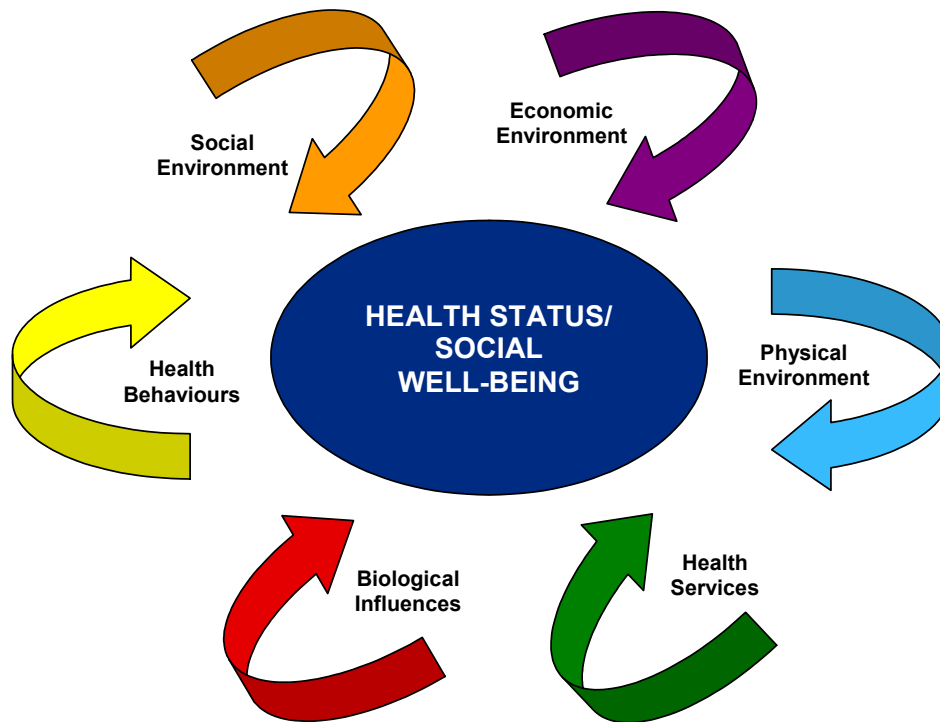


## APPENDIX A: DETERMINANTS OF HEALTH AND WELL-BEING MODEL



### Definitions:

**Economic Environment** – Refers to financial status – related factors such as income and employment.

**Social Environment** – Refers to social factors such as family structure, ethnicity, mother tongue and education.

**Health Behaviours** – Refers to personal lifestyle behaviours, such as smoking, physical activity and nutrition, as well as, healthy child development.

**Biological Influences** – Refers to conditions which are passed on from a parent to an offspring.

**Health Services** – Includes those services which: promote, protect, maintain and restore good health.

**Physical Environment** – Refers to such physical factors as: working conditions, air and water quality, communicable disease, condition of housing and community safety

*Source: Modified from model cited by the Canadian Public Health Association, 1997, and developed by the British Columbia Provincial Health Office, 1994.*



**APPENDIX B: ONTARIO PUBLIC HEALTH UNIT PEER GROUPS: A SPECIAL REPORT**



## Ontario Public Health Unit Peer Groups: A Special Report

### Background

The opportunity for comparing health regions has emerged through the expansion of existing data sources to the health region level of geography. After accounting for the effects of various social and economic characteristics known to influence health status, it is then possible to compare the relative effectiveness of health promotion, prevention, and monitoring activities across regions (Veenstra 2002). One way to remove the effects of socio-economic determinants of health on measured differences in health status between health regions is to classify health regions into groups of comparable social and economic characteristics and conduct comparisons only among communities of the same peer group (Studnicki et al. 2001, Zodet and Clark 1996). This way, the identified differences in health status would not likely be attributed to socio-economic determinants of health.

In February 2002, Larry MacNabb of the Health Statistics Division of Statistics Canada wrote a working paper entitled 'Health Regions Peer Groups' (MacNabb 2002). The paper outlined the data, methodology, empirical techniques and results of a study that defined health regions across Canada, based on an analysis of 24 social and economic characteristics known to influence health status. The final result was the construction of 10 groups of peer health regions, representing all health regions across Canada.

In November 2003, a revised set of peer groups was released in the Health Indicators product due to the availability of newer data inputs and a number of health region boundary changes since Spring 2002.

