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4 **Using a Service Day Method to Calculate Physician Supply – A Complementary Perspective**

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30 **Competing Interests:** The authors have no competing interests to declare. This study is
31 based in part on data provided by Alberta Health. The interpretation and conclusions
32 contained herein are those of the researchers and do not necessarily represent the views of
33 the Government of Alberta. Neither the Government of Alberta nor Alberta Health express
34 any opinion in relation to this study.
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40 **Acknowledgement:** The authors wish to extend sincere thanks to Diane Lorenzetti PhD,
41 MLS, Director, Health Sciences Library, University of Calgary, for her assistance with the
42 literature review supporting this project.
43

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46 **Funding:** Departments of Family Medicine, University of Calgary and University of Alberta
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64**Abstract**

Background: Provincial physician resource planning relies on head counts and full-time equivalent (FTE) estimates calculated using income percentiles. The income percentile (IP) method assumes a unit of FTE provides equal service, without distinguishing between provider service day provision and broader availability. We offer an alternative method based on service day activities.

Methods: Two methods of calculating the number of part-time (PT) and full-time (FT) GPs were compared. The IP approach was calculated using CIHI's method applied to Alberta Health fee-for-service billing data from 2011-2016. The service day method calculated annual service days for each PT and FT GP. A categorical comparative descriptive analysis was conducted.

Results: Both methods estimated 39% of all FFS GPs were PT, but not exactly the same individuals. The proportions of PT GPs were 44% and 36% for Calgary and Edmonton respectively, vs. a low of 29% in central Alberta. Panel size was smaller among those classified as PT by service days but FT by IP. The proportion of visits from GPs' own panels was highest among GPs who were FT by service days and PT by IP (72.0%) and lowest among GPs PT by service days but FT by IP (38.0%).

Interpretation: The SVD method provides an alternative approach to calculating GP supply. It identifies high income PT GPs who are classified as FT by the IP method. They provide fewer service days than might be expected by policymakers and have low patient continuity. A substantial fraction of GPs, notably in metropolitan areas, are PT.

65 Introduction

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67 Estimating primary care physician resources in Canadian provinces, both in numbers and
68 patterns of practice, is important for health resource planning. Accurate estimates are
69 necessary to guide policies that support patient access and continuity, as both have been
70 shown to improve health outcomes.(1-5)

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72 Across Canada, health resource planning relies largely on GP head counts and full-time-
73 equivalent (FTE) estimates using methods from the Canadian Institute for Health
74 Information (CIHI) (6-11). The CIHI method estimates the number of FTEs based on
75 income thresholds using gross physician income using fee for service payments. GPs with
76 incomes falling below, within, or above the 40th to 60th percentile interval are categorized
77 as being less than, equal to, or more than 1.0 FTE respectively (6, 12).

78
79 These FTE counts are then used to calculate national and provincial physician-to-
80 population ratios or to serve as simple head counts. The income percentiles approach can
81 classify high-billing part-time physicians as full time and low-billing full-time physicians
82 as part-time. That is important to understand for health policy makers who rely on these
83 method estimates for evaluating current service supply. In the public domain, this
84 information is often referenced in terms of equating physician to population ratios to patient
85 access (13). However, because it could count a physician who provides a large number of
86 very short visits on a minority of days a week as full time, the income percentile method
87 may not provide an accurate picture of patient service or access (14-16)

88
89 As an alternative and complementary perspective, we propose a novel method using service
90 activity days to calculate the number of GPs in full-time and part-time practice. Our
91 research objective is to compare the income percentile methodology to this service-day
92 method using a large administrative billing data set from Alberta. We developed the
93 service day method to identify and describe high volume GPs in Alberta (17). In that work
94 we discovered that there were physicians in clinic relatively few days but generating very
95 high billings, leading us to hypothesize that the income percentile method may not yield an
96 accurate picture of full-time and part-time GPs.

97 Methods:

98 *Study Cohort*

99 All FFS GPs in Alberta practicing between 2011 and 2016 are included in this study. This
100 comprises over 80% of GPs practicing in Alberta.

101 *Data Sources*

102 Provincial physician claims data were obtained from Alberta Health for all study physicians
103 for the period April 1st, 2011 to March 30th, 2016. Each GP's main service delivery site
104 was identified from billing data. This dataset has been shown to have value and face
105 validity for health services research (18).

