Measuring performance and quality indicators of CRC screening

Ondřej MÁJEK

Institute of Biostatistics and Analyses, Masaryk University

screening kolorektálního karcinomu

Institute of Biostatistics and Analyses, Masaryk University, Brno

Performance indicators of screening programmes

screening kolorektálního karcinomu

Cancer screening is efficacious

„Evidence exists concerning the efficacy of screening for breast cancer and colorectal cancer, derived from randomised trials, and for cervical cancer, derived from observational studies.“ (Council Recommendation)

Colorectal cancer screening with FOBT

Mandel *et al* (1993) – United States
- decrease in mortality by 33 %

Hardcastle *et al* (1996) – United Kingdom
- decrease in mortality by 15 %

Kronborg *et al* (2004) – Denmark
- decrease in mortality by 11 %,
  by **43% in persons participating in all 9 rounds**

Mandel *et al* (2000) – United States
- decrease in incidence by 20 %

Colorectal cancer screening with colonoscopy

Winawer *et al* (1993) – United States
- decrease in incidence by 76-90 %

Kahi *et al* (2009) – United States
- decrease in incidence by 67 %, decrease in mortality by 65 %

Brenner *et al* (2010) – Germany
- decrease in advanced neoplasia rate by 48 %

Cancer screening is efficacious, but …

„Evidence exists concerning the efficacy of screening for breast cancer and colorectal cancer, derived from randomised trials, and for cervical cancer, derived from observational studies.“ (Council Recommendation)

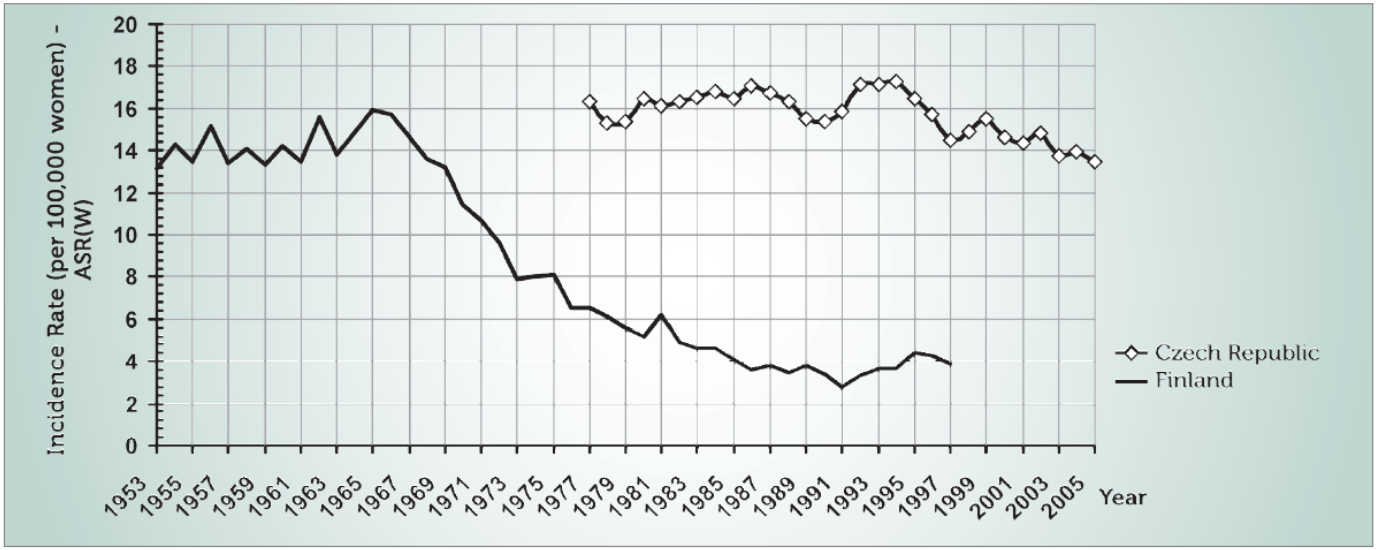


Figure 7.41 Age standardised incidence rate – comparison of time trends between Finland and the Czech Republic (source of data: Cancer Incidence in Five Continents (Parkin, Whelan, Ferlay, & Storm, 2005), CNCR).

