Health Care Costs Associated with Minor Ailments and Cost Minimization Analysis of Pharmacists Prescribing for Minor Ailments in Ontario, Canada

by

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AUTHOR'S DECLARATION

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners. I understand that my thesis may be made electronically available to the public.

ABSTRACT

Background: Pharmacists in Ontario, Canada are now able to prescribe for certain minor ailments. Minor ailments are defined as health conditions that can be managed with minimal treatment and/or self-care strategies. Economic evaluations with costs and burden associated with minor ailment conditions using Ontario health administrative data are needed to accurately evaluate the economic impact of the pharmacist prescribing for minor ailment (PPMA) program.

Objectives: The objectives of this research thesis are to: 1) assess the baseline characteristics, mean health care costs, and predictors of health care costs of minor ailment cases using a retrospective analysis of Ontario health administrative data for patients presenting with minor ailment conditions and 2) perform a cost-minimization analysis to determine the economic impact of a remunerated program for PPMA compared with usual care.

Methodology: First, using Ontario health administrative data from ICES, baseline characteristics, mean health care costs, and predictors of health care costs were determined for patients diagnosed with the 16 studied minor ailments. Second, a decision-analytic model was implemented to perform the cost-minimization analysis for the minor ailments. Two prescribing strategies were considered in this analysis: PPMA and usual care. In the PPMA strategy, patients have the option of either seeking care from a community pharmacist or a physician. In the usual care model, all patients seek care from physicians. Probabilities and costs used in the model were derived from mostly Ontario health administrative data, literature, or expert opinion when there was insufficient literature. This analysis used a public payer perspective and outcomes were expressed in costs in 2019 Canadian dollars.

Results: Analysis of Ontario health administrative data from ICES identified that the minor ailments with the highest number of unique patients billed were musculoskeletal sprains and strains

(8,099,393; 24%), gastroesophageal reflux disease (5,822,495; 17%), dermatitis (5,649,829; 17%), urinary tract infection (3,356,887; 10%), and insect bites and urticaria (2,699,684; 8%). Health care costs varied by minor ailment and cost category, with older age, lower income quintiles, urban residency, and comorbidities as predictors of higher total health care costs. Cost-minimization analyses from a public payer perspective provided evidence that implementing a PPMA program for the studied minor ailments could yield cost savings for the Ontario government compared to the usual care model, with savings ranging from $19.05 to $77.38 per patient. One-way sensitivity analyses showed that results were most sensitive to the likelihood of patients receiving care from a pharmacist rather than a physician. In probabilistic sensitivity analyses, the PPMA model proved cost-saving in 100% of the simulations for all 16 minor ailments studied.

Conclusion: The results of the thesis research identified the baseline characteristics, health care cost burden, and predictors of total health care costs for patients presenting with minor ailments using Ontario health administrative data. In addition, the cost-minimization analyses conducted from a public payer perspective provided evidence that implementing a PPMA program provided cost-savings for the Ontario government when compared to the usual care model for the studied minor ailments. The results of this research can continue to help shape implementation strategies of a PPMA program in Ontario, Canada.

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LIST OF ABBREVIATIONS

ALLR – Allergic Rhinitis

CAND – Candidal Stomatitis (Oral Thrush)

CANK – Aphthous Ulcers (Canker Sores)

CAP – Capitation Payment

CI – Confidence Interval

CIHI – Canadian Institute of Health Information

CONJ – Conjunctivitis (Bacterial, Allergic, Viral)

COPD – Chronic Obstructive Pulmonary Disease

DAD – Discharge Abstract Database

DAS – Data & Analytic Services

DERM – Dermatitis (Atopic, Eczema, Allergic, Contact)

DYSM – Dysmenorrhea

ED – Emergency Department

FFS – Fee-For-Service

GERD – Gastroesophageal Reflux Disease

HEMO – Hemorrhoids

HERP – Herpes Labialis (Cold Sores)

IMPE – Impetigo

INSBI – Insect Bites (including Tick Bites) and Urticaria (Hives)

HF – Heart Failure

MI – Myocardial Infarction

MUSC – Musculoskeletal Sprains and Strains

NACRS – National Ambulatory Care Reporting System

ODB – Ontario Drug Benefit

OHIP – Ontario Health Insurance Plan

OTC – Over-The-Counter Medication

PIN – Pin/Threadworms

PPMA – Pharmacists Prescribing for Minor Ailments

PSA – Probabilistic Sensitivity Analysis

RPDP – Registered Persons Database

RPh – Registered Pharmacist

Rx – Prescription Medication

UTI – Urinary Tract Infection (Uncomplicated)

VAGY – Vaginal Yeast Infection

CHAPTER 1

INTRODUCTION

Minor Ailment Prescribing

As of January 1, 2023, pharmacists in Ontario, Canada are now able to prescribe certain drugs for minor ailments.[2] According to the Ontario College of Pharmacists, minor ailments are defined as health conditions that can be managed with minimal treatment and/or self-care strategies.[2] In addition, minor ailments are usually short-term conditions, do not usually require lab results, present a low risk of treatment masking underlying conditions, have no red flags related to medication or medical history that could suggest a more serious condition, and require only minimal or short-term follow-up.[2]

As of October 2023, Ontario pharmacists are authorized to prescribe for a total of 19 minor ailments including acne, allergic rhinitis, aphthous ulcers (canker sores), candidal stomatitis (oral thrush), conjunctivitis (bacterial, allergic, and viral), dermatitis (atopic, eczema, allergic, and contact), diaper dermatitis, dysmenorrhea, gastroesophageal reflux disease (GERD), hemorrhoids, herpes labialis (cold sores), impetigo, insect bites and urticaria (hives), tick bites, post-exposure prophylaxis to prevent Lyme disease, musculoskeletal sprains and strains, nausea and vomiting of pregnancy, pinworms and threadworms, urinary tract infections (uncomplicated), vulvovaginal candidiasis (yeast infection).[2] Currently, pharmacies receive $19 as payment for services provided in-person or $15 for services provided virtually for each valid claim submitted for minor ailment services regardless of whether a prescription is issued.[3] Since January 2023, more than 1 million minor ailment assessments have been completed in Ontario with more than 4,600 pharmacies (99%) participating in the program.[4]

By authorizing pharmacists to use the full extent of their therapeutic expertise to prescribe for certain minor ailments, this can divert patients away from busy family physician offices, walk-in clinics, and overloaded emergency departments, and allow doctors and nurse practitioners to focus on patients with more complex needs. Pharmacists can prescribe certain medications for authorized minor ailments, reducing the need to refer to another prescribing health care provider.[5] A physician survey in Canada estimated that 10% - 30% of medical appointments were for minor ailments.[6] "Pharmacist prescribing for minor ailments" (PPMA) programs are authorized in other Canadian provinces (i.e., Alberta, Saskatchewan, Manitoba) and in some parts of the United Kingdom (i.e., Wales, England, Scotland, and Northern Ireland).[5,7] In addition, the feasibility for a PPMA program is also being considered in other countries including Spain, New Zealand, and Australia.[7]

Published cost-minimization studies in Canada have shown potential savings for the public health care system if a PPMA program is implemented.[8–10] A study by Kim et al., performed a cost-minimization analysis to assess the economic impact of pharmacists prescribing for upper respiratory tract infections, contact dermatitis, and conjunctivitis in Ontario.[8] The results of this study showed that the PPMA model with a prescription-detached scenario (pharmacist remunerated $18 CAD for each consultation) predicted savings of $7.51, $4.08, and $5.15 per patient for upper respiratory tract infections, contact dermatitis, and conjunctivitis respectively.[8] However, one of the limitations of this study is that many probabilities and costs in this economic model were derived based on non-Ontario data and modelling assumptions where there was insufficient literature.[8] In addition, only a limited number of minor ailments were assessed in their analyses.[8] An older study by Rafferty et al. evaluated the cost of Saskatchewan's PPMA service compared to usual care from a societal and public payer perspective predicted an estimated

$3,482,660 CAD savings after five years of implementation in this province.[9] However, this study was criticized for its design and cost inputs that may have biased in favour of the PPMA scenario.[11] In addition, Saskatchewan's relatively small population of approximately 1.2 million can make it challenging to generalize these findings to larger, more populous provinces. [8]

Therefore, an economic evaluation with costs and burden associated with minor ailment conditions using Ontario health administrative data is needed to accurately evaluate the economic impact of the PPMA program in Ontario, Canada. Providing objective assessments can aid policymakers in determining both the allocation and level of funding for these services.

OBJECTIVES

In this thesis, there were two main research objectives: 1) assess the baseline characteristics, mean health care costs, and predictors of health care costs of minor ailment cases using a retrospective analysis of Ontario health administrative data for patients presenting with minor ailment conditions currently managed by pharmacists in Ontario, and 2) perform a cost-minimization analysis to determine the economic impact of a remunerated program for PPMA compared with usual care.

These analyses included minor ailment conditions that Ontario pharmacists are currently authorized to currently prescribe as outlined in Table A1 which include acne, allergic rhinitis, candidal stomatitis, canker sores, conjunctivitis, dermatitis, dysmenorrhea, GERD, hemorrhoids, herpes labialis, impetigo, insect bites and urticaria, musculoskeletal sprains and strains, pin/threadworm, UTI (uncomplicated), and vaginal yeast infection.

CHAPTER 2

Health care costs associated with pharmacist prescribing for minor ailments in Ontario, Canada: a retrospective cohort study

METHODOLOGY

Study design

A retrospective cohort study was conducted using Ontario health administrative data, to assess the baseline characteristics, mean health care costs, and predictors of health care costs among patients presenting with minor ailments currently managed by pharmacists in Ontario.

Data source

This study used health administrative data from ICES (formerly known as the Institute for Clinical Evaluative Sciences) which has the largest and most comprehensive collection of health-related data in Ontario, Canada. ICES Data & Analytic Services (DAS) provides access to research-ready linked health administrative data and analytic tools through a secure online desktop infrastructure.[12] ICES is designated a prescribed entity which permits health information custodians to disclose to personal health information to ICES without individual patient consent for the purposes of analysis in relation to evaluation, planning and/or monitoring of the healthcare system.[12] ICES receives records related to health services for the 13.4 million residents in Ontario, Canada.[13] This project was conducted from the public payer perspective including costs paid by the Ontario Ministry of Health. Costs were adjusted to 2019 Canadian dollars.

Health services administrative databases used included the Ontario Health Insurance Plan (OHIP), Canadian Institute of Health Information (CIHI) Discharge Abstract Database (DAD), CIHI National Ambulatory Care Reporting System (NACRS), and Ontario Drug Benefit (ODB)

database.[14] OHIP is the universal health insurance system based on a unique 10-digit identifier that provides claims data on almost all Ontario residents with publicly funded physician health care services.[13] However, certain health care services are not universal and only paid based on eligibility criteria such as prescription drugs.[13] The Registered Persons Database (RPDB) includes demographic information such as age, sex, health insurance eligibility, and death information on every individual with an OHIP card.[13] In addition, the RPDB provides linkage to ICES records and is uniquely converted to an anonymous ICES identifier (IKN).[13] The CIHI DAD database includes administrative, clinical, and demographic information on hospital discharges (including deaths, sign-outs, and transfers) received directly from acute care facilities, health authorities, or ministries of health.[15] The CIHI NACRS database contains data for all hospital-based and community based ambulatory care including day surgery, outpatient and community-based clinics, and emergency departments from participating facilities, regional health authorities, or ministries of health.[16] The data was organized in these databases by fiscal year which started from April 1, 2011 until March 31 of the next year as per the study period. In addition, these databases included the costs associated with each record. These costs were reported by the health facility and were not validated or audited.

Cohort

The inclusion criteria for the cohort in this project included patients who received a diagnosis code for a minor ailment condition between April 1, 2011, and March 31, 2019, in OHIP. The OHIP diagnosis codes that were used for each of the selected minor ailments are listed in Table A1. These diagnosis codes were not formally validated but were reviewed for accuracy by a clinical expert.

Patients were required to have provincial eligibility for at least 365 days before the billing date. For patients who met the criteria more than once within the study period, they were allowed to enter the minor ailment cohort more than once and an indicator was applied. Exclusion criteria included patients with an invalid IKN (each person in Ontario is assigned an IKN that provides successful linkage across datasets), missing age or sex, and death on cohort entry date.

Time Frame

The time frame of this project was from April 1, 2011, to March 31, 2019, with the observation window terminating one year after the latest minor ailment record (maximum follow-up date is March 31, 2020). Lookback window included 12 months for medication use and other covariates (comorbidities).

Statistical analysis

Baseline characteristics of the patients for each minor ailment group was extracted on the index date (date of diagnosis). This included the OHIP diagnosis code, age group at index date (five categories: 0-18, 19-24, 25-54, 55-64, 65+), sex, nearest census-based neighbourhood income quintile, rural or urban (rural includes communities with <10,000 residents), and comorbidities 12 months prior to index date. History of comorbidities prior to minor ailment billing date analyzed include hypertension, myocardial infarction (MI), heart failure (HF), chronic obstructive pulmonary disease (COPD), asthma, cancer, arthritis, psychiatric disorders, cerebrovascular disease, and fracture. For the cohort examined in the baseline characteristics analysis and predictors for total health care cost, it was assumed that if a patient entered one of the minor ailment cohorts more than once (e.g., diagnosed with UTI on multiple visits), their baseline characteristics would be determined from their earliest visit with the diagnosis code within the minor ailment. In

addition, if a patient presented with more than one of the studied minor ailments within the studied time frame (e.g., diagnosed with UTI and GERD within the time frame), their baseline characteristics were considered separately based on their earliest visit for each of the minor ailments.

Mean health care costs in the 30 days after the index date (date of minor ailment billing) were estimated for the studied minor ailments. The 95% confidence intervals (CIs) and total counts were also presented. 95% confidence interval was calculated in SAS using the parametric approach with the t-distribution. This included costs of emergency department (NACRS ED), OHIP non-physician, inpatient (DAD), OHIP laboratory, and OHIP physician costs. Inpatient cost per night was also found by dividing the total inpatient costs by the mean length of hospitalization. Length of hospitalization was determined from the DAD database by subtracting the day of admission from the day of discharge. Physician costs included a sum of costs of total fee-for-service (FFS) visits, non-FFS General Practitioners (GP)/Family Physicians (FP) visits, cost of other non-FFS visits, cost of ED-Alternate Funding Arrangements (AFA) non-FFS visits, cost of non-FFS medical oncologist visits, and apportioned cost of radiation oncologist AFA payments after index date. In addition, ODB costs on the index date (date of minor ailment billing) were also determined. ODB costs only include patients who have drug coverage under ODB including Ontario residents ≤24 years old (coverage started January 1, 2018), ≥65 years of age, living in a long-term care home or a home for special care, receiving professional home and community care services, enrolled in the Trillium Drug Program (high prescription-drug costs compared to household income), Ontario Works or the Ontario Disability Program (social assistance).[17] Health care costs were estimated using standard methods for Ontario administrative data.[18]

Predictors of total health care costs for each studied minor ailment were determined using a gamma regression model with a logarithmic link. This was used to identify predictors associated with the cost response variable. The relative costs were calculated by taking exp (B), where B is the coefficient in the multiple regression predicting log-transformed cost. Relative cost for any category represents the proportion by which mean cost is increased relative to the reference category, holding all other variables constant. This model to determine predictors of costs using a gamma distribution with a logarithmic link are used commonly in other costing studies including those using ICES data.[19,20] Statistical analyses of health care cost data often have non-negative data that are positively skewed, can have heavy tails, and are often multimodal due to excess zeroes.[21] Logarithmic-link and gamma distribution have been found to be appropriate for cost analyses which perform satisfactorily with distributions with zeroes and long right tails.[21,22] The same cohort from the baseline characteristics was used for this gamma regression model. The total health care costs were the sum of the 30 days (after index date) mean health care costs including inpatient emergency department (ED), physician, OHIP laboratory, and OHIP non-physician costs. Predictors that were analyzed included age group at index date (five categories: 0-18, 19-24, 25-54, 55-64, 65+), sex, nearest census-based neighbourhood income quintile, rural or urban (rural includes communities with <10,000 residents), and comorbidities 12 months prior to index date. SAS® was used for data analysis.

RESULTS

Baseline Characteristics

The dataset analyzed included patients diagnosed with the studied minor ailments that Ontario pharmacists are authorized to prescribe for as shown in Table A1. The baseline characteristics of the 16 studied minor ailments are presented in Tables 1, 2, 3, and 4.

Table 1: Baseline characteristics of patients with ACNE, ALLR, CAND, and CANK

	ACNE (n = 1059504)		ALLR (n = 1704153)		CAND (n = 362566)		CANK (n = 180886)	
	N	%	N	%	N	%	N	%
OHIP Diagnosis code								
	706 = Acne, acne vulgaris, sebaceous cyst	(100.0)						
			477 = Allergic rhinitis, hay fever	(100.0)				
					112 = Candidiasis, monilia infection - all sites, thrush	(100.0)		
							528 = Stomatitis, aphthous ulcers, canker sore, diseases of lips	(100.0)
Age Group								
0-18	315338	(29.8)	427723	(25.1)	96982	(26.7)	43405	(24.0)
19-24	157523	(14.9)	136014	(8.0)	33075	(9.1)	15240	(8.4)
25-54	416183	(39.3)	744936	(43.7)	144210	(39.8)	71634	(39.6)
55-64	79779	(7.5)	189977	(11.1)	34701	(9.6)	21692	(12.0)
65+	90681	(8.6)	205503	(12.1)	53598	(14.8)	28915	(16.0)
Sex								
Female	635671	(60.0)	925980	(54.3)	234919	(64.8)	103329	(57.1)
Male	423833	(40.0)	778173	(45.7)	127647	(35.2)	77557	(42.9)
Nearest Census Based Neighbourhood Income Quintile								

Quintile 1 (Lowest)	184827	(17.4)	340713	(20.0)	76469	(21.1)	38503	(21.3)
Quintile 2	199547	(18.8)	343881	(20.2)	73469	(20.3)	37935	(21.0)
Quintile 3	215383	(20.3)	356357	(20.9)	75479	(20.8)	38879	(21.5)
Quintile 4	228003	(21.5)	351159	(20.6)	72549	(20.0)	35971	(19.9)
Quintile 5 (Highest)	231744	(21.9)	312043	(18.3)	64600	(17.8)	29598	(16.4)
Rural or Urban								
Urban	974191	(91.9)	1605636	(94.2)	327990	(90.5)	169423	(93.7)
Rural	85313	(8.1)	98517	(5.8)	34576	(9.5)	11463	(6.3)
Comorbidities								
History of Hypertension	133875	(12.6)	322364	(18.9)	74001	(20.4)	39377	(21.8)
History of MI	7010	(0.7)	14879	(0.9)	4448	(1.2)	2073	(1.1)
History of Heart Failure	9595	(0.9)	20797	(1.2)	8427	(2.3)	3533	(2.0)
History of COPD	41942	(4.0)	96242	(5.6)	29653	(8.2)	13009	(7.2)
History of Asthma	198393	(18.7)	371550	(21.8)	65549	(18.1)	33730	(18.6)
History of Cancer	33635	(3.2)	60203	(3.5)	19207	(5.3)	9293	(5.1)
History of Arthritis	6439	(0.6)	13904	(0.8)	4465	(1.2)	2563	(1.4)
History of Psychiatric Disorder	14291	(1.3)	19200	(1.1)	7434	(2.1)	3213	(1.8)
History of Cerebrovascular Disease	2664	(0.3)	4877	(0.3)	1963	(0.5)	809	(0.4)

History of Fracture	22047	(2.1)	29652	(1.7)	9009	(2.5)	3895	(2.2)

Table 2: Baseline characteristics of patients with CONJ, DERM, DYSM, and GERD

	CONJ (n = 1872280)		**DERM (n = 5649829)**		**DYSM (n = 300291)**		**GERD (n = 5822495)**	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**
OHIP Diagnosis code								
	372 = Conjunctiva disorders (e.g., conjunctivitis, pterygium)	(100.0)						
			232 = Skin	(2.7)				
			691 = Dermatitis Allergic, Atopic	(55.8)				
			692 = Dermatitis Allergic, Contact	(13.2)				
			709 = Other disorders of skin and subcutaneous tissue	(28.3)				
					625 = Dyspareunia, dysmenorrhea, premenstrual tension, stress incontinence	(100.0)		

							536 = Hyperchlorhydria, hypochlorhydria, dyspepsia, indigestion	(5.3)
							787 = Heartburn, dysphagia	(94.7)
Age Group								
0-18	596893	(31.9)	1431036	(25.3)	44252	(14.7)	1053034	(18.1)
19-24	117725	(6.3)	420436	(7.4)	47020	(15.7)	465163	(8.0)
25-54	714816	(38.2)	2171809	(38.4)	178232	(59.4)	2437705	(41.9)
55-64	212254	(11.3)	687616	(12.2)	16628	(5.5)	766044	(13.2)
65+	230592	(12.3)	938932	(16.6)	14159	(4.7)	1100549	(18.9)
Sex								
Female	1042083	(55.7)	3122172	(55.3)	296150	(98.6)	3328510	(57.2)
Male	830197	(44.3)	2527657	(44.7)	4141	(1.4)	2493985	(42.8)
Nearest Census Based Neighbourhood Income Quintile								
Quintile 1 (Lowest)	349908	(18.7)	1076222	(19.0)	60907	(20.3)	1202410	(20.7)
Quintile 2	360713	(19.3)	1096168	(19.4)	58748	(19.6)	1175997	(20.2)
Quintile 3	384891	(20.6)	1140808	(20.2)	60637	(20.2)	1178926	(20.2)
Quintile 4	406890	(21.7)	1187075	(21.0)	61617	(20.5)	1180650	(20.3)
Quintile 5 (Highest)	369878	(19.8)	1149556	(20.3)	58382	(19.4)	1084512	(18.6)
Rural or Urban								
Urban	1741424	(93.0)	5134923	(90.9)	273613	(91.1)	5285696	(90.8)
Rural	130856	(7.0)	514906	(9.1)	26678	(8.9)	536799	(9.2)
Comorbidities								
History of Hypertension	344469	(18.4)	1204967	(21.3)	31835	(10.6)	1463176	(25.1)
History of MI	17782	(0.9)	71585	(1.3)	807	(0.3)	96404	(1.7)
History of Heart Failure	28119	(1.5)	111066	(2.0)	1600	(0.5)	159211	(2.7)

History of COPD	99189	(5.3)	363606	(6.4)	9951	(3.3)	469529	(8.1)
History of Asthma	307546	(16.4)	888975	(15.7)	56816	(18.9)	953085	(16.4)
History of Cancer	73062	(3.9)	278185	(4.9)	8409	(2.8)	359285	(6.2)
History of Arthritis	15851	(0.8)	53495	(0.9)	2169	(0.7)	63103	(1.1)
History of Psychiatric Disorder	21586	(1.2)	75554	(1.3)	5791	(1.9)	100265	(1.7)
History of Cerebrovascular Disease	7555	(0.4)	27849	(0.5)	531	(0.2)	37974	(0.7)
History of Fracture	37463	(2.0)	135722	(2.4)	4861	(1.6)	159223	(2.7)

Table 3: Baseline characteristics of patients with HEMO, HERP, IMPE, INSBI

	HEMO (n = 919831)		**HERP (n = 267052)**		**IMPE (n = 194035)**		**INSBI (n = 2699684)**	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**
OHIP Diagnosis code								
	455= Haemorrhoids	(51.5)						
	569 = Anal or rectal polyp, rectal prolapse, anal or rectal stricture, rectal bleeding, other disorders of intestine	(48.5)						
			054 = Herpes simplex, cold sore	(100)				
					1684 = Impetigo	(100.0)		
							698 = Pruritus ani, other itchy conditions	(4.3)

							708 = Hives/ Urticaria, Allergic	(19.2)
							709 = Other disorders of skin and subcutaneous tissue	(0)
							919 = Bites, Non-venomous / Bee Sting / Sting, Bee or Wasp	(70.1)
							173136	(6.4)
Age Group								
0-18	38888	(4.2)	31080	(11.6)	108415	(55.9)	678743	(25.1)
19-24	57767	(6.3)	29887	(11.2)	14681	(7.6)	210383	(7.8)
25-54	447955	(48.7)	150216	(56.2)	45833	(23.6)	997962	(37.0)
55-64	155484	(16.9)	30393	(11.4)	11099	(5.7)	321272	(11.9)
65+	219737	(23.9)	25476	(9.5)	14007	(7.2)	491324	(18.2)
Sex								
Female	469663	(51.1)	178674	(66.9)	101624	(52.4)	1463810	(54.2)
Male	450168	(48.9)	88378	(33.1)	92411	(47.6)	1235874	(45.8)
Nearest Census Based Neighbourhood Income Quintile								
Quintile 1 (Lowest)	175253	(19.1)	47076	(17.6)	38001	(19.6)	535251	(19.8)
Quintile 2	180656	(19.6)	50897	(19.1)	36217	(18.7)	532716	(19.7)
Quintile 3	186342	(20.3)	53958	(20.2)	38264	(19.7)	547766	(20.3)
Quintile 4	191344	(20.8)	57758	(21.6)	40998	(21.1)	556380	(20.6)
Quintile 5 (Highest)	186236	(20.2)	57363	(21.5)	40555	(20.9)	527571	(19.5)

Rural or Urban								
Urban	820109	(89.2)	251982	(94.4)	163688	(84.4)	2389488	(88.5)
Rural	99722	(10.8)	15070	(5.6)	30347	(15.6)	310196	(11.5)
Comorbidities								
History of Hypertension	289710	(31.5)	42294	(15.8)	20067	(10.3)	631395	(23.4)
History of MI	20043	(2.2)	1559	(0.6)	1304	(0.7)	43363	(1.6)
History of Heart Failure	34532	(3.8)	2327	(0.9)	2096	(1.1)	73550	(2.7)
History of COPD	94278	(10.2)	12899	(4.8)	7611	(3.9)	213730	(7.9)
History of Asthma	147233	(16.0)	48899	(18.3)	34562	(17.8)	497754	(18.4)
History of Cancer	74905	(8.1)	10606	(4.0)	5103	(2.6)	143188	(5.3)
History of Arthritis	12274	(1.3)	2638	(1.0)	1234	(0.6)	28451	(1.1)
History of Psychiatric Disorder	18216	(2.0)	4476	(1.7)	2947	(1.5)	50992	(1.9)
History of Cerebrovascular Disease	7452	(0.8)	637	(0.2)	491	(0.3)	17877	(0.7)
History of Fracture	29712	(3.2)	5411	(2.0)	3953	(2.0)	88773	(3.3)

Table 4: Baseline characteristics of patients with MUSC, PIN, UTI, VAGY

	MUSC (n = 8099393)		PIN (n = 41663)		UTI (n = 3356887)		VAGY (n = 1702830)	
	N	%	N	%	N	%	N	%
OHIP Diagnosis code								
739 = Other diseases of musculoskeletal system and connective tissue (505152)	(6.2)							
756 = Other musculoskeletal anomalies (6460)	(0.1)							
781 = Leg cramps, leg pain, muscle pain, joint pain, arthralgia, joint swelling, masses (3312848)	(40.9)							
840 = Strains, Sprains and Other Trauma (Shoulder, Upper Arm) (533609)	(6.6)							
842 = Strains, Sprains and Other Trauma (Wrist, Hand, Fingers) (413977)	(5.1)							
844 = Strains, Sprains and Other Trauma (Knee, Leg) (794110)	(9.8)							

	845 = Strains, Sprains and Other Trauma (Ankle, Foot, Toes) (781155)	(9.6)								
	847 = Strains, Sprains and Other Trauma (Coccyx, Neck) (1019805)	(12.6)								
	848 = Strains, Sprains and Other Trauma (Other) (732277)	(9.0)								
			127 = Pinworm (41663)	(100.0)						
					595 = Cystitis (1394364)	(41.5)				
					599 = Other disorders of urinary tract (1962523)	(58.5)				
							112 = Candidiasis, monilia infection - all sites, thrush (638088)	(37.5)		

							616 = Vaginitis (Not trichomonas) (1064742)	(62.8)
Age Group								
0-18	1266404	(15.6)	25788	(61.9)	453566	(13.5)	281510	(16.5)
19-24	583484	(7.2)	1618	(3.9)	288682	(8.6)	208821	(12.3)
25-54	3701817	(45.7)	12428	(29.8)	1370374	(40.8)	851282	(50.0)
55-64	1151413	(14.2)	1006	(2.4)	455366	(13.6)	171735	(10.1)
65+	1396275	(17.2)	823	(2.0)	788899	(23.5)	189482	(11.1)
Sex								
Female	4273608	(52.8)	25176	(60.4)	2395503	(71.4)	1438436	(84.5)
Male	3825785	(47.2)	16487	(39.6)	961384	(28.6)	264394	(15.5)
Nearest Census Based Neighbourhood Income Quintile								
Quintile 1 (Lowest)	1559223	(19.3)	8043	(19.3)	651020	(19.4)	349305	(20.5)
Quintile 2	1599940	(19.8)	7382	(17.7)	665349	(19.8)	339950	20.0)
Quintile 3	1644951	(20.3)	7806	(18.7)	679215	(20.2)	347358	(20.4)
Quintile 4	1686533	(20.8)	9038	(21.7)	695846	(20.7)	344826	(20.3)
Quintile 5 (Highest)	1608746	(19.9)	9394	(22.5)	665457	(19.8)	321391	18.9)
Rural or Urban								
Urban	7298139	(90.1)	37156	(89.2)	3036220	(90.4)	1565602	(91.9)
Rural	801254	(9.9)	4507	(10.8)	320667	(9.6)	137228	(8.1)
Comorbidities								
History of Hypertension	1966199	(24.3)	1763	(4.2)	972680	(29.0)	290839	(17.1)
History of MI	119308	(1.5)	77	(0.2)	61561	(1.8)	12601	(0.7)

History of Heart Failure	170790	(2.1)	106	(0.3)	112084	(3.3)	24004	(1.4)
History of COPD	590159	(7.3)	619	(1.5)	302254	(9.0)	99742	(5.9)
History of Asthma	1303995	(16.1)	6242	(15.0)	560165	(16.7)	297067	(17.4)
History of Cancer	409089	(5.1)	507	(1.2)	242418	(7.2)	75443	(4.4)
History of Arthritis	76307	(0.9)	126	(0.3)	43566	(1.3)	17939	(1.1)
History of Psychiatric Disorder	117679	(1.5)	387	(0.9)	59515	(1.8)	31904	(1.9)
History of Cerebrovascular Disease	43245	(0.5)	30	(0.1)	28719	(0.9)	6112	(0.4)
History of Fracture	226324	(2.8)	563	(1.4)	105751	(3.2)	34196	(2.0)

Musculoskeletal sprains and strains (8,099,393; 24%), GERD (5,822,495; 17%), dermatitis (5,649,829; 17%), UTI (3,356,887; 10%), and insect bites/urticaria (2,699,684; 8%) accounted for the highest number of unique patients billed among the minor ailments. Patients were primarily aged between 25 and 54 years across most minor ailment conditions, with this age group comprising over 40% of patients for dysmenorrhea (59.4%), herpes labialis (56.2%), vaginal yeast infections (50.0%), and hemorrhoids (48.7%). The youngest age group (0-18 years) had higher representation for pin/threadworm (61.9%) and impetigo (55.9%), while the highest proportion of older adults (65+ years) was seen in hemorrhoids (23.9%), urinary tract infections (23.5%), and GERD (18.9%). The proportion of female to male patients varied across minor ailment conditions. Dysmenorrhea (98.6%) and vaginal yeast infections (84.5%) had the highest percentage of female patients, while hemorrhoids, musculoskeletal sprains and strains, and impetigo had more balanced distributions between sexes. Income quintile distribution was generally balanced across conditions, though certain minor ailments such as canker sores and acne showed some differences between the lowest (Q1) and highest (Q5) quintiles. Canker sores had 21.3% of patients in Q1 compared to 16.4% in Q5, and acne had 17.4% in Q1 compared to 21.9% in Q5. Urban residency exceeded 90% for nearly all conditions, with the highest urban representation in herpes labialis (94.4%) and allergic rhinitis (94.2%). Rural representation was higher compared to other minor ailments for insect bites/urticaria (11.5%), hemorrhoids (10.8%), and musculoskeletal sprains and strains (9.9%).

