

Supplementary materials

Supplementary Table S1: Diagnostic codes used to identify all-cause pneumonia, fracture, and skin and soft tissue infection in Ontario and British Columbia

Study Outcome and Diagnosis	ICD-10 codes for hospitalization
All-cause pneumonia	
Pneumococcal pneumonia	J13
Bronchopneumonia and lobar pneumonia, unspecified	J18.0, J18.1
Other pneumonia	J14, J15, J16, J17, J10.0, J11.0
Viral pneumonia	J12
Empyema	J86.9
Abscess of lung with pneumonia	J85.1
Fracture	
Fracture of skull and facial bones	S02
Fracture of neck	S12
Fracture of rib(s), sternum and thoracic spine	S22
Fracture of lumbar spine and pelvis	S32
Fracture of shoulder and upper arm	S42
Fracture of forearm	S52
Fracture at wrist and hand level	S62
Fracture of femur	S72
Fracture of lower leg, including ankle	S82
Fracture of foot, except ankle	S92
Skin and soft tissue infection	
Staphylococcal scalded skin syndrome	L00
Impetigo	L01
Cutaneous abscess, furuncle and carbuncle	L02
Cellulitis	L03
Acute lymphadenitis	L04

Supplemental Table S2: Annual incidence of invasive pneumococcal disease (IPD) and hospitalized all-cause pneumonia, fracture, and skin and soft tissue infection (SSTI) in adults aged ≥65 years in Ontario and British Columbia, 2005–2018

Year	Incidence per 100,000 population (95% Confidence interval)							
	Ontario				British Columbia			
	IPD	All-cause pneumonia	Fracture	SSTI	IPD	All-cause pneumonia	Fracture	SSTI
≥65 years								
2005	20.9 (17.3, 25.2)	429.2 (357.0, 516.0)	1121.3 (932.7, 1348.0)	354.2 (311.1, 403.3)	12.2 (8.5, 17.3)	367.6 (327.7, 412.3)	1180.9 (1126.4, 1238.1)	169.9 (156.7, 184.3)
2006	25.8 (21.8, 30.5)	394.1 (325.9, 476.5)	1078.9 (896.2, 1298.9)	342.3 (300.4, 390.0)	12.4 (8.7, 17.5)	362.4 (323.3, 406.2)	1158.6 (1105.3, 1214.5)	180.0 (166.5, 194.6)
2007	22.8 (19.12, 27.2)	383.2 (316.7, 463.5)	1053.0 (874.6, 1267.7)	329.6 (289.0, 375.9)	19.2 (14.6, 25.3)	358.3 (319.9, 401.3)	1004.1 (955.1, 1055.6)	155.7 (143.3, 169.1)
2008	24.2 (20.5, 28.6)	386.5 (320.5, 466.0)	1037.3 (862.5, 1247.6)	340.0 (299.2, 386.3)	18.9 (14.4, 24.8)	378.3 (339.2, 421.8)	967.5 (920.1, 1017.4)	168.8 (156.0, 182.6)
2009	26.3 (22.4, 30.8)	390.8 (325.2, 469.5)	991.3 (822.8, 1194.3)	342.5 (302.1, 388.3)	16.2 (12.1, 21.6)	335.4 (299.3, 375.9)	922.8 (877.2, 970.9)	189.3 (175.9, 203.6)
2010	27.6 (23.7, 32.2)	404.6 (338.7, 483.5)	978.0 (812.8, 1176.7)	365.2 (323.9, 411.8)	13.0 (9.5, 17.9)	333.7 (298.1, 373.5)	934.8 (889.5, 982.4)	202.8 (189.4, 217.4)
2011	26.4 (22.7, 30.8)	445.7 (377.2, 526.6)	978.6 (815.8, 1174.0)	380.5 (338.9, 427.1)	14.9 (11.1, 20.0)	378.1 (340.7, 419.6)	931.0 (886.5, 977.8)	209.3 (195.6, 223.9)
2012	27.8 (24.0, 32.2)	439.3 (372.6, 518.1)	973.8 (814.3, 1164.5)	385.1 (344.0, 431.0)	18.0 (13.8, 23.3)	391.5 (354.1, 432.8)	914.2 (871.0, 959.6)	213.3 (199.8, 227.7)
2013	23.1 (19.7, 27.1)	453.0 (386.3, 531.1)	976.7 (819.8, 1163.7)	391.8 (351.1, 437.2)	17.2 (13.3, 22.4)	399.2 (362.2, 439.9)	902.3 (860.2, 946.4)	228.6 (214.9, 243.2)
2014	22.9 (19.6, 26.8)	529.5 (458.2, 612.0)	957.6 (804.8, 1139.4)	391.2 (351.2, 435.7)	18.6 (14.5, 23.8)	395.6 (359.5, 435.3)	917.4 (875.8, 960.9)	221.8 (208.5, 235.8)
2015	22.4 (19.2, 26.2)	534.9 (464.3, 616.3)	920.3 (772.9, 1095.8)	392.4 (352.9, 436.2)	16.5 (12.8, 21.3)	352.0 (318.7, 388.8)	845.5 (806.4, 886.5)	225.6 (212.5, 239.5)
2016	20.4 (17.4, 23.9)	539.6 (469.7, 619.9)	912.6 (768.1, 1084.3)	393.4 (354.5, 436.5)	18.8 (14.9, 23.8)	301.1 (271.0, 334.6)	811.7 (774.1, 851.1)	212.6 (200.2, 225.9)
2017	22.4 (19.3, 26.0)	600.2 (527.4, 683.0)	901.3 (760.1, 1068.9)	403.3 (364.5, 446.1)	19.8 (15.8, 24.8)	317.0 (286.6, 350.6)	782.3 (746.1, 820.2)	194.0 (182.4, 206.5)
2018	22.7 (19.6, 26.2)	638.0 (564.0, 721.7)	876.9 (739.9, 1039.3)	401.6 (363.5, 443.6)	17.9 (14.1, 22.5)	275.4 (247.7, 306.2)	656.3 (623.9, 690.5)	151.4 (141.3, 162.2)
65-74 years								

