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3 **1 Supply and Demographic Characteristics of Ontario's Ophthalmologists from 2010-2019:**
4 **2 A Population-Based Analysis**
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3 **47 ABSTRACT**

4 **48 BACKRGOUND:** Ontario continues to have a rapidly aging population. Ophthalmologists
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7 **49** provide most of their care to the elderly, which has prominent human resource implications when
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9 **50** considering that the utilization of ophthalmic services is highest amongst older individuals.
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11 **51** Therefore, this study investigated the supply and demographic characteristics of Ontario's
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13 **52** ophthalmologists.
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18 **54 METHODS:** In this retrospective, population-based analysis, cohort demographics including
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20 **55** sex and career stage of Ontario's ophthalmologists from 2010-2019 were evaluated and reported
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22 **56** using descriptive statistics. Ophthalmologist supply within different areas of care were similarly
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24 **57** detailed using descriptive statistics.
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29 **59 RESULTS:** Over the study period, a median of 464 ophthalmologists were practicing in Ontario.
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31 **60** The proportion female ophthalmologists increased from 18.7% to 24.1% over the study period.
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33 **61** Late-career ophthalmologists (>55 years old) increased by 6.4% and compromised 45.3% of the
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35 **62** workforce in 2019. Comprehensive cataract surgery was the most common area of care (yearly
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37 **63** median=199). While the number of ophthalmologists/100,000 people remained stable over the
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39 **64** study period (3.27 ophthalmologists/100,000 people in 2019), the number of
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41 **65** ophthalmologists/100,000 people 65 years of age and older fell by 18.4%. Moderate-volume
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43 **66** comprehensive cataract surgeons experienced the greatest supply reduction (-20.2%; -35.4%
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45 **67** relative to the population 65 and over).
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52 **69 Interpretation:** Between 2010 and 2019, the overall number of ophthalmologists in Ontario
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54 **70** remained stable, however declines in the number of ophthalmologists per 100,000 individuals 65
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3 71 years of age and older for most areas of care were evidenced. Nearly half of the ophthalmology
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5 72 workforce is now over 55 years of age and female representation in the field continues to
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8 73 increase.

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10 74 **Keywords:** ophthalmology; health policy; health services research
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Confidential

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3 **100 INTRODUCTION**

4 101 Ophthalmologists afford most of their care to seniors and provide 11% of all health services
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7 102 received by the elderly in Canada (1). Ontario, which is Canada's most populated province,
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9 103 continues to have a rapidly aging population and projections indicate that individuals over 65
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11 104 years old will account for 25% of the population by 2041 (2). This has prominent human
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13 105 resource implications when considering that the utilization of ophthalmic services is higher
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15 106 amongst older individuals who commonly present with age-related conditions such as cataracts,
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17 107 glaucoma, macular degeneration and diabetic retinopathy (3-6). Technological advances have
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19 108 also led to diagnostic and treatment advances which have greatly improved efficiency in the
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21 109 field. To understand how these factors impact the sustainability of eye care delivery, human
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23 110 resource analyses have been performed to assess for the adequacy of the current and future
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25 111 supply of physicians that will serve the Canadian population (7-10).

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32 113 Previous studies in Ontario have explored workforce trends in focused subspecialty areas (11-
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34 114 16). However, a current and comprehensive analysis of the status of Ontario's ophthalmology
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36 115 workforce is necessary to better understand human resource trends in the specialty. As such, this
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38 116 paper examines the supply and demographic characteristics of Ontario's ophthalmologists from
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40 117 2010 to 2019.