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4 106 A second dataset containing GP demographic characteristics including provider sex, years
5 107 since medical school graduation, and country of medical school training was obtained from
6 108 the College of Physicians and Surgeons of Alberta. This dataset is a complete registry of all
7 109 practicing GPs in Alberta.

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10 110 *Data Variables*

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12 111 *Physicians' Service Days and Average Patient Volumes*

13 112 The average daily patient visit volume was calculated as the average number of visits per
14 113 service day. One service day was defined by the physician billing 10 or more patient visits
15 114 on one calendar day. Only visits with fees of \$25 or more were counted toward the 10. This
16 115 amount captures almost all GP services codes from the Schedule of Medical Benefits from
17 116 the Alberta Health Care Insurance Plan including office visits as well as hospital and long-
18 117 term care visits (19, 20). The common exceptions that are under \$25 include Pap smears
19 118 (which are billed alongside a visit code - we wished to exclude them to avoid double
20 119 counting two fees in a visit as two visits) and phone calls. Total service days for each GP
21 120 for the entire fiscal year in 2015 were used. Duplicate visits were considered genuine
22 121 clinical activity and included in the total average daily visit volume. GPs that had evidence
23 122 of any shadow billing (760 in total) were removed. In Alberta, shadow billing is used for
24 123 physicians in academic or other salaried arrangements. Their practice patterns are different
25 124 and are not the focus of this analysis.

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31 126 *Physician Full-Time and Part-Time Status*

32 127 FT is defined as providing 3 or more service days per week over 46 weeks of the year. PT
33 128 is defined as providing less than 3 days per week of service activity. Each fiscal year was
34 129 considered independently, so a GP may be classified as FT in one fiscal year and PT in
35 130 another.

36 131

37 132 The income percentile method used by CIHI classifies FT vs. PT by calculating the total
38 133 amount paid to each primary care physician. The 40th and 60th percentiles of all physicians
39 134 are calculated. Those falling between the 40th and 60th percentiles are considered 1.0 FTE.
40 135 The FTE for those paid under the 40th percentile are calculated as $(\text{total payments} \div \text{lower}$
41 136 $\text{benchmark})$ and those over the 60th percentile are calculated as $(1 + \ln(\text{total}$
42 137 $\text{payments} \div \text{upper benchmark}))$. We considered those under 1.0 as PT, and those greater than
43 138 or equal to 1.0 as FT. (6)

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48 140 *Patient Provider Continuity*

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50 141 Patient continuity was determined by the percentage of each patient's claims attributed to
51 142 their primary provider. Primary providers were determined using the Health Quality
52 143 Council of Alberta's published method (21).

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4 145 *Alberta Geographic Zones and Rural-Urban Continuum*

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6 146 The Province of Alberta is divided by Alberta Health Services into five zones for health
7 147 administration and into the rural-urban continuum for planning and analytical purposes.
8 148 The rural-urban continuum represents seven designated population density ranges, from
9 149 high (metro centers) to low (rural remote), across the province(22). Both zone and the rural-
10 150 urban continuum were considered in this analysis.

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13 151 *Analytical Approach*

14 152
15 153 The unit of analysis was the physician. Categorical variables were reported using
16 154 proportion and counts, while measured variables were reported with mean and standard
17 155 deviation. Descriptive statistics were reported for FT vs PT categories using both the
18 156 income percentile method and service days method. Number of service days and dollar
19 157 amount billed were also aggregated across provider income percentiles and plotted included
20 158 as figures. The analyses were conducted using R Statistical Software version 3.3.2.

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23 159 *Ethics*

24 160 Ethics approval was obtained from the Health Research Ethics Board (University of
25 161 Calgary) Study Identification no. REB17-1301.

26 162

27 163 **Results**

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29 165 *Part-time and Full-time GP Counts*

30 166 As shown in Table 1, the income percentiles and service days methods agreed on the FT
31 167 (named FT^{SI} throughout the rest of the paper) or PT classification (named PT^{SI} throughout
32 168 the rest of the paper) of 85% of physicians. However, the income percentiles method
33 169 estimates 239 physicians work FT who according to the service days method only work PT
34 170 (named PT^{SFT} throughout the rest of the paper). Similarly, 251 physicians are considered
35 171 PT according to the income percentiles method, who based upon the service day method
36 172 work more than 3 days per week seeing at least 10 patients per day (named FT^{SPT}
37 173 throughout the rest of the paper).

