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The Whole is Greater than the Sum of the Parts: Using Data Linkage and Cohort Designs to Create Synergy at MCHP

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Background

- ✧ Linked databases provide the opportunity to create “new” data from existing sources
- ✧ MCHP is uniquely positioned to address novel research questions with linked databases because of the
 - large (and growing) number of databases in the Research Data Repository, and
 - availability of multiple years of data

Presentation Outline

- ✧ Linkage of Administrative Databases to Other Databases
 - Canadian Community Health Survey (CCHS)
 - Manitoba Bone Density Program

- ✧ Longitudinal Linkage of Administrative Databases
 - Multiple years of registry data

Example #1: Linkage to Canadian Community Health Survey (Lix et al., 2006, 2008, 2010)

- ✧ Validate and compare case definitions in administrative data for chronic diseases
- ✧ Investigate variables associated with agreement between the two data sources
- ✧ **Who uses this research?** Public Health Agency of Canada, provincial health ministries, researchers who use cohort studies

Methods: Linking Administrative and CCHS Data

Manitoba CCHS Sample, Cycle 3.1
N = 7,004

CCHS Sample Linked
to Administrative Data
N = 6,232 (89.0%)

CCHS Linked Sample with
5 Years Coverage
N = 5,800 (82.8%)

Adult Cohort (19+ years)
N = 5,099

Youth Cohort (12 – 18 years)
N = 701

Methods: CCHS Questions About Chronic Disease

Disease	Relevant CCHS Question(s)
Arthritis	Do you have arthritis or rheumatism, excluding fibromyalgia? What kind of arthritis do you have?
Asthma	Do you have asthma?
Diabetes	Do you have diabetes?
Hypertension	Do you have high blood pressure?
Irritable Bowel Syndrome	Do you suffer from a bowel disorder such as Crohn's Disease, ulcerative colitis, Irritable Bowel Syndrome or bowel incontinence? What kind of bowel disease do you have?

Validating Case Definitions for Arthritis using CCHS Data, Cycle 3.1, Manitoba

# Yrs Data	Algorithm	κ	Sensitivity (%)	Specificity (%)
1	1+ P	0.32	43.2	87.6
	2+ P	0.28	26.7	95.4
	1+ H or 2+ P	0.28	27.2	95.4
	1+ H or 2+ P or (1 P & 2+ Rx)	0.34	34.2	94.2
2	1+ P	0.33	58.8	79.0
	2+ P	0.35	41.6	90.4
	1+ H or 2+ P	0.35	41.8	90.4
	1+ H or 2+ P or (1 P & 2+ Rx)	0.38	48.6	88.0

Note: P = physician claims; H = hospital records; Rx = prescription drug records

Validating Case Definitions for Hypertension using CCHS Data, Cycle 3.1, Manitoba

# Yrs Data	Algorithm	κ	Sensitivity (%)	Specificity (%)
1	1+P	0.59	56.7	96.2
	1+H or 1+ P	0.60	57.8	96.2
	1+ H or 2+ P	0.50	42.5	98.5
	1+ H or 1+ P or 1+ Rx	0.70	78.5	92.4
	1+ H or 1+ P or 2+ Rx	0.70	77.5	93.1
2	1+P	0.63	68.6	93.0
	1+H or 1+ P	0.64	69.9	92.8
	1+ H or 2+ P	0.60	56.7	96.7
	1+ H or 1+ P or 1+ Rx	0.66	81.4	89.1
	1+ H or 1+ P or 2+ Rx	0.67	80.9	90.0

Note: P = physician claims; H = hospital records; Rx = prescription drug records

Case Definitions for Irritable Bowel Syndrome (IBS)

- ✧ Until recently, survey data have been the primary source for population-based estimates of IBS
- ✧ Increasing, attention has turned to the potential for ascertaining IBS cases from administrative data
- ✧ However, no gold standard exists for the diagnosis of IBS
 - Symptom-based criteria (Rome criteria)
 - Rule out other chronic conditions (e.g., Crohn's disease)
- ✧ The pattern of diagnoses in administrative data are most useful for identifying probable disease cases

Characteristics of CCHS Survey Respondents, Manitoba, Cycle 3.1

	IBS (<i>N</i> = 152)	Crohn's Disease/Ulcerative Colitis (<i>N</i> = 41)	No Bowel Disorder (<i>N</i> = 4892)
	%	%	%
Male	14.4	36.5	46.2
Female	85.6	63.5	53.8
< 45 years	44.7	43.9	39.2
45 – 64 years	41.5	34.1	34.6
65+ years	13.8	22.0	26.2

IBS: Estimates of agreement (κ) for administrative and CCHS data using IBS diagnosis code

Condition	3 Years Before CCHS Interview Date	1 Year After CCHS Interview Date
Self-Reported IBS	0.22 (0.22, 0.23)	0.11 (0.11, 0.12)
Self-Reported Crohn's Disease or Ulcerative Colitis	0.65 (0.64, 0.66)	0.48 (0.46, 0.49)