Efficacy of a screening effort in studies does not guarantee effectiveness in different settings

Organised cancer screening programmes

- **Screening for cancer of breast, colorectum and uterine cervix is effective in decreasing mortality of the disease**
- **These programmes are recommended to all member states by the Council of the European Union (2003/878/EC)**
- **To guarantee their effectiveness, safety and cost-effectiveness, it is highly recommended to implement the prevention as organized programmes comprising:**
  - **an explicit policy, with specified age categories, method and interval of screening**
  - **defined target population**
  - **a management team responsible for the implementation**
  - **a health care team for decisions and care**
  - **a quality assurance structure (performance monitoring including collection of all relevant data)**
  - **a method for identifying cancer occurrence in the target population**

IARC Handbooks of Cancer Prevention

Sources of data for colorectal cancer screening information support

Monitoring of Cancer Burden

- epidemiology of cancer in target population
- evaluation of screening programmes impact

Source of data: CZECH NATIONAL CANCER REGISTRY
13 regional data collection points / 57 district points
annual no. of records: 8,236 colorectal cancer cases in 2008

Performance Monitoring of Health Care Facilites

- performance indicators at screening centres
- detection of cancer and precancerous lesions

Source of data: RECOMMENDED HEALTH CARE FACILITIES
160 centres (summer 2011)
annual no. of records: 22,227 preventive colonoscopies in 2010

Monitoring using Administrative Data

- population-based performance indicators
- monitoring of programmes accessibility by target population
- assessment of programmes cost-effectiveness

Source of data: HEALTH INSURANCE COMPANIES – NATIONAL REFERENCE CENTRE
8 health insurance companies / 4,400 general practitioner offices, 1,200 gynaecologist offices
annual no. of records: 521,000 FOBTs performed in 2010

Information Support Provider
MASARYK UNIVERSITY, INSTITUTE OF BIOSTATISTICS AND ANALYSES

Peformance indicators in screening programmes

- EARLY PERFORMANCE INDICATORS
  - relating to target population
    - coverage by examination, ...
  - relating to screening centres
    - detection rates, complication rates, ...
- LONG-TERM IMPACT INDICATORS
  - relating to screening outcomes
    - mortality, incidence rates

→ PAYERS – NATIONAL REFERENCE CENTRE

→ SCREENING REGISTRY

→ CZECH NATIONAL CANCER REGISTRY

→ definite indicator of success

- decrease in mortality is inevitably long-term and difficult to measure

→ MONITORING OF SCREENING PROGRAMMES REQUIRE EARLY PERFORMANCE INDICATORS

Czech Cancer Screening Registries

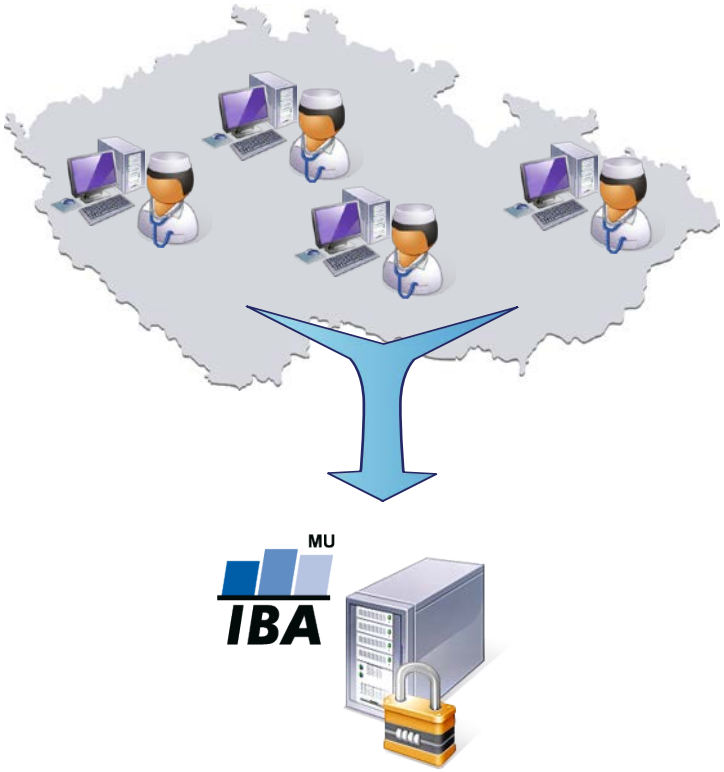
- recommended by EU Council to
  „collect, manage and evaluate data on all screening tests, assessment and final diagnoses“
- screening programmes are equipped with specific registries
  - Breast Cancer Screening Registry
  - Colorectal Cancer Screening Registry
  - Cervical Cancer Screening Registry
- datasets include information on final diagnoses (including precancerous lesions)

→ **IRREPLACEABLE SOURCE OF DATA**

- registries enable computation of basic performance indicators, as internationally recommended