Comorbidities, including a history of hypertension, MI, heart failure, COPD, asthma, psychiatric disorders, cerebrovascular disease, and fractures, were commonly observed among patients presenting with minor ailments. Hypertension was the most prevalent comorbidity, especially among patients with hemorrhoids (31.5%), UTI (29.0%), GERD (25.1%), and

musculoskeletal sprains and strains (24.3%). Asthma was frequently observed, particularly in patients with allergic rhinitis (21.8%). COPD showed higher prevalence in hemorrhoids (10.2%) and UTI (9.0%), while cancer was most often seen in patients with hemorrhoids (8.1%) and UTI (7.2%). Arthritis, cerebrovascular disease, fractures, heart failure, MI, and psychiatric disorders were observed less frequently, each with a prevalence below 5% among patients presenting with the studied minor ailments.

Mean Health Care Costs

The mean health care costs varied significantly across minor ailments and cost categories as shown in Tables 5, 6, 7, and 8.

Table 5: Mean health care costs (2019 Canadian dollars) for patients diagnosed with ACNE, ALLR, CAND, and CANK

	ACNE		ALLR		CAND		CANK	
	Mean Cost (95% CI), $	**Total Count**	**Mean Cost (95% CI), $**	**Total Count**	**Mean Cost (95% CI), $**	**Total Count**	**Mean Cost (95% CI), $**	**Total Count**
NACRS ED cost per visit (within 30 days)	292.80 (290.89-294.70)	74930	311.28 (309.87-312.68)	148174	366.83 (363.06-370.59)	32917	351.45 (345.83-357.06)	12696
Non-Physician OHIP Cost per visit (within 30 days)	54.32 (53.33-55.30)	51919	54.74 (54.17-55.31)	112633	67.02 (65.36-68.68)	12674	97.64 (89.85-105.42)	7396
Inpatient cost per visit (within 30 days)	7666.89 (7465.70-7868.09)	7326	6994.42 (6890.75-7098.09)	20805	9682.56 (9442.38-9922.74)	7954	8964.88 (8599.51-9330.25)	3268
Inpatient cost per night	1650.39	34033	1503.99	96755	1424.54	54063	1368.07	21415
OHIP lab cost per visit (within 30 days)	64.71 (64.53-64.89)	343083	69.78 (69.62-69.94)	550348	58.92 (58.59-59.26)	105333	68.04 (67.46-68.62)	39324
Physician cost per visit (within 30 days)	138.83 (138.23-139.42)	944653	152.16 (151.77-152.55)	2495818	224.01 (219.24-228.78)	264168	214.27 (211.22-217.33)	118550
ODB cost (medications that can be prescribed by RPh, index date)	18.33 (18.21-18.44)	6025	29.54 (29.42-29.66)	90089	16.47 (16.37-16.56)	32923	16.48 (16.39-16.57)	18027

Table 6: Mean health care costs (2019 Canadian dollars) for patients diagnosed with CONJ, DERM, DYSM, and GERD

	CONJ		DERM		DYSM		GERD	
	Mean Cost (95% CI), $	**Total Count**	**Mean Cost (95% CI), $**	**Total Count**	**Mean Cost (95% CI), $**	**Total Count**	**Mean Cost (95% CI), $**	**Total Count**
NACRS ED cost per visit (within 30 days)	266.03 (264.82-267.25)	161310	329.77 (329-330.55)	664229	361.82 (357.99-365.65)	22589	450.82 (447.06-454.59)	51842
Non-Physician OHIP Cost per visit (within 30 days)	61.53 (61.2-61.86)	172150	63.86 (63.58-64.14)	406455	58.08 (54.51-61.65)	7406	61.63 (60.64-62.63)	26903
Inpatient cost per visit (within 30 days)	7151.74 (7027.06-7276.42)	17431	8614.56 (8562.41-8666.71)	124367	5057.06 (4922.34-5191.79)	5055	8566.36 (8406.86-8725.85)	14022
Inpatient cost per night	1265.03	98545	1242.78	862076	1789.91	14282	1424.22	84339
OHIP lab cost per visit (within 30 days)	62.70 (62.51-62.89)	326656	72.70 (72.49-72.91)	2150457	65.86 (65.54-66.18)	125238	81.00 (80.67-81.34)	206509
Physician cost per visit (within 30 days)	171.65 (171.04-172.26)	1336238	200.75 (199.47-202.03)	6504671	208.14 (206.76-209.53)	229822	257.29 (255.84-258.74)	518753
ODB cost (medications that can be prescribed by RPh, index date)	16.04 (15.98-16.09)	38962	12.07 (12.05-12.09)	553901	19.65 (19.3-20.01)	5449	25.78 (25.61-25.94)	96448

Table 7: Mean health care costs (2019 Canadian dollars) for patients diagnosed with HEMO, HERP, IMPE, INSBI

	HEMO		HERP		IMPE		INSBI	
	Mean Cost (95% CI), $	**Total Count**	**Mean Cost (95% CI), $**	**Total Count**	**Mean Cost (95% CI), $**	**Total Count**	**Mean Cost (95% CI), $**	**Total Count**
NACRS ED cost per visit (within 30 days)	464.66 (462.3-467.01)	116791	313.80 (309.46-318.15)	14989	271.66 (267.49-275.84)	19254	371.00 (369.74-372.26)	394365
Non-Physician OHIP Cost per visit (within 30 days)	65.98 (65.13-66.83)	41310	58.11 (55.51-60.71)	7080	52.79 (51.84-53.74)	6102	70.82 (70.26-71.39)	156621
Inpatient cost per visit (within 30 days)	8548.74 (8491.1-8606.38)	120094	7447.62 (7098.45-7796.78)	2370	6980.19 (6636.95-7323.43)	2407	9571.28 (9518.12-9624.43)	138145
Inpatient cost per night	1574.12	652206	1422.31	12410	1290.42	13020	1334.43	990851
OHIP lab cost per visit (within 30 days)	75.24 (74.99-75.49)	331184	61.02 (60.57-61.46)	61370	55.54 (54.88-56.21)	28022	66.60 (66.46-66.74)	694169
Physician cost per visit (within 30 days)	437.39 (434.18-440.6)	869610	165.43 (163.72-167.14)	173224	153.74 (151.62-155.87)	108373	274.68 (273.83-275.52)	2468248
ODB cost (medications that can be prescribed by RPh, index date)	11.87 (11.8-11.94)	11241	27.47 (26.83-28.1)	7578	24.79 (24.66-24.93)	26044	12.98 (12.86-13.1)	25156

Table 8: Mean health care costs (2019 Canadian dollars) for patients diagnosed with MUSC, PIN, UTI, VAGY

	MUSC		PIN		UTI		VAGY	
	Mean Cost (95% CI), $	**Total Count**	**Mean Cost (95% CI), $**	**Total Count**	**Mean Cost (95% CI), $**	**Total Count**	**Mean Cost (95% CI), $**	**Total Count**
NACRS ED cost per visit (within 30 days)	387.84 (387.34-388.34)	2216973	279.92 (270.7-289.14)	2346	463.19 (462.42-463.96)	911589	351.82 (350.19-353.44)	133106
Non-Physician OHIP Cost per visit (within 30 days)	68.17 (67.88-68.46)	1036962	54.91 (44.59-65.22)	1273	69.98 (69.61-70.35)	331578	60.41 (59.34-61.49)	47144
Inpatient cost per visit (within 30 days)	9555.98 (9535.18-9576.79)	865000	13400.22 (11643.6-15156.84)	371	8873.09 (8849.93-8896.26)	611085	7320.65 (7119.17-7442.12)	19837
Inpatient cost per night	1390.70	5943716	2760.40	1801	1534.79	3532877	1391.73	104345
OHIP lab cost per visit (within 30 days)	71.17 (71.12-71.22)	5481078	43.17 (42.35-44)	9995	53.39 (53.33-53.44)	3617349	52.67 (52.57-52.78)	935085
Physician cost per visit (within 30 days)	306.39 (306.11-306.67)	20391151	169.49 (161.97-177)	17802	336.80 (336.11-337.48)	5843361	188.45 (187.40-189.51)	1360534
ODB cost (medications that can be prescribed by RPh, index date)	10.75 (10.74-10.77)	514202	21.91 (21.65-22.17)	8298	14.93 (14.88-14.99)	159784	14.97 (14.90-15.03)	44877

Hemorrhoids had the highest mean ED cost per visit at $464.66, closely followed by UTI ($463.19) and GERD ($450.82), while conjunctivitis ($266.03), impetigo ($271.66), and pin/threadworm ($279.92) had the lowest ED costs. Non-physician OHIP costs were highest for canker sores ($97.64) followed by insect bites and urticaria ($70.82), and lowest for impetigo ($52.79), acne ($54.32), allergic rhinitis ($54.74), and pin/threadworm ($54.91). Inpatient costs were higher for pin/threadworm ($13,400.22), candidal stomatitis ($9,682.56), and musculoskeletal sprains and strains ($9555.98), while dysmenorrhea ($5,057.06), impetigo ($6980.19), and allergic rhinitis ($6994.42) had the lowest inpatient costs. When looking at inpatient cost per night, pin/threadworm had the highest cost per night at $2,760.40 followed by dysmenorrhea ($1,789.91), and the lowest inpatient cost per night was for dermatitis ($1,242.78), conjunctivitis ($1,265.03), and impetigo ($1,290.42). For OHIP lab services, GERD patients incurred the highest costs at $81.00, while pin/threadworm patients had the lowest at $43.17. The highest physician visit costs were for hemorrhoids ($437.39) and UTI ($336.80), whereas acne patients had the lowest costs at $138.83. The ODB costs in this study ranged from $10.75 (musculoskeletal sprains and strains) to $29.54 (allergic rhinitis), with the highest costs observed for allergic rhinitis ($29.54), herpes labialis ($27.47), and GERD ($25.78).

Predictors of Cost

The gamma regression models to determine predictors of total health care costs for patients with the studied minor ailments are shown in Tables 9, 10, 11, and 12, and Figures 1, 2, 3, and 4.

Table 9: Predictors of total health care costs for patients with ACNE, ALLR, CAND, and CANK

	Regression model; relative cost (95% CI)			
	ACNE (n = 1059504)	**ALLR (n = 1704153)**	**CAND (n = 362566)**	**CANK (n = 180886)**
Age Group				
0-18	Reference	Reference	Reference	Reference
19-24	1.06 (1.04-1.07)	1.10 (1.08-1.11)	0.95 (0.94-0.97)	1.12 (1.08-1.16)
25-54	1.32 (1.31-1.33)	1.29 (1.28-1.30)	1.18 (1.17-1.20)	1.37 (1.34-1.40)
55-64	1.54 (1.51-1.56)	1.44 (1.42-1.45)	1.50 (1.47-1.52)	1.55 (1.50-1.60)
65+	1.81 (1.78-1.84)	1.75 (1.73-1.77)	1.96 (1.93-2.00)	1.72 (1.66-1.78)
Sex				
Sex (Female vs. Male)	0.97 (0.97-0.98)	1.01 (1.01-1.02)	0.87 (0.87-0.88)	0.91 (0.90-0.93)
Nearest Census Based Neighbourhood Income Quintile				
Quintile 1 (Lowest)	Reference	Reference	Reference	Reference
Quintile 2	0.94 (0.93-0.95)	0.96 (0.95-0.97)	0.93 (0.92-0.94)	0.90 (0.87-0.92)
Quintile 3	0.90 (0.89-0.91)	0.94 (0.93-0.95)	0.91 (0.89-0.92)	0.85 (0.83-0.87)
Quintile 4	0.88 (0.87-0.89)	0.93 (0.92-0.93)	0.85 (0.84-0.86)	0.89 (0.87-0.92)
Quintile 5 (Highest)	0.86 (0.85-0.87)	0.92 (0.92-0.93)	0.84 (0.83-0.85)	0.85 (0.83-0.87)
Rural or Urban				
Urban	1.13 (1.12-1.15)	1.13 (1.12-1.14)	1.26 (1.25-1.28)	1.30 (1.26-1.35)
Rural	Reference	Reference	Reference	Reference
Comorbidities				
History of Hypertension (Yes vs. No)	1.35 (1.33-1.36)	1.24 (1.23-1.25)	1.48 (1.47-1.50)	1.29 (1.26-1.32)
History of MI (Yes vs. No)	1.25 (1.21-1.29)	1.39 (1.36-1.42)	1.19 (1.15-1.23)	1.29 (1.21-1.38)
History of Heart Failure (Yes vs. No)	2.34 (2.27-2.40)	2.24 (2.19-2.28)	2.31 (2.25-2.36)	2.53 (2.40-2.66)

History of COPD (Yes vs. No)	1.18 (1.16-1.20)	1.24 (1.23-1.26)	1.26 (1.24-1.28)	1.32 (1.28-1.36)
History of Asthma (Yes vs. No)	1.09 (1.08-1.10)	1.04 (1.03-1.04)	1.07 (1.06-1.08)	1.09 (1.07-1.11)
History of Cancer (Yes vs. No)	1.71 (1.68-1.73)	1.66 (1.64-1.68)	2.38 (2.34-2.42)	3.14 (3.04-3.25)
History of Arthritis (Yes vs. No)	1.27 (1.23-1.31)	1.23 (1.20-1.26)	1.68 (1.63-1.74)	1.44 (1.36-1.53)
History of Psychiatric Disorder (Yes vs. No)	2.21 (2.15-2.26)	2.23 (2.18-2.27)	2.09 (2.04-2.15)	2.08 (1.97-2.20)
History of Cerebrovascular Disease (Yes vs. No)	2.13 (2.02-2.25)	1.44 (1.38-1.50)	1.75 (1.66-1.83)	1.84 (1.66-2.05)
History of Fracture (Yes vs. No)	1.43 (1.40-1.46)	1.26 (1.23-1.28)	1.48 (1.45-1.52)	1.58 (1.50-1.67)

Table 10: Predictors of total health care costs for patients with CONJ, DERM, DYSM, and GERD

	Regression model; relative cost (95% CI)			
	CONJ (n = 1872280)	**DERM (n = 5649829)**	**DYSM (n = 300291)**	**GERD (n = 5822495)**
Age Group				
0-18	Reference	Reference	Reference	Reference
19-24	1.11 (1.10-1.13)	1.11 (1.10-1.12)	1.03 (1.01-1.05)	1.01 (1.01-1.02)
25-54	1.31 (1.30-1.31)	1.33 (1.32-1.33)	1.50 (1.47-1.53)	1.21 (1.20-1.21)
55-64	1.41 (1.40-1.42)	1.47 (1.46-1.47)	1.64 (1.59-1.68)	1.61 (1.61-1.62)
65+	1.84 (1.82-1.86)	1.77 (1.76-1.78)	1.98 (1.91-2.04)	2.29 (2.28-2.30)
Sex				
Sex (Female vs. Male)	0.94 (0.93-0.94)	0.94 (0.94-0.94)	0.92 (0.87-0.96)	0.80 (0.80-0.80)
Nearest Census Based Neighbourhood Income Quintile				

Quintile 1 (Lowest)	Reference	Reference	Reference	Reference
Quintile 2	0.95 (0.94-0.96)	0.93 (0.93-0.94)	1.00 (0.98-1.02)	0.95 (0.94-0.95)
Quintile 3	0.91 (0.90-0.92)	0.89 (0.89-0.90)	1.00 (0.98-1.02)	0.92 (0.91-0.92)
Quintile 4	0.90 (0.89-0.91)	0.87 (0.87-0.88)	0.95 (0.93-0.96)	0.90 (0.89-0.90)
Quintile 5 (Highest)	0.87 (0.86-0.87)	0.85 (0.84-0.85)	0.91 (0.89-0.92)	0.90 (0.90-0.91)
Rural or Urban				
Urban	1.12 (1.11-1.13)	1.13 (1.12-1.13)	1.31 (1.28-1.33)	1.25 (1.25-1.26)
Rural	Reference	Reference	Reference	Reference
Comorbidities				
History of Hypertension (Yes vs. No)	1.26 (1.26-1.27)	1.35 (1.34-1.35)	1.32 (1.29-1.34)	1.34 (1.33-1.34)
History of MI (Yes vs. No)	1.18 (1.16-1.21)	1.27 (1.26-1.29)	1.20 (1.08-1.32)	1.15 (1.14-1.17)
History of Heart Failure (Yes vs. No)	2.03 (1.99-2.07)	2.31 (2.28-2.33)	2.13 (1.98-2.28)	2.16 (2.14-2.18)
History of COPD (Yes vs. No)	1.24 (1.23-1.25)	1.27 (1.26-1.28)	1.13 (1.09-1.16)	1.27 (1.26-1.27)
History of Asthma (Yes vs. No)	1.07 (1.06-1.07)	1.08 (1.08-1.09)	1.09 (1.07-1.10)	0.99 (0.99-0.99)
History of Cancer (Yes vs. No)	1.58 (1.56-1.60)	1.66 (1.65-1.67)	1.56 (1.52-1.61)	2.11 (2.09-2.12)
History of Arthritis (Yes vs. No)	1.23 (1.20-1.26)	1.26 (1.24-1.28)	1.12 (1.05-1.18)	1.26 (1.25-1.28)
History of Psychiatric Disorder (Yes vs. No)	2.20 (2.16-2.25)	2.36 (2.33-2.38)	1.90 (1.84-1.97)	1.70 (1.69-1.72)
History of Cerebrovascular Disease (Yes vs. No)	1.89 (1.83-1.95)	1.59 (1.56-1.61)	1.77 (1.57-1.99)	1.60 (1.57-1.63)
History of Fracture (Yes vs. No)	1.30 (1.28-1.32)	1.46 (1.44-1.47)	1.33 (1.27-1.38)	1.43 (1.41-1.44)

Table 11: Predictors of total health care costs for patients with HEMO, HERP, IMPE, INSBI

	Regression model; relative cost (95% CI)			
	HEMO (n = 919831)	**HERP (n = 267052)**	**IMPE (n = 194035)**	**INSBI (n = 2699684)**
Age Group				
0-18	Reference	Reference	Reference	Reference
19-24	0.76 (0.74-0.78)	0.85 (0.82-0.87)	1.23 (1.19-1.28)	1.22 (1.21-1.23)
25-54	0.91 (0.89-0.93)	0.99 (0.96-1.01)	1.56 (1.52-1.59)	1.36 (1.35-1.37)
55-64	1.21 (1.18-1.23)	1.01 (0.98-1.04)	1.92 (1.85-1.99)	1.59 (1.58-1.61)
65+	1.83 (1.79-1.87)	1.54 (1.49-1.60)	2.23 (2.14-2.31)	2.62 (2.60-2.65)
Sex				
Sex (Female vs. Male)	0.90 (0.89-0.91)	1.01 (1.00-1.03)	0.90 (0.89-0.92)	0.86 (0.85-0.86)
Nearest Census Based Neighbourhood Income Quintile				
Quintile 1 (Lowest)	Reference	Reference	Reference	Reference
Quintile 2	0.92 (0.91-0.93)	0.95 (0.93-0.98)	0.81 (0.79-0.83)	0.93 (0.92-0.94)
Quintile 3	0.89 (0.88-0.90)	0.99 (0.96-1.01)	0.80 (0.78-0.82)	0.91 (0.90-0.91)
Quintile 4	0.85 (0.84-0.86)	0.94 (0.92-0.96)	0.75 (0.73-0.77)	0.89 (0.89-0.90)
Quintile 5 (Highest)	0.81 (0.80-0.82)	0.95 (0.93-0.97)	0.70 (0.69-0.72)	0.89 (0.88-0.90)
Rural or Urban				
Urban	1.17 (1.15-1.18)	1.16 (1.12-1.20)	1.18 (1.15-1.21)	1.22 (1.21-1.23)
Rural	Reference	Reference	Reference	Reference
Comorbidities				
History of Hypertension (Yes vs. No)	1.45 (1.43-1.46)	1.22 (1.20-1.25)	1.37 (1.33-1.42)	1.36 (1.36-1.37)
History of MI (Yes vs. No)	1.28 (1.25-1.31)	1.55 (1.44-1.67)	0.91 (0.84-0.99)	1.23 (1.21-1.25)
History of Heart Failure (Yes vs. No)	2.34 (2.29-2.38)	2.25 (2.12-2.39)	2.57 (2.40-2.75)	2.09 (2.06-2.11)

History of COPD (Yes vs. No)	1.34 (1.33-1.36)	1.17 (1.14-1.21)	1.27 (1.22-1.32)	1.27 (1.26-1.28)
History of Asthma (Yes vs. No)	1.02 (1.01-1.03)	1.10 (1.08-1.12)	1.06 (1.04-1.09)	1.02 (1.02-1.03)
History of Cancer (Yes vs. No)	2.17 (2.15-2.20)	1.77 (1.71-1.82)	1.72 (1.64-1.80)	1.64 (1.62-1.65)
History of Arthritis (Yes vs. No)	1.29 (1.25-1.33)	1.25 (1.18-1.33)	1.57 (1.44-1.71)	1.20 (1.18-1.22)
History of Psychiatric Disorder (Yes vs. No)	1.93 (1.88-1.98)	2.11 (2.02-2.21)	2.50 (2.36-2.66)	2.48 (2.44-2.52)
History of Cerebrovascular Disease (Yes vs. No)	1.71 (1.65-1.77)	1.33 (1.18-1.49)	1.36 (1.18-1.55)	1.62 (1.58-1.66)
History of Fracture (Yes vs. No)	1.52 (1.49-1.56)	1.29 (1.23-1.35)	1.25 (1.18-1.33)	1.75 (1.73-1.77)

Table 12: Predictors of total health care costs for patients with MUSC, PIN, UTI, VAGY

	Regression model; relative cost (95% CI)			
	MUSC (n = 8099393)	**PIN (n = 41663)**	**UTI (n = 3356887)**	**VAGY (n = 1702830)**
Age Group				
0-18	Reference	Reference	Reference	Reference
19-24	1.07 (1.06-1.07)	1.16 (1.06-1.27)	0.97 (0.97-0.98)	1.08 (1.08-1.08)
25-54	1.13 (1.12-1.13)	1.44 (1.38-1.50)	1.22 (1.21-1.23)	1.29 (1.28-1.29)
55-64	1.45 (1.44-1.46)	1.63 (1.47-1.81)	1.59 (1.58-1.61)	1.64 (1.64-1.64)
65+	2.41 (2.39-2.42)	1.71 (1.51-1.93)	2.80 (2.78-2.83)	2.49 (2.49-2.50)
Sex				
Sex (Female vs. Male)	0.90 (0.90-0.90)	1.10 (1.06-1.14)	0.74 (0.74-0.74)	0.83 (0.83-0.83)
Nearest Census Based Neighbourhood Income Quintile				
Quintile 1 (Lowest)	Reference	Reference	Reference	Reference