IBS: Selected Diagnoses in Administrative Data for CCHS Respondents (up to 3 years prior to interview)

	IBS (<i>N</i> = 152)	CD/UC (<i>N</i> = 41)	No Bowel Disorder (<i>N</i> = 4892)
Diagnoses in physician claims	%	%	%
ICD-9-CM 564 (Functional digestive disorders, not elsewhere classified)	25.9	15.3	2.5
ICD-9-CM 555, 556 (IBD)	22.5	70.3	4.7
ICD-9-CM 562 (Diverticula of intestine)	10.6	3.6	1.0

Strengths and Limitations of Using Linked Administrative and CCHS Data to Study Chronic Diseases

Strengths	Limitations
<ul style="list-style-type: none">• Multiple chronic diseases are captured in the CCHS• Predictors of agreement between administrative and survey data can be investigated• Comparisons can be made for multiple waves of CCHS data	<ul style="list-style-type: none">• Limited/no information about diagnosis date in CCHS• Survey data may be subject to recall bias• CCHS excludes residents of First Nations communities• Researcher access to linked CCHS data may be limited in some jurisdictions

Example #2: Linkage to Bone Density Program Data (Leslie et al., in press)

- ✧ Validate osteoporosis case definitions in administrative data
- ✧ Develop and validate models of fracture risk prediction
- ✧ **Who uses this research?** Public Health Agency of Canada, provincial health ministries, clinicians

Background

- ✧ In Manitoba, bone mineral density (BMD) testing data are available from 1997 onward
- ✧ WHO's operational definition of osteoporosis is based on BMD
 - T-score/z-score: number of standard deviations (SDs) above or below a reference standard
 - Cut-off criterion: -2.5 SDs below the mean for young white females

Validating Osteoporosis Case Definitions using Manitoba BMD Data (2001/02 – 2002/03)

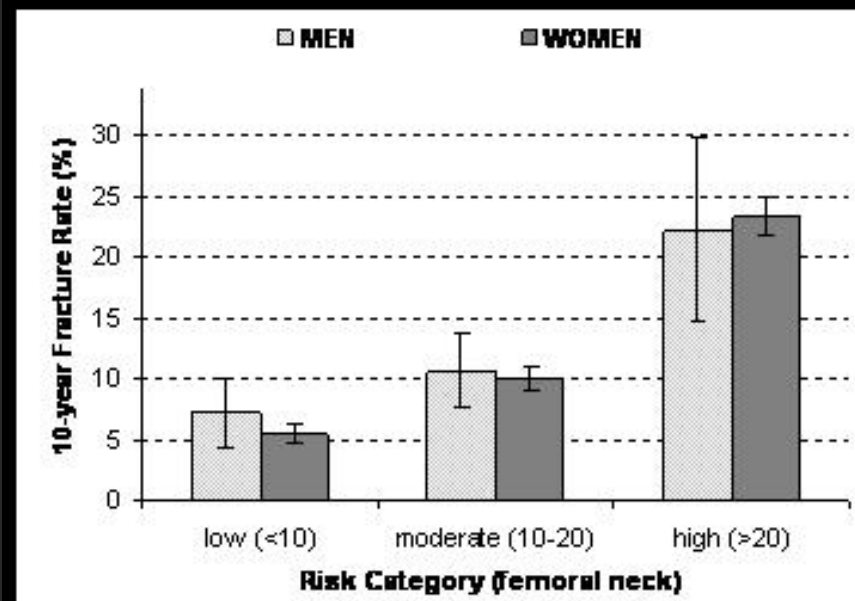
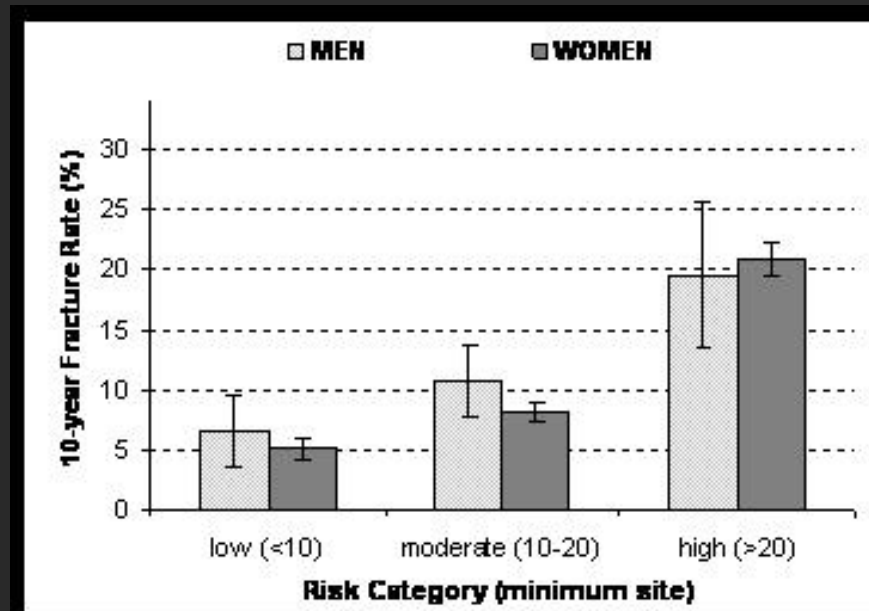
# Yrs data	Algorithm	Sensitivity (%)	Specificity (%)
1	1+Rx	78.5	70.7
	1+H or 1+P	69.4	69.0
	1+H or 2+P	34.1	91.4
	1+H or 1+P or 1+Rx	89.4	57.2
	1+H or 2+P or 2+Rx	77.7	72.0
2	1+Rx	82.2	67.6
	1+H or 1+P	74.0	64.9
	1+H or 2+P	43.9	86.0
	1+H or 1+P or 1+Rx	92.0	53.7
	1+H or 2+P or 2+Rx	83.4	67.4