After reviewing the methodology, the City of Hamilton determined that the aforementioned analysis should be redone using only health regions in the province of Ontario because health regions outside the province impacted too heavily on outcomes of health regions within the province. In January 2004, representatives from the City of Hamilton approached the Health Statistics Division to have a new set of peer groups constructed, using the same empirical techniques as those presented in Health Indicators, but only for health regions across Ontario. Because there are 37 health units in Ontario, it was determined that the numbers would be sufficient to complete the analysis.

### Methodology

#### *Data*

While data used in the original paper were collected through the 1996 Canadian Census (MacNabb 2002), 2001 Canadian Census data were available at the time of analysis and, therefore, used wherever possible. Data for the 37 health regions in Ontario were used in the present analysis. As with the original peer groups' working paper, data from 24 socio-economic and socio-demographic determinants of health variables were analyzed. Figure 1 displays the complete list of variables included in the present analysis.

#### *Analysis*

Data were analyzed using SAS, Version 8 (Cary, NC). Health Regions were grouped using a non-hierarchical clustering algorithm, which minimized the within cluster sum of squared errors for a predefined number of clusters. The maximum number of clusters was set at six, which would yield an average number of 6 to 7 health regions per cluster. While the maximum cluster number is different than in the original working paper, the average number of health regions per cluster is consistent.

For the current project, two different decisions were made with respect to the member numbers in a cluster before the analysis took place. One decision included not forcing the City of Toronto into another peer group, if it was shown to be distinct from all other health regions. The other decision was to allow a possible peer group of northern health



regions to remain separate from other peers, if such a group should arise. These decisions were made because both Toronto and Ontario's north are perceived to be so regionally unique from the rest of the province that forcing them to be part of other peer groups would be unreasonable.

Standardization of variables was carried out the same as the original working paper (MacNabb 2002).

## **Results**

### *Initial Clusters*

The clustering algorithm was instructed to group the 37 Ontario health units into a set of no more than six clusters. The result was indeed six clusters. This indicated that setting the initial maximum at six clusters was appropriate.

Two principal components accounted for approximately 70% of the variability between peer groups. The first principal component was a measure of urban economic prosperity (i.e. high population growth, high levels of post-secondary education, low unemployment rates, high proportion of immigrants). The second principal component was a measure of overall wealth distribution (i.e. low income rate, owning a home, share of total income held by the lower 50th percentile of households).

Sex distribution and proportion of population under age 15 years added about 15% of variability to the model. Overall, there were four principal components that accounted for 85% of the variability in the model. Table 1-1 shows details of the principal component analysis for the first four principal components.

The overall result for the initial clusters is found in Step 4.2 of Table 1-2.

### *Exclusion of outliers*

The FASTCLUS procedure was used to determine which outliers, or peer group clusters, should be excluded from the analysis. The FASTCLUS procedure was re-run using the cluster means for all clusters with a frequency greater than one. Toronto was the only cluster that was excluded in this step.

Looking at Table 1-2, results differed between Step 4.2 and Step 4.3, where Toronto was excluded. This means that once the influence of Toronto was removed from the analysis, a number of other influential factors arose that helped differentiate the assignment of other health regions into peer groups.

To determine which variables played a key role in defining the health region peer groups, the final clusters were run against all 24 variables in a stepwise discriminant analysis. Partial R-SQ statistics for entry and removal were set at 0.15. Any variable which had an R-SQ of 0.5 or higher when regressed against a variable already in the model was removed from the analysis.

The strongest predictors of the final peer groupings are (1) Population Density and (2) Growth Rate. Looking at the correlations with other variables, population density was highly correlated with the overall population size, the proportion of visible minorities and the proportion of recent immigrants as a proportion of the total population. These variables are ones that generally define urban or rural environments.

Population growth was highly correlated with economic conditions such as unemployment rate, average income, average value of dwellings, and the proportion of children in low income families.



## *Collapsing Small Clusters*

As mentioned previously, a priori decisions were made to not force Toronto or a handful of northern health regions into a peer group. Results showed Toronto as a peerless health region. Moreover, there was a peer group of just two northern health units that was not forced to join with others.

Results of the final peer groupings for the 37 health regions in Ontario are presented in Step 5.3 in Table 1-2. Note that there is no difference between Step 5.3 and Step 4.3, save a re-ordering of peer group letter codes. Summary statistics of each peer group are shown in Table 1-3.

