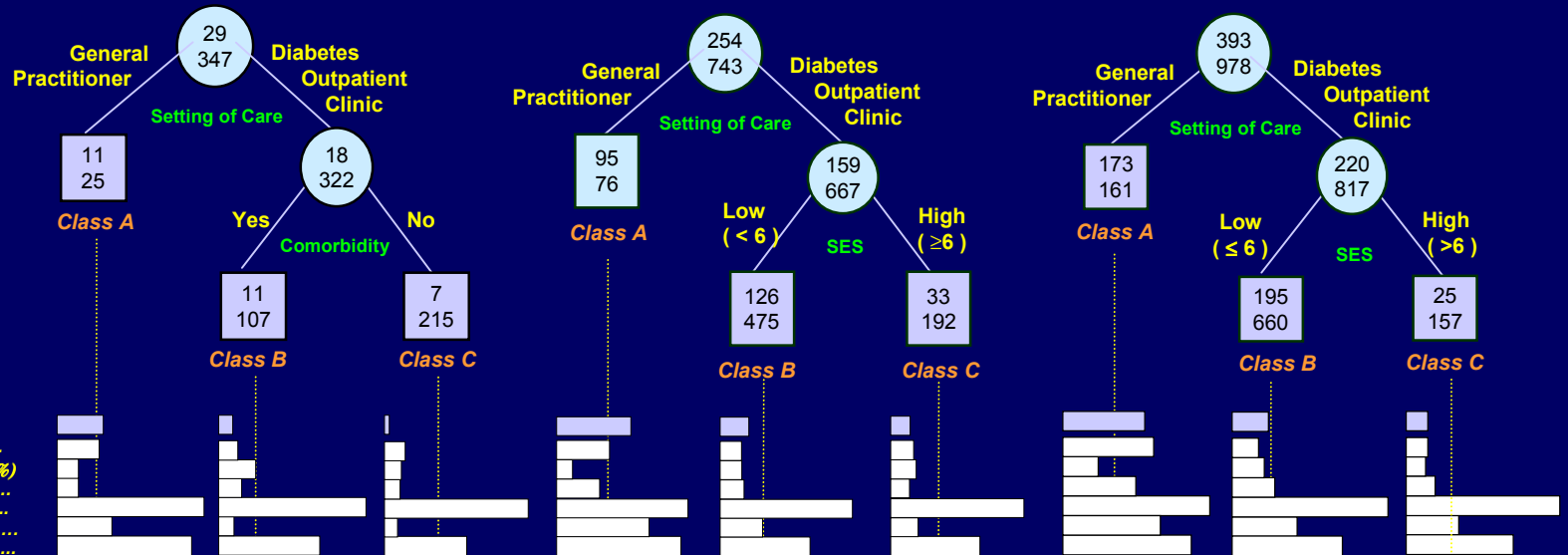
Evidence-based practice

? Questions

exploratory/validation studies

New (existing) **Databases**

POPULATION (DIABETICS)

Modelling tool (RECPAM)

254 / 743

General Practitioner — *Setting of Care* — *Diabetes Outpatient Clinic*

95 / 76 — **Class A**

159 / 667

Low (<6) — *SES* — *High (>6)*

126 / 475 — **Class B**

33 / 192 — **Class C**

29 / 347

General Practitioner — *Setting of Care* — *Diabetes Outpatient Clinics*

11 / 25 — **Class A**

18 / 322

Yes — *Comorbidity* — *No*

11 / 107 — **Class B**

7 / 215 — **Class C**

393 / 978

General Practitioner — *Setting of Care* — *Diabetes Outpatient Clinic*

173 / 161 — **Class A**

220 / 817

Low (≤6) — *SES* — *High (>6)*

195 / 660 — **Class B**

25 / 157 — **Class C**

Classification

Type 1
Class I .....
Class II ....
Type 2
Class I .....
Class II ....

Population/Administrative Data
Clinical Practice ??

△ **Clinical guidelines**