38 174

39 175 *Service Days Provided*

40 176 PT^{SI} GPs worked an average of ~1.5 days per week compared to ~4.49 days per week by
41 177 FT^{SI} GPs. Those who were PT by service days but FT by income percentiles (the PT^{SFT}
42 178 cohort) worked fewer days per week (~2.4) than those who were FT by service days but PT
43 179 by income percentiles (~3.6) (the FT^{SPT} cohort). See Appendix 1 for a detailed histogram
44 180 of average service day by GP cohort.

45 181

46 182 The average number of worked weekend service days seeing 10+ patients over a 46-week
47 183 period by PT^{SI} GPs was 8.08 days compared to 22.42 days by FT^{SI} GPs. Those who were
48 184 PT by service days but FT by income percentiles (the PT^{SFT} cohort) were similar to FT^{SI}
49 185 GPs, working on average 24.07 weekend service days, while those FT by service days but

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4 186 PT by income category (the FT^{SPT}^I cohort) worked many fewer: on average 8.63 weekend
5 187 days.

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8 189 Considering all days on any patient was seen, PT^{SI} GPs averaged ~2.33 days per week
9 190 compared to ~4.95 days per week for FT^{SI}. Those who were PT by service days but FT by
10 191 income percentile (the PT^{SFT}^I cohort) saw at least one patient on fewer days than those in
11 192 the reverse category (~3.22 vs. ~4.1).

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14 194 As shown in Figure 1 full-time, part-time, and FT^{SPT}^I GP cohorts are divided into annual
15 195 income quintiles. The average income as well as average service days per week for each
16 196 quintile are plotted for each group of GPs. FT^{SI} earn more than PT^{SI} and work more days
17 197 across all percentiles. However, across all quintiles, the FT^{SPT}^I cohort more closely
18 198 resembles PT^{SI} in terms of income, but FT^{SI} in terms of service days.

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20 200 Similarly, in Figure 2, FT^{SI}, PT^{SI}, and PT^{SFT}^I GP cohorts are divided into annual income
21 201 quintiles. The average income as well as average service days per week for each quintile
22 202 are plotted for each group. Again, FT^{SI} earn more than PT^{SI} and work more days across all
23 203 percentiles. However, across all quintiles, the misclassified PT^{SFT}^I group more closely
24 204 resembles FT^{SI} in terms of income, but PT^{SI} in terms of service days.

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26 206 *Average annual income*

27
28 207 The average annual income for FT^{SI} physicians is \$452,255 and \$119,024 for PT^{SI}
29 208 physicians (Table 1). The FT^{SPT}^I group earns on average \$196,447 per year while the
30 209 PT^{SFT}^I cohort earns \$324,860.

31 210

32 211 *Panel Size and Continuity*

33 212 Average panel size was notably smaller among PT^{SFT}^I cohort than the reverse pattern (527
34 213 vs. 760). Continuity, as estimated by the percent of each physician's claims that were
35 214 patients in their own panels, was notably low (38%) among the PT^{SFT}^I cohort by income
36 215 percentiles, while the FT^{SPT}^I cohort by income percentiles were similar to FT^{SI} GPs. See
37 216 Appendix for a detailed histogram of panel size by GP cohort.

38 217

39 218 *Patients seen per day*

40 219 The average volume of patients seen per day for FT^{SI} physicians is 29.27 and 16.69 for PT^{SI}
41 220 physicians (Table 1). The FT^{SPT}^I cohort see an average of 17.77 patients per day while the
42 221 PT^{SFT}^I cohort sees 26.78. See Appendix for a detailed histogram of patients per day by GP
43 222 cohort.

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46 225 *GP Practice Location*

47 226 The proportion of PT providers was greatest in Zones 2 and 4, which contain Calgary and
48 227 Edmonton (Table 1). The same urban-centric pattern of part-time practice was seen on the
49 228 urban-rural continuum.

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51 230 *Differences by Year*

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231 Differences across study years are presented in Table 2. Between 2011 and 2015. A
 232 consistent number of GPs who were FT by income percentiles methods were classified as
 233 PT by service days. Similarly, a consistent number of GPs FT by service days were
 234 classified as PT by income percentiles. The overall proportion of PT GPs increased over the
 235 period.