Quintile 2	0.91 (0.91-0.91)	0.96 (0.91-1.02)	0.93 (0.92-0.93)	0.93 (0.93-0.93)
Quintile 3	0.89 (0.89-0.90)	0.90 (0.85-0.96)	0.90 (0.90-0.91)	0.90 (0.90-0.90)
Quintile 4	0.89 (0.89-0.90)	0.91 (0.86-0.96)	0.86 (0.86-0.87)	0.88 (0.88-0.88)
Quintile 5 (Highest)	0.87 (0.87-0.87)	0.84 (0.79-0.89)	0.83 (0.83-0.84)	0.86 (0.86-0.86)
Rural or Urban				
Urban	1.27 (1.27-1.28)	1.12 (1.06-1.20)	1.24 (1.23-1.24)	1.26 (1.26-1.26)
Rural	Reference	Reference	Reference	Reference
Comorbidities				
History of Hypertension (Yes vs. No)	1.34 (1.33-1.34)	1.47 (1.34-1.60)	1.41 (1.40-1.41)	1.36 (1.36-1.36)
History of MI (Yes vs. No)	1.22 (1.21-1.23)	0.81 (0.57-1.14)	1.22 (1.20-1.23)	1.23 (1.22-1.23)
History of Heart Failure (Yes vs. No)	2.23 (2.21-2.25)	4.39 (3.35-5.76)	2.20 (2.17-2.22)	2.26 (2.26-2.27)
History of COPD (Yes vs. No)	1.32 (1.32-1.33)	1.11 (0.97-1.27)	1.27 (1.26-1.28)	1.29 (1.29-1.29)
History of Asthma (Yes vs. No)	1.01 (1.01-1.02)	1.14 (1.08-1.19)	1.01 (1.01-1.02)	1.00 (1.00-1.01)
History of Cancer (Yes vs. No)	1.83 (1.82-1.83)	2.01 (1.75-2.31)	1.78 (1.77-1.79)	1.98 (1.97-1.98)
History of Arthritis (Yes vs. No)	1.38 (1.37-1.40)	1.57 (1.22-2.02)	1.28 (1.27-1.30)	1.28 (1.28-1.29)
History of Psychiatric Disorder (Yes vs. No)	2.17 (2.15-2.19)	2.39 (2.05-2.78)	2.15 (2.12-2.18)	2.03 (2.02-2.04)
History of Cerebrovascular Disease (Yes vs. No)	1.74 (1.72-1.77)	0.65 (0.36-1.19)	1.75 (1.71-1.78)	1.71 (1.70-1.72)
History of Fracture (Yes vs. No)	1.71 (1.69-1.72)	0.98 (0.85-1.14)	1.66 (1.64-1.68)	1.55 (1.55-1.56)

Figure 1: Age group as a predictor of total health care costs for patients with minor ailments

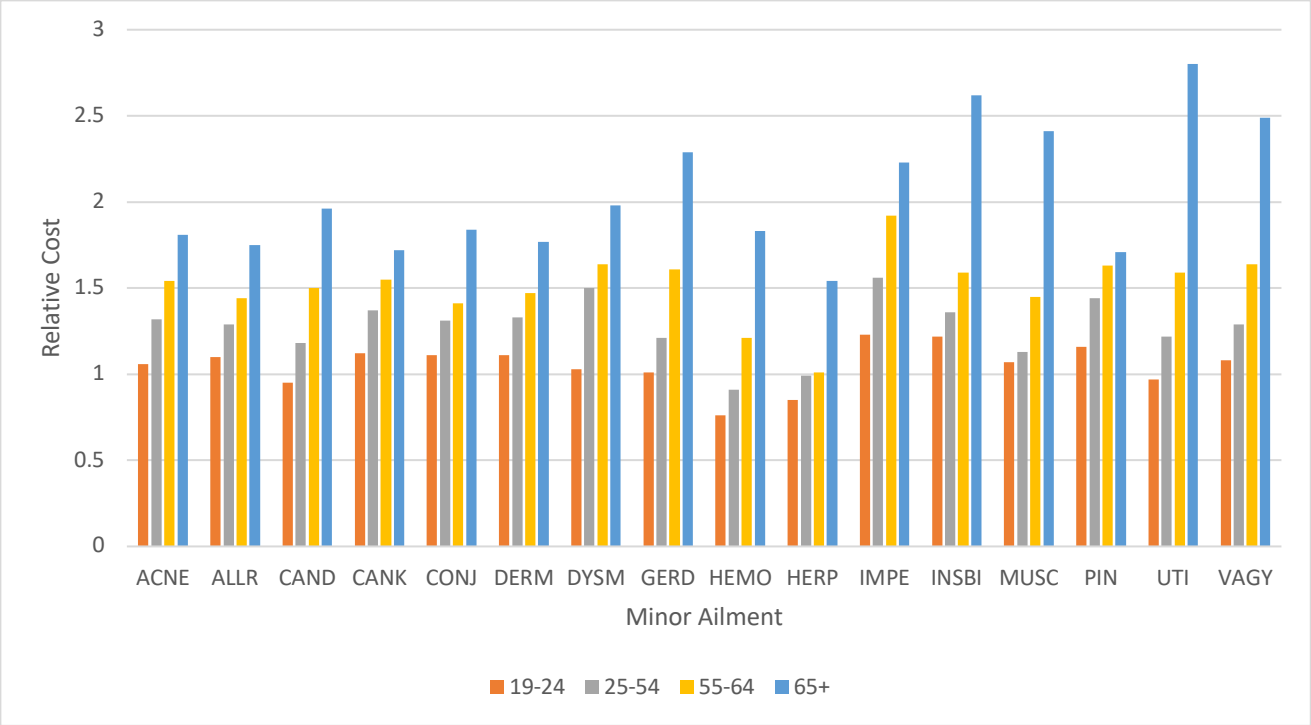


Figure 2: Sex as a predictor of total health care costs for patients with minor ailments

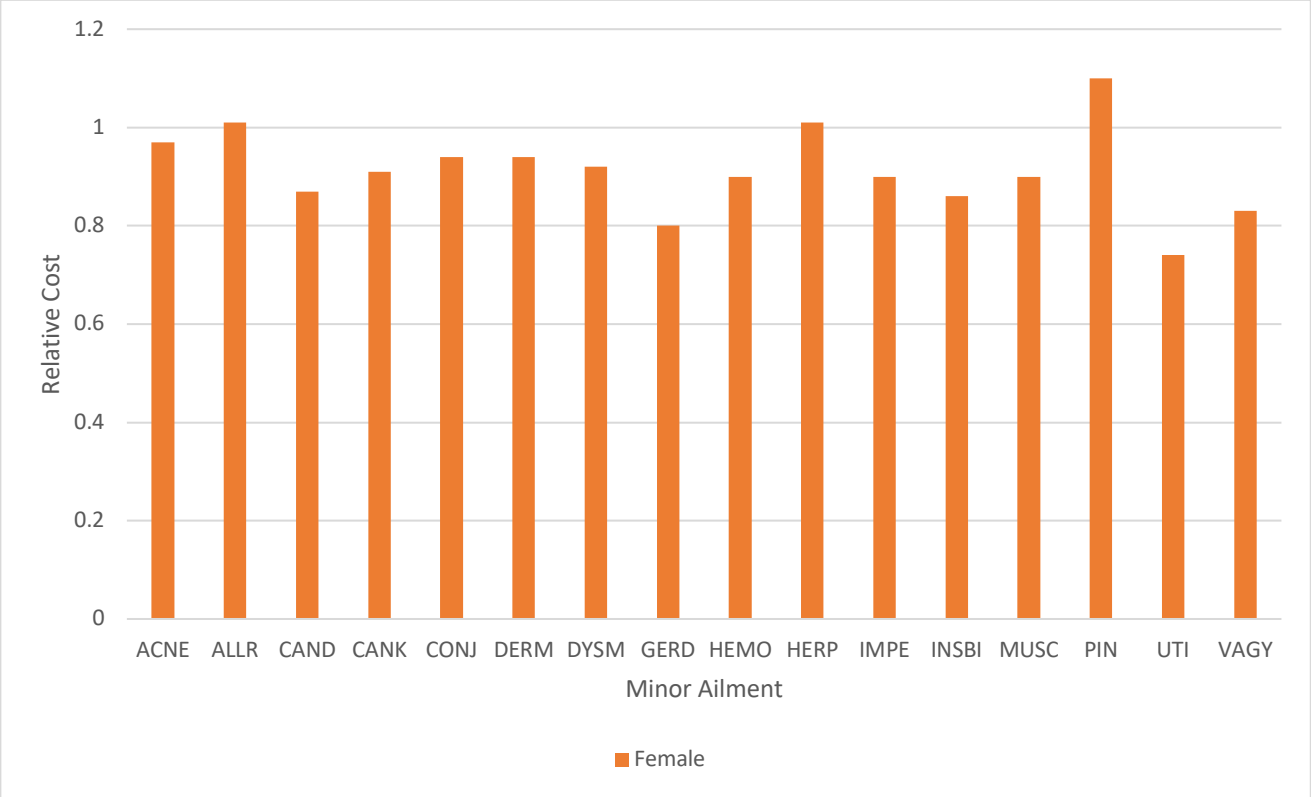


Figure 3: Income quintile as a predictor of total health care costs for patients with minor ailments

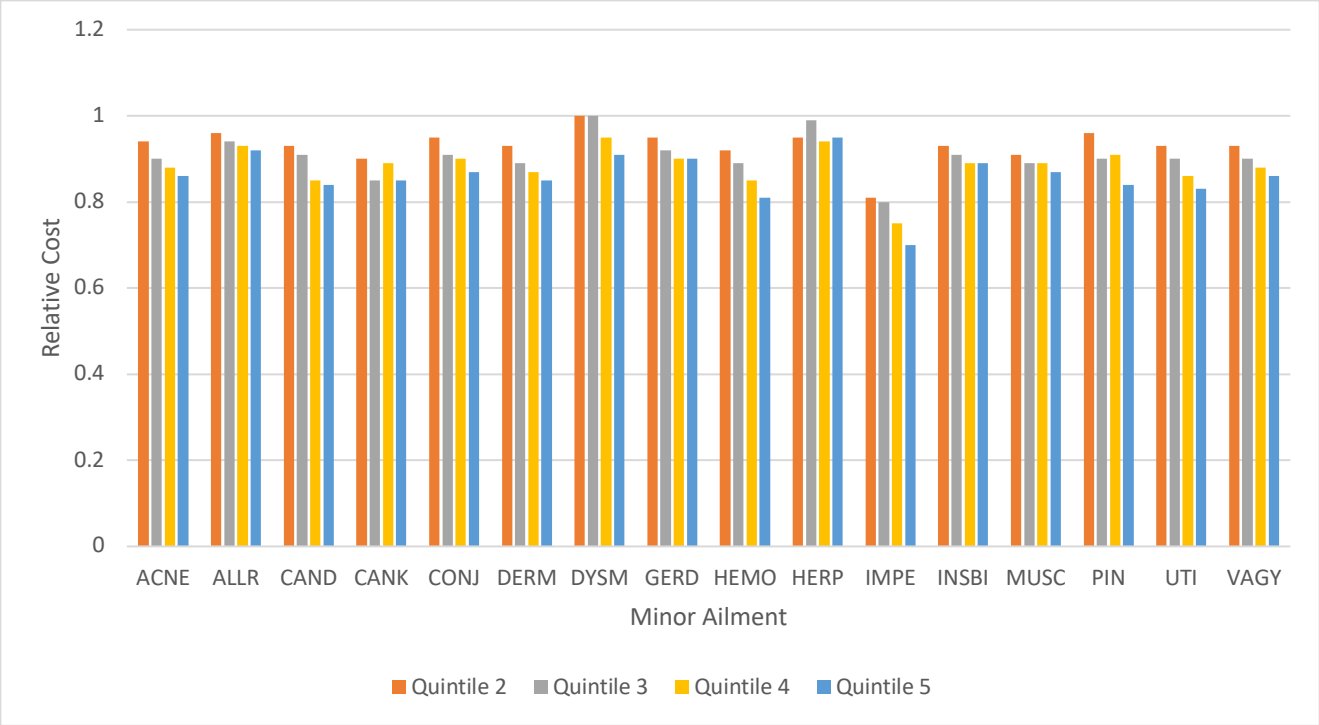


Figure 4: Urban or rural as a predictor of total health care costs for patients with minor ailments

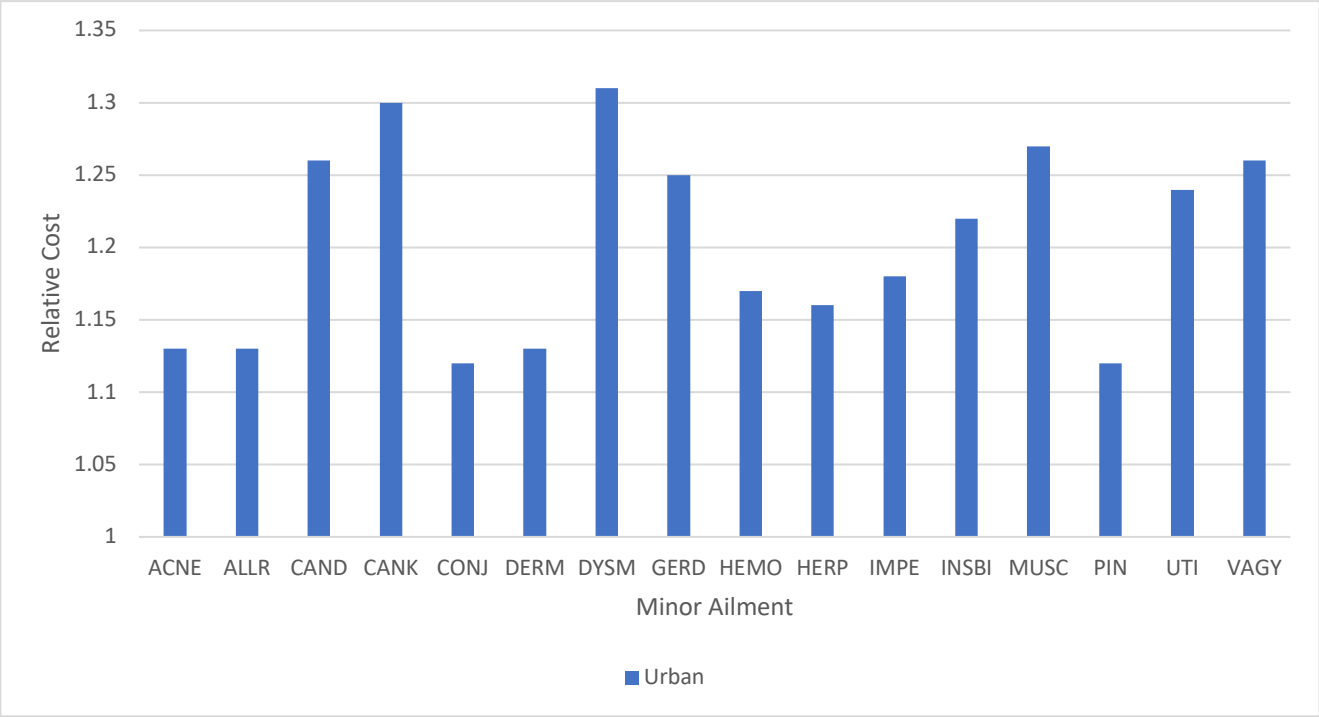
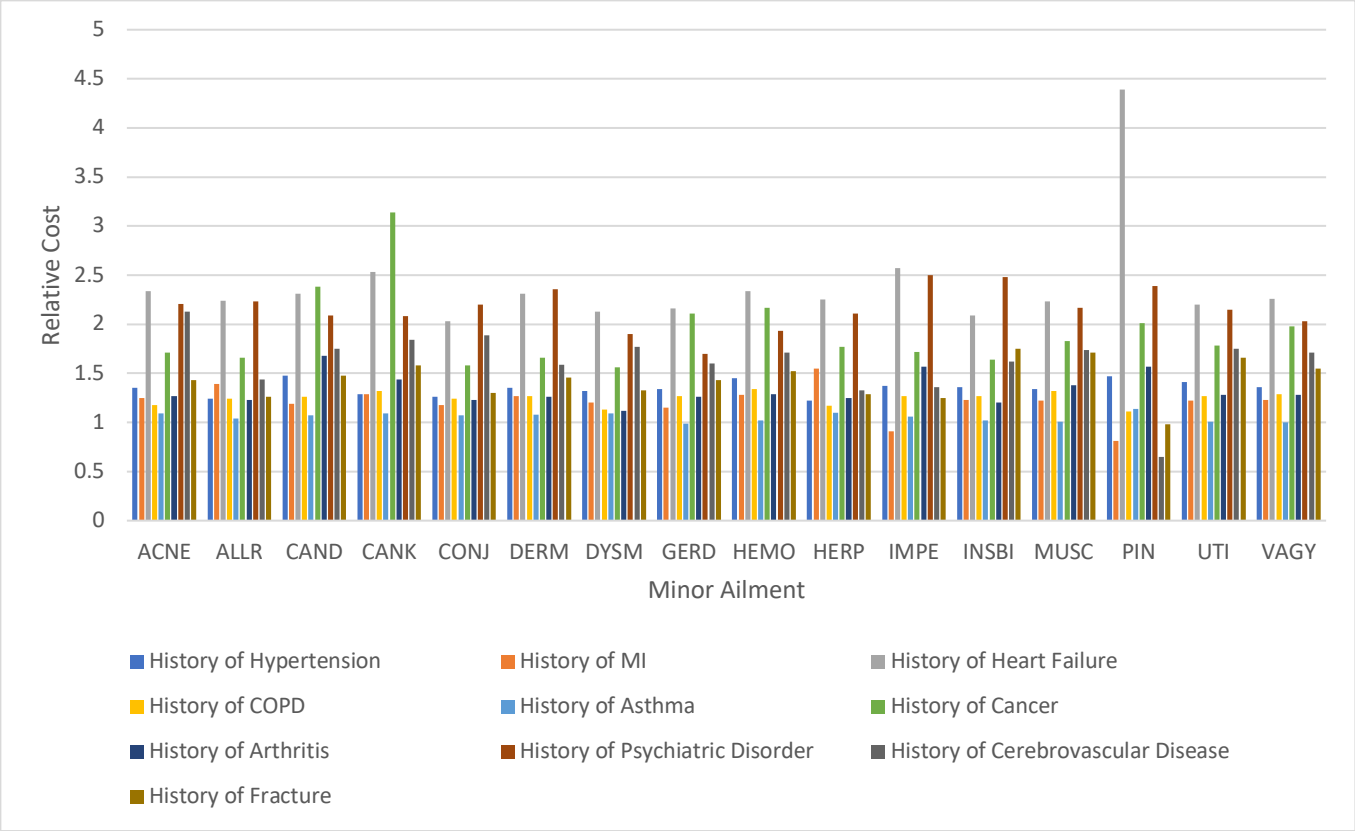


Figure 5: Comorbidities as a predictor of total health care costs for patients with minor ailments



The predictors of total health care costs varied across age, sex, income, urban or rural residency, and history of comorbidities. When other predictors were held constant, costs increased significantly with increasing age groups for the minor ailments with older age groups consistently associated with higher total health care costs as shown in Figure 1. For example, UTI patients aged 65+ years had a relative cost 2.80 times higher than those aged 0-18 years. Similarly, other minor ailments such as insect bites and urticaria, vaginal yeast infection, and musculoskeletal sprains and strains also showed increased costs for patients 65+ years with relative costs of 2.62, 2.49, and 2.41 higher than the 0-18 years age group, respectively. Sex was another predictor examined, with female patients generally incurring lower costs than males, except in pin/threadworm, where females had a relative cost 1.10 times higher than males as

shown in Figure 2. Income quintiles was another predictor for total health care costs with patients in higher income quintiles (Q5) with lower costs compared to those in the lowest quintile (Q1), particularly for impetigo and hemorrhoids as shown in Figure 3. Urban residency was associated with higher costs across several minor ailments, with dysmenorrhea, canker sores, and candidal stomatitis patients residing in urban areas incurring 1.31, 1.30, and 1.26 times higher costs, respectively, compared to rural residents as shown in Figure 4.

Comorbidities were also predictors of total health care costs as shown in Figure 5. History of heart failure, cancer, and psychiatric disorders comorbidities were associated with higher total health care costs compared to those without these comorbidities, respectively. Heart failure was a predictor of higher total health care costs where patients across all the studied 16 minor ailments had greater than two times higher relative costs compared to those without a history of heart failure. For pin/threadworm, having a history of heart failure was found to be associated with relative costs 4.39 higher than those without history of heart failure. Having a history of having psychiatric disorders was also associated with higher total health care costs with 2.48, 2.39, and 2.36 higher relative costs for insect bites and urticaria, pin/threadworm, and dermatitis respectively. Lastly, cancer was another strong predictor with having a history of cancer associated with increased relative costs of 3.14, 2.38, and 2.17 for canker sores, candidal stomatitis, and hemorrhoids, respectively.

DISCUSSION

This thesis aimed to determine the baseline characteristics, mean health care costs, and predictors of health care costs for minor ailments in Ontario that are authorized under the PPMA program. Using health administrative data from ICES, this study provides an estimate of the economic burden of minor ailments that pharmacists in Ontario are able to prescribe for.

The results of this study showed that musculoskeletal sprains and strains (8,099,393; 24%), GERD (5,822,495; 17%), dermatitis (5,649,829; 17%), UTI (3,356,887; 10%), and insect bites/urticaria (2,699,684; 8%) were the minor ailments studied with the highest number of unique patients billed. In comparison, recently published data from the British Columbia Minor Ailments and Contraception Service in 2024 found that contraception (20%), UTI (20%), conjunctivitis (9%), allergic rhinitis (6%), herpes labialis (6%), and dermatitis (6%) comprised the majority of their minor ailment conditions serviced between June 1, 2023 and May 31, 2024.[23] The main difference is that the results of this study was based on the epidemiology of minor ailments whereas the British Columbia report relied on pharmacist provided minor ailment services which may not correspond with the epidemiology. Additionally, previous reports such as a survey of 1202 citizens in a Canadian city presented a list of minor ailments known to be common which included cold/flu, headache, muscle ache, dry skin, constipation, heartburn, sore back, allergies, and insomnia.[24] It would be valuable to examine the distribution of pharmacist prescribing for minor ailments in Ontario once such data becomes available. Understanding which minor ailments are most frequently assessed and treated by pharmacists in Ontario, and how this aligns with the conditions highlighted in this study, could provide important insights into the utilization and impact of the PPMA program.

The baseline characteristics of patients presenting with minor ailments varied across age groups, sex, geographical location, income quintiles, and history of comorbidities. Although the majority of patients presenting with minor ailments were in the age group between 25 and 54 years, it also showed higher representation in the younger age groups for minor ailment conditions that tend to be more prevalent in children including pin/threadworm and impetigo.[25,26] Similarly, minor ailments such as hemorrhoids, UTI, and GERD were more common among older adults (65+),

which is also consistent with their age-related prevalence.[27–29] Sex distribution also varied between conditions. Female patients were more frequently diagnosed with dysmenorrhea, vaginal yeast infections, and UTI, reflecting the sex-specific or sex-predominant nature of these minor ailments.[28,30,31] The prevalence of comorbidities among patients presenting with each of the minor ailments were also presented with the most common comorbidities including hypertension, asthma, and COPD which is consistent with previous reports discussing trends in chronic disease incidence in Canada.[32] These findings help demonstrate the diverse demographic and clinical factors influencing the management of minor ailments in Ontario. This highlights that pharmacist prescribing for minor ailments involves providing care to diverse populations. It also presents an opportunity for pharmacists to address multiple health concerns, such as managing comorbidities such as hypertension.

The analysis of mean health care costs revealed significant variations across minor ailments and cost categories. With pharmacists in Ontario now authorized to prescribe for these minor ailments, this could help reduce overcrowding in EDs and family doctor offices, in addition to providing cost savings which will be further explored in Chapter 3 of this thesis. Hemorrhoids, UTIs, and GERD incurred the highest mean ED costs. These conditions were also most common among the oldest age group (65+), where age-related comorbidities and more complex care needs may contribute to higher ED costs. In contrast, minor ailments such as conjunctivitis, impetigo, and pin/threadworm incurred lower ED costs, likely due to their simpler presentation and treatment requirements, as well as their higher prevalence among younger age groups, who typically experience less complex care needs. When comparing to cost parameters used in previous cost minimization analyses for minor ailments, cost of ED visits was estimated to be lower in other studies compared to this analysis. In Kim et al., ED visits were estimated to cost $172.94 and

Rafferty et al., estimated to be $138. These studies did not depend on empirical data rather assumption on other health care systems. Whereas in this analysis, the ED costs for the 16 studied minor ailments were found to range from $266.03 to $464.66, demonstrating the cost burden of these ED visits. Physician visit costs were also a driver of overall health care costs with hemorrhoids ($437.39) and UTIs ($336.80) incurring the highest costs, while acne patients had the lowest costs at $138.83. These findings highlight the potential role of pharmacists in managing minor ailment cases typically presenting to EDs, family physicians, or walk-in clinics. In a retrospective quantitative cohort study using Ontario administrative databases, it was found that 34.8% ED visits were for conditions considered to be potentially manageable by pharmacists, representing 4.3% of all ED visits.[33] Inpatient costs were also a significant driver of overall health care expenses, particularly for minor ailment conditions such as pin/threadworm and candidal stomatitis, where prolonged or severe cases may necessitate inpatient hospitalization. On the index date, prescription medication costs were relatively similar across conditions, however allergic rhinitis incurred the highest costs and musculoskeletal sprains and strains the lowest. In comparison, the estimated cost of prescription medication in the cost minimization study by Kim et al. was assumed to be $7.80 which is lower than the ODB costs estimated in this study which ranged from $10.75 to $29.54.

The predictors of total health care costs identified in this study provide valuable insights into the factors that drive costs for minor ailments. Age was a significant predictor, with older patients consistently incurring higher costs across minor ailment conditions likely reflecting the increased comorbidities and more complex care needs of older adults. With Canada's aging population, this older age group could also continue be a cost driver in health care and further increase the burden on the health care system in Ontario.[34] Other predictors of health care costs

analyzed included sex, with female patients generally incurring lower costs than male patients. Income quintile was associated with lower costs for patients in higher quintiles which could suggest that socioeconomic factors, such as income, may influence the overall cost burden of minor ailments. This finding is consistent with a report from 2016 that found that health care costs generally decline as income rises, and socioeconomic health inequalities represents over 14% of annual expenditures on acute care inpatient hospitalizations, prescription medications, and physician consultations.[35] Urban residency was also a significant predictor of higher health care costs, with urban residents incurring higher costs for several conditions. This trend may reflect increased access to health care services in urban areas, resulting in greater utilization of resources. A Canadian analysis looking at health-care services found that participants in rural areas were less likely to have seen a family physician or specialist physician but were more likely to visit an ED compared to urban areas even have adjusting for sociodemographic and health-related variables.[36] Comorbidities, particularly cancer, heart failure, COPD, and hypertension, were predictors of increased costs. For example, cancer was a strong predictor, with more than two times relative costs compared to those without a history of cancer for conditions such as candidal stomatitis and canker sores which could be a side effect of chemotherapy and radiation regimens.[37] These findings emphasize the impact of predictors of health care costs which include age, sex, income quintile, urban or rural residency, and history of comorbidities on health care costs for minor ailments. Understanding these predictors can help inform strategies to allocate healthcare resources more effectively, ensuring that patients with greater care needs receive appropriate attention and support.

This study has several strengths. First, health administrative data from ICES was used for this analysis which provides records for every Ontario resident who has been eligible for health care over time including 13.4 million people living in Ontario, Canada.[13] Since Ontario has

publicly funded health insurance for physician and hospital services, we are likely able to reliably estimate baseline characteristics, mean costs, and predictors of total health care costs. In addition, the time frame for this study was from April 1, 2011, to March 31, 2019, with the maximum follow up date 1 year after the latest minor ailment record (March 31, 2020) and a 12-month lookback window. To our knowledge, the baseline characteristics, mean health care costs, and predictors of total health care costs for minor ailment conditions in Ontario, Canada have not been previously evaluated in studies.

However, there were several limitations in this study. The mean cost analyses were also not able to distinguish between minor ailment related costs and non-related costs. In addition, the OHIP codes used for minor ailments have not yet been validated, which may result in either an overestimation or underestimation of the study's results. Patients without a valid OHIP card and those with missing demographic data were excluded which may limit the generalizability of the findings. The estimates for prescription drug costs only account for patients who have prescription drug coverage through ODB and are dispensed medications on the ODB formulary. Therefore, costs covered by private health insurance or out of pocket costs paid by patients are not included in these results. Lastly, for the analysis of baseline characteristics and predictors of total health care costs, only the first visit for each minor ailment diagnosis in the selected time frame will be included and did not account for recurrent minor ailment conditions throughout the time frame.

CONCLUSION

This study highlights the need for further research to explore the role of pharmacist-prescribed treatments in reducing health care costs for minor ailments. These results can help inform economic models aiming to predict cost-savings of remunerated pharmacist-managed care for Ontarians for minor ailments compared to usual care. In addition, this research provided the

baseline characteristics of patients seeking care for minor ailments and the burden of different minor ailments in Ontario which can help continue shape the implementation of a PPMA program in Ontario, Canada. Lastly, it is important to note that this analysis was done on datasets with a time frame prior to the implementation of a PPMA program in Ontario. Therefore, when data is available after the implementation of the PPMA program, this analysis could be performed again.