2005	16.1 (12.3, 21.0)	240.1 (208.9, 276.1)	484.6 (444.0, 528.9)	230.1 (209.1, 253.2)	9.2 (5.5, 15.2)	205.9 (181.8, 233.2)	575.5 (537.2, 616.5)	115.7 (102.2, 130.9)
2006	19.8 (15.6, 25.1)	228.3 (198.1, 263.1)	465.6 (426.2, 508.8)	223.0 (202.5, 245.6)	11.5 (7.3, 18.0)	203.9 (180.2, 230.7)	570.5 (532.8, 610.8)	117.1 (103.7, 132.2)
2007	16.8 (13.0, 21.7)	220.5 (191.1, 254.3)	464.6 (425.6, 507.2)	210.8 (191.1, 232.5)	18.0 (12.7, 25.6)	213.3 (189.3, 240.3)	500.5 (465.7, 537.9)	113.5 (100.5, 128.2)
2008	17.3 (13.5, 22.1)	215.6 (187.0, 248.6)	462.9 (424.5, 504.8)	211.2 (191.8, 232.6)	12.9 (8.6, 19.5)	220.7 (196.6, 247.7)	469.3 (436.2, 504.9)	120.7 (107.5, 135.6)
2009	20.0 (15.9, 25.1)	231.6 (202.2, 265.1)	438.4 (401.6, 478.6)	220.8 (201.2, 242.3)	12.8 (8.5, 19.1)	205.0 (182.2, 230.5)	443.9 (412.3, 477.9)	120.6 (107.6, 135.2)
2010	21.4 (17.3, 26.6)	219.7 (191.7, 251.9)	419.4 (384.0, 458.0)	226.8 (207.2, 248.2)	9.2 (5.8, 14.7)	200.8 (178.7, 225.6)	423.4 (393.1, 456.0)	137.6 (123.9, 152.8)
2011	18.9 (15.1, 23.7)	241.9 (212.9, 274.8)	424.2 (389.2, 462.3)	231.3 (211.9, 252.5)	9.9 (6.4, 15.4)	220.6 (197.8, 246.0)	448.9 (418.3, 481.8)	137.1 (123.7, 152.0)
2012	19.8 (16.0, 24.5)	245.6 (217.1, 277.9)	425.6 (391.5, 462.6)	236.5 (217.3, 257.3)	13.4 (9.3, 19.4)	231.4 (208.7, 256.6)	447.2 (417.5, 479.0)	133.4 (120.6, 147.7)
2013	17.8 (14.3, 22.2)	244.1 (216.3, 275.3)	431.9 (398.4, 468.3)	241.1 (222.3, 261.6)	12.9 (9.0, 18.6)	231.8 (209.7, 256.3)	446.5 (417.6, 477.3)	149.5 (136.2, 164.0)
2014	16.4 (13.1, 20.5)	286.1 (256.6, 319.0)	425.2 (392.6, 460.5)	248.4 (229.6, 268.6)	13.6 (9.6, 19.2)	225.8 (204.6, 249.3)	446.0 (417.9, 476.0)	144.2 (131.5, 158.1)
2015	15.7 (12.6, 19.7)	276.1 (247.6, 307.8)	402.2 (371.1, 435.8)	260.2 (241.3, 280.5)	11.6 (8.0, 16.7)	194.9 (175.7, 216.1)	414.7 (388.4, 443.0)	141.5 (129.2, 154.9)
2016	15.9 (12.7, 19.8)	286.2 (257.7, 317.8)	406.7 (376.0, 439.8)	258.2 (239.8, 278.02)	18.0 (13.5, 23.9)	183.5 (165.3, 203.6)	406.5 (381.0, 433.7)	145.9 (133.7, 159.1)
2017	17.6 (14.3, 21.6)	310.6 (281.4, 342.9)	416.9 (386.4, 449.8)	262.5 (244.3, 282.1)	16.4 (12.3, 22.0)	179.7 (162.1, 199.2)	411.3 (386.2, 438.1)	132.8 (121.4, 145.2)
2018	16.6 (13.5, 20.4)	334.8 (305.0, 367.6)	394.0 (364.9, 425.4)	263.0 (245.0, 282.2)	16.5 (12.4, 22.0)	168.4 (151.7, 186.9)	333.0 (310.9, 356.6)	104.3 (94.5, 115.1)
75-84 years								
2005	20.55 (15.8, 26.72)	532.7 (459.5, 617.5)	1333.5 (1209.2, 1470.7)	428.9 (401.4, 458.3)	11.1 (6.9, 18.0)	460.1 (412.1, 513.7)	1306.4 (1231.3, 1386.0)	207.8 (187.8, 230.0)
2006	25.75 (20.41, 32.48)	484.0 (415.1, 564.3)	1259.7 (1140.1, 1391.9)	407.3 (380.7, 435.7)	11.9 (7.5, 18.9)	427.2 (381.3, 478.5)	1286.3 (1212.4, 1364.7)	216.2 (195.9, 238.7)
2007	22.89 (17.92, 29.24)	466.6 (399.5, 544.9)	1229.9 (1112.6, 1359.6)	401.1 (374.9, 429.0)	15.1 (10.0, 22.7)	432.9 (387.0, 484.3)	1115.5 (1047.2, 1188.2)	181.8 (163.4, 202.4)
2008	26.41 (21.06, 33.13)	484.4 (416.3, 563.6)	1206.8 (1091.2, 1334.5)	398.3 (372.4, 426.1)	20.0 (14.1, 28.5)	462.7 (415.4, 515.5)	1062.9 (996.6, 1133.6)	188.7 (170.0, 209.5)