Note: P = physician claims; H = hospital records; Rx = prescription drug records

Fracture Risk Prediction from BMD Test Data

	Women		Men	
	N	Fractures (%)	N	Fractures (%)
Risk category (based on BMD for hip)				
Low (<10%)	12,878	2.6	1255	3.3
Moderate (10-20%)	13,813	5.4	1187	6.0
High (>20%)	10,039	12.9	431	11.6
P-value (linear trend)		<.001		<.001
Risk category (based on minimum BMD at any site)				
Low (<10%)	98,66	2.3	1120	2.9
Moderate (10-20%)	12,960	4.6	1199	5.8
High (>20%)	13,904	11.1	554	10.8
P-value (linear trend)		<.001		<.001

Ten-Year Fracture Rate by Risk Category



Strengths and Limitations of Linking Administrative and BMD Data

Strengths	Limitations
<ul style="list-style-type: none">• Multiple clinical risk factors are now captured in BMD data (i.e., BMI, smoking status)• Many research questions about bone health and its impact on health care use and population health can be addressed	<ul style="list-style-type: none">• BMD testing uses targeted case finding rather than population screening; some populations may not be well covered (e.g., men)

Example #3: Longitudinal Linkage of Registry Data (Lix et al., 2006)

- ✧ To investigate residential mobility of population-based cohorts
- ✧ To investigate variables associated with residential mobility
- ✧ **Who uses this research?** Housing and health policy analysts

Background

- ✧ Residential mobility can result in discontinuities in health care use
 - Moorin et al. (2006) : Australia
 - Urban drift is evident among individuals with diagnosed mental illness
 - Yiannakoulias et al. (2007): Canada
 - Individuals diagnosed with MS and Parkinson's disease are more likely to move than matched controls
 - However, most residence changes occurred within a small area (i.e., municipality)

Defining Study Cohorts

- ✧ **Schizophrenia cohort:** ICD-9-CM 295
- ✧ **Matched cohort:** Matched on age, sex, region of residence (urban/rural)
 - no mental disorder diagnoses
- ✧ **Inflammatory Bowel Disease (IBD) cohort:** ICD-9-CM 555 or 556

Defining Mobility

- ✧ **Mover/non-mover:** any change in six-digit postal code
- ✧ **Rural-to-rural mover/non-mover:** change in postal code that corresponds to a move between rural regional health authorities (RHAs)
- ✧ **Rural-to-urban mover/non-mover:** change in postal code that corresponds to a move from a rural RHA to Winnipeg RHA
- ✧ **Suburban to inner core mover/non-mover:** change in postal code that corresponds to a move within Winnipeg from the suburbs to the inner core area

Frequency of Moving over a Three-Year Period by Study Cohort

	Schizophrenia Cohort (<i>N</i> = 3,384)	Matched Cohort (<i>N</i> = 16,920)	IBD Cohort (<i>N</i> = 1,267)
	%	%	%
At least one move	34.0	21.6	23.2
Rural-to-rural move	3.3	1.7	3.3
Rural-to-urban move	2.6	1.1	1.5

Odds Ratios (95% CIs) for Three Definitions of Mobility

	Any Move	Rural-to-Rural Move	Rural-to-Urban Move
Schizophrenia Cohort	2.0 (1.6, 2.6)	1.3 (0.9, 1.7)	1.3 (1.0, 1.9)
Matched Cohort	Ref	Ref	Ref

Strengths and Limitations of Linked Registry Data for Studies About Residential Mobility

Strengths	Limitations
<ul style="list-style-type: none">• Broad geographic coverage• Comparisons can be made for multiple cohorts• Changes over time can be studied• Many definitions of mobility can be investigated: direction, degree (i.e., frequency)	<ul style="list-style-type: none">• Potential for measurement error in diagnoses and postal code• Validation studies are needed for address information contained in population registries• No information on reason for move

Final Thoughts

- ✧ Data linkage projects have multiple benefits
 - Monitoring health outcomes
 - Planning for delivery of services
 - Investigating populations defined by geographic, socioeconomic status, and time
- ✧ Database linkage also raises privacy concerns
 - Researchers who access linked databases must attend to these concerns through responsible data stewardship practices