CHAPTER 3

Cost-minimization analysis of pharmacist prescribing for minor ailments in Ontario, Canada

METHODOLOGY

Study Design

A decision-analytic model was implemented to perform the cost-minimization analysis for the studied minor ailments in Table A1.

Strategies

Two prescribing strategies for minor ailments were considered in this study (decision tree diagram shown in Figure 6):

Figure 6: Decision tree showing patient progression through the two prescribing strategies (PPMA and UCM)



1. PPMA: In this strategy, pharmacists are authorized to prescribe certain medications for minor ailments. Patients who are seeking care for a minor ailment have the option of either going to a community pharmacist or physician (walk-in clinic, ED, or family physician). Unless there is a need for urgent referral to the ED, the prescriber has the option of prescribing a drug (prescription or non-prescription) or recommending no drug therapy. If the minor ailment does not resolve following the first encounter, the patient will return a second time for further assessment and treatment. For the second encounter, patients who initially received care from a pharmacist will either return to the pharmacist or go to a physician. Whereas those who initially received care from a physician are assumed to return to a physician to seek care. For either option in the second encounter, a prescription drug is assumed to be recommended in all cases.
2. Usual care model (UCM): This strategy represents the prescribing strategy prior to the authorization of the pharmacist prescribing for minor ailment program in Ontario. In this model, pharmacists are unable to prescribe for minor ailments. Therefore, all patients seeking care for minor ailments will receive care from a physician (walk-in clinic, ED, or family physician) who will have the option of prescribing a drug (prescription or non-prescription) or recommending no drug therapy. Similar to the PPMA model, if the minor ailment does not resolve after the first encounter, patients will return to the physician to seek care, and a prescription drug is assumed to be prescribed.

Model Structure

A decision-analytical model was developed to perform a cost-minimization analysis of a PPMA program. A cost-minimization analysis was performed for this analysis because in this case it is assumed that the health outcomes of these two options (UCM and PPMA model) are

identical so the option that has the lowest cost will be preferred.[38] In this analysis, the proposed PPMA program in Ontario, Canada was compared to UCM as shown in Figure 6. TreeAge Pro 2024 decision analysis software was be used to implement the decision-analytical model. The model included patient progression through the two prescribing strategies described above where patients could choose to seek care from either the PPMA or UCM.

Cohort

The study cohort included participants who are eligible to receive publicly funded minor ailment prescribing who are Ontarians and have a valid Ontario health number presenting with one of the studied minor ailments authorized for pharmacist minor ailment prescribing in Ontario.[3] In addition, this cohort included patients that were examined in the health administrative data retrospective cohort study in Chapter 2 which includes Ontarians who received an OHIP diagnosis code for a minor ailment between April 1, 2011, and March 31, 2019. The OHIP diagnosis codes are listed in Table A1. Inclusion criteria also included that the date of provincial health coverage eligibility was at least 365 days before billing date and Ontario resident on index date. Patients were excluded if they had an invalid OHIP card, missing age or sex, or death on cohort entry date.

Input Data

Probabilities and costs used in the model were derived from health administrative data from ICES, literature, or expert opinion when there was insufficient literature as listed in Tables 13 to 28.

Table 13: Model Parameters for ACNE

Parameter	Parameter Estimate	Lower Limit	Upper Limit	Source
Costs ($CAD)				
Cost of going to ED	215.75	193.25	238.26	From ICES. Mean cost of ACNE ED visit within 30 days of index date (minor ailment billing date)
Cost of family doctor CAP	5.29	5.26	5.30	From ICES. Mean CAP cost within 30 days of index date divided by average number of CAP visits within 30 days.
Cost of family doctor FFS	106.21	105.74	106.67	From ICES. Mean FFS cost within 30 days of index date divided by average number of FFS visits within 30 days.
Cost of OTC product	0.00	0.00	0.00	Modelling assumption
Cost of pharmacist minor ailment assessment	18.32	15.00	19.00	Ministry of Health ($19 for in person visit, $15 for virtual visit)[39] Based on weighted average 83% in person visits and 17% virtual visits.
Cost of walk-in clinic visit	106.21	105.74	106.67	From ICES. Same as cost of family doctor FFS.
Cost of Rx medication	18.33	18.21	18.44	From ICES. Mean ODB cost for Rx that can be prescribed by RPh for ACNE.[40]
Probabilities				
Probability of going to the emergency department	0.000719	0.000540	0.000900	From ICES. Probability of any ED visit for ACNE within 7 days of index date.
Probability of having a family doctor	0.933	0.700	1.000	Health Quality Ontario[41]
Probability of family doctor billing by CAP	0.370	0.278	0.463	Canadian Institute for Health Information[42]
Probability of family doctor billing by FFS	0.630	0.473	0.788	Canadian Institute for Health Information[42]
Probability that family doctor has no appointments available	0.594	0.446	0.743	Health Quality Ontario[41]

Probability of pharmacist referring	0.100	0.075	0.125	Expert opinion
Probability of receiving care by pharmacist	0.380	0.285	0.475	Modelling assumption
Probability of revisiting pharmacist	0.100	0.075	0.125	Modelling assumption
Probability of going to a walk-in clinic	0.594	0.446	0.743	Modelling assumption
Probability of family doctor giving OTC **Probability of pharmacist giving OTC**	0.100	0.075	0.125	Expert opinion
Probability of family doctor giving Rx **Probability of pharmacist giving Rx**	0.00254	0.00191	0.00318	From ICES. Of those 65+, how many received ACNE Rx ODB billing within 14 days.
Probability family doctor does not give Rx or OTC **Probability pharmacist does not give Rx or OTC**	0.897	0.673	1.000	Determined based on probability giving OTC and probability giving Rx
Probability patient gets better (no Rx/OTC) **Probability of getting better with OTC product (not Rx)** **Probability of getting better with Rx**	0.978	0.733	1.000	From ICES. From OHIP, NACRS, and DAD, probability of no visit of ACNE within 7 days from index date.

Table 14: Model Parameters for ALLR

Parameter	Parameter Estimate	Lower Limit	Upper Limit	Source
Costs ($CAD)				
Cost of going to ED	263.73	248.57	278.89	From ICES. Mean cost of ALLR ED visit within 30 days of index date (minor ailment billing date)
Cost of family doctor CAP	2.98	2.97	2.98	From ICES. Mean CAP cost within 30 days of index date divided by average number of CAP visits within 30 days.
Cost of family doctor FFS	87.74	87.51	87.96	From ICES. Mean FFS cost within 30 days of index date divided by average number of FFS visits within 30 days.
Cost of OTC product	0.00	0.00	0.00	Modelling assumption
Cost of pharmacist minor ailment assessment	18.32	15.00	19.00	Ministry of Health ($19 for in person visit, $15 for virtual visit)[39] Based on weighted average 83% in person visits and 17% virtual visits.
Cost of walk-in clinic visit	87.74	87.51	87.96	From ICES. Same as cost of family doctor FFS.
Cost of Rx medication	29.54	29.42	29.66	From ICES. Mean ODB cost for Rx that can be prescribed by RPh for ALLR.[40]
Probabilities				
Probability of going to the emergency department	0.00140	0.00105	0.00175	From ICES. Probability of any ED visit for ALLR within 7 days of index date.
Probability of having a family doctor	0.933	0.700	1.000	Health Quality Ontario[41]
Probability of family doctor billing by CAP	0.370	0.278	0.463	Canadian Institute for Health Information[42]
Probability of family doctor billing by FFS	0.630	0.473	0.788	Canadian Institute for Health Information[42]
Probability that family doctor has no appointments available	0.594	0.446	0.743	Health Quality Ontario[41]

Probability of pharmacist referring	0.100	0.075	0.125	Expert opinion
Probability of receiving care by pharmacist	0.380	0.285	0.475	Modelling assumption
Probability of revisiting pharmacist	0.100	0.075	0.125	Modelling assumption
Probability of going to a walk-in clinic	0.594	0.446	0.743	Modelling assumption
Probability of family doctor giving OTC **Probability of pharmacist giving OTC**	0.10	0.075	0.125	Expert opinion
Probability of family doctor giving Rx **Probability of pharmacist giving Rx**	0.1435	0.108	0.179	From ICES. Of those 65+, how many received ALLR Rx ODB billing within 14 days.
Probability family doctor does not give Rx or OTC **Probability pharmacist does not give Rx or OTC**	0.756	0.567	0.946	Determined based on probability giving OTC and probability giving Rx
Probability patient gets better (no Rx/OTC) **Probability of getting better with OTC product (not Rx)** **Probability of getting better with Rx**	0.978	0.733	1.000	From ICES. From OHIP, NACRS, and DAD, probability of no visit of ALLR within 7 days from index date.

Table 15: Model Parameters for CAND

Parameter	Parameter Estimate	Lower Limit	Upper Limit	Source
Costs ($CAD)				
Cost of going to ED	327.90	314.87	340.93	From ICES. Mean cost of CAND ED visit within 30 days of index date (minor ailment billing date)
Cost of family doctor CAP	6.21	6.18	6.24	From ICES. Mean CAP cost within 30 days of index date divided by average number of CAP visits within 30 days.
Cost of family doctor FFS	180.48	176.37	184.61	From ICES. Mean FFS cost within 30 days of index date divided by average number of FFS visits within 30 days.
Cost of OTC product	0.00	0.00	0.00	Modelling assumption
Cost of pharmacist minor ailment assessment	18.32	15.00	19.00	Ministry of Health ($19 for in person visit, $15 for virtual visit)[39] Based on weighted average 83% in person visits and 17% virtual visits.
Cost of walk-in clinic visit	180.48	176.37	184.61	From ICES. Same as cost of family doctor FFS.
Cost of Rx medication	16.47	16.37	16.56	From ICES. Mean ODB cost for Rx that can be prescribed by RPh for CAND.[40]
Probabilities				
Probability of going to the emergency department	0.0182	0.0136	0.0227	From ICES. Probability of any ED visit for CAND within 7 days of index date.
Probability of having a family doctor	0.933	0.700	1.000	Health Quality Ontario[41]
Probability of family doctor billing by CAP	0.370	0.278	0.463	Canadian Institute for Health Information[42]
Probability of family doctor billing by FFS	0.630	0.473	0.788	Canadian Institute for Health Information[42]
Probability that family doctor has no appointments available	0.594	0.446	0.743	Health Quality Ontario[41]

Probability of pharmacist referring	0.100	0.075	0.125	Expert opinion
Probability of receiving care by pharmacist	0.380	0.285	0.475	Modelling assumption
Probability of revisiting pharmacist	0.100	0.075	0.125	Modelling assumption
Probability of going to a walk-in clinic	0.594	0.446	0.743	Modelling assumption
Probability of family doctor giving OTC **Probability of pharmacist giving OTC**	0.100	0.075	0.125	Expert opinion
Probability of family doctor giving Rx **Probability of pharmacist giving Rx**	0.323	0.242	0.403	From ICES. Of those 65+, how many received CAND Rx ODB billing within 14 days.
Probability family doctor does not give Rx or OTC **Probability pharmacist does not give Rx or OTC**	0.577	0.433	0.721	Determined based on probability giving OTC and probability giving Rx
Probability patient gets better (no Rx/OTC) **Probability of getting better with OTC product (not Rx)** **Probability of getting better with Rx**	0.963	0.722	1.000	From ICES. From OHIP, NACRS, and DAD, probability of no visit of CAND within 7 days from index date.

Table 16: Model Parameters for CANK

Parameter	Parameter Estimate	Lower Limit	Upper Limit	Source
Costs ($CAD)				
Cost of going to ED	287.70	269.34	306.06	From ICES. Mean cost of CANK ED visit within 30 days of index date (minor ailment billing date)
Cost of family doctor CAP	6.09	6.03	6.15	From ICES. Mean CAP cost within 30 days of index date divided by average number of CAP visits within 30 days.
Cost of family doctor FFS	191.25	188.44	194.06	From ICES. Mean FFS cost within 30 days of index date divided by average number of FFS visits within 30 days.
Cost of OTC product	0.00	0.00	0.00	Modelling assumption
Cost of pharmacist minor ailment assessment	18.32	15.00	19.00	Ministry of Health ($19 for in person visit, $15 for virtual visit)[39] Based on weighted average 83% in person visits and 17% virtual visits.
Cost of walk-in clinic visit	191.25	188.44	194.06	From ICES. Same as cost of family doctor FFS.
Cost of Rx medication	16.48	16.39	16.57	From ICES. Mean ODB cost for Rx that can be prescribed by RPh for CANK.[40]
Probabilities				
Probability of going to the emergency department	0.592	0.444	0.740	From ICES. Probability of any ED visit for CANK within 7 days of index date.
Probability of having a family doctor	0.933	0.700	1.000	Health Quality Ontario[41]
Probability of family doctor billing by CAP	0.370	0.278	0.463	Canadian Institute for Health Information[42]
Probability of family doctor billing by FFS	0.630	0.473	0.788	Canadian Institute for Health Information[42]
Probability that family doctor has no appointments available	0.594	0.446	0.743	Health Quality Ontario[41]

Probability of pharmacist referring	0.100	0.075	0.125	Expert opinion
Probability of receiving care by pharmacist	0.380	0.285	0.475	Modelling assumption
Probability of revisiting pharmacist	0.100	0.075	0.125	Modelling assumption
Probability of going to a walk-in clinic	0.594	0.446	0.743	Modelling assumption
Probability of family doctor giving OTC **Probability of pharmacist giving OTC**	0.100	0.075	0.125	Expert opinion
Probability of family doctor giving Rx **Probability of pharmacist giving Rx**	0.308	0.231	0.385	From ICES. Of those 65+, how many received CANK Rx ODB billing within 14 days.
Probability family doctor does not give Rx or OTC **Probability pharmacist does not give Rx or OTC**	0.592	0.444	0.740	Determined based on probability giving OTC and probability giving Rx
Probability patient gets better (no Rx/OTC) **Probability of getting better with OTC product (not Rx)** **Probability of getting better with Rx**	0.960	0.720	1.000	From ICES. From OHIP, NACRS, and DAD, probability of no visit of CANK within 7 days from index date.

Table 17: Model Parameters for CONJ

Parameter	Parameter Estimate	Lower Limit	Upper Limit	Source
Costs ($CAD)				
Cost of going to ED	206.48	204.42	208.55	From ICES. Mean cost of CONJ ED visit within 30 days of index date (minor ailment billing date)
Cost of family doctor CAP	5.84	5.84	5.86	From ICES. Mean CAP cost within 30 days of index date divided by average number of CAP visits within 30 days.
Cost of family doctor FFS	151.71	151.15	152.26	From ICES. Mean FFS cost within 30 days of index date divided by average number of FFS visits within 30 days.
Cost of OTC product	0.00	0.00	0.00	Modelling assumption
Cost of pharmacist minor ailment assessment	18.32	15.00	19.00	Ministry of Health ($19 for in person visit, $15 for virtual visit)[39] Based on weighted average 83% in person visits and 17% virtual visits.
Cost of walk-in clinic visit	151.71	151.15	152.26	From ICES. Same as cost of family doctor FFS.
Cost of Rx medication	16.04	15.98	16.09	From ICES. Mean ODB cost for Rx that can be prescribed by RPh for CONJ.[40]
Probabilities				
Probability of going to the emergency department	0.0524	0.0393	0.0655	From ICES. Probability of any ED visit for CONJ within 7 days of index date.
Probability of having a family doctor	0.933	0.700	1.000	Health Quality Ontario[41]
Probability of family doctor billing by CAP	0.370	0.278	0.463	Canadian Institute for Health Information[42]
Probability of family doctor billing by FFS	0.630	0.473	0.788	Canadian Institute for Health Information[42]
Probability that family doctor has no appointments available	0.594	0.446	0.743	Health Quality Ontario[41]

Probability of pharmacist referring	0.100	0.075	0.125	Expert opinion
Probability of receiving care by pharmacist	0.380	0.285	0.475	Modelling assumption
Probability of revisiting pharmacist	0.100	0.075	0.125	Modelling assumption
Probability of going to a walk-in clinic	0.594	0.446	0.743	Modelling assumption
Probability of family doctor giving OTC **Probability of pharmacist giving OTC**	0.100	0.075	0.125	Expert opinion
Probability of family doctor giving Rx **Probability of pharmacist giving Rx**	0.0777	0.0583	0.0971	From ICES. Of those 65+, how many received CONJ Rx ODB billing within 14 days.
Probability family doctor does not give Rx or OTC **Probability pharmacist does not give Rx or OTC**	0.822	0.617	1.000	Determined based on probability giving OTC and probability giving Rx
Probability patient gets better (no Rx/OTC) **Probability of getting better with OTC product (not Rx)** **Probability of getting better with Rx**	0.967	0.726	1.000	From ICES. From OHIP, NACRS, and DAD, probability of no visit of CONJ within 7 days from index date.

Table 18: Model Parameters for DERM

Parameter	Parameter Estimate	Lower Limit	Upper Limit	Source
Costs ($CAD)				
Cost of going to ED	473.62	471.10	474.14	From ICES. Mean cost of DERM ED visit within 30 days of index date (minor ailment billing date)
Cost of family doctor CAP	4.43	4.42	4.43	From ICES. Mean CAP cost within 30 days of index date divided by average number of CAP visits within 30 days.
Cost of family doctor FFS	239.43	238.92	239.93	From ICES. Mean FFS cost within 30 days of index date divided by average number of FFS visits within 30 days.
Cost of OTC product	0.00	0.00	0.00	Modelling assumption
Cost of pharmacist minor ailment assessment	18.32	15.00	19.00	Ministry of Health ($19 for in person visit, $15 for virtual visit)[39] Based on weighted average 83% in person visits and 17% virtual visits.
Cost of walk-in clinic visit	239.43	238.92	239.93	From ICES. Same as cost of family doctor FFS.
Cost of Rx medication	12.07	12.05	12.09	From ICES. Mean ODB cost for Rx that can be prescribed by RPh for DERM.[40]
Probabilities				
Probability of going to the emergency department	0.000587	0.000441	0.000734	From ICES. Probability of any ED visit for DERM within 7 days of index date.
Probability of having a family doctor	0.933	0.700	1.000	Health Quality Ontario[41]
Probability of family doctor billing by CAP	0.370	0.278	0.463	Canadian Institute for Health Information[42]
Probability of family doctor billing by FFS	0.630	0.473	0.788	Canadian Institute for Health Information[42]
Probability that family doctor has no appointments available	0.594	0.446	0.743	Health Quality Ontario[41]

Probability of pharmacist referring	0.100	0.075	0.125	Expert opinion
Probability of receiving care by pharmacist	0.380	0.285	0.475	Modelling assumption
Probability of revisiting pharmacist	0.100	0.075	0.125	Modelling assumption
Probability of going to a walk-in clinic	0.594	0.446	0.743	Modelling assumption
Probability of family doctor giving OTC **Probability of pharmacist giving OTC**	0.100	0.075	0.125	Expert opinion
Probability of family doctor giving Rx **Probability of pharmacist giving Rx**	0.184	0.138	0.230	From ICES. Of those 65+, how many received DERM Rx ODB billing within 14 days.
Probability family doctor does not give Rx or OTC **Probability pharmacist does not give Rx or OTC**	0.716	0.537	0.895	Determined based on probability giving OTC and probability giving Rx
Probability patient gets better (no Rx/OTC) **Probability of getting better with OTC product (not Rx)** **Probability of getting better with Rx**	0.968	0.726	1.000	From ICES. From OHIP, NACRS, and DAD, probability of no visit of DERM within 7 days from index date.

Table 19: Model Parameters for DYSM

Parameter	Parameter Estimate	Lower Limit	Upper Limit	Source
Costs ($CAD)				
Cost of going to ED	408.48	379.93	437.03	From ICES. Mean cost of DYSM ED visit within 30 days of index date (minor ailment billing date)
Cost of family doctor CAP	5.90	5.86	5.93	From ICES. Mean CAP cost within 30 days of index date divided by average number of CAP visits within 30 days.
Cost of family doctor FFS	189.25	188.00	190.49	From ICES. Mean FFS cost within 30 days of index date divided by average number of FFS visits within 30 days.
Cost of OTC product	0.00	0.00	0.00	Modelling assumption
Cost of pharmacist minor ailment assessment	18.32	15.00	19.00	Ministry of Health ($19 for in person visit, $15 for virtual visit)[39] Based on weighted average 83% in person visits and 17% virtual visits.
Cost of walk-in clinic visit	189.25	188.00	190.49	From ICES. Same as cost of family doctor FFS.
Cost of Rx medication	19.65	19.30	20.01	From ICES. Mean ODB cost for Rx that can be prescribed by RPh for DYSM.[40]
Probabilities				
Probability of going to the emergency department	0.00835	0.00626	0.0104	From ICES. Probability of any ED visit for DYSM within 7 days of index date.
Probability of having a family doctor	0.933	0.700	1.000	Health Quality Ontario[41]
Probability of family doctor billing by CAP	0.370	0.278	0.463	Canadian Institute for Health Information[42]
Probability of family doctor billing by FFS	0.630	0.473	0.788	Canadian Institute for Health Information[42]
Probability that family doctor has no appointments available	0.594	0.446	0.743	Health Quality Ontario[41]

Probability of pharmacist referring	0.100	0.075	0.125	Expert opinion
Probability of receiving care by pharmacist	0.380	0.285	0.475	Modelling assumption
Probability of revisiting pharmacist	0.100	0.075	0.125	Modelling assumption
Probability of going to a walk-in clinic	0.594	0.446	0.743	Modelling assumption
Probability of family doctor giving OTC **Probability of pharmacist giving OTC**	0.100	0.075	0.125	Expert opinion
Probability of family doctor giving Rx **Probability of pharmacist giving Rx**	0.0271	0.0203	0.0339	From ICES. Of those 65+, how many received DYSM Rx ODB billing within 14 days.
Probability family doctor does not give Rx or OTC **Probability pharmacist does not give Rx or OTC**	0.873	0.655	1.000	Determined based on probability giving OTC and probability giving Rx
Probability patient gets better (no Rx/OTC) **Probability of getting better with OTC product (not Rx)** **Probability of getting better with Rx**	0.976	0.732	1.000	From ICES. From OHIP, NACRS, and DAD, probability of no visit of DYSM within 7 days from index date.

Table 20: Model Parameters for GERD

Parameter	Parameter Estimate	Lower Limit	Upper Limit	Source
Costs ($CAD)				
Cost of going to ED	902.35	879.38	925.32	From ICES. Mean cost of GERD ED visit within 30 days of index date (minor ailment billing date)
Cost of family doctor CAP	4.53	4.53	4.54	From ICES. Mean CAP cost within 30 days of index date divided by average number of CAP visits within 30 days.
Cost of family doctor FFS	283.29	282.95	283.63	From ICES. Mean FFS cost within 30 days of index date divided by average number of FFS visits within 30 days.
Cost of OTC product	0.00	0.00	0.00	Modelling assumption
Cost of pharmacist minor ailment assessment	18.32	15.00	19.00	Ministry of Health ($19 for in person visit, $15 for virtual visit)[39] Based on weighted average 83% in person visits and 17% virtual visits.
Cost of walk-in clinic visit	283.29	282.95	283.63	From ICES. Same as cost of family doctor FFS.
Cost of Rx medication	22.76	22.69	22.82	From ICES. Mean ODB cost for Rx that can be prescribed by RPh for GERD.[40]
Probabilities				
Probability of going to the emergency department	0.00333	0.00250	0.00417	From ICES. Probability of any ED visit for GERD within 7 days of index date.
Probability of having a family doctor	0.933	0.700	1.000	Health Quality Ontario[41]
Probability of family doctor billing by CAP	0.370	0.278	0.463	Canadian Institute for Health Information[42]
Probability of family doctor billing by FFS	0.630	0.473	0.788	Canadian Institute for Health Information[42]
Probability that family doctor has no appointments available	0.594	0.446	0.743	Health Quality Ontario[41]

Probability of pharmacist referring	0.100	0.075	0.125	Expert opinion
Probability of receiving care by pharmacist	0.380	0.285	0.475	Modelling assumption
Probability of revisiting pharmacist	0.100	0.075	0.125	Modelling assumption
Probability of going to a walk-in clinic	0.594	0.446	0.743	Modelling assumption
Probability of family doctor giving OTC **Probability of pharmacist giving OTC**	0.100	0.075	0.125	Expert opinion
Probability of family doctor giving Rx **Probability of pharmacist giving Rx**	0.334	0.250	0.417	From ICES. Of those 65+, how many received GERD Rx ODB billing within 14 days.
Probability family doctor does not give Rx or OTC **Probability pharmacist does not give Rx or OTC**	0.566	0.425	0.708	Determined based on probability giving OTC and probability giving Rx
Probability patient gets better (no Rx/OTC) **Probability of getting better with OTC product (not Rx)** **Probability of getting better with Rx**	0.942	0.707	1.000	From ICES. From OHIP, NACRS, and DAD, probability of no visit of GERD within 7 days from index date.

Table 21: Model Parameters for HEMO

Parameter	Parameter Estimate	Lower Limit	Upper Limit	Source
Costs ($CAD)				
Cost of going to ED	385.22	377.46	392.99	From ICES. Mean cost of HEMO ED visit within 30 days of index date (minor ailment billing date)
Cost of family doctor CAP	4.67	4.66	4.69	From ICES. Mean CAP cost within 30 days of index date divided by average number of CAP visits within 30 days.
Cost of family doctor FFS	281.33	279.19	283.47	From ICES. Mean FFS cost within 30 days of index date divided by average number of FFS visits within 30 days.
Cost of OTC product	0.00	0.00	0.00	Modelling assumption
Cost of pharmacist minor ailment assessment	18.32	15.00	19.00	Ministry of Health ($19 for in person visit, $15 for virtual visit)[39] Based on weighted average 83% in person visits and 17% virtual visits.
Cost of walk-in clinic visit	281.33	279.19	283.47	From ICES. Same as cost of family doctor FFS.
Cost of Rx medication	11.87	11.80	11.94	From ICES. Mean ODB cost for Rx that can be prescribed by RPh for HEMO.[40]
Probabilities				
Probability of going to the emergency department	0.0201	0.0151	0.0251	From ICES. Probability of any ED visit for HEMO within 7 days of index date.
Probability of having a family doctor	0.933	0.700	1.000	Health Quality Ontario[41]
Probability of family doctor billing by CAP	0.370	0.278	0.463	Canadian Institute for Health Information[42]
Probability of family doctor billing by FFS	0.630	0.473	0.788	Canadian Institute for Health Information[42]
Probability that family doctor has no appointments available	0.594	0.446	0.743	Health Quality Ontario[41]

Probability of pharmacist referring	0.100	0.075	0.125	Expert opinion
Probability of receiving care by pharmacist	0.380	0.285	0.475	Modelling assumption
Probability of revisiting pharmacist	0.100	0.075	0.125	Modelling assumption
Probability of going to a walk-in clinic	0.594	0.446	0.743	Modelling assumption
Probability of family doctor giving OTC **Probability of pharmacist giving OTC**	0.100	0.075	0.125	Expert opinion
Probability of family doctor giving Rx **Probability of pharmacist giving Rx**	0.0237	0.0178	0.0297	From ICES. Of those 65+, how many received HEMO Rx ODB billing within 14 days.
Probability family doctor does not give Rx or OTC **Probability pharmacist does not give Rx or OTC**	0.876	0.657	1.000	Determined based on probability giving OTC and probability giving Rx
Probability patient gets better (no Rx/OTC) **Probability of getting better with OTC product (not Rx)** **Probability of getting better with Rx**	0.947	0.710	1.000	From ICES. From OHIP, NACRS, and DAD, probability of no visit of HEMO within 7 days from index date.

