A Latent Variable Investigation of Emergency Room Use

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OUTLINE

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1. Introduction

- Many studies have focused on a unidimensional characterization of ER users.
  - E.g., frequent vs. infrequent ER users
- Insight into ER use may be limited by a focus on single traits.
- This study hypothesized that further insight can be achieved by using a set of characteristics to define groups of users and adopting a methodology that does not rely on *a priori* classification.

1. Introduction cont'd

- In health services research, recent research has focused on methods for exploring subpopulations
- Latent class analysis (LCA): multivariate technique analogous to factor analysis, but for categorical variables.
  - Lafortune et al. (2009): investigated service utilization of an elderly population; LCA revealed substantial differences in user groups – impacted costs of care.

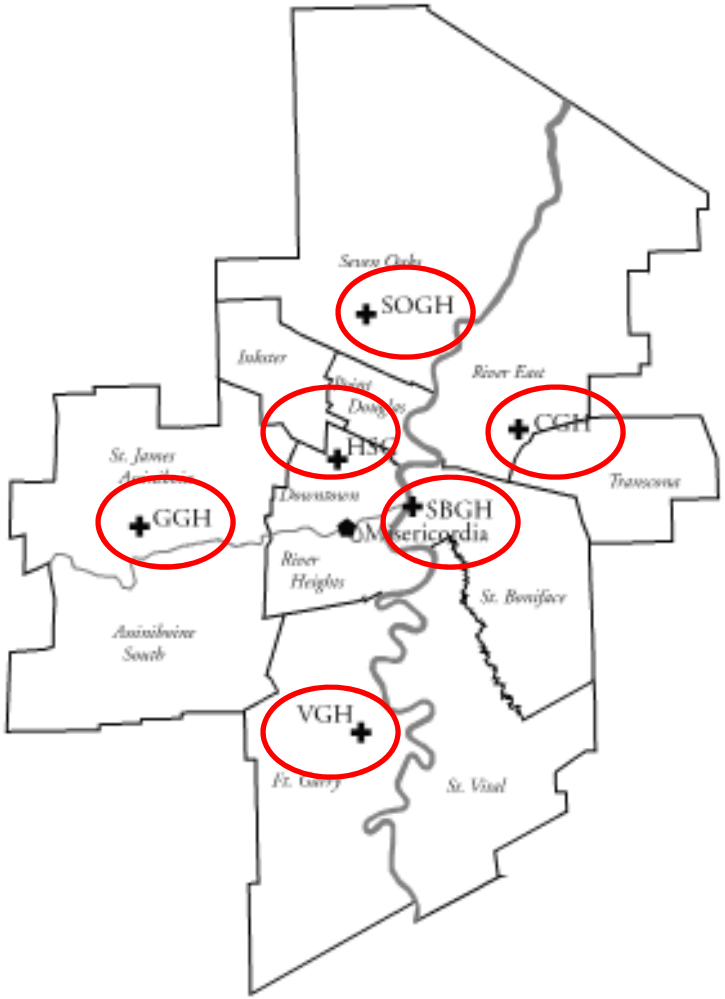
1. Introduction cont'd

- Purpose: to characterise urban ER users focussing on multiple characteristics and using population-based administrative data
  - Objective 1: To use the Andersen-Newman framework of healthcare utilization to select variables for characterizing different types of ER users
  - Objective 2: To use LCA to develop typologies of ER users

2. Methods – Design and Cohort Selection

- Retrospective cohort design
- Study sample: All adult users (18+ years) of Winnipeg Regional Health Authority (WRHA) ERs in FY 2003/04 to 2004/05
  - Stratified into younger (< 65 years) and older (65+ years) cohorts
  - Will focus on the results for the younger cohort in this presentation
- Validation sample: ER users from FY 2001/02 to 2002/03

2. Methods – Location of Winnipeg ERs



Source: Manitoba Centre for Health Policy, 2008

2. Methods cont'd

- The analysis could not be conducted on line-level (i.e., individual) data using the personal computer containing the LCA software.
- Data had to be aggregated, with cell sizes >5
- This resulted in some censoring of observations in the study sample (i.e., analytical sample)

2. Methods cont'd

- Characteristics of ER users defined from the Andersen-Newman framework of healthcare utilization:
  - Predisposing Characteristics: are present prior to an individual's illness, and predispose an individual to use health services
  - Enabling Characteristics: permit (or block) access to the health care system, given an individual's predisposition for use
  - Need Characteristics: the amount of illness or disability present in an individual