Colorectal Cancer Screening Registry

- **web-based application and database for collection, validation and reporting of data related to preventive colonoscopies**



Subject's Demography Characteristics	
Sex	Male/Female
Date of birth	Date
Place of residence - district	List
Insurance company	List
FOBT Test	
Type	FIT/gFOBT
Date	Date
Health centre	Text
Colonoscopy	
Indication	Screening/FOBT follow-up
Date	Date
Type	Total/Partial
Number of polyps found	Number
Number of polyps removed	Number
Complication	Perforation, Bleeding
Result	Normal, **Adenoma**, **Carcinoma**, Hyperplastic polyp, Inflammatory polyp, Mixed polyp, Other polyp, Other abnormality

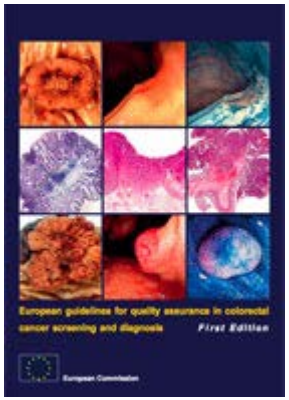
Removed adenoma		Detected carcinoma	
Size	Under 10 mm/over 10 mm	**Clinical TNM**	List
Histopathology	Tubular/Villous/Tubulovillous/Serrated	**pTNM staging**	List
Dysplasia	Mild/Moderate/Severe	**ICD-O code**	Number
Site	Rectum/Sigmoid/Descending/ Transverse/Ascending colon/Caecum	**Site**	Rectum/Sigmoid/Descending/ Transverse/Ascending colon/Caecum

Performance indicators of screening programmes according to European Guidelines

screening kolorektálního karcinomu

Early performance indicators

- **Programme coverage and uptake**
  - **Coverage by invitation**
    Recommendation: 95%
    programme is not population-based – no invitation
  - **Coverage by examination**
    NÁRODNÍ REFERENČNÍ CENTRUM
  - **Uptake (participation) rate**
    Recommendation : 45% / 65%
    programme is not population-based – no invitation



Source: European Guidelines

Early performance indicators

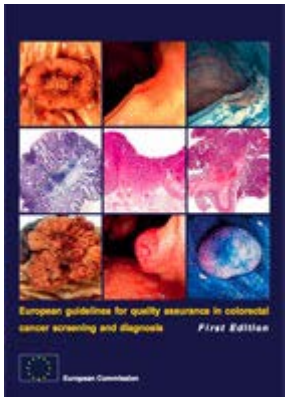
- **Outcomes with FOBT for primary screening**
  - **Inadequate FOBT rate** *data not collected*
  - **Positive FOBT rate**
  - **Referral to follow-up colonoscopy after FOBT**
  - **Follow-up colonoscopy compliance rate** *no individual linkage between FOBT and colonoscopy*
  - **Completion of follow-up colonoscopy after FOBT**
    Recommendation : 90% / 95%
  - **Detection rates of FOBT screening programme** *no individual linkage between FOBT and colonoscopy*
  - **Stage of screen-detected cancers**
    Recommendation : favourable compared to clinically diagnosed
  - **Positive predictive values for FOBT screening programmes**
  - **Endoscopic complications in FOBT screening programme**
    Recommendation : monitor the rate carefully

Source: European Guidelines

Early performance indicators

- **Outcomes with colonoscopy (CS) as primary screening test**
  - **Inadequate CS rates** *data not collected*
  - **Complete CS rate**
  - **Positive CS rate**
  - **Detection rates of CS screening programmes**
  - **Referral to follow-up colonoscopy after CS** *data not collected*
  - **Follow-up colonoscopy compliance rate after screening CS**
  - **Completion of follow-up colonoscopy after CS**
  - **Endoscopic complications of CS screening programmes**

    Recommendation : monitor the rate carefully



Source: European Guidelines

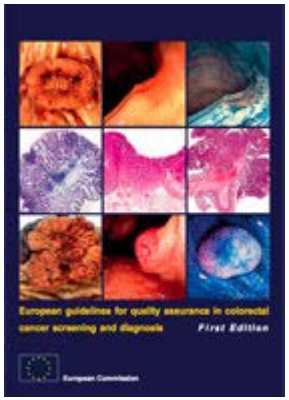
Early performance indicators

- **Screening organisation**

  data not collected

  - **Time interval between completion of test and receipt of results**
  - **Time interval beteen positive test and follow-up colonoscopy**
    Recommendation : 90% / 95% within 31 days
  - **Time interval between positive endoscopy and start of definitive management**
  - **Time interval between consecutive primary screening tests**