Table 22: Model Parameters for HERP

Parameter	Parameter Estimate	Lower Limit	Upper Limit	Source
Costs ($CAD)				
Cost of going to ED	249.14	230.33	267.95	From ICES. Mean cost of HERP ED visit within 30 days of index date (minor ailment billing date)
Cost of family doctor CAP	6.22	6.17	6.26	From ICES. Mean CAP cost within 30 days of index date divided by average number of CAP visits within 30 days.
Cost of family doctor FFS	149.24	147.66	150.81	From ICES. Mean FFS cost within 30 days of index date divided by average number of FFS visits within 30 days.
Cost of OTC product	0.00	0.00	0.00	Modelling assumption
Cost of pharmacist minor ailment assessment	18.32	15.00	19.00	Ministry of Health ($19 for in person visit, $15 for virtual visit)[39] Based on weighted average 83% in person visits and 17% virtual visits.
Cost of walk-in clinic visit	149.24	147.66	150.81	From ICES. Same as cost of family doctor FFS.
Cost of Rx medication	27.47	26.83	28.10	From ICES. Mean ODB cost for Rx that can be prescribed by RPh for HERP.[40]
Probabilities				
Probability of going to the emergency department	0.00641	0.00481	0.00801	From ICES. Probability of any ED visit for HERP within 7 days of index date.
Probability of having a family doctor	0.933	0.700	1.000	Health Quality Ontario[41]
Probability of family doctor billing by CAP	0.370	0.278	0.463	Canadian Institute for Health Information[42]
Probability of family doctor billing by FFS	0.630	0.473	0.788	Canadian Institute for Health Information[42]
Probability that family doctor has no appointments available	0.594	0.446	0.743	Health Quality Ontario[41]

Probability of pharmacist referring	0.100	0.075	0.125	Expert opinion
Probability of receiving care by pharmacist	0.380	0.285	0.475	Modelling assumption
Probability of revisiting pharmacist	0.100	0.075	0.125	Modelling assumption
Probability of going to a walk-in clinic	0.594	0.446	0.743	Modelling assumption
Probability of family doctor giving OTC **Probability of pharmacist giving OTC**	0.100	0.075	0.125	Expert opinion
Probability of family doctor giving Rx **Probability of pharmacist giving Rx**	0.133	0.010	0.166	From ICES. Of those 65+, how many received HERP Rx ODB billing within 14 days.
Probability family doctor does not give Rx or OTC **Probability pharmacist does not give Rx or OTC**	0.767	0.575	0.959	Determined based on probability giving OTC and probability giving Rx
Probability patient gets better (no Rx/OTC) **Probability of getting better with OTC product (not Rx)** **Probability of getting better with Rx**	0.971	0.728	1.000	From ICES. From OHIP, NACRS, and DAD, probability of no visit of HERP within 7 days from index date.

Table 23: Model Parameters for IMPE

Parameter	Parameter Estimate	Lower Limit	Upper Limit	Source
Costs ($CAD)				
Cost of going to ED	230.64	223.14	238.14	From ICES. Mean cost of IMPE ED visit within 30 days of index date (minor ailment billing date)
Cost of family doctor CAP	5.86	5.81	5.90	From ICES. Mean CAP cost within 30 days of index date divided by average number of CAP visits within 30 days.
Cost of family doctor FFS	138.47	136.45	140.39	From ICES. Mean FFS cost within 30 days of index date divided by average number of FFS visits within 30 days.
Cost of OTC product	0.00	0.00	0.00	Modelling assumption
Cost of pharmacist minor ailment assessment	18.32	15.00	19.00	Ministry of Health ($19 for in person visit, $15 for virtual visit)[39] Based on weighted average 83% in person visits and 17% virtual visits.
Cost of walk-in clinic visit	138.47	136.45	140.39	From ICES. Same as cost of family doctor FFS.
Cost of Rx medication	24.79	24.66	24.93	From ICES. Mean ODB cost for Rx that can be prescribed by RPh for IMPE.[40]
Probabilities				
Probability of going to the emergency department	0.108	0.081	0.134	From ICES. Probability of any ED visit for IMPE within 7 days of index date.
Probability of having a family doctor	0.933	0.700	1.000	Health Quality Ontario[41]
Probability of family doctor billing by CAP	0.370	0.278	0.463	Canadian Institute for Health Information[42]
Probability of family doctor billing by FFS	0.630	0.473	0.788	Canadian Institute for Health Information[42]
Probability that family doctor has no appointments available	0.594	0.446	0.743	Health Quality Ontario[41]

Probability of pharmacist referring	0.100	0.075	0.125	Expert opinion
Probability of receiving care by pharmacist	0.380	0.285	0.475	Modelling assumption
Probability of revisiting pharmacist	0.100	0.075	0.125	Modelling assumption
Probability of going to a walk-in clinic	0.594	0.446	0.743	Modelling assumption
Probability of family doctor giving OTC **Probability of pharmacist giving OTC**	0.100	0.075	0.125	Expert opinion
Probability of family doctor giving Rx **Probability of pharmacist giving Rx**	0.422	0.316	0.527	From ICES. Of those 65+, how many received IMPE Rx ODB billing within 14 days.
Probability family doctor does not give Rx or OTC **Probability pharmacist does not give Rx or OTC**	0.478	0.359	0.598	Determined based on probability giving OTC and probability giving Rx
Probability patient gets better (no Rx/OTC) **Probability of getting better with OTC product (not Rx)** **Probability of getting better with Rx**	0.847	0.636	1.000	From ICES. From OHIP, NACRS, and DAD, probability of no visit of IMPE within 7 days from index date.

Table 24: Model Parameters for INSBI

Parameter	Parameter Estimate	Lower Limit	Upper Limit	Source
Costs ($CAD)				
Cost of going to ED	235.23	228.45	242.01	From ICES. Mean cost of INSBI ED visit within 30 days of index date (minor ailment billing date)
Cost of family doctor CAP	5.13	5.12	5.14	From ICES. Mean CAP cost within 30 days of index date divided by average number of CAP visits within 30 days.
Cost of family doctor FFS	174.45	174.28	175.73	From ICES. Mean FFS cost within 30 days of index date divided by average number of FFS visits within 30 days.
Cost of OTC product	0.00	0.00	0.00	Modelling assumption
Cost of pharmacist minor ailment assessment	18.32	15.00	19.00	Ministry of Health ($19 for in person visit, $15 for virtual visit)[39] Based on weighted average 83% in person visits and 17% virtual visits.
Cost of walk-in clinic visit	174.45	174.28	175.73	From ICES. Same as cost of family doctor FFS.
Cost of Rx medication	12.89	12.80	12.97	From ICES. Mean ODB cost for Rx that can be prescribed by RPh for INSBI.[40]
Probabilities				
Probability of going to the emergency department	0.00231	0.00173	0.00288	From ICES. Probability of any ED visit for INSBI within 7 days of index date.
Probability of having a family doctor	0.933	0.700	1.000	Health Quality Ontario[41]
Probability of family doctor billing by CAP	0.370	0.278	0.463	Canadian Institute for Health Information[42]
Probability of family doctor billing by FFS	0.630	0.473	0.788	Canadian Institute for Health Information[42]
Probability that family doctor has no appointments available	0.594	0.446	0.743	Health Quality Ontario[41]

Probability of pharmacist referring	0.100	0.075	0.125	Expert opinion
Probability of receiving care by pharmacist	0.380	0.285	0.475	Modelling assumption
Probability of revisiting pharmacist	0.100	0.075	0.125	Modelling assumption
Probability of going to a walk-in clinic	0.594	0.446	0.743	Modelling assumption
Probability of family doctor giving OTC **Probability of pharmacist giving OTC**	0.100	0.075	0.125	Expert opinion
Probability of family doctor giving Rx **Probability of pharmacist giving Rx**	0.0331	0.0248	0.0414	From ICES. Of those 65+, how many received INSBI Rx ODB billing within 14 days.
Probability family doctor does not give Rx or OTC **Probability pharmacist does not give Rx or OTC**	0.867	0.650	1.000	Determined based on probability giving OTC and probability giving Rx
Probability patient gets better (no Rx/OTC) **Probability of getting better with OTC product (not Rx)** **Probability of getting better with Rx**	0.979	0.734	1.000	From ICES. From OHIP, NACRS, and DAD, probability of no visit of INSBI within 7 days from index date.

Table 25: Model Parameters for MUSC

Parameter	Parameter Estimate	Lower Limit	Upper Limit	Source
Costs ($CAD)				
Cost of going to ED	524.48	518.90	530.06	From ICES. Mean cost of MUSC ED visit within 30 days of index date (minor ailment billing date)
Cost of family doctor CAP	3.80	3.79	3.80	From ICES. Mean CAP cost within 30 days of index date divided by average number of CAP visits within 30 days.
Cost of family doctor FFS	152.18	152.04	152.32	From ICES. Mean FFS cost within 30 days of index date divided by average number of FFS visits within 30 days.
Cost of OTC product	0.00	0.00	0.00	Modelling assumption
Cost of pharmacist minor ailment assessment	18.32	15.00	19.00	Ministry of Health ($19 for in person visit, $15 for virtual visit)[39] Based on weighted average 83% in person visits and 17% virtual visits.
Cost of walk-in clinic visit	152.18	152.04	152.32	From ICES. Same as cost of family doctor FFS.
Cost of Rx medication	10.75	10.74	10.77	From ICES. Mean ODB cost for Rx that can be prescribed by RPh for MUSC.[40]
Probabilities				
Probability of going to the emergency department	0.00241	0.00181	0.00301	From ICES. Probability of any ED visit for MUSC within 7 days of index date.
Probability of having a family doctor	0.933	0.700	1.000	Health Quality Ontario[41]
Probability of family doctor billing by CAP	0.370	0.278	0.463	Canadian Institute for Health Information[42]
Probability of family doctor billing by FFS	0.630	0.473	0.788	Canadian Institute for Health Information[42]
Probability that family doctor has no appointments available	0.594	0.446	0.743	Health Quality Ontario[41]

Probability of pharmacist referring	0.100	0.075	0.125	Expert opinion
Probability of receiving care by pharmacist	0.380	0.285	0.475	Modelling assumption
Probability of revisiting pharmacist	0.100	0.075	0.125	Modelling assumption
Probability of going to a walk-in clinic	0.594	0.446	0.743	Modelling assumption
Probability of family doctor giving OTC **Probability of pharmacist giving OTC**	0.100	0.075	0.125	Expert opinion
Probability of family doctor giving Rx **Probability of pharmacist giving Rx**	0.109	0.0821	0.137	From ICES. Of those 65+, how many received MUSC Rx ODB billing within 14 days.
Probability family doctor does not give Rx or OTC **Probability pharmacist does not give Rx or OTC**	0.791	0.593	0.988	Determined based on probability giving OTC and probability giving Rx
Probability patient gets better (no Rx/OTC) **Probability of getting better with OTC product (not Rx)** **Probability of getting better with Rx**	0.958	0.718	1.000	From ICES. From OHIP, NACRS, and DAD, probability of no visit of MUSC within 7 days from index date.

Table 26: Model Parameters for PIN

Parameter	Parameter Estimate	Lower Limit	Upper Limit	Source
Costs ($CAD)				
Cost of going to ED	258.36	239.87	276.84	From ICES. Mean cost of PIN ED visit within 30 days of index date (minor ailment billing date)
Cost of family doctor CAP	5.57	5.47	5.66	From ICES. Mean CAP cost within 30 days of index date divided by average number of CAP visits within 30 days.
Cost of family doctor FFS	135.47	129.15	141.79	From ICES. Mean FFS cost within 30 days of index date divided by average number of FFS visits within 30 days.
Cost of OTC product	0.00	0.00	0.00	Modelling assumption
Cost of pharmacist minor ailment assessment	18.32	15.00	19.00	Ministry of Health ($19 for in person visit, $15 for virtual visit)[39] Based on weighted average 83% in person visits and 17% virtual visits.
Cost of walk-in clinic visit	135.47	129.15	141.79	From ICES. Same as cost of family doctor FFS.
Cost of Rx medication	21.91	21.65	22.17	From ICES. Mean ODB cost for Rx that can be prescribed by RPh for PIN.[40]
Probabilities				
Probability of going to the emergency department	0.0575	0.0431	0.0719	From ICES. Probability of any ED visit for PIN within 7 days of index date.
Probability of having a family doctor	0.933	0.700	1.000	Health Quality Ontario[41]
Probability of family doctor billing by CAP	0.370	0.278	0.463	Canadian Institute for Health Information[42]
Probability of family doctor billing by FFS	0.630	0.473	0.788	Canadian Institute for Health Information[42]
Probability that family doctor has no appointments available	0.594	0.446	0.743	Health Quality Ontario[41]

Probability of pharmacist referring	0.100	0.075	0.125	Expert opinion
Probability of receiving care by pharmacist	0.380	0.285	0.475	Modelling assumption
Probability of revisiting pharmacist	0.100	0.075	0.125	Modelling assumption
Probability of going to a walk-in clinic	0.594	0.446	0.743	Modelling assumption
Probability of family doctor giving OTC **Probability of pharmacist giving OTC**	0.100	0.075	0.125	Expert opinion
Probability of family doctor giving Rx **Probability of pharmacist giving Rx**	0.374	0.280	0.467	From ICES. Of those 65+, how many received PIN Rx ODB billing within 14 days.
Probability family doctor does not give Rx or OTC **Probability pharmacist does not give Rx or OTC**	0.526	0.395	0.658	Determined based on probability giving OTC and probability giving Rx
Probability patient gets better (no Rx/OTC) **Probability of getting better with OTC product (not Rx)** **Probability of getting better with Rx**	0.934	0.700	1.000	From ICES. From OHIP, NACRS, and DAD, probability of no visit of PIN within 7 days from index date.

Table 27: Model Parameters for UTI

Parameter	Parameter Estimate	Lower Limit	Upper Limit	Source
Costs ($CAD)				
Cost of going to ED	472.62	471.10	474.14	From ICES. Mean cost of UTI ED visit within 30 days of index date (minor ailment billing date)
Cost of family doctor CAP	4.43	4.42	4.43	From ICES. Mean CAP cost within 30 days of index date divided by average number of CAP visits within 30 days.
Cost of family doctor FFS	186.65	186.26	187.04	From ICES. Mean FFS cost within 30 days of index date divided by average number of FFS visits within 30 days.
Cost of OTC product	0.00	0.00	0.00	Modelling assumption
Cost of pharmacist minor ailment assessment	18.32	15.00	19.00	Ministry of Health ($19 for in person visit, $15 for virtual visit)[39] Based on weighted average 83% in person visits and 17% virtual visits.
Cost of walk-in clinic visit	186.65	186.26	187.04	From ICES. Same as cost of family doctor FFS.
Cost of Rx medication	14.93	14.88	14.99	From ICES. Mean ODB cost for Rx that can be prescribed by RPh for UTI.[40]
Probabilities				
Probability of going to the emergency department	0.0812	0.0609	0.102	From ICES. Probability of any ED visit for UTI within 7 days of index date.
Probability of having a family doctor	0.933	0.700	1.000	Health Quality Ontario[41]
Probability of family doctor billing by CAP	0.370	0.278	0.463	Canadian Institute for Health Information[42]
Probability of family doctor billing by FFS	0.630	0.473	0.788	Canadian Institute for Health Information[42]
Probability that family doctor has no appointments available	0.594	0.446	0.743	Health Quality Ontario[41]

Probability of pharmacist referring	0.100	0.075	0.125	Expert opinion
Probability of receiving care by pharmacist	0.380	0.285	0.475	Modelling assumption
Probability of revisiting pharmacist	0.100	0.075	0.125	Modelling assumption
Probability of going to a walk-in clinic	0.594	0.446	0.743	Modelling assumption
Probability of family doctor giving OTC **Probability of pharmacist giving OTC**	0.100	0.075	0.125	Expert opinion
Probability of family doctor giving Rx **Probability of pharmacist giving Rx**	0.0731	0.0549	0.0914	From ICES. Of those 65+, how many received UTI Rx ODB billing within 14 days.
Probability family doctor does not give Rx or OTC **Probability pharmacist does not give Rx or OTC**	0.827	0.620	1.000	Determined based on probability giving OTC and probability giving Rx
Probability patient gets better (no Rx/OTC) **Probability of getting better with OTC product (not Rx)** **Probability of getting better with Rx**	0.909	0.682	1.000	From ICES. From OHIP, NACRS, and DAD, probability of no visit of UTI within 7 days from index date.

Table 28: Model Parameters for VAGY

Parameter	Parameter Estimate	Lower Limit	Upper Limit	Source
Costs ($CAD)				
Cost of going to ED	359.12	347.82	370.41	From ICES. Mean cost of VAGY ED visit within 30 days of index date (minor ailment billing date)
Cost of family doctor CAP	5.68	5.66	5.70	From ICES. Mean CAP cost within 30 days of index date divided by average number of CAP visits within 30 days.
Cost of family doctor FFS	156.34	155.42	157.25	From ICES. Mean FFS cost within 30 days of index date divided by average number of FFS visits within 30 days.
Cost of OTC product	0.00	0.00	0.00	Modelling assumption
Cost of pharmacist minor ailment assessment	18.32	15.00	19.00	Ministry of Health ($19 for in person visit, $15 for virtual visit)[39] Based on weighted average 83% in person visits and 17% virtual visits.
Cost of walk-in clinic visit	156.34	155.42	157.25	From ICES. Same as cost of family doctor FFS.
Cost of Rx medication	15.90	15.80	16.00	From ICES. Mean ODB cost for Rx that can be prescribed by RPh for VAGY.[40]
Probabilities				
Probability of going to the emergency department	0.00371	0.00278	0.00463	From ICES. Probability of any ED visit for VAGY within 7 days of index date.
Probability of having a family doctor	0.933	0.700	1.000	Health Quality Ontario[41]
Probability of family doctor billing by CAP	0.370	0.278	0.463	Canadian Institute for Health Information[42]
Probability of family doctor billing by FFS	0.630	0.473	0.788	Canadian Institute for Health Information[42]
Probability that family doctor has no appointments available	0.594	0.446	0.743	Health Quality Ontario[41]

Probability of pharmacist referring	0.100	0.075	0.125	Expert opinion
Probability of receiving care by pharmacist	0.380	0.285	0.475	Modelling assumption
Probability of revisiting pharmacist	0.100	0.075	0.125	Modelling assumption
Probability of going to a walk-in clinic	0.594	0.446	0.743	Modelling assumption
Probability of family doctor giving OTC **Probability of pharmacist giving OTC**	0.100	0.075	0.125	Expert opinion
Probability of family doctor giving Rx **Probability of pharmacist giving Rx**	0.108	0.0809	0.135	From ICES. Of those 65+, how many received VAGY Rx ODB billing within 14 days.
Probability family doctor does not give Rx or OTC **Probability pharmacist does not give Rx or OTC**	0.792	0.594	0.990	Determined based on probability giving OTC and probability giving Rx
Probability patient gets better (no Rx/OTC) **Probability of getting better with OTC product (not Rx)** **Probability of getting better with Rx**	0.962	0.722	1.000	From ICES. From OHIP, NACRS, and DAD, probability of no visit of VAGY within 7 days from index date.

Probabilities

Probabilities that were determined from the health administrative data from ICES include probability of going to the ED, probability of giving prescription medication, and probability that the patient gets better after intervention. Probability of going to the ED was determined based on the probability of any ED visit for the minor ailment (based on the ICD-10 codes in Table A1) within 7 days of the minor ailment billing date. Probability of giving a prescription medication was the probability of receiving a prescription for minor ailment (based on medications for minor ailments that Ontario pharmacists are authorized to prescribe for) within 14 days of the minor ailment billing date. This was based on the age group 65 years and older who receive prescription drug coverage through ODB. Lastly, the probability that the patient gets better after the intervention was based on the OHIP, NACRS, and DAD databases, to determine the probability of no visit for the minor ailment for any of the databases within 7 days of the minor ailment billing.

Probabilities for seeking care from a family physician were obtained from the Health Quality Ontario from 2019 to determine the probability of having a family doctor in Ontario and probability that the family doctor has no appointment available.[41] In addition, probabilities of family doctor billing by capitation or fee-for-service payment were derived from the Canadian Institute for Health Information published in 2022.[42] Other probabilities including the probability of the pharmacist referring and the probability of the family physician or pharmacist recommending a non-prescription product were based on expert opinion from a panel of two pharmacists. Modelling assumptions were also used to determine the probability of receiving care by a pharmacist, probability of revisiting a pharmacist, and the probability of going to a walk-in clinic (over the ED).

Costs

Since this model was assessed from a public payer perspective, out-of-pocket costs such as purchasing non-prescription drugs or other patient-specific costs were not considered. In addition, prescription drug costs are reimbursed by the government only for patients who are covered by the ODB. This includes patients who are eligible for OHIP+, 65 years of age or older, living in a long-term care home or home for special care, receiving professional home and community care services, or enrolled in the Trillium Drug Program.[17] Therefore, for the base case analysis we only included patients who are 65 years of age or older to determine their prescription costs. For patients who do not have prescription drug coverage through ODB, drug costs are out-of-pocket or billed through private insurance and are not accounted in this model.

Costs determined from Ontario health administrative data included costs of going to the ED, cost of family doctor under capitation payment (CAP), cost of family doctor under fee-for-service (FFS). These costs were determined as a mean cost within 30 days of the minor ailment billing date. The cost of family doctor CAP and FFS payments were determined as a mean cost within 30 days divided by the number of visits for CAP or FFS respectively within 30 days of the index date (minor ailment billing). The cost of a prescription drug was determined based on a mean cost for prescriptions that can be prescribed by pharmacists on the day of the minor ailment billing date. The costs for these medications were obtained from the ICES ODB dataset.

The prescription-detached billing scenario was used for the PPMA model as pharmacists in Ontario are financially compensated by the government through a professional fee ($19 for in person visit, $15 for virtual visit) for providing minor ailment services in-person at the pharmacy regardless of whether a prescription was issued.[3]

Modelling Assumptions

There were several modelling assumptions in this analysis. This included the prescribing decisions made by the pharmacists and physicians. It was assumed that the probability of recommending a prescription medication, non-prescription medication, or no drug therapy would be identical between pharmacists and physicians. This assumption is the basis of a cost-minimization model where it is assumed that the health outcomes of the two interventions are identical. In addition, there is a lack of literature comparing the clinical effectiveness of pharmacist and physicians treating for minor ailments. Second, it was also assumed that if a patient does not get better and requires a second visit, that a prescription would be provided. In addition, a patient would only require at most two visits or two treatments to improve. Lastly, it was assumed that for patients who chose to seek care from a physician over a pharmacist. If the patient was able to make a same-day appointment with their family physician that they would choose to visit their family physician over going to an emergency department or walk-in clinic.

Outcomes

The primary outcome of interest was the overall difference in cost to treat a minor ailment when comparing PPMA program with usual care. This study was performed from the public payer perspective. The time horizon was not explicitly modelled due to the nature of the decision-analytic model, but it included the time it takes from patient seeking care for a minor ailment to the time that the minor ailment is resolved. Minor ailments are usually a short-term condition with only minimal or short-term follow-up, thus there was a short time horizon for this analysis. Discounting was also not required for this analysis due to the short time horizon.

The costs were presented in 2019 Canadian dollars as the costs obtained from the ICES health administrative databases were adjusted to 2019 Canadian dollars. Guidelines for economic

evaluation by Canada's Drug Agency (formerly known as the Canadian Agency for Drugs and Technologies in Health or CADTH) was followed in this analysis.[43] In addition, a one-way sensitivity analysis and a probabilistic sensitivity analysis (PSA) was performed to assess the uncertainties in the model parameters on the overall outcome of the study.

RESULTS

Base Case Analysis

The results of the base case analysis of Canadians seeking care for the studied minor ailments was presented in Table 29 with the costs associated with the UCM compared to PPMA, change in cost, and the 95% CIs.

Table 29: Base case analysis

		Cost ($ CAD)	Δ in Cost	95% CI Lower Limit	95% CI Upper Limit
ACNE	**UCM**	94.40			
	PPMA	69.87	24.53	24.46	24.60
ALLR	**UCM**	82.53			
	PPMA	63.48	19.05	18.99	19.11
CAND	**UCM**	170.28			
	PPMA	122.88	47.40	47.27	47.53
CANK	**UCM**	179.47			
	PPMA	129.10	50.37	50.23	50.51
CONJ	**UCM**	139.93			
	PPMA	101.02	38.91	38.79	39.03
DERM	**UCM**	215.30			
	PPMA	151.62	63.68	63.51	63.85
DYSM	**UCM**	169.98			
	PPMA	120.39	49.59	49.45	49.73
GERD	**UCM**	268.57			
	PPMA	191.19	77.38	77.17	77.59
HEMO	**UCM**	257.32			
	PPMA	180.65	76.67	76.46	76.88
HERP	**UCM**	137.73			
	PPMA	100.33	37.40	37.29	37.51
IMPE	**UCM**	162.70			
	PPMA	125.04	37.66	37.53	37.79
INSBI	**UCM**	154.37			
	PPMA	109.77	44.60	44.48	44.72
MUSC	**UCM**	139.01			
	PPMA	100.76	38.25	38.14	38.36
PIN	**UCM**	141.76			
	PPMA	106.11	35.65	35.54	35.76
UTI	**UCM**	201.81			
	PPMA	145.77	56.04	55.88	56.20
VAGY	**UCM**	142.95			
	PPMA	103.43	39.52	39.40	39.64

When comparing the results of the 16 studied minor ailments, the PPMA program achieved the largest cost-savings per patient for GERD ($77.38), hemorrhoids ($76.67), dermatitis ($63.68), and UTI ($56.04) compared to the UCM. Specifically, the cost per GERD patient in the UCM was $268.57, compared to $191.19 in the PPMA model. The cost per hemorrhoids patient was $257.32 in the UCM versus $180.65 in the PPMA model. Similarly, the cost per dermatitis patient was $215.30 in the UCM compared to $151.62 in the PPMA model, and for UTI, the cost was $201.81 in the UCM versus $145.77 in the PPMA model

One-way Sensitivity Analysis

One-way sensitivity analyses were performed using the same assumptions as the base-case analysis to determine the effect of parameters on the cost-savings of the screening strategies. The sensitivity analysis was performed on all parameters using either the reported 95% CIs (if available) or +/- 25% of the reference values as shown in Tables 13 to 28. The results of the sensitivity analysis are presented using tornado diagrams in Figures 7 to 22 that summarized the ten most sensitive model parameters for each studied minor ailment.