2009	26.33 (21.01, 33)	461.5 (395.4, 538.6)	1149.6 (1037.5, 1273.9)	403.0 (377.0, 430.7)	15.7 (10.6, 23.4)	402.4 (358.6, 451.5)	1049.6 (984.0, 1119.5)	225.4 (204.9, 248.0)
2010	25.84 (20.6, 32.41)	491.8 (423.8, 570.6)	1135.0 (1024.3, 1257.7)	429.1 (402.5, 457.5)	14.6 (9.7, 22.0)	404.8 (361.2, 453.8)	1033.5 (968.8, 1102.4)	238.0 (217.0, 260.9)
2011	29.15 (23.59, 36.03)	534.8 (464.2, 616.2)	1137.8 (1027.7, 1259.7)	451.6 (424.5, 480.6)	17.0 (11.7, 24.8)	446.0 (400.4, 496.8)	1037.3 (973.0, 1105.7)	224.6 (204.4, 246.7)
2012	31.4 (25.64, 38.45)	514.7 (446.0, 594.0)	1129.0 (1020.1, 1249.6)	458.3 (431.1, 487.2)	15.9 (10.8, 23.4)	476.5 (429.7, 528.4)	1020.5 (957.3, 1087.9)	258.5 (237.0, 282.0)
2013	24.7 (19.7, 30.98)	543.9 (473.7, 624.5)	1133.8 (1025.5, 1253.5)	459.9 (432.9, 488.6)	17.8 (12.4, 25.5)	503.2 (455.4, 556.0)	1004.6 (942.4, 1070.9)	259.6 (238.2, 282.9)
2014	23.18 (18.39, 29.22)	628.9 (553.7, 714.3)	1116.1 (1009.6, 1233.7)	455.7 (429.1, 484.0)	20.4 (14.6, 28.5)	478.7 (432.5, 529.7)	1046.6 (983.7, 1113.5)	255.1 (234.1, 278.0)
2015	26.51 (21.39, 32.86)	640.3 (565.0, 725.6)	1064.8 (961.8, 1178.8)	439.8 (413.9, 467.4)	22.0 (16.0, 30.3)	430.0 (386.9, 478.0)	927.4 (869.0, 989.8)	265.8 (244.5, 288.8)
2016	20.87 (16.42, 26.51)	643.4 (568.6, 728.0)	1040.1 (939.4, 1151.7)	442.2 (416.4, 469.5)	18.6 (13.2, 26.2)	371.2 (331.7, 415.3)	917.6 (860.2, 978.8)	242.5 (222.5, 264.2)
2017	23.12 (18.48, 28.94)	704.3 (626.9, 791.3)	1032.6 (933.6, 1142.2)	458.8 (432.9, 486.2)	21.6 (15.8, 29.4)	385.2 (345.6, 429.3)	871.4 (816.4, 930.1)	218.2 (199.6, 238.6)
2018	24.01 (19.33, 29.81)	737.5 (659.4, 824.8)	1006.7 (910.6, 1113.1)	448.3 (423.1, 475.0)	18.1 (12.9, 25.2)	326.7 (291.1, 366.7)	740.0 (690.4, 793.1)	166.7 (150.9, 184.3)
≥85 years								
2005	45.03 (32.93, 61.58)	1004.2 (819.3, 1230.9)	3501.2 (3236.2, 3787.9)	709.3 (662.2, 759.7)	28.0 (16.3, 48.0)	792.1 (669.4, 937.3)	3410.5 (3215.5, 3617.4)	292.5 (252.2, 339.3)
2006	53.34 (40.43, 70.37)	870.7 (705.3, 1074.9)	3310.8 (3062.3, 3579.5)	684.5 (639.9, 732.3)	17.1 (8.8, 33.4)	837.5 (714.5, 981.6)	3232.7 (3048.4, 3428.0)	339.7 (297.3, 388.2)
2007	49.16 (37.16, 65.04)	849.0 (690.4, 1044.1)	3104.3 (2870.8, 3356.3)	638.6 (596.8, 683.3)	35.0 (22.2, 55.1)	742.8 (630.4, 875.3)	2731.6 (2567.0, 2906.7)	255.9 (220.3, 297.3)
2008	47.46 (35.97, 62.61)	838.5 (684.8, 1026.7)	3005.8 (2782.4, 3247.1)	724.0 (680.6, 770.2)	39.4 (25.9, 59.9)	787.2 (673.5, 920.1)	2699.7 (2539.6, 2870.0)	308.2 (269.7, 352.2)
2009	52.48 (40.61, 67.83)	863.6 (711.1, 1048.7)	2869.0 (2656.4, 3098.5)	686.7 (645.5, 730.5)	30.9 (19.5, 49.1)	684.5 (581.2, 806.3)	2500.0 (2349.3, 2660.5)	370.9 (329.2, 417.8)
2010	57.44 (45.23, 72.96)	935.1 (779.4, 1121.8)	2855.9 (2649.0, 3079.0)	765.7 (723.2, 810.6)	24.2 (14.5, 40.5)	685.3 (583.7, 804.6)	2711.4 (2557.1, 2875.1)	374.6 (333.5, 420.8)
2011	50.13 (39.03, 64.39)	1050.8 (888.4, 1243.0)	2834.4 (2632.6, 3051.6)	808.2 (765.4, 853.3)	29.9 (18.9, 47.1)	842.1 (730.3, 971.1)	2593.5 (2445.1, 2751.0)	459.4 (414.4, 509.4)
2012	51.76 (40.68, 65.86)	1051.0 (891.8, 1238.5)	2846.6 (2648.7, 3059.2)	816.7 (774.3, 861.0)	41.3 (28.3, 60.5)	845.5 (735.1, 972.5)	2571.6 (2426.0, 2726.0)	433.1 (390.0, 480.9)

2013	41.26 (31.67, 53.75)	1104.5 (944.0, 1292.2)	2866.5 (2671.7, 3075.5)	855.8 (813.6, 900.2)	34.1 (22.6, 51.5)	861.1 (751.2, 987.1)	2579.3 (2435.6, 2731.4)	489.2 (443.9, 539.1)
2014	49.81 (39.32, 63.1)	1317.4 (1143.9, 1517.3)	2818.8 (2628.9, 3022.4)	838.9 (797.8, 882.1)	35.9 (24.2, 53.4)	935.3 (822.1, 1064.1)	2647.6 (2504.2, 2799.2)	478.8 (434.8, 527.4)
2015	41.28 (31.97, 53.3)	1383.9 (1208.5, 1584.8)	2773.0 (2587.7, 2971.5)	840.7 (800.3, 883.3)	25.5 (16.0, 40.5)	866.8 (759.5, 989.3)	2557.0 (2418.1, 2703.9)	505.2 (460.4, 554.2)
2016	38.35 (29.57, 49.73)	1371.9 (1200.5, 1567.7)	2754.7 (2573.6, 2948.5)	852.2 (812.3, 894.2)	22.9 (14.2, 37.1)	670.3 (578.0, 777.3)	2390.4 (2258.1, 2530.5)	444.7 (403.5, 490.2)
2017	40.9 (31.94, 52.38)	1590.5 (1408.0, 1796.6)	2654.9 (2480.1, 2842.0)	873.7 (833.9, 915.4)	31.3 (20.8, 47.0)	788.5 (689.1, 902.3)	2273.6 (2146.4, 2408.5)	418.8 (379.4, 462.4)
2018	45.35 (35.97, 57.17)	1705.2 (1518.4, 1915.0)	2641.7 (2469.7, 2825.6)	886.8 (847.2, 928.2)	23.5 (14.8, 37.3)	652.0 (563.3, 754.6)	1959.3 (1842.9, 2083.0)	333.8 (299.2, 372.4)

Supplemental Table S3: Annual incidence of pneumococcal conjugate vaccine (PCV) serotype-specific invasive pneumococcal disease in adults aged ≥ 65 years in Ontario and British Columbia, 2005–2018.