    not yet available through NRC

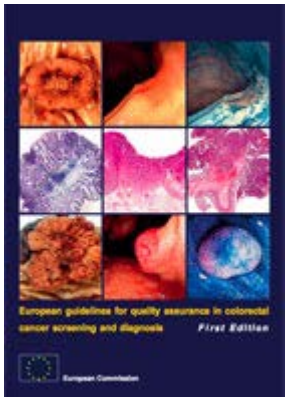


Source: European Guidelines

Long-term impact indicators

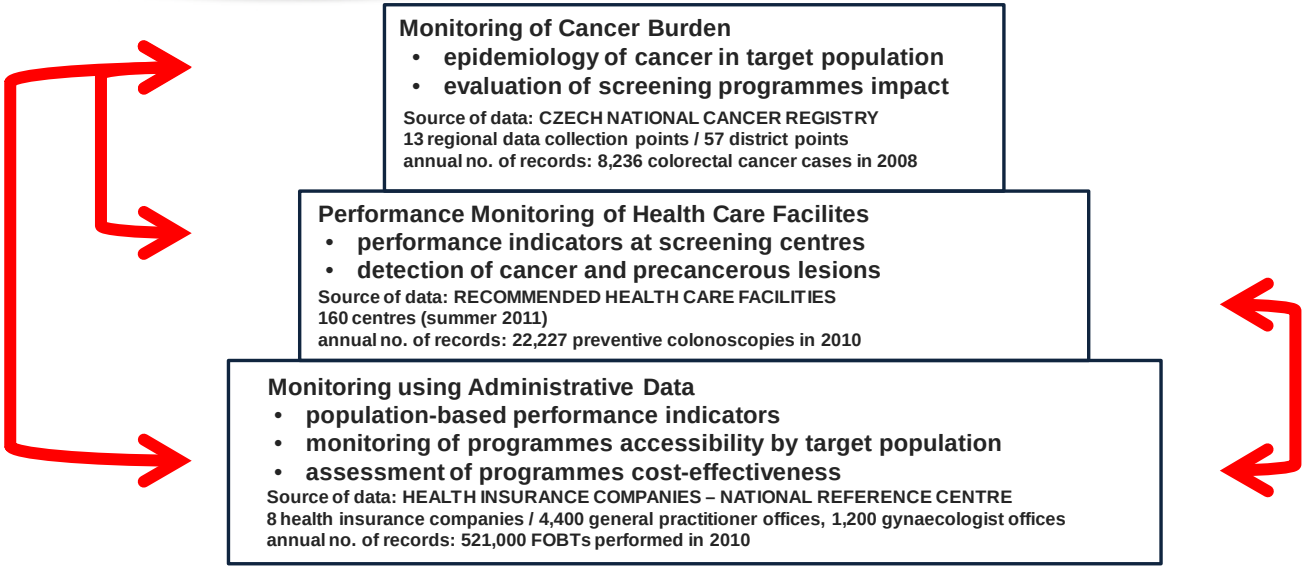
- **Interval cancers** *no individual linkage between test and cancer*
- **CRC incidence rates**
- **Rates of advanced-stage disease**
- **CRC mortality rates**
  - **Population trends**
  - **Cohort studies**
  - **Case-control studies**

no individual linkage between test and cancer



Source: European Guidelines

Summary: fulfilling the guidelines on evaluation



- separate sources of data are available for performance monitoring
  - administrative data – FOBTs
  - screening registry data – screening and follow-up colonoscopies
  - cancer registry data – colorectal cancer cases
- it is not yet possible to perform individual linkage, precluding
  - estimation of detection rates of FOBT screening
  - estimation of interval cancer rates (programme sensitivity)
  - estimation of programme effectiveness based on individual records

Profiling providers of colorectal cancer screening

screening kolorektálního karcinomu

Objectives

- to identify providers of preventive colonoscopy examinations, whose performance shows deviation from recommended benchmark

- problems
  - small caseloads
  - case-mix adjustments
  - regression-to-the mean bias

- proposed solution
  - hierarchical Bayesian model
  - computation of the probability that a provider has performed acceptably

Improving the statistical approach to health care provider profiling - Christiansen et al, 1997