237 *Sensitivity Analysis*

238 The descriptive statistics were calculated for each fiscal year, with no material differences
 239 between years. We varied the definition of a “service day” for a provider from our base
 240 case of 10 or more patients to ≥ 1 , ≥ 5 , and ≥ 20 . Using these different cut-points changed
 241 counts in the categories, but the overall pattern remained unchanged.

243 **Interpretation**

244 Having an accurate count of physicians and a measurable understanding of their service
 245 provision are important points for physician resource planning (23, 24). Based on our
 246 analysis, the income percentile method and service day method yield somewhat different
 247 pictures. It is important that policymakers understand the differences of each method and
 248 their implications for planning.

250 There are two cohorts that the methods disagree on. The first are physicians who provide a
 251 high volume of services per day, have a high income, but are in clinic few days per week
 252 (the PT^SFT^I cohort). The second are physicians working full-time by service days but are
 253 PT by income, i.e., are in clinic often but do not bill large volumes (the FT^SPT^I cohort).

255 These patterns have implications for workforce planning. Physicians who are FT by income
 256 percentiles (i.e., billing volume) but PT by service days (PT^SFT^I) may be achieving that
 257 volume by providing a large number of short visits, i.e., “unbundling and churning,” using
 258 “one problem per visit” rules (25). Further, such physicians had notably lower continuity of
 259 care in our data. Hence, though the volume of service billed for may be large, the access
 260 they provide and the number of patients properly cared for may not correspond to their
 261 ostensible FT status.

263 Conversely, physicians who are PT by income percentiles but FT by service days (FT^SPT^I),
 264 while they have the small panels expected of PT physicians, are in clinic often and have
 265 high continuity. Hence they may be providing more service from the public’s perspective
 266 than their income percentiles suggest.

268 These patterns’ impact on timeliness of access and continuity of care should be considered
 269 by health workforce planners. Together with the access and continuity impact of the general
 270 trend toward PT practice (26, 27), they will affect estimates of desired physician supply in
 271 Canada.

274 *Weaknesses*

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276 The primary limitation of this study was the absence of a time stamp on GP claims. Hence,
277 we could not estimate the number of work hours per week. Of necessity, we also excluded
278 physicians on alternative reimbursement plans. In this first analysis, we did not assess
279 specialized practices such as low-risk obstetrics or palliative care, in which a physician
280 might well bill < 10 visits in what is nonetheless a full work day. Finally, it is possible that
281 some of the high-billing-volume physicians are actually physicians supervising one or more
282 nurse-practitioners as those arrangements are not distinguishable in Alberta's data.
283 However, such arrangements are very few in number in Alberta.

284

285 *Conclusion:*

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287 Our next step is to explore the full scope of practice activities being provided by GPs, and
288 compare PT and FT by activities. Given the trend toward the Patient's Medical Home
289 model of care delivery, along with newer graduates offering less direct patient care,
290 working less but providing full spectrum of primary care may be the new norm.
291 Policymakers will need a clear picture of these nuances to plan accurately for health
292 workforce supply in Alberta and across Canada.

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Table 1: Physician Categorization and Characteristics for 2015

