British Columbia Health Atlas

1st edition

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project coordinator

Peter Schaub
cartographer

Centre for Health Services and Policy Research,
University of British Columbia

January 2002
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Foreword

Welcome to the first edition of the British Columbia Health Atlas. This compilation represents an initial attempt to present information in map format on several dimensions of health, its determinants, and health care use in British Columbia.

This volume includes some maps that will be familiar because the underlying data are drawn from publicly available sources. Other maps offer representations of data that have been analyzed explicitly for this atlas. We chose to include the former because these data are of central importance in understanding health care and the context in which it is provided in British Columbia. We also believe there is utility in presenting in map form numbers that have previously been available only as tables or perhaps charts. The latter provide additional detail or offer new perspectives on various dimensions of health and health care delivery in the province. In particular, we have chosen to develop a number of maps that provide information and perspective available only through the use of multiple data sets contained within the B.C. Linked Health Data.

Maps provide the basis for a different sort of understanding, a visual cue about geography and the potential influence of geography on a variable under consideration. For this atlas, we have concentrated on the production of two basic types of maps. The first is a standard representation of British Columbia divided into its eighty-eight constituent Local Health Areas. The local health area is the basic administrative and planning unit that underlies all other geographic boundary systems used by the Ministries of Health Services and Planning and associated agencies and bodies.

The second type of map is a cartogram based on the twenty Health Regions in the province. A cartogram, instead of showing geographic boundaries, uses size (of circles in this case) to denote relative ‘importance’ of different areas. For the majority of cartograms, the size of circles is based on population size. The result is that the southern part of the province, where the majority of people live, is ‘blown up’ and emphasized in a different way. Where a variable other than population is used to create the circle size, the text accompanying the map notes and describes this.

The atlas is divided into several sections. The first includes basic information on British Columbia’s demographics and its residents’ health status. The second provides information on some of the social determinants of health – the economic and social structures outside the health care system known to have an influence on a population’s health. The third section then provides fairly standard information about the supply of health human resources such as physicians and nurses and basic patterns of utilization across the province.

... continued next page
Following this is a section mapping analyses of a few ‘special topics’. These topics were chosen because of their potential interest to health planners, administrators, researchers and the general public, and because they highlight the utility of linkable administrative data in addressing research questions of policy interest.

Finally, we provide a short section of maps that break Vancouver into twenty-three neighbourhoods. These maps are included as an illustration of the flexibility and capability of geographic analysis, especially highlighting the benefits of investigation at smaller units of geography in places of larger population size that are expected to have some heterogeneity.

Our overriding objective in producing the first edition of the BC Health Atlas is to promote discussion on many fronts. First, there are some interesting differences in the maps that in some cases may be easily explained, but in other cases may require further investigation to understand. Second, we recognize that what is included here is ultimately – and necessarily – only a scratch at the surface of what might be done with linkable data and longitudinal and spatial analysis. The multitude of interesting questions that have policy relevance means that moving forward from here will best be accomplished with the benefit of feedback from people who read and use this atlas.

To that end, we encourage any and all feedback, suggestions, comments, and offers of ideas and assistance with the next edition. A feedback form is provided at the end of this document, or you can e-mail comments to health-atlas@chspr.ubc.ca.

Thank you for your interest. We hope you enjoy the first edition of the BC Health Atlas.

Kimberlyn McGrail
Project Coordinator
December 2001
Vancouver, BC

Note: this atlas is available on-line for free download at http://health-atlas.chspr.ubc.ca
Also available on compact disc.
Acknowledgements

The first edition of the British Columbia Health Atlas is the result of effort that began during the summer of 2001 and continued up through December of that year. The atlas evolved considerably through that time, thanks in large part to critical comments and suggestions provided by our colleagues both within and external to the Centre for Health Services and Policy Research.

The overall direction of the atlas was shaped by the Atlas Working Group, which was coordinated by Kimberlyn McGrail, and included Morris Barer, Clyde Hertzman, Rob Reid, Bob Evans, and Peter Schaub, the atlas’ cartographer. The project was undertaken through the Centre’s Health Information Development Unit, which is responsible for the administration of the BC Linked Health Data set and dedicated to the promotion of the use of administrative data for research in policy, population health and health services.

The atlas is, of course, the result of efforts of many people beyond the Working Group. Within the Centre for Health Services and Policy Research, data analysis was undertaken by Kerry Kerluke, Harold Yip, Bo Green, and Li-Xiang Yan. Invaluable data, advice and review of drafts of maps was provided by Arminée Kazanjian, Anne-Marie Broemeling, Sherin Jamal, Nino Pagliccia, Diane Helmer, Allyson MacDonald, Steve Morgan, Carolyn Green, and Tobin Copley.

We are also grateful for the wealth of advice, data, and support we received from a wide range of outside groups and individuals. Thanks are extended to Sidney McLean (Department of Health Care and Epidemiology, UBC), Barbara Poole (Capital Health Region), Bob Hogg (BC Centre for Excellence in HIV/AIDS), Victor Glickman (EduData Canada), Allison Prue (Canada Post), Jim Dunn (University of Calgary), Paul Degrace, Michael Hayes, and Nadine Schuurman (Simon Fraser University), Colin Mills and Eric Grass (Langara College), Bill Warburton (BC Ministry of Human Resources) and many representatives of municipal and regional governments around British Columbia, unfortunately too many to name here. Our appreciation is also expressed to Safe Software for their continuing support of population health mapping in British Columbia.

Analysis of linked data was supported by several research granting agencies including the BC Health Research Foundation (small for gestational age babies), the Canadian Health Services Research Foundation (continuity of care), and the National Health Research and Development Program (high users, loss of independence).

Finally, thanks go to the ongoing support of the Ministry of Health Planning and the University of British Columbia in making this atlas possible, and helping to promote an informed discussion as to how best to promote population health in British Columbia.
Table of Contents

Foreword
Acknowledgements
Table of Contents

I. Introduction
  1.1 How to Use This Atlas
  1.2 Health Jurisdictions
  1.3 Health Region Summaries

II. Demographics and Health Status
  2.1 Population
  2.2 Population Sub-groups
    2.2.1 Aboriginal Population
    2.2.2 Older Adults
    2.2.3 Young Children
    2.2.4 Sex Ratio
  2.3 Fertility
    2.3.1 General Fertility
    2.3.2 Teenage Fertility
    2.3.3 Small for Gestational Age
  2.4 Health Status
    2.4.1 Life Expectancy
    2.4.2 Potential Years of Life Lost
    2.4.3 Mortality
    2.4.4 AMI (Heart Attack)
    2.4.5 HIV / AIDS
    2.4.6 Immunizations
    2.4.7 Screening Mammography

III. Social Determinants of Health
  3.1 Income
    3.1.1 Median Household Income
    3.1.2 Low Income / Child Poverty
    3.1.3 Income Assistance
    3.1.4 Median Income Share
  3.2 Employment
    3.2.1 Primary Industries
    3.2.2 Unemployment
  3.3 Education
    3.3.1 High School Completion
    3.3.2 Educational Attainment
  3.4 Crime
    3.4.1 Violent Crime
    3.4.2 Property Crime

Special Topic: Drinking Water Quality
IV. Health Services

4.1 Supply
   4.1.1 Health Workforce
   4.1.2 Generalist Physicians
   4.1.3 Specialist Physicians
   4.1.4 Nurses
   4.1.5 Therapists

4.2 Utilization
   4.2.1 Acute Care Hospitalizations
   4.2.2 Medical Services Plan
   4.2.3 Continuing Care

V. Analysis of Linked Data

5.1 Continuity of Physician Care
5.2 High Users of Physician Services
5.3 Prescription Drugs and Older Adults
5.4 Loss of Independence

VI. Custom Boundary Mapping: A Focus on Vancouver

6.1 Introduction
6.2 The Vancouver Health Region
   6.2.1 Older Adults
   6.2.2 Young Children
   6.2.3 Sex Ratio
   6.2.4 Small for Gestational Age
   6.2.5 Unemployment
   6.2.6 Median Household Income
   6.2.7 Education

Notes to Maps
Cartographic Methods
Bibliography/Reading List
Order Form / Response Form
The following pages contain samples of the types of maps used most commonly in this Atlas. For example, the next page shows a sample map based on the 88 Local Health Areas (LHAs) of British Columbia. For many of the variables presented in this Atlas, the LHA is the standard geographic unit. LHA names are listed on map 1.2, which follows this section.

Some Local Health Areas, however, present problems when dealing with certain derived variables, such as incidence rates of diseases or conditions. For example, there are four LHAs, (51 Snow Country, 83 Central Coast, 87 Stikine, and 94 Telegraph Creek) with a 1996 census population below 2,000 persons. These small numbers cause problems when calculating, for example, general fertility rates, or pharmcare expenditures per capita. In some cases, LHA-level data were aggregated, but this approach is not always appropriate.

These and other limitations of relying solely on the Local Health Area as a unit of measurement led to the complementary use of British Columbia’s 20 Health Regions. Health Regions are shown in red outline on the adjacent map, and their constituent LHAs have been colour-coded for ease of discrimination. Their names are listed on map 1.2, which follows this section. The Health Region Summaries section (map 1.3) provides detail on the mapping of LHAs to HRs and their 1999 population sizes.

Health Regions offer a level of generality that is suitable in some cases, and provide a means of viewing an overall provincial trend very quickly. However, it can be very difficult to examine - even with an inset - the data for Health Regions in Greater Vancouver. This area makes up less than one percent of B.C.’s land mass, yet it contains more than half the population, and six of the twenty Health Regions, with portions of four others.

One way of dealing with the geographic unevenness of British Columbia’s population distribution is to present the Health Region - level data using a cartogram, or a value-by-area map. A cartogram is a representation of geographic data that abstracts and deliberately distorts features based on a given variable.

In the cartogram to the right, the Health Regions have been abstracted as circles which have then been scaled to their population size. As a result, the circles representing the six Greater Vancouver Health Regions include the largest circles on the map, whereas Coast - Garibaldi or Cariboo, the Health Regions with the smallest population sizes, appear as the smallest circles.

More information on selected cartographic methods used in this Atlas can be found in either the Notes to Maps section, or the Cartographic Methods section, depending on the level of technical information desired.
1.1 How to Use This Atlas

This space contains a brief section of text to accompany each map. Here, you will find an explanation of the map variables and the reasons why they were chosen as a topic for this Atlas.

There may also be a brief description of any trends apparent in the data, as well as correlations or other relationships of interest.

Note that this is a basic template, and not all of the elements shown are included on all maps.
Local Health Area Map

1 Section Title
Instead of page numbers, this Atlas is divided into section numbers, which are found in the top-right corner of each page. The title of the section is just below.

2 Map Title or Variable Name
Each map within a section has a unique title describing its topic. For example, the section entitled ‘Prescription Drugs and Older Adults’ includes maps with a wide range of titles.

3 Year of Data, or other information
A space is made here to identify the year and/or timespan of the data used, or other similar qualifying information.

4 Measure or Indicator Used
Where appropriate, this space contains a description of the type of measure that is used.

5 Legend Bar
The legend bar describes the distribution of the data and the exact boundaries of each class. The sizes of each segment are proportional to the sizes of the classes. The legend bar may thus be used to get a rough sense of the distribution of the data.

6 Unavailable or Unreliable Data
In some cases, data are simply unavailable, or are unreliable for any number of reasons. In such cases, the local health area is ‘greyed’ on the map. The criteria for ‘reliability’ is outlined in full in the Notes to Maps section, or - space permitting - is indicated here.

7 Health Region Boundary
Health region boundaries have been added to these maps to aid comparison. Note that the data are still, of course, presented at the local health area level.

The colour of the health region boundaries and names is chosen to contrast with the colour ramp used by the local health areas (shown in the legend bar). On this map, for example, the health region boundaries are shown in magenta to contrast with the light green - dark green colour ramp used by the local health areas.

8 Classification Method
The local health area data are usually displayed in five classes, as this is a generally accepted ideal given a sufficiently high number of records. In unusual circumstances, data may be subdivided in other ways. Under normal circumstances this space indicates the classification method used. For more information on classification methods, please refer to the Cartographic Methods section.

9 Provincial Average
Where available and appropriate, the British Columbian average for the data is indicated alongside the legend.

10 Inset Box
The black box delineates the area found in the inset below. This inset is intended to show more clearly the local health areas in the Georgia Basin.

11 Vancouver Local Health Areas
In order to more carefully capture the variation among neighbourhoods in Vancouver, the city is broken up into six local health areas numbered 161 through 166. Because Vancouver remains small even on the inset, this area is used to show the relevant areas and colours. Not all data are available at this level of disaggregation.

12 Source of Data
This space indicates the source(s) of the data.

13 Local Health Area Numbers
These small black numbers refer to the local health area numbers, listed in section 1.2

14 Health Region Names
These names, which may appear in red or blue according to the map, refer to the health regions. See section 1.2 for further details.

15 Additional Details
In almost all cases, the technical details and exact definitions used are provided in the ‘Notes to Maps’ section at the end of the Atlas.
### Comparing Health Regions

**Variable Name Here**

<table>
<thead>
<tr>
<th>Population Range</th>
<th>Region Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>50,000 - 100,000</td>
<td>47.5 - 55 %</td>
</tr>
<tr>
<td>100,000 - 200,000</td>
<td>43 - 57.5 %</td>
</tr>
<tr>
<td>200,000 - 500,000</td>
<td>37 - 43 %</td>
</tr>
<tr>
<td>Above 500,000</td>
<td>below 37 %</td>
</tr>
</tbody>
</table>

- **47.5 - 55 %**
  - 52.2 % West Kootenay - Bdry
  - 51.0 % Capital
  - 48.2 % Okanagan - Similkameen
  - 48.0 % Vancouver

- **43 - 57.5 %**
  - 47.4 % East Kootmay
  - 47.0 % Upper Island - Ctri Coast
  - 45.8 % Ctri Vancouver Island
  - 45.1 % Burnaby
  - 44.7 % North Okanagan
  - 43.8 % Coast - Garibaldi

- **37 - 43 %**
  - 42.6 % North Shore
  - 42.5 % North West
  - 41.9 % Simon Fraser
  - 38.9 % Fraser Valley
  - 38.7 % Northern Interior
  - 38.0 % Thompson

- **below 37 %**
  - 36.2 % Richmond
  - 34.1 % Cariboo
  - 30.2 % Peace - Liard
  - 28.6 % South Fraser

---

### Related Text

This space will usually contain a section of text that more fully illustrates the general provincial trend of the data. It may be a continuation of text from the previous page.
Health Region Cartogram

16 **Background Map**

This background shape is meant to replicate the general shape of British Columbia so as to provide a visual cue to aid interpretation of the cartogram. It should help the reader ‘place’ the health regions close to their true locations. This outline was derived by ‘warping’ a true map of British Columbia, according to both population and aesthetic quality.

17 **Data Table**

The data table appears in various forms, according to the nature of the data. In this case the fictitious data are grouped into four classes. Note that these class boundaries do not correspond to the natural breaks in the health region - level data, but rather to the natural breaks in the local health area - level data shown in the previous map. These classes were preserved for ease of comparison.

18 **Cartogram Legend**

The cartogram is used as a way of correcting for the fact that two-thirds of British Columbia’s population lives on less than 2 percent of its land mass - the Georgia Basin. The health regions are abstracted and represented as circles and sized according to their 1999 populations; and this legend is used to describe the sizing of the cartogram’s circles. These circles are then shaded according to their value, based on the same classes outlined in the table and on the local health area map. See the Cartographic Methods section for details. Note also that the top class has been ‘dropped’ through aggregation (see point 15 for details).

19 **Greater Vancouver**

The six health regions which are completely within Greater Vancouver have been grouped together.
Historically, British Columbia has been subdivided into 20 Health Regions for the purposes of health administration. These Health Regions (HRs) are further subdivided into 88 Local Health Areas (LHAs).

Maps of the recently-adopted boundary system are available (see gold box below).

NOTE: Detailed, full-colour maps of the post-December 2001 health authorities are available free of charge. Free download at http://health-atlas.chspeubc.ca or contact the Centre for Health Services and Policy Research
## Health Region Summaries

### East Kootenay

<table>
<thead>
<tr>
<th></th>
<th>Region</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Fernie</td>
<td>16,512</td>
</tr>
<tr>
<td>2</td>
<td>Cranbrook</td>
<td>26,208</td>
</tr>
<tr>
<td>3</td>
<td>Kimberley</td>
<td>8,933</td>
</tr>
<tr>
<td>4</td>
<td>Windermere</td>
<td>9,416</td>
</tr>
<tr>
<td>5</td>
<td>Creston</td>
<td>13,131</td>
</tr>
<tr>
<td>18</td>
<td>Golden</td>
<td>7,764</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>81,964</strong></td>
</tr>
</tbody>
</table>

### West Kootenay - Boundary

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<th></th>
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<tbody>
<tr>
<td>6</td>
<td>Kootenay Lake</td>
<td>3,827</td>
</tr>
<tr>
<td>7</td>
<td>Nelson</td>
<td>25,296</td>
</tr>
<tr>
<td>9</td>
<td>Castlegar</td>
<td>13,803</td>
</tr>
<tr>
<td>10</td>
<td>Arrow Lakes</td>
<td>5,377</td>
</tr>
<tr>
<td>11</td>
<td>Trail</td>
<td>20,906</td>
</tr>
<tr>
<td>12</td>
<td>Grand Forks</td>
<td>9,353</td>
</tr>
<tr>
<td>13</td>
<td>Kettle Valley</td>
<td>3,824</td>
</tr>
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<td><strong>Total</strong></td>
<td></td>
<td><strong>82,386</strong></td>
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### North Okanagan

<table>
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<tr>
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<tr>
<td>19</td>
<td>Revelstoke</td>
<td>8,724</td>
</tr>
<tr>
<td>20</td>
<td>Salmon Arm</td>
<td>33,082</td>
</tr>
<tr>
<td>21</td>
<td>Armstrong - Spallumcheen</td>
<td>9,889</td>
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<tr>
<td>22</td>
<td>Vernon</td>
<td>58,892</td>
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<tr>
<td>78</td>
<td>Enderby</td>
<td>7,742</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>118,329</strong></td>
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### Okanagan - Similkameen

<table>
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</thead>
<tbody>
<tr>
<td>14</td>
<td>Southern Okanagan</td>
<td>18,670</td>
</tr>
<tr>
<td>15</td>
<td>Penticton</td>
<td>40,255</td>
</tr>
<tr>
<td>16</td>
<td>Keremeos</td>
<td>4,712</td>
</tr>
<tr>
<td>17</td>
<td>Princeton</td>
<td>5,221</td>
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<tr>
<td>23</td>
<td>Central Okanagan</td>
<td>150,518</td>
</tr>
<tr>
<td>77</td>
<td>Summerland</td>
<td>11,397</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>230,773</strong></td>
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</tbody>
</table>

Source: Health Data Warehouse, BC Ministries of Health Planning and Health Services
Thompson
24 Kamloops 105,431
26 North Thompson 5,316
29 Lillooet 4,894
30 South Cariboo 7,861
31 Merritt 12,181
Total 135,683

Fraser Valley
32 Hope 8,447
33 Chilliwack 71,434
34 Abbotsford 114,859
75 Mission 37,269
76 Agassiz - Harrison 8,135
Total 240,144

South Fraser
35 Langley 113,065
36 Surrey 353,164
37 Delta 101,503
Total 567,732

Simon Fraser
40 New Westminster 54,094
42 Maple Ridge 76,794
43 Coquitlam 187,621
Total 318,509

source: Health Data Warehouse, BC Ministries of Health Planning and Health Services
### Coast - Garibaldi

<table>
<thead>
<tr>
<th>Code</th>
<th>Area</th>
<th>Population</th>
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</thead>
<tbody>
<tr>
<td>46</td>
<td>Sunshine Coast</td>
<td>27,207</td>
</tr>
<tr>
<td>47</td>
<td>Powell River</td>
<td>20,736</td>
</tr>
<tr>
<td>48</td>
<td>Howe Sound</td>
<td>30,963</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>78,906</strong></td>
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### Central Vancouver Island

<table>
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</tr>
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<tr>
<td>65</td>
<td>Cowichan</td>
<td>53,550</td>
</tr>
<tr>
<td>66</td>
<td>Lake Cowichan</td>
<td>6,592</td>
</tr>
<tr>
<td>67</td>
<td>Ladysmith</td>
<td>16,142</td>
</tr>
<tr>
<td>68</td>
<td>Nanaimo</td>
<td>93,654</td>
</tr>
<tr>
<td>69</td>
<td>Qualicum</td>
<td>39,942</td>
</tr>
<tr>
<td>70</td>
<td>Alberni</td>
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<tr>
<td><strong>Total</strong></td>
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### Upper Island - Central Coast

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<thead>
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<tr>
<td>71</td>
<td>Courtenay</td>
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<tr>
<td>72</td>
<td>Campbell River</td>
<td>42,031</td>
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<tr>
<td>83</td>
<td>Central Coast</td>
<td>2,040</td>
</tr>
<tr>
<td>84</td>
<td>Vancouver Island West</td>
<td>3,155</td>
</tr>
<tr>
<td>85</td>
<td>Vancouver Island North</td>
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<td><strong>Total</strong></td>
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<td><strong>122,359</strong></td>
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### Cariboo

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<tbody>
<tr>
<td>25</td>
<td>100 Mile House</td>
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</tr>
<tr>
<td>27</td>
<td>Cariboo - Chilcotin</td>
<td>29,319</td>
</tr>
<tr>
<td>28</td>
<td>Quesnel</td>
<td>27,434</td>
</tr>
<tr>
<td>49</td>
<td>Bella Coola Valley</td>
<td>3,494</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>76,659</strong></td>
</tr>
</tbody>
</table>

source: Health Data Warehouse, BC Ministries of Health Planning and Health Services
### North West

<table>
<thead>
<tr>
<th>Code</th>
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<th>Population</th>
</tr>
</thead>
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<tr>
<td>50</td>
<td>Queen Charlotte</td>
<td>5,799</td>
</tr>
<tr>
<td>51</td>
<td>Snow Country</td>
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</tr>
<tr>
<td>52</td>
<td>Prince Rupert</td>
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<tr>
<td>53</td>
<td>Upper Skeena</td>
<td>6,064</td>
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<tr>
<td>54</td>
<td>Smithers</td>
<td>18,737</td>
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<td>80</td>
<td>Kitimat</td>
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<tr>
<td>87</td>
<td>Stikine</td>
<td>1,348</td>
</tr>
<tr>
<td>88</td>
<td>Terrace</td>
<td>23,934</td>
</tr>
<tr>
<td>92</td>
<td>Nisga’a</td>
<td>2,319</td>
</tr>
<tr>
<td>94</td>
<td>Telegraph Creek</td>
<td>644</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>91,403</strong></td>
</tr>
</tbody>
</table>

### Peace - Liard

<table>
<thead>
<tr>
<th>Code</th>
<th>Region</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>59</td>
<td>Peace River South</td>
<td>29,100</td>
</tr>
<tr>
<td>60</td>
<td>Peace River North</td>
<td>30,678</td>
</tr>
<tr>
<td>81</td>
<td>Fort Nelson</td>
<td>6,580</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>66,358</strong></td>
</tr>
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</table>

### Northern Interior

<table>
<thead>
<tr>
<th>Code</th>
<th>Region</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>55</td>
<td>Burns Lake</td>
<td>7,922</td>
</tr>
<tr>
<td>56</td>
<td>Nechako</td>
<td>18,441</td>
</tr>
<tr>
<td>57</td>
<td>Prince George</td>
<td>106,684</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>133,047</strong></td>
</tr>
</tbody>
</table>

### Vancouver

<table>
<thead>
<tr>
<th>Code</th>
<th>Region</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>161</td>
<td>Vancouver - City Centre</td>
<td>94,683</td>
</tr>
<tr>
<td>162</td>
<td>Vancouver - Downtown Eastside</td>
<td>52,746</td>
</tr>
<tr>
<td>163</td>
<td>Vancouver - North East</td>
<td>94,515</td>
</tr>
<tr>
<td>164</td>
<td>Vancouver - Westside</td>
<td>122,491</td>
</tr>
<tr>
<td>165</td>
<td>Vancouver - Midtown</td>
<td>85,594</td>
</tr>
<tr>
<td>166</td>
<td>Vancouver - South Vancouver</td>
<td>118,694</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>568,723</strong></td>
</tr>
</tbody>
</table>

Source: Health Data Warehouse, BC Ministries of Health Planning and Health Services
Population

As a result of a variable and often impenetrable geography, the distribution of the human population of British Columbia is very uneven.

Greater Vancouver (often referred to as the Lower Mainland) is home to half of all British Columbians, with 2.02 out of BC’s 4.06 million residents in 1999. The Georgia Basin, which includes the Lower Mainland plus Greater Victoria, the Fraser Valley, and parts of Coast-Garibaldi, includes 2.67 million people.

Thus, more than 70% of the province’s population resides on 1.3% of its land mass. The remaining 30% is settled with some density in the Okanagan, the Kootenays, and hugging the few highways that extend north.

The size of British Columbia - 95 million hectares, or four times the area of Great Britain - and the distribution of its population creates a challenge for the planning and delivery of health care services.

source: 1996 census, Health Data Warehouse, BC Ministries of Health Planning and Health Services
Population Growth

The population of BC grew more than 20% between 1991 and 2000, an average annual increase of just over 2.1%. Three-quarters of this population growth is because of net migration – people moving into the province from other parts of Canada or the world. Only one-quarter of the growth can be attributed to ‘natural’ growth, the difference between births and deaths.

The Simon Fraser and Coast Garibaldi regions showed the highest rates of population growth in the province, with both having average annual increases in population of about 3%. In terms of absolute increases, however, the South Fraser region is noteworthy in that it is the most populous, and also one of the fastest growing.

In contrast, the populations of the Capital (Victoria) and North West regions increased less than 1% per year, on average.
Demographic Change

Population pyramids show the relative distribution of a population by age and sex. This slightly stylized population pyramid for British Columbia illustrates striking changes in the age structure of the population from 1976 to 2001 and projected to 2021.

In 1976 the ‘bulge’ in the population was in the 10-29 age range. This bulge reflects the post-war baby boom. As expected, the aging of this cohort can be seen moving steadily to the older age groups in the pyramids for 2001 and 2021.

In addition to the baby boomers, it is clear that there has been a general trend to increasing the proportion of the elderly in the population. This is in part attributable to decreasing fertility rates, which are now below ‘replacement level’ and in part to decreasing mortality rates at older ages. The combination of these factors means that without immigration, BC’s population in the not too distant future would be predicted to decline.

As shown on the following page, this age distribution varies considerably across the province, with the extremes represented by the Vancouver and the Okanagan.

There is a very large population of young adults in Vancouver, which makes the shape of its population pyramid quite distinctive. In contrast, the shape of the Okanagan-Similkameen pyramid is much more rectangular, implying a more even distribution of the population across the age groups.

... see population pyramids by Health Region on following page
Health Regions - 1999 total population

Bars refer to percentages of total population for that sex.
Top bar contains all persons above the age of 95
Bottom bar contains only those persons below the age of 1.

Dependency Ratio
Population of those under 15 and 65 and over as proportion of total population, 1999

High Dependence (above 35%)
- 38.1 % Okanagan - Similkameen
- 37.3 % Fraser Valley
- 36.3 % North Okanagan
- 36.1 % Ctl Vancouver Island

34 - 35 %
- 34.6 % Capital
- 34.5 % South Fraser
- 34.4 % West Kootenay - Bdry

Medium Dependence (31 - 34 %)
- 33.5 % East Kootenay
- 33.1 % Peace - Liard
- 33.0 % Upper Island / Ctl Coast
- 32.7 % Thompson
- 32.4 % British Columbia Average
- 32.4 % Cariboo
- 32.4 % North West
- 31.9 % Coast - Garibaldi
- 31.8 % North Shore

28 - 31 %
- 30.9 % Northern Interior
- 30.6 % Simon Fraser
- 29.2 % Burnaby

Low Dependence (below 28 %)
- 27.6 % Richmond
- 25.9 % Vancouver

source: Health Data Warehouse, BC Ministries of Health Planning and Health Services
It is well known that aboriginals have a lower life expectancy and a higher prevalence of many health conditions compared to the general population. While a fair proportion (even the majority) of this may be related to socioeconomic factors, it is a population that is of special concern for health policy and planning.

Despite this interest, it is difficult to identify aboriginals with any degree of accuracy. There are issues about formal vs. informal (or self-) identification, relationships between responsible...

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federal and provincial agencies and concerns around trust that have prevented any kind of reliable, consistent recording of aboriginal heritage.

The data in this map are derived from the 1996 census, and are thus based on self-identification. There are problems with under-counting in some areas because of the choice of some groups to not participate in the census, but the census still represents one of the better sources of data for this population.

BC Stats reports that in the 1996, 139,655 people in BC – 3.8% of the population -- were considered to have aboriginal identity.

The absolute numbers of aboriginals are higher in the southern, most heavily populated areas of the province, but their proportion of the total population is lower because of the higher overall population density in these areas.

The aboriginal population has an age distribution that is significantly different from the overall population of British Columbia; almost half of the aboriginal population is less than 25 years old, compared to about a third of the total BC population. This is both because aboriginals have a higher fertility rate (though the gap is narrowing) and higher age-specific mortality rates. For example, refer to the section on Infant Mortality, in which aboriginal rates are contrasted with the province-wide rates by health region.

source: 1996 census, Health Data Warehouse, BC Ministry of Health Planning and Health Services
Older adults are another population of interest for health planning because ill-health, and therefore use of health services, tends to increase with age.

There is a more than 10-fold variation in the proportion of older adults by local health area, with higher proportions in general in the southern part of the province.

The heaviest concentrations of seniors are found on parts of Vancouver Island, West Vancouver, the Okanagan-Similkameen and a piece of East Kootenay. Despite its reputation, Victoria does not fall into the top category.
The distribution of young children is an inverse of that of older adults. There is more than a four-fold variation in the proportion of the population made up of those under age five, with the highest levels in the north and in a couple local health areas of the Lower Mainland.

There is some overlap in concentration of aboriginals and concentration of young children, likely because of higher fertility rates among aboriginals.
A sex ratio displays the relative proportion of males and females in the population. In the province as a whole in 2000 there were about 25,000 more females than males, or a ratio of 99 males for every 100 females.

There is variation in sex ratio across local health areas, with all but the very southern areas of the province showing a dominance of males. This may be partly due to the economic opportunities in more rural areas of BC, which are heavily resource-based.

The areas more dominated by females tend to be those that also have a higher proportion of seniors. This is as expected, since females have a longer life expectancy than males (see map 2.4.1).
The general fertility rate is the number of live births in a given year, expressed per 1,000 women of child-bearing age. In this case, the data reflect an average of yearly births over the five years 1995 to 1999 to women aged 15-49.

There is a three-fold variation in fertility across the province, with the lowest rates in the southeast and the highest in the central region and far northeast. Two local health areas in the very southern, more populated part of the province defy the general trend of lower fertility rates in more urban areas.

**General Fertility Rate**

(1995-99 data)

Live births per 1,000 women aged 15-49

Local Health Areas

see map 1.2 for names

Cariboo

see cartogram on following page

INSET - The Georgia Basin

source: Health Data Warehouse, BC Ministries of Health Planning and Health Services
Comparing Health Regions

General Fertility Rate
Live births per 1,000 Females aged 15 - 49

<table>
<thead>
<tr>
<th>Rate per 1,000</th>
<th>Regions</th>
</tr>
</thead>
<tbody>
<tr>
<td>above 47.5 per 1,000</td>
<td>54.8 Fraser Valley, 54.2 Peace - Liard, 51.9 North West, 51.4 South Fraser</td>
</tr>
<tr>
<td>43 - 47.5 per 1,000</td>
<td>47.0 Cariboo, 46.6 Northern Interior, 45.0 Simon Fraser</td>
</tr>
<tr>
<td>37 - 43 per 1,000</td>
<td>42.3 Coast Garibaldi, 42.0 Upper Island / Ctrl Coast, 40.8 Thompson, 40.8 Okanagan - Similkameen, 40.5 Ctrl Vancouver Island, 39.7 North Okanagan, 38.9 Burnaby, 38.4 East Kootenay</td>
</tr>
<tr>
<td>below 37 per 1,000</td>
<td>36.9 Richmond, 36.7 North Shore, 36.5 Vancouver, 36.3 West Kootenay - Bdry, 35.5 Capital</td>
</tr>
</tbody>
</table>

Three or more children
Percentage of two-parent families with 3 or more children

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Regions</th>
</tr>
</thead>
<tbody>
<tr>
<td>above 27%</td>
<td>North West, Peace - Liard</td>
</tr>
<tr>
<td>22.5 - 27%</td>
<td>Fraser Valley, Cariboo, Northern Interior, Simon Fraser</td>
</tr>
<tr>
<td>19 - 22.5%</td>
<td>Coast Garibaldi, Upper Island / Ctrl Coast, Thompson, Okanagan - Similkameen, Ctrl Vancouver Island, North Okanagan, Burnaby, East Kootenay</td>
</tr>
<tr>
<td>below 19%</td>
<td>Richmond, North Shore, Vancouver, West Kootenay - Bdry, Capital</td>
</tr>
</tbody>
</table>

Source: Health Data Warehouse, BC Ministries of Health Planning and Health Services
The teen fertility rate is the number of live births per 1,000 girls aged 15-19. As with the general fertility rate, the data here reflect an average of yearly births over the five years 1995 through 1999.

The variation in teen fertility rates across local health areas is one of the largest in this atlas, from 2 per 1,000 to 81 per 1,000. At the high end, this means one in eleven births in some local health areas in British Columbia are to females aged 15 to 19.

Higher teen fertility rates may reflect a lack of economic opportunity or choice in some areas of the province. In general, rates are low in the Lower Mainland and southern part of Vancouver Island.
A baby that is small for gestational age is one that has a low birth weight after consideration of the duration of the mother’s pregnancy.

This measure is generally considered to be more useful than looking strictly at low birth weight because there is a stronger connection to the future use of health services; babies that are small for gestational age typically have long-lasting health consequences and a greater need for services, than low birth weight babies (though there is, of course, some overlap between the two groups).

... continued next page
The smallest 10% of babies at each gestational age - after excluding twins and triplets - are defined as ‘small for gestational age’. This means that in British Columbia about 10% of births are defined as small for gestational age, but the range among local health areas is from just over 5% to nearly 20%.

At the health region level, there is a higher proportion of babies born small for gestational age in the Lower Mainland and in the southeastern corner of the province. In this case, the size of the circles on the cartogram is determined by the number of births in each health region.
Life expectancy is a basic measure expressing the age to which a baby born today is expected to live. The utility of this measure lies, in part, in the ease with which the number can be compared across geographic areas and over time as well as its fairly simple definition.

There is a thirteen year difference in life expectancy within British Columbia (see legend), and there is also a general north / south trend with higher life expectancy in the southern, more populated areas.

... continued next page
Comparing Health Regions
Closest Global Match (where available)
<table>
<thead>
<tr>
<th>Life Expectancy in years (1996-2000 data)</th>
<th>Longer than 81 years</th>
<th>79 - 81 years</th>
<th>78 - 79 years</th>
<th>76 - 78 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Macao</td>
<td>81.5 Richmond</td>
<td>80.4 South Fraser</td>
<td>78.9 Ctrl Vancouver Island</td>
<td>77.8 Thompson</td>
</tr>
<tr>
<td>San Marino</td>
<td>81.3 North Shore</td>
<td>80.1 Capital</td>
<td>78.9 Fraser Valley</td>
<td>77.6 North West</td>
</tr>
<tr>
<td>Japan</td>
<td>80.6 Okanagan - Similkameen</td>
<td>79.8 East Kootenay</td>
<td>78.9 Fraser Valley</td>
<td>77.3 Cariboo</td>
</tr>
<tr>
<td>Singapore</td>
<td>80.4 South Fraser</td>
<td>79.8 East Kootenay</td>
<td>78.6 West Kootenay - Bdry</td>
<td>77.2 Northern Interior</td>
</tr>
<tr>
<td>Australia</td>
<td>80.1 Capital</td>
<td>79.2 Coast - Garibaldi</td>
<td>78.6 Upper Island / Ctrl Coast</td>
<td>77.2 Northern Interior</td>
</tr>
<tr>
<td>Iceland</td>
<td>80.0 Burnaby</td>
<td>79.1 North Okanagan</td>
<td>78.4 Peace Liard</td>
<td>77.2 Northern Interior</td>
</tr>
<tr>
<td>Italy</td>
<td>79.0 Vancouver</td>
<td>79.1 Simon Fraser</td>
<td>78.4 Peace Liard</td>
<td>77.2 Northern Interior</td>
</tr>
</tbody>
</table>

... continued from previous page

This general north-south trend is also apparent in the cartogram, though at this level of aggregation the variation decreases considerably – to just over 4 years separating the high and low health regions.

There is not a strong match between the patterns seen here and the patterns for measures of income or supply of health professionals. This implies that the relationship among these variables – which has been shown to exist – is quite complex.
Potential years of life lost is another lens through which the notion of longevity can be examined. In this case, the difference between 75 and age at death (for people who die before age 75) is accumulated across the population. Assuming age 75 is a reasonable life expectancy, the resulting sum indicates the number of years ‘lost’ because of early death.

... continued next page
Comparing Health Regions

Potential Years of Life Lost Index
observed / expected

1.10 - 1.40
1.30 Cariboo
1.22 Thompson
1.20 North West
1.19 Vancouver
1.18 Northern Interior
1.17 West Kootenay - Bay
1.11 Upper Island - Ctrl Coast

0.85 - 1.10
1.08 Ctrl Vancouver Island
1.07 North Okanagan
1.06 Fraser Valley
1.03 Coast - Garibaldi
0.97 Peace - Liard
0.93 Capital
0.92 Simon Fraser
0.90 Okanagan - Similkameen
0.90 South Fraser
0.88 East Kootenay
0.85 Burnaby

below 0.85
0.71 North Shore
0.65 Richmond

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Comparisons of potential years of life lost can be tricky across geographic areas because areas may differ in their age structure – as we know they do in British Columbia. This is because an infant death contributes 75 years to the total while a death at age 70 contributes only five years; a relatively young population, therefore, has a greater likelihood of more deaths at younger ages even if age-specific death rates are the same.

The index shown here adjusts for differences in the age structure of each local health area using direct standardization. Areas with an index greater than 1 have more early deaths than expected, while those with an index less than 1 have fewer early deaths than expected.

source: British Columbia Vital Statistics Agency
The number deaths before age 1 per 1,000 live births that die between birth and 1 year of age is called the infant mortality rate. Lower infant mortality rates are generally considered a good indicator of higher population health status in general.

The trend in virtually all countries over the last century has been toward decreasing rates of infant deaths. There are many factors that have contributed to this decline including better nutrition, improved housing, and more effective medical treatments such as immunizations and antibiotics.
British Columbia has an average infant mortality rate of 3.76 per 1,000, which is quite good by global standards, and is in fact far better than the Canadian national rate, which hovers in the 5.5 range. However, within the province there is a great deal of variation. A few local health areas actually report no infant deaths over the five years from 1994-1998, while others report rates as high as 19.8 per 1,000, or nearly 2% of all babies born. This is similar to rates seen in Greenland (over 20) or Argentina (about 18.8).

The National Centre for Health Statistics (United States) has compared infant mortality among different ethnic groups within the United States and found significant variation. The same is true in British Columbia, where, on the whole, the aboriginal rate is noticeably higher than the overall rate. In two health regions, for example, the aboriginal infant mortality rate is over three times higher than the overall rate.

source: British Columbia Vital Statistics Agency
The age-standardized mortality rate is yet another means of comparing relative death – and by proxy, health status – across geographic areas. In this case, age-specific rates of death are made comparable using a standard population age distribution. The rates themselves are not particularly meaningful, but the comparison among rates is.

There is a two-fold difference in age-standardized mortality rate across the province with lower rates concentrated in the southern areas.
Breast cancer is a significant cause of cancer-related deaths among women, although not the leading cause. There is a ten-fold variation in the age-standardized mortality rate from breast cancer across local health areas in British Columbia.

There are large variations even within some regions – for example East Kootenay, where both the highest and lowest ranges are present. Mortality rates may vary for a number of reasons including stage of disease at diagnosis. There is not, however, anything near perfect correlation between screening mammography (see map 2.4.7 in this atlas) and breast cancer mortality.
The incidence of prostate cancer has been increasing in recent years, though much (perhaps all) of that increase may be the result of increased screening. Men are more likely to die with than to die from this particular type of cancer.

Age-standardized mortality rates from prostate cancer show an even greater variation than breast cancer mortality rates – from a low of no reported cases over the five years 1995-1999 to a high of 8.45 deaths per thousand population.
Lung cancer is a major cause of cancer deaths in the province. There is a large variation in age-standardized mortality from lung cancer, with the northeast corner of the province showing a rate from 1995-1999 that is nearly twice as high as anywhere else.

Smoking is the leading cause of lung cancer, with nearly 9 out of 10 cases of lung cancer attributable to past smoking habits.

Occupational exposures are also important, however. The nature of employment in conjunction with smoking trends may account for much of the variation in lung cancer seen across British Columbia.
Acute myocardial infarctions, or heart attacks, are of interest because heart disease is the leading cause of death in Canada and in BC. Proper care immediately following a heart attack can prevent death and limit long-term disability.

Because of the availability of data, we were only able to count heart attacks that resulted in acute care admissions. Within those admissions, we excluded anyone who died within one hour, who was discharged alive after less than three days, or who had an acute care admission for a heart attack in the preceding year.

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Comparing Health Regions

Age-standardized Acute Myocardial Infarction Hospitalizations
Ratio of observed to expected

1.27 to 1.80
1.36 Northern Interior
1.34 North West
1.29 South Fraser

1.18 to 1.27
1.24 Fraser Valley
1.23 North Shore
1.23 Peace - Liard
1.20 Coast - Garibaldi

1.00 to 1.18
1.16 Cariboo
1.16 West Kootenay - Bdry
1.15 Ctrl Vancouver Island
1.14 North Okanagan
1.13 Upper Island - Ctrl Coast
1.12 Thompson

below 1.00
0.98 East Kootenay
0.91 Okanagan - Similkameen
0.86 Capital
0.83 Burnaby
0.74 Vancouver
0.74 Simon Fraser
0.62 Richmond

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The map and cartogram here compare rates of admission for acute myocardial infarction across regions in BC. The rates are indirectly standardized for age to permit fair comparisons. The maps reveal substantial variations but no clear geographic pattern for local health areas, while the cartogram suggests rates may be lower in more populated areas of the province.

Because these data are based on hospital admissions, they do not include people who suffer an AMI but do not survive to hospital admission (such as those who die in ambulances or emergency departments). This may relate to severity of the heart attack, but it may also be related to accessibility and availability of emergency services (including ambulance) and/or hospital beds.

It is possible, for example, that heart attack rates are lower in the very northwest corner of the province not because they are relatively fewer in number, but because it is less likely that people there will make it to hospital in time to be resuscitated and then admitted to acute care.

... continued next page

source: Centre for Health Services and Policy Research
The survival cartogram shows the proportion of heart attacks that result in death within thirty days, death between thirty days and one year, and a greater than one year survival.

The chance of long-term survival appears to be greater in the northern health regions, though this again may be related to available data as much as real differences in heart attacks.

Comparing Health Regions

<table>
<thead>
<tr>
<th>Post-AMI Mortality</th>
<th>death within 30 days</th>
<th>death in 30 d to 1 yr</th>
<th>no death</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern Interior</td>
<td>10.0</td>
<td>4.5</td>
<td>85.5</td>
</tr>
<tr>
<td>Peace - Liard</td>
<td>10.1</td>
<td>5.6</td>
<td>84.3</td>
</tr>
<tr>
<td>North West</td>
<td>10.1</td>
<td>6.2</td>
<td>83.7</td>
</tr>
<tr>
<td>Cariboo</td>
<td>9.7</td>
<td>8.0</td>
<td>82.3</td>
</tr>
<tr>
<td>Coast - Garibaldi</td>
<td>13.8</td>
<td>6.9</td>
<td>79.3</td>
</tr>
<tr>
<td>South Fraser</td>
<td>13.3</td>
<td>7.8</td>
<td>78.9</td>
</tr>
<tr>
<td>North Okanagan</td>
<td>15.1</td>
<td>6.4</td>
<td>78.5</td>
</tr>
<tr>
<td>Ctrl Vancouver Island</td>
<td>14.7</td>
<td>7.0</td>
<td>78.3</td>
</tr>
<tr>
<td>Upper Island - Ctrl Coast</td>
<td>14.9</td>
<td>6.9</td>
<td>78.2</td>
</tr>
<tr>
<td>East Kootenay</td>
<td>13.1</td>
<td>8.8</td>
<td>78.1</td>
</tr>
<tr>
<td>Fraser Valley</td>
<td>13.5</td>
<td>8.5</td>
<td>78.0</td>
</tr>
<tr>
<td>Okanagan - Similkameen</td>
<td>15.2</td>
<td>7.0</td>
<td>77.8</td>
</tr>
<tr>
<td>Simon Fraser</td>
<td>14.8</td>
<td>7.8</td>
<td>77.4</td>
</tr>
<tr>
<td>Capital</td>
<td>15.5</td>
<td>8.1</td>
<td>76.4</td>
</tr>
<tr>
<td>Thompson</td>
<td>18.8</td>
<td>5.7</td>
<td>75.5</td>
</tr>
<tr>
<td>Richmond</td>
<td>16.1</td>
<td>8.4</td>
<td>75.5</td>
</tr>
<tr>
<td>North Shore</td>
<td>16.6</td>
<td>8.2</td>
<td>75.2</td>
</tr>
<tr>
<td>Burnaby</td>
<td>16.5</td>
<td>8.4</td>
<td>75.1</td>
</tr>
<tr>
<td>West Kootenay - Bdry</td>
<td>19.1</td>
<td>8.0</td>
<td>72.9</td>
</tr>
<tr>
<td>Vancouver</td>
<td>20.1</td>
<td>8.1</td>
<td>71.8</td>
</tr>
</tbody>
</table>
Anti-retroviral Care

Over the past twenty years, and particularly in the last decade, HIV/AIDS has been slowly transforming from a diagnosis with an almost certain guarantee of death to a chronic – albeit still clinically complicated – condition. As a result, a measurement of those on anti-retroviral care is perhaps one of the best measures of the prevalence of HIV.

Much of the responsibility for this transition lies with the development of anti-retroviral drug therapy, which is made available without charge to all persons in British Columbia who are clinically eligible to receive it. The use of this therapy has thus become one of the more reliable means of identifying people with HIV/AIDS.

There is a twenty-five-fold variation in the use of anti-retroviral therapy across the province as well as a north – south gradient. By far the highest rate – four times the second highest – is in the city of Vancouver.

One explanation for this high rate is likely the prevalence and concentration of intravenous drug use on the city’s downtown eastside. Another contributing factor may be that people with the diagnosis often choose to move to Vancouver to be closer to the specialized services, including social support services, that help them cope with the disease.
Kindergarten Immunizations

Childhood immunizations are considered a good measure of preventive health care; their provision should be nearly universal.

The data mapped show immunization rates by Health Region for four years starting in 1997 for DPT – a combined series for protection against diphtheria, tetanus and pertussis. In most cases, the series is administered to infants, so measurement of immunization status at entry to kindergarten is a reasonable estimate of population coverage.

With one exception, immunization rates in all regions in all years exceed 85%. Though generally high, there is still some variation across the province.

There is a north—south difference seen here, in this case with immunization rates tending to be higher in the north and lower in the south. The lowest rates overall are found in the South Fraser Health Region.

source: Health Data Warehouse, BC Ministries of Health Planning and Health Services
Another generally accepted preventive health practice is screening mammography—particularly for women over age 50. The data mapped here represent participation rates for women aged 50-74 over the two years 1998-1999.

The range in mammography participation is from 8% to 70% of women. The lowest rates tend to be concentrated in the southeast corner of the province, and the highest in a few local health areas of the southern half of the province. It is interesting to note the variation within a single...

... continued next page
Screening Mammography Participation Rate among Women aged 50-74

Comparing Health Regions
Screening Mammography Participation Rate among women aged 50-74

- **above 50 %**
  - Okanagan - Similkameen 56.0%
  - North Okanagan 54.4%
  - Thompson 53.2%
  - Capital 53.0%
  - Richmond 52.9%
  - Northern Interior 51.1%
  - Capital Vancouver Island 51.0%

- **40 - 50 %**
  - North Shore 49.8%
  - Fraser Valley 49.8%
  - Burnaby 48.0%
  - Simon Fraser 46.3%
  - South Fraser 46.3%
  - Vancouver 44.7%
  - Upper Island / Central Coast 44.0%

- **30 - 40 %**
  - West Kootenay - Bdry 38.5%
  - Peace - Liard 38.4%
  - Cariboo 38.3%
  - North West 37.5%
  - Coast - Garibaldi 35.4%

- **below 30 %**
  - East Kootenay 28.7%

... continued from previous page

Health Region, for example the comparison between the city of Victoria (LHA 61) compared to the rest of the Capital Health Region.

The cartogram, as expected, decreases the variability seen at the local health area level, but there remains an almost two-fold difference across health regions. With the exception of Richmond, fewer than half of women in health regions in greater Vancouver have mammograms over a two-year period.

In contrast, several more rural health regions have participation rates greater than 50%. If there is continued support for screening mammography as a preventive measure against breast cancer, it would be interesting to investigate the reasons for these differences, particularly because they suggest something other a traditional notion of access is having an influence.

One note on the cartogram is that while Cariboo-Chilcotin (LHA 27) shows one of the highest screening mammography participation rates, its neighbour to the south (100 Mile House, LHA 25) appears to have a rate of zero. This significantly lowers the participation rate for the Cariboo Health Region.

Source: Screening Mammography Program of British Columbia, BC Cancer Agency, obtained through Health Data Warehouse, BC Ministry of Health Planning and Health Services
Data for median household income are derived from the 1996 census. All sources of income are included, such as wages, investment income, transfer payments and so on. No adjustment has been made either for cost of living by area of the province or household size.

Though not a perfect measure, median household income provides a broad-brush picture of spending power by area of the province. Higher income areas are in the southwest and northern two-thirds of the province. Lower income areas are in the south-central section of the province.

... continued next page
In some cases, lower income may be related to a higher proportion of elderly in the population. In the northern areas of the province, income will in large part be driven by the success of the resource-extracting industries that predominate in each region.

Greater Vancouver includes the health regions with both the highest (North Shore) and (almost) lowest median incomes (Vancouver). This correlates well with education levels (see section 3.3), in which North Shore has the highest percentage of university graduates and the highest percentage of high-school completion, and Vancouver has the second-highest percentage of university graduates, but the lowest high-school completion rate.
3.1.2 Low Income / Child Poverty

The incidence of low income and child poverty are also derived from the 1996 census, which defines the low income-cut-off as the income level “… at which a family may be in straitened circumstances because it has to spend a greater portion of its income on the basics (food, clothing and shelter) than does the average family of similar size.”

The incidence of low income shows a ten-fold variation across the province with the areas most affected being the city of Vancouver and two local health areas that have a high proportion of aboriginal residents.

High rates of child poverty tend to follow with low income; more than half of kids in the downtown eastside of Vancouver and in Telegraph Creek are living in poverty.
### Low Income / Child Poverty

**Incidence of Low Income**

<table>
<thead>
<tr>
<th>Population</th>
<th>Percentage of Households</th>
</tr>
</thead>
<tbody>
<tr>
<td>500,000</td>
<td>above 27.8%</td>
</tr>
<tr>
<td>200,000</td>
<td>20.0 - 27.8%</td>
</tr>
<tr>
<td>100,000</td>
<td>15.2 - 20.0%</td>
</tr>
<tr>
<td>50,000</td>
<td>15.2 - 8.0%</td>
</tr>
</tbody>
</table>

#### Comparing Health Regions

**Low Income Households as percentage of all households**

- **above 27.8%**
  - 31.0% Vancouver

- **20.0 - 27.8%**
  - 27.8% Burnaby
  - 26.0% Richmond

- **15.2 - 20.0%**
  - 19.2% Simon Fraser
  - 17.9% South Fraser
  - 17.4% Central Vancouver Island
  - 17.2% Thompson
  - 17.1% West Kootenay - Bdcy
  - 17.1% Okanagan - Similkameen
  - 16.8% North Okanagan
  - 16.8% Fraser Valley
  - 15.7% North Shore
  - 15.6% Cariboo
  - 15.4% Capital

- **15.2 - 8.0%**
  - 15.2% Upper Island / Central Coast
  - 15.2% East Kootenay
  - 14.4% Coast - Garibaldi
  - 14.2% Northern Interior
  - 13.7% Peace - Liard
  - 12.8% North West

*Source: 1996 census, obtained through Health Data Warehouse, BC Ministries of Health Planning and Health Services*
Income Assistance

Income assistance, or welfare benefits, are available in British Columbia under a variety of circumstances. Some people may qualify after exhausting employment insurance benefits, others may be covered because they are deemed ‘unemployable’.

The data shown here are coverage rates for people aged 19-64 excluding aboriginals living on reserve and those who qualify for disability benefits.

The receipt of income assistance is mapped based on eligibility as of June 2000. We compared these rates to those from December 2000 to see ... continued next page
3.1.3 Income Assistance

... continued from previous page

whether patterns seen would change based on seasonal variations, but no seasonal patterns emerged.

The proportion of population receiving benefits ranged from slightly less than 1% to nearly 20%. There is some correlation between receipt of income assistance and unemployment but it is by no means
What is meant by “Median Income Share”?

A region’s median income share is the proportion of total income received by the poorest half of the region’s residents. A region with a perfectly even income distribution would have a median income share of 50% -- half of all income is distributed to the poorest half of residents. The poorest half of the population is worse off as median income share decreases from 50%.

The relationship between median income share (or other measures of income inequality) and overall population health has been the subject of extensive debate over the past few years. Studies at the national level have shown that countries with a more even distribution of income have healthier populations. Within the United States, the same finding holds true comparing income distribution among states.

Canadian metropolitan data, when added to data from the US, tend to show less variation and consequently less association between income distribution and population health. It is not yet clear whether this weakens the hypothesized association between the two variables, or if, instead, it suggests important differences in individual behaviour or social organization between the two countries.

It is possible, for example, that Canada’s commitment to universal programs such as health care contribute in both direct (through the provision of health services) and indirect (through the security generated by a safety net) ways to the population’s health.
Across the United States and Canada, median income share values range from a low of 15% in the American south (for example, cities Texas or Louisiana) to a high of about 27%, in small towns and cities with traditionally blue-collar workforces such as Barrie, Oshawa or BC’s Kitimat.

Among BC local health areas, the range in median income share is from 17% to just over 27%. There is no clear geographic pattern either from north to south or between more urban and more rural areas.
Mining, forestry and agriculture are three of the largest industries of employment in British Columbia. Many areas of the province are heavily reliant on one of these industries for employment, as shown in the accompanying map.

Economic Base Theory classifies employment into basic - employment that exports goods or services from a region – and non-basic – employment that depends on a basic industry for its well-being.

For example, one quarter of the working population in Fernie is employed in mining, a basic industry. The labour force engaged in mining and resident in Fernie in turn supports many non-basic industries in the town, such as restaurants, perhaps a local hardware store, and so on.

This type of relationship is known as an ‘economic multiplier’, or the amount by which one basic industry job is ‘multiplied’ in the local economy through that employee’s consumption of local goods and services. If each miner (in this case) creates two additional local jobs through his/her spending, the mining industry is said to have a multiplier of two.

Smaller areas such as Fernie can be at a disadvantage for two reasons. First, heavy dependence on a single industry for employment makes an area vulnerable to economic fluctuations associated with that industry; lay-offs affect each employee and the overall livelihood of the area as well. Second, and related, the multipliers in smaller areas tend to be much lower because of a greater likelihood of people choosing or being forced to spend money outside their home region because of the local availability of goods or services.

see 'Notes to Maps' for exact definitions of industries.

source: 1996 census, Health Data Warehouse, BC Ministries of Health Planning and Health Services
3.2.2 Unemployment

Unemployment figures are derived from the 1996 census, and refer to the proportion of the labour force aged 15 and over (excluding institutional residents) who were without paid work and were searching for paid work (see ‘Notes to Maps’ for full definition).

The highest rates of unemployment are found on the central and northern coast of the province as well as the downtown eastside of Vancouver. Not surprisingly, youth unemployment tends to be high in parallel with unemployment overall.

In general, there are far lower rates of unemployment in the southern areas of the province. The Capital Health Region and greater Vancouver enjoy among the lowest rates of unemployment in B.C.

source: 1996 census, obtained through Health Data Warehouse, BC Ministries of Health Planning and Health Services
Data from the 1996 census are available indicating the proportion of the population aged 15 and over who have completed grade 12. This measure is, of course, a bit problematic because the normal age of grade 12 completion is greater than fifteen. But since this definition is applied consistently across the province it still has some utility – though it will underestimate a true high school completion rate.

Note that this map is based on the entire population, and thus will include elderly citizens who may not have had the same opportunities for formal education that exist today.

Source: 1996 census, obtained through Health Data Warehouse, BC Ministries of Health Planning and Health Services
In order to graduate, students must complete English 12 (or its modified version, Communications 12) by successfully writing the Provincial Examination (a standardized, province-wide examination) prepared for that course each year. This gives us an approximate indicator of the current high-school completion rate, although some sources of error remain (see notes to maps for further details).

There are pockets of the province where fewer than half of students complete English / Communications 12. This is perhaps surprising since these data reflect the educational status of the current cohort of young adults.
In comparing the university graduation rate (green) to the grade nine non-completion rate (brown), one item of interest is the sharp contrast between the North Shore and Vancouver. The North Shore has the highest percentage of University graduates in the province, and also the lowest percentage of residents without grade 9.

Yet, just across the harbour, Vancouver has the second highest percentage of University graduates in the province (a scant 0.1 % behind), yet simultaneously has the highest percentage of residents without grade 9.
Violent crime includes acts committed against a person, such as assault, battery and murder (BC Stats definition). The data mapped are aggregated over the 1996 to 1998, so the rate reflects violent crime experienced over that three-year period.

By far the highest rates of violent crime are found in a few local health areas in the north and the city of Vancouver. There is a concentration of local health areas with very low rates of violent crime in the Okanagan and West Kootenay.
Property crime is of interest because it is very likely to have an effect on feelings of safety and perhaps ‘trust’ in local areas. Property crime rates are mapped aggregating incidents from 1996-1998.

Vancouver experiences very high rates of both property and violent crime, but otherwise the patterns across the province do not appear to be highly correlated.

The variation in property crime is five-fold across local health areas; this is much less than the more than ten-fold variation seen for violent crime. Property crime is also a much more common occurrence than is violent crime.
Drinking Water Sources

How many of us can accurately trace our drinking water from rainfall to kitchen tap? Drinking water quality has long been a matter of concern, but only recently has it taken on a higher profile in public debate - perhaps in part because of the tragedy in Walkerton, Ontario and a more recent contamination event in Ladysmith.

This section is included in recognition of increased public interest regarding water sources and quality.

Drinking water is often thought of as being drawn from the more visible sources such as lakes, rivers, creeks or man-made reservoirs, and in many cases this is correct. These surface water sources are often readily accessible, and tend to be fairly clean and abundant, but are also prone to bacterial and other contamination.

Much of rural and small-town British Columbia relies instead on groundwater to supply municipal systems. Globally, about two-thirds of drinking water comes from groundwater sources. The Earth’s crust stores fresh water in underground layers of permeable rock (sandstone, for example) called aquifers, which may in turn be covered by layers of impermeable rock (such as granite) creating confined aquifers. This covering can protect the aquifer from chemical infiltration from sources like septic tanks, landfills, oils, and other pollutants. In many cases, groundwater is the safest and cleanest source of drinking water. In fact, one of the best ways to purify drinking water, given a long enough timeframe, is to simply step back and “let the dirt do its work”!

... continued next page
But pumping water out of a well (or aquifer) can deplete groundwater sources if the extraction rate exceeds the replenishing processes of rainfall and snowmelt, collectively termed “recharge”. This is an irresponsible and unsustainable situation that leads to falling water tables and, in extreme cases, slumping – physical changes in topography – and, in several cases, property damage.

The highly modified landscapes of cities make it difficult to rely on groundwater. Instead of rainfall being absorbed into the soil, it is carried away on impermeable surfaces covered in pollutants, such as roads. At some point of population size, reliance on groundwater becomes unsafe and unwise.

sources: interviews with municipalities shown, Summer 2001
Special Topic: Drinking Water Quality

These numbers refer to average numbers of boil-water advisories from 1993 through 1998.

Note that these figures are based on the number of water systems, and is not corrected for the size of these systems. A contributor to the high count of the West Kootenay - Boundary region is due to its large number of separate, small-scale surface water systems. Despite this, the trend shown on this map is believed to be qualitatively true.

Also note that in some cases a boil-water advisory may be used as a preventative measure in areas where only a very small risk of contamination is present.

### Number of Boil-water Advisories

<table>
<thead>
<tr>
<th>Region</th>
<th>AVG.</th>
<th>6/95</th>
<th>10/96</th>
<th>10/97</th>
<th>11/98</th>
</tr>
</thead>
<tbody>
<tr>
<td>West Kootenay - Boundary</td>
<td>73</td>
<td>47</td>
<td>83</td>
<td>80</td>
<td>83</td>
</tr>
<tr>
<td>Thompson</td>
<td>25</td>
<td>34</td>
<td>23</td>
<td>23</td>
<td>19</td>
</tr>
<tr>
<td>Central Vancouver Island</td>
<td>22</td>
<td>20</td>
<td>18</td>
<td>20</td>
<td>29</td>
</tr>
<tr>
<td>Fraser Valley</td>
<td>20</td>
<td>22</td>
<td>18</td>
<td>19</td>
<td>19</td>
</tr>
<tr>
<td>East Kootenay</td>
<td>17</td>
<td>10</td>
<td>18</td>
<td>20</td>
<td>18</td>
</tr>
<tr>
<td>Coast - Garibaldi</td>
<td>11</td>
<td>15</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Upper Island / Central Coast</td>
<td>11</td>
<td>9</td>
<td>9</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Capital</td>
<td>11</td>
<td>7</td>
<td>11</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Simon Fraser</td>
<td>7</td>
<td>9</td>
<td>8</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Okanagan - Similkameen</td>
<td>7</td>
<td>8</td>
<td>7</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>Northern Interior</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>North Okanagan</td>
<td>7</td>
<td>5</td>
<td>5</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>North Shore</td>
<td>6</td>
<td>4</td>
<td>6</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>North West</td>
<td>5</td>
<td>6</td>
<td>6</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>Cariboo</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>South Fraser</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

**NOTE:** Vancouver-Richmond and Peace - Laird did not have any outstanding boil-water advisories in effect through these periods.

**Source:** Public Health Protection Branch, Public and Preventive Health Services, BC Ministry of Health, obtained through Health Data Warehouse, BC Ministries of Health Planning and Health Services
# Health Workforce

There are a myriad of professional groups that are employed in the health care industry, from physicians and nurses to laboratory technicians, occupational therapists, dental hygienists and social workers.

Labour is the single largest expense in health care, and is, of course, essential to the functioning of the health care system.

There are different ways that labour could potentially be deployed to deliver services. Finding the mix of health personnel which best enhances public choice and ensures public safety is a challenge for system managers.

The maps on the following pages detail some of the differences in the supply of health professionals across regions in British Columbia. As an introduction, the chart on this page shows the number of professionals in select health workforce groups, and their relative composition of males and females.

Females are predominant in most of the professions detailed here (which are those covered by regulatory bodies, for which membership is mandatory in order to practice in the province).

## Numbers and Sex Distribution of the Health Workforce

<table>
<thead>
<tr>
<th>Profession</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Certified Dental Assistants</td>
<td>n = 4885</td>
</tr>
<tr>
<td>Dental Hygienists</td>
<td>n = 1743</td>
</tr>
<tr>
<td>Registered Nurses</td>
<td>n = 31512</td>
</tr>
<tr>
<td>Occupational Therapists</td>
<td>n = 966</td>
</tr>
<tr>
<td>Licensed Practical Nurses</td>
<td>n = 4863</td>
</tr>
<tr>
<td>Physical Therapists</td>
<td>n = 2118</td>
</tr>
<tr>
<td>Registered Psychiatric Nurses</td>
<td>n = 2495</td>
</tr>
<tr>
<td>Massage Therapists</td>
<td>n = 1371</td>
</tr>
<tr>
<td>Pharmacists</td>
<td>n = 3008</td>
</tr>
<tr>
<td>Psychologists</td>
<td>n = 944</td>
</tr>
<tr>
<td>Directory Active Physicians</td>
<td>n = 8809</td>
</tr>
<tr>
<td>Emergency Medical Assistants</td>
<td>n = 2802</td>
</tr>
<tr>
<td>Dentists</td>
<td>n = 2666</td>
</tr>
<tr>
<td>Chiropractors</td>
<td>n = 698</td>
</tr>
<tr>
<td><strong>Total of all above categories</strong></td>
<td>n = 69122</td>
</tr>
</tbody>
</table>

71.6 %

source: ROLLCALL 99, Vancouver Health Human Resources Unit, 2000
Physical Therapists data are from ROLLCALL 98.
General Practitioners

The availability of general practitioners is generally considered one indicator of an area’s ability to provide proper primary health care, though the ‘right’ number of GPs per population remains of considerable debate.

The maps here provide numbers of full-time equivalent general practitioners per 10,000 population in each health region. Counting full-time-equivalents (based on annual payments made from the Ministry of Health to each physician, see Notes to Maps for more detail) instead of number of physicians provides an adjustment for work patterns, or the actual provision of services.
General Practitioners

General patterns of in-migration to BC from other parts of Canada as well as immigration from other countries makes it no surprise that a substantial proportion of physicians practicing in BC did not go to medical school in the province.

Graduates of UBC’s medical school account for the largest proportion of the physician workforce in the North Shore, the North Okanagan and Cariboo health regions. While this does not follow any particular pattern, there is a general trend toward a heavier dependence on foreign graduates in health regions that have a smaller supply of physicians overall.