Methods

- **presented example**
  - **estimated proportion of patients at follow-up colonoscopy detected with adenoma (PPV of FOBT for adenoma) in 2010**
  - **adjustment for age and sex**
  - **logistic regression, fitted with WinBugs**

$$\text{logit}\,\pi(X_{ij}, b_i) = \beta_0 + x_{ij,1}\beta_1 + \ldots + x_{ij,p}\beta_p + b_i$$

$$b_i \sim N(0, \sigma)$$

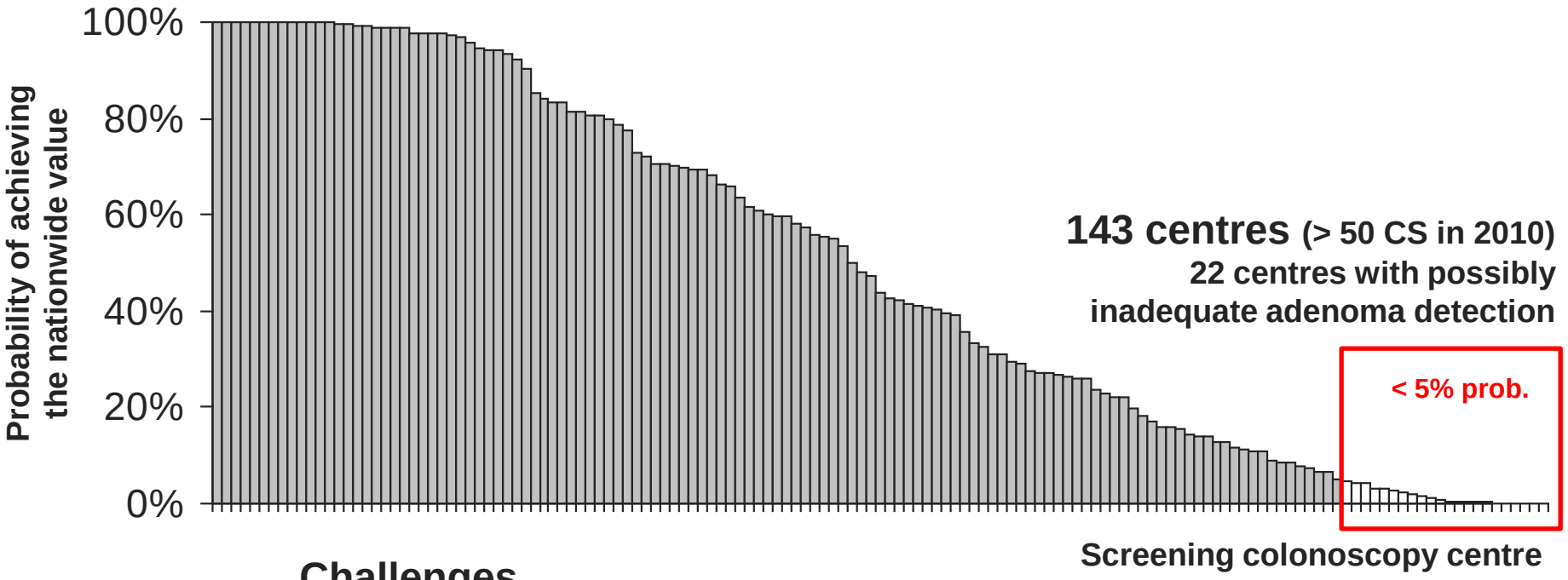
X_{ij} = ($x_{ij,1}$,...,$x_{ij,p}$) contains p patient-specific predictors values in j^{th} patient at i^{th} centre (j = 1,...,n_i)

b_i shows centre-specific effect (random effect)

$\pi(X_{ij},b_i)$ is a probability of detecting adenoma in j^{th} patient at i^{th} centre

Profiling of colonoscopy providers: Proportion of patients at follow-up colonoscopy detected with adenoma

Estimated indicator → Probability distribution → Probability achieving benchmark



Challenges

- easy-to-use reporting
- assuring adequacy of used models
- setting acceptable benchmarks

