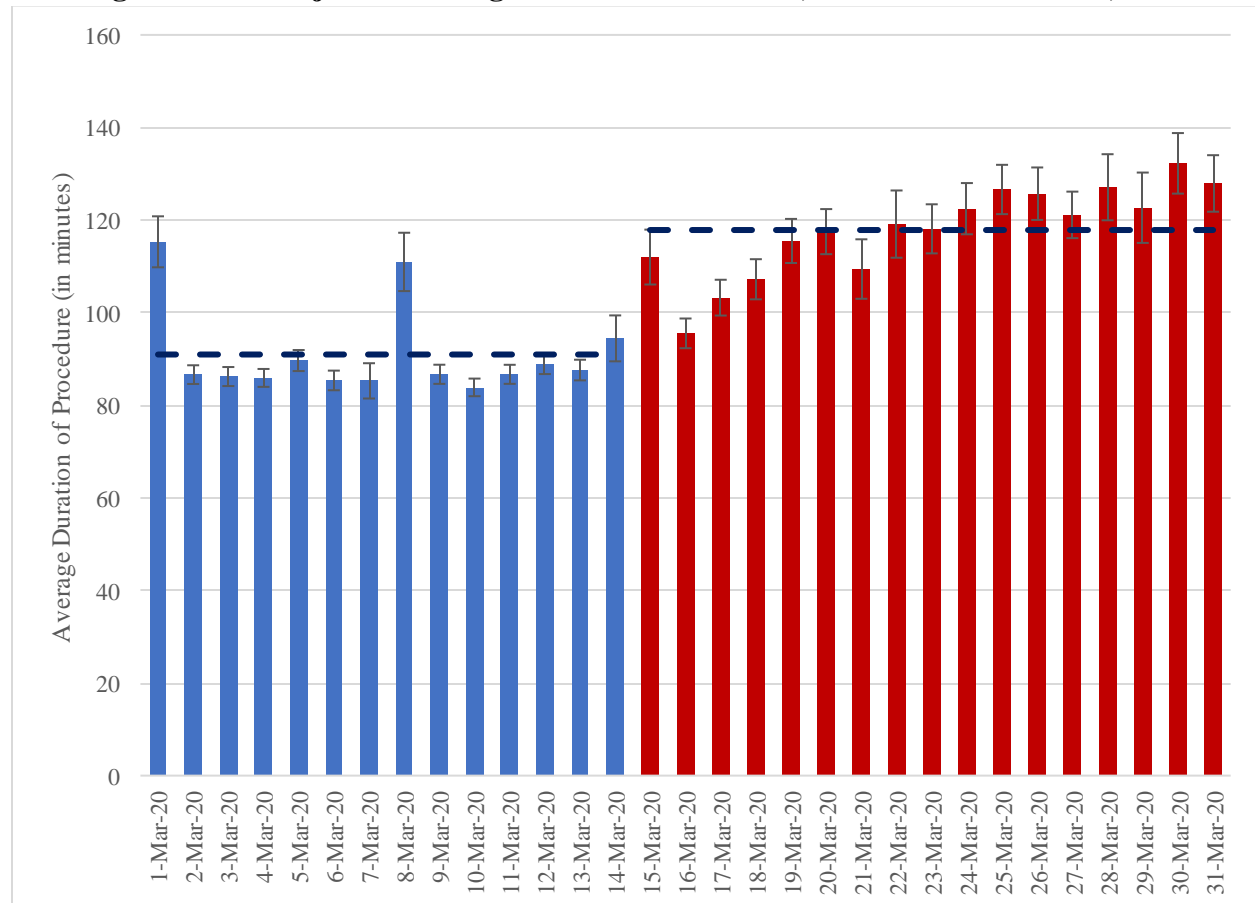


## COVID-19 and the duration of operating room procedures in Ontario: A population-based retrospective study – Appendix

**Figure A1. Unadjusted Average Procedure Duration, March 1 to March 31, 2020**



**Table A1. Average Descriptive Statistics**

Average Stats	Pre- COVID-19	COVID-19		
		Entire Period	Non-elective Period	Elective period
Average daily procedures	3,048	1,159	751	1,389
Physician age	47.5	47.1	47.4	47.1
Percentage of male physicians	67.6%	68.2%	69.3%	68.7%
Physician tenure	20.0	19.5	19.8	19.6
Patient age	53.4	52.3	51.1	52.8
Percentage of male patients	43.8%	40.3%	37.3%	41.5%
Patient complexity	3.9	4.3	4.6	4.2
Number of procedures performed in hospital by hospital size				
Quartile 1 (smallest)	214	91	19	72
Quartile 2	6,395	1,691	362	1,329
Quartile 3	93,123	21,720	4,870	16,850
Quartile 4 (largest)	963,953	208,102	48,828	159,274
Number of procedures performed by region				
Central	259,539	51,186	11,365	39,821
East	245,898	49,860	11,132	38,728
North	89,598	22,653	5,690	16,963
Toronto	174,015	41,811	9,886	31,925
West	285,208	64,596	15,757	48,839

**Table A2. Unadjusted Differences in Procedure Duration (in minutes)**

	Pre- COVID-19	COVID-19			% Difference with pre-COVID-19		
		Entire Period	Non- elective Period	Elective period	Entire Period	Non- elective Period	Elective period
Overall	87.7	110.3	121.5	106.9	25.8%	38.5%	21.9%
By physician age							