Figure 7: Tornado diagram (ACNE)

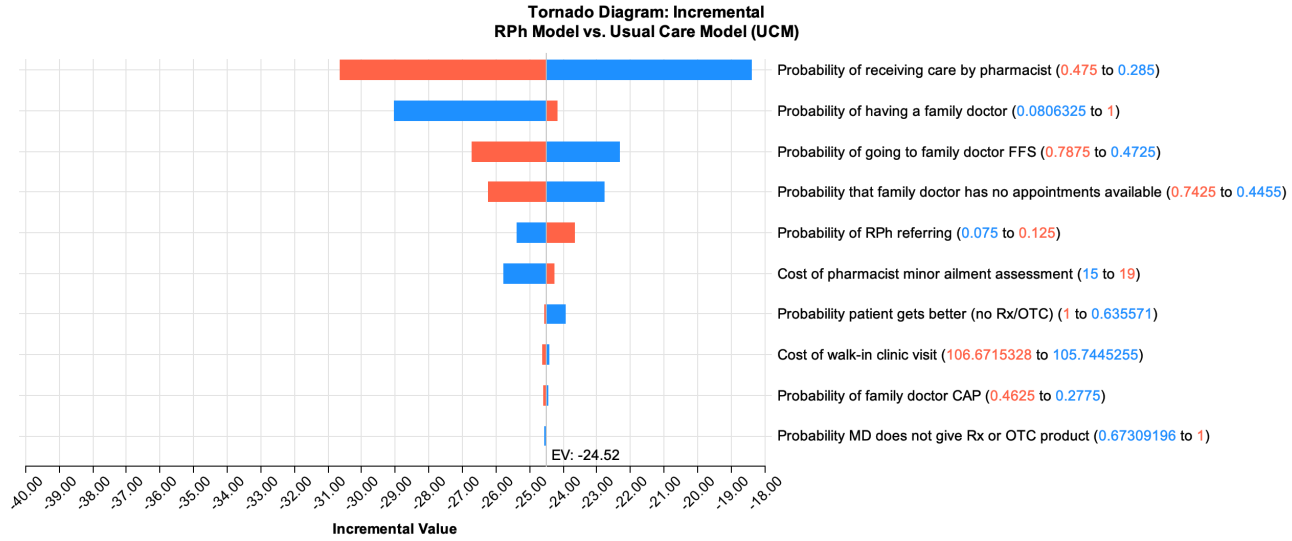


Figure 8: Tornado diagram (ALLR)

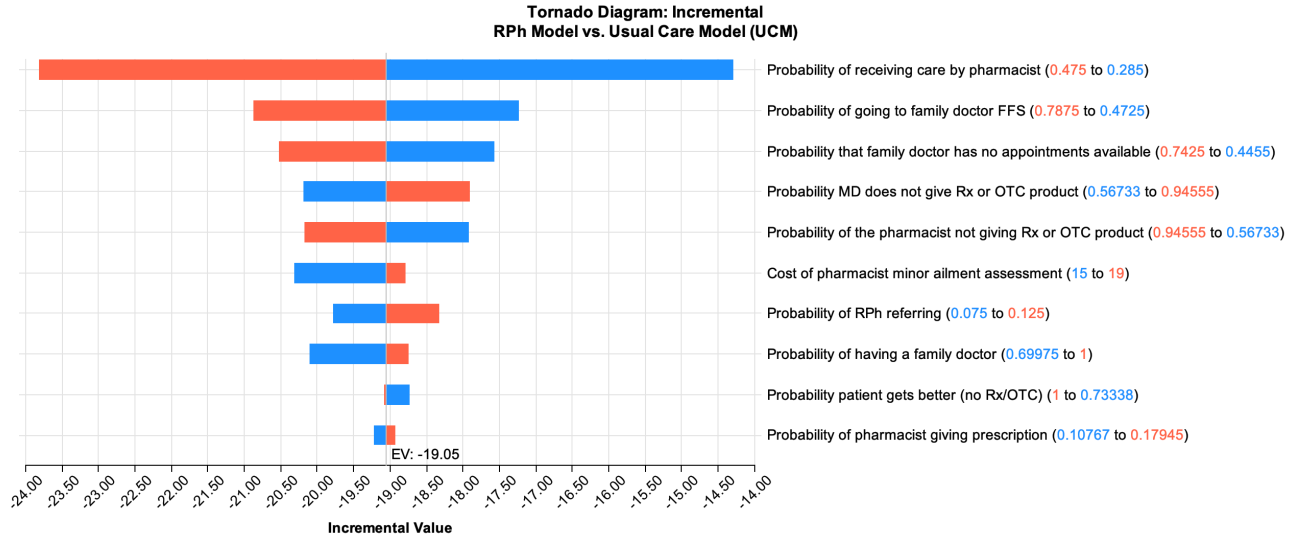


Figure 9: Tornado Diagram (CAND)

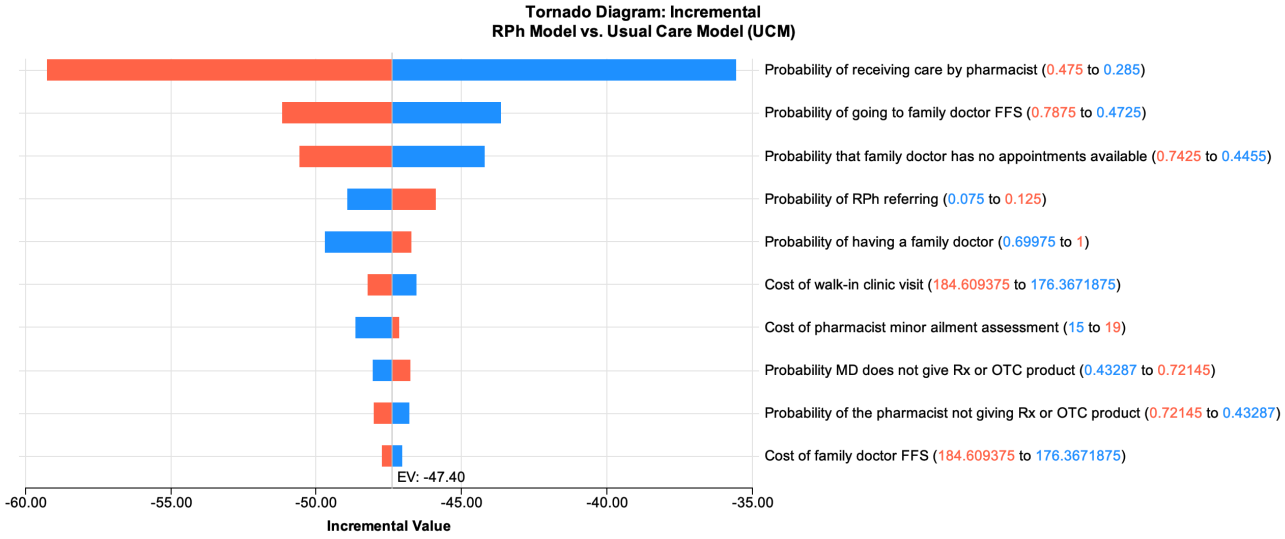


Figure 10: Tornado Diagram (CANK)

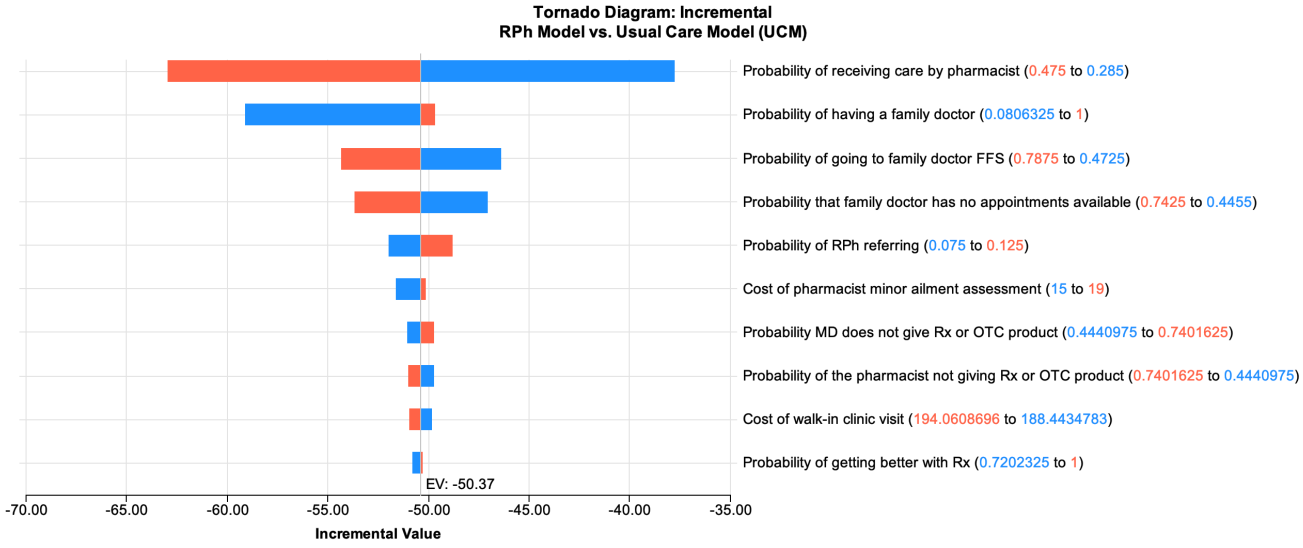


Figure 11: Tornado Diagram (CONJ)

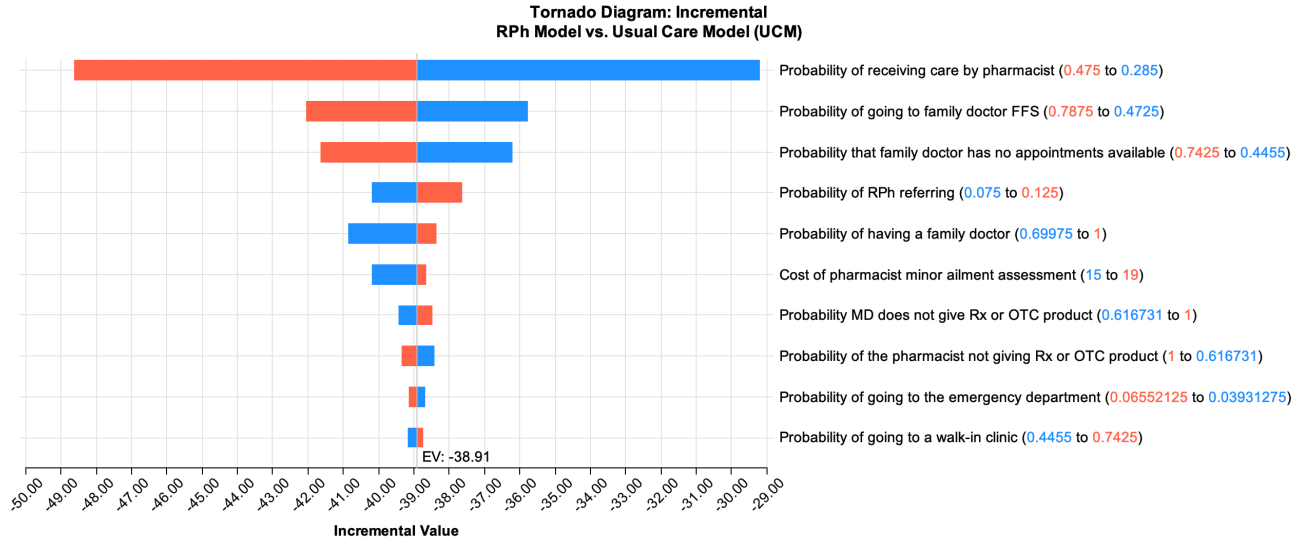


Figure 12: Tornado Diagram (DERM)

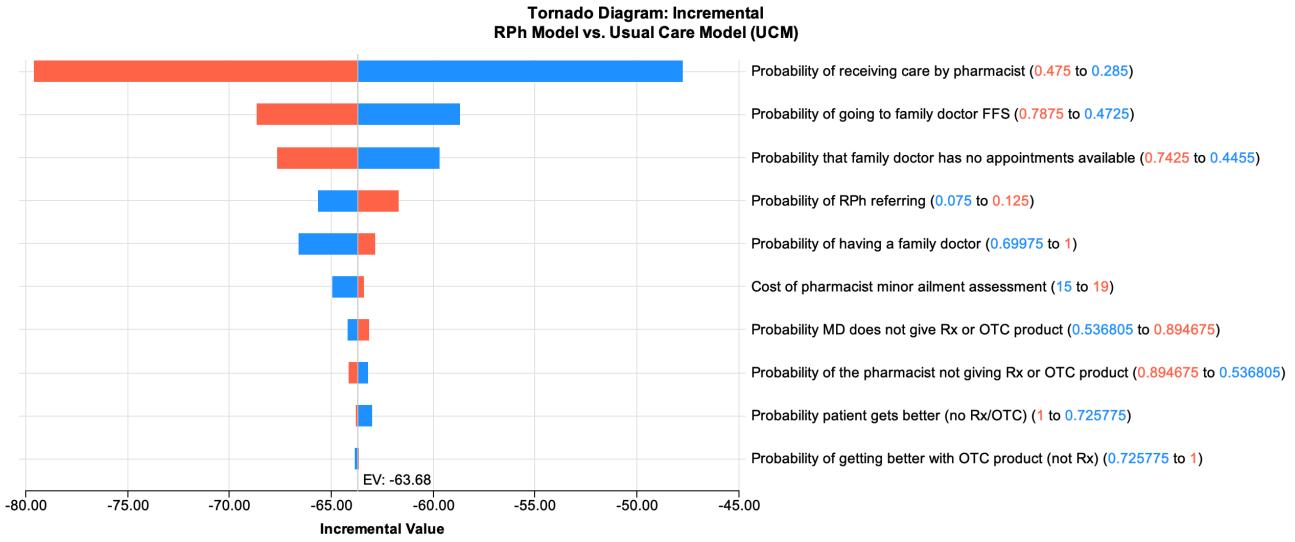


Figure 13: Tornado Diagram (DYSM)

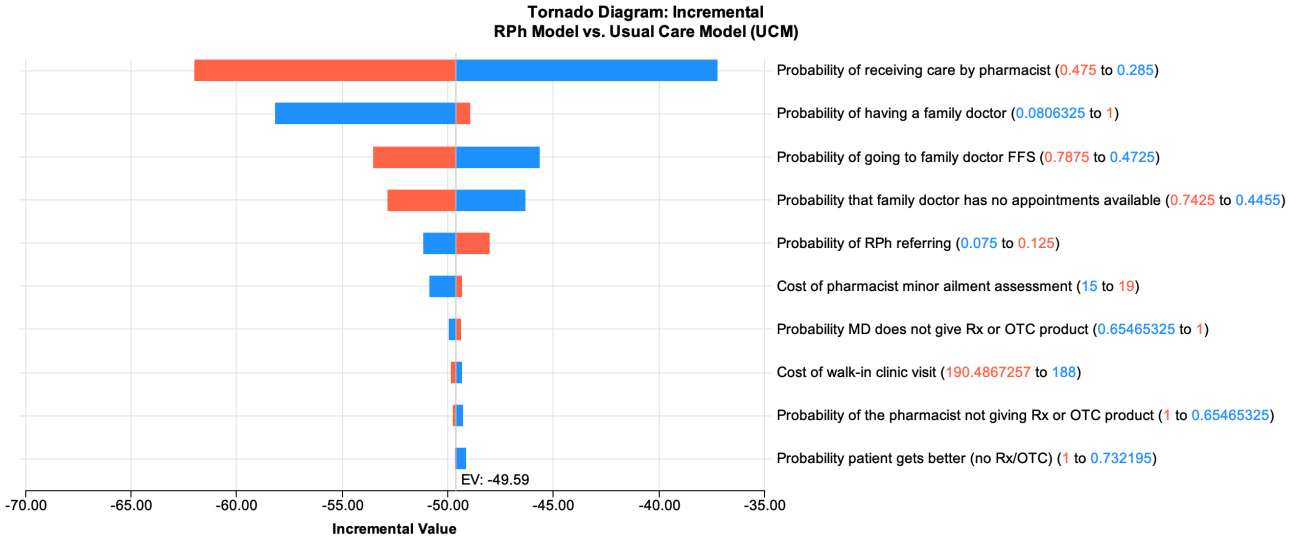


Figure 14: Tornado Diagram (GERD)

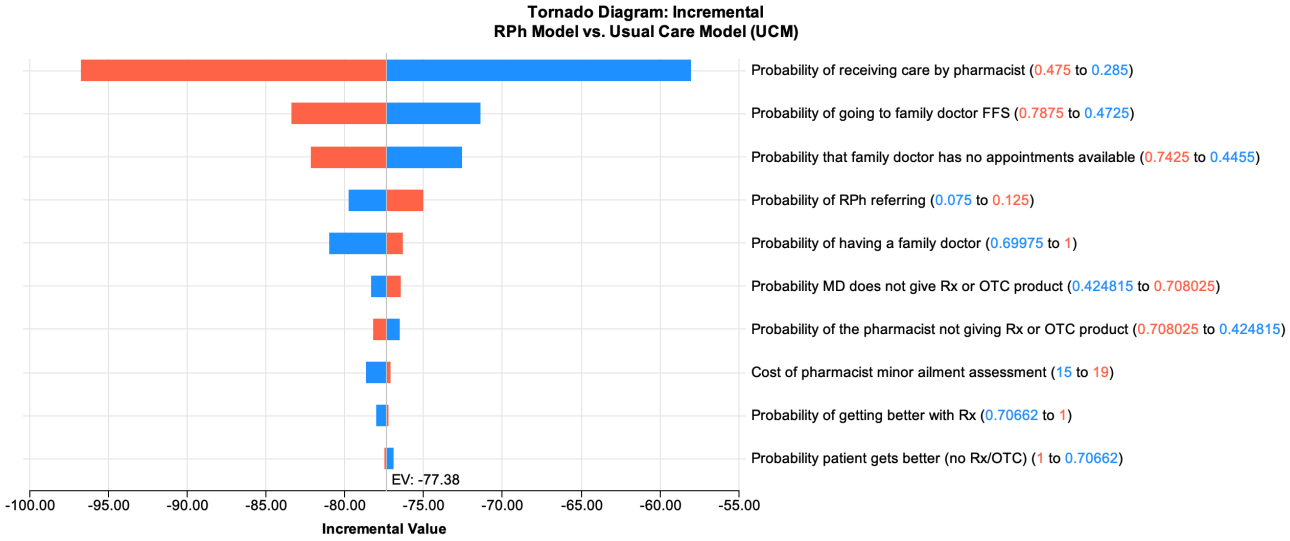


Figure 15: Tornado Diagram (HEMO)

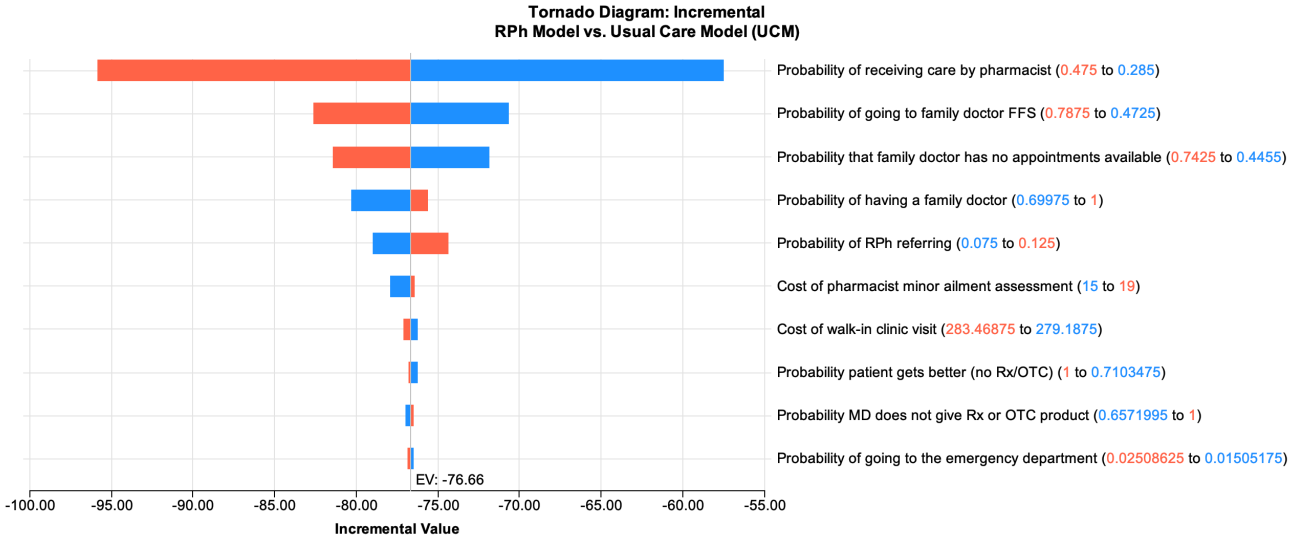


Figure 16: Tornado Diagram (HERP)

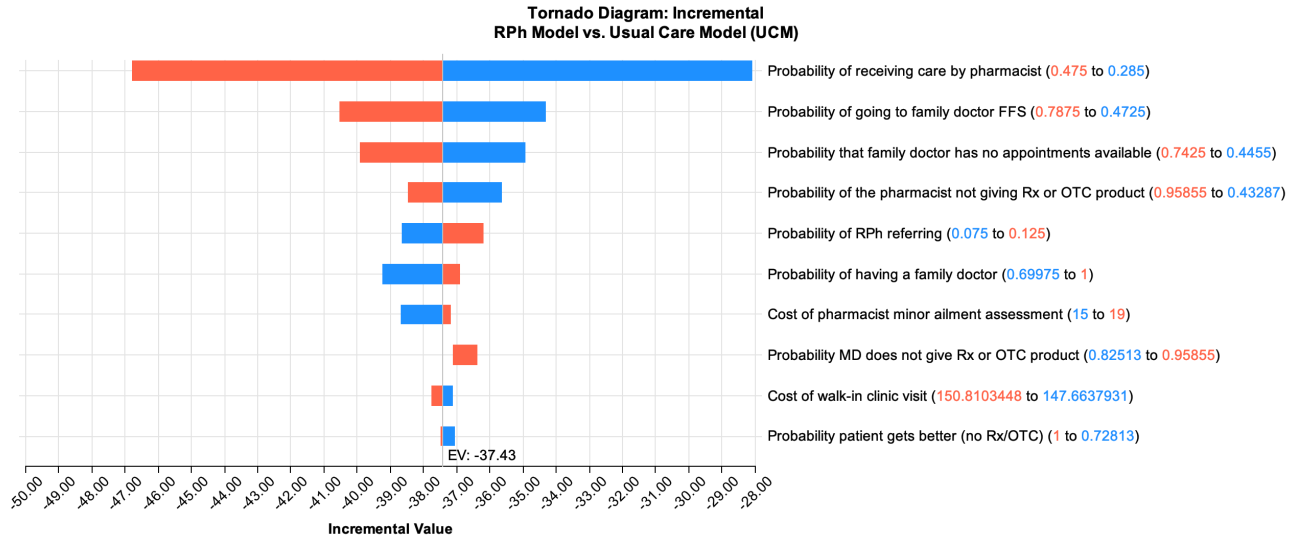


Figure 17: Tornado Diagram (IMPE)

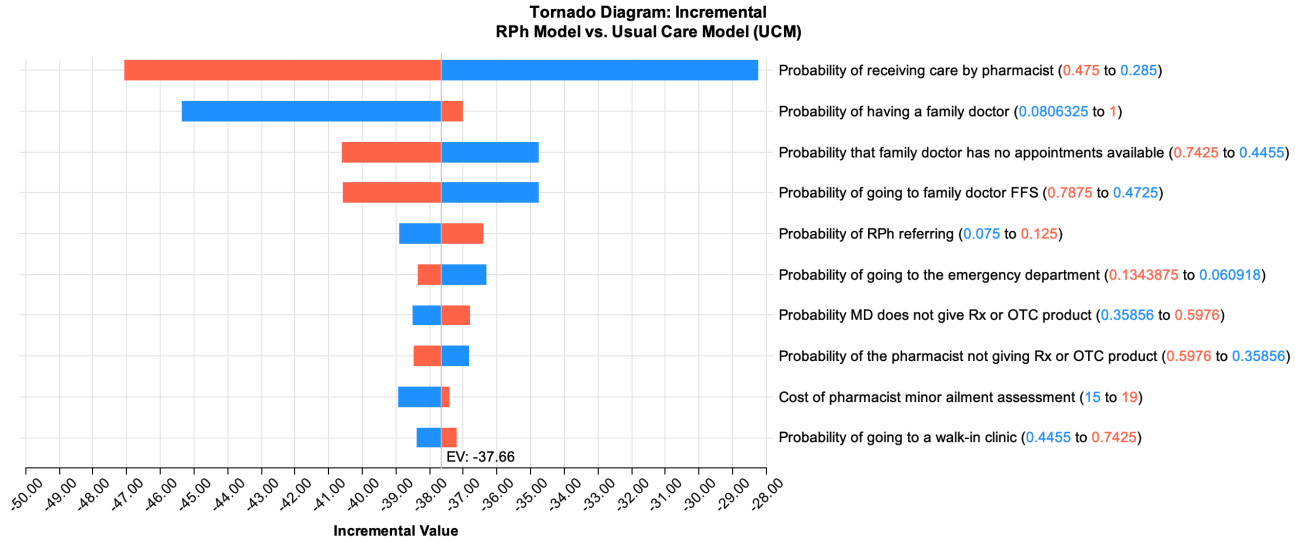


Figure 18: Tornado Diagram (INSBI)

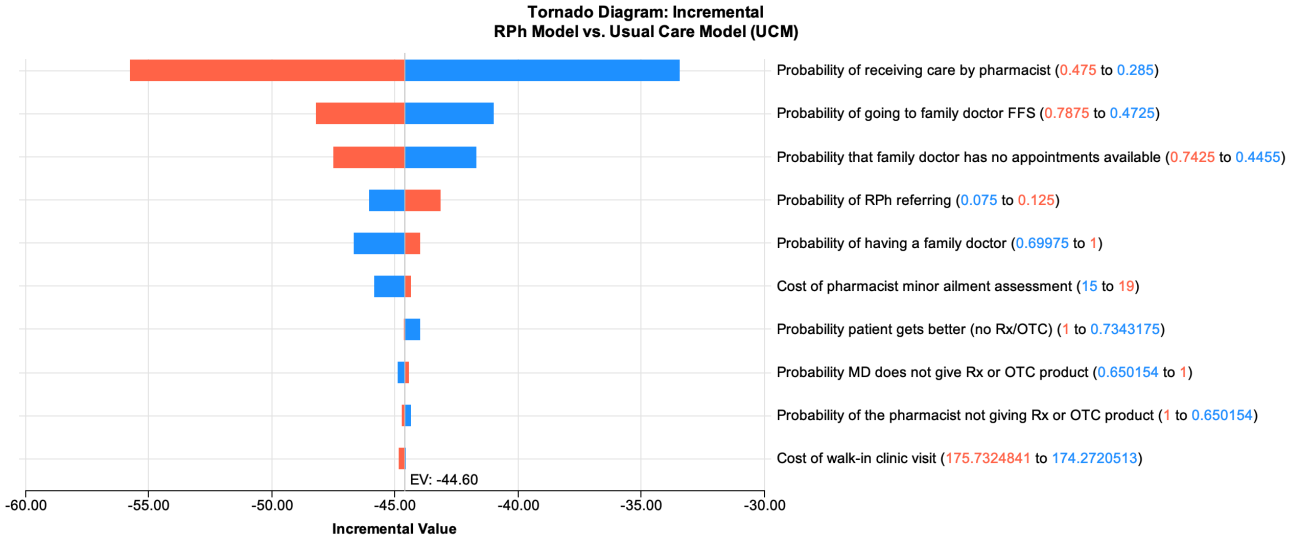


Figure 19: Tornado Diagram (MUSC)

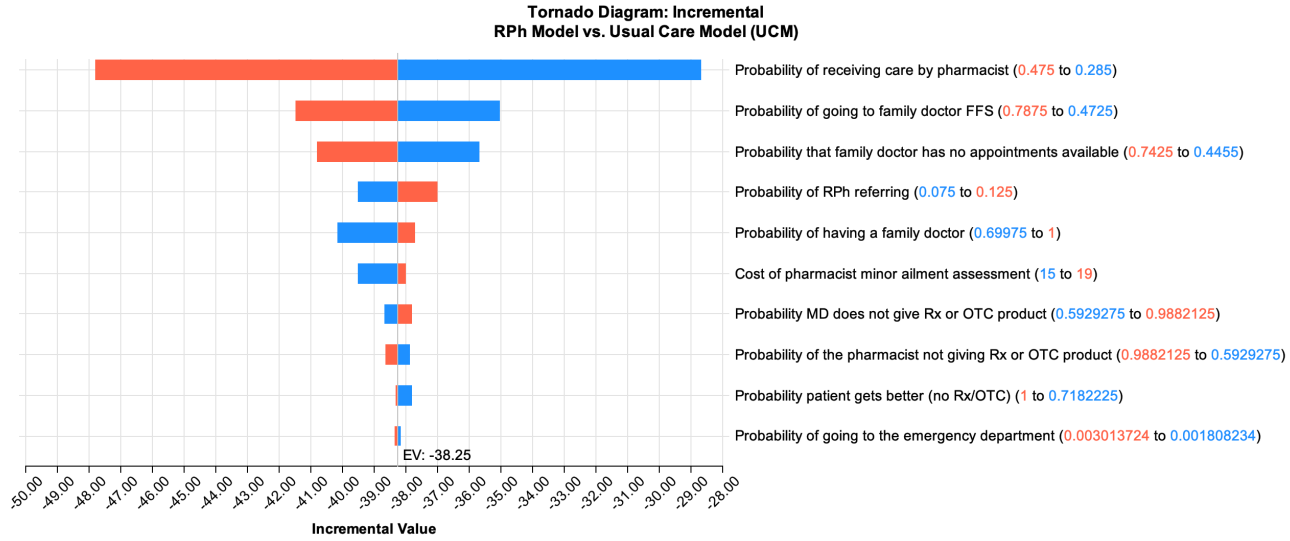


Figure 20: Tornado Diagram (PIN)