Overcoming barriers in availability of data

screening kolorektálního karcinomu

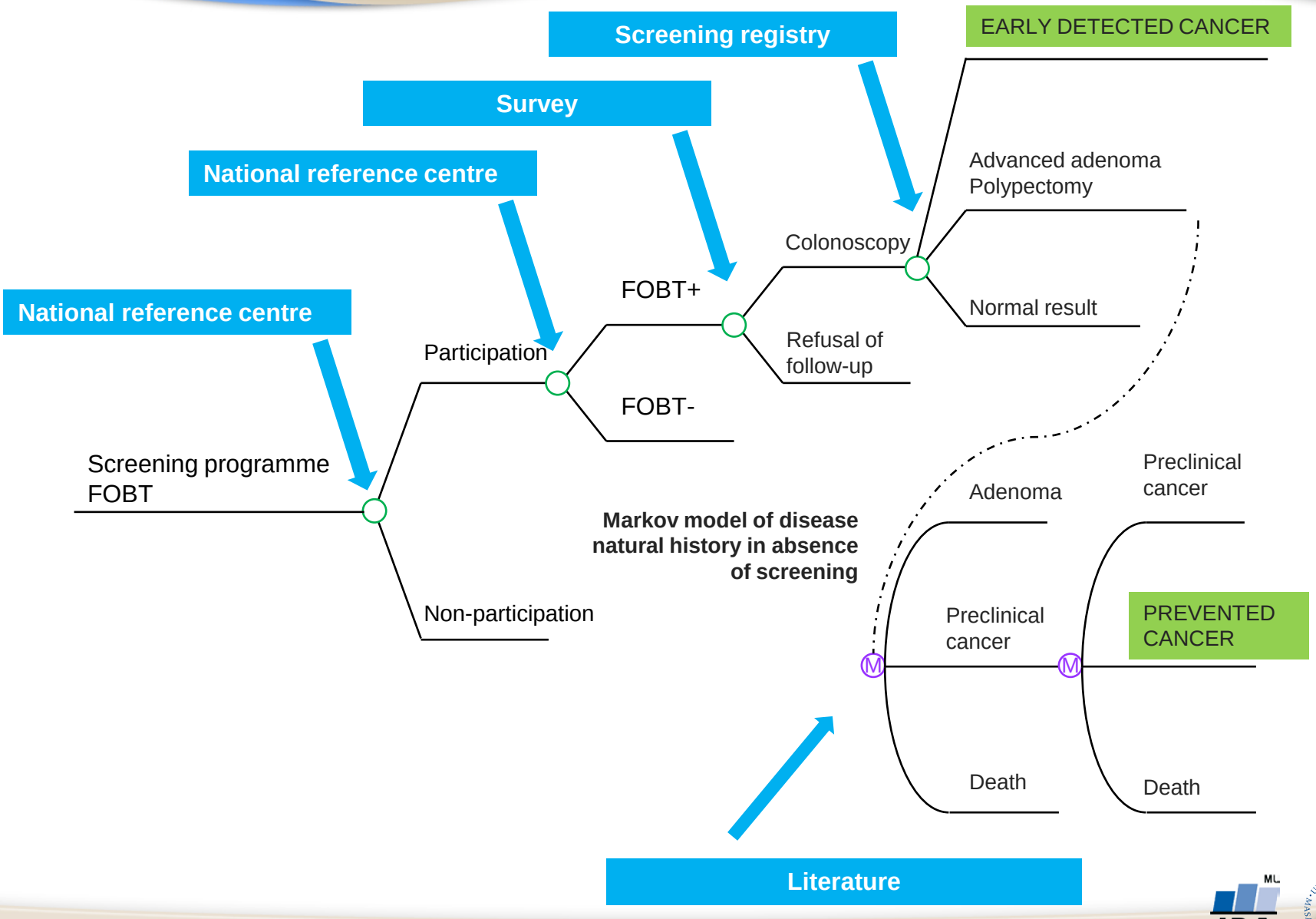
IBA

UNIVERSITAS MASARYKIANA BRUNENSIS

Objective

- availability of independent sources of data precludes direct estimation of colorectal cancer screening outcomes (completeness of registry is < 100%)
- modelling using parameters estimated from different sources of data can help us to determine outcomes of the FOBT screening programme

Estimating outcomes of CRC screening
Methods



Estimating outcomes of CRC screening
Results

YEAR	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Colorectal cancer burden (source of data: Czech National Cancer Registry)										
Number of new disease cases	7,479	7,700	8,110	7,905	8,025	8,008	7,771	7,809	8,140	8,093
Number of deaths	4,454	4,476	4,574	4,424	4,280	4,292	4,335	4,203	4,270	4,115
Coverage by the screening programme (source of data: NRC)										
Number of FOBTs	12,555	167,783	187,644	207,854	228,062	248,272	268,133	315,026	345,866	404,298
Coverage by screening	**0.4%**	**5.4%**	**10.5%**	**11.5%**	**12.4%**	**13.4%**	**14.3%**	**15.9%**	**17.9%**	**18.6%**
Modelled performance of the screening programme (source of data: NRC, IBA MU)										
Number of follow-up colonoscopies	405	5,377	6,028	6,676	7,326	7,974	8,626	9,359	12,892	18,211
Removed advanced adenomas	52	676	763	845	928	1,009	1,097	1,163	1,943	2,858
aADR (per 1000 FOBTs)	**4.1**	**4.0**	**4.1**	**4.1**	**4.1**	**4.1**	**4.1**	**3.7**	**5.6**	**7.1**
Early detected CRCs	**27**	**337**	**384**	**424**	**467**	**508**	**552**	**576**	**795**	**974**
CRC detection rate (per 1000 FOBTs)	**2.2**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**	**2.1**	**1.8**	**2.3**	**2.4**
Prevented CRCs	**0**	**1**	**6**	**13**	**24**	**38**	**54**	**71**	**92**	**118**