Categorization, Service Days (SVD) vs Income Percentiles (IP) methods	PT ^{SI}	PT ^{SFT}	FT ^{SPT}	FT ^{SI}
GP Counts & Characteristics				
GP Count (%)	931 (28%)	239 (7.2%)	251 (7.6%)	1900 (57.2%)
Gender – M (sd)	355 (38.1)	157 (65.7)	108 (43.0)	1344 (70.7)
Years Since Graduation (sd)	20.30 (13.79)	20.79 (11.96)	23.10 (12.65)	22.53 (11.54)
International Medical Graduate (sd)	164 (17.6)	36 (15.1)	47 (18.7)	747 (39.4)
Registered as Family Physician (sd)	208 (22.3)	57 (23.8)	89 (35.5)	668 (35.2)
Service Days				
Service Days with 10 patient min (sd)	70.02 (39.92)	110.80 (25.16)	166.55 (22.64)	206.53 (37.96)
Service Days with 20 patient min (sd)	30.88 (29.52)	82.80 (33.58)	67.99 (42.08)	166.27 (56.65)
Service Days with any patients (sd)	107.21 (56.27)	148.17 (37.98)	189.00 (28.76)	227.79 (40.48)
Average Service Days per week with 10 patient min	2.33	3.22	4.10	4.93
Days <10 Patients (sd)	37.20 (45.76)	37.37 (47.34)	22.45 (20.45)	21.27 (23.36)
Weekend Days with 10+ (sd)	8.08 (10.19)	24.07 (14.45)	8.63 (12.60)	22.42 (20.23)
Weekend Days with 20+ (sd)	5.54 (8.70)	21.05 (14.27)	4.90 (9.53)	17.65 (18.94)
Average Annual Income				
Average Annual Income (sd)	\$119034 (61033)	\$324860 (103153)	\$196447 (26182)	\$453255 (207759)
Panel Characteristics and Patient Volume				
Panel Size (sd)	295.93 (212.04)	527.30 (350.98)	760.06 (226.31)	1257.84 (674.26)
Percentage of Claims from Panel (sd)	47.10 (24.77)	38.03 (22.40)	72.00 (19.76)	69.12 (21.52)
Average Patient Volume (sd)	16.69 (7.86)	26.78 (14.73)	17.77 (3.85)	29.27 (11.41)
GP Practice Location				
Zone 1	56 (6.0)	11 (4.6)	13 (5.2)	158 (8.3)
Zone 2	408 (43.8)	87 (36.4)	105 (41.8)	680 (35.8)
Zone 3	83 (8.9)	23 (9.6)	14 (5.6)	256 (13.5)
Zone 4	278 (29.9)	87 (36.4)	104 (41.4)	623 (32.8)
Zone 5	67 (7.2)	31 (13.0)	14 (5.6)	176 (9.3)
Unknown Zone	39 (4.2)	0 (0)	1 (0.4)	7 (0.4)
URBAN	72 (7.7)	29 (12.1)	19 (7.6)	223 (11.7)
METRO	572 (61.4)	132 (55.2)	163 (64.9)	964 (50.7)
MODERATE METRO INFLUENCE	72 (7.7)	27 (11.3)	39 (15.5)	262 (13.8)
MODERATE URBAN INFLUENCE	4 (0.4)	2 (0.8)	3 (1.2)	21 (1.1)
RURAL	126 (13.5)	39 (16.3)	16 (6.4)	301 (15.8)
RURAL CENTRE AREA	30 (3.2)	6 (2.5)	6 (2.4)	85 (4.5)
RURAL REMOTE	16 (1.7)	4 (1.7)	4 (1.6)	37 (1.9)
unknown	39 (4.2)	0 (0)	1 (0.4)	7 (0.4)

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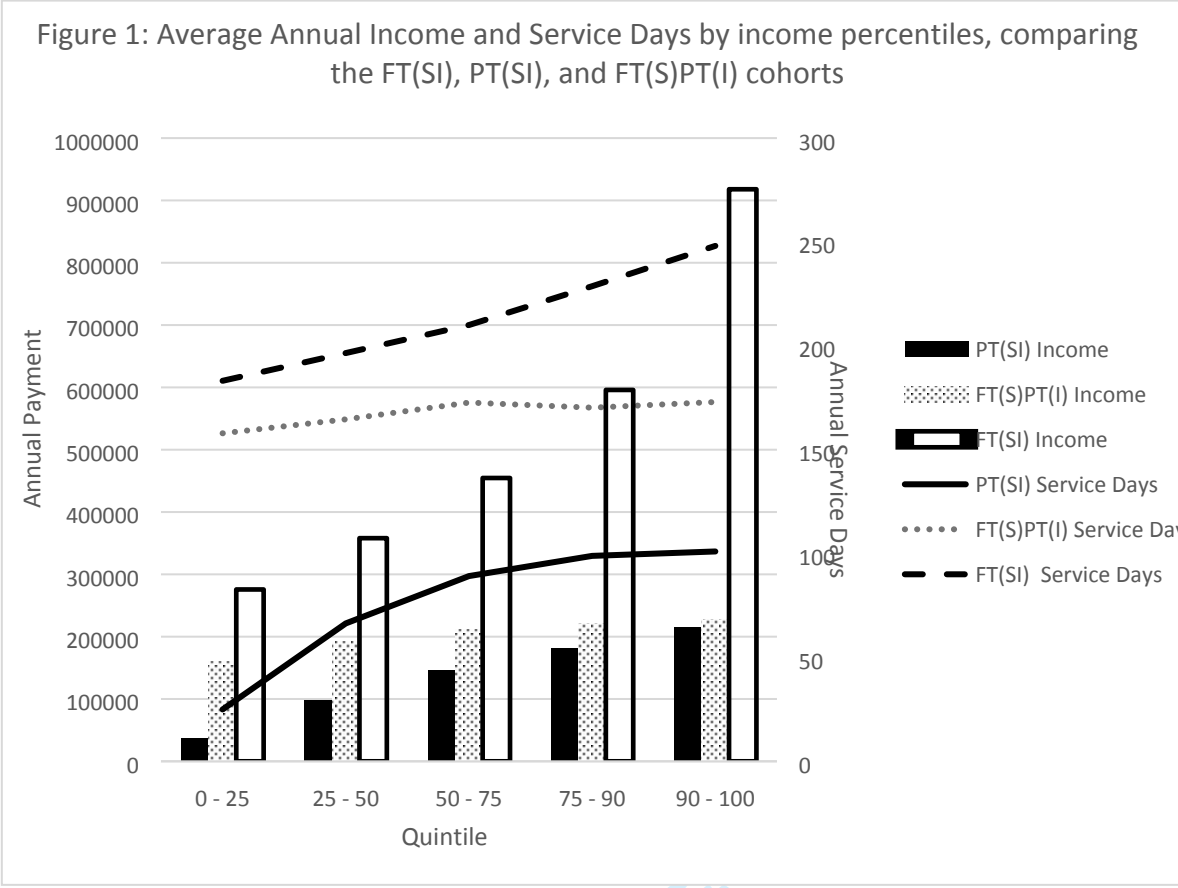
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Table 2. Service Day Method vs. Income Percentile Method - Part-time and Full-time Counts (2011-2015)

Year	Service Day Method			Income Percentile Method		
	Full-time	Part-time	PT ^{SFT} ¹ Cohort	Full-time	Part-time	FT ^{SPT} ¹ Cohort
2015	2151	1170	239	2139	1182	251
2014	2106	1076	237	2098	1084	245
2013	1985	1036	246	2007	1014	224
2012	1935	865	210	1917	983	228
2011	1895	868	172	1812	951	255

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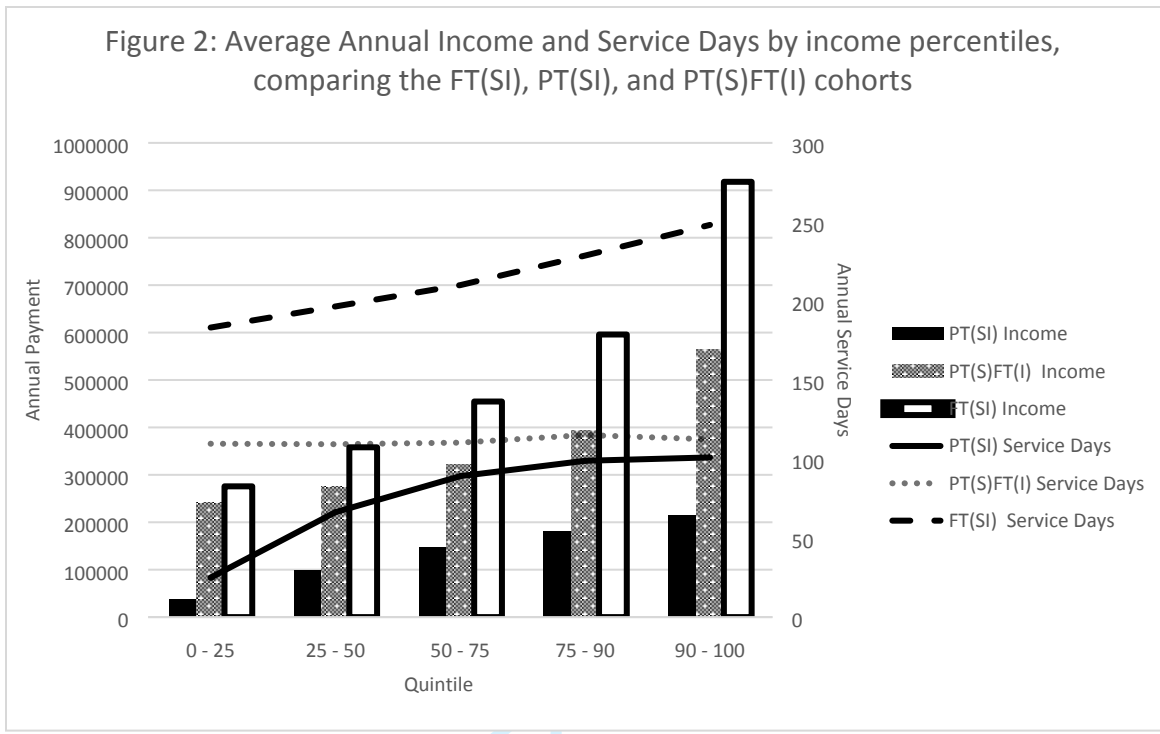


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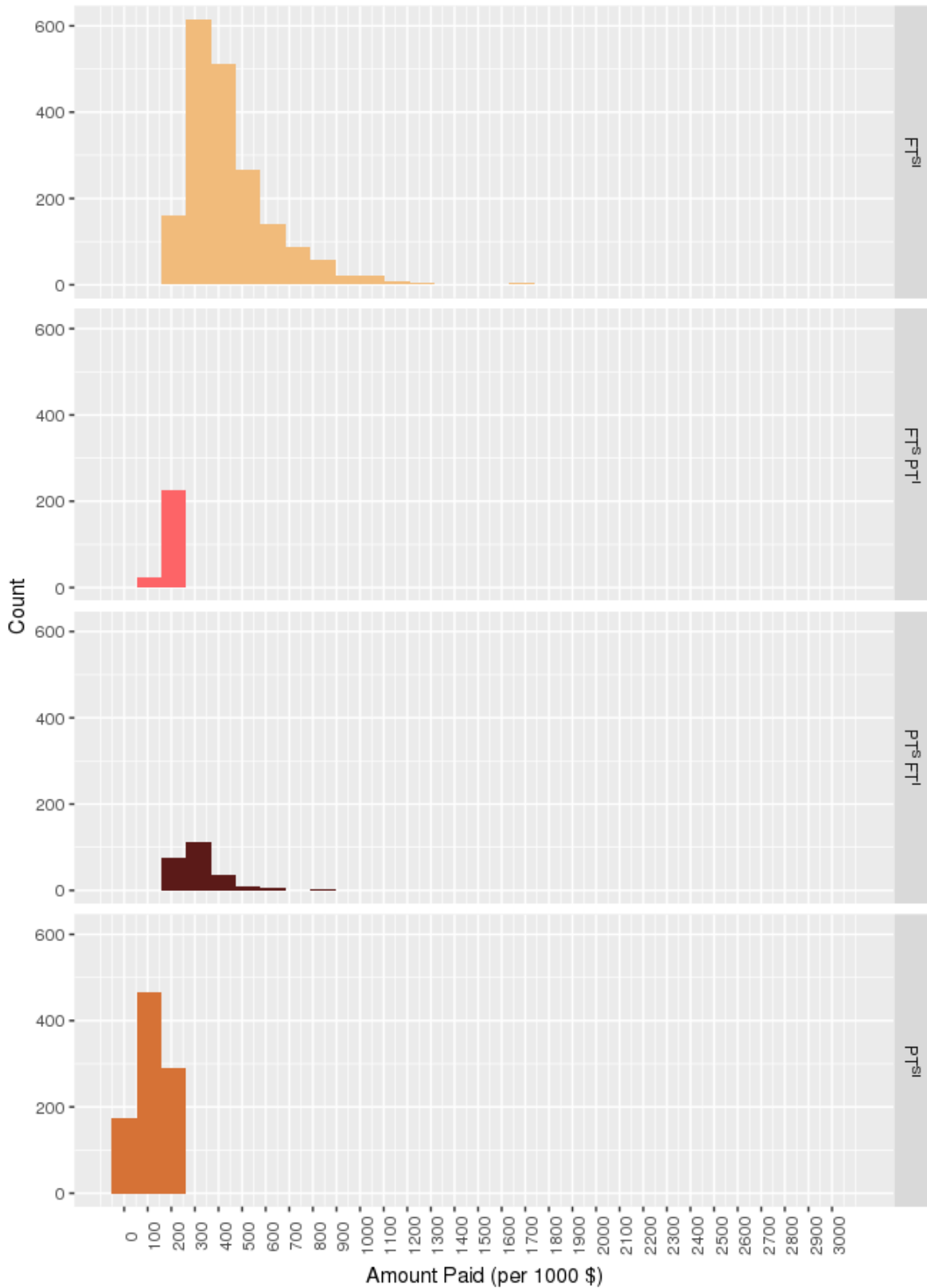
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Appendix

Figure A1: Average Annual Income by GP cohort.



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Figure A2 Panel Size by GP cohorts

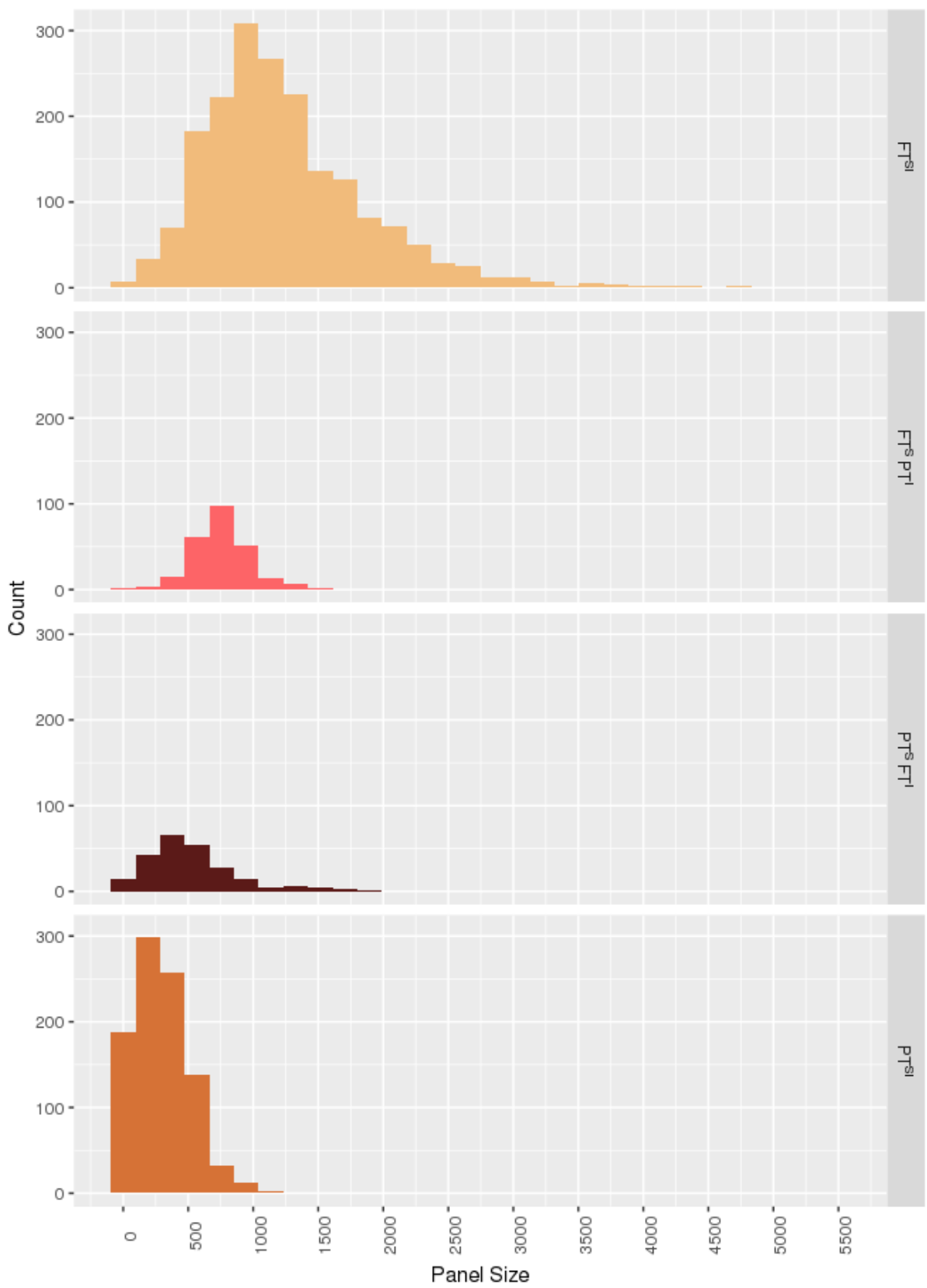


Figure A3: Average Patient Volume by GP cohort