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3 120 **MATERIALS AND METHODS**
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5 121 *Overview & Data Sources*
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8 122 Ontario provides publicly funded healthcare to all its citizens through the Ontario Health
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10 123 Insurance Plan (OHIP). Given that OHIP is the sole payer of health care services, billing data has
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12 124 been validated as an accurate source of information which can capture details on all actively
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15 125 practicing ophthalmologists, the services they provide and the patients they see (17,18).
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19 127 Population-level healthcare data were obtained from the Ontario Ministry of Health and Long-
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21 128 Term Care (MOH) under an agreement with the Ontario Medical Association (OMA). The OMA
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23 129 and MOH had no involvement in or control over the design and conduct of the study; collection,
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26 130 management, analysis and interpretation of the data; preparation, review or approval of the
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28 131 manuscript; and decision to submit the manuscript for publication. In this study, a population-
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30 132 based analysis was conducted in Ontario from April 1st, 2010 to March 31st, 2020 (fiscal years
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32 133 2010-2019, inclusive). Characterization of Ontario's ophthalmology workforce included the
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34 134 evaluation of demographic characteristics including sex, career stage and overall
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37 135 ophthalmologist supply. Anonymized data was extracted and reported in a manner which
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39 136 protected the identity of all included physicians and patients. Ontario's population estimates for
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41 137 the study period were obtained from Statistics Canada (19).
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3 143 ***Ophthalmologist Identification & Data Collection***
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5 144 To capture actively practicing ophthalmologists in Ontario, we included all physicians who use
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7 145 the unique OHIP ophthalmology specialty code and submitted at least 100 billing claims per
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9 146 fiscal year. Physicians were then classified into specific areas of care using the classification
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11 147 criteria indicated in ‘Table 1’. Exact coding details can be found in ‘Supplementary Table 1’. We
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14 148 note a distinction between areas of care and subspecialty: billing information rather than
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16 149 fellowship training was used to characterize an ophthalmologist’s scope of practice, given that
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18 150 daily clinical services may differ considerably from the specialization of training. Billing data
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20 151 has previously been used to examine the supply of ophthalmologists in various areas of care over
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22 152 time (11-16); this is also referenced in ‘Table 1’. By means of a thorough, consultative process
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24 153 with ophthalmologists from every subspeciality and economists from the OMA, definitions for
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26 154 each area of care were created to accurately reflect the scope of practice and billing patterns from
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29 155 2010-2019.

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32 156 Sex and age data were also extracted for all ophthalmologists as demographic characteristics of
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34 157 each claimant were available. Ophthalmologists younger than 45 years old were considered
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36 158 early-career physicians, those 45-55 years old were middle-career physicians and those older
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38 159 than 55 years old were late-career physicians. The overall number of late-career
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40 160 ophthalmologists were further subdivided into 4 cohorts (56-60, 61-65, 66-70 and older than 70
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42 161 years old).
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3 166 ***Statistical Analysis***
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5 167 To explore representation by sex, we investigated the proportion of female ophthalmologists in
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7 168 the overall sample and across areas of care. To characterize the age of ophthalmologists, we
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9 169 determined the proportions of early, middle and late-career ophthalmologists in the overall
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11 170 sample and in various areas of care. The number of ophthalmologists per 100,000 people and the
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13 171 number of ophthalmologists per 100,000 people 65 years of age and older were calculated within
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15 172 each area of care. Growth was defined as the percentage change over the 10-year period for each
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17 173 analysis. All descriptive statistics were computed and graphically represented using Microsoft
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19 174 Excel ® (Microsoft Corporation, Redmond, Washington). This study included all actively
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21 175 practicing ophthalmologists in Ontario, so there was no statistical testing required when
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23 176 comparing cohort groups as any differences were true differences.
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31 178 ***Ethics Approval***
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33 179 The study's protocol was approved by University of Toronto's Research Ethics Board (Protocol
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35 180 ID: 00040078), in Toronto, Ontario, Canada.
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43 184 **RESULTS**

44 185 Across the study period, there was a yearly median of 464 (IQR: 447-477) actively practicing
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46 186 ophthalmologists in Ontario. While the overall number of ophthalmologists/100,000 people
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48 187 remained stable (2010=3.25 ophthalmologists/100,000 people, 2019=3.27
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50 188 ophthalmologists/100,000 people, percentage change=+0.7%), there was a substantial decline in
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52 189 the number of ophthalmologists/100,000 people 65 years of age and older (2010=23.30
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54 190 ophthalmologists/100,000 people 65 years of age and older, 2019=19.00
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3 191 ophthalmologists/100,000 people 65 years of age and older, percentage change=-18.4%) across
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5 192 the study period.