5,044 early detected cancers, 417 prevented cancers

Getting one step further
Utilising nationwide administrative data

Association of Colonoscopy and Death From Colorectal Cancer: A Population-Based, Case–Control Study

Nancy N. Baxter, MD, PhD; Meredith A. Goldwasser, ScD; Lawrence F. Paszat, MD, MS; Refik Saskin, MSc; David R. Urbach, MD, MSc; and Linda Rabeneck, MD, MPH

Background: Colonoscopy is advocated for screening and prevention of colorectal cancer (CRC), but randomized trials supporting the benefit of this practice are not available.

Objective: To evaluate the association between colonoscopy and CRC deaths.

Design: Population-based, case–control study.

Setting: Ontario, Canada.

Patients: Persons age 52 to 90 years who received a CRC diagnosis from January 1996 to December 2001 and died of CRC by December 2003. Five controls matched by age, sex, geographic location, and socioeconomic status were randomly selected for each case patient.

Measurements: Administrative claims data were used to detect exposure to any colonoscopy and complete colonoscopy (to the cecum) from January 1992 to an index date 6 months before diagnosis in each case patient and the same assigned date in matched controls. Exposures in case patients and controls were

Results: 10 292 case patients and 51 460 controls were identified; 719 case patients (7.0%) and 5031 controls (9.8%) had undergone colonoscopy. Compared with controls, case patients were less likely to have undergone any attempted colonoscopy (adjusted conditional odds ratio [OR], 0.69 [95% CI, 0.63 to 0.74; $P < 0.001$]) or complete colonoscopy (adjusted conditional OR, 0.63 [CI, 0.57 to 0.69; $P < 0.001$]). Complete colonoscopy was strongly associated with fewer deaths from left-sided CRC (adjusted conditional OR, 0.33 [CI, 0.28 to 0.39]) but not from right-sided CRC (adjusted conditional OR, 0.99 [CI, 0.86 to 1.14]).

Limitation: Screening could not be differentiated from diagnostic procedures.

Conclusion: In usual practice, colonoscopy is associated with fewer deaths from CRC. This association is primarily limited to deaths from cancer developing in the left side of the colon.