2. Methods cont'd

Characteristic	Measure
Predisposing	○ Age group ○ Sex
Enabling	○ Area of residence ○ Income quintile
Need	○ Arthritis ○ Diabetes ○ Any mental health ○ Comorbidities ○ ER visits ○ Physician visits ○ Hospitalizations ○ Continuity of care

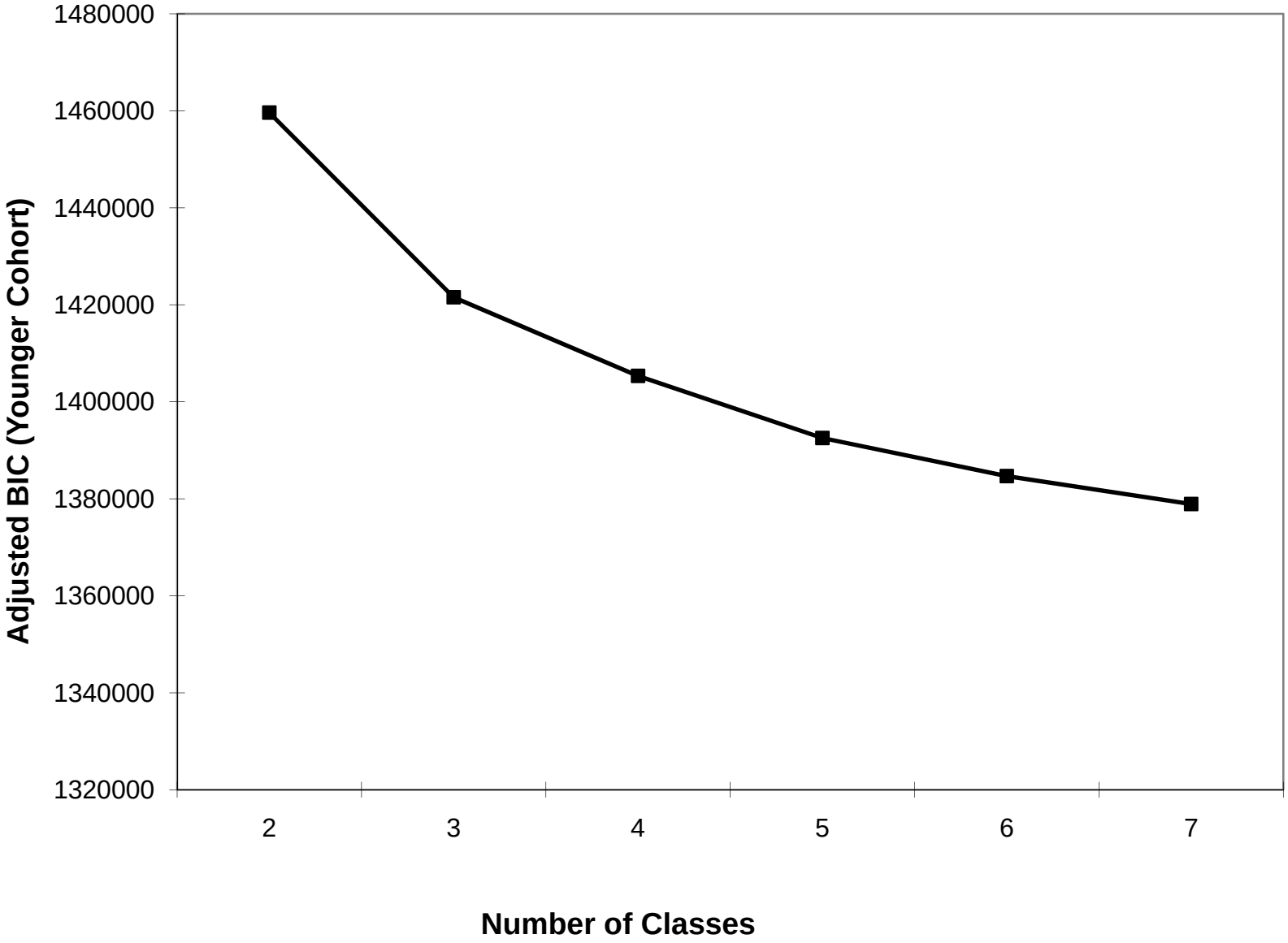
2. Methods cont'd

- LCA Model evaluation:
  - Bayesian-Schwarz Information Criterion (BIC)
  - Lo-Mendell-Rubin test
  - Focused on goodness of fit for 2 to 8 classes
- Method of estimation
  - Maximum likelihood
- Software: M-plus

3. Results

	Younger Cohort
Study Sample (N=143,584)	n=108,714 (76% of study sample) Age: 38.5 (38.0) years 50% female 60% suburbs 2+ ER visits:34%
Analytical Sample	n=92,511(86% of younger cohort) 51% female 63% suburbs 2+ ER visits:32%