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10 194 ***Ophthalmologist Demographic Analyses***

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12 195 Overall, female representation amongst Ontario's ophthalmologists increased from 18.7% to
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14 196 24.1% of all ophthalmologists during the study period. Subspecialty surgeons (15.4% in 2019)
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16 197 had a lower proportion of female ophthalmologists than low-volume (35.7% in 2019) and
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18 198 moderate-volume comprehensive cataract surgeons (26.1% in 2019), but had a comparable
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20 199 proportion to high-volume comprehensive cataract surgeons (14.6% in 2019) ('Figure 1').
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22 200 Moderate-volume (+11.5%) and high-volume comprehensive cataract surgeons (+5.8%) had an
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24 201 increase in representation of female ophthalmologists, while the proportion of female
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26 202 subspecialty surgeons (+4.7%) and low-volume comprehensive cataract surgeons (-1.8%)
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28 203 remained stable ('Table 2'). The areas of care with the least and greatest proportion of female
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30 204 ophthalmologists were retina surgeons (7.5% in 2019) and paediatric ophthalmologists (48.0% in
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32 205 2019), respectively.

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40 207 Across the study period, the overall proportion of early-career ophthalmologists stayed stable
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42 208 ('Figure 2'). Middle-career ophthalmologists decreased from 32.8% to 26.0% from 2010-2013
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44 209 and then plateaued at this level from 2014-2019 ('Figure 3'). Late-career ophthalmologists
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46 210 increased from 38.9% to 44.6% from 2010-2013, and then plateaued at this level from 2014-
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48 211 2019 ('Figure 4'). In 2019, 12.2% of Ontario's ophthalmologists were 56-60 years old, 14.9%
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50 212 were 61-65, 8.0% were 66-70 and 10.3% were older than 70; the proportion of ophthalmologists
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52 213 who were 61-65 approximately doubled over the study period while the other late-career cohorts
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3 214 remained comparatively stable. Furthermore, the distribution of ophthalmologists at various
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5 215 career stages was variable across general medical ophthalmologists and low, moderate and high-
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7 216 volume comprehensive cataract surgeons. The greatest changes over time amongst early-career
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9 217 ophthalmologists were the decrease in the proportion of high-volume comprehensive cataract
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11 218 surgeons (-5.5%) and the increase in proportion of low-volume comprehensive cataract surgeons
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13 219 (+ 4.8%), though these absolute differences were small ('Table 3'). The greatest changes
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15 220 amongst middle-career ophthalmologists were decreases in the proportion of high-volume
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17 221 comprehensive cataract surgeons (-20.2%), general medical ophthalmologists (-13.1%) and
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19 222 ophthalmologists practicing in subspecialty areas (-9.6%). The greatest changes amongst late-
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21 223 career ophthalmologists were the increases in the proportion of high-volume comprehensive
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23 224 cataract surgeons (+25.8%), general medical ophthalmologists (+11.1%) and ophthalmologists
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25 225 practicing in subspecialty areas (+9.5%).
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33 227 ***Ophthalmologist Areas of Care***

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35 228 The number of ophthalmologists /100,000 people and the changes over time differed amongst the
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37 229 various areas of care ('Figure 5' & 'Table 4'). Neuro-ophthalmologists (n=11 in 2019, +65.3%
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39 230 over the study period), glaucoma surgeons (n=18 in 2019, +47.6%) and low vision rehabilitation
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41 231 ophthalmologists (n=7 in 2019, +27.5%) experienced the greatest growth. Overall, the supply of
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43 232 comprehensive cataract surgeons decreased over time (n=198 in 2019) (-8.9%). While there was
44
45 233 an increase in low (n=42 in 2019, +18.4%) and high-volume comprehensive cataract surgeons
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47 234 (n=41 in 2019, +8.7%), moderate-volume cataract surgeons (n=115 in 2019, -20.2%)
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49 235 experienced the greatest reduction in supply of any area of care.
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3 237 The number of ophthalmologists/100,000 people 65 years of age and older and the changes over
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5 238 time also differed amongst the various areas of care ('Figure 6' & 'Table 4'). Only neuro-
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7 239 ophthalmologists (+33.9%), glaucoma surgeons (+19.5%) and low vision rehabilitation
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9 240 ophthalmologists (+5.4%) experienced positive growth over the study period. The three areas
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11 241 with greatest reduction were moderate-volume cataract surgeons (-35.4%), general medical
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13 242 ophthalmologists (n=98 in 2019, -19.6%) and retinal surgeons (n=40 in 2019, -16.6%).
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20 245 **DISCUSSION**