## **Discussion**

Overall, there was a moderate amount of cluster homogeneity on the first two principal components urban economic propensity and overall wealth distribution. With the effect of Toronto as an outlier being removed from the analysis, there was a shuffling of urban health regions into peer groups with other urban health regions. Similarly, some semi-rural health regions were merged with other semi-rural health regions into a common peer group.

The most important defining variables were population density and population growth in a region, closely followed by proportion of lone-parent families and proportion of Aboriginals in the region. Employment rate and proportion of post-secondary graduates appeared to have a minor influence on the groupings. Looking at correlations with other variables, population density was highly correlated with overall population size, proportion of visible minorities and proportion of recent immigrants as a proportion of the total population. Population growth was highly correlated with economic conditions, such as unemployment rate, average household income, average value of dwellings, and the proportion of children in low income families.

Since Toronto and Ontario's north (Northwestern Health Unit and Porcupine Health Unit) were not forced to merge with other peer groups, the final result is a set of six peer groups ranging in size from one to 12 health regions.

Peer groupings constructed in the present study have similarities to those presented in the Health Indicators product in November 2003. Both sets of peer groupings identify Toronto as a unique region compared to all other health regions in the province and report that Northwestern Health Unit and Porcupine Health Unit are similar to each other, but distinct from other health regions in Ontario. This suggests that these regions indeed are different from the rest of the province and substantiates the decision to not force them into peer groups with other health regions.

Differences exist between the resulting peer groupings and those provided in November 2003. There are subtle differences in the grouping of health regions with high population densities, high population growth, and a low proportion of Aboriginal persons in the population. Considerable differences were found in groupings of health regions with fairly high population density, average population growth, and a low proportion of Aboriginal persons in the population. Northern health regions not characterized by low population density, heavy population decline, and a high proportion of Aboriginal persons in the population, including Algoma Health Unit and North Bay & District Health Unit, were grouped with health regions with slight population decline and low population density, rather than being grouped on their own. This demonstrates that conducting the analysis with only health regions in Ontario and excluding Toronto from the analysis, greatly impacted on the resulting peer groupings.

In 2004, the Central West Health Planning Information Network (CWHPIN) explored how and in what ways Ontario health regions were similar to others in the peer groupings presented in Statistics Canada's (2003) Health Indicators. For each health region, a variance distance score was calculated for all socioeconomic variables and added together



to generate an overall distance score. This score was then used to assess the degree of difference between health regions (CWHPIN 2004).

Results from CWHPIN's (2004) study are consistent with the peer groupings constructed in the present study. Both studies, for example, identify Toronto as an extreme outlier. Moreover, health regions within peer groups have relatively small distance scores, suggesting that they are socio-economically similar. It should be noted, however, that not all health regions in a particular peer group were identified as the closest neighbours by CWHPIN (2004). This may be indicative of the difference in methodologies used, as the present study employed clustering methods while CWHPIN's study used univariable analyses.

Results from both studies, therefore, validate the other's findings demonstrating the rigor of both methodologies. Using peer groups constructed in the present study is, therefore, a reliable way to identify health regions in Ontario that are socio-economically comparable.

The methodology used in the present study has some limitations. Each province defines the geographic boundaries for health regions based on administrative preferences and, in some instances, are composed of several smaller administrative areas to ensure that survey sample estimates will attain a sufficient coefficient of variation to be reportable. This is one of the major limiting factors affecting the peer grouping methodology exercise. Health regions can also be strictly urban or rural, or some combination of both. The lack of homogeneity in defining health region boundaries makes the exercise of assigning health regions to peer groups much more difficult as it can have a large impact on the extent to which a variable represents a specific region and, resultantly, important defining factors can be missed.

### **Future Research**

This study shows that excluding health regions outside of Ontario from the peer group cluster analysis strengthens the utility of the peer groups constructed for Ontario health regions.

Given the wealth of data sources that have information at the provincial and Canada-wide scale, health regions within Ontario could further utilize these information sources by coordinating their content selection for population health surveys in order to facilitate comparison and joint reporting efforts within peer groups. Examination of health outcomes using the peer group comparison methodology offers health regions insight into the relative effectiveness of current health intervention programs on health outcomes and provides opportunities for information sharing and collaboration. Furthermore, it has potential public health policy implications related to the evaluation of existent programs and joint opportunities among peer communities to plan, design and implement future health promotion and program intervention strategies.

### **Acknowledgments**

On behalf of the City of Hamilton, the author would like to thank the Health Statistics Division, Statistics Canada for conducting the analysis to establish the peer groups presented.

### **References**

Central West Planning Information Network. Identifying Peers by Socio-Economic Status: Rationale and Methodology Report. Hamilton: Central West Health Planning Information Network (CWHPIN), 2004.

MacNabb L. Health Regions Peer Groups – Technical Document. Ottawa: Statistics Canada, 2002.



Studnicki J, Hevner A, Berndt , Luther S. Rating the health status of U.S. communities. *Managed Care Interface* 2001. 11: 43-51.

Veenstra G. Social capital and health plus wealth, income inequality and regional health governance). *Social Science and Medicine* 2002. 54(6): 849-68.

Zodet M, Clark J. Creation of hospital peer groups. *Clinical Performance & Quality Health Care* 1996. 4(1): 51-7.



**Figure 1.** Variables used in cluster analysis to define peer groups.

<b>Variable</b>	<b>Short Form</b>
2001 Population	Pop01
Aboriginal Percentage	AboPer
Average Dwelling Value	AvgDwl
Average Income	AvgInc
Post-Secondary Graduates	PostSec
Employment Rate	Emp
Growth Rate	Growth
Government Transfer Income	GovTran
Housing Affordability	HouAff
Immigrant Percentage	ImmPer
Median Share of Income	MedShr
Internal Migrant Mobility	MigMob
Lone-Parent Families	LnePrnt
Long Term Unemployment Rate	LtUnemp
Low Income, Individuals Age 15+ Years	Low15
Low Income Children	LowKids
Male-Female Ratio	MFRat
Owner-Occupied Dwellings	OwnDwl
Population Density	PopDen
Population Under 15 Years	Pop15
Population 65 Years and Older	Pop65
Strong Census Metropolitan and Agglomeration Influenced Zones	MIZ
Unemployment Rate	Unemp
Visible Minority	VisMin



**Table 1-1 Principal Component Analysis**

	Eigenvalue	Difference	Proportion	Cumulative Proportion	Eigenvectors for the first four principal components				
						Prin1	Prin2	Prin3	Prin4
1	8.647	0.572	0.360	0.360	MedShr	0.085	-0.305	-0.012	-0.074
2	8.075	5.695	0.337	0.697	MFRat	-0.036	-0.196	0.396	0.305
3	2.380	1.149	0.099	0.796	Pop01	0.215	0.237	-0.015	0.278
4	1.231	0.287	0.051	0.847	Pop15	0.152	-0.175	0.402	-0.003
5	0.944	0.139	0.039	0.887	AvgDwl	0.321	0.055	-0.017	0.090
6	0.806	0.348	0.034	0.920	OwnDwl	0.004	-0.295	0.013	0.014
7	0.457	0.044	0.019	0.939	MigMob	0.079	-0.224	-0.188	-0.080
8	0.414	0.138	0.017	0.957	GovTran	-0.316	0.006	-0.176	0.117
9	0.275	0.075	0.012	0.968	VisMin	0.264	0.182	0.073	0.199
10	0.200	0.020	0.008	0.976	LnePrnt	-0.024	0.297	0.176	-0.180
11	0.180	0.074	0.008	0.984	Emp	0.228	-0.209	-0.147	0.069
12	0.106	0.039	0.004	0.988	PopDen	0.156	0.245	-0.054	0.399
13	0.067	0.008	0.003	0.991	MIZ	0.170	0.111	0.012	-0.592
14	0.059	0.016	0.003	0.993	Unemp	-0.239	0.163	0.276	-0.119
15	0.043	0.006	0.002	0.995	LtUnemp	-0.257	0.157	0.203	-0.087
16	0.037	0.011	0.002	0.997	Low15	-0.085	0.326	-0.058	-0.024
17	0.026	0.006	0.001	0.998	LowKids	-0.073	0.331	-0.060	0.015
18	0.020	0.008	0.001	0.999	AvgInc	0.312	-0.009	0.147	-0.089
19	0.012	0.003	0.001	0.999	HouAff	0.070	0.276	-0.156	-0.096
20	0.009	0.004	0.000	1.000	Pop65	-0.223	-0.036	-0.448	0.145
21	0.005	0.001	0.000	1.000	AboPer	-0.187	0.032	0.421	0.077
22	0.003	0.001	0.000	1.000	ImmPer	0.260	0.190	0.054	0.237
23	0.002	0.001	0.000	1.000	Growth	0.311	-0.061	-0.013	-0.109
24	0.001	0.000	1.000		PostSec	0.223	0.134	-0.047	-0.273



**Table 1-2 Summary of Cluster Assignments**

Region Number	Region Name	Step 4.2	Step 4.3	Step 5.3 (FINAL)
3595	City of Toronto Health Unit	D	F	A
3549	Northwestern Health Unit	C	C	B
3556	Porcupine Health Unit	C	C	B
3526	The District of Algoma Health Unit	A	A	C
3527	Brant County Health Unit	B	A	C
3538	Hastings and Prince Edward Counties Health Unit	A	A	C
3540	Chatham-Kent Health Unit	B	A	C
3541	Kingston, Frontenac and Lennox and Addington Health Unit	B	A	C
3542	Lambton Health Unit	B	A	C
3546	Niagara Regional Area Health Unit	B	A	C
3547	North Bay and District Health Unit	A	A	C
3555	Peterborough County-City Health Unit	A	A	C
3561	Sudbury and District Health Unit	A	A	C
3562	Thunder Bay District Health Unit	A	A	C
3563	Timiskaming Health Unit	A	A	C
3537	City of Hamilton Health Unit	B	B	D
3544	Middlesex-London Health Unit	B	B	D
3551	City of Ottawa Health Unit	B	B	D
3568	Windsor-Essex County Health Unit	B	B	D
3531	Elgin-St Thomas Health Unit	B	D	E
3533	Grey Bruce Health Unit	E	D	E
3534	Haldimand-Norfolk Health Unit	E	D	E
3535	Haliburton, Kawartha, Pine Ridge District Health Unit	E	D	E
3539	Huron County Health Unit	E	D	E
3543	Leeds, Grenville and Lanark District Health Unit	E	D	E
3545	Muskoka-Parry Sound Health Unit	E	D	E
3552	Oxford County Health Unit	E	D	E
3554	Perth District Health Unit	E	D	E
3557	Renfrew County and District Health Unit	E	D	E
3558	The Eastern Ontario Health Unit	B	D	E
3530	Durham Regional Health Unit	F	E	F
3536	Halton Regional Health Unit	F	E	F
3553	Peel Regional Health Unit	B	E	F
3560	Simcoe County District Health Unit	B	E	F
3565	Waterloo Health Unit	B	E	F
3566	Wellington-Dufferin-Guelph Health Unit	F	E	F
3570	York Regional Health Unit	F	E	F



**Table 1-3 Cluster Descriptive Analysis of each Peer Group**

Cluster		N	Mean	Min	Max
A	PopDen	1	3939.4	3939.4	3939.4
	Growth	1	4.0	4	4
	LnePrnt	1	19.7	19.7	19.7
	AboPer	1	0.5	0.5	0.5
	PostSec	1	61.1	61.1	61.1
B	PopDen	2	0.4	0.32	0.47
	Growth	2	-6.3	-9.5	-3
	LnePrnt	2	15.1	14.4	15.7
	AboPer	2	19.1	11.6	26.5
	PostSec	2	47.2	46.1	48.2
C	PopDen	12	42.8	0.65	220.37
	Growth	12	-1.7	-9.2	3.5
	LnePrnt	12	14.9	13.3	16.8
	AboPer	12	5.2	1.3	11.7
	PostSec	12	52.4	48	58.7
D	PopDen	4	260.4	121.55	438.87
	Growth	4	5.7	3.5	7.3
	LnePrnt	4	16.1	15.9	16.6
	AboPer	4	1.4	1.1	1.9
	PostSec	4	57.9	50.9	68.6
E	PopDen	11	26.3	6.44	48.68
	Growth	11	1.4	-1.2	3.2
	LnePrnt	11	11.7	9.8	13.2
	AboPer	11	1.7	0.4	3.6
	PostSec	11	48.9	46.2	54.2
F	PopDen	7	322.1	57.53	796.26
	Growth	7	13.2	8.2	23.1
	LnePrnt	7	13.0	10.9	14.7
	AboPer	7	0.9	0.4	2.6
	PostSec	7	57.6	51.9	65.5