3. Results


1480000
1460000
1440000
1420000
1400000
1380000
1360000
1340000
1320000
Adjusted BIC (Younger Cohort)
2
3
4
5
6
7
Number of Classes

3. Results (Younger Cohort)

Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7
11.1%	7.5%	15.4%	20.0%	14.1%	20.7%	11.2%
Poor health, older and less wealthy	*High co-morbidities, younger and female*	*Poorer health, older, female and more affluent*	*Low ER users, with moderate health, middle-aged and less wealthy*	*Healthy younger males from inner core, low resource users*	*Low ER users with moderate health, middle-aged and affluent*	*Healthy suburban younger males, low resource users*
I/core: 72%	I/core: 63%	I/core: 0%	I/core: 66%	I/core: 63%	I/core: 1%	I/core: 1%
DM: 12%	DM: 0%	DM: 5%	DM: 2%	DM: 0%	DM: 3%	DM: 0%
ART:57%	ART:12%	ART:34%	ART:16%	ART:7%	ART:17%	ART:8%
MH:60%	MH:42%	MH:35%	MH:27%	MH:15%	MH:19%	MH:8%
7+pvis: 98% 2+ER:49%	7+pvis: 79% 2+ER:50%	7+pvis: 89% 2+ER:34%	7+pvis: 18% 2+ER:31%	7+pvis: 5% 2+ER:23%	7+pvis: 15% 2+ER:20%	7+pvis: 0% 2+ER:15%

3. Results (Younger Cohort)

		Conditional Probabilities	
		Class 1	Class 2
Comorbidity (# ADGs)	5+	0.91	1.00
	2-4	0.09	0.00
	0-1	0.00	0.00
ER visits	5+	0.07	0.05
	2-4	0.42	0.45
	1	0.51	0.50
Physician visits	7+	0.98	0.79
	3-6	0.02	0.21

3. Results (Younger Cohort)

		Conditional Probabilities	
		Class 1	Class 2
Age Group	45-64	0.65	0.04
	25-44	0.35	0.65
	17-24	0.00	0.31
Female Sex		0.60	0.81
Arthritis		0.57	0.10
Diabetes		0.12	0.00
Any Mental Health		0.60	0.42

3. Results (Class 1)

		Class 1 11.1 %		
		Probability	N	N of Visits
ER visits	5+	0.07	717(0.8)	5,880(3.7)
	2-4	0.42	4,299(4.6)	13,327(8.5)
	1	0.51	5,220(5.6)	5,220(3.3)

- Younger cohort responsible for an estimated 157,580 ER visits
- Class 1 responsible for approximately 16% of total visits, while comprising 11.1% of total sample size
- 5+ ER visit members: 0.8% of sample size, but responsible for almost 4% of total visits

4. Discussion

- Classes with high resource users were also more likely to include members with diagnosed mental health conditions.
- High resource users had both a high burden of morbidity, and included older members.
  - HOWEVER: This was not always the case.
- Residence in the inner core of Winnipeg, and living in less wealthy neighbourhoods were both associated with a high burden of illness and resource utilization
  - HOWEVER: Pockets of poor health in wealthier neighbourhoods, with high ER and other resource use

Policy Implications

- Highlights the need to have mental health integrated into primary care, or as a component of ER care
- Those who more frequently use ERs also use an abundance of other resources:
  - Indicative of:
    - Availability and access?

  OR:
    - Fragmentation of services?
- High resource users important group – but must remember the other 80-90% of ER users

Strengths and Limitations

Strengths:

- Population-based, multi-site
- Empirically derived ER user groups, based on multiple characteristics; validated model

Limitations:

- Potential biased sample – censored ER users tended to be the most extreme users
- Administrative data are subject to misclassification
- ER use is both objectively and subjectively determined

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Thank you!

Questions?

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Appendix 1: Large Sample Sizes

- χ^2 test is known to be sensitive to sample size – large sample sizes are known to confer too much power to reject the null hypothesis – from the SEM literature [p. 136, Kline (2005)], as well as the LCA literature [Song and Fox (2005)];
- Other indices have been suggested, including:
  - Grover & Srinivasan (1987): adjusted R-square
  - Prosser (2008) recommended three others: I(d) – dissimilarity index (Dayton, 1998), AIC/BIC (penalizes for complexity and sample size), and lambda criterion (Goodman and Kruskal, 1954).
- I(d) – represents the sum overall response profile of |(E-O)/N|
- Lambda criterion: % of cases 'correctly classified'; improvement over chance assignment of cases
- To determine best fit, Prosser recommends:

1. Comparing the various fit statistics as a first step
2. Comparing in different years of data (if possible)
3. Non-parametric bootstrapping to derive estimates of the SEs of all statistics

Appendix 1: Large Sample Sizes

- Huang had this to say about statistical methods for choosing the number of classes when sample size is large: "our experience suggests that the BIC continues to decrease for models with ever-increasing numbers of classes"

- Suggests this as a strategy:

1. Interpretability of the classes;
2. Whether class distinctions have any important theoretical or practical value;
3. Context of study objectives and conceptual or theoretical perspectives
4. Parsimony is desired in order to facilitate comparisons

Are they mere variations on a theme?

Appendix 1: Large Sample Sizes

VARIATIONS ON A THEME:

- Younger Analytical Cohort:
- Moving from 7 to 8 classes caused Class 6 (the low ER user, affluent and middle-aged group) to split and create two classes:
  - One class that was the same as Class 6, and another that was basically Class 1, with slightly less physician visits and comorbidities

Appendix 2: Local Independence

- The assumption that indicator variables are uncorrelated (i.e., independent) within classes once a latent structure is imposed upon the data.
  - Violation introduces biased standard errors and often results in spurious classes
- A central assumption, in that it does drive the solution towards simplifying a large number of response patterns to a smaller number of consistent ones (i.e., the latent classes);

HOWEVER 1:

- Rebouisson et al. (2008) : "Idealization"
- Clogg (1988): Axiom vs. Assumption

HOWEVER 2:

- **Assumption should be checked (Uebersax, among others)**

A couple of issues, however (Zhang, 2004):

1. How is it actually assessed?
2. What to do about it?

Appendix 2: Local Independence

Issue 1: Assessment

- Vermunt and Magidson bivariate residuals evaluation (BVR)
- Garett & Zeger's log-odds ratio check
- BVR available in Mplus

Even with BVR:

- No agreement on cutoff [Muthen: 1.96; Suftin et al. (2008): 3.84]
- To what degree is LCA robust against this violation?
- Performance in large sample sizes unknown

- Checked BVR on both younger and older cohorts – 'slight' dependency in older, more so in younger cohort

Appendix 2: Local Independence

Issue 2: What to do about it

- Aside from exclusion of suspected variable two strategies: i) Stratification (by suspected variable) and; ii) relax independence assumption, by e.g., "modeling dependencies"
- Latter option, once choose to i) join manifest variable; ii) introduce multiple latent variables ; and iii) reformulate as loglinear models, and impose constraints

Parsimonious approach:

- Stratified by sex (younger cohort)

Result:

- Solved some issues; introduced other suspected pairs
- Further iterations need to try to model dependencies
- HOWEVER: Rebouisson et al. warn that:
- Under certain conditions, misspecification of dependence structure may lead to more biased results than what is observed in unconstrained models that violate the independence assumption
- Therefore, need to explore further

Appendix 3: Collapsing of mental health categories

Probably lose some resolution when categories are collapsed

- And more finite categories would prove to be useful

However, important to consider these 3 points:

- First, as Drake et al. (2001) and others have suggested, mental health issues do not often occur in isolation, and are often intermingled with other psychiatric disorders – THUS, there is a usefulness to 'bundling' different mental health disorders
- Secondly, at a policy level, as Craddock et al. (1997) and Tiet et al. (2006) have shown, even taken in isolation, major psychiatric disorders, although of course etiologically different, often result in similar needs related to: housing, employment, social, and medical needs
- Third, in dealing with clients with either single or multiple issues, as illustrated by Tsuang et al. (2006), the most proximal need is related to compliance and positive outcomes.
  - Therefore: knowing about some issues has broader dividends, both in 1) understanding disease complexity, and 2) in treatment

Appendix 3: Collapsing of mental health categories

- However, there is a definite benefit to more discrete categories: Perron et al (2009) illustrate that among those with diagnosed substance use disorder, certain clusters are more prevalent than others, having implications in screening and treatment, etc.
- As well, for certain progressive disorders, such as dementia, it may be important to develop more specific models of care (Keady et al., 2004).

Aggregated Tables

ID	Sex	DM
1	Male	No
2	Male	No
3	Male	No
4	Male	No
5	Male	No
6	Male	No
7	Male	Yes
8	Male	Yes
9	Male	Yes
10	Female	No
11	Female	No
12	Female	No
13	Female	No
14	Female	Yes
15	Female	Yes

Aggregated Tables

Sex	DM	Frequency Weights
Male	No	6
Male	Yes	3
Female	No	4
Female	Yes	2