

## SUPPLEMENTARY FIGURES AND TABLES

Figure S1: Study cohort diagram.

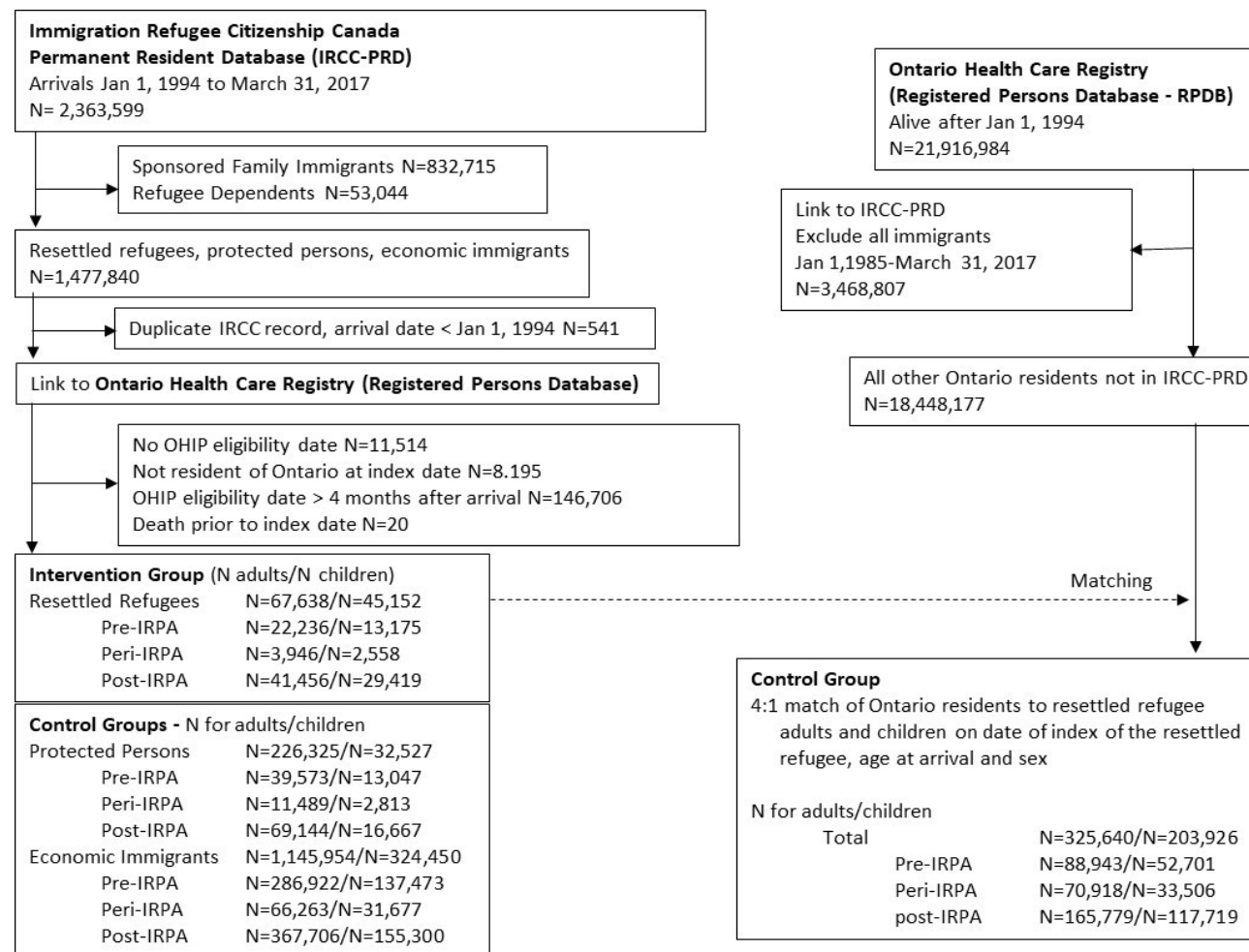


Table S1: Description of linked administrative health and demographic databases, corresponding variables used in current study.

Name of Database	Data Provider	Description
Immigration, Refugees, and Citizenship Canada's Permanent Resident Database	Immigration & Refugees and Citizenship Canada (IRCC)	Permanent residents' demographic information collected by the IRCC during the immigration application process. Overall 86.97% of immigrants and 92% of refugees in the IRCC database used in this study (1985-2017) were linked to the healthcare registry, with minimal variability by immigration category, region of birth and minimal differences in characteristics between linked and unlinked refugees.[1]
OHIP Registered Persons Database (RPDB) (healthcare registry)	Ontario Ministry of Health	Basic demographic information (age, sex, location of residence, date of birth, and date of death for deceased individuals) for all individuals issued an Ontario health insurance number. Also indicates the time periods individuals are eligible for health insurance and provides the best-known postal code for each registrant on July 1st of each year which is updated yearly. Linkable to all other ICES data holdings using an encrypted health card number.
Canadian Institute for Health Information – Discharge Abstract (DAD) Database	Canadian Institute for Health Information (CIHI)	Contains administrative (admission and discharge dates), clinical (diagnoses and procedures/interventions) and demographic information from the chart abstraction of all admissions to acute care hospitals in Ontario. Records are sent from hospitals to CIHI, where they are validated and cleaned before being sent to ICES for use in healthcare administrative research. At ICES, consecutive DAD records are linked together to form “episodes of care” among the hospitals to which patients have been transferred after their initial admission. All admissions for a given patient (or admissions to other data at ICES) can be linked using the individual's encrypted health card number.
National Ambulatory Care Reporting System	Canadian Institute for Health Information (CIHI)	Contains administrative, clinical (diagnoses and procedures) and demographic information for all patient visits to hospital- and community-based ambulatory care centres (emergency departments, day surgery units, hemodialysis units, and cancer care clinics) in Ontario. Records are sent from hospitals to CIHI, where they are validated and cleaned before being sent to ICES for use in healthcare administrative research. At ICES, NACRS records are linked with other data sources to identify transitions to other settings, such as inpatient acute care or psychiatric care, and can be linked to other ICES data using the individual's encrypted health card number.
Ontario Health Insurance Plan (OHIP)	Ontario Ministry of Health	Contains information on inpatient and outpatient services provided to Ontario residents eligible for health insurance by fee-for-service health care practitioners (primarily physicians) and “shadow billings” for those paid through non-fee-for-service payment plans. Billing codes on the claims (OHIP fee codes) identify the care provider, their area of specialization and the type and location of service. OHIP billing claims also contain a 3-digit diagnosis code – the

Name of Database	Data Provider	Description
		main reason for the service – captured using a modified version of the ICD, 8 <sup>th</sup> revision coding system.
Vital Statistics - Death	Office of the Registrar General Deaths database (ORGD)	An annual dataset containing information on all deaths registered in Ontario starting on January 1, 1990. Information on cause of death lags other variables by about 2 years. ICES receives the dataset without health card numbers, but with direct identifiers such as name, postal code, and date of birth. ICES uses deterministic and probabilistic data linkage with the RPDB to assign encrypted health card numbers to these records.
Postal Code Conversion File (PCCF)+	Statistics Canada	A conversion template between the six-character postal code and Statistics Canada's standard geographic areas. Through the link between postal codes and standard geographic areas, the PCCF permits the integration of data from various census derived variables.

**Table S2: List of Variables used in this study**

Variables	Database Source	Variable Definition & Categories	Collected/ measured at
Immigration Refugee Protection Act (IRPA) implementation periods	Immigration, Refugees, and Citizenship Canada's (IRCC) Permanent Resident Database	Intervention and control groups were divided into three groups based on the arrival date: i) before IRPA (pre-IRPA) implementation – arrivals between January 1, 1994 to June 28, 2002 ii) IRPA implementation period (peri-IRPA) – arrivals between June 29, 2002 to June 28, 2004 iii) after IRPA (post-IRPA) implementation – arrivals after June 29, 2004 to December 31, 2017	immigration application
<b>Intervention and control groups</b>			
Immigration category	Immigration, Refugees, and Citizenship Canada's (IRCC) Permanent Resident Database	<ul style="list-style-type: none"> <li>Resettled refugees: government sponsored refugees, privately sponsored refugees, blended visa office referred refugees.</li> <li>Protected persons: successful asylum-seekers.</li> <li>Economic Immigrants: must meet criteria for education, official language ability and employment skills along with few pre-existing medical conditions.</li> </ul>	Time of immigration application
Other Ontarians (i.e., those not found in the IRCC database)	OHIP Registered Persons Database (RPDB) (healthcare registry)	This group includes: i) those born in Ontario (the majority), ii) interprovincial migrants who were either immigrants to Canada or born in Canada but who moved to Ontario between 1991 and 2017, and iii) immigrants to Ontario who are permanent or temporary residents who arrived in Ontario after December 31, 2017.	Health care registration/renewal
<b>Outcome</b>			
Resource Utilization Bands (RUBS)	CIHI DAD 1991-2019 CIHI NACRS 1991-2019 OHIP 1991-2019	Uses The Johns Hopkins ACG System (Johns Hopkins Bloomberg School of Public Health, 2014). The ACG system is a statistically valid software-based methodology using patient diagnosis code history from health care encounters to predict healthcare utilization and costs. The ACG system uses both ICD 9 and ICD 10 coding systems, accommodating the transition to the ICD 10 CI/CCP coding system that occurred in Ontario in 2002. Individuals who are expected to use the same level of resources are grouped together in a RUB category, even though they may have very	Assessed in the two years after becoming a permanent resident (if OHIP eligible prior to becoming a permanent resident) OR

Variables	Database Source	Variable Definition & Categories	Collected/ measured at
		<p>different illnesses and epidemiological patterns. Outpatient healthcare costs were based on unit costs of services during an episode of care paid to healthcare providers. Costs for hospitalizations, same-day surgeries, and emergency department visits were calculated using case-mix methodology. The cost of a healthcare encounter was based on the intensity of resources used (Wodchis et al., 2013).</p> <ul style="list-style-type: none"> <li>• Categorizes users into 6 groups from non-users (0) to high resource users (5)</li> <li>• Main study outcome operationalized as moderate to high resource users (RUBs 3-5)</li> <li>• Secondary outcome operationalized as high to high resource users (RUBs 4-5)</li> </ul>	in the two years after becoming eligible for OHIP (if eligibility occurs on or within 4 months of OHIP eligibility date)
<b>Covariates</b>			
Age category	OHIP Registered Persons Database (RPDB) (healthcare registry)	<p>Calculated using the index date and the date of birth recorded in the RPDB.</p> <p>For children categorized into: 0-6 years, 7-12 years and 13-18 years.</p> <p>For adults categorized into: 10 year intervals to 80+ years</p>	At study index time
Sex	OHIP Registered Persons Database (RPDB) (healthcare registry)	Sex (male/female) of the individual as recorded in the individual's health card. We recognize that this binary categorization does not necessarily reflect gender identity.	Health care registration/renewal
Neighborhood material deprivation quintile (based on postal code in health care registry)		<p>Conceptualized as a measure of access to and ability to attain basic material needs and includes measures of income, family composition, educational attainment and housing quality (Matheson and van Ingen, 2018). Based on the residential postal code recorded in the RPDB as of the index date and the Statistics Canada census.</p> <p>Categorized into Q1 [least deprived neighborhood], Q2, Q3, Q4 and Q5 [most deprived neighborhood]. Those areas with suppressed data were</p>	

Variables	Database Source	Variable Definition & Categories	Collected/ measured at
		merged with the highest deprivation quintile, as they are usually low income.	
Education level at arrival	Immigration, Refugees, and Citizenship Canada's (IRCC) Permanent Resident Database	For adults: <ul style="list-style-type: none"> <li>• secondary or less</li> <li>• trade/non-university diploma</li> <li>• some or completed university</li> <li>• missing</li> </ul>	Time of immigration application
Marital status at arrival	Immigration, Refugees, and Citizenship Canada's (IRCC) Permanent Resident Database	For adults: <ul style="list-style-type: none"> <li>• single</li> <li>• married/common-law</li> <li>• separated/divorced</li> <li>• widowed</li> <li>• missing</li> </ul>	Time of immigration application
Region of birth	Immigration, Refugees, and Citizenship Canada's (IRCC) Permanent Resident Database	Countries of birth categorized into 12 world regions: <ul style="list-style-type: none"> <li>• Caribbean</li> <li>• Central America</li> <li>• South America</li> <li>• Eastern Europe a&amp; former USSR</li> <li>• Middle East/North Africa</li> <li>• West/Central/East/South Africa &amp; Africa unspecified</li> <li>• South Asia</li> <li>• Australasia/Southeast Asia/Oceania/Asia unspecified</li> <li>• East Asia</li> <li>• Europe &amp; former Yugoslavia</li> <li>• North America &amp; Western Hemisphere</li> <li>• Not Stated</li> </ul>	Time of immigration application

Table S3: Comparing IRCC “excessive demand thresholds” in 2005, 2009, 2012 and 2017 to the average per capita health care costs in resource utilizations bands (RUBs) 3+4+5 and RUBs 4+5 based on a 20% random sample of Ontario residents eligible for OHIP.

Calendar Year	IRCC Excessive demand threshold	RUBs 3+4+5		RUBs 4+5	
		population prevalence (%)	average per capita health care costs (\$)	population prevalence (%)	average per capita health care costs (\$)
2005	\$4,057	46.4%	\$3,556	8.8%	\$10,954
2009	\$4,806	46.9%	\$4,955	9.1%	\$14,578
2012	\$6,141	46.4%	\$5,383	9.3%	\$15,709
2017	\$6,655	48.0%	\$5,717	10.2%	\$15,961

Table S4: Average per capita crude and age-sex standardized health care costs in the first two years after arrival among study population groups, arriving between 2015-2017 only, and matched other Ontario residents.

Study Group arriving in Ontario between 2015-2017	N	Average crude per capita costs (CDN) (\$) <sup>a</sup>	Average age-sex standardized <sup>b</sup> per capita costs (CDN) (\$) <sup>b</sup>
Resettled Refugees	28,541	\$3,671.20	\$6,548.17
Protected Persons	12,387	\$4,049.92	\$6,344.46
Economic Immigrants	84,299	\$1,761.15	\$2,312.88
Other Ontarians (matched 4:1 to Resettled Refugees)	113,802	\$2,853.38	\$5,279.29

<sup>a</sup>IRCC excessive demand threshold for 2017 it was \$6,655 (Government of Canada, 2018)

<sup>b</sup>Standard population is the 2017 Ontario population. Note that this standard population has higher proportions in older age groups compared to immigrant groups, while immigrant groups tend to have higher proportions of children and working-age adults. Refugee groups have much greater age-sex standardized costs than crude costs, likely because greater proportions of older age groups in the standard population upweight higher healthcare costs in older refugee groups.

Table S5: Sensitivity analyses - Level and slope changes in morbidity prevalence (RUB 3-5): interrupted time series (ITS) and comparative interrupted time series (CITS) results among adult resettled refugees and control groups, age and sex adjusted values.

Model #	Intervention (I), Control (C) Group	Analytic Approach	Level changes at IRPA implementation % RUB 3-5 (95% CI)	Slope changes post- vs. pre-IRPA % RUB 3-5 (95% CI)
1	Resettled Refugees (I)	ITS	3.17 (-0.41, 6.75)	<b>0.79 (0.27, 1.31)</b>
	Protected Persons (C)	ITS	-0.53 (-2.84, 1.78)	<b>0.83 (0.45, 1.21)</b>
	Resettled Refugees vs. Protected Persons	CITS	3.70 (-0.56, 7.96)	-0.05 (-0.69, 0.60)
2	Resettled Refugees (I)	ITS	3.04 (-2.16, 8.23)	<b>0.81 (0.05, 1.56)</b>
	Economic Immigrants (C)	ITS	<b>-3.45 (-4.79, -2.11)</b>	<b>0.71 (0.49, 0.93)</b>
	Resettled Refugees vs. Economic Immigrants	CITS	<b>6.48 (1.12, 11.85)</b>	0.10 (-0.69, 0.88)
3	Resettled Refugees (I)	ITS	2.90 (-1.29, 7.09)	<b>0.80 (0.20, 1.41)</b>
	Other Ontarians (C)	ITS	1.13 (-0.97, 3.22)	0.15 (-0.16, 0.45)
	Resettled Refugees vs. Other Ontarians	CITS	1.77 (-2.91, 6.45)	0.66 (-0.02, 1.34)

Table S6: Sensitivity analyses - Level and slope changes in morbidity prevalence (RUB 3-5): interrupted time series (ITS) and comparative interrupted time series (CITS) results among children arriving as resettled refugees and control groups, age and sex adjusted values.

Model #	Intervention (I), Control (C) Group	Analytic Approach	Level changes at IRPA implementation % RUB 3-5 (95% CI)	Slope changes post- vs. pre-IRPA % RUB 3-5 (95% CI)
1	Resettled Refugees (I)	ITS	1.84 (-2.26, 5.94)	<b>1.38 (0.75, 2.01)</b>
	Protected Persons (C)	ITS	<b>5.77 (1.73, 9.81)</b>	<b>1.17 (0.50, 1.84)</b>
	Resettled Refugees vs. Protected Persons	CITS	-3.93 (-9.69, 1.83)	0.21 (-0.71, 1.13)
2	Resettled Refugees (I)	ITS	2.00 (-3.59, 7.58)	<b>1.33 (0.48, 2.18)</b>
	Economic Immigrants (C)	ITS	-3.14 (-4.87, -1.40)	<b>1.38 (1.09, 1.66)</b>
	Resettled Refugees vs. Economic Immigrants	CITS	5.13 (-0.72, 10.98)	-0.05 (-0.95, 0.85)
3	Resettled Refugees (I)	ITS	1.79 (-4.05, 7.63)	<b>1.41 (0.52, 2.30)</b>
	Other Ontarians (C)	ITS	2.46 (-0.46, 5.38)	<b>0.48 (0.03, 0.92)</b>
	Resettled Refugees vs. Other Ontarians	CITS	-0.67 (-7.20, 5.85)	0.94 (-0.06, 1.93)



Table S7: Level and slope changes in morbidity prevalence (RUB 4-5): interrupted time series (ITS) and comparative interrupted time series (CITS) results among adult resettled refugees and control groups.

Model #	Intervention (I), Control (C) Group	Analytic Approach	Level changes at IRPA implementation % RUB 3-5 (95% CI)	Slope changes post- vs. pre-IRPA % RUB 3-5 (95% CI)
1	Resettled Refugees (I)	ITS	0.37 (-0.49, 1.24)	<b>0.79 (0.31, 1.28)</b>
	Protected Persons (C)	ITS	-2.1 (-3.95, -0.25)	<b>0.90 (0.59, 1.21)</b>
	Resettled Refugees vs. Protected Persons	CITS	2.91 (-0.49, 6.32)	-0.11 (-0.63, 0.41)
2	Resettled Refugees (I)	ITS	0.37 (-0.49, 1.24)	<b>0.79 (0.31, 1.28)</b>
	Economic Immigrants (C)	ITS	-0.66 (-1.52, 0.21)	<b>0.41 (0.27, 0.55)</b>
	Resettled Refugees vs. Economic Immigrants	CITS	1.48 (-1.99, 4.94)	0.38 (-0.12, 0.89)
3	Resettled Refugees (I)	ITS	0.37 (-0.49, 1.24)	<b>0.79 (0.31, 1.28)</b>
	Other Ontarians (C)	ITS	0.61 (-0.79, 2.01)	0.19 (-0.01, 0.40)
	Resettled Refugees vs. Other Ontarians	CITS	0.21 (-2.92, 3.33)	<b>0.60 (0.14, 1.05)</b>

Table S8: Level and slope changes in morbidity prevalence (RUB 4-5): interrupted time series (ITS) and comparative interrupted time series (CITS) results among resettled refugee children and control groups.

Model #	Intervention (I), Control (C) Group	Analytic Approach	Level changes at IRPA implementation % RUB 3-5 (95% CI)	Slope changes post- vs. pre-IRPA % RUB 3-5 (95% CI)
1	Resettled Refugees (I)	ITS	<b>1.72 (0.21, 3.23)</b>	<b>0.45 (0.22, 0.68)</b>
	Protected Persons (C)	ITS	0.20 (-1.37, 1.78)	<b>0.28 (0.02, 0.54)</b>
	Resettled Refugees vs. Protected Persons	CITS	1.51 (-0.73, 3.75)	0.18 (-0.18, 0.53)
2	Resettled Refugees (I)	ITS	<b>1.72 (0.21, 3.23)</b>	<b>0.45 (0.22, 0.68)</b>
	Economic Immigrants (C)	ITS	-0.63 (-1.10, -0.16)	<b>0.26 (0.18, 0.34)</b>
	Resettled Refugees vs. Economic Immigrants	CITS	<b>2.34 (0.77, 3.92)</b>	0.18 (-0.05, 0.44)
3	Resettled Refugees (I)	ITS	<b>1.72 (0.21, 3.23)</b>	<b>0.45 (0.22, 0.68)</b>
	Other Ontarians (C)	ITS	<b>0.85 (0.15, 1.55)</b>	<b>0.14 (0.03, 0.24)</b>
	Resettled Refugees vs. Other Ontarians	CITS	0.87 (-0.69, 2.42)	<b>0.32 (0.11, 0.52)</b>

Figure S1: Adults arriving as resettled refugees in Ontario, Canada (1994 to 2017) compared with those arriving as protected persons or economic immigrants and matched CDN/LTRs – observed and predicted (linear regression) resource utilization band (RUBs) 4 to 5 prevalence, before (1994-2002) and after (2004 to 2017) implementation of the Immigration and Refugee Protection Act (IRPA) (June 28, 2002).

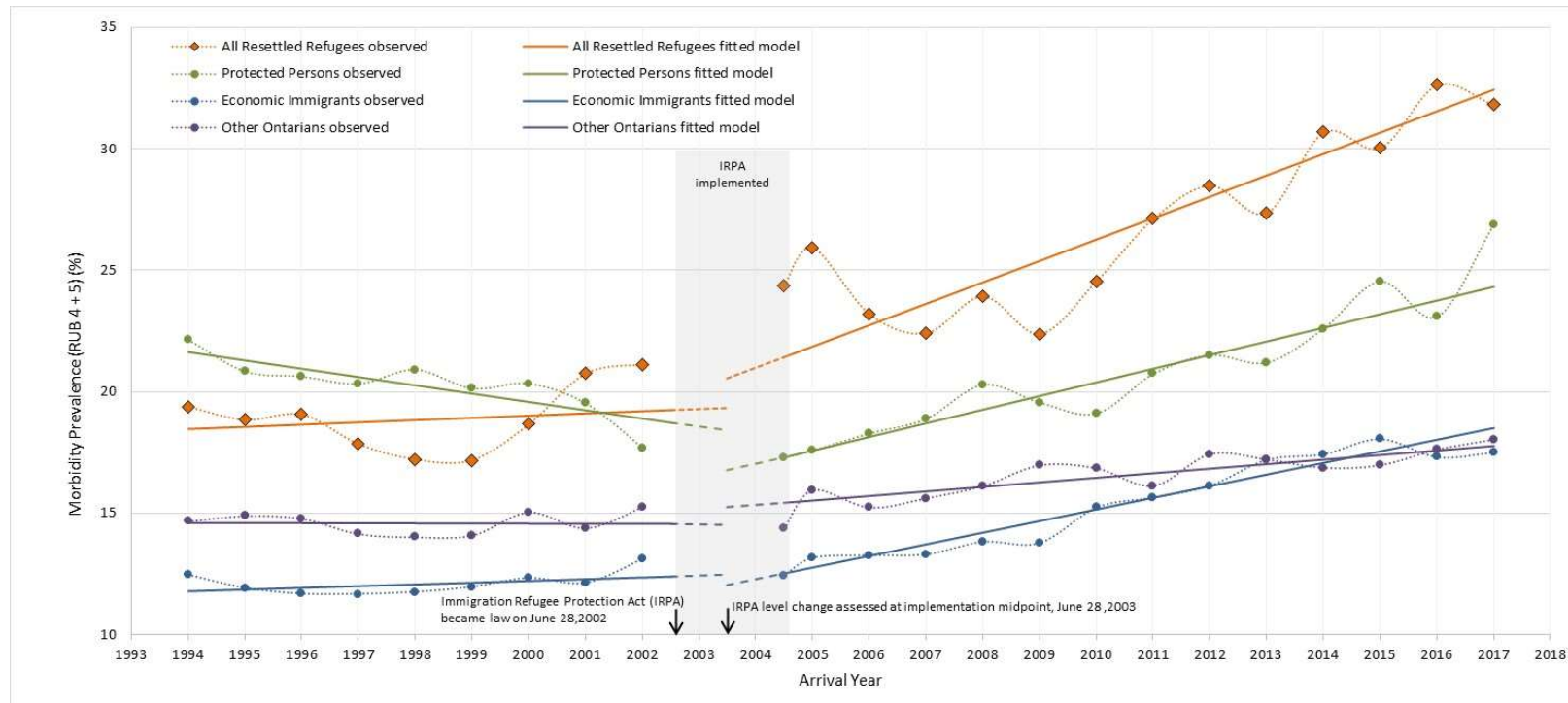


Figure S2: Children arriving as resettled refugees in Ontario, Canada (1994 to 2017) compared with those arriving as protected persons or economic immigrants and matched CDN/LTRs – observed and predicted (linear regression) resource utilization band (RUBs) 4 to 5 prevalence, before (1994-2002) and after (2004 to 2017) implementation of the Immigration and Refugee Protection Act (IRPA) (June 28, 2002).