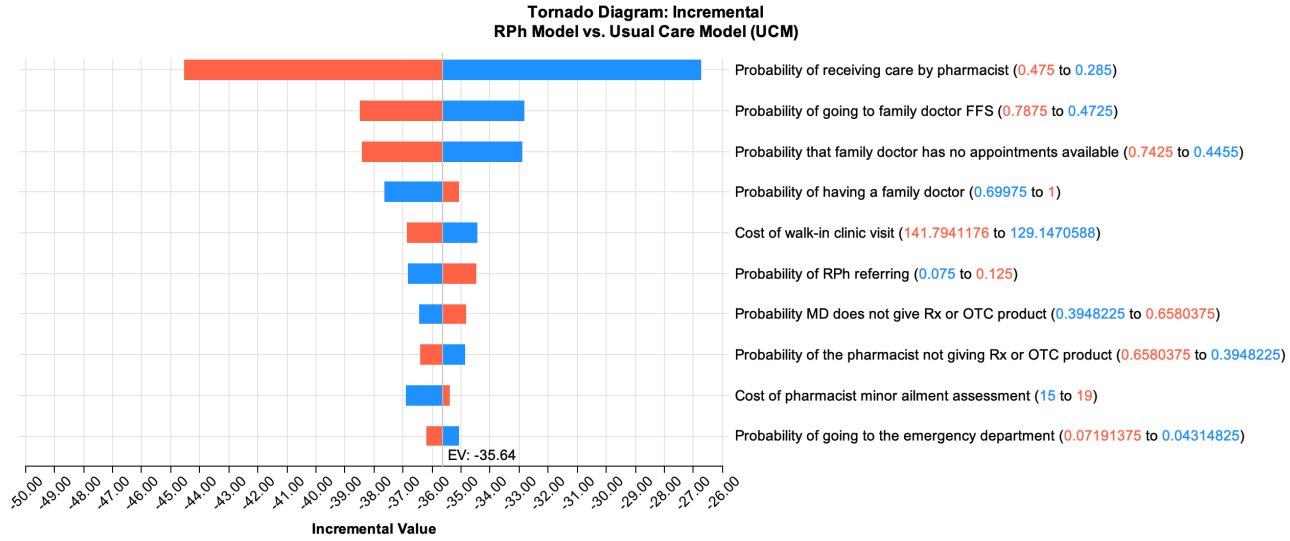


Figure 21: Tornado Diagram (UTI)

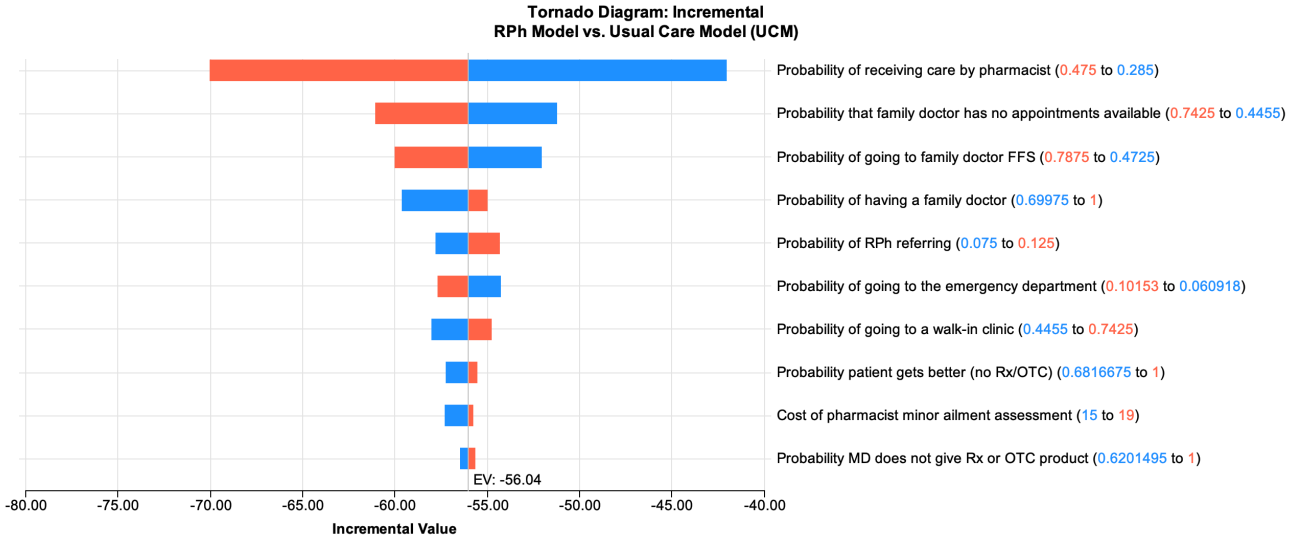
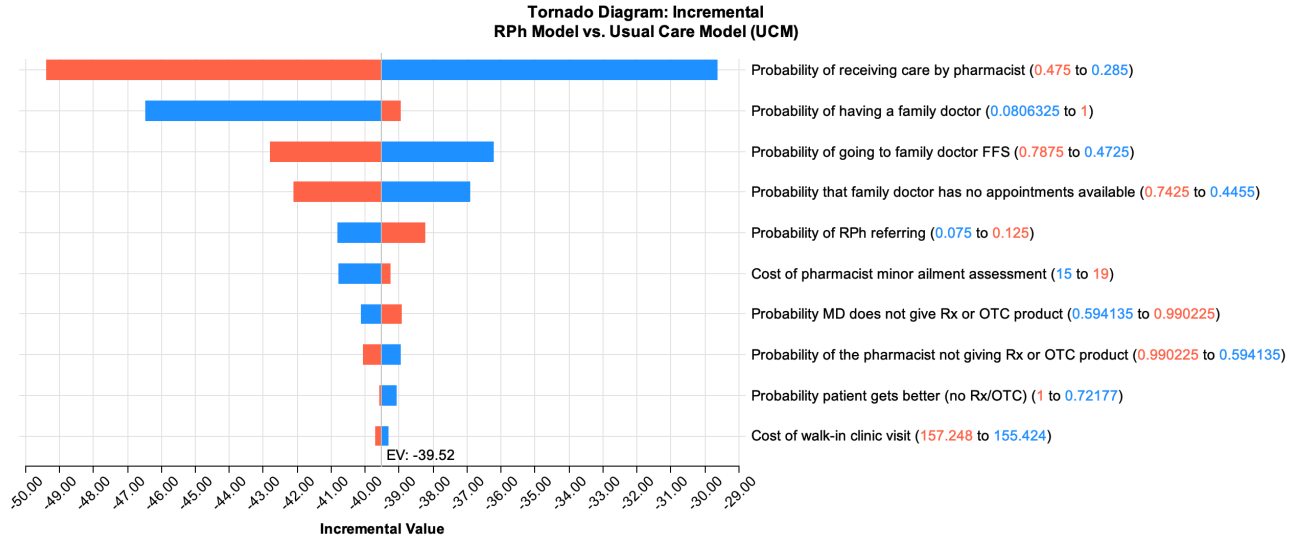


Figure 22: Tornado Diagram (VAGY)



Parameters related to probabilities had the largest impact on the results for all the studied minor ailments. The variable that had the greatest impact on the results was the probability of receiving care by pharmacist (PPMA model compared to UCM) which was the probability that a patient chooses to seek care from a pharmacist instead of a physician (service uptake rate). The higher the service uptake rate for receiving care by a pharmacist, the greater the cost-savings for

the Ontario government. Other sensitive parameters included probability of going to a family doctor, probability that the family doctor has no appointments available, and the probability of the pharmacist referring. Overall, this one-way sensitivity analysis indicates that model parameters did not impact the overall outcome of the study as the PPMA model was still found to provide cost-savings for the Ontario government.

Probabilistic Sensitivity Analysis

Probabilistic sensitivity analyses were conducted using 10,000 Monte Carlo simulations on 95% CIs (if available) or +/- 25% of the reference values as shown in Tables 14 to 29. This analysis was performed to characterize uncertainty of all the input parameters. The results of these analyses are shown in Figures 23 to 38. It was found from the probabilistic sensitivity analyses that the PPMA model was cost saving in 100% of the simulations for all the studied minor ailments.

Figure 23: Probabilistic sensitivity analysis (ACNE)

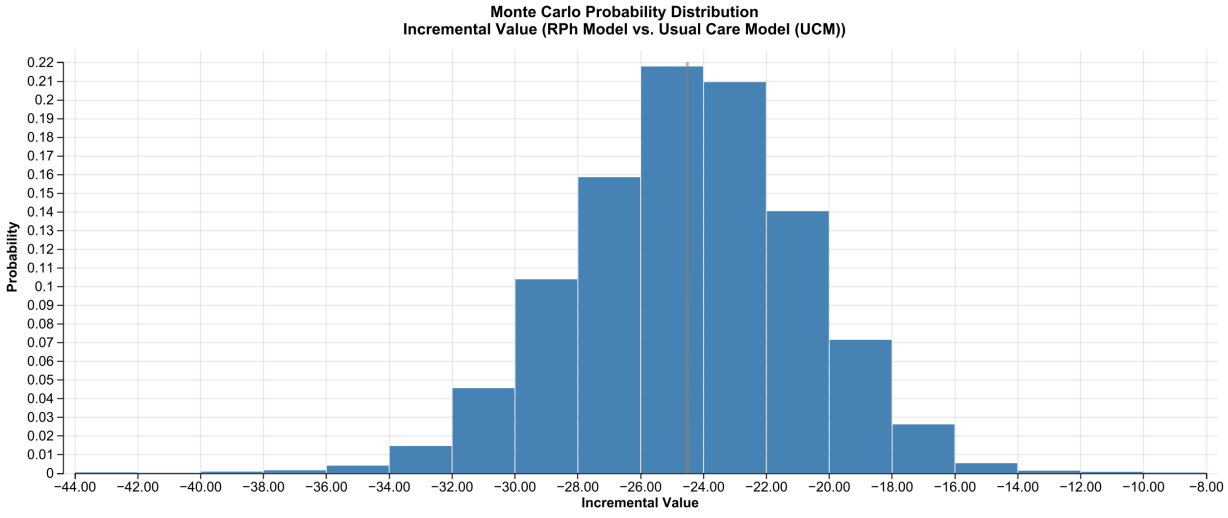


Figure 24: Probabilistic sensitivity analysis (ALLR)

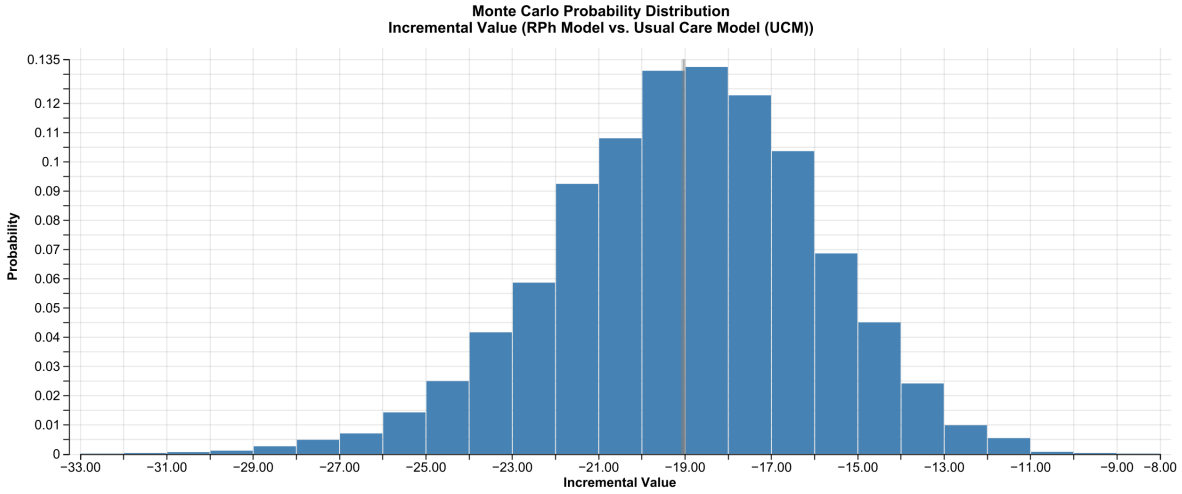


Figure 25: Probabilistic sensitivity analysis (CAND)

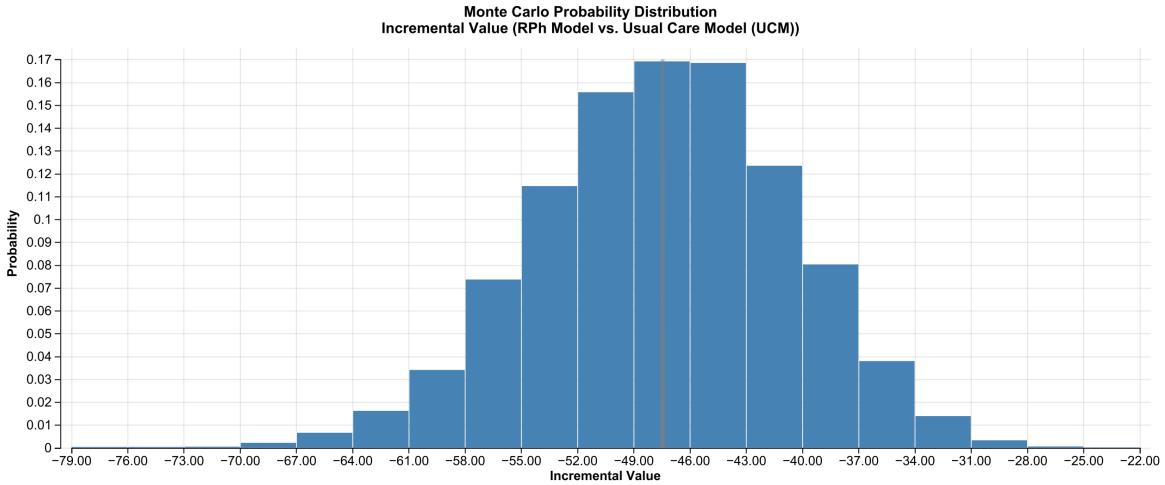


Figure 26: Probabilistic sensitivity analysis (CANK)

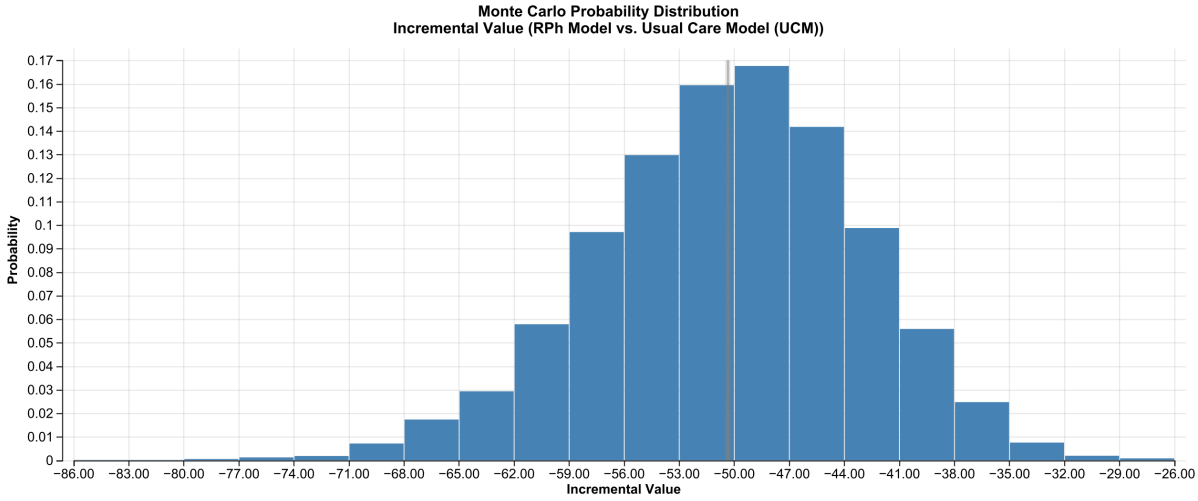


Figure 27: Probabilistic sensitivity analysis (CONJ)

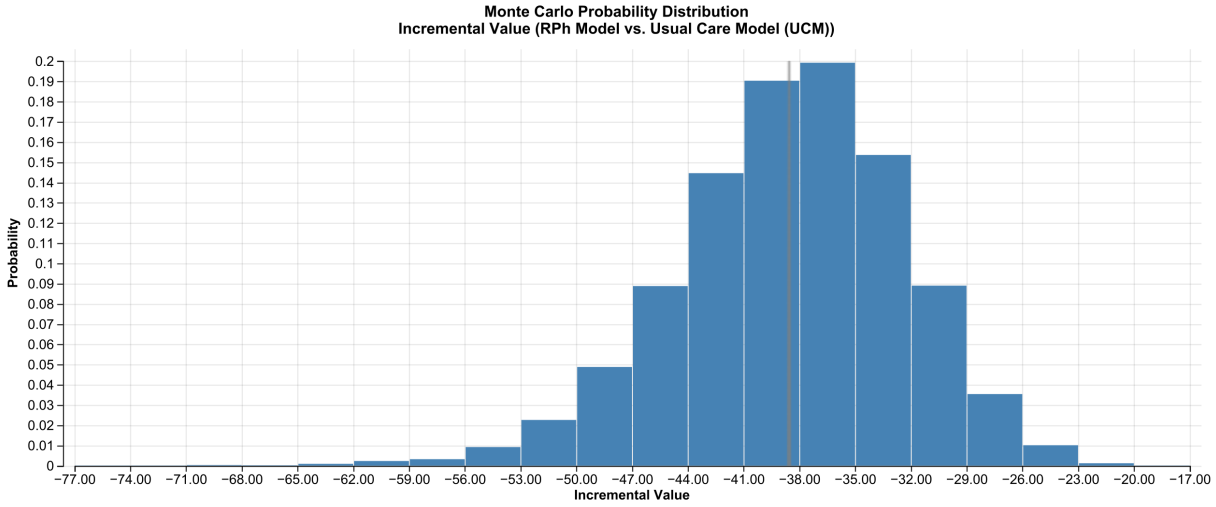


Figure 28: Probabilistic sensitivity analysis (DERM)

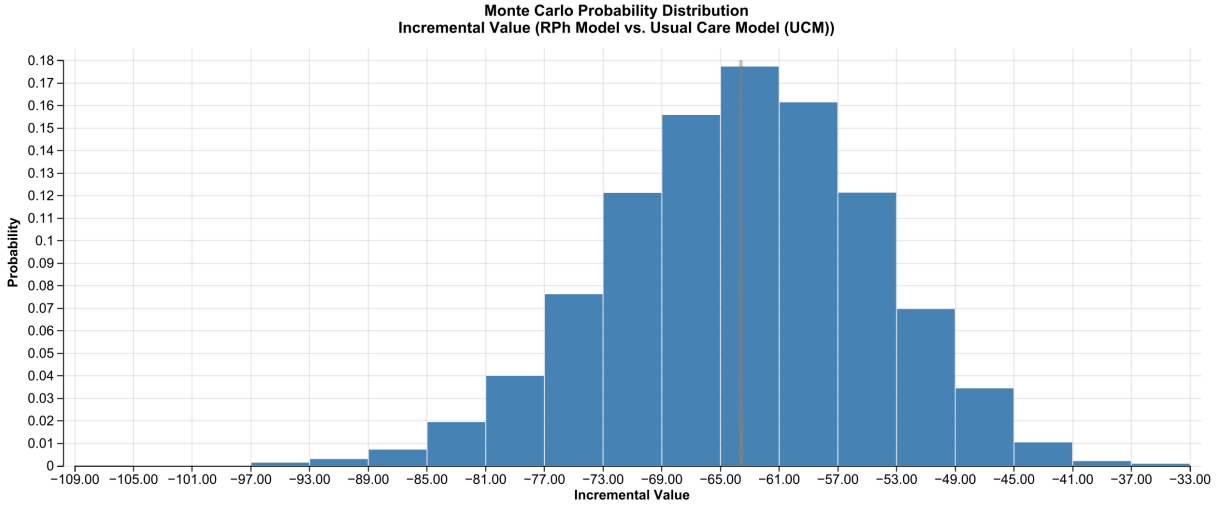


Figure 29: Probabilistic sensitivity analysis (DYSM)

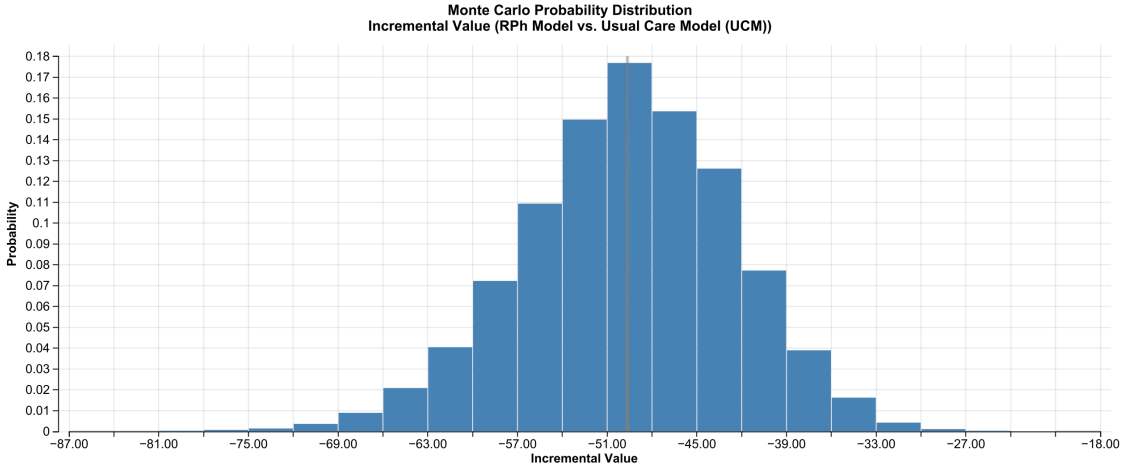


Figure 30: Probabilistic sensitivity analysis (GERD)

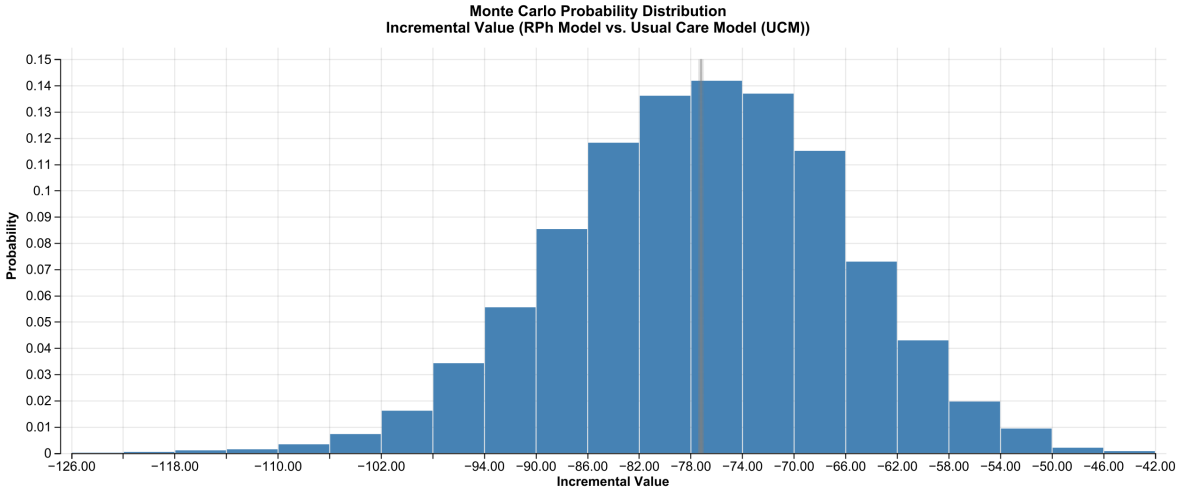


Figure 31: Probabilistic sensitivity analysis (HEMO)

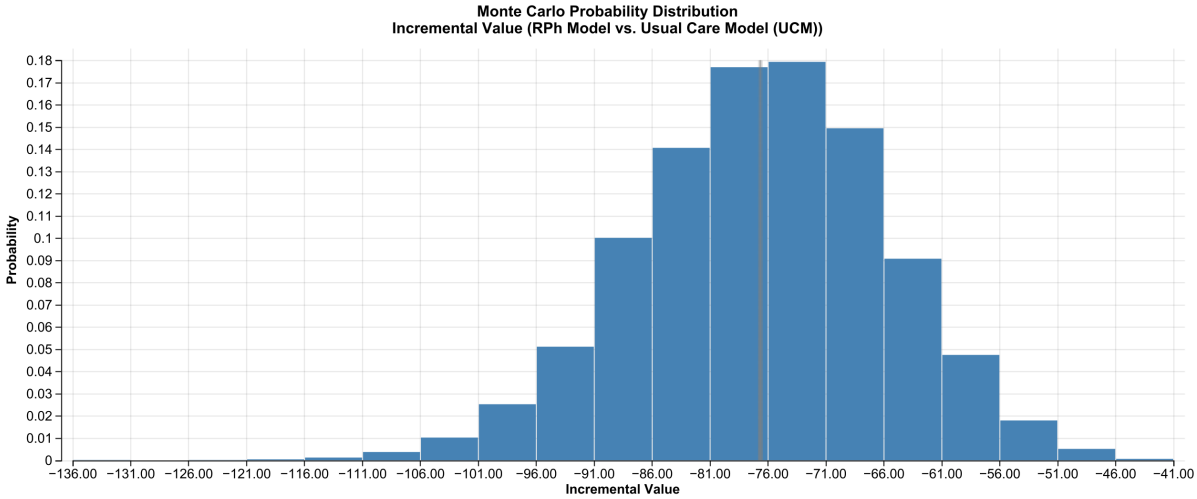


Figure 32: Probabilistic sensitivity analysis (HERP)

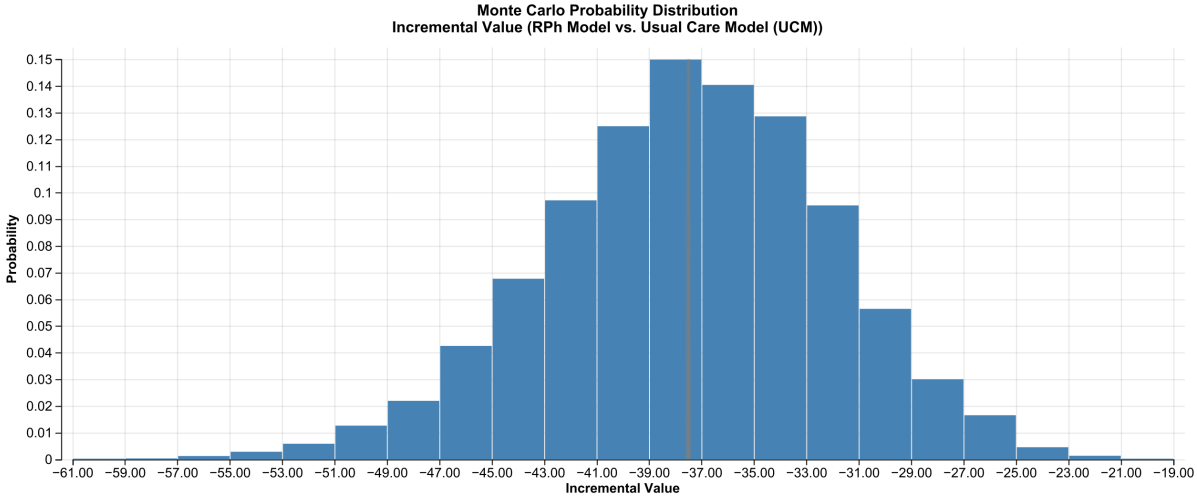


Figure 33: Probabilistic sensitivity analysis (IMPE)