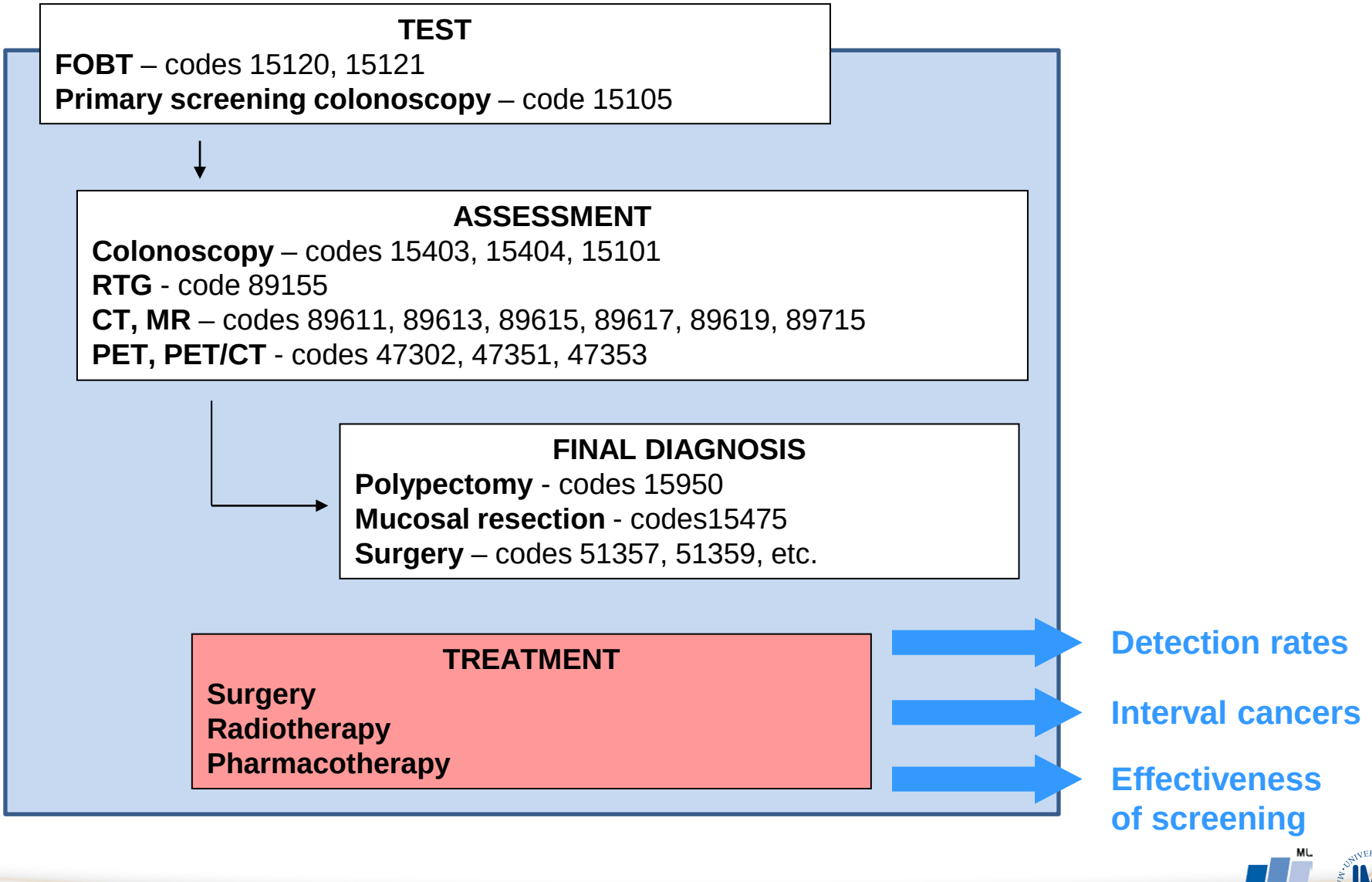
Funding: Canadian Institutes of Health Research and American Society of Clinical Oncology.

Analysis of Administrative Data Finds Endoscopist Quality Measures Associated With Postcolonoscopy Colorectal Cancer

NANCY N. BAXTER,[*,‡,§] RINKU SUTRADHAR,[‡,‖] SHAWN S. FORBES,[‡] LAWRENCE F. PASZAT,[‡,§,‖] REFIK SASKIN,[‡] and LINDA RABENECK[‡,§,‖,¶,#]

[*]Department of Surgery and Keenan Research Centre, Li Ka Shing Knowledge Institute, St Michael's Hospital, University of Toronto; [‡]Institute for Clinical Evaluative Sciences; [§]Department of Health Policy, Management, and Evaluation, [‖]Dalla Lana School of Public Health, and [#]Department of Medicine, University of Toronto; and [¶]Odette Cancer Centre, Sunnybrook Health Sciences Centre, Toronto, Ontario, Canada

Utilising nationwide administrative data



SUMMARY

screening
kolorektálního
karcinomu

IBA

MU

UNIVERSITAS MASARYKIANA BRUNENSIS

Conclusions

- The Czech Republic established organized screening programmes for cancer of breast, colon and rectum, and uterine cervix
- Apart from collection of clinical data from screening centres, the system for information support utilises available data on cancer epidemiology and claims data collected by health care payers
- It is not yet possible to monitor part of recommended indicators due to non-existence of individual linkage between different sources of data

- It is possible to use available data for performance monitoring of screening centres
- Parameters estimated from different sources of data can be used together using mathematical modelling to obtain information on programme quality and effectiveness
- Extensive use of administrative data can lead to more comprehensive system for evaluation of performance and impact indicators

ACKNOWLEDGEMENT

Development of methodology for monitoring of colorectal cancer screening programme is part of project: „Mathematical and statistical models in evaluation of cancer screening programmes“ (MUNI/A/0828/2011) Masaryk University / Student Project Grant at MU (specific research, rector's programme)

ACKNOWLEDGEMENT

- **Screening colonoscopy centres, for participation at data collection**

screening kolorektálního karcinomu

- **Providers of administrative and cancer registry data**

ÚZIS ČR

KSRZIS

NÁRODNÍ REFERENČNÍ CENTRUM