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23 247 The aim of this population-based analysis was to explore the supply and demographic
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25 248 characteristics of Ontario's ophthalmology workforce over the past decade. Our study indicated
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27 249 an aging ophthalmologist workforce and overall growth in female representation. The overall
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29 250 number of ophthalmologists/100,000 people was stable across the study period. Several
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31 251 subspecialties increased in supply over the study period, however, most subspecialties had
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33 252 substantial reductions in supply when examined relative to the population 65 years of age and
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35 253 older, especially for comprehensive cataract surgeons.
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41 255 The proportion of early-career ophthalmologists remained comparatively stable, middle-career
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43 256 ophthalmologists decreased by 7.6% and late-career ophthalmologists increased by 6.4% over
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45 257 the study period. These trends are similar to a population-based analysis which was conducted in
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47 258 Ontario from 1999-2013 (20). Furthermore, amongst low-volume comprehensive cataract
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49 259 surgeons, there was only growth in the proportion of early-career physicians, who now make up
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51 260 most physicians in this area (54.8% in 2019). Amongst high-volume comprehensive cataract
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53 261 surgeons, there was only considerable growth amongst late-career physicians, who make up
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3 262 nearly half of the physicians in this area (46.3% in 2019). These findings speak to the difficulties
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5 263 that younger graduates face in securing equitable access to operating room time relative to their
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7 264 colleagues who are later in their careers, an issue that is projected to worsen (21,22).

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10 265 Additionally, there was considerable growth in the proportion of late-career general medical
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12 266 ophthalmologists, who made up nearly 80% of all physicians in this area of care in 2019.

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14 267 Moreover, women continued to be underrepresented relative to their male colleagues, most
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16 268 strikingly in surgical subspecialties such as retinal surgery (7.5%), which aligns with a recent
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18 269 national study (23). We found that the greater the surgical volume amongst comprehensive
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20 270 cataract surgeons, the less women were represented. This gender gap has been similarly
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22 271 highlighted in previous research (24).
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28 273 Although the number of ophthalmologists/100,000 people in 2019 (3.27) seems adequate given
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30 274 the proposed ideal ratio of 3.37 indicated by The Royal College of Physicians and Surgeons of
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32 275 Canada (RCPSC) in 1988, this suggestion was made decades ago on the assumption of a vastly
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34 276 different demographic mix, which did not consider the current realities of our rapidly aging
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36 277 population as well as the large technological advances in therapeutics and scope of practice of
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38 278 ophthalmologists and optometrists (25). For instance, the refinement of phacoemulsification,
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40 279 micro-invasive glaucoma surgery (MIGS), lamellar keratoplasty, intravitreal anti-vascular
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42 280 endothelial growth factor injections and other procedures have allowed for increased clinic
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44 281 efficiency. Nonetheless, it is projected that there will be 14.8 ophthalmologists/100,000 people
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46 282 65 years of age and older in 2030, a further decrease of 22.1% in ophthalmologist supply relative
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48 283 to our study's 2019 measure (10). This is in the context of underlying population demographic
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3 284 trends, with 62% of ophthalmic services directed towards seniors and a third of the population
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5 285 over the age of 65 that have visually threatening conditions (1,26).
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10 287 Although neuro-ophthalmologists, glaucoma surgeons and low vision rehabilitation
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12 288 ophthalmologists had the most notable increases in supply, these were also subspecialties with
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14 289 the smallest baseline proportion of ophthalmologists and the analyses was therefore sensitive to
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17 290 small changes in supply. The growth in some of these areas was also likely confounded. For
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19 291 example, the consult code A231 which was used to capture neuro-ophthalmologists was
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22 292 introduced mid-way into the 2010 fiscal year and their growth could partly be explained by the
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24 293 uptake of this code's use into practice early in the study period rather than an actual increase in
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26 294 physicians (27). This hypothesis is supported by our data, which showed that the average growth
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28 295 in the number of neuro-ophthalmologists year-to-year from 2011-2013 was 22.6% compared to
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30 296 the average of 3.5% for the remainder of the study period. To maintain consistency in
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33 297 definitions, this study also only considered ophthalmology residency-trained neuro-
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35 298 ophthalmologists and not neurology residency-trained neuro-ophthalmologists, which would
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37 299 impact the overall proportion, supply and growth values for this subspecialty. Moreover, while
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40 300 the supply of glaucoma surgeons remained stable from 2010-2016, the growth from 2017-2019
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42 301 was likely inflated because of the increased number of general surgical ophthalmologists
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44 302 performing MIGS. There is currently no specific MIGS billing code in Ontario; as such,
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47 303 surgeons could submit combinations of existing glaucoma filtering surgery codes to be
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49 304 reimbursed for this service (28). There was growth of low vision rehabilitation ophthalmologists
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51 305 over the study period, likely secondary to increasing interest of graduates and demand for this
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54 306 emerging subspecialty within ophthalmology (29).
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5 308 ***Limitations***