Quartile 1 (youngest)	95.7	113.7	119.5	111.7	18.8%	24.9%	16.7%
Quartile 2	89.9	112.0	122.2	108.7	24.6%	35.9%	20.9%
Quartile 3	86.6	110.0	124.2	105.9	27.0%	43.4%	22.3%
Quartile 4 (oldest)	83.9	106.3	119.2	102.6	26.7%	42.1%	22.3%
By physician gender							
Male	87.4	111.0	124.7	107.2	27.0%	42.7%	22.7%
Female	88.8	108.1	114.0	105.8	21.7%	28.4%	19.1%
By physician location							
East	85.5	107.8	118.3	104.8	26.1%	38.4%	22.6%
West	88.8	111.1	126.0	106.3	25.1%	41.9%	19.7%
Central	73.4	92.6	102.0	90.0	26.2%	39.0%	22.6%
North	85.5	102.3	114.0	98.4	19.6%	33.3%	15.1%
By patient age							
Quartile 1 (youngest)	91.7	103.1	108.9	100.9	12.4%	18.8%	10.0%
Quartile 2	82.6	108.3	120.3	105.2	31.1%	45.6%	27.4%
Quartile 3	84.5	114.9	132.4	110.3	36.0%	56.7%	30.5%
Quartile 4 (oldest)	92.5	116.4	132.9	111.6	25.8%	43.7%	20.6%
By patient gender							
Male	87.0	112.8	128.0	108.6	29.7%	47.1%	24.8%
Female	88.3	108.5	117.6	105.5	22.9%	33.2%	19.5%
By patient complexity							
Quartile 1 (least complex)	80.6	109.0	121.0	105.3	35.2%	50.1%	30.6%
Quartile 2	83.5	108.4	120.5	105.1	29.8%	44.3%	25.9%
Quartile 3	87.8	107.9	117.0	105.1	22.9%	33.3%	19.7%
Quartile 4 (most complex)	96.9	114.5	126.0	110.8	18.2%	30.0%	14.3%
By hospital size							
Quartile 1 (smallest)	104.9	113.8	107.6	115.4	8.5%	2.6%	10.0%
Quartile 2	83.2	94.6	104.3	92.0	13.7%	25.4%	10.6%
Quartile 3	80.8	97.7	107.5	94.9	20.9%	33.0%	17.5%
Quartile 4 (largest)	88.4	111.7	123.0	108.3	26.4%	39.1%	22.5%

Notes: Pre-COVID-19 period includes procedures performed April 1, 2019 to March 14, 2020. Non-elective COVID-19 period includes procedures performed March 15, 2020 to May 25, 2020. Elective COVID-19 period

Appendix 1 to Kantarevic J, Chami N, Vinden C, et al. COVID-19 and the duration of operating room procedures in Ontario: a population-based retrospective study. *Can J Surg* 2022. Copyright © 2022 The Author(s) or their employer(s). To receive this resource in an accessible format, please contact us at [cmajgroup@cmaj.ca](mailto:cmajgroup@cmaj.ca).

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includes procedures performed May 26, 2020 to September 20, 2020. \* p-value<0.1, \*\* p-value<0.05, \*\*\*p-value<0.01

**Table A3. Multivariate Regression Results Across Entire Period**

	Model 1	Model 2	Model 3	Model 4	Model 5
<b>COVID-19</b>	22.56*** (0.163)	6.408*** (0.0935)	6.687*** (0.104)	6.687*** (0.106)	6.678*** (0.106)
<b>Physician age</b>					
Quartile 1 (youngest)					
Quartile 2			-3.354*** (0.118)	-3.365*** (0.120)	-3.343*** (0.120)
Quartile 3			-4.359*** (0.114)	-4.292*** (0.116)	-4.227*** (0.116)
Quartile 4 (oldest)			-4.848*** (0.115)	-4.820*** (0.117)	-4.755*** (0.117)
<b>Physician gender</b>					
Female (reference)					
Male			-5.506*** (0.0981)	-5.608*** (0.0998)	-5.614*** (0.0998)
<b>Physician location</b>					
Central Ontario (reference)					
East Ontario			3.762*** (0.107)	3.757*** (0.109)	3.665*** (0.109)
North Ontario			-1.570*** (0.145)	-1.744*** (0.148)	-2.040*** (0.150)
West Ontario			1.332*** (0.104)	1.224*** (0.106)	1.112*** (0.106)
<b>Patient age</b>					
Quartile 1 (reference)					
Quartile 2				-1.202*** (0.124)	-1.201*** (0.124)
Quartile 3				-0.854*** (0.132)	-0.869*** (0.132)
Quartile 4 (oldest)				-1.087*** (0.135)	-1.115*** (0.135)
<b>Patient gender</b>					
Female (reference)					
Male				2.314*** (0.0834)	2.318*** (0.0834)
<b>Patient complexity</b>					
Quartile 1 (reference)					
Quartile 2				0.321**	0.322**

			(0.108)	(0.108)
Quartile 3			0.949***	0.949***
			(0.109)	(0.109)
Quartile 4 (most complex)			3.865***	3.859***
			(0.108)	(0.108)
<b>Hospital size</b>				
Quartile 1 (reference)				
Quartile 2				-7.606**
				(2.551)
Quartile 3				-4.487
				(2.513)
Quartile 4 (largest)				-6.143*
				(2.511)
Fee code fixed effects	No	Yes	Yes	Yes
OHIP Specialty fixed Effects	No	No	Yes	Yes
Month of Year Fixed Effects	No	No	Yes	Yes
Sample Size	1,295,509	1,295,509	1,196,418	1,149,378
Adjusted R <sup>2</sup>	0.015	0.695	0.701	0.701

Note: The outcome variable is procedure duration in minutes. Standard errors in parentheses.

\* p<0.05, \*\* p<0.01, \*\*\* p<0.001

**Table A4. Multivariate Regression: Fee Codes in Non-elective COVID-19 Period**

Sample restriction	Sample Size	COVID-19		COVID-19 non-elective period		Adjusted R <sup>2</sup>
		Coefficient	Standard Error	Coefficient	Standard Error	
<i>No Interaction Term for Non-elective COVID-19 Period</i>						
Main	1,149,170	6.678***	(0.106)			0.701
Non-elective fee codes in all periods	1,135,447	6.708***	(0.106)			0.701
<i>Interaction Term for Non-elective COVID-19 Period</i>						
Main	1,149,170	4.676***	(0.122)	7.692***	(0.230)	0.701
Non-elective fee codes in all periods	1,135,447	4.684***	(0.122)	7.716***	(0.230)	0.702

*Notes:* The outcome variable is procedure duration in minutes. Each model includes fee code fixed effects, controls for characteristics of physicians (age, sex, OHIP specialty and region), patients (age, sex, complexity), and hospitals (size), and monthly fixed effects. \* p<0.05, \*\* p<0.01, \*\*\* p<0.001

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### **Anaesthesiologists' Services: Extra Units**

An amount is paid when extra units are billed along with the basic unit when an anaesthesiologist administers an anaesthetic to:

E022C	ASA III -patient with severe systemic disease limiting activity but not incapacitating	2 units
E017C	ASA IV – patient with incapacitating systemic disease that is a constant threat to life	10 units
E016C	ASA V – moribund patient not expected to live 24 hours <i>with or without</i> operation	20 units
E020C	ASA E -patient undergoing anaesthesia for emergency surgery which commences within 24 hours of operating room booking, to E022C, E017C or E016C	4 units

From: OHIP Schedule of Benefits 2020. Available at:

[http://www.health.gov.on.ca/en/pro/programs/ohip/sob/physserv/sob\\_master20200306.pdf](http://www.health.gov.on.ca/en/pro/programs/ohip/sob/physserv/sob_master20200306.pdf)



**Table A5. Sensitivity Analysis: Sample Restrictions**

Sample restriction	Sample Size	COVID-19		COVID-19 non-elective period		Adjusted R <sup>2</sup>
		Coefficient	Standard Error	Coefficient	Standard Error	
<i>Procedure and Patient Restrictions</i>						
Restriction 1	585,302	5.303***	(0.192)	8.744***	(0.348)	0.697
Restriction 2	144,292	4.281***	(0.366)	9.737***	(0.601)	0.647
Restriction 3	157,922	2.631***	(0.318)	6.522***	(0.523)	0.609
Restriction 4	89,353	2.026***	(0.423)	6.900***	(0.693)	0.656
Restrictions 1, 2, 3 or 4	677,236	4.864***	(0.170)	7.601***	(0.305)	0.694
<i>Physician and Hospital Restrictions (pre-COVID-19 and COVID-19 period)</i>						
Same group of physicians	1,118,802	4.681***	(0.122)	7.797***	(0.231)	0.703
Same group of hospitals	1,147,490	4.691***	(0.122)	7.691***	(0.231)	0.701
Same group of physicians and hospitals	1,117,457	4.698***	(0.122)	7.795***	(0.231)	0.703

*Notes:* The outcome variable is procedure duration in minutes. Each model includes fee code fixed effects, controls for characteristics of physicians (age, sex, OHIP specialty and region), patients (age, sex, complexity), and hospitals (size), and monthly fixed effects. Restriction 1 = surgeries billed in conjunction with fee code E020 (ASA III), fee code E017 (ASA IV), fee code E022 (ASAV), fee code E016 (ASA E), and trauma surgeries (fee code E420). Restriction 2 = surgeries on patients who had emergency department visits within a week prior to the surgery. Restriction 3 = surgeries performed in evenings or nights. Restriction 4 = surgeries performed on weekends and holidays. \* p<0.05, \*\* p<0.01, \*\*\* p<0.001

**Table A6. Sensitivity to the Definition of Start Date for COVID-19**

Sample Period	“Start date of COVID”	COVID-19 Coefficient	Standard Error
<i>Alternate Start Dates of COVID-19</i>			
April 1, 2019 – September 30, 2020	March 10, 2020	5.933	0.0949
April 1, 2019 – September 30, 2020	March 22, 2020	6.4290	0.0993
April 1, 2019 – September 30, 2020	April 1, 2020	6.1370	0.1004
<i>Falsification Experiment</i>			
April 1, 2019 – March 15, 2020	July 1, 2019	0.7035	0.0865
April 1, 2019 – March 15, 2020	October 1, 2019	0.1663	0.0773
April 1, 2019 – March 15, 2020	January 1, 2020	-0.1114	0.0934

*Notes:* The outcome variable is procedure duration in minutes. Each model includes fee code fixed effects, controls for characteristics of physicians (age, sex, OHIP specialty and region), patients (age, sex, complexity), and hospitals (size).

**Table A7. Multivariate Regression with COVID-19 Month Variables**

	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)
<b>COVID-19</b>	26.96*** (0.571)	8.335*** (0.320)	8.728*** (0.377)	8.723*** (0.383)	8.708*** (0.383)
<b>COVID-19 Month Indicators (2020)</b>					
March (reference)					
April	13.33*** (0.768)	6.089*** (0.429)	6.402*** (0.497)	6.416*** (0.504)	6.410*** (0.504)
May	5.960*** (0.720)	3.846*** (0.401)	4.275*** (0.471)	4.291*** (0.479)	4.305*** (0.479)
June	-2.990*** (0.664)	-0.424 (0.370)	-0.519 (0.445)	-0.552 (0.453)	-0.557 (0.453)
July	-8.257*** (0.644)	-3.364*** (0.360)	-3.951*** (0.437)	-4.041*** (0.444)	-4.003*** (0.444)
August	-10.34*** (0.653)	-5.298*** (0.365)	-6.555*** (0.443)	-6.512*** (0.451)	-6.503*** (0.451)
September	-12.65*** (0.707)	-6.592*** (0.395)	-7.354*** (0.468)	-7.288*** (0.476)	-7.323*** (0.476)
<b>Physician Gender</b>					
Female (reference)					
Male			-5.506*** (0.0980)	-5.608*** (0.0997)	-5.614*** (0.0997)
<b>Physician Age</b>					
Quartile 1 (reference)					
Quartile 2			-3.343*** (0.117)	-3.354*** (0.119)	-3.333*** (0.120)
Quartile 3			-4.324*** (0.114)	-4.257*** (0.116)	-4.192*** (0.116)
Quartile 4 (oldest)			-4.805*** (0.115)	-4.777*** (0.117)	-4.712*** (0.117)
<b>Physician location</b>					
Central Ontario (reference)					
East Ontario			3.733*** (0.106)	3.729*** (0.109)	3.637*** (0.109)
North Ontario			-1.636*** (0.145)	-1.809*** (0.148)	-2.104*** (0.150)
West Ontario			1.269*** (0.104)	1.161*** (0.106)	1.049*** (0.106)
<b>Patient Gender</b>					
Female (reference)					
Male				2.303***	2.306***

				(0.0834)	(0.0834)
<b>Patient Age</b>					
Quartile 1 (reference)					
Quartile 2				-1.194***	-1.193***
				(0.124)	(0.124)
Quartile 3				-0.859***	-0.874***
				(0.131)	(0.131)
Quartile 4 (oldest)				-1.099***	-1.127***
				(0.135)	(0.135)
<b>Patient Complexity</b>					
Quartile 1 (reference)					
Quartile 2				0.355**	0.357***
				(0.108)	(0.108)
Quartile 3				0.987***	0.986***
				(0.109)	(0.109)
Quartile 4 (most complex)				3.900***	3.894***
				(0.108)	(0.108)
<b>Hospital Size</b>					
Quartile 1 (reference)					
Quartile 2					-7.711**
					(2.549)
Quartile 3					-4.654
					(2.511)
Quartile 4 (largest)					-6.309*
					(2.509)
Fee code fixed effects	No	Yes	Yes	Yes	Yes
OHIP Specialty fixed Effects	No	No	Yes	Yes	Yes
Month of Year Fixed Effects	No	No	Yes	Yes	Yes
Sample Size	1,295,509	1,295,509	1,196,418	1,149,378	1,149,170
Adjusted R <sup>2</sup>	0.017	0.696	0.702	0.701	0.701

Note: The outcome variable is procedure duration in minutes. Standard errors in parentheses.

\* p<0.05, \*\* p<0.01, \*\*\* p<0.001

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**Table A8. Multivariate Regression by Surgical Time Quartiles**

Sample restriction	Sample Size	COVID-19		COVID-19 non-elective period		Adjusted R <sup>2</sup>
		Coefficient	Standard Error	Coefficient	Standard Error	
Surgical Time Quartiles						
Quartile 1 (shortest time)	608,900	4.234	0.114	7.597	0.235	0.418
Quartile 2	232,461	5.418	0.240	8.407	0.437	0.315
Quartile 3	172,880	5.482	0.353	5.608	0.616	0.504
Quartile 4 (longest time)	134,929	3.257	0.591	11.544	1.131	0.502

*Notes:* The outcome variable is procedure duration in minutes. The time quartiles are based on the duration of procedures in the pre-COVID-19 period. Each model includes fee code fixed effects, controls for characteristics of physicians (age, sex, OHIP specialty and region), patients (age, sex, complexity), and hospitals (size), and monthly fixed effects. All coefficients in the table are significant at the 1% level.

**Table A9. Impact of COVID-19 on Anaesthesia Time Units – Multivariate Regression**

	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)
<b>COVID-19</b>	2.96*** (0.033)	0.81*** (0.019)	0.79*** (0.022)	0.79*** (0.023)	0.79*** (0.023)
<b>COVID-19 non-elective period</b>	2.59*** (0.062)	1.22*** (0.037)	1.35*** (0.042)	1.36*** (0.043)	1.36*** (0.043)
Fee code fixed effects	No	Yes	Yes	Yes	Yes
OHIP Specialty fixed Effects	No	No	Yes	Yes	Yes
Month of Year Fixed Effects	No	No	Yes	Yes	Yes
Sample Size	1, 291,866	1, 291,866	1, 193,019	1, 146,076	1, 145,869
Adjusted R <sup>2</sup>	0.013	0.669	0.674	0.673	0.673

Note: The outcome variable is anaesthesia time in units. Standard errors are in parentheses. Model (3) controls for physician characteristics only (age, gender, and geographical location). Model (4) controls for physician and patient characteristics (age, gender, and complexity). Model (5) controls for physician, patient, and hospital characteristics (hospital size).

\* p<0.05, \*\* p<0.01, \*\*\* p<0.001

**Table A10. Multivariate Regression by Specialty Procedure Type**

Type of Procedure	Sample Size	COVID-19		COVID-19 non-elective period		Adjusted R <sup>2</sup>
		Coefficient	Standard Error	Coefficient	Standard Error	
Cardiovascular Surgical Procedures	23,039	6.578	1.412	4.898	2.388	0.589
Clinical Procedures associated with Diagnostic Radiological Examinations	2,457	8.255	4.355	<b>6.737</b>	7.573	0.318
Diagnostic and Therapeutic Procedures	20,237	2.510	0.991	4.638	1.671	0.754
Digestive System Surgical Procedures	526,952	3.743	0.151	12.579	0.318	0.736
Endocrine Surgical Procedures	6,617	9.397	1.774	6.412	3.432	0.281
Female Genital Surgical Procedures	68,681	7.300	0.495	10.539	1.031	0.666
Haematic and Lymphatic Surgical Procedures	9,631	10.939	2.232	11.830	3.572	0.517
Integumentary System Surgical Procedures	33,312	7.244	0.849	3.673	1.572	0.596
Male Genital Surgical Procedures	23,193	6.456	0.746	5.289	1.621	0.671
Musculoskeletal System Surgical Procedures	160,196	2.249	0.346	11.401	0.690	0.517
Neurological Surgical Procedures	20,105	13.200	1.726	<b>0.868</b>	2.898	0.652
Obstetrics	90,677	1.404	0.224	1.030	0.356	0.071
Ocular and Aural Surgical Procedures	55,329	4.801	0.439	12.639	1.105	0.564
Respiratory Surgical Procedures	27,197	7.856	0.885	10.260	1.824	0.413
Spinal Surgical Procedures	12,093	8.001	2.284	13.248	4.463	0.359
Urogenital and Urinary Surgical Procedures	53,810	9.517	0.528	7.802	0.964	0.680

Notes: The outcome variable is procedure duration in minutes. Coefficients in bold are not significant at the 10% level. Each model includes fee code fixed effects, controls for characteristics of physicians (age, sex, OHIP specialty and region), patients (age, sex, complexity), and hospitals (size), and monthly fixed effects.

### *CIHI Pop Grouper*

Patient-level clinical complexity was derived from the CIHI Population Grouping Methodology (known as the CIHI Pop Grouper) by processing physician billings data from OHIP claims, hospital discharge records from CIHI's Discharge Abstract Database (DAD), and emergency department and outpatient clinic records from CIHI's National Ambulatory Care Reporting System (NACRS) (Li et al. 2019). The CIHI Pop Grouper builds clinical and demographic profiles for each person in the Ontario population, including health system non-users. The clinical profile summarizes all health conditions identified from inpatient, day surgery, emergency department, and physician claims administrative data over a pre-specified lookback period. The demographic profile comprises age and sex information captured for all persons eligible to receive publicly funded health services in Ontario. These profiles may be used to explain current period costs and predict person-level health care resource utilization needs one year into the future. In this study, we used the indicators for current and expected future costs to the health system in Ontario. These indicators were calculated using the claims data for fiscal year (FY) 2018-19 as the current period (which uses a five-year baseline or lookback period to construct clinical and demographic profiles) to explain current period relative resource utilization and predict relative resource utilization for FY2019-20.

### **References:**

Li Y, Weir S, Steffler M, Shaikh S, Wright JG, Kantarevic J. Using Diagnoses to Estimate Health Care Cost Risk in Canada. *Medical Care*. 2019 Nov;57(11):875–881.



### *Multivariate Regression Analysis*

Our baseline regression model can be expressed as

$$y_{it} = \alpha + \beta_1 COVID_t + \beta_2 Nonelective_t + \gamma_i + \delta_t + X_{it} + \varepsilon_{it}$$

where  $y_{it}$  is the average duration for procedure  $i$  at time  $t$ ,  $COVID=1$  for dates post March 15, 2020 and =0 otherwise,  $Nonelective$  is a dummy variable which equals 1 for dates between (and including) March 15, 2020 and May 25, 2020,  $\gamma$  is the fixed fee code effect,  $\delta$  is the fixed month effect, and  $X$  includes a set of physician, patient and hospital characteristics.

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Patient and procedure restriction criteria based on fee codes billed in conjunction with main procedure fee code that generate additional payment when an anaesthesiologist administers an anaesthetic to:

Fee Code	Description
E016	Moribund patients not expected to live 24 hours with or without operation
E017	Patients with incapacitating systemic disease that constitute a constant threat to life
E020	Patients undergoing emergency procedure commencing within 24 hours of OR booking
E022	Patients with severe systemic disease limiting activity

Source: [http://www.health.gov.on.ca/en/pro/programs/ohip/sob/physerv/sob\\_master20200306.pdf](http://www.health.gov.on.ca/en/pro/programs/ohip/sob/physerv/sob_master20200306.pdf)