Year	Incidence per 100,000 population (95% Confidence interval)							
	Ontario				British Columbia			
	PCV7	Additional PCV13	Unique PPV23	Non-vaccine serotype	PCV7	Additional PCV13	Unique PPV23	Non-vaccine serotype
≥ 65 years								
2005	-	-	-	-	5.82 (3.90, 8.68)	3.25 (1.85, 5.73)	2.40 (1.25, 4.60)	0.68 (0.23, 2.00)
2006	-	-	-	-	3.50 (2.11, 5.83)	3.34 (1.92, 5.80)	3.17 (1.81, 5.55)	1.67 (0.85, 3.29)
2007	2.96 (2.25, 3.89)	3.84 (2.81, 5.26)	2.19 (1.47, 3.26)	2.37 (1.57, 3.56)	3.91 (2.43, 6.29)	5.70 (3.75, 8.65)	5.05 (3.26, 7.83)	3.09 (1.89, 5.06)
2008	2.94 (2.24, 3.86)	5.99 (4.68, 7.67)	2.71 (1.90, 3.86)	3.05 (2.14, 4.35)	3.65 (2.24, 5.93)	5.39 (3.53, 8.24)	6.34 (4.31, 9.33)	3.33 (2.09, 5.32)
2009	2.58 (1.94, 3.44)	7.68 (6.19, 9.53)	4.32 (3.28, 5.69)	3.42 (2.46, 4.76)	2.00 (1.05, 3.82)	6.78 (4.67, 9.84)	4.47 (2.84, 7.03)	2.77 (1.67, 4.60)
2010	2.13 (1.56, 2.90)	9.76 (8.08, 11.79)	5.29 (4.14, 6.77)	5.02 (3.83, 6.57)	1.20 (0.53, 2.73)	5.84 (3.93, 8.67)	3.29 (1.96, 5.55)	2.10 (1.18, 3.72)
2011	1.06 (0.68, 1.63)	8.62 (7.07, 10.50)	4.70 (3.64, 6.08)	7.03 (5.62, 8.80)	0.87 (0.34, 2.25)	4.50 (2.89, 7.00)	4.50 (2.90, 6.97)	5.08 (3.53, 7.29)
2012	1.17 (0.78, 1.75)	7.97 (6.52, 9.75)	6.09 (4.88, 7.60)	6.20 (4.90, 7.83)	1.25 (0.58, 2.72)	5.43 (3.66, 8.06)	5.57 (3.78, 8.19)	5.57 (3.97, 7.81)
2013	0.93 (0.59, 1.45)	5.62 (4.44, 7.11)	6.30 (5.09, 7.80)	6.06 (4.80, 7.64)	0.67 (0.24, 1.89)	5.47 (3.72, 8.05)	5.60 (3.85, 8.17)	5.34 (3.80, 7.49)
2014	0.80 (0.50, 1.29)	4.72 (3.66, 6.07)	6.32 (5.13, 7.79)	7.12 (5.77, 8.79)	0.64 (0.23, 1.82)	4.61 (3.06, 6.96)	6.92 (4.96, 9.64)	6.41 (4.73, 8.67)
2015	1.10 (0.74, 1.63)	4.61 (3.59, 5.93)	7.04 (5.79, 8.55)	7.04 (5.71, 8.66)	0.98 (0.43, 2.24)	3.94 (2.54, 6.09)	5.04 (3.44, 7.39)	6.52 (4.86, 8.75)
2016	1.02 (0.68, 1.53)	4.20 (3.24, 5.44)	5.97 (4.84, 7.35)	6.45 (5.21, 7.99)	1.77 (0.97, 3.24)	3.19 (1.99, 5.14)	7.10 (5.18, 9.73)	6.50 (4.87, 8.68)
2017	1.15 (0.79, 1.68)	3.67 (2.80, 4.82)	7.13 (5.91, 8.60)	8.46 (7.04, 10.16)	2.16 (1.27, 3.69)	3.98 (2.62, 6.05)	7.17 (5.27, 9.75)	6.37 (4.79, 8.49)
2018	1.32 (0.94, 1.86)	3.71 (2.85, 4.85)	7.51 (6.27, 8.99)	7.67 (6.35, 9.28)	2.30 (1.38, 3.82)	4.38 (2.97, 6.47)	6.68 (4.89, 9.13)	4.49 (3.21, 6.28)
65-74 years								

2005	-	-	-	-	3.92 (2.13, 7.22)	1.96 (0.78, 4.91)	2.94 (1.35, 6.4)	0.33 (0.04, 2.43)
2006	-	-	-	-	3.19 (1.64, 6.22)	2.23 (0.95, 5.23)	3.51 (1.74, 7.09)	2.23 (1.05, 4.77)
2007	2.47 (1.64, 3.74)	2.70 (1.59, 4.59)	1.35 (0.68, 2.69)	1.57 (0.82, 3.01)	3.11 (1.59, 6.06)	6.22 (3.76, 10.28)	4.66 (2.55, 8.51)	2.49 (1.22, 5.05)
2008	2.08 (1.33, 3.23)	4.48 (2.98, 6.72)	1.75 (0.96, 3.17)	1.75 (0.95, 3.21)	3.01 (1.54, 5.87)	4.82 (2.74, 8.45)	3.01 (1.44, 6.29)	2.11 (0.99, 4.50)
2009	2.75 (1.88, 4.02)	5.82 (4.10, 8.26)	2.96 (1.89, 4.65)	2.54 (1.55, 4.17)	2.03 (0.91, 4.51)	5.80 (3.51, 9.59)	3.77 (1.97, 7.19)	1.16 (0.43, 3.16)
2010	1.43 (0.86, 2.40)	8.71 (6.57, 11.55)	5.02 (3.57, 7.06)	3.07 (1.97, 4.79)	1.12 (0.39, 3.22)	4.19 (2.35, 7.50)	2.52 (1.16, 5.47)	1.12 (0.41, 3.05)
2011	0.39 (0.15, 1.04)	6.80 (4.97, 9.30)	3.55 (2.38, 5.28)	4.63 (3.25, 6.60)	1.34 (0.52, 3.45)	2.68 (1.32, 5.47)	4.02 (2.2, 7.35)	1.88 (0.88, 4.01)
2012	0.84 (0.44, 1.60)	5.97 (4.32, 8.27)	5.04 (3.64, 6.97)	4.20 (2.93, 6.03)	0.51 (0.11, 2.26)	4.81 (2.87, 8.06)	3.80 (2.08, 6.93)	4.3 (2.65, 7.00)
2013	0.53 (0.24, 1.17)	4.52 (3.14, 6.50)	4.87 (3.53, 6.72)	4.96 (3.59, 6.86)	0.24 (0.03, 1.97)	4.77 (2.89, 7.90)	4.06 (2.31, 7.14)	3.58 (2.13, 6.01)
2014	0.51 (0.23, 1.12)	3.39 (2.25, 5.12)	4.92 (3.60, 6.73)	4.16 (2.94, 5.88)	0.68 (0.20, 2.30)	3.84 (2.23, 6.63)	3.84 (2.18, 6.76)	5.20 (3.42, 7.90)
2015	0.73 (0.39, 1.40)	3.59 (2.42, 5.31)	4.81 (3.53, 6.56)	4.65 (3.37, 6.41)	0.43 (0.10, 1.91)	2.79 (1.49, 5.20)	4.72 (2.87, 7.75)	3.64 (2.24, 5.93)
2016	0.86 (0.48, 1.55)	2.98 (1.96, 4.55)	4.63 (3.39, 6.32)	4.94 (3.64, 6.71)	2.25 (1.19, 4.25)	3.88 (2.32, 6.50)	6.95 (4.66, 10.36)	4.70 (3.09, 7.14)
2017	0.98 (0.57, 1.68)	3.17 (2.12, 4.74)	5.82 (4.43, 7.63)	6.04 (4.61, 7.93)	2.15 (1.14, 4.07)	2.54 (1.36, 4.74)	6.65 (4.46, 9.91)	4.89 (3.27, 7.30)
2018	1.53 (1.00, 2.33)	3.06 (2.05, 4.57)	5.32 (4.02, 7.03)	5.17 (3.88, 6.90)	2.44 (1.36, 4.39)	4.70 (2.99, 7.37)	6.01 (3.98, 9.08)	3.38 (2.11, 5.43)
75-84 years								
2005	-	-	-	-	6.77 (4.15, 11.04)	2.90 (1.18, 7.13)	0.97 (0.23, 4.11)	0.48 (0.06, 4.11)
2006	-	-	-	-	3.33 (1.67, 6.66)	5.24 (2.69, 10.18)	2.86 (1.24, 6.59)	0.48 (0.06, 4.05)
2007	2.17 (1.29, 3.65)	3.51 (2.09, 5.90)	2.34 (1.27, 4.30)	2.84 (1.63, 4.94)	3.77 (1.97, 7.20)	4.71 (2.35, 9.46)	3.30 (1.52, 7.14)	2.83 (1.18, 6.77)
2008	3.14 (2.04, 4.82)	5.45 (3.60, 8.24)	3.47 (2.11, 5.70)	4.29 (2.74, 6.72)	3.26 (1.63, 6.52)	3.26 (1.42, 7.51)	8.39 (5.18, 13.58)	4.66 (2.37, 9.17)

2009	1.31 (0.68, 2.53)	8.18 (5.84, 11.45)	4.58 (2.98, 7.04)	3.92 (2.46, 6.26)	1.39 (0.48, 3.99)	6.01 (3.26, 11.07)	5.54 (3.07, 10.01)	2.77 (1.16, 6.64)
2010	1.13 (0.56, 2.29)	9.21 (6.72, 12.62)	4.36 (2.81, 6.76)	5.98 (4.10, 8.70)	1.82 (0.73, 4.55)	6.84 (3.87, 12.08)	2.74 (1.19, 6.31)	1.82 (0.63, 5.32)
2011	1.27 (0.66, 2.47)	10.04 (7.44, 13.55)	4.62 (3.03, 7.05)	7.81 (5.63, 10.82)	0.45 (0.07, 2.80)	5.83 (3.16, 10.74)	4.48 (2.35, 8.56)	6.28 (3.54, 11.12)
2012	1.10 (0.54, 2.23)	8.64 (6.26, 11.90)	5.97 (4.12, 8.64)	6.91 (4.90, 9.75)	1.76 (0.71, 4.41)	4.41 (2.20, 8.86)	5.29 (2.93, 9.56)	4.41 (2.24, 8.68)
2013	1.54 (0.86, 2.79)	5.25 (3.49, 7.90)	6.95 (4.95, 9.76)	6.18 (4.30, 8.86)	0.87 (0.24, 3.16)	5.20 (2.75, 9.83)	6.50 (3.83, 11.02)	5.20 (2.80, 9.65)
2014	1.36 (0.73, 2.54)	4.54 (2.94, 7.02)	6.21 (4.35, 8.87)	8.33 (6.12, 11.34)	0.00	4.25 (2.12, 8.54)	11.48 (7.74, 17.01)	4.68 (2.45, 8.92)
2015	1.04 (0.51, 2.11)	5.81 (3.97, 8.50)	8.04 (5.90, 10.97)	8.19 (6.02, 11.15)	1.25 (0.43, 3.59)	4.57 (2.35, 8.89)	5.82 (3.37, 10.06)	10.40 (6.78, 15.95)
2016	1.02 (0.50, 2.07)	5.11 (3.42, 7.64)	6.86 (4.92, 9.56)	6.27 (4.43, 8.89)	1.21 (0.42, 3.49)	3.24 (1.48, 7.06)	6.48 (3.88, 10.80)	7.69 (4.71, 12.57)
2017	0.99 (0.49, 2.01)	3.40 (2.09, 5.53)	7.23 (5.26, 9.96)	9.50 (7.19, 12.57)	2.74 (1.37, 5.48)	4.70 (2.49, 8.89)	8.23 (5.27, 12.86)	5.88 (3.38, 10.21)
2018	1.37 (0.76, 2.48)	3.70 (2.34, 5.86)	8.09 (6.01, 10.89)	7.41 (5.43, 10.11)	2.26 (1.07, 4.77)	4.14 (2.13, 8.05)	7.90 (5.06, 12.35)	3.76 (1.91, 7.41)
≥85 years								
2005	-	-	-	-	11.20 (6.46, 19.40)	9.80 (4.45, 21.57)	4.20 (1.25, 14.16)	2.80 (0.66, 11.88)
2006	-	-	-	-	5.27 (2.42, 11.46)	2.63 (0.60, 11.53)	2.63 (0.59, 11.67)	2.63 (0.62, 11.18)
2007	7.37 (4.68, 11.63)	9.83 (5.93, 16.31)	5.41 (2.78, 10.53)	4.42 (2.00, 9.77)	7.49 (3.97, 14.13)	6.24 (2.45, 15.88)	11.24 (5.57, 22.66)	6.24 (2.50, 15.58)
2008	6.05 (3.71, 9.87)	13.96 (9.23, 21.11)	4.65 (2.31, 9.36)	5.12 (2.50, 10.48)	7.17 (3.80, 13.52)	13.14 (7.00, 24.67)	14.33 (7.81, 26.32)	4.78 (1.72, 13.28)
2009	5.29 (3.18, 8.81)	14.11 (9.46, 21.06)	9.26 (5.72, 15.00)	5.73 (2.97, 11.09)	3.43 (1.40, 8.43)	12.59 (6.71, 23.64)	4.58 (1.60, 13.12)	9.16 (4.44, 18.87)
2010	7.55 (4.98, 11.44)	15.51 (10.69, 22.51)	8.81 (5.44, 14.26)	10.48 (6.52, 16.86)	0.00	9.92 (4.94, 19.89)	7.71 (3.48, 17.09)	6.61 (2.87, 15.23)
2011	3.21 (1.72, 5.99)	12.43 (8.28, 18.67)	9.63 (6.13, 15.11)	14.84 (10.04, 21.94)	0.00 0	8.53 (4.08, 17.85)	6.40 (2.71, 15.11)	14.92 (8.64, 25.78)
2012	2.68 (1.38, 5.23)	14.57 (10.09, 21.04)	10.74 (7.07, 16.30)	12.65 (8.36, 19.14)	3.10 (1.26, 7.61)	10.34 (5.34, 20.01)	13.44 (7.49, 24.09)	13.44 (7.62, 23.69)

2013	1.11 (0.40, 3.06)	11.05 (7.31, 16.71)	10.68 (7.09, 16.10)	10.32 (6.58, 16.17)	2.00 (0.67, 6.02)	9.02 (4.50, 18.10)	10.02 (5.15, 19.51)	13.03 (7.39, 22.98)
2014	0.71 (0.20, 2.48)	10.67 (7.06, 16.14)	12.45 (8.57, 18.09)	16.72 (11.82, 23.65)	1.94 (0.65, 5.83)	8.74 (4.36, 17.54)	9.71 (4.99, 18.9)	15.54 (9.32, 25.91)
2015	2.75 (1.47, 5.14)	6.19 (3.63, 10.56)	14.10 (9.99, 19.91)	14.45 (10.01, 20.85)	2.83 (1.15, 6.95)	7.55 (3.61, 15.81)	4.72 (1.84, 12.1)	10.39 (5.61, 19.24)
2016	1.65 (0.75, 3.64)	7.27 (4.49, 11.79)	9.59 (6.36, 14.45)	13.22 (9.08, 19.26)	0.92 (0.19, 4.34)	0.00	9.17 (4.71, 17.84)	11.92 (6.76, 21.02)
2017	2.24 (1.15, 4.36)	6.39 (3.85, 10.60)	12.46 (8.75, 17.75)	16.30 (11.68, 22.74)	0.89 (0.19, 4.23)	8.93 (4.61, 17.29)	7.14 (3.39, 15.04)	14.29 (8.57, 23.82)
2018	0.31 (0.05, 1.81)	6.52 (3.98, 10.69)	15.53 (11.36, 21.22)	18.95 (13.97, 25.69)	1.74 (0.58, 5.22)	3.48 (1.22, 9.88)	6.95 (3.3, 14.64)	11.30 (6.41, 19.93)

Supplemental Table S4: Indirect impact of PCV13 on invasive pneumococcal disease and hospitalized pneumonia in older adults by age group in Ontario, 2005–2018*

Age group, years	Fracture control				Skin and soft tissue infection control			
	Incidence per 100,000		Ratio of risk ratios (95% CI)	P-value	Incidence per 100,000		Ratio of risk ratios (95% CI)	P-value
	Case, pre-PCV13, PCV13	Control, pre-PCV13, PCV13			Case, pre-PCV13, PCV13	Control, pre-PCV13, PCV13		
All IPD								
65-74	15.1, 15.4	45.0, 46.2	0.99 (0.79, 1.26)	0.9651	15.0, 15.0	44.4, 45.1	0.99 (0.79, 1.23)	0.8959
75-84	22.1, 24.7	66.4, 74.0	1.00 (0.79, 1.26)	1.0000	22.0, 24.3	65.2, 72.9	0.99 (0.80, 1.22)	0.8914
≥85	45.3, 44.5	135.5, 133.5	1.00 (0.77, 1.30)	0.9857	44.6, 42.8	130.9, 128.5	0.98 (0.77, 1.24)	0.8640
PCV7 IPD								
65-74	2.3, 0.4	6.8, 1.3	1.00 (0.59, 1.71)	1.0000	2.2, 0.4	6.4, 1.2	0.95 (0.56, 1.62)	0.8615
75-84	2.0, 1.2	6.1, 3.5	1.00 (0.51, 1.97)	1.0000	2.0, 1.2	6.0, 3.5	0.98 (0.52, 1.82)	0.9367
≥85	6.0, 1.9	17.9, 5.7	1.00 (0.49, 2.02)	1.0000	6.0, 1.6	17.5, 4.9	0.97 (0.49, 1.92)	0.9270
Additional PCV13 IPD								
65-74	3.3, 4.4	9.8, 13.1	0.99 (0.65, 1.52)	0.9686	3.3, 4.1	10.0, 12.4	1.00 (0.66, 1.49)	0.9836
75-84	4.8, 6.3	14.4, 18.8	1.00 (0.66, 1.52)	1.0000	4.7, 6.0	13.9, 17.9	0.99 (0.67, 1.45)	0.9406
≥85	10.7, 10.6	31.9, 31.9	0.99 (0.62, 1.59)	0.9769	10.6, 10.4	30.6, 31.1	0.97 (0.62, 1.51)	0.8774
Unique PPV23 IPD								
65-74	1.6, 3.8	4.7, 11.4	0.98 (0.63, 1.52)	0.9173	1.6, 3.8	4.9, 11.4	0.99 (0.65, 1.51)	0.9570
75-84	2.9, 5.2	8.7, 15.5	1.00 (0.63, 1.60)	1.0000	2.9, 5.0	8.7, 15.0	0.99 (0.63, 1.54)	0.9576

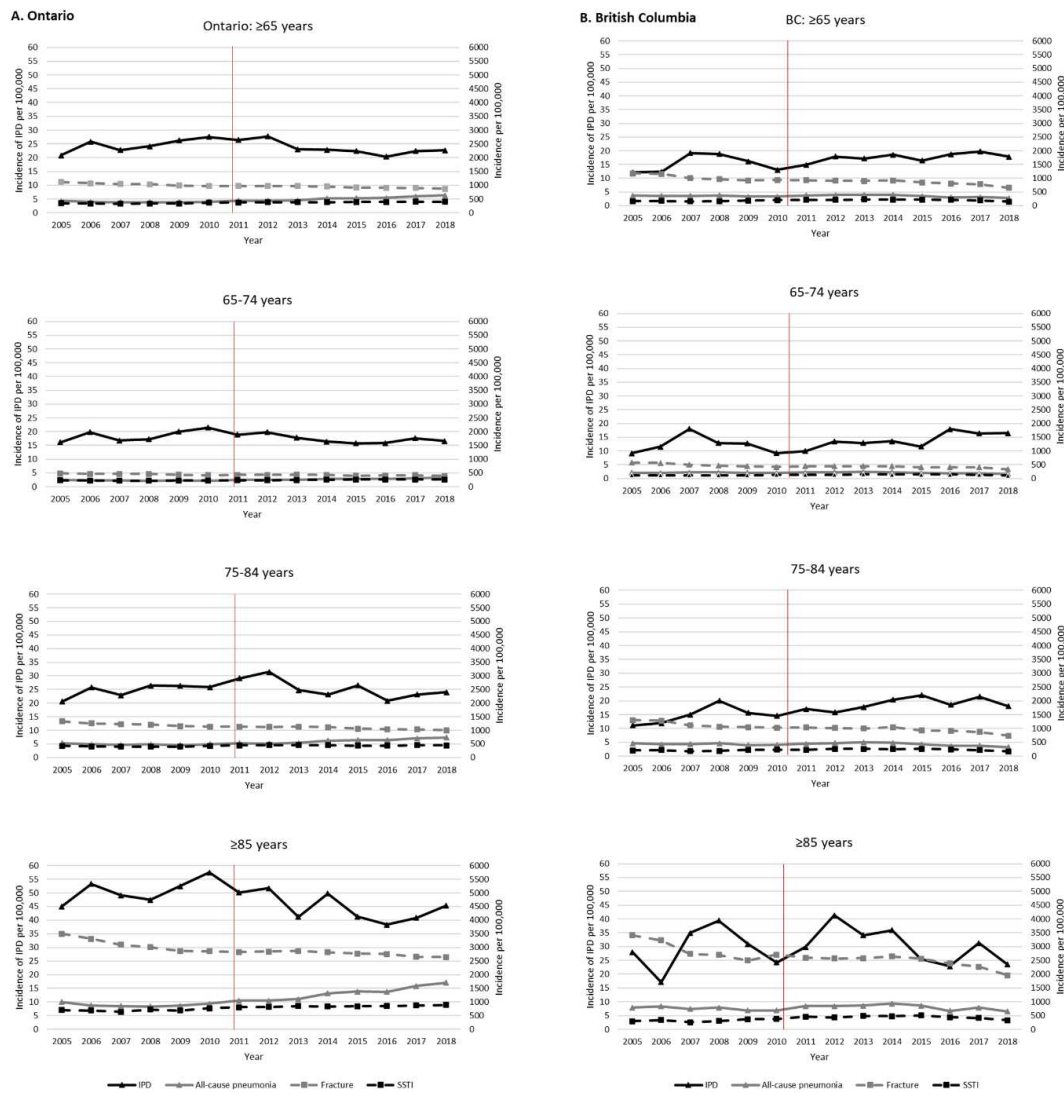
≥85	6.3, 9.9	18.4, 29.7	0.98 (0.58, 1.67)	0.9504	6.4, 9.4	18.8, 28.3	0.98 (0.60, 1.60)	0.9462
Non-vaccine serotype IPD								
65-74	1.6, 3.8	4.7, 11.5	1.00 (0.59, 1.67)	0.9854	1.6, 3.8	4.7, 11.5	1.00 (0.60, 1.66)	1.0000
75-84	3.2, 6.9	9.6, 20.8	1.00 (0.66, 1.53)	1.0000	3.2, 7.1	9.6, 21.4	1.00 (0.66, 1.51)	1.0000
≥85	4.7, 11.9	13.7, 35.7	0.98 (0.56, 1.70)	0.9301	4.4, 11.6	12.7, 34.9	0.96 (0.56, 1.63)	0.8656
All-cause pneumonia								
65-74	223.7, 269.3	461.1, 406.1	1.37 (1.27, 1.47)	<0.0001	220.4, 232.3	220.2, 232.3	1.00 (0.93, 1.08)	0.9806
75-84	484.1, 603.7	1221.8, 1068.8	1.43 (1.32, 1.54)	<0.0001	470.5, 428.3	411.2, 428.3	0.87 (0.80, 0.95)	0.0019
≥85	865.7, 1262.7	2517.2, 2667.8	1.38 (1.23, 1.54)	<0.0001	793.7, 773.2	694.5, 773.2	0.87 (0.78, 0.98)	0.0166

* Invasive pneumococcal disease (IPD) identified from public health laboratory data, and pneumonia identified from CIHI hospital admission discharge abstract database (DAD)

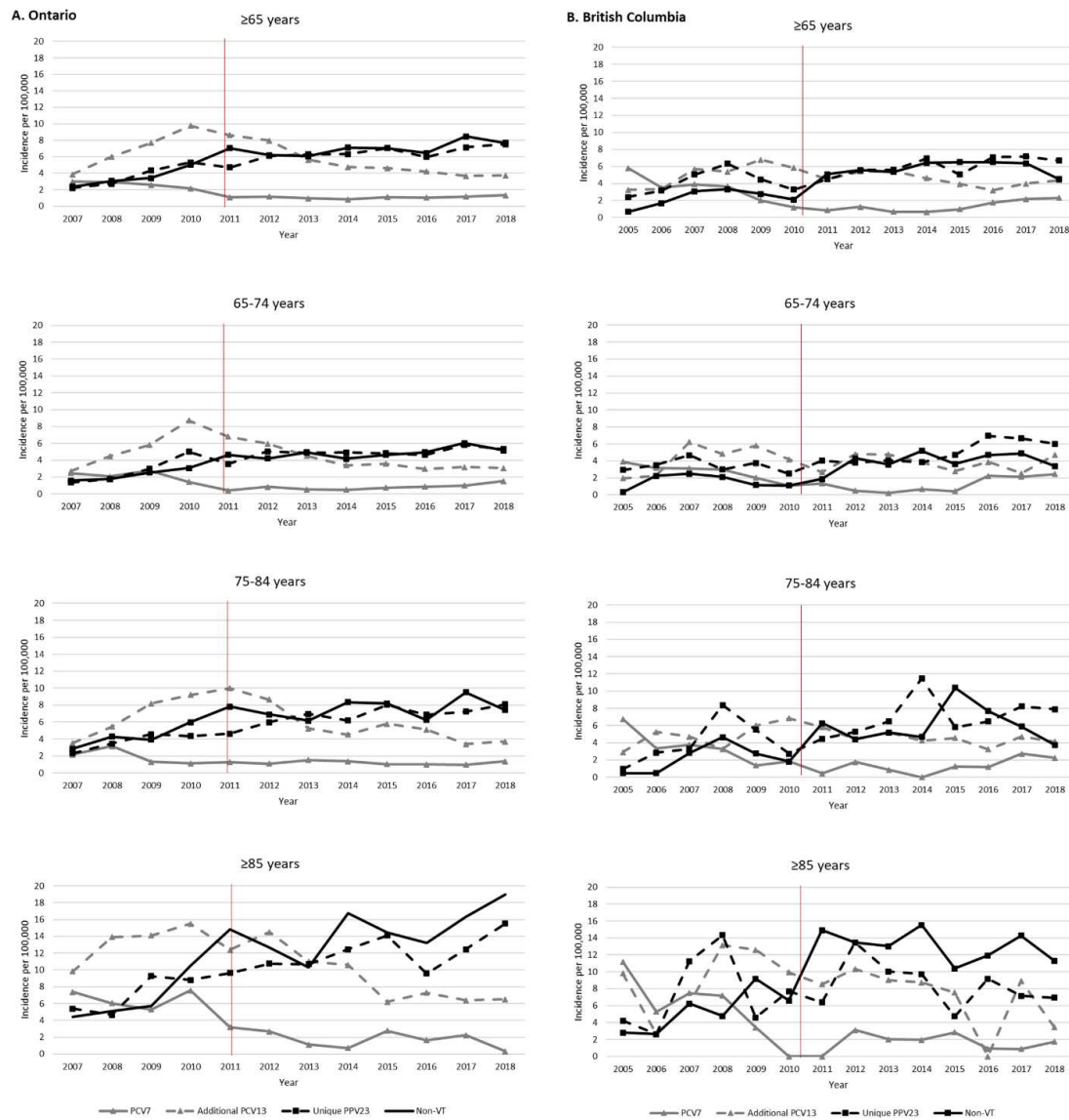
Supplemental Table S5: Indirect impact of PCV13 on invasive pneumococcal disease and hospitalized pneumonia in older adults by age group in British Columbia, 2005–2018

Age group, years	Fracture control				Skin and soft tissue infection control			
	Incidence per 100,000		Ratio of risk ratios (95% CI)	P-value	Incidence per 100,000		Ratio of risk ratios (95% CI)	P-value
	Case, pre-PCV13, PCV13	Control, pre-PCV13, PCV13			Case, pre-PCV13, PCV13	Control, pre-PCV13, PCV13		
All IPD								
65-74	12.5, 13.6	37.3, 41.0	1.00 (0.77, 1.28)	0.9795	12.5, 13.7	37.5, 40.9	1.00 (0.78, 1.29)	0.9991
75-84	14.8, 18.1	44.2, 54.2	0.99 (0.79, 1.26)	0.9533	14.7, 18.1	44.0, 54.4	1.00 (0.79, 1.26)	0.9766
≥85	29.1, 29.4	87.8, 88.1	1.01 (0.76, 1.33)	0.9693	29.4, 29.4	87.1, 88.1	0.99 (0.75, 1.31)	0.9384
PCV7 IPD								
65-74	2.9, 1.3	8.5, 3.9	0.97 (0.58, 1.64)	0.9197	2.9, 1.3	8.6, 3.9	1.00 (0.59, 1.69)	1.00
75-84	3.5, 1.4	10.6, 4.1	1.00 (0.55, 1.82)	1.00	3.5, 1.4	10.6, 4.1	1.00 (0.55, 1.83)	1.00
≥85	6.2, 1.5	18.7, 4.6	1.00 (0.50, 2.01)	1.00	6.2, 1.5	18.5, 4.6	0.99 (0.49, 1.98)	0.971
Additional PCV13 IPD								
65-74	4.1, 3.8	12.4, 11.3	1.00 (0.69, 1.45)	1.00	4.1, 3.8	12.4, 11.3	1.00 (0.69, 1.45)	1.00
75-84	4.7, 4.6	14.0, 13.8	1.00 (0.66, 1.51)	1.00	4.7, 4.6	13.8, 13.9	0.98 (0.65, 1.48)	0.924
≥85	8.9, 7.3	26.6, 21.8	1.00 (0.59, 1.69)	1.00	8.9, 7.3	26.6, 21.8	1.00 (0.59, 1.69)	1.00
Unique PPV23 IPD								
65-74	3.5, 4.9	10.6, 14.7	1.00 (0.69, 1.45)	1.00	3.5, 4.9	10.6, 14.7	1.00 (0.69, 1.45)	1.00
75-84	4.3, 6.5	12.9, 19.5	1.00 (0.66, 1.52)	1.00	4.3, 6.5	12.9, 19.5	1.00 (0.66, 1.52)	1.00

≥85	7.4, 8.2	22.3, 24.5	1.00 (0.59, 1.68)	1.00	7.4, 8.2	22.0, 24.5	0.99 (0.59, 1.66)	0.9674
Non-vaccine serotype IPD								
65-74	1.7, 3.7	5.0 11.0	1.00 (0.61, 1.63)	1.00	1.7, 3.7	5.0, 11.0	1.00 (0.62, 1.62)	1.00
75-84	2.1, 5.7	6.4, 17.1	1.00 (0.54, 1.85)	1.00	2.1, 5.7	6.4, 17.1	1.00 (0.54, 1.84)	1.00
≥85	5.2, 12.4	15.5, 37.2	1.00 (0.59, 1.70)	1.00	5.2, 12.4	15.5, 37.2	1.00 (0.59, 1.70)	1.00
All-cause pneumonia								
65-74	189.3, 183.0	568.2, 549.0	1.00 (0.92, 1.09)	0.998	189.0, 183.3	566.6, 549.6	1.00 (0.92, 1.09)	0.9919
75-84	397.6, 381.0	1191.7, 1142.9	1.00 (0.91, 1.09)	0.9853	396.4, 381.2	1190.0, 1144.9	1.00 (0.92, 1.09)	0.992
≥85	721.1, 731.9	2167.2, 2194.6	1.00 (0.90, 1.12)	0.9664	721.3, 732.1	2150.7, 2195.0	0.99 (0.89, 1.11)	0.9217



Supplemental Figure 1: Annual incidence of invasive pneumococcal disease, IPD (left-hand axes), all-cause pneumonia (right-hand axes), fracture (right-hand axes), and skin and soft tissue infection, SSTI (right-hand axes), ≥ 65 years and for each age group in Ontario (A) and British Columbia (B), 2005–2018. Red vertical line indicates the introduction of PCV13 in publicly funded childhood vaccination program in 2010.



Supplemental Figure 2: Annual incidence of pneumococcal conjugate vaccine (PCV) serotype-specific invasive pneumococcal disease, ≥ 65 years and for each age group in Ontario (A) and British Columbia (B), 2005–2018. Red vertical line indicates the introduction of PCV13 in publicly funded childhood vaccination program in 2010.