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8 309 A limitation of using billing data to characterize ophthalmologists is the mis-categorization of
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10 310 comprehensive ophthalmologists in subspecialty categories if they have a focused scope of
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12 311 practice in a limited number of areas of care. However, the intention of our analysis was to
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14 312 evaluate providers of care and not training, and as a result, this limitation would not affect the
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16 313 interpretation. Additionally, some category definitions were not mutually exclusive, and it was
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18 314 possible for an ophthalmologist to be categorized as both an oculoplastic surgeon and neuro-
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20 315 ophthalmologist for example if they met the criteria for both subspecialties. To address these
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22 316 limitations, we used conservative thresholds for the minimum number of performed services to
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24 317 mitigate any billing errors and ensure appropriate inclusion of ophthalmologists in certain areas
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26 318 of care. For example, one Ontario study defined retina medical ophthalmologists as those who
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28 319 conducted greater than equal to 100 photocoagulation therapies and intravitreal injections (13);
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30 320 we increased this threshold of minimum injections to 300 to best ensure general
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32 321 ophthalmologists were not captured in our definition. Additionally, for paediatric
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34 322 ophthalmology, we chose a high-volume threshold of strabismus surgery which was referenced
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36 323 in the literature as part of our definition (14). Furthermore, classifying the career stage of
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38 324 ophthalmologists using age did not consider the possible early and late entry of physicians into
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40 325 ophthalmology. Unfortunately, the year of medical school graduation was not an available
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42 326 parameter.

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3 330 **CONCLUSIONS**
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5 331 In conclusion, there was an overall decline in the supply of comprehensive cataract surgeons
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7 332 over the study period. When standardized to the population 65 years old and over, there were
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9 333 substantial supply reductions in most areas of care. An aging ophthalmology workforce was
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11 334 observed over the study period, which is expected to continue. Gender gaps in the provision of
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13 335 subspeciality and high-volume surgical care were evident, as was the trend that early-career
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15 336 ophthalmologists had lower surgical volumes relative to late-career peers. Notably, these
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17 337 findings compromise only one critical component amongst a multitude of others that influence
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19 338 the current and future sustainability of eye care delivery in the province.
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26 340 Future research is needed to better contextualize study findings and allow for a more
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28 341 comprehensive interpretation of data. The currently recommended ideal ratio of
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30 342 ophthalmologists/100,000 people is outdated and a more modern, evidence-based value is
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32 343 unknown. Future work should aim to update this metric to allow for more accurate assessments
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34 344 of human resource adequacy. The extent to which supply reductions have been compensated by
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36 345 increased clinical efficiency (e.g. increased patient and procedural volume) afforded by medical
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38 346 and technological innovations remains unclear. Scope of practice changes should also be further
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40 347 characterized given a paucity of data. Additionally, the current and future role of optometry in
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42 348 the co-delivery of Ontario's eye services was beyond the scope of our research question, but an
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44 349 important consideration when developing policy for future human resource requirements.
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Areas of Care	This Study's Classification Criteria	Criteria in Literature
Neuro-ophthalmologist	≥50 neuro-ophthalmology consultations	N/A
Corneal surgeon	≥10 corneal transplants (any combination of penetrating, lamellar limbal or stem cell)	Significant volume: ≥50 corneal transplants (any combination of penetrating or lamellar limbal) (11)
Glaucoma surgeon	≥50 glaucoma filtering procedures (no combination procedure)	<p>Significant volume: ≥50 glaucoma filtering procedures (glaucoma filtering and combination cataract extraction/glaucoma filtering) and bleb repair procedures (11)</p> <p>Higher volume: ≥ 100 glaucoma filtering procedures (glaucoma filtering and combination cataract extraction/glaucoma filtering) (12)</p> <p>Lower volume: <100 glaucoma filtering procedures (glaucoma filtering and combination cataract extraction/glaucoma filtering) (12)</p>
Retina medical ophthalmologist	≥300 intravitreal injections AND ≥100 laser photocoagulation procedures, excluding those who conducted any retina surgery	High/low volume not specified: ≥100 intravitreal injections AND ≥100 laser photocoagulation procedures (13)
Retinal surgeon	≥15 of any combination of vitrectomies or scleral buckle procedures	<p>Significant volume: ≥ 50 any combination of vitrectomy or scleral buckle procedures (11)</p> <p>High/low volume not specified: ≥5 PRMP or segmentation including PPV (13)</p>

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Oculoplastic surgeon	≥20 of any combination of tumor or foreign body excisions/biopsies/lateral orbitotomies, orbital decompressions, dermis fat grafts, fornix reconstructions, free mucous membrane grafts, dacryocystectomies, lacerated canaliculus repairs, dacryocystorhinostomies and lacrimal bypass procedures	N/A
Pediatric ophthalmologist**	≥50 pediatric strabismus surgeries OR ≥50% of all consults conducted on pediatric patients AND does not meet the criteria of any of the above categories	Significant volume: ≥50 strabismus surgeries *** (11) High volume: ≥50 pediatric strabismus surgeries *** (14) High volume: ≥30 strabismus surgeries *** (15)
Low vision rehabilitation ophthalmologist	≥50 of any combination of initial or follow-up low vision rehabilitation assessments AND does not meet the criteria of any of the above categories	High volume/low volume not specified: ≥1 of initial or follow-up low vision rehabilitation assessments (16)
Low-volume comprehensive cataract surgeon	≥1 but <200 cataract surgeries AND does not meet the criteria of any of the above categories	N/A
Moderate-volume comprehensive cataract surgeon	200-800 cataract surgeries AND does not meet the criteria of any of the above categories	N/A
High-volume comprehensive cataract surgeon	>800 cataract surgeries AND does not meet the criteria of any of the above categories	N/A

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General medical ophthalmologist	≥100 of any combination of ophthalmic consultations or assessments AND does not perform ophthalmic surgeries AND does not meet the criteria of any of the above categories	N/A
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Table 1: Classification criteria for the inclusion of ophthalmologists to an area of care in each fiscal year for 2010-2019 fiscal years, inclusive

*All fee-for-service (FFS) and shadow billing professional claims were considered to capture ophthalmologists under different payment plans

** Pediatric population considered patients younger than 18 years old

*** These literature definitions characterized strabismus surgeons only, not pediatric ophthalmologists which could also be medical-only

≥ means “Greater than or equal to”

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Area of Care	Change in the proportion of female ophthalmologists from 2010-2019 fiscal years
Overall	+5.4%
General Medical Ophthalmologists	-2.5%
Low-Volume Comprehensive Cataract Surgeons	-1.8%
Subspecialty Surgeons	+4.7%
High-Volume Comprehensive Cataract Surgeons	+5.8%
Moderate-Volume Comprehensive Cataract Surgeons	+11.5%

Table 2: Change in the proportion of female ophthalmologists practicing overall, in subspecialty surgical areas, general medical and comