PREDICTING HIGH HEALTHCARE RESOURCE UTILIZATION IN ONTARIO

2013/14 – 2018/19
CHARACTERIZING HIGH RESOURCE USERS IN PUBLIC HEALTH UNITS

Population Health Analytics Laboratory
HSPRN health system performance research network
UNIVERSITY OF TORONTO DALLA LANA SCHOOL OF PUBLIC HEALTH

AUTHORS

The following individuals contributed to the report:

Meghan O'Neill, *Epidemiologist*, Dalla Lana School of Public Health (DLSPH), University of Toronto

Kathy Kornas, *Epidemiologist,* DLSPH, University of Toronto

Emmalin Buajitti, *Epidemiologist,* DLSPH, University of Toronto

Catherine Bornbaum, *Research Associate*, DLSPH, University of Toronto

Walter Wodchis, *Professor,* Institute of Health Policy, Management and Evaluation, University of Toronto

Laura C. Rosella, *Associate Professor*, DLSPH, University of Toronto

CITING THIS REPORT

Cite as:

O'Neill M, Kornas K, Buajitti E, Bornbaum C, Wodchis W, Rosella LC. Predicting high healthcare resource utilization in Ontario, 2013/14-2018/19: Characterizing high resource users in Public Health Units. Toronto, ON: Population Health Analytics Lab; 2019.

For inquiries, comments and corrections please contact:

Population Health Analytics Laboratory
Health Sciences Building, Suite 661
155 College St., Toronto ON M5T 3M7
Telephone: (416) 978-2201
Website: http://www.pophealthanalytics.com/
Email: pophealthanalytics.dlsph@utoronto.ca

ACKNOWLEDGEMENTS

This work was supported by the Health System Performance Research Network (HSRPN), which is funded by a network grant provided by the Ontario Ministry of Health and Long-Term Care.

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

FIGURES AND MAPS

TABLES

1 INTRODUCTION

The majority of health care spending is concentrated among a small proportion of the population (1). From 2009 to 2011, 5% of health care users in Ontario accounted for 65% of health care costs (1). In an effort to identify populations at high risk of poor health outcomes over the next five years, Ontario researchers have developed the High Resource User Population Risk Tool (HRUPoRT) (2). This predictive model considers both clinical and social determinants of health that contribute to the development of chronic conditions resulting in high use of health services.

1.1 HIGH RESOURCE USER POPULATION RISK TOOL

The HRUPoRT is a validated risk prediction model that leverages routinely collected population health data to estimate the number of new and existing high resource users (HRUs) in a population. This tool can be applied to assist with prevention and resource planning, to facilitate decision making, and to enhance our understanding of the distribution of risk among the population. To increase applicability, the tool uses risk factor data from the Canadian Community Health Survey (CCHS), which is available to users at community, regional and provincial levels. The HRUPoRT SAS and STATA code are available upon request.[1] The tool encompasses clinical, sociodemographic, and health behaviour information in population survey data to predict who will become the top 5% of health care service users over a 5-year period (2). The top 5% of users was calculated based on ranking individuals according to gradients of cost within the CCHS cohort using a person-centered costing methodology developed at ICES (3). The risk factors most likely to predict high use of health services are:

- sex
- age
- history of a chronic condition
- ethnicity
- immigrant status
- household income quintile
- food security
- perceived general health
- body mass index
- smoking status
- physical activity quartile
- alcohol consumption

[1] For information on how to access and apply the HRUPoRT SAS and STATA code please contact the Population Health Analytics Lab (pophealthanalytics.dlsph@utoronto.ca)

1.2 DATA SOURCES

In this report, the HRUPoRT is applied to data from the Ontario portion of the 2013/14 CCHS to predict the number of new cases and rate of HRUs over a 5-year period in Public Health Units (PHUs). The results from the HRUPoRT is a rate that is interpreted as the total number of predicted adults per 1,000 that will become the top 5% of health care users in a given PHU over a 5-year period.

The CCHS is a cross-sectional survey conducted by Statistics Canada that is representative of approximately 98% of the Canadian population aged ≥12 years (4). The CCHS uses a complex stratified and cluster sampling technique to achieve representativeness. Individuals excluded from the CCHS include those living on reserves and other Aboriginal settlements, institutionalized residents, full-time members of the Canadian Forces, and residents of certain remote regions (4). Predicted number of HRU cases and rates are described according to key sociodemographic, health status, and health behavioural risk factor variables from the CCHS.

PHUs can use the HRUPoRT as a tool to help identify priority populations and target interventions. Furthermore, understanding HRU from a broader perspective is imperative to ensure better management of patients who are currently a HRU or at an increased risk of becoming a HRU. Knowledge on the upstream determinants of HRU is particularly important in supporting prevention efforts. Determining priority groups for prevention of HRU provides a substantial opportunity to make tangible improvements in addressing the social determinants of health.

2 PUBLIC HEALTH UNITS IN ONTARIO

In Ontario, 36 community-based PHUs are responsible for identifying and responding to public health needs of the local population. PHUs are funded by and accountable to the Ontario Ministry of Health and Long-Term Care and are responsible for delivering programs and services that fall within their mandate (5). While the Ministry is the main source of funding for PHUs, they also receive funding from other sources including the Ministry of Children and Youth Services, Health Canada, and community organizations (5). Ontario's PHUs are organized primarily based on municipal boundaries, which range in size and population profile. The boundaries for Ontario's 36 PHUs are shown in Figure 2.0.

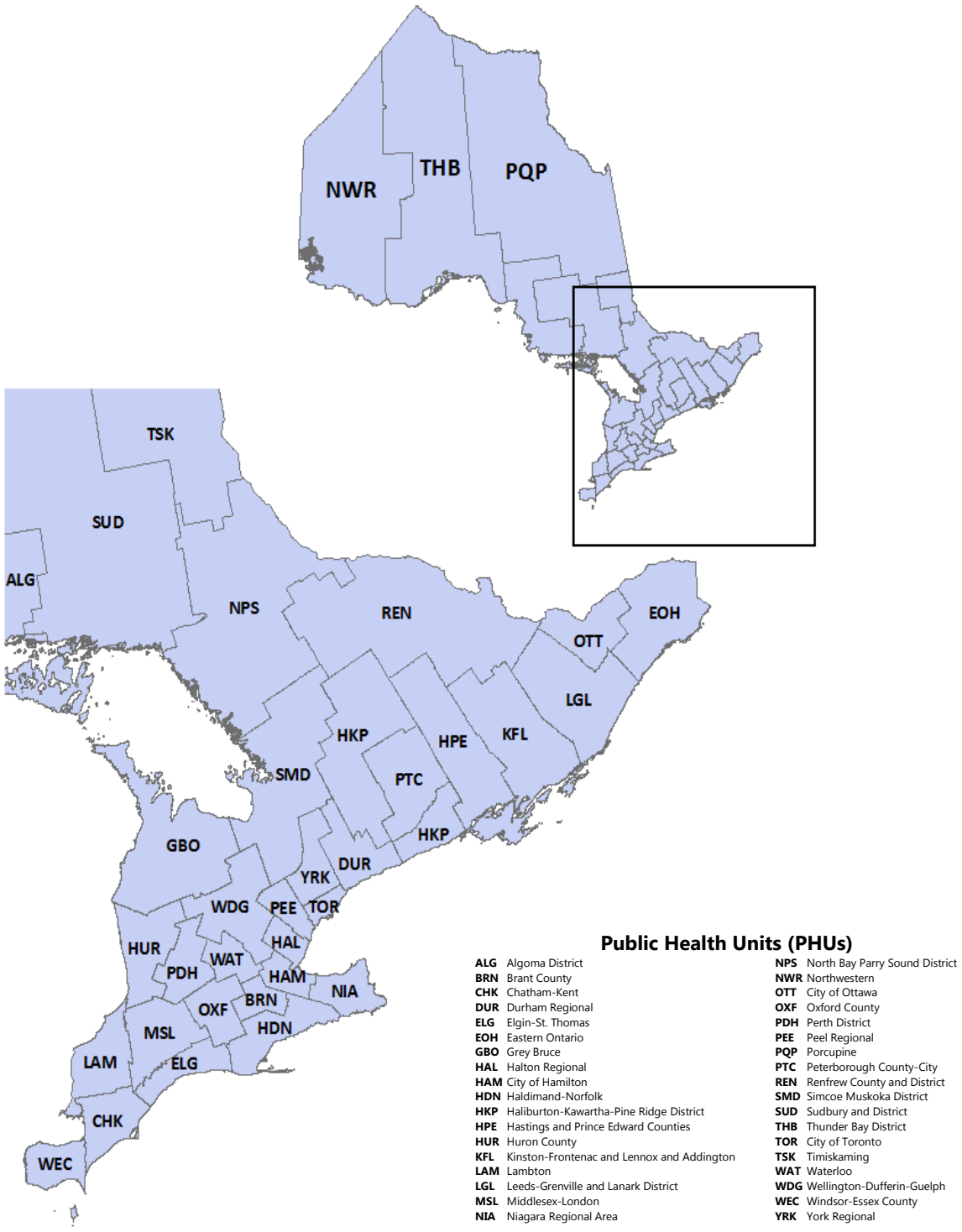


Figure 2.0 Public Health Unit boundaries, Ontario.

2.1 NUMBER OF HIGH RESOURCE USERS PER 1,000 BY PUBLIC HEALTH UNIT

Figure 2.1 illustrates the rates of HRU according to PHUs in Ontario. In total, the HRUPoRT predicted 758,190 HRU in Ontario by 2018/19. The highest rates of predicted HRU was observed in the District of Algoma, Timiskaming, North Bay Perry Sound District, Leeds, Grenville and Lanark District, Hastings and Prince Edward Counties, Haliburton, Kawartha, Pine Ridge District, and Chatham-Kent Health Unit, ranging from 92 per 1,000 people to 101 per 1,000 people. The lowest rates were observed in Waterloo, Wellington-Dufferin-Guelph, Halton Regional, Peel Regional, York Regional, City of Toronto, Durham Regional Health Unit, and the City of Ottawa, ranging from 58 per 1,000 people to 67 per 1,000 people. Figure 2.2 depicts both the rate of HRU according to PHUs and the number of predicted HRU over a 5-year period. The City of Toronto (HRU rate= 66 per 1,000) was predicted to have a HRU rate consistent with the Ontario average (HRU Ontario average rate= 70 per 1000), however due to the large population density in this area there were a large number (150,529) of predicted HRU (Figure 2.2). After the City of Toronto, Peel Regional Health Unit and York Regional Health Unit were predicted to have the next highest number of HRU, totaling 62,966 and 53,511, respectively. For predicted HRU number and rate over the 5-year period by public health unit, refer to Table 2.1 in the Appendix.

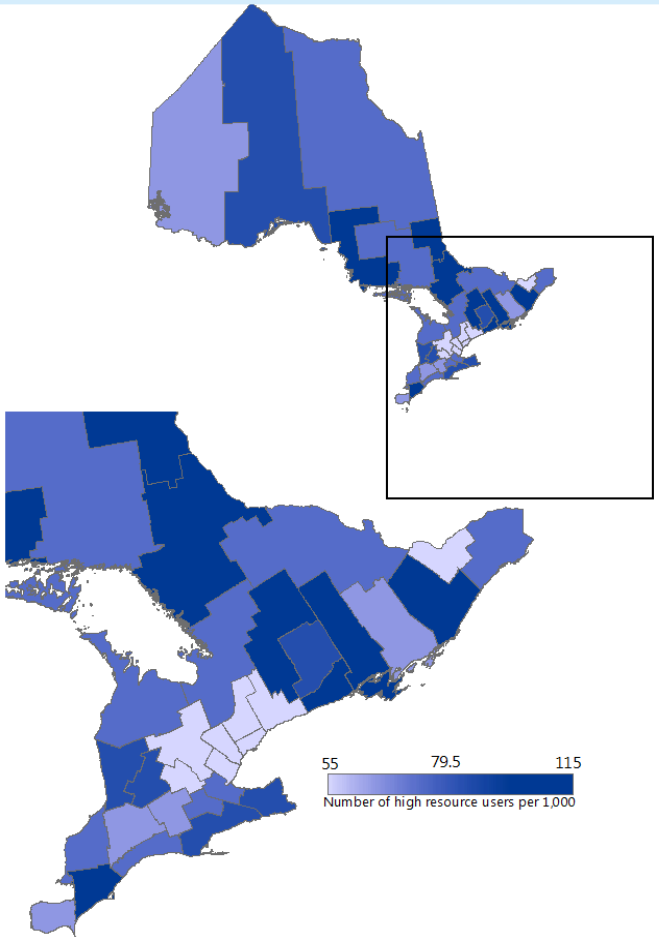
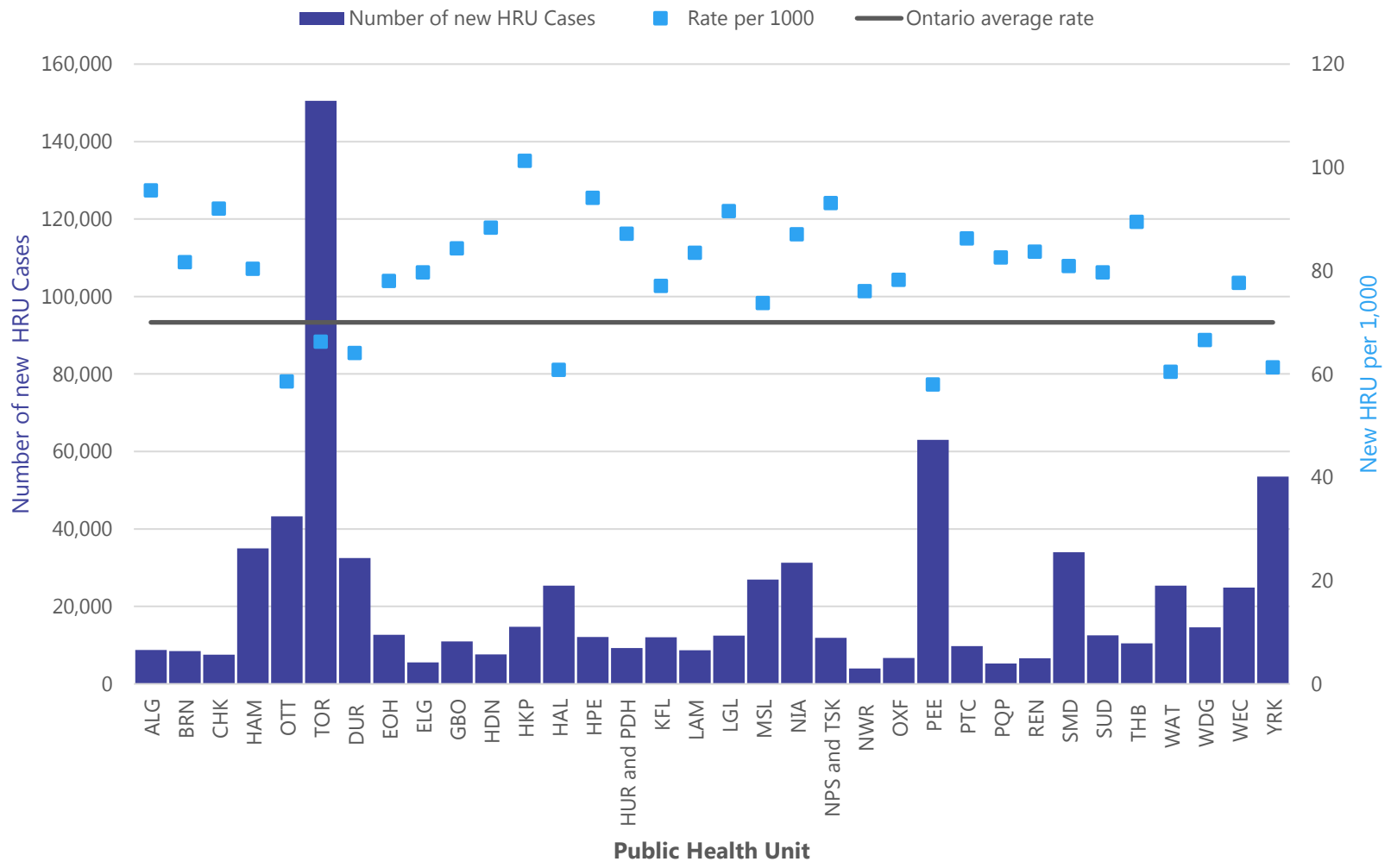


Figure 2.1 Number of high resource users by Public Health Unit, Ontario.

Figure 2.2 The HRUPoRT number and rate of high resource users in Ontario by Public Health Unit (2013/14-2018/19)



3 HIGH RESOURCE USER CHARACTERIZATIONS

This section displays the number of HRU per 1,000 persons by several socio-demographic and health behavioural characteristics. These risk factors include: sex, age, income, food security, body mass index (BMI), smoking status, and number of chronic conditions. For details regarding definitions of exposure variables please refer to the supplementary material in Rosella et al. (2018) (2).

3.1 HIGH RESOURCE USE BY KEY SOCIODEMOGRAPHIC RISK FACTORS AND BEHAVIOURAL CHARACTERISTICS

Figure 3.0 displays the number of HRU per 1,000 among males and females in Ontario PHUs. This figure demonstrates that in almost all PHU regions, men, in comparison to women, have a higher predicted rate HRU over a 5-year period. The only exception is Brant County Health Unit where the rate among women (HRU rate= 83 per 1,000) slightly exceed that in men (HRU rate= 80 per 1,000). In Waterloo and the City of Toronto, the HRU rate is the same among males and females (Waterloo HRU rate=60 per 1,000 and City of Toronto HRU rate= 66 per 1,000). The largest sex differences are observed in two neighbouring PHUs, Halliburton-Kawartha-Pine Ridge District (difference of 28 per 1,000), and Peterborough County-City Health Unit (difference of 19 per 1,000). For predicted HRU rate over the 5-year period by PHUs and sex, refer to Table 3.0 in the Appendix.

When examining the rate of predicted HRU by age in Ontario (Figure 3.1), it was unsurprising to find that the older age categories had the highest HRU rates, ranging from a minimum of 11 people per 1,000 in the less than 30 age category, to a maximum of 367 people per 1,000 for the 80 plus age category. The greatest burden of new HRU cases is expected to occur in the age groups that encompass 50 years and older.

Trends in predicted new HRU by household income showed a decrease as household income increased (Figure 3.2). The top 5% of HRU that reported a household income less than $20,000 had the highest predicted rate of HRU (94 people per 1,000), compared to individuals who reported a household income greater than $80,000 (39 people per 1,000). The difference in predicted HRU between the less than $20,000 and $20,000-$39,000 range was small (8 people per 1,000) compared to larger increase between an income range of $20,000-$39,000 and $40,000-$59,000 (28 people per 1,000). The majority new HRU cases were earning a household income of $59,000 or less.

Although there were a smaller number of new HRU cases who were food insecure, the predicted rate in this category was high, relative to those who consider themselves to be food secure (a difference of 22 people per 1,000 between the two groups) (Figure 3.3).

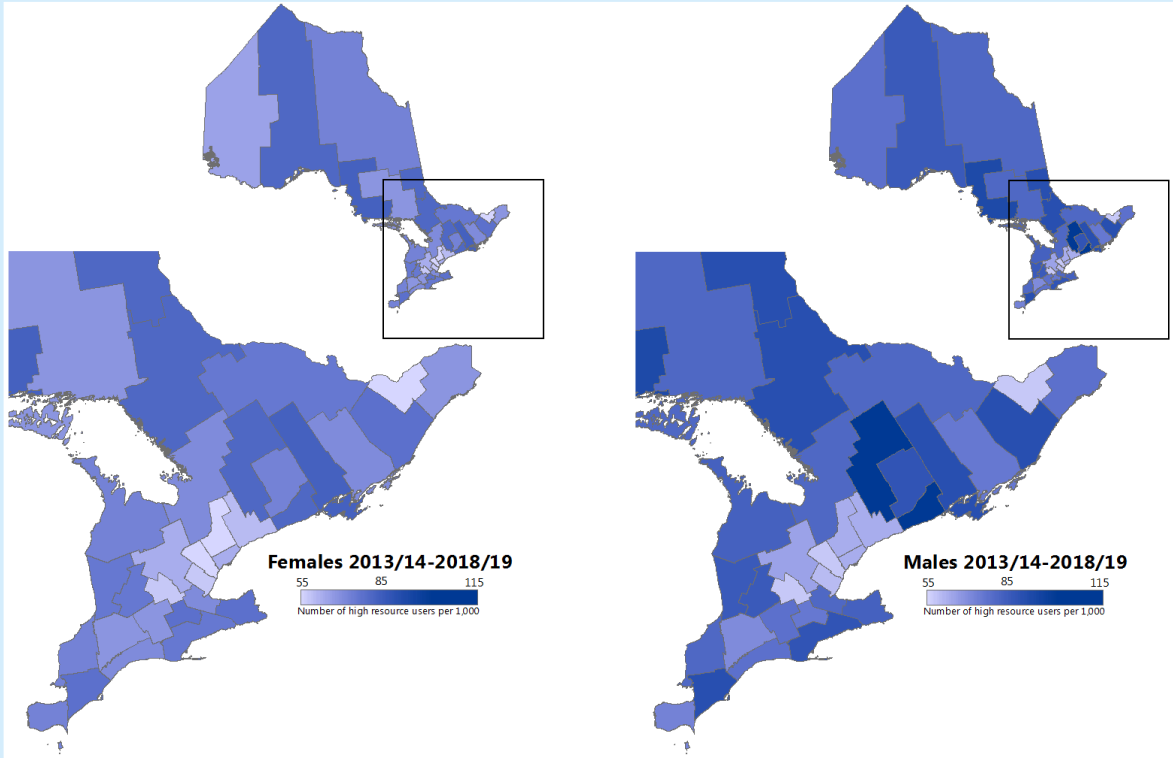


Figure 3.0 Rate of high resource use in Ontario's Public Health Units, by sex.

Trends in HRU by immigration status indicated that recent immigrants (i.e. less than 10 years) had a decreased rate of predicted HRU compared to non-immigrants and immigrants who lived in Ontario for more than 10 years (Figure 3.4). Immigrants who have been living in Ontario for more than 10 years were predicted to have a higher HRU rate than non-immigrants, with a difference of 24 people per 1,000 between.

The predicted rate of becoming a HRU over a 5-year period increased with BMI (Figure 3.5). Normal weight (BMI: 18.5-24.9) individuals had the lowest HRU rate (52 people per 1,000) and severely obese (BMI: ≥40.0) individuals had the highest HRU rate (128 people per 1,000). Individuals who were underweight (BMI: <18.5) had a slightly higher predicted rate of HRU than those who were normal weight (a difference of 3 people per 1,000) and a substantially lower rate than those who were overweight (BMI: 25.0-29.9) (a difference of 19 people per 1,000). The number of people predicted to be in the top 5% of HRU who were classified as overweight (number of new HRU cases= 259,431) were predicted to exceed the number of people who were normal weight (number of new HRU cases= 228,804), with the majority of HRU concentrated among these two categories.

Examining predicted HRU over a 5-year period by smoking status showed that former heavy smokers (158 people per 1,000) had more than twice the rate of becoming a HRU, compared to never smokers (57 people per 1,000) (Figure 3.6). Light smokers had a similar rate of predicted HRU over a 5-year period compared to never smokers (a difference of 6 people per 1,000). Approximately half (51%) of the predicted top 5% of HRU fall into current or former smoker categories.

Figure 3.1 Expected number and rate of high resource users in Ontario by age group (2013/14-2018/19)[2]

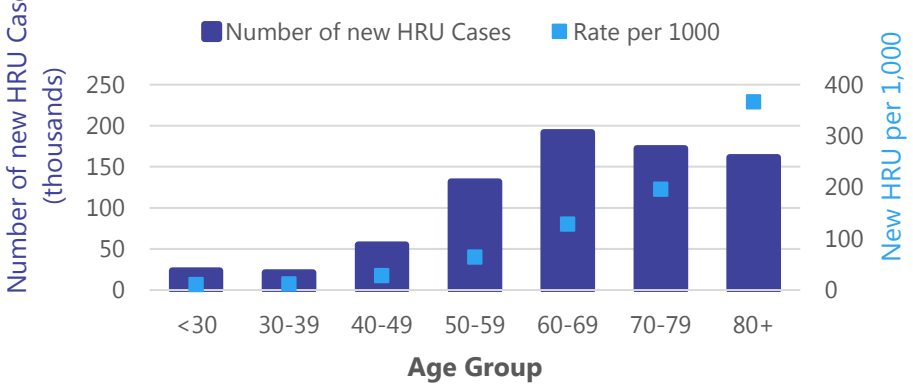


Figure 3.2 Expected number and rate of high resource users in Ontario by income range (2013/14- 2018/19)[2]

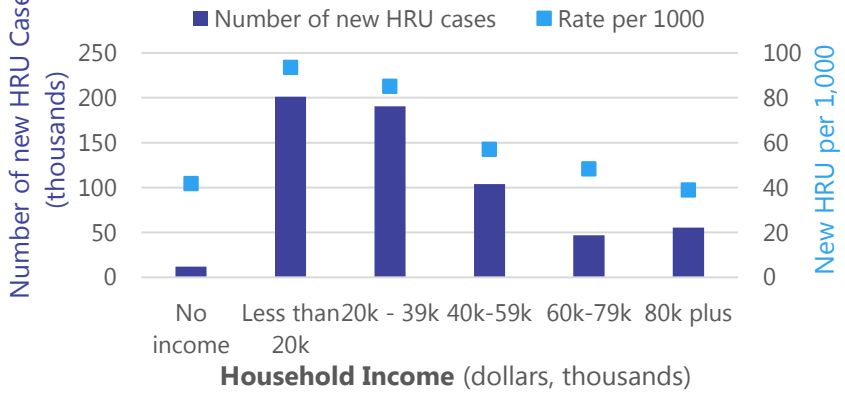


Figure 3.3 Expected number and rate of high resource users in Ontario by food security (2013/14- 2018/19)[2]

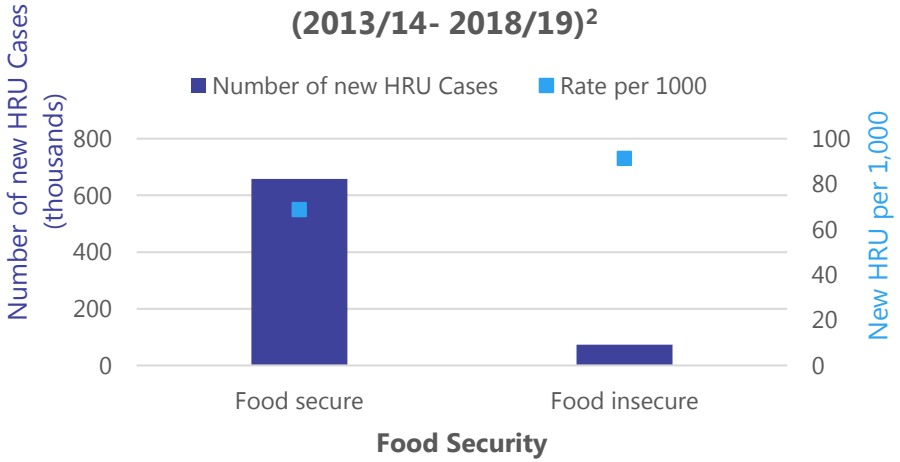
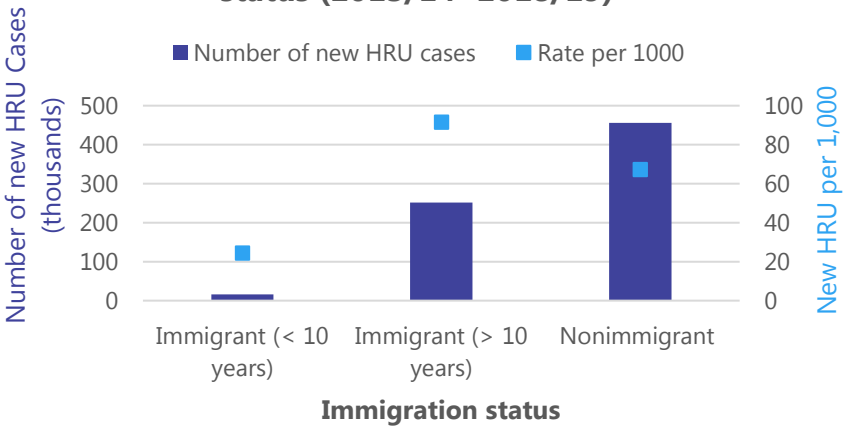


Figure 3.4 Expected number and rate of high resource users in Ontario by immigration status (2013/14- 2018/19)[2]



[2] *Note*: number of new HRU cases do not sum to 758,184 due to missing information on key stratification variables for some individuals.

Figure 3.5 Expected number and rate of high resource users in Ontario by body mass index (2013/14- 2018/19)[2]

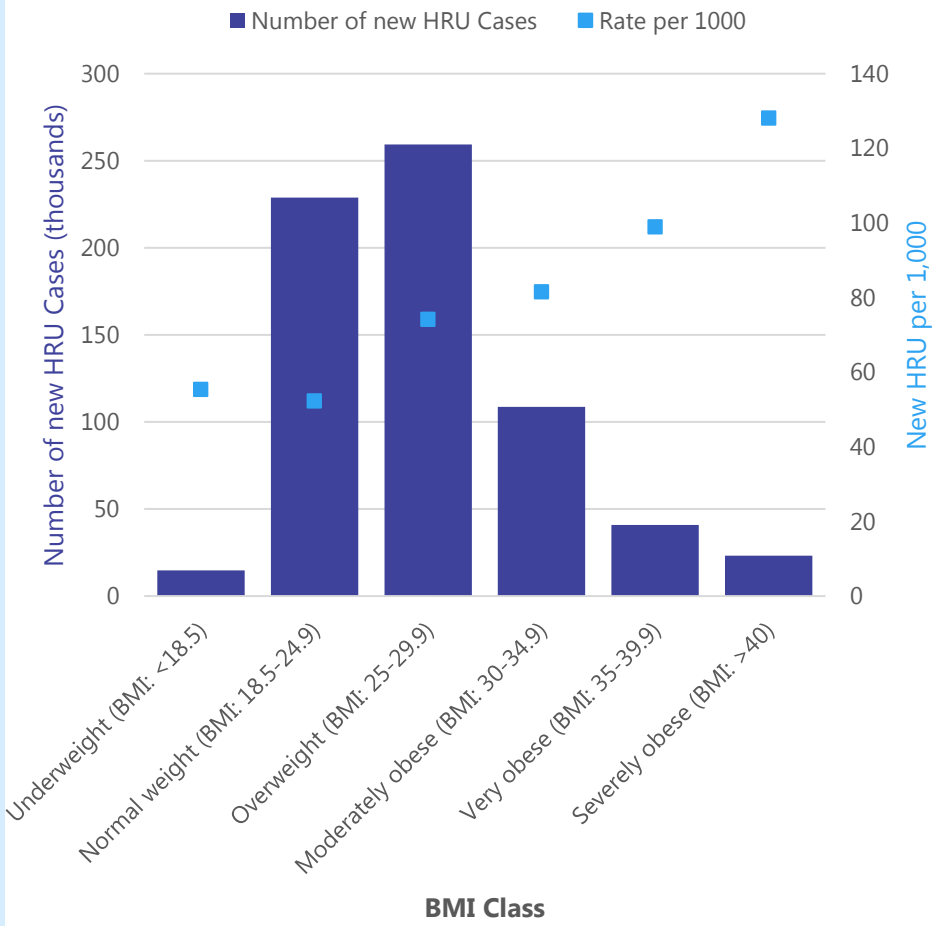
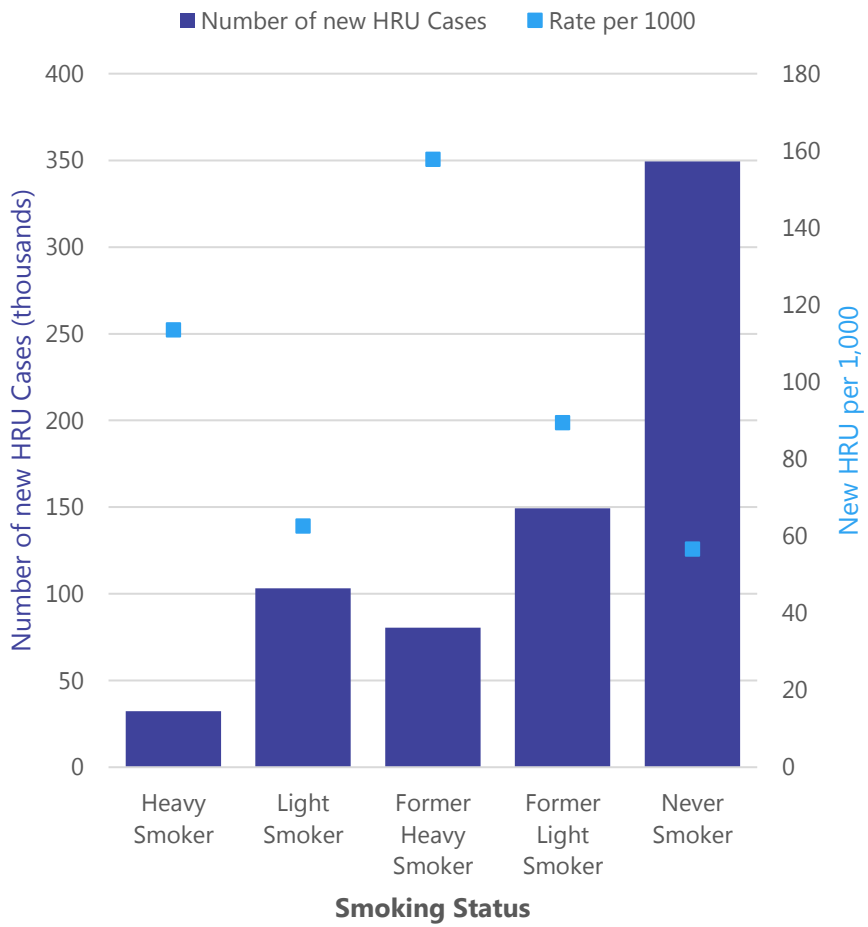


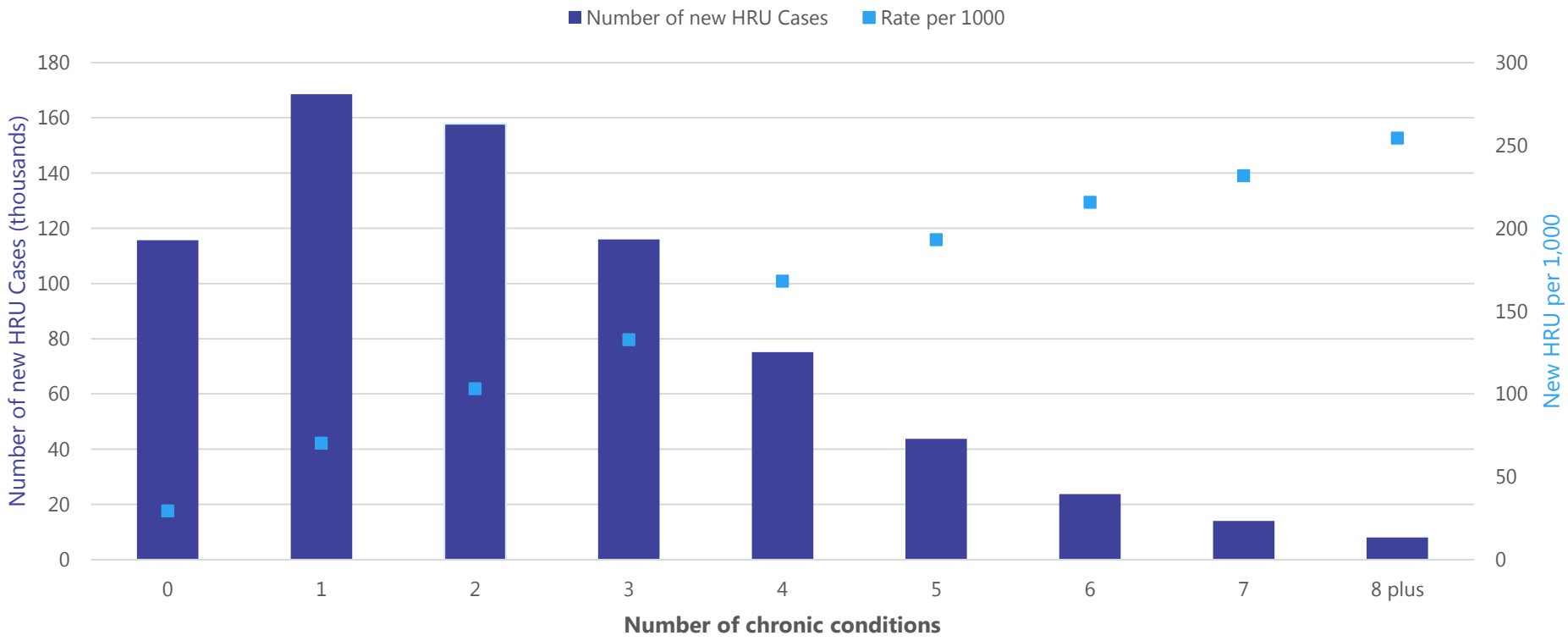
Figure 3.6 Expected number and rate of high resource users in Ontario by smoking status (2013/14- 2018/19)[2]



[2] *Note*: number of new HRU cases do not sum to 758,184 due to missing information on key stratification variables for some individuals.

Figure 3.7 shows the predicted rate of HRU over a 5-year period by number of self-reported chronic conditions. Individuals with multiple co-morbidities had a positive, linear increase in the rate of becoming a HRU over a 5-year period. For every chronic condition accumulated, the rate of HRU increased by approximately 28 people per 1,000 to a maximum of 255 per 1,000 people in the 8 or more chronic conditions category. Approximately two thirds (61%) of individuals predicted to become a HRU in the next 5 years had between one and three chronic conditions.

Figure 3.7 Expected number and rate of high resource users in Ontario by number of chronic conditions (2013/14- 2018/19) [2,3]



[2] *Note*: number of new HRU cases do not sum to 758,184 due to missing information on key stratification variables for some individuals.

[3] Chronic conditions include self-reported asthma, arthritis, back problems, migraine headaches, chronic obstructive pulmonary disease, diabetes, hypertension, heart disease, cancer, stomach or intestinal ulcers, stroke, urinary incontinence, bowel disorder, mood disorder, and anxiety disorder.

4 SUMMARY AND INTERPRETIVE CONSIDERATIONS

In summary, this report describes the predicted burden of HRUs in Ontario and across PHUs. The report demonstrates considerable variation in HRUs across Ontario. This variation is a function of many factors that vary by geography, including lifestyle behaviours, demographic characteristics, and social determinants. The algorithm was validated for use on self-reported risk factor information widely available in population health surveys. Using population-level survey data that are routinely collected enables regular updates and ensures relevance across health units in Ontario. HRUPoRT is intended to be used by health decision-makers as an aid in population-based planning and the design of HRU prevention strategies at the community level.

Some important interpretive considerations should be noted when reading this report. HRUPoRT does not capture domains of health care spending that are not covered by Ontario's Universal Health Insurance Plan, such as dental care, eye care, physiotherapy and prescription claims for those below 65 years old. In addition, HRUPoRT was not validated to capture HRU transitions among institutionalized persons (e.g. those living in long-term care or complex continuing care facilities), full-time members of the Canadian Forces, and Indigenous persons living on-reserve, as these populations are excluded from the CCHS sampling frame. Similarly, HRUPoRT does not capture HRU transitions among children below 18 years old. As a result, HRUPoRT projections may be an underestimate of the total HRU burden experienced in the population.

Health planning tools that consider the upstream determinants of high-cost users of the health system are lacking. We found that across jurisdictions in Ontario, socioeconomic and health behavioural characteristics are important predictors of health care utilization. This report demonstrates the variation that exists within Ontario and the utility of using population-level predictive modelling to inform public health and health care system activities. The findings underscore the importance of the determinants of high health resource use, which along with a community lens are a core focus of public health. Predictive tools, such as HRUPoRT, that can project high health care use at the population-level and among priority subgroups are useful for health system planners and decision-makers that need guidance on how to better integrate health care services to appropriately manage multimorbidity and contribute to health system sustainability.

DATA APPENDIX

Table 2.1 The HRUPoRT predicted number and per 1,000 of high resource use by Public Health Unit, Ontario, 2013/14 – 2018/19.

Public Health Unit[4]	Predicted number of HRU	Rate per 1,000
Algoma District	8,792	96
Brant County	8,487	82
Durham Regional	32,492	64
Elgin-St. Thomas	5,519	80
Grey Bruce	10,981	84
Haldimand-Norfolk	7,649	88
Haliburton-Kawartha-Pine Ridge District	14,717	101
Halton Regional	25,351	61
City of Hamilton	34,955	80
Hastings and Prince Edward Counties	12,092	94
Huron County and Perth District	9,246	87
Chatham-Kent	7,536	92
Kinston-Frontenac and Lennox and Addington	12,066	77
Lambton	8,662	83
Leeds-Grenville and Lanark District	12,495	92
Middlesex-London	26,923	74
Niagara Regional Area	31,273	87
North Bay Parry Sound District and Timiskaming	11,917	93
Northwestern	4,009	76
City of Ottawa	43,234	59
Oxford County	6,720	78
Peel Regional	62,966	58
Peterborough County-City	9,725	86
Porcupine	5,235	83
Renfrew County and District	6,599	84
Eastern Ontario	12,675	78
Simcoe Muskoka District	33,988	81
Sudbury and District	12,539	80
Thunder Bay District	10,437	89
Waterloo	25,391	60
Waterloo	14,610	67
Windsor-Essex County	24,858	78
York Regional	53,511	61
City of Toronto	150,529	66
All Ontario	**758,184**	**71**

[4]Statistics Canada combined Huron County and Perth and North Bay Parry Sound District and Timiskaming due to small cell counts.

Table 3.0 The HRUPoRT predicted number and per 1,000 of high resource use by Public Health Unit, Ontario, 2013/14-2018/19, by sex.

Public Health Unit[4]	Sex	Predicted number of HRU	Rate per 1,000
Algoma District	Female	4,198	90
	Male	4,594	101
Brant County	Female	4,437	83
	Male	4,050	80
Durham Regional	Female	16,566	63
	Male	15,926	65
Elgin-St. Thomas	Female	2,629	75
	Male	2,891	85
Grey Bruce	Female	5,136	78
	Male	5,845	91
Haldimand-Norfolk	Female	3,574	82
	Male	4,076	95
Haliburton-Kawartha-Pine Ridge District	Female	6,413	87
	Male	8,304	115
Halton Regional	Female	12,847	59
	Male	12,504	62
City of Hamilton	Female	16,726	75
	Male	18,229	86
Hastings and Prince Edward Counties	Female	5,909	90
	Male	6,183	99
Huron County and Perth District	Female	4,358	81
	Male	4,887	93
Chatham-Kent	Female	3,622	85
	Male	3,914	99
Kinston-Frontenac and Lennox and Addington	Female	5,998	74
	Male	6,068	81
Lambton	Female	4,165	79
	Male	4,497	88
Leeds-Grenville and Lanark District	Female	5,939	85
	Male	6,556	99
Middlesex-London	Female	13,477	72
	Male	13,446	76
Niagara Regional Area	Female	15,373	83
	Male	15,900	91

North Bay Parry Sound District and Timiskaming	Female	5,615	86
	Male	6,303	100
Northwestern	Female	1,826	69
	Male	2,183	83
City of Ottawa	Female	21,331	56
	Male	21,903	61
Oxford County	Female	3,160	73
	Male	3,560	84
Peel Regional	Female	30,492	55
	Male	32,474	61
Peterborough County-City	Female	4,519	77
	Male	5,205	96
Porcupine	Female	2,507	79
	Male	2,729	86
Renfrew County and District	Female	3,293	81
	Male	3,305	87
Eastern Ontario	Female	5,952	72
	Male	6,723	85
Simcoe Muskoka District	Female	15,914	75
	Male	18,074	88
Sudbury and District	Female	5,879	73
	Male	6,660	87
Thunder Bay District	Female	5,127	87
	Male	5,311	92
Waterloo	Female	12,852	60
	Male	12,539	60
Waterloo	Female	7,161	65
	Male	7,449	68
Windsor-Essex County	Female	12,378	77
	Male	12,481	78
York Regional	Female	25,247	57
	Male	28,264	66
City of Toronto	Female	78,387	66
	Male	72,141	66
All Ontario		**758,184**	**71**

[4]Statistics Canada combined Huron County and Perth and North Bay Parry Sound District and Timiskaming due to small cell counts.

REFERENCES

1. Wodchis WP, Austin PC, Henry DA. A 3-year study of high-cost users of health care. CMAJ: Canadian Medical Association Journal. 2016 2016/02/16/:182+.

2. Rosella LC, Kornas K, Yao Z, Manuel DG, Bornbaum C, Fransoo R, et al. Predicting High Health Care Resource Utilization in a Single-payer Public Health Care System: Development and Validation of the High Resource User Population Risk Tool. Med Care. 2018;56(10):e61-e9.

3. Wodchis WP, Bushmeneva K, Nikitovic M, McKillop I: Guidelines on Person-level Costing Using Administrative Databases in Ontario. Working Paper Series. Vol 1. 2013, Health System Performance Research Network, Toronto.

4. Canada S. Canadian Community Health Survey- Annual Component (CHHS) 2018 [July 4, 2018]. Available from: http://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&SDDS=3226.

5. The Office of the Auditor General of Ontario. Public Health: Chronic Disease Prevention (Ministry of Health andLong-Term Care) 2017. Available from: http://www.auditor.on.ca/en/content/annualreports/arreports/en17/v1_310en17.pdf.