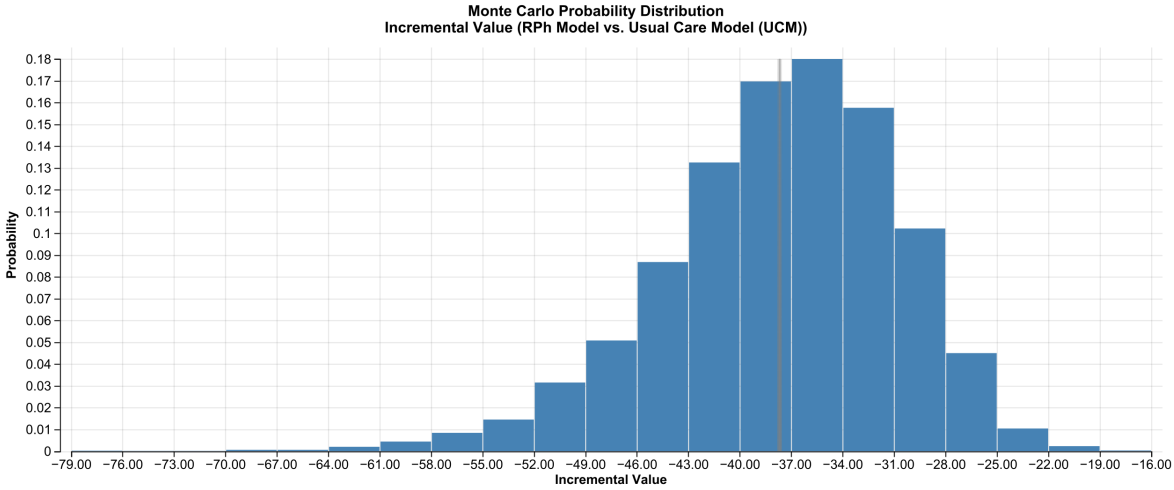


Figure 34: Probabilistic sensitivity analysis (INSBI)

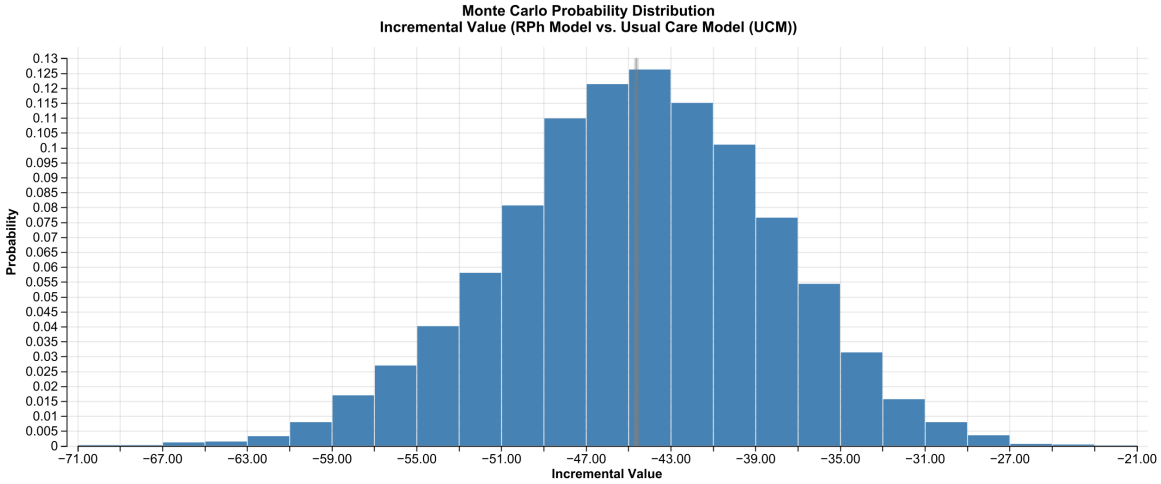


Figure 35: Probabilistic sensitivity analysis (MUSC)

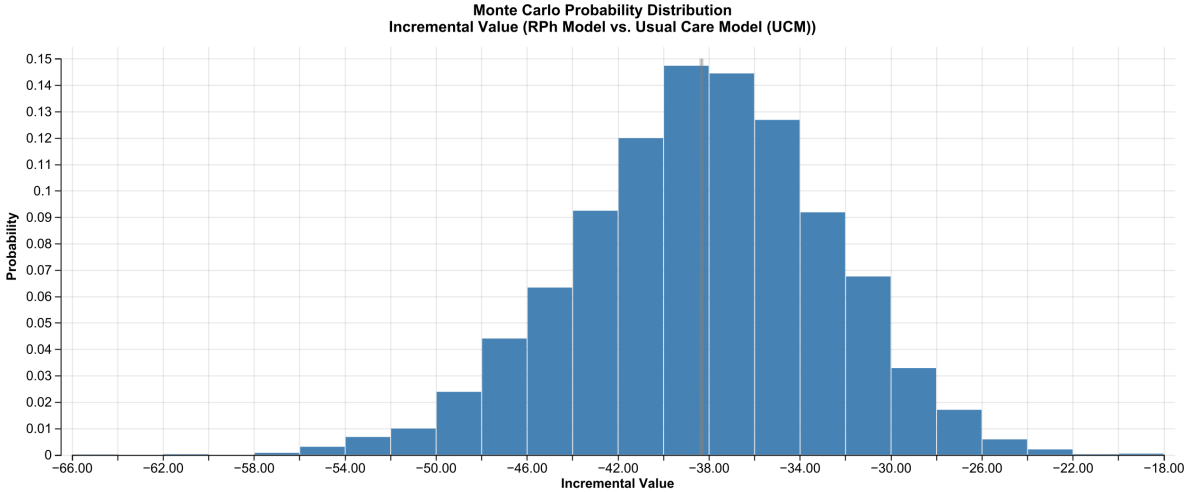


Figure 36: Probabilistic sensitivity analysis (PIN)

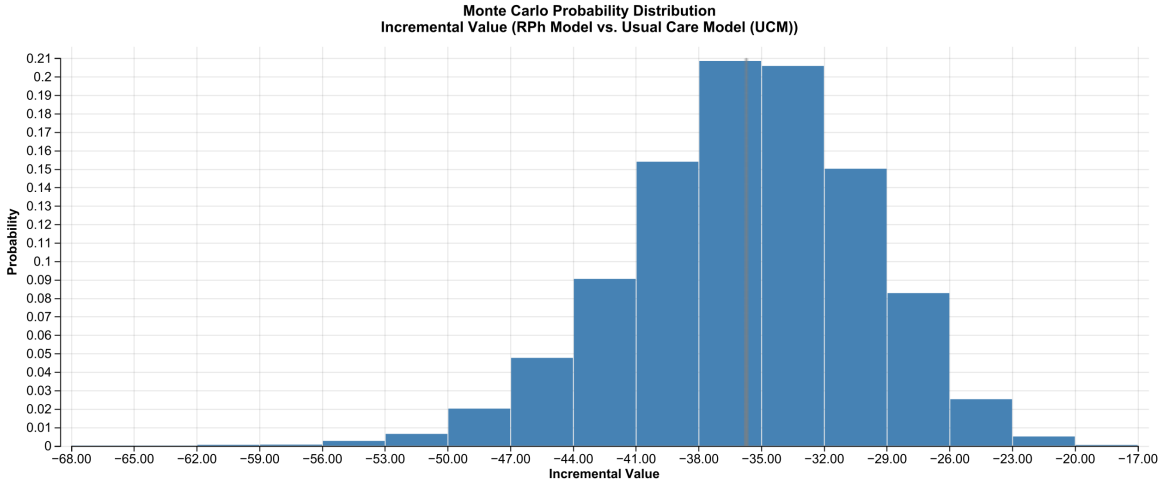


Figure 37: Probabilistic sensitivity analysis (UTI)

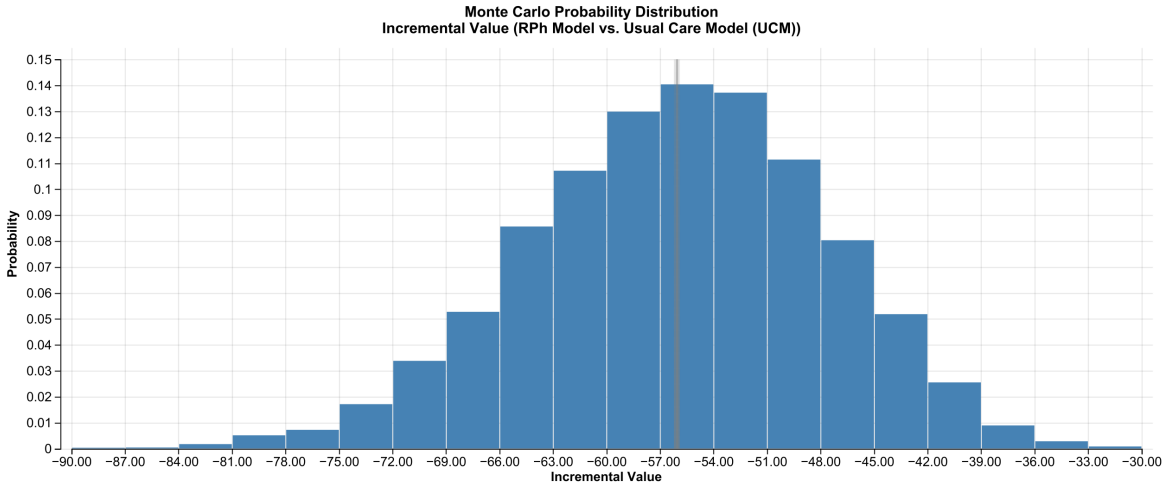
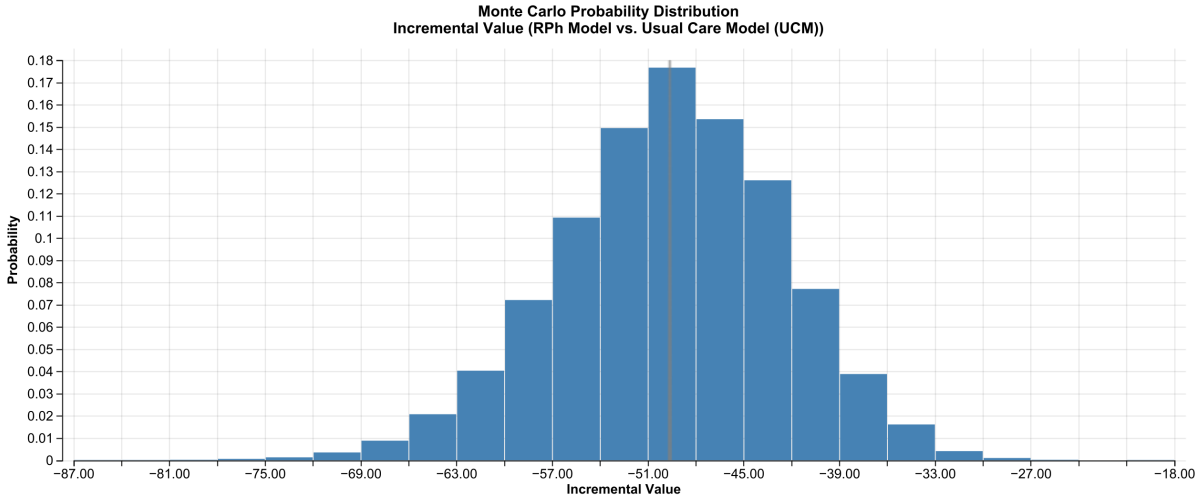


Figure 38: Probabilistic sensitivity analysis (VAGY)



DISCUSSION

In these cost-minimization analyses conducted from the public payer perspective, it was found that a PPMA program for each of the studied minor ailments would provide cost-savings for the Ontario government when compared to the UCM with savings ranging from $19.05 to $77.38 per patient.

The results of this study were found to be consistent with the other published studies in Canada and internationally that have demonstrated savings for the government when implementing a PPMA program. A study by Kim et al. in Ontario found that implementing a PPMA model for upper respiratory tract infections, contact dermatitis, and conjunctivitis from a public payer perspective provided cost savings of $7.51, $4.08 and $5.15 per patient respectively. The primary difference between the Kim et al. study and the current study lies in the use of data inputs. This study utilized empirically derived health administrative data wherever available, providing more robust input parameters for the model. Additionally, this study analyzed a broader scope of 16 minor ailments, whereas the Kim et al. study focused on only three minor ailments. A study by Rafferty et al. calculated costs for the PPMA program found that after 5 years of implementation, the Saskatchewan PPMA program cumulative cost-savings were projected to be $3,482,660 from a societal perspective.[9] There have also been studies conducted outside of Canada including an analysis conducted in Australia for their minor ailment scheme for community pharmacists for seven conditions (common cold, cough, heartburn/reflux, headache, menstrual pain or primary dysmenorrhea, and acute low back pain).[44] This study found that from a societal perspective, the Australian minor ailments scheme was cost-effectiveness compared to usual care with an ICER of 2,277 $AUD/QALY.[44] The ICER represents the additional cost required to gain one additional QALY, which is a standardized measure of health

outcomes that accounts for both the quantity and quality of life gained from an intervention. Unlike some other countries, Australia does not operate with an explicit cost-effectiveness threshold to determine what is considered cost-effective.[44] Lastly, there was also a cost utility analysis for the Spanish health system to evaluate their minor ailment service (for dermatological problems, gastrointestinal disturbances, pain, and upper respiratory tract) in community pharmacy compared with usual care that found that the ICER was 24,733€/QALY with a 47.4% probability of cost-effectiveness (willingness to pay of 25,000€/QALY).[45] However, the overall cost savings per patient were found to be different when compared with other studies which can be accounted for by differences in the minor ailments compared, study design, methods, and model parameters used.[45] Also, when comparing internationally there may be differences in the health care systems and minor ailments included accounting for the variation in costs. This study did have a strength compared to other literature in this area which includes the use of Ontario health administrative data from ICES to determine probabilities and costs implemented in the model including costs of going to the ED, cost of family doctor visits (FFS and CAP), cost of prescription medication, probability of going to the ED, probability of giving a prescription, and probability that a patient gets better. Other published cost-minimization studies in Canada (Kim et al. and Rafferty et al.) had limitations that many probabilities and costs were derived based on non-Ontario data, use of modelling assumptions, and biased cost inputs.[8,9]

The findings of this study demonstrate that the PPMA program is cost-saving in 100% of cases with a fee of $15 to $19 per consultation. This highlights the value of continuing to fund this service, as it not only enhances patient care by providing accessible and convenient care but also reduces healthcare costs. Furthermore, the study identified key predictors of healthcare costs, such as older age, which is particularly relevant given Canada's aging population. Older

individuals tend to incur higher healthcare costs, and the PPMA program offers a cost-saving opportunity to address the needs of this growing demographic. Additionally, by managing minor ailments in pharmacies, the program can alleviate the burden on other healthcare providers, such as physicians and emergency departments, allowing them to focus on more complex and urgent cases.

Lastly, this study had several limitations including the modelling assumption that treatment decisions and outcomes between physicians and pharmacists were identical. Other limitations related to the modelling assumptions included that in the PPMA model, urgent and non-urgent referrals were not differentiated. In addition, it is also assumed that if the minor ailment does not resolve following the first encounter, the patient will return, and a prescription drug is assumed to be recommended. This may not be suitable for all minor ailment cases and in some instances, it may be grounds for an urgent or non-urgent referral from the pharmacist. Also, probabilities and costs for prescribing rates were based on the 65 years of age and older cohort due to ODB prescription drug coverage However, this parameter based on this older age group (65 years and older) may not be applicable for other age groups. Lastly, a limitation for this analysis is that the model parameters that were determined from ICES were not derived from actual PPMA cases after the implementation of the program in 2023. In addition, the service uptake rate for PPMA assumed to be 38% and was also found to be the most sensitive parameter as shown in the tornado diagram. It can be challenging to determine or estimate the service uptake rate for the PPMA program in Ontario based on available literature as the program started in January 2023 and data regarding the service uptake rate has not been publicly released yet.

CONCLUSION

By authorizing pharmacists in Ontario to prescribe for minor ailments, this can provide cost-savings for the Ontario government and reduce the burden on physician visits (family doctor, walk-in clinic, and ED).

CHAPTER 4

SUMMARY OF RESULTS

In Chapter 2, baseline characteristics, mean health care costs, and predictors of total health care costs for minor ailment conditions were analyzed using Ontario health administrative data from ICES. Since Ontario has publicly funded health insurance, these data provide a reliable estimation of costs. The analyses identified musculoskeletal sprains and strains, GERD, dermatitis, UTIs, and insect bites/urticaria as the minor ailments with the highest number of unique patients billed during the study period. Baseline characteristics, health care costs, and predictors of total health care costs were presented. Patients presenting with the studied minor ailments were primarily in the 25-54 age group (when compared to the other age groups) for most minor ailments, with varying sex distributions highlighting some minor ailments with sex predominance. Income quintiles were relatively balanced, urban and rural residence had similar distributions across minor ailments, and history of comorbidities varied in the minor ailments. Health care costs showed differences across minor ailments and cost categories, with older age, lower income quintiles, urban residency, and comorbidities emerging as predictors of higher total health care costs. This study, which is the first to examine the cost and burden of minor ailments using Ontario health administrative data, offers valuable insights into the economic impact of the 16 studied minor ailments currently included in the PPMA program on the health care system. This can help inform policymakers on the baseline characteristics, costs, and cost predictors for minor ailments in Ontario.

In Chapter 3, cost-minimization analyses from a public payer perspective provided evidence that implementing a PPMA program for the 16 studied minor ailments could yield cost savings for the Ontario government compared to the UCM, with savings ranging from $19.05 to

$77.38 per patient. These findings are particularly significant for policymakers, as they demonstrate that funding the PPMA program not only reduces healthcare costs but also helps to free up healthcare resources. By allowing pharmacists to prescribe for certain minor ailments, the program alleviates the burden on other healthcare providers, such as physicians and emergency departments, allowing them to focus on more complex and urgent cases. Additionally, one-way sensitivity analyses showed that results were most sensitive to the likelihood of patients receiving care from a pharmacist rather than a physician. In the probabilistic sensitivity analyses, the PPMA model proved cost-saving in 100% of the simulations for all 16 studied minor ailments, further demonstrating the PPMA program's potential to provide cost savings.

This analysis has a unique strength compared to previous studies, as it leverages Ontario health administrative data from ICES to estimate probabilities and costs implemented in the model. Previous cost-minimization studies have limitations, often relying on non-Ontario data, assumptions in modeling, and biased cost inputs. The findings of this thesis can help guide policymakers in the ongoing implementation of pharmacist-led minor ailment prescribing programs and expanded pharmacist scope in Ontario, Canada.

FUTURE WORK

In the future to strengthen this research, it would be valuable to conduct follow-up analyses a few years after the implementation of the PPMA program in Ontario. This could help reduce the assumptions in the current model by providing updated data on parameters such as the probability of receiving care by a pharmacist, probability revisiting a pharmacist, and prescribing probabilities of pharmacists compared to physicians. Additionally, future research could expand to include cost-minimization analyses for additional minor ailments that Ontario pharmacists may be authorized to prescribe for in 2025 and beyond. This would provide a more

comprehensive assessment of the overall cost-savings achieved through the PPMA program in Ontario.

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Appendix

Table A1: Minor Ailment OHIP and ICD-10 Codes

Minor Ailment	Acronym	OHIP Diagnosis Code	ICD-10 Codes
Acne	ACNE	706 = Acne, acne vulgaris, sebaceous cyst	L70 = Acne
Allergic rhinitis (nasal symptoms from allergies)	ALLR	477 = Allergic rhinitis, hay fever	J30 = Allergic rhinitis J31 = Chronic rhinitis, nasopharyngitis and pharyngitis
Candidal stomatitis (oral thrush)	CAND	112 = Candidiasis, monilia infection - all sites, thrush	B37.0 = Candidiasis stomatitis
Canker sores	CANK	528 = Stomatitis, aphthous ulcers, canker sore, diseases of lips	K12 = Stomatitis and related lesions
Conjunctivitis (bacterial, allergic, viral)	CONJ	372 = Conjunctiva disorders (e.g., conjunctivitis, pterygium)	B30 = Viral conjunctivitis H10 = Conjunctivitis
Dermatitis (atopic/eczema, allergic and contact skin rashes)	DERM	232 = Skin 691 = Dermatitis Allergic, Atopic 692 = Dermatitis Allergic, Contact 709 = Other disorders of skin and subcutaneous tissue	L20 = Atopic dermatitis L22 = Diaper dermatitis L23 = Allergic contact dermatitis L24 = Irritant contact dermatitis L25 = Unspecified contact dermatitis L30 = Other dermatitis L01 = Atopic dermatitis
Dysmenorrhea	DYSM	625 = Dyspareunia, dysmenorrhea, premenstrual tension, stress incontinence	N94.6 = Dysmenorrhea
Gastroesophageal reflux disease (GERD)	GERD	536 = Hyperchlorhydria, hypochlorhydria, dyspepsia, indigestion 787 = Heartburn, dysphagia	K21.0 = Gastro-esophageal reflux disease with esophagitis. K21.9 = Gastro-esophageal reflux disease without esophagitis
Hemorrhoids	HEMO	455= Haemorrhoids 569 = Anal or rectal polyp, rectal prolapse, anal or rectal stricture, rectal bleeding, other disorders of intestine	K64.9 = Haemorrhoids, unspecified
Herpes labialis (cold sores)	HERP	054 = Herpes simplex, cold sore	B00.2 = Herpesviral gingivostomatitis and pharyngotonsillitis B00.89 = Other herpesviral infection B00.9 = Herpes simplex virus (infection)

Impetigo (bacterial skin infection common in children)	IMPE	684 = Impetigo	L01 = Impetigo
Insect bites (including tick bites) and urticaria (hives)	INSBI	698 = Pruritus ani, other itchy conditions 708 = Hives/ Urticaria, Allergic 709 = Other disorders of skin and subcutaneous tissue 919 = Bites, Non-venomous / Bee Sting / Sting, Bee or Wasp 989 = Adverse Effects Other Chemicals (e.g., lead pesticides and venomous bites)	L29 = Pruritis L50 = Urticaria S00.06 = Insect bite (nonvenomous) of scalp S00.26 = Insect bite (nonvenomous) of eyelid and periocular area S00.36 = Insect bite (nonvenomous) of nose S00.46 = Insect bite (nonvenomous) of ear S00.56 = Insect bite (nonvenomous) of lip and oral cavity S00.86 = Insect bite (nonvenomous) of other part of head S00.96 = Insect bite (nonvenomous) of unspecified part of head S10.16 = Insect bite (nonvenomous) of throat S10.86 = Insect bite of other specified part of neck S10.96 = Insect bite of unspecified part of neck S20.16 = Insect bite (nonvenomous) of breast S20.36 = Insect bite (nonvenomous) of front wall of thorax S20.46 = Insect bite (nonvenomous) of back wall of thorax S20.96 = Insect bite (nonvenomous) of unspecified parts of thorax S30.86 = Insect bite (nonvenomous) of abdomen, lower back, pelvis and external genitals S40.26 = Insect bite (nonvenomous) of shoulder S40.86 = Insect bite (nonvenomous) of upper arm S50.36 = Insect bite (nonvenomous) of elbow S50.86 = Insect bite (nonvenomous) of forearm S60.36 = Insect bite (nonvenomous) of thumb S60.46 = Insect bite (nonvenomous) of fingers S60.56 = Insect bite (nonvenomous) of hand S60.86 = Insect bite (nonvenomous) of wrist S70.26 = Insect bite (nonvenomous) of hip S70.36 = Insect bite (nonvenomous) of thigh S80.26 = Insect bite (nonvenomous) of knee
Musculoskeletal sprains and strains	MUSC	739 = Other diseases of musculoskeletal system and connective tissue 756 = Other musculoskeletal anomalies 781 = Leg cramps, leg pain, muscle pain, joint pain, arthralgia, joint swelling, masses	G47.62 = Sleep related leg cramps M54.9 = Musculoskeletal back pain R29.9 = Unspecified symptoms and signs involving the nervous and musculoskeletal systems S09.11 = Strain of muscle and tendon of head S16.1 = Strain of muscle, fascia and tendon at neck level S29.01 = Strain of muscle and tendon of thorax S29.01 = Strain of muscle and tendon of thorax

	845 = Strains, Sprains and Other Trauma (Ankle, Foot, Toes) 847 = Strains, Sprains and Other Trauma (Coccyx, Neck) 844 = Strains, Sprains and Other Trauma (Knee, Leg) 840 = Strains, Sprains and Other Trauma (Shoulder, Upper Arm) 842 = Strains, Sprains and Other Trauma (Wrist, Hand, Fingers) 848 = Strains, Sprains and Other Trauma (Other)	S39.01 = Strain of muscle, fascia and tendon of abdomen, lower back and pelvis S46.01 = Strain of muscle(s) and tendon(s) of the rotator cuff of shoulder S46.11 = Strain of muscle, fascia and tendon of long head of biceps S46.21 = Strain of muscle, fascia and tendon of other parts of biceps S46.31 = Strain of muscle, fascia and tendon of triceps S46.81 = Strain of other muscles, fascia and tendons at shoulder and upper arm level S46.91 = Strain of unspecified muscle, fascia and tendon at shoulder and upper arm level S56.01 = Strain of flexor muscle, fascia and tendon of thumb at forearm level S56.11 = Strain of flexor muscle, fascia and tendon of other and unspecified finger at forearm level S56.21 = Strain of other flexor muscle, fascia and tendon at forearm level S56.31 = Strain of extensor or abductor muscles, fascia and tendons of thumb at forearm level S56.41 = Strain of extensor muscle, fascia and tendon of other and unspecified finger at forearm level S56.51 = Strain of other extensor muscle, fascia and tendon at forearm level S56.81 = Strain of other muscles, fascia and tendons at forearm level S56.91 = Strain of unspecified muscles, fascia and tendons at forearm level S66.01 = Strain of long flexor muscle, fascia and tendon of thumb at wrist and hand level S66.11 = Strain of flexor muscle, fascia and tendon of other and unspecified finger at wrist and hand level S66.21 = Strain of extensor muscle, fascia and tendon of thumb at wrist and hand level S66.31 = Strain of extensor muscle, fascia and tendon of other and unspecified finger at wrist and hand level S66.41 = Strain of intrinsic muscle, fascia and tendon of thumb at wrist and hand level S66.51 = Strain of intrinsic muscle, fascia and tendon of other and unspecified finger at wrist and hand level S66.81 = Strain of other specified muscles, fascia and tendons at wrist and hand level S66.91 = Strain of unspecified muscle, fascia and tendon at wrist and hand level

			S76.01 = Strain of muscle, fascia and tendon of hip S76.11 = Strain of quadriceps muscle, fascia and tendon S76.21 = Strain of adductor muscle, fascia and tendon of thigh S76.31 = Strain of muscle, fascia and tendon of the posterior muscle group at thigh level S76.81 = Strain of other specified muscles, fascia and tendons at thigh level S76.91 = Strain of unspecified muscles, fascia and tendons at thigh level S86.01 = Strain of Achilles tendon S86.11 = Strain of other muscle(s) and tendon(s) of posterior muscle group at lower leg level S86.21 = Strain of muscle(s) and tendon(s) of anterior muscle group at lower leg level S86.31 = Strain of muscle(s) and tendon(s) of peroneal muscle group at lower leg level S86.81 = Strain of other muscles and tendons at lower leg level S86.91 = Strain of unspecified muscle and tendon at lower leg level S96.01 = Strain of muscle and tendon of long flexor muscle of toe at ankle and foot level S96.11 = Strain of muscle and tendon of long extensor muscle of toe at ankle and foot level S96.21 = Strain of intrinsic muscle and tendon at ankle and foot level S96.81 = Strain of other specified muscles and tendons at ankle and foot level S96.91 = Strain of unspecified muscle and tendon at ankle and foot level Z13.828 = Encounter for screening for other musculoskeletal disorder
Pin/threadworm	PIN	127 = Pinworm	B80 = Enterobiasis
Urinary tract infection (uncomplicated)	UTI	595 = Cystitis 599 = Other disorders of urinary tract	N39.0 = Urinary tract infection N30.1 = Interstitial cystitis, chronic N30.9 = Cystitis, unspecified
Vaginal yeast infection	VAGY	112 = Candidiasis, monilia infection - all sites, thrush 616 = Vaginitis (Not trichomonas)	B37.3 = Candidiasis of vulva and vagina