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S1. International classification of disease (ICD-9 and ICD-10) codes of chronic diseases

Conditions	ICD-9	ICD-10	Algorithm
Acute myocardial infarction	410	I21	<i>Ages 20-105:</i> All patients with a most responsible diagnosis of listed ICD codes in the CIHI-DAD, CIHI-SDS database and then several exclusion criteria were applied.
Angina	413	I20	<i>Ages 20-105:</i> All patients with a most responsible diagnosis of listed ICD codes in the CIHI-DAD, CIHI-SDS database, NACRS and OHIP claims.
Asthma	493	J45, J46	<i>(OASIS) Ages 0-99:</i> Individuals with ≥ 1 hospital admission with an asthma diagnosis or ≥ 2 OHIP claims with asthma diagnosis within two years.
Chronic obstructive pulmonary disease (COPD)	491, 492, 496	J41, J42, J43, J44	<i>(COPD Database) Ages 35-105:</i> Individuals with ≥ 1 COPD diagnosis in OHIP or CIHI-SDS or CIHI-DAD databases.
Congestive heart failure	428	I500, I501, I509	<i>Ages 45-105:</i> Individuals with ≥ 1 hospital admission with a CHF diagnosis or ≥ 1 OHIP claim/NACRS ED record with a CHF diagnosis followed within one year by a second record with a CHF diagnosis from any source.
Diabetes	250	E10, E11, E13, E14	<i>Ontario Diabetes Database (ODD): Pediatric definition (≤ 18 years):</i> ≥ 4 OHIP claims with diagnostic code 250 or ≥ 1 OHIP claim with fee code Q040, K029 or K030 within 2 years. <i>Adult definition (> 18 years):</i> ≥ 2 OHIP claims with diagnostic code 250 or ≥ 1 OHIP claim with fee code Q040, K029 or K030 or ≥ 1 CIHI admission within 2 years.
Hypertension	401, 402, 403, 404, 405	I10, I11, I12, I13, I15	<i>Ages 20-105:</i> Individuals with ≥ 1 hospital admission with a hypertension diagnosis, or ≥ 1 OHIP claim with a hypertension diagnosis followed within two years by either ≥ 1 OHIP claim or ≥ 1 hospital admission with a hypertension diagnosis.
Ischemic heart disease	411, 414	I24, I251, I258, I259	<i>Ages 20-105:</i> All patients with a most responsible diagnosis of any of listed ICD codes in the CIHI-DAD, CIHI-SDS database, NACRS and OHIP claims.

Lung cancer	162, 163	C34.0-C34.9, C38.4, C45.0	<i>Age 20-105:</i> The Ontario Cancer Registry (OCR) is a computerized database of information on all adult Ontario residents who have been newly diagnosed with cancer ("incidence") or who have died of cancer ("mortality"). All new cases of cancer are registered, except non-melanoma skin cancer. Individuals age 20-105 in the OCR database who had any of listed ICD codes indicated as primary cancer.
Non-lung cancers	140-239 Except for 162, 163	C00-D29 except for C34.0-C34.9, C38.4 and C45.0	<i>Age 20-105:</i> Individuals in the OCR database who had any of listed ICD codes (except for lung cancer specified above) indicated as primary cancer.
Stroke	433, 434, 435, 436	G45, G46, I63, I64	<i>Ages 20-105:</i> All patients with a most responsible diagnosis of any of listed stroke ICD codes in the CIHI-DAD, CIHI-SDS database, NACRS and OHIP claims.

CIHI-DAD=Discharge abstract data collected by the Canadian Institute for Health Information

CIHI-SDS=Same day surgery data collected by the Canadian Institute for Health Information

NACRS=National Ambulatory Care Reporting System

OHIP=Ontario Health Insurance Plan

ICD=International Classification of Disease

S2. AQHI and quality control measures conducted on Ministry of Environment datasets

Air quality Index and AQHI:

The air quality index, like the AQHI, is a near real-time summary measure of air quality used to communicate information about air pollution to the public. The air quality index triggers air quality advisories based on individual pollutant thresholds. The AQHI is a multi-pollutant index that reports risk based on a continuous scale, reflects the mixture of air pollutants to which people are exposed, and has integrated risk reduction messages for normal and high risk individuals. Details comparing the differences between air quality index and AQHI are beyond the current study, but can be found in a report produced by Public Health Ontario.

Pollutants such as NO₂ and O₃ exist in a complex air multi-pollutant mixture; they are not independent. For example, the correlation between NO₂ and O₃ can be positive or negative depending on the solar radiation. Therefore, under different circumstances, AQHI may sometimes under- or over-estimate the overall health impact of air pollution. In our prior asthma study and in this study, we have demonstrated the utility of AQHI in quantifying acute morbidity as measured by health services use of increased exposure to pollutants in individuals living with asthma.[1] In these studies, the AQHI was more consistent than individual pollutants in the demonstration of relative risks.

Reference: Ontario Agency for Health Protection and Promotion (Public Health Ontario), Chen H, Copes R. Review of air quality index and air quality health index. Toronto, ON: Queen's Printer for Ontario; 2013. ISBN 978-1-4606-0936-1

Quality control measures conducted on Ministry of Environment datasets:

The air quality data used in this study were obtained from The Ontario Ministry of the Environment and Climate Change. Day-to-day maintenance and support of the instruments used in the monitoring stations are administered by the Environmental Monitoring and Reporting Branch (EMRB) staff. Instrumentation precision is verified by daily automatic internal zero and span checks. Data analysts and station operators review span control charts to confirm instrument precision using a telemetry system. A quarterly quality assurance and quality control review is performed on the ambient data set to highlight anomalies and administer corrective action in a timely manner.

The instrumentation used throughout the provincial air monitoring network has been standardized to Thermo Electron Corporation analyzers in an effort to streamline parts inventory and leverage common hardware used within each analyzer. EMRB operates a laboratory with gas reference standards that adhere to those of the U.S. National Institute of Standards and Technology and the Air Quality Research Division of Environment Canada. Continuous real-time data are consistently reviewed, assessed and validated by EMRB staff. Immediate actions are taken to correct any inconsistencies that may affect data validity. These measures ensure ambient air monitoring data are valid, complete, comparable, representative and accurate. As a result, the 2011 ambient air quality monitoring network had reported >99% valid data from over one million hourly data points.

Reference: Environmental Monitoring and Reporting Branch of the Ontario Ministry of the Environment. Air Quality in Ontario Report for 2011. Report no.: PIBS 9196e; 2-13.

S3. Distributions of AQHI, NO₂, PM_{2.5} and O₃ by year and season, Ontario, 2003 to 2010

Year	AQHI		NO ₂ (ppb)		PM _{2.5} (µg/m ³)		O ₃ (ppb)	
	Mean ± SD	IQR	Mean ± SD	IQR	Mean ± SD	IQR	Mean ± SD	IQR
2003	3.87 ± 1.35	3.00 - 4.50	29.70 ± 13.69	20.00 - 38.00	16.03 ± 10.37	9.00 - 20.50	40.52 ± 15.58	30.50 - 48.00
2004	3.65 ± 1.20	3.00 - 4.00	27.93 ± 12.43	19.00 - 36.00	15.19 ± 10.34	8.00 - 19.50	37.58 ± 13.12	29.00 - 44.33
2005	3.85 ± 1.41	3.00 - 5.00	28.14 ± 13.68	18.00 - 37.00	16.11 ± 11.84	8.00 - 21.00	41.25 ± 16.59	30.00 - 50.00
2006	3.37 ± 1.13	2.67 - 4.00	23.47 ± 11.92	14.50 - 30.75	13.90 ± 9.12	7.00 - 18.00	38.59 ± 14.50	28.25 - 46.67
2007	3.47 ± 1.19	3.00 - 4.00	23.63 ± 11.33	15.00 - 31.00	13.97 ± 9.82	7.00 - 18.00	41.18 ± 14.94	31.00 - 48.00
2008	3.30 ± 1.03	2.50 - 4.00	22.54 ± 11.20	14.00 - 29.50	13.00 ± 8.09	7.33 - 16.50	39.97 ± 13.36	30.00 - 48.00
2009	3.07 ± 0.9	2.50 - 3.67	21.13 ± 10.78	13.00 - 28.00	11.44 ± 6.41	7.00 - 14.60	37.66 ± 11.35	29.67 - 45.00
2010	3.13 ± 0.98	2.33 - 4.00	19.67 ± 10.51	11.60 - 26.00	11.81 ± 8.03	6.00 - 15.80	39.83 ± 12.53	31.00 - 47.00
2003-2010	3.45 ± 1.19	3.00 - 4.00	24.39 ± 12.41	15.00 - 32.00	13.93 ± 9.53	7.00 - 18.00	39.57 ± 14.15	30.00 - 47.00
Seasons								
Spring	3.79 ± 1.09	3.00 - 4.00	27.16 ± 14.18	16.00 - 37.00	13.14 ± 8.54	7.00 - 17.00	45.92 ± 10.24	39.67 - 51.00
Summer	3.73 ± 1.35	3.00 - 4.67	19.71 ± 10.14	12.00 - 25.50	18.06 ± 11.31	9.50 - 24.00	48.63 ± 15.53	37.00 - 58.00
Fall	3.02 ± 1.13	2.00 - 3.50	22.78 ± 10.47	15.00 - 29.50	13.33 ± 9.49	7.00 - 17.00	32.72 ± 12.51	25.00 - 37.00
Winter	3.27 ± 0.97	3.00 - 4.00	27.98 ± 12.58	19.00 - 36.00	11.12 ± 6.77	6.50 - 14.00	30.76 ± 7.12	26.50 - 35.75

SD = standard deviation; IQR = interquartile range

S4a. Risk of health services use by pollutants on day 1 of exposure: AQHI, NO₂, PM_{2.5} and O₃

Disease Categories (In alphabetical order)	Outpatient Visits				ED Visits				Hospitalizations			
	Rate Ratio [†]	L _{95%}	U _{95%}	p-value	Rate Ratio [†]	L _{95%}	U _{95%}	p-value	Rate Ratio [†]	L _{95%}	U _{95%}	p-value
Acute myocardial infarction												
AQHI	0.96	0.96	0.97	<.0001	0.94	0.94	0.94	<.0001	0.96	0.96	0.97	<.0001
NO ₂	1.01	1.01	1.02	<.0001	0.98	0.97	0.98	<.0001	1.05	1.05	1.06	<.0001
PM _{2.5}	0.96	0.96	0.96	<.0001	0.95	0.95	0.96	<.0001	0.94	0.94	0.94	<.0001
O ₃	0.98	0.97	0.98	<.0001	0.98	0.98	0.99	<.0001	0.96	0.96	0.96	<.0001
Angina												
AQHI	1.04	1.04	1.04	<.0001	1.00	1.00	1.01	0.0010	1.02	1.02	1.03	<.0001
NO ₂	1.11	1.11	1.11	<.0001	1.02	1.01	1.02	<.0001	1.08	1.08	1.08	<.0001
PM _{2.5}	0.96	0.95	0.96	<.0001	0.99	0.99	1.00	<.0001	0.96	0.96	0.97	<.0001
O ₃	0.98	0.98	0.98	<.0001	1.00	0.99	1.00	0.0261	0.99	0.99	0.99	<.0001
Asthma												
AQHI	1.03	1.02	1.03	<.0001	0.99	0.99	1.00	<.0001	1.00	1.00	1.01	0.0344
NO ₂	1.05	1.05	1.06	<.0001	0.99	0.98	0.99	<.0001	1.02	1.02	1.02	<.0001
PM _{2.5}	0.98	0.98	0.98	<.0001	1.01	1.01	1.01	<.0001	0.97	0.97	0.98	<.0001
O ₃	0.99	0.99	0.99	<.0001	1.00	1.00	1.00	0.6829	1.01	1.01	1.01	<.0001
Non-lung cancers												
AQHI	1.04	1.04	1.05	<.0001	0.99	0.99	0.99	<.0001	1.02	1.02	1.02	<.0001
NO ₂	1.12	1.12	1.13	<.0001	1.00	1.00	1.00	0.6765	1.10	1.10	1.10	<.0001
PM _{2.5}	0.95	0.95	0.95	<.0001	1.00	0.99	1.00	0.3071	0.94	0.94	0.95	<.0001
O ₃	0.98	0.98	0.98	<.0001	0.99	0.99	1.00	<.0001	0.98	0.98	0.99	<.0001
Congestive heart failure												
AQHI	1.02	1.02	1.02	<.0001	0.99	0.99	0.99	<.0001	1.02	1.01	1.02	<.0001
NO ₂	1.07	1.07	1.08	<.0001	1.00	1.00	1.00	0.8680	1.08	1.08	1.08	<.0001
PM _{2.5}	0.96	0.96	0.97	<.0001	1.00	1.00	1.00	0.8968	0.96	0.96	0.96	<.0001
O ₃	0.98	0.98	0.98	<.0001	0.98	0.98	0.99	<.0001	0.98	0.97	0.98	<.0001
Chronic obstructive pulmonary disease (COPD)												
AQHI	1.05	1.05	1.05	<.0001	1.01	1.00	1.01	<.0001	1.03	1.03	1.03	<.0001
NO ₂	1.10	1.10	1.10	<.0001	1.00	1.00	1.00	0.5313	1.08	1.08	1.09	<.0001
PM _{2.5}	0.97	0.97	0.97	<.0001	1.02	1.01	1.02	<.0001	0.97	0.96	0.97	<.0001
O ₃	0.98	0.98	0.98	<.0001	0.99	0.99	0.99	<.0001	0.98	0.98	0.98	<.0001
Diabetes												
AQHI	1.03	1.03	1.03	<.0001	1.00	1.00	1.00	0.0152	1.04	1.03	1.04	<.0001
NO ₂	1.07	1.07	1.07	<.0001	1.00	1.00	1.00	0.0017	1.06	1.06	1.07	<.0001
PM _{2.5}	0.97	0.97	0.97	<.0001	1.01	1.00	1.01	<.0001	0.98	0.98	0.98	<.0001
O ₃	0.99	0.99	0.99	<.0001	1.00	1.00	1.00	0.3977	1.00	1.00	1.00	0.0946
Hypertension												
AQHI	1.03	1.03	1.03	<.0001	0.97	0.97	0.98	<.0001	1.02	1.01	1.02	<.0001
NO ₂	1.07	1.07	1.07	<.0001	1.00	1.00	1.00	0.5793	1.06	1.05	1.06	<.0001
PM _{2.5}	0.97	0.97	0.97	<.0001	0.99	0.99	0.99	<.0001	0.97	0.97	0.98	<.0001
O ₃	0.99	0.99	0.99	<.0001	0.98	0.98	0.98	<.0001	0.99	0.99	0.99	<.0001
Ischemic heart disease												
AQHI	1.01	1.01	1.02	<.0001	1.00	1.00	1.00	0.4156	0.98	0.98	0.98	<.0001
NO ₂	1.04	1.04	1.04	<.0001	1.00	0.99	1.00	0.2535	1.05	1.05	1.05	<.0001
PM _{2.5}	0.98	0.98	0.98	<.0001	1.00	1.00	1.01	0.1988	0.94	0.94	0.95	<.0001
O ₃	0.99	0.99	0.99	<.0001	1.00	0.99	1.00	0.0720	0.98	0.97	0.98	<.0001
Lung cancer												
AQHI	0.98	0.98	0.99	<.0001	0.97	0.97	0.98	<.0001	0.96	0.96	0.96	<.0001
NO ₂	1.05	1.05	1.06	<.0001	0.99	0.98	0.99	<.0001	1.02	1.01	1.02	<.0001
PM _{2.5}	0.94	0.94	0.95	<.0001	0.99	0.98	0.99	<.0001	0.95	0.94	0.95	<.0001
O ₃	0.98	0.98	0.99	<.0001	0.99	0.98	0.99	<.0001	0.98	0.97	0.98	<.0001
Stroke												
AQHI	1.00	1.00	1.00	0.0040	0.96	0.96	0.96	<.0001	0.98	0.98	0.98	<.0001
NO ₂	1.03	1.03	1.04	<.0001	0.99	0.99	0.99	<.0001	1.04	1.03	1.04	<.0001
PM _{2.5}	0.97	0.97	0.97	<.0001	0.97	0.97	0.97	<.0001	0.96	0.96	0.96	<.0001
O ₃	0.99	0.99	0.99	<.0001	0.99	0.98	0.99	<.0001	0.97	0.97	0.98	<.0001

[†] The Risk Ratios were obtained from Poisson Regressions and they correspond to increase/decrease in risk of the respective health services use per unit increase in AQHI or per 10-unit increase in the air pollutants. All Risk Ratios were adjusted for age groups, sex, seasons, temperature, day of week, years, Local Health Integration Network and income quintiles.

L_{95%} = lower bound of 95% confidence interval; U_{95%} = upper bound of 95% confidence interval.

ED = Emergency Department

S4b. Risk of health services use by pollutants on day 2 of exposure: AQHI, NO₂, PM_{2.5} and O₃

Disease Categories (In alphabetical order)	Outpatient Visits				ED Visits				Hospitalizations			
	Rate Ratio [†]	L _{95%}	U _{95%}	p-value	Rate Ratio [†]	L _{95%}	U _{95%}	p-value	Rate Ratio [†]	L _{95%}	U _{95%}	p-value
Acute myocardial infarction (AMI)												
AQHI	0.96	0.96	0.96	<.0001	0.94	0.94	0.94	<.0001	0.96	0.96	0.96	<.0001
NO ₂	1.01	1.01	1.01	<.0001	0.97	0.97	0.98	<.0001	1.05	1.05	1.05	<.0001
PM _{2.5}	0.96	0.96	0.96	<.0001	0.95	0.95	0.96	<.0001	0.94	0.94	0.94	<.0001
O ₃	0.98	0.97	0.98	<.0001	0.99	0.98	0.99	<.0001	0.96	0.96	0.96	<.0001
Angina												
AQHI	1.03	1.03	1.03	<.0001	1.00	1.00	1.01	0.0101	1.02	1.02	1.02	<.0001
NO ₂	1.10	1.10	1.10	<.0001	1.01	1.01	1.02	<.0001	1.08	1.07	1.08	<.0001
PM _{2.5}	0.96	0.96	0.96	<.0001	0.99	0.99	1.00	0.0008	0.96	0.96	0.97	<.0001
O ₃	0.98	0.98	0.98	<.0001	1.00	0.99	1.00	0.0014	0.99	0.98	0.99	<.0001
Asthma												
AQHI	1.02	1.02	1.02	<.0001	0.99	0.99	1.00	<.0001	1.00	1.00	1.00	0.5109
NO ₂	1.04	1.04	1.05	<.0001	0.99	0.98	0.99	<.0001	1.02	1.01	1.02	<.0001
PM _{2.5}	0.99	0.98	0.99	<.0001	1.01	1.01	1.01	<.0001	0.98	0.97	0.98	<.0001
O ₃	0.99	0.99	0.99	<.0001	1.00	1.00	1.00	0.8933	1.01	1.01	1.01	<.0001
Non-lung cancers												
AQHI	1.04	1.04	1.04	<.0001	0.99	0.99	0.99	<.0001	1.02	1.02	1.02	<.0001
NO ₂	1.11	1.11	1.11	<.0001	1.00	1.00	1.00	0.6174	1.09	1.09	1.09	<.0001
PM _{2.5}	0.95	0.95	0.95	<.0001	1.00	0.99	1.00	0.1998	0.95	0.94	0.95	<.0001
O ₃	0.98	0.98	0.98	<.0001	0.99	0.99	1.00	<.0001	0.98	0.98	0.99	<.0001
Congestive heart failure												
AQHI	1.02	1.02	1.02	<.0001	0.99	0.99	0.99	<.0001	1.01	1.01	1.02	<.0001
NO ₂	1.07	1.06	1.07	<.0001	1.00	1.00	1.00	0.5226	1.07	1.07	1.08	<.0001
PM _{2.5}	0.97	0.96	0.97	<.0001	1.00	1.00	1.00	0.8216	0.96	0.96	0.97	<.0001
O ₃	0.99	0.98	0.99	<.0001	0.99	0.98	0.99	<.0001	0.98	0.98	0.98	<.0001
Chronic obstructive pulmonary disease (COPD)												
AQHI	1.04	1.04	1.04	<.0001	1.00	1.00	1.01	0.0003	1.03	1.03	1.03	<.0001
NO ₂	1.09	1.09	1.09	<.0001	1.00	1.00	1.00	0.4471	1.08	1.07	1.08	<.0001
PM _{2.5}	0.97	0.97	0.98	<.0001	1.02	1.01	1.02	<.0001	0.97	0.96	0.97	<.0001
O ₃	0.99	0.98	0.99	<.0001	0.99	0.99	0.99	<.0001	0.98	0.98	0.99	<.0001
Diabetes												
AQHI	1.02	1.02	1.02	<.0001	1.00	1.00	1.00	0.0563	1.03	1.03	1.03	<.0001
NO ₂	1.05	1.05	1.06	<.0001	1.00	1.00	1.00	0.0014	1.06	1.05	1.06	<.0001
PM _{2.5}	0.97	0.97	0.97	<.0001	1.01	1.00	1.01	<.0001	0.98	0.98	0.98	<.0001
O ₃	1.00	1.00	1.00	<.0001	1.00	1.00	1.00	0.2802	1.00	1.00	1.00	0.4701
Hypertension												
AQHI	1.02	1.02	1.02	<.0001	0.97	0.97	0.98	<.0001	1.01	1.01	1.02	<.0001
NO ₂	1.05	1.05	1.05	<.0001	1.00	0.99	1.00	0.0101	1.05	1.05	1.06	<.0001
PM _{2.5}	0.97	0.97	0.97	<.0001	0.99	0.99	0.99	<.0001	0.97	0.96	0.97	<.0001
O ₃	0.99	0.99	1.00	<.0001	0.98	0.98	0.98	<.0001	0.99	0.99	1.00	0.0003
Ischemic heart disease (IHD)												
AQHI	1.01	1.01	1.01	<.0001	0.99	0.99	1.00	0.0034	0.98	0.97	0.98	<.0001
NO ₂	1.04	1.04	1.04	<.0001	1.00	0.99	1.00	0.0405	1.05	1.04	1.05	<.0001
PM _{2.5}	0.98	0.98	0.98	<.0001	1.00	1.00	1.01	0.4148	0.94	0.94	0.95	<.0001
O ₃	0.99	0.99	1.00	<.0001	1.00	0.99	1.00	0.0084	0.98	0.97	0.98	<.0001
Lung cancer												
AQHI	0.98	0.98	0.98	<.0001	0.97	0.97	0.98	<.0001	0.96	0.95	0.96	<.0001
NO ₂	1.04	1.04	1.05	<.0001	0.99	0.98	0.99	<.0001	1.01	1.01	1.02	<.0001
PM _{2.5}	0.94	0.94	0.95	<.0001	0.99	0.98	1.00	<.0001	0.95	0.94	0.95	<.0001
O ₃	0.99	0.98	0.99	<.0001	0.99	0.98	0.99	<.0001	0.98	0.97	0.98	<.0001
Stroke												
AQHI	0.99	0.99	1.00	<.0001	0.96	0.96	0.96	<.0001	0.98	0.97	0.98	<.0001
NO ₂	1.02	1.02	1.03	<.0001	0.99	0.98	0.99	<.0001	1.03	1.03	1.03	<.0001
PM _{2.5}	0.97	0.97	0.98	<.0001	0.97	0.97	0.97	<.0001	0.96	0.96	0.97	<.0001
O ₃	0.99	0.99	0.99	<.0001	0.99	0.98	0.99	<.0001	0.98	0.97	0.98	<.0001

[†] The Risk Ratios were obtained from Poisson Regressions and they correspond to increase/decrease in risk of the respective health services use per unit increase in AQHI or per 10-unit increase in the air pollutants. All Risk Ratios were adjusted for age groups, sex, seasons, temperature, day of week, years, Local Health Integration Network and income quintiles.

L_{95%} = lower bound of 95% confidence interval; U_{95%} = upper bound of 95% confidence interval.

ED = Emergency Department

S5. Yearly distributions of ever been diagnosed major chronic diseases, Ontario, 2003-2010