Some of the differences seen here reflect variations in different regions’ ability to attract graduates of UBC, or of other Canadian medical schools, and to retain such physicians once recruited.
General Practitioners

902 (Vancouver)

100 - 200
50 - 100
15 - 50
10 - 15
5 to 10
below 5

Aggregations Made:

Comox Valley
- Courtenay
- Comox
- Cumberland

Duncan / N.C.
- Includes Duncan and North Cowichan (which includes Chemainus), as well as the South Cowichan Valley (which includes Lake Cowichan lake, Mill Bay, and Cowichan Bay)

S. Gulf Islands
- Includes Galiano, Mayne, the Penderas, Saturna, and Salt Spring

Saanich Peninsula
- Sidney
- North Saanich
- Central Saanich

East Shore (Victoria)
- Langford
- Colwood
- Metchosin

Tri-Cities
- Coquitlam
- Port Coquitlam
- Port Moody

Southern Interior Abbreviations:

Av = Armstrong
An = Acrhcroft
Bc = Balfour
Ch = Chase
Cf = Canal Flats
Cl = Christinna Lake
En = Enderby
Fs = Fort Steele
Lk = Logan Lake
M = Meadow Creek
Mc = Midway
Nk = Nakusp
Gn = Golden
K = Keremeos
Lm = Lumby
O = Okanagan Falls
Phn = Princeton
Sa = Salmo
Sc = Sicamous
Si = Shuswap / New Denver
Sz = Sardine
Sp = Sparwood
SpGr = Spences Bridge
SS = South Slocan

source: Medical Services Plan, BC Ministry of Health. Geographic postal code data provided by Canada Post Corporation.

This map is based on data for general practitioner office addresses and the number of practicing GPs in each of these offices. It is geocoded by six-digit postal code, and in urban areas this is precise to within a city block. Precision in rural areas is consistent with the method of postal delivery in these areas, but will not affect the result at this scale. Data are unavailable for Ladysmith and parts of the Central Coast owing to recent changes in postal delivery. Any GP office within 10km of a municipality is grouped with that municipality, with exceptions made for significant natural barriers. Consideration was made to the layout of transportation routes in outlying areas. Note several aggregations were made in cases where multiple municipalities effectively operate as one region, such as Courtenay-Comox-Cumberland.

Data may not be perfectly consistent with other sources.
Specialist Physicians

Physicians with specialty training can be divided into a variety of groupings. We have chosen to use the classifications developed by the Royal College of Physicians and Surgeons of Canada. Details on the mapping of specialties to these groups can be found in the Notes to Maps section.

For this cartogram, the size of the circle for each health region determined by the supply of specialists per 10,000 population rather than the size of the population. This means that health regions with larger circles have a greater availability of specialists after considering population size.

It should be no surprise that there is a greater supply of specialists in Vancouver, because this is where a large proportion of the province’s tertiary services – which depend on specialists – are provided.

Relative differences in other areas suggest something about access to care, or the ability of residents to receive needed services without a great deal of travel.
Nursing Supply, 1999

Nurses are the single largest health profession in British Columbia. They are essential to the provision of health care services in acute hospitals as well as in long term care facilities and the community.

There is a far greater supply of nurses in the Vancouver and Capital health regions and in southern regions more generally compared to the north. As with the supply of physicians, this may in part reflect the greater need of nurses for the provision of tertiary care services.
Registered Nurses, 1999

Registered Nurses are 80% of the overall nursing workforce, so the patterns seen here are very similar to those on the ‘Overall Nursing Supply’ map.

Of particular interest is that there is no health region in which the supply of nurses per capita declined between 1994 and 1999. In fact, 6 health regions increased their nurse to population ratios, and two of these showed increases greater than 10% over this five-year period.
Registered Psychiatric Nurses, 1999

The Simon Fraser health region has the greatest number of registered psychiatric nurses – nearly three times as many per capita as the second highest health region.

This concentration in Simon Fraser can be explained by the presence of Riverview Hospital, the province’s residential mental health care facility.
Licensed Practical Nurses, 1999

Licensed practical nurses are most heavily concentrated in the three health regions that make up the southeast corner of the province.

In all but one health region, their numbers have declined since 1994; and in all but one of these health regions the decline was greater than 10% over those five years.

These trends suggest there has been a deliberate strategy during the 1990s to decrease the use of licensed practical nurses, despite growing concern over a ‘nursing shortage’.
Occupational Therapists, 2000

An Occupational Therapist plans and carries out individually-designed programs of activity for patients with physical or mental health problems to enhance their ability to care for themselves and to engage in work and/or recreational pursuits. Many Occupational Therapists work in acute or long-term care environments.

Their numbers have increased throughout most areas of British Columbia, with the exception of the Northern Interior, where numbers per 10,000 have declined since 1994.
Physical Therapists, 1998

A Physical Therapist (formerly a physiotherapist) provides physical, diagnostic, and rehabilitative services to patients with selected physical dysfunctions. A significant portion of them work in private practice, as well as in acute and long-term care facilities.

Their numbers per 10,000 population are increasing rapidly in some southern areas of the province, yet are declining in the northern interior and in Vancouver - Richmond.
The use of acute, inpatient hospital care has been declining in British Columbia and around the world for at least the last three decades. The decrease, for example, between 1969 and 1998/99 was 43% in cases admitted to acute care and 65% in the number of days of acute care provided.

Despite these overall changes, there remains a four-fold variation in the indirectly-standardized use of acute care days across local health areas with the lowest rates tending to be in the southwest corner of the province.

These data are age-standardized, and do not reflect differences in the age structure of local health areas.
There is a similar level of variation in number of acute care separations across the province. Separations from acute care tell us something about the relative use of inpatient hospital care. Their combination with length of stay results in total days of care.

The patterns for separations and days are fairly similar across local health areas, This implies that it is not length of stay but rather admission to acute care that varies by local health areas.
The Medical Services Plan in British Columbia provides payment for services provided by physicians and alternative providers such as naturopaths, chiropractors, massage therapists and physical therapists. The data shown here include only fee-for-service payments. This limitation underestimates spending on psychiatry and general practitioners in some rural local health areas.

Payments to physicians are attributed to local health areas based on the home address of the patient receiving the service. In other words, the rates seen here reflect the use of services regardless of whether that service was received in a local physician office or in a specialist’s office some
This map shows Medical Services Plan billings for general practitioners per capita.

There is a far greater variation in spending on General Practitioners than on MSP services overall, though, as noted, some GP services are excluded. The highest per capita spending occurs in several less-populated local health areas.

These data are age-standardized, and do not reflect differences in the age structure of local health areas.
The continuing care system in British Columbia provides care and support services for people who require assistance with activities of daily living. There are two broad types of services available. Home support, such as homemaker services or short-term home nursing care, provides services to people in an effort to allow them to remain in their own homes. Residential care is available to people who can no longer safely live on their own, and who do not have an informal support network of friends and family to care for them in the community.

The maps here provide a count of the number of individuals who received continuing care services during the fiscal year 1998/99.
Residential care services in British Columbia are utilized at a lower rate than home care services, although the disparity between these rates does vary.

Utilization rates (in this case, expressed as an age-standardized rate per 1,000 population) show peaks in the northeast, the central coast, and parts of the Kootenays.

Residential care services are not universally available throughout all areas of the province; we see that several predominantly rural local health areas have utilization rates of zero.

source: PURRFECT, obtained through BC Ministries of Health Planning and Health Services
The concept of continuity of care has gained popularity over the past few years though as yet no standard definition for it exists. Continuity is promoted as a goal in the delivery of health care because of its (in many cases presumed) relationship with quality outcomes.

The map here defines continuity of care as the proportion of total physician care during 1995/96 received from the general practitioner seen most often by each patient. Visits to specialists are attributed to the general practitioner who made the referral under the assumption that care provided by such physicians will be coordinated by the GP.

Based on a random sample of 200,000 residents with at least 3 physician visits over 1995-1996. Specialist referrals accrue back to the patient’s GP.

(see ‘notes to maps’ for further information)
Continuity of Physician Care

Percentage of Patient Visits to that Patient’s Usual Physician

(see ‘Notes to Maps’ for details)

- above 66%
- 63 - 66%
- 61 - 63%
- 57 - 61%

Comparing Health Regions

Percentage of Physician Visits to that Patient’s Usual Physician

see ‘Notes to Maps’ for details

- above 66%
  - 66.6% Vancouver

- 63 - 66%
  - 65.2% Richmond
  - 64.4% Northern Interior
  - 63.9% Thompson
  - 63.2% Okanagan - Similkameen
  - 63.1% Central & North Okanagan
  - 63.0% Capital

- 61 - 63%
  - 62.8% Fraser Valley
  - 62.8% West Kootenay - Bdry
  - 62.4% Burnaby
  - 62.0% North West
  - 61.9% Upper Island - Ctrl Coast
  - 61.9% Simon Fraser
  - 61.1% Coast - Garibaldi

- 57 - 61%
  - 60.1% Cariboo
  - 59.2% South Fraser
  - 58.8% North Shore
  - 58.4% Peace - Liard
  - 57.8% East Kootenay

... continued from previous page

Continuity of care was calculated for a random sample of 200,000 British Columbians. People with 2 or fewer visits to a physician during the year were excluded because their continuity measure would be artificially high because of a low visit rate.

The range in continuity is from 50% to 72% of care received from a single provider. Neither the map of local health areas nor the cartogram suggest any strong geographic pattern to these rates. The range in rates of continuity is much smaller among health regions than among local health areas.

... continued next page

source: BC Linked Health Data Set
While there is intuitive appeal to the notion that receiving a majority of care from a single provider will improve health outcomes for any number of reasons, it is important to put this assumption to an empirical test.

The map and cartogram here demonstrate the relationship between continuity and hospital utilization in the year following the measurement of continuity. The underlying hypothesis is that people (and geographic regions) that experience higher continuity will have a lower hospitalization rate.

source: BC Linked Health Data Set
Continuity of Physician Care

Acute Care Hospitalization Rate based on Continuity of Care sample

Population | Acute Care Hospitalizations per 1,000
--- | ---
60 to 110 | 0.050
110 to 125 | 0.125
125 to 160 | 0.160
160 to 200 | 0.200

Comparing Health Regions

<table>
<thead>
<tr>
<th>Hospitalizations rate per 1,000</th>
<th>Region</th>
</tr>
</thead>
<tbody>
<tr>
<td>160 to 200 per 1,000</td>
<td>180.2 West Kootenay - Bdry</td>
</tr>
<tr>
<td>125 to 160 per 1,000</td>
<td>158.2 Cariboo, 157.8 Peace - Liard, 144.9 North Okanagan, 135.5 East Kootenay, 130.5 Coast - Garibaldi, 129.3 Northern Interior, 128.0 North West</td>
</tr>
<tr>
<td>110 to 125 per 1,000</td>
<td>123.9 Okanagan - Similkameen, 123.3 Upper Island - Ctlr Coast, 117.4 Thompson, 115.6 Capital, 112.1 Ctlr Vancouver Island, 107.5 Fraser Valley</td>
</tr>
<tr>
<td>60 to 110 per 1,000</td>
<td>98.0 South Fraser, 93.8 Simon Fraser, 89.9 North Shore, 89.3 Burnaby, 88.2 Vancouver, 79.8 Richmond</td>
</tr>
</tbody>
</table>

... continued from previous page

One explanation for this might be that primary prevention efforts (i.e. prevention of the occurrence of a condition) are more possible in an atmosphere of higher continuity. Another is that higher continuity may enable physicians to more readily pick up on early signs of trouble, and institute secondary prevention or other means of minimizing the impact of illness – and thus avoid hospitalization.
High Users of Physician Services

People who make frequent use of the health care system are of interest for a number of reasons, not least of which is that modifying their patterns of use has the potential for the largest impact on health system costs.

In many cases, the rhetoric around ‘high users’ implies that there is rampant abuse of health services; this analysis was intended to address and either verify or refute that notion.

‘High use’ can be defined in any number of ways such as making a lot of visits to physicians, seeing a lot of different physicians, incurring a large amount of expense and so on.

... continued next page
High Users of Physician Services

We developed twenty-five different measures by which a person may become a high user, and identified individuals as such if they were in the top 5% of the distribution for any of these measures.

The result was the identification of over 600,000 residents of British Columbia – more than 15% of the 1996/97 population – as high users.

The local health area map in particular indicates a clear north-south gradient in this proportion, with people in the south of the province far more likely to become high users.
One reason that people make heavy use of the health care system is because they are sick. We used diagnostic codes from physician and hospital contacts to apply the Adjusted Clinical Group classification system developed at Johns Hopkins University and validated in British Columbia. This system groups people according to the type and severity of medical conditions, and provides a way of estimating expected costs based on those illness profiles.

... continued next page
Comparing Health Regions

‘Unexpected’ high users
percentage of total population

- **above 5.2 %**
  - 5.9 % Capital
  - 5.6 % North Shore
  - 5.2 % Okanagan - Similkameen

- **4.75 - 5.2 %**
  - 5.1 % Vancouver
  - 4.8 % Central Vancouver Island

- **4.1 - 4.75 %**
  - 4.7 % Richmond
  - 4.6 % West Kootenay - Bdry
  - 4.6 % Burnaby
  - 4.5 % North Okanagan
  - 4.5 % South Fraser
  - 4.4 % Coast Garibaldi
  - 4.4 % Simon Fraser
  - 4.3 % North West
  - 4.3 % Thompson
  - 4.3 % Fraser Valley
  - 4.1 % Upper Island / Central Coast

- **3.3 - 4.1 %**
  - 3.9 % Cariboo
  - 3.6 % East Kootenay
  - 3.5 % Northern Interior

- **below 3.3 %**
  - 2.8 % Peace - Liard

... continued from previous page

Using the ACG system, high users were divided into those whose use was within limits expected based on what was known about their morbidity, and those whose use was higher than expected based on what was known about their morbidity. The latter are ‘unexpected high users’, and make up 2.2% to 6.8% of the population of each local health area (as shown on previous page).

The strong geographic pattern seen for the high users overall disappears here. This suggests that people who are sick – perhaps people who have chronic diseases – may move to areas of the province that are more likely to be able to provide the types of services (specialty services or others) they require.

... continued next page
Spending on high users can similarly be divided into ‘expected’ and ‘unexpected’ portions. The concluding maps show the proportion of ‘unexpected’ spending on ‘unexpected’ high users. In some areas, this group accounts for more than 10% of total spending on physician services, though they are a much lower proportion of the population.
### Comparing Health Regions

**Percentage of MSP spending to "unexpected" high users**

#### 9.25 - 11%
- 10.79%  Capital
- 10.28%  Vancouver
- 10.28%  North Shore
- 9.66%  Okanagan - Similkameen
- 9.61%  Richmond

#### 8 - 9.25%
- 9.23%  North West
- 9.13%  West Kootenay - Bdry
- 8.67%  North Okanagan
- 8.52%  Cariboo
- 8.48%  Simon Fraser
- 8.31%  Upper Island / Ctl Coast
- 8.26%  Thompson
- 8.25%  Ctrl Vancouver Island
- 8.12%  Burnaby

#### 7.25 - 8%
- 7.91%  South Fraser
- 7.68%  Coast - Garibaldi
- 7.62%  Fraser Valley
- 7.47%  Northern Interior

#### below 7.25%
- 6.55%  East Kootenay
- 6.47%  Peace - Liard

---

**Source:** BC Linked Health Data Set
The BC PharmaCare program provides first-dollar coverage of prescription medications (less a dispensing fee) for all residents aged 65 and over. The only exception in this coverage is status Indians aged 65 and over, who are covered federally.

Data on this and following maps show various measures of prescription pharmaceutical use for the elderly population with adjustments made by LHA based on census aboriginal population.

The total number of prescriptions per senior provides an introduction to the topic, albeit with some caveats because the number of prescriptions will vary depending on the number of pills dispensed as well as the number of different medicines actually required.
Costs per capita provide a picture of how overall expenditures differ across British Columbia. Costs may vary because seniors in certain areas of the province are prescribed more medications, and/or they are prescribed more expensive medications.

There is a 2½-fold variation in expenditures per person across local health areas, with no clear geographic pattern to the trend.
The concept of ‘days supplied’ refers to the number of days that a given prescription is intended to last, according to directions for usage provided by the prescribing physician. A ‘days supplied’ of 30, for example, applies to a medication that is dispensed in a quantity intended to last one month.

The range in days supplied per older adult is from 428 to 869 for the year 1999. This implies that the average BC resident over age 65 is taking more than one medication at a time; the average is just over one in the lower usage areas and greater than 2 in the higher usage areas.
Prescription Drugs and Older Adults

Costs per day is a simple calculation that divides total expenditures by total number of days supplied. This provides an indication of the average daily expense of drugs supplied to seniors across British Columbia.

The more ‘expensive’ areas of the province include older adults who are taking medications that are nearly twice as expensive on a daily basis than the least expensive areas of the province.

This may reflect a preference on the part of physicians for newer (and more expensive) drugs in some areas of the province, but may also reflect differences in the mix of prescription medications provided to the older adult population. This difference in mix may in turn imply geographic variations in the types of illness present.
Examination of one particular therapeutic class of drugs avoids some of the complications of comparing data that may vary for many reasons. Cardiovascular drugs are chosen because they are the single largest component of PharmaCare spending, accounting for 42.1% of total PharmaCare spending on older adults in 1999.

There is a nearly three-fold variation in spending per older adult across the local health areas. Similar to total spending per capita, there is no clear geographic pattern to this variation.
There are areas of the province where the average older adult is taking one medication per day to treat a cardiovascular condition.

Not every older adult is, of course, taking such medications, which implies there are some who are on multiple medications over the course of the year.
There is also a fair variation in the average cost per day for cardiovascular drugs. This measure takes into account the number of days supplied, and in this case is limited to one therapeutic class of drugs, so the differences reflect different patterns of prescribing.

The presence of higher and lower cost areas suggests that there is a tendency in some geographic areas of the province to prescribe more expensive drugs.

It is possible that this tendency relates to variations in the types or severity of cardiovascular conditions experienced by residents, but this could be confirmed (or refuted) by further analysis.

**Costs per day for Cardiovascular Drugs**

(1999 data)

In dollars per day per older adult (65+)

- $1.12
- $1.00
- 97¢
- 93¢
- 89¢
- 77¢

Local Health Areas

- 60

classified by natural breaks

Data unreliable

fewer than 100 prescriptions for Cardiovascular Drugs

Cariboo

Health Regions

**INSET - The Georgia Basin**

- 161 - City Centre
- 162 - Dntr. Eastside
- 163 - North East
- 164 - Westside
- 165 - Midtown
- 166 - South Van.

Vancouver (city)

Source: BC Linked Health Data Set

Note: denominator does not include aboriginals over 65 as they are not eligible for PharmaCare coverage.
The use of health care services by older adults is of interest in the health care system because this use tends to rise with age. The concept of defining the 'frail elderly' population, in an attempt to identify them before they become frail and thus prevent some measure of disability and health care use, is currently of interest to many involved in health care.

One aspect of frailty relates to the level of 'dependence' that people have on the formal health care system. There are many ways independence/dependence... continued next page
### Comparing Health Regions

#### Loss of Independence

<table>
<thead>
<tr>
<th>Percentage of at-risk population losing independence</th>
<th>Region Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 - 10.2 %</td>
<td>8.66 % Vancouver  &lt;br&gt; 8.63 % Burnaby  &lt;br&gt; 8.59 % Capital  &lt;br&gt; 8.52 % West Kootenay - Bdry</td>
</tr>
<tr>
<td>6.5 - 8 %</td>
<td>7.89 % Simon Fraser  &lt;br&gt; 7.77 % North Okanagan  &lt;br&gt; 7.58 % North Shore  &lt;br&gt; 7.51 % Richmond  &lt;br&gt; 7.41 % Peace - Liard  &lt;br&gt; 7.29 % Fraser Valley  &lt;br&gt; 7.16 % Okanagan - Similkameen  &lt;br&gt; 7.16 % South Fraser  &lt;br&gt; 6.91 % Central Vancouver Island</td>
</tr>
<tr>
<td>4.9 - 6.5 %</td>
<td>6.37 % Cariboo  &lt;br&gt; 6.34 % Thompson  &lt;br&gt; 6.21 % East Kootenay  &lt;br&gt; 6.15 % Upper Island / Central Coast  &lt;br&gt; 5.90 % Coast Garibaldi  &lt;br&gt; 5.49 % North West</td>
</tr>
<tr>
<td>below 4.9 %</td>
<td>4.28 % Northern Interior</td>
</tr>
</tbody>
</table>

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could be thought about or measured, but for purposes of this map we have relied on this perspective. Loss of independence is defined as the point at which people appear to become permanently dependent on either high-level in home support services or residential care services provided through the continuing care system, concentrating only people aged 65 and over.

The ‘loss of independence’ group is defined as the number of older adults who made this transition during 1994 or 1995 as a proportion of all seniors who were deemed ‘independent’ as of 1 January, 1995.
Custom Region Mapping: A Focus on Vancouver

This section is included as an example of the potential utility of mapping some regions of the province at a finer level of detail than local health area. Vancouver was chosen for this section because the city has an established set of twenty-three neighbourhoods that are used for various planning purposes. The definition of neighbourhoods for other urban or semi-urban areas is possible, but requires local expertise to ensure that they have relevance in terms of the social make-up of the city.

Text for individual maps is not provided. In all cases, definitions for the variables are the same as their counterparts in the main body of this atlas. Overall, the maps demonstrate the rich variety of experience within residents of Vancouver, and the importance of taking that variation into consideration when planning the delivery of health services.

The Centre for Health Services and Policy Research is available to assist health regions and other organizations with either mapping or developing local mapping capabilities. Our data infrastructure is extremely well-developed, giving us the capability to map at a wide range of spatial scales including not only the traditional (and new December 2001) health boundaries, but also by six-digit postal code, enumeration area, municipality, regional district, or virtually any other boundary of interest.

Details on how to access these services are available following this section.
Presenting a **health mapping service** that is

... **customizable**

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- Census Tract (where available)
- Enumeration Area
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- Neighbourhood Unit

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#429 - 2194 Health Sciences Mall,
University of British Columbia
Vancouver, BC Canada V6T 1Z3

The Custom Health Mapping Service is provided by

**CENTRE FOR HEALTH SERVICES AND POLICY RESEARCH**
6.2.1
Older Adults

Percentage of Population Over 65
(1996 data)

City of Vancouver Neighbourhoods

- Strathcona
- Arbutus - Ridge
- Oakridge

- South Cambie
- Shaughnessy
- Kerrisdale

- Victoria - Fraserview
- West Point Grey
- Hastings - Sunrise
- West End
- Fairview
- Marpole

- Killarney, Riley Park
- Renfrew - Collingwood, Sunset, Dunbar - Southlands
- Kensington - Cedar Cottage

- Central Business District
- Grandview - Woodlands
- Kitsilano

source: 1996 census, City of Vancouver
Young Children

Percentage of Population Under 5
(1996 data)

<table>
<thead>
<tr>
<th>Percentage</th>
<th>City of Vancouver Neighbourhoods</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.3</td>
<td>Sunset</td>
</tr>
<tr>
<td>6.25</td>
<td>Kensington - Cedar Cottage</td>
</tr>
<tr>
<td></td>
<td>Renfrew - Collingwood</td>
</tr>
<tr>
<td></td>
<td>Grandview - Woodlands</td>
</tr>
<tr>
<td>5.5</td>
<td>Hastings - Sunrise</td>
</tr>
<tr>
<td></td>
<td>Mount Pleasant</td>
</tr>
<tr>
<td></td>
<td>Riley Park</td>
</tr>
<tr>
<td></td>
<td>Killarney</td>
</tr>
<tr>
<td>4</td>
<td>Victoria - Fraserview</td>
</tr>
<tr>
<td></td>
<td>South Cambie</td>
</tr>
<tr>
<td></td>
<td>Dunbar - Southlands</td>
</tr>
<tr>
<td></td>
<td>West Point Grey</td>
</tr>
<tr>
<td>3</td>
<td>Marpole</td>
</tr>
<tr>
<td></td>
<td>Strathcona</td>
</tr>
<tr>
<td></td>
<td>Shaughnessy</td>
</tr>
<tr>
<td></td>
<td>Kerrisdale</td>
</tr>
<tr>
<td></td>
<td>Kitsilano</td>
</tr>
<tr>
<td></td>
<td>Arbutus - Ridge</td>
</tr>
<tr>
<td>1.6</td>
<td>Fairview</td>
</tr>
<tr>
<td></td>
<td>Oakridge</td>
</tr>
<tr>
<td></td>
<td>West End</td>
</tr>
<tr>
<td></td>
<td>Central Business District</td>
</tr>
</tbody>
</table>

Source: 1996 Census, City of Vancouver

Note: University Lands (not part of the City of Vancouver)
This map provides an example of data displayed at the level of enumeration area. Enumeration area is the smallest geographic boundary used by Statistics Canada and defines the area for which a single census enumerator is responsible. These areas are defined loosely on population size, so are smaller geographically in cities and larger in more rural regions.

Mapping at the enumeration area level, and even at the six-digit postal code level, is possible. Each may be of interest in certain circumstances. Postal code level mapping may, for example, be appropriate for showing an outbreak of measles or the distribution of other communicable diseases.

However, because some enumeration areas may have low population sizes (such as those in Vancouver’s downtown core), some rates may be unstable. This is one area of concern when mapping by enumeration area, and it is stressed that the overall trend on this map is more reliable than data at the individual EA level, although these data were deemed sufficiently reliable to be mapped here.

The apparently strong female surplus in Oakridge and Kerrisdale may be inflated in that these areas have significant elderly populations, which will tend to feminize the sex ratio, as women have a longer life expectancy than men. (See text in section 2.2.4).
Median Household Income

City of Vancouver Neighbourhoods

- Shaughnessy
- Dunbar - Southlands
- Kitsilano
- West Point Grey
- Arbutus - Ridge
- South Cambie
- Oakridge
- Kinsale
- Renfrew-Collingwood
- Grandview-Woodlands
- Central Business District
- Strathcona

Source: 1996 Census, City of Vancouver
Percentage of Population without High School Graduation
(1996 data)

City of Vancouver Neighbourhoods

- Strathcona
- Hastings - Sunrise
- Renfrew - Collingwood
- Kensington - Cedar Cottage
- Sunrise
- Victoria - Fraserview
- Grandview - Woodlands
- Riley Park
- Mount Pleasant
- Killarney
- Central Business District
- Oakridge
- Marpole
- Arbutus - Ridge
- South Cambie
- Kerrisdale
- West End
- Shaughnessy
- Dunbar - Southlands
- West Point Grey, Kitsilano
- Fairview

source: 1996 census, City of Vancouver
Note
University of British Columbia and Simon Fraser University graduate students total approximately 7,000, or about one-hundredth the size of Vancouver’s population.

Percentage of Population with any University Degree
(1996 data)

source: 1996 census, City of Vancouver
2.1 Population

This layout shows the spatial distribution, growth rates, and age-sex structures of British Columbia’s overall population.

The dot map is based on enumeration-area level data from the 1996 census, however health region and local health area boundaries were included for reference.

Data on percentage population change is based on health region population estimates for 1991 and 2000, found on the Health Data Warehouse, BC Ministries of Health Planning and Health Services. Health regions were classified directly by natural breaks with no adjustments.

Population pyramids are convenient ways to quickly summarize the age-sex structure of a population. The vertical axis is organized by age, split into male and female, and the horizontal axis is a measure of the percentage of the overall population which falls into the category. For example, in the 1976 pyramid (blue line) we can see that roughly 3.5% of males were between the ages of 65 and 69. This percentage roughly stays the same in the 2001 data, but by 2021, the census projects that more than 6% of males will be between 65 and 69.

Another example: looking from the 1976 to the 2001 to the 2021 pyramids, the postwar "baby boom" becomes visible as a swelling moving upwards through the pyramid - that is, a large segment of the population growing older. This is a good way to track changes in a population’s structure.

2.2.1 Aboriginal Population

This shows the percentage of census population reporting any aboriginal status, including North American, Metis, Inuit, or any other Aboriginal response, as defined in the 1996 census. The term First Nations was not used because not all of those who were included in the definition of 'Aboriginal' are First Nations.

The population pyramid is derived from data found in the 1996 census. Because the top age category is [75 and over] as opposed to the usual [95 and over], there is a widening at the top of these pyramids, the extent of which will reflect life expectancies in excess of 75 years.

For more information on population pyramids in general, please refer to the notes to map 2.1

2.2.2 Older Adults

This map shows the percentage of total population that is 65 or over (i.e. those residents who have already passed their 65th birthday). Data were obtained for 1999 from the Health Data Warehouse, BC Ministries of Health Planning and Health Services.

2.2.3 Young Children

These maps simply describe the percentage of total population below 5 years of age (i.e. who have not yet had their 5th birthday). These data are from the Health Data Warehouse, BC Ministries of Health Planning and Health Services, and were classified by adjusted natural breaks.

2.2.4 Sex Ratio

Sex ratio data were obtained through the Health Data Warehouse, BC Ministries of Health Planning and Health Services. Tables for male and female populations by LHA (1999) were obtained, and the ratio was calculated following the form [ (MALES / FEMALES) * 100 ], giving the number of males per 100 females in each LHA. These data were classified by starting at the 100 value (indicating a 1 to 1 relationship between males and females), and moving away from it in either direction, selecting the two most significant natural breaks.

Health region level data were classified using the same boundaries as the LHA data above, but were not displayed as the variation at the health region level was not significant.

Women tend to live longer than men, so areas with high percentages of populations over 65 will tend to have relatively more women than men on the whole. A good example of this is the Okanagan-Similkameen Health Region.

2.3.1 General Fertility Rate

The General Fertility Rate, or GFR, is defined as the number of live births per 1,000 females aged 15 to 49. These data were found on Health Data Warehouse, BC Ministries of Health Planning and Health Services, and represent an aggregation of 1995 through 1999 data. Some aggregations of local health areas were made.
2.3.2 Teenage Fertility

This section was prepared using data from the Health Data Warehouse, BC Ministries of Health Planning and Health Services. These figures represent aggregated rates over 1995 - 1999. A 'teen' is defined here as anyone between the ages of fifteen and nineteen, inclusive (i.e. anyone past their fifteenth but before their twentieth birthday).

Local health areas with fewer than 250 females between the ages of 15 and 19 were discarded, and certain other LHAs were aggregated in the original dataset.

2.3.3 Small for Gestational Age

The term 'small for gestational age' (SGA) refers to children with a low birthweight relative to the duration of the pregnancy. This is not the same as 'low birthweight' which does not take into account the duration of pregnancy. For example, a baby born at less than 2500 grams is considered to be a low-birthweight baby. However, a baby born at thirty-four weeks may very well be 'low birth weight' but would only be SGA if they are in the lowest 10% of birth weights for all babies born at thirty-four weeks of pregnancy.

Data from 1996 for small for gestational age births were divided by total live births in each local health area to calculate percentage SGA. There were thirteen local health areas with less than 5 SGA births in 1996. Where possible, these local health areas were merged with their neighbours; if this was not possible, they were excluded because of small numbers, as follows:

- LHA 6 - aggregated with LHA 7
- LHA 10 - left off the map (could not aggregate to LHA 7 again, other adjacent LHAs were in different Health Regions)
- LHA 13 - aggregated with LHA 12
- LHA 17 - aggregated with LHA 16
- LHA 30 - aggregated with LHA 29
- LHA 49 - left off the map (too far to aggregate with LHA 27, and no other adjacent LHA)
- LHA 50 - left off the map (no adjacent LHA)
- LHA 51 - left off the map (no SGA data available)
- LHA 83 - left off the map (could not add 85/72, no other adjacent)
- LHA 84 - aggregated with LHA 72
- LHA 87 - left off the map (no adjacent LHA)
- LHA 92 - left off the map (no SGA data available)
- LHA 94 - left off the map (no adjacent LHA)

The remaining local health areas and aggregations were classified by adjusted natural breaks, and these same classifications were carried over and used for the health region level data. Circle sizes on the cartogram refer to the total number of live births (the sample size) as opposed to actual population size.

2.4.1 Life Expectancy

Data for expectation of life at birth for both sexes over four-year periods was obtained through the Health Data Warehouse, BC Ministries of Health Planning and Health Services.

These data were classified approximately according to a standard deviation function, in order that the life expectancy values for each Local Health Area might be more easily compared with the provincial average. The same classification breaks were carried over for use in the health region cartogram, which resulted in the lowest class being dropped.

A 'World Equivalent’ was added to provide context to life expectancy values. The global data were derived from the CIA World Factbook for 1999. Countries were matched within an arbitrarily small threshold, and in the event that multiple countries provided suitable matches, the better known or more comparable country was chosen.

Percentage change in life expectancy was derived from the same data by calculating the percentage change from the 1987-91 (aggregated) figures to the 1996-2000 (aggregated) figures.

Careful track was also kept of the number of 'zero values' for each Local Health Area. A 'zero value' arises when there are no deaths within certain age groups in that LHA during the timeframe in question, thus weakening the reliability of the generated rate. Four local health areas (Stikine, Telegraph Creek, Snow Country, and Vancouver Island West) had more than five zero values, putting the reliability of these values below the threshold suggested by the Health Data Warehouse.

2.4.2 Potential Years of Life Lost

Potential Years of Life Lost (or PYLL) is a useful measure of overall population health, but like any measure it is best taken with a host of others. It is quite simply the number of years “lost” by early death, if one were to assume a reasonable life expectancy of 75 years. That is, a death at 74 would contribute 1 to a region’s value, whereas a death at fifteen would contribute sixty. As a result, this measure is most meaningful for comparative purposes when expressed as a ratio of observed to expected, as in the case of the Potential Years of Life Lost Index (PYLLI), used here.

Additional caveats related to a population’s age structure
are mentioned in the text accompanying these maps. These data are derived from the Vital Statistics Agency, and were obtained through the Health Data Warehouse, BC Ministries of Health Planning and Health Services.

2.4.3 Mortality

The inclusion of mortality maps in the Atlas is meant to provide an update to "The Geography of Death: Mortality Atlas of British Columbia 1985-89", produced by the Western Geographical Series, University of Victoria (see references). Those who wish a more in-depth look at British Columbia’s mortality rates by selected cause are referred to this work, as it is a much more comprehensive resource for this topic.

The source of the Infant Mortality Rate data is the British Columbia Vital Statistics Agency, which provides both an overall rate, as well as an aboriginal-specific rate at the health region level.

It seems that a number of local health areas have not experienced any cases of infant mortality over the period of data aggregation (1994-98), while others had very high rates (for example, 18 per 1,000 in Princeton, which is the highest rate in British Columbia, but is adjacent to Keremeos, with no cases of infant mortality over the aggregated years.)

As with the map for life expectancy, (refer to 2.4.1) a ‘world equivalent’ was added here to provide context. The British Columbia overall rate is far lower than the Canadian average, and several local health areas are well above that average.

All of the additional mortality maps included in this section are based on local health area level data provided through the Health Data Warehouse, BC Ministries of Health Planning and Health Services. All data were classified by adjusted natural breaks, and all maps display data aggregated over 1995-99. Any LHA (or aggregation) with population less than 1,000 was discarded.

2.4.4 AMI (Heart Attack)

AMI (Acute Myocardial Infarction, or heart attack) data are from the Centre for Health Services and Policy Research, where an initiative was undertaken to examine post-AMI mortality rates, 1992-1998.

The text accompanying the maps lists several exclusions. In addition to these, heart attacks suffered by people under age twenty or over age 105 were dropped, as were those that did not appear as the first diagnosis in the hospital file. Taken as a whole, these exclusions mean the data here are comparable with data produced by the Canadian Institute for Health Information.

The first map describes the geographic variation in AMI hospitalizations per 10,000 population around the province, which is age-adjusted using the indirect standardization method and nineteen age groups. Indirect standardization allows the creation of ‘observed to expected’ ratios which are mapped. These data were classified by adjusted natural breaks, and the classifications were carried over to the health region cartogram.

2.4.5 HIV / AIDS

Some discussion was held as to how many maps to include in this section. Finally, it was decided that, given the prevalence of anti-retroviral care, mapping the use of anti-retroviral therapy would give us the best measure of the spread of HIV.


2.4.6 Immunizations

This map describes the DPT (diptheria, pertussis, tetanus) immunization rate among Kindergarten students in each year from 1997 through 2000. These data are from the Health Data Warehouse, BC Ministries of Health Planning and Health Services.

Bar graphs were chosen so that both historical and current data might be depicted, given there are interesting variations over this time period. Using bars is also an advantage in that it allows us to highlight values below a certain threshold - in this case 90% - by setting the base of the graph there, and having low values extend downward in red. It also allows us to accentuate high values by applying a dark green fill, emphasizing their prominence on the display.
2.4.7 Screening Mammography

These data are from the Health Data Warehouse, BC Ministries of Health Planning and Health Services, and describe the participation rate among women aged 50-74 in the Screening Mammography Program of the British Columbia Cancer Agency. These data are aggregated from 1998 to 1999.

Although the data were classified by natural breaks, no adjustment was necessary, as, by coincidence, the natural breaks fell on evenly-spaced values divisible by ten.

There appears to be a participation rate of zero in LHA 25 (100 Mile House), which pushes down the otherwise very high average for the Cariboo Health Region. This anomaly was checked, and seems to be valid.

3.1.1 Median Household Income

Data for Median Household Income are from the 1996 census and obtained through the Health Data Warehouse, BC Ministries of Health Planning and Health Services. They were classified by LHA according to adjusted natural breaks.

3.1.2 Low Income / Child Poverty

Data for the percentage of (census) families receiving income below the low income cut-off are derived from the 1996 census, obtained through the Health Data Warehouse, BC Ministries of Health Planning and Health Services. The 1996 census defines the low income cut off as the income level “... at which a family may be in straitened circumstances because it has to spend a greater portion of its income on the basics (food, clothing and shelter) than does the average family of similar size.” It therefore follows that the low-income cut-off itself varies from region to region, as it is corrected not only for conditions within the family (such as the number of children), but also external conditions (such as geographic variations in the cost of living). These rates were classified by adjusted natural breaks.

Data on child poverty rates are also from the Health Data Warehouse, and LHAs listed for child poverty rates are listed from greatest to least.

3.1.3 Income Assistance

Income assistance data derive from the Health Data Warehouse, BC Ministries of Health Planning and Health Services. Data for some local health areas for certain variables were not available.

A ‘recipient’ is defined as a person living alone or with a family who is receiving BC Benefits. These data do not include aboriginals living on reserve as this would be a federal jurisdiction. Individuals who qualify for disability benefits are also excluded from these calculations.

3.1.4 Median Income Share

The concept of median income share is defined in the text of the Atlas, and examples of median income shares for indicator North American cities are given. The LHA-level data are taken from BC Stats and classified by adjusted natural breaks.

3.2.1 Occupational Structure

These data derive from the 1996 census, and were obtained through the Health Data Warehouse, BC Ministries of Health Planning and Health Services.

The occupational classifications are based on the 1980 Standard Industrial Classifications. (Agriculture and related services, Logging or Forestry, and Mining-Quarrying-Oil/Gas). A 10 % threshold was used, even though this may underestimate the importance of certain industries to a region (see text in Atlas regarding the multiplier effect).

3.2.2 Unemployment

Data for unemployment are from the 1996 census, obtained through the Health Data Warehouse, Ministries of Health Planning and Health Services.

The general unemployment rate refers to the unemployed labour force expressed as a percentage of the total labour force (15 years of age or over) in the week prior to 1 July, 1996. Unemployment in the context of the census refers to "...persons, who, during the week prior to Census Day, were without paid work and were available for work and either: (a) had actively looked for work in the past four weeks; or (b) were on temporary lay-off and expected to return to their job; or (c) had definite arrangements to start a new job in four weeks or less."
Youth unemployment is defined as unemployment (as above) among those aged fifteen through twenty-four.

3.3 Education

All data used in this section were derived from the 1996 census and obtained through the Health Data Warehouse, BC Ministries of Health Planning and Health Services. In all cases, LHA-level data were classified according to adjusted natural breaks, and the same classification boundaries were applied to the health region level data in the cartograms.

In the English examination completion rate map, note that these exams may be written before a student's grade 12 year (for example, a student taking English 12 in the summer before their grade 12 year), or after a student has passed all other grade 12 courses (for example, re-taking the course over the following summer). This will tend to depress the completion rate shown here, but it is believed that such cases are the exception.

3.4 Crime

These rates are taken from BC Stats, and refer to violent crime incidents (eg. assault, battery) per 1,000 population, and property crime incidents (eg. breaking and entering, theft from auto) per 1,000 population. These rates are aggregated over 3 years, and are classified by adjusted natural breaks. Data were unavailable for some local health areas, presumably due to low population size.

Special Topic: Drinking Water Quality

This section was included as a special interest topic, and in future editions of the Atlas, we hope to include more data relating to the physical environment and its potential influences on population health. A section on air quality, especially in certain areas of the province, would be most useful, and is currently being pursued, but was not ready for print.

Municipal water source data were collected by telephone and e-mail from municipalities and regional districts throughout British Columbia over the summer of 2001. In many cases, water services are supplied by the municipality itself, and by the regional district in outlying areas. The data shown here represent only municipal sources. Several municipalities have more than one source.

Initially it was thought to describe these sources as small pie charts, indicating the percentage of reliance on each type of source, but this would vary at different times of the year. In such cases, multiple icons are used, with 'major' or 'minor' designations (as in legend) reflecting the relative prominence of (or reliance on) these sources. Emergency or 'backup' sources were not shown, as these would of course not experience regular use.

The number of boil-water advisories by health authority comes from the Health Data Warehouse, BC Ministries of Health Planning and Health Services. These figures, however, refer to the absolute number of water systems on which a boil-water advisory has been placed, regardless of the size or extent of that water system. For example, West Kootenay-Boundary has a higher number of boil-water advisories on average, but it also has a high number of small, separate surface water systems (eg. a private creek), each of which would be counted separately, thus inflating the total. Since is it not possible to tally the exact numbers of water systems in every Health Region, these data were used as is, with the above caveat.

It may also be the case that certain 'high-risk' water systems may have boil-water advisories on them continuously simply as a precautionary measure.

Despite these caveats, the trend shown on this map is believed to be qualitatively true.

4.1.1 Health Workforce

The data used for this graph were derived from ROLLCALL 99. Further information on each of the groups presented here, including governing bodies and regulations, scope of practice, and related material are available in that publication, which is available through the Centre for Health Services and Policy Research.

Certified Dental Assistants are regulated under the Regulations of the College of Dental Surgeons of British Columbia, as revised May 1995. A CDA may be delegated certain tasks while under the personal supervision of a duly licensed member of the College of Dental Surgeons of B.C.

Dental Hygienists assess and provide therapeutic and preventive care for teeth and adjacent tissues. They are governed by the College of Dental Hygienists of British Columbia.

Registered Nurses are the most numerous of these categories, with over 30,000 members in the Registered
Nurses Association of British Columbia (RNABC). A Registered Nurse performs health care services which require the application of professional nursing knowledge and skills.

Occupational Therapists plan and carry out individually designed programs of study for patients with physical or mental health problems to enhance their ability to care for themselves and to engage in work and recreational pursuits. They are governed by the College of Occupational Therapists of British Columbia. Membership in the British Columbia Society of Occupational Therapists is voluntary.

Licensed Practical Nurses are employed in a wide variety of health care settings and may carry out such nursing duties related to the care of patients as are consistent with his/her training and ability. All such duties are to be carried out under the direction of a physician, or under the supervision of a Registered Nurse, except in an emergency.

Physical Therapists provide physical, diagnostic, and rehabilitative services to patients with physical dysfunctions caused by trauma, congenital abnormality, disease, surgery, obstetrical and gynaecological conditions, and aging processes to restore and / or achieve optimal function. They are governed by the College of Physical Therapists of British Columbia.

Registered Psychiatric Nurses practice in primary, secondary, and tertiary care settings and provide services to individuals whose primary care needs relate to mental and developmental health. The basis of psychiatric nursing is a caring, therapeutic relationship; the core knowledge and skills of psychiatric nursing are developed from the nursing, psycho-social, biological, and physical sciences.

Massage therapists provide assessment, treatment, and prevention of soft tissue and joint disorders, dysfunction, or injury using treatment methods which include (but are not limited to) manual techniques, hydrotherapy, light therapy, electrical modalities, therapeutic exercise, and patient education to rehabilitate, relieve pain, and promote overall health.

Pharmacists are responsible for the advisory, storage, and monitoring components related to medications. They are governed by the College of Pharmacists of British Columbia.

Psychologists diagnose psychological and emotional disorders, counsel clients, provide therapy and research, and apply theory relating to behaviour and mental processes.

Physicians in this chart include all directory active physicians, encompassing those in post-graduate training, general practitioners and specialists.

Emergency medical assistants provide first aid, nursing, and medical services to minimize disability or loss of life in emergency situations. Emergency medical assistants are trained in the areas of first aid, general ambulance practices and procedures, basic nursing, patient assessment, specialized diagnostics, and treatments.

A chiropractor diagnoses or treats patients’ disorders of the spine and other body joints by adjusting the spinal column or applying other corrective manipulation. They are governed by the British Columbia College of Chiropractors.

4.1.2 Generalist Physicians

Data on the supply of generalist physicians in British Columbia are from the Centre for Health Services and Policy Research, and are taken from the publication ‘Doctors and Patients 98-99’. Note here that full-time equivalents are used here to correct for the different working arrangements taken by some doctors.

Data on the place of physician graduation are derived from the Ministries of Health Services and Health Planning practitioner file. Pie charts were used for the places of graduation on this map, sized by the absolute number of general practitioners in each health authority. These pies were then broken up into five categories regarding place of graduation.

The same colours and ordering used in the pie charts are used in the horizontal bar graph below. The bars are sorted by the proportion of British Columbia (i.e. U.B.C. Medical School) graduates.

The final map of general practitioners shows the locations of offices in British Columbian communities. This map is one of the few made for this atlas that are based directly on six-digit postal code data. Six-digit postal codes of general and family practice offices were collected and linked to a geographic ‘shapefile’ of the over 109,000 unique postal codes in British Columbia. Any office either within municipal boundaries or within 10 km of a municipality was linked to that municipality (with corrections and adjustments made for transportation routes and natural barriers). Other offices were simply placed at the unincorporated community in which they are located. In total, over 97 % of the registered offices were matched with postal codes, and the vast majority of these occurred - not surprisingly - within municipal boundaries.
One result of this process, as outlined on the map sheet, was that some areas of the province have been omitted due to recent changes in mail delivery, such as Ladysmith and much of the Central Coast.

In this section, family practitioners have been included in the dataset, although some place these physicians in a separate category.

### 4.1.3 Specialist Physicians

Data for specialist physicians are derived from the report *Doctors and Patients 98-99* produced by the Health Human Resources Unit. Unadjusted full-time equivalents are used in this case.

The Royal College of Physicians and Surgeons of Canada (RCPSC) specialties are used in this map, and have been grouped by colour into three broader categories consistent with those used in ROLLCALL 99.

The ‘clinical specialties’ broad group is associated with shades of green, and includes the RCPSC categories of general internal medicine, medical subspecialties, paediatrics, psychiatry, and anaesthesiology. The ‘surgical specialties’ broad group is associated with shades of red, and includes the RCPSC categories of general surgery, surgical specialties, and obstetrics and gynaecology. Finally, the lab/radiology broad group is identified by a shade of blue, and consists of the laboratory / radiology specialties.

Note that in the cartogram, the sizes of the circles are proportional not to the absolute number of specialists, but to the number of specialist full-time-equivalents per 10,000.

### 4.1.4 Nurses

Data on the supply of nurses in British Columbia are from the Centre for Health Services and Policy Research publications ROLLCALL 99 and ROLLCALL UPDATE 94. Numbers per 10,000 population were calculated and classified by natural breaks in the 1999 data. These are slightly different than the numbers published in ROLLCALL 1999, as that publication uses a different source for its population figures. The population estimates for these calculations in the Atlas are from P.E.O.P.L.E. 26, obtained through the Health Data Warehouse, BC Ministries of Health Planning and Health Services.

A rate of change for Registered Psychiatric Nurses was not calculated, since the numbers of RPNs in most areas of the province are too low to make any percentage rate of change calculations meaningful. The vast majority of Registered Psychiatric Nurses in B.C. are in the Simon Fraser Health Authority, which is where the province's major psychiatric institution is located.

### 4.1.5 Therapists

Data for Occupational Therapists are from ROLLCALL 99 and ROLLCALL UPDATE 94, Health Human Resources Unit. The data used are based on voluntary membership in the British Columbia Society of Occupational Therapy. It is thought that BCSOT members comprise the vast majority of Occupational Therapists in British Columbia.

Data for Physical Therapists are from the Centre for Health Services and Policy Research publication ROLLCALL 98, as errors were found in the ROLLCALL 99 data for Physical Therapists.

In 1994, registrants under parts I and II were counted, and for 1998, full and interim members were counted. These categories are roughly equivalent.

### 4.2.1 Acute Care Hospitalizations

Data for acute care hospitalizations in 1998/99 (fiscal year) were derived from the PURRFECT data set developed by the Ministries of Health Planning and Health Services. The rates exclude newborns and have been age-standardized (indirect method) by 19 age groups.

Residents of British Columbia treated out of province are included at their place of residence, and non-B.C. residents treated in B.C. are excluded.

### 4.2.2 Medical Services Plan

Data on Medical Services plan expenditures by local health area and health region were derived from the PURRFECT data set developed by the Ministries of Health Planning and Health Services. The data have been age-adjusted (indirect method) using 19 age groups and are expressed spending dollars per capita.
4.2.3 Continuing Care

This section identifies two types of continuing care, residential (i.e. institutional) care, and home care. Home care services were mapped by local health area, and both types of continuing care were summarized at the health region level, again as a rate per 1,000, this time as a bar graph.

These data were derived from the PURRFECT data set developed by the Ministries of Health Planning and Health Services. and pertain to fiscal 1998/99.

5.1 Continuity of Physician Care

A commonly used continuity of care index was applied by the Centre for Health Services and Policy Research to a random sample of 200,000 British Columbians. This index measures the percentage of total physician visits made to that patient's normal physician (or ‘usual provider of care’). Individuals who made two or fewer visits during fiscal 1995/96 were excluded because their continuity of care index would either be undefined (with zero visits) or artificially high (with one or two).

A high continuity of care index means that patients are visiting the same family doctor most of the time, whereas a low index implies that patients are not seeing the same doctor, and perhaps do not have an opportunity to develop a strong relationship with their physician.

For purposes of calculating this index, referral visits to specialists accrue back to the general practitioner who made the referral. For example, if your ‘usual’ family doctor referred you to a specialist, that specialist visit will count as a visit to your family doctor, since he/she made the referral and is assumed to be coordinating treatment.

The local health area level data for continuity of care were classified by adjusted natural breaks, though the data are roughly normally distributed about the mean. The same class boundaries were applied to the health region cartogram, which resulted in the lowest class being dropped.

Seven local health areas were discarded as they had a sample size of less than thirty and thus an unstable continuity of care index.

Following this, as outlined in the text, is a map of acute care hospitalizations in the year following that for which the continuity of care index was calculated (1996/97). These hospitalizations are based on the same random sample.

The data were classified at the local health area level by adjusted natural breaks. These same class boundaries were applied to the health region level data shown in the cartogram.

5.2. High Users of Physician Services

Data for this section were derived from a larger research project concerned with identifying reasons for high use of physician services in British Columbia. It was originally hypothesized that we would be able to develop scenarios for high use, such as ‘doctor shopping’ for prescription drugs, or a short-term increase in the use of services following a traumatic event such as a motor vehicle accident. As the project unfolded, however, it became obvious that the real culprit in high use was multiple morbidity – a complex and varied mix of conditions, acute and chronic, that affect a small but substantial proportion of the population.

The Adjusted Clinical Group (ACG) case-mix adjustment system developed at Johns Hopkins – and validated in both British Columbia and Manitoba – became an important tool for this project because it takes the phenomenon of multiple medical conditions into account. We used the ACG system, which is designed to predict health care costs for individuals, to identify both ‘unexpected’ high users and the ‘unexpected’ costs associated with those high users. More information about this project is available through publications of the Centre for Health Services and Policy Research (see Bibliography and the Centre’s web site).

5.3 Prescription Drugs and Older Adults

All data are for 1999, and were obtained through the Centre for Health Services and Policy Research.

Three types of maps were produced. The first is based PharmaCare prescriptions per senior citizen (less aboriginal seniors whose coverage is provided through the federal government).

The second is based on PharmaCare spending per eligible senior citizen. This was calculated for all drugs, and also for cardiovascular drugs alone, since these account for more than 40% of PharmaCare drug expenditures.

The third type of map is - in a sense - a refinement of the first and second: PharmaCare costs per day of prescription supplied per eligible senior citizen. This
corrects for the fact that not all prescriptions are for the same duration.

For the non-drug specific PharmaCare maps, local health areas with fewer than 500 prescriptions overall were excluded, and for the cardiovascular drug maps, local health areas with fewer than 100 prescriptions were excluded.

5.4 Loss of Independance

Data for loss of independance were derived from a research project undertaken at the Centre for Health Services and Policy Research. These data represent older adults aged 65, 75-76, 85-87 or 90-93 at the beginning of 1993 who were deemed to be living in the community without ongoing formal care services. This group was considered at risk for losing independence. The proportion of the group who during 1994 or 1995 became permanently dependent on the formal health care system were considered to have ‘lost independence’. Local health areas where there were less than seventy-five people at risk of losing independence were dropped.

Further information about this project will be available in early 2002 from the Centre for Health Services and Policy Research web site.

6 Vancouver Maps

The same definitions apply to Vancouver as do to their equivalent categories in the remainder of the Atlas, with a few notes:

Unlike the sex ratio map for the entire province, the sex ratio map for the City of Vancouver is based on enumeration area level data provided by the 1996 census, obtained through Data Services, University of British Columbia. Note that some enumeration areas - especially in the business district - may have very low populations, as no bottom threshold for population was established. While this is based on the entire population, census data is generally rounded to the nearest 5 to protect the privacy of those present.

For display purposes, boundaries of enumeration areas were cut inwards where large parks or other undeveloped areas are present.
This section will briefly summarize and explain some of the more common cartographic methods used in the production of the British Columbia Health Atlas. Certainly this is no replacement for the vast body of literature that exists on this subject, but it should serve as a very quick introduction to some of the methodology used.

I. What is Cartography?

Cartography is the art and science of visualizing spatial information in a meaningful way, such that it becomes useful knowledge. It is an art form which attempts to facilitate the communication of ideas in a clear, understandable manner, using tools found in the sciences of computing, mathematics, statistics, and map-user psychology.

Cartography is a branch of Geography, the environmental science concerned with the spatial relationships or locational dimensions of phenomena. An economic geographer, for example, might ask why certain regions have different economic structures, or might be interested in how the diffusion of products takes place. But all of these questions have ultimately to do with space, and the spatial relationships of patterns of interest.

As such, it is no surprise that cartography is so vital; it is the language by which we understand space, it is how we express ideas about the world around us.

II. What is Thematic Mapping?

Thematic maps are designed to give emphasis to a particular theme, such as electoral results, landfill sites, or (in the case of this atlas), health care and population health. Because of this versatility, the use of thematic maps is more ubiquitous than we might at first assume. Transit maps posted in bus shelters are thematic maps, as are the decorative global airline route maps found in travel agencies and maps on the backs of tourist pamphlets. They are stylized, abstracted, and designed to highlight a particular theme.

Topographic maps, on the other hand, are intended for general reference use. As such, these exhibit a standardized set of symbols and scales, and tend to focus on the physical environment in great detail. The best North American examples of topographic maps are the National Topographic Series maps, produced by Natural Resources Canada, or the U.S. Geological Survey Maps produced in the United States. These ‘topo maps’ might be useful references when planning a back-country hike or on a canoeing trip.

Cartography is often associated with standardization and accuracy - elements best exemplified by topographic maps - even though most of the maps we come into contact with on a day-to-day basis are thematic. The idea that “... every map has to have a north arrow and scale”, seems to have mistakenly become a universal standard, when it is really only applied to topographic maps. Thematic maps, which can be highly abstract, need only contain these items if required.
III. Abstraction and Generalization

Here is a philosophical question: Can any part of the world ever be completely mapped? The Earth, and the social systems it supports, exhibit what is termed continuous variation. Continuous variation is a way of describing how reality changes continuously over space, such that any space becomes infinitely complex even at a very local scale.

As a result, cartography requires that we abstract some elements of the real world so that ideas about them can be communicated. Which elements are of interest depends on the map’s purpose and intended audience. A map of an office, for example, might include where people sit, where the lunchroom and restrooms are, or where the meeting room is. The superintendent of building operations, however, might be more interested in mapping the ambient temperature in different parts of the office, and a network administrator might be interested in mapping the locations of network ports or computers. We all perceive space in different ways, and with different purposes.

The map’s intended audience and purpose will also dictate the selection of an appropriate scale for mapping - the level of generalization and simplification used.

IV. Ethics in Cartography

Thematic mapping, by its nature, includes a subjective component, such as decisions about classification, that must be made on the basis of the cartographer’s judgement. There are no absolutely correct thematic maps. Rather, we accept what cartographer Borden Dent describes as “... the best among several alternatives”.

There is currently no professional body that oversees the cartographic profession (such as that which regulates surveyors, for example), and enforcing professional standards is becoming more of a concern. A map is rarely held to the same level of public scrutiny as a newspaper or television report, yet the results of geographic information systems (GIS) analyses are now being used as evidence in legal proceedings. Dramatic increases in computing power and the availability of “ready-to-use” mapping software have also made it far easier, as Mark Monmonnier puts it, to “Lie with Maps,” (see bibliography) either unwittingly, or with intent.

In Canada, the Canadian Institute of Geomatics is currently in the process of developing a certification program for the cartographic profession, along with other branches of geomatics. This would help to ensure that professional standards are adhered to and that, eventually, a formal ‘code of ethics’ can be developed to replace the several similar systems of unofficial guidelines which currently exist.
V. Selected Methods

There are countless methods of visualization that could be explored here, but we will focus instead on those most commonly used in this atlas: the choropleth/dot map, and the proportional circle map.

**Choropleth and Dot Maps**

The most commonly used cartographic style in this atlas is the choropleth map. A choropleth map is a way of displaying data that are aggregated over an area as opposed to at a certain point. It relies on a set of (usually political) boundaries that are well-known and comparable, but do not have any relationship with the dataset.

The resolution of a choropleth map is limited by the boundaries selected. For example, a population map of Canadian provinces will tell us nothing about the population of Kaslo, however a population map based on the 49,000 census enumeration areas in Canada would tell us much more *but only if* the boundaries of Kaslo were resolvable at that scale.

Both choropleth maps and dot maps (in which one dot is the equivalent of, for example, 100 farms or 500 residents) also assume that the values mapped are evenly distributed over each region. Unless one is mapping data taken directly from individually known points, then the data are aggregated at a regional level. With regionally-aggregated data (a local health area, for example), one is either assigning one value to a region, or drawing a number of dots within it - both methods assume that the region is homogenous.

Consider the examples here, showing the 1996 census population of a portion of the Kootenays, by enumeration area. The population is shown as a traditional choropleth map, followed by a dot map. But because the enumeration area boundaries extend up into the mountains and into Kootenay Glacier Park, it appears as though there are thousands of people living in forests of the mountainside, when in fact the population resides primarily in the valley bottoms, along the shores of Kootenay Lake! In this example, the dots would be individually moved so as to more truly reflect the distribution of the population within each enumeration area, highlighting the importance of regional knowledge on the part of the cartographer.
Classification:

There are several ways to classify data in cartography, and the choice that is finally made must reflect the distribution of the data, and be simple to understand. As a general rule, data in this atlas were grouped into five classes (which is a standard convention) although in some cartograms, extreme classes were occasionally ‘lost’ through aggregation.

One obvious type of classification is simply using equal intervals as breaks. This works best with fairly evenly-distributed data, as shown at right. Most data, however, do not display an even distribution across their range. In fact, this atlas makes no use of equal intervals.

Much of the data presented in this atlas exhibit what are called ‘natural breaks’, in which the data are classified with reference to the occurrence of clusters with breaks between them. The data on PharmaCare (section 5.3) shows this type of distribution quite well.

This, however, would only yield comparable class sizes if the natural breaks themselves were more-or-less evenly distributed, which does not always occur. Thus we have often chosen to use adjusted natural breaks, in which the break points between classes are modified in order to approach equal class sizes while at the same time remaining true to the natural breaks. This obviously results in a trade-off, with decisions based on the judgement of the cartographer as opposed to relying completely on a strict, rule-based, algorithm of the computer.

There are several reasons why a simple natural break-point might be moved to a new break. There may be an attempt to switch the original break to a new break that more truly reflects the distribution of the data (by attempting to equalize class sizes). It is emphasized that in all cases, class boundaries are set at significant natural breaks - they may not always be the largest natural breaks, however.

One final classification type that should be mentioned here is by standard deviation. This method is useful in the rare cases in which a dataset is normally distributed; one example in this atlas are the maps related to Life Expectancy. As the name suggests, the standard deviation classification starts at the mean and moves outwards, setting class boundaries at values that are one-half or one standard deviation away from the mean.
**Cartograms and Proportional Circles:**

A cartogram is a value-by-area map, in which the features of the map are distorted according to a certain value. If for example, we were preparing a world cartogram of per-capita energy consumption, Canada and the United States would appear quite large when compared to Latin America or Africa.

Cartograms are powerful visualization tools, in that they allow our mind to contrast familiar geographic shapes with the distorted features of the cartogram, as in the example to the left. Initial reactions are quite telling in that we may recognise the overall shape, and then, within it, visualize the data through the amount of distortion.

As discussed in the ‘How to Use this Atlas’ section (section 1.1), mapping socioeconomic data in British Columbia is always challenging in that more than two-thirds of the B.C. population lives in the Georgia Basin (i.e. on less than two percent of the land). This population distribution makes a cartogram invaluable, however a traditional constrained cartogram in this case might prove to be too distorted to truly be useful.

As a result, for this atlas, the outline of British Columbia was ‘warped’ through an adjusted function of population density, and used as a backdrop for a proportional circle map of health regions, sized according to 1999 population size and placed approximately where they would have been placed in a true cartogram. In effect, each cartogram in this Atlas is more like a proportional circle map superimposed on a cartogram of British Columbia.

The process of sizing these proportional circles is shown below.

<table>
<thead>
<tr>
<th>RAW</th>
<th>SQRT</th>
<th>MULT</th>
<th>FLAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>116</td>
<td>10.770</td>
<td>340.6</td>
<td>381.4</td>
</tr>
<tr>
<td>105</td>
<td>10.247</td>
<td>324.0</td>
<td>362.9</td>
</tr>
<tr>
<td>96</td>
<td>9.798</td>
<td>309.8</td>
<td>347.0</td>
</tr>
<tr>
<td>85</td>
<td>9.220</td>
<td>291.5</td>
<td>326.5</td>
</tr>
<tr>
<td>78</td>
<td>8.832</td>
<td>279.3</td>
<td>312.8</td>
</tr>
<tr>
<td>75</td>
<td>8.660</td>
<td>273.9</td>
<td>306.7</td>
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<td>8.185</td>
<td>258.8</td>
<td>289.9</td>
</tr>
<tr>
<td>63</td>
<td>7.937</td>
<td>251.0</td>
<td>281.1</td>
</tr>
<tr>
<td>59</td>
<td>7.681</td>
<td>242.9</td>
<td>272.0</td>
</tr>
<tr>
<td>56</td>
<td>7.483</td>
<td>236.6</td>
<td>265.0</td>
</tr>
<tr>
<td>43</td>
<td>6.557</td>
<td>207.4</td>
<td>232.2</td>
</tr>
<tr>
<td>15</td>
<td>3.873</td>
<td>122.5</td>
<td>137.2</td>
</tr>
<tr>
<td>10</td>
<td>3.162</td>
<td>100.0</td>
<td>112.0</td>
</tr>
</tbody>
</table>

Begin by importing or entering the raw data, [RAW]. These figures should be checked by mapping them.

Take the square root [SQRT] of the raw data [to correct for area], and sort the result by value.

We would like to know what percentage difference exists between a given circle and the smallest circle in the dataset (which we will call the ‘base circle’). To calculate this, we will divide each value by the least value as in (in this case 10) and multiply the result by 100, giving us the column [MULT].

It has been found through map-user interface studies that a typical audience tends to underestimate the sizes of large circles by 11 to 12%, (see sidebar) We will correct for this by scaling each value up by an additional 12%, giving us the column [FLAN].

A base circle is then drawn, and additional circles are drawn which are [FLAN] percent the size of the smallest (base) circle.

**Flannery Adjustment**

Flannery Scaling, (also known as apparent magnitude-scaling) was developed as a response to several studies finding that map users tend to systematically underestimate the sizes of proportional circles by about 11 - 12%.

It is named for Dr. James Flannery, professor of Geography at the University of Wisconsin who pioneered this work.
**BC Stats**  http://www.bcstats.gov.bc.ca/data/sep/index.htm, accessed October and December 2001


**Flannery** J, 1956 “The Graduated Circle” unpublished PhD dissertation, Dept of Geography, University of Wisconsin


**HHRU** 2000 “Rolcall 99: A status report of selected Health Personnel in the Province of British Columbia” Centre for Health Services and Policy Research, Vancouver

**HHRU** 2000 “Place of Graduation 99: A status report on Place of Graduation for selected Health Personnel in the Province of British Columbia” Centre for Health Services and Policy Research, Vancouver

**HHRU** 1996 “Production 95: A status report on the Production of Health Personnel in the Province of British Columbia” Centre for Health Services and Policy Research, Vancouver

**HHRU** 1995 “Rolcall Update 94: A status report of selected Health Personnel in the Province of British Columbia” Centre for Health Services and Policy Research, Vancouver

**HHRU** 2000 “Rolcall 1999: A status report on selected Health Personnel in the Province of British Columbia” Centre for Health Services and Policy Research, Vancouver


**Monmonier** M, 1996 “How to Lie with Maps” University of Chicago Press, Chicago


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Survey

1. How did you first hear about the atlas? 

2. Were the data shown in a clear, effective manner? 
   if 'no', please specify

3. What topics would you like to see in future editions of the British Columbia Health Atlas? 
   (Please don’t worry about details if you don’t want to - be as general or as specific as you like!)

4. Were there any topics in this edition that you found unnecessary or inappropriate?

5. Future editions/components of the atlas may be entirely on-line, featuring online database queries and user-defined maps via the world wide web. How likely would you be to use such a service? (circle one)
   
   not at all likely  probably not  perhaps  fairly likely  almost certainly

6. In order for us to get a better idea of our audience, please tell us:

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   city, town, rural area  OR  
   Outside B.C.  OR  
   Outside Canada

   Do you work in a health-related occupation? 
   (eg. nurse, therapist, administrator, researcher, academic)  NO  YES... please specify:

7. General comments:

   
   continue on reverse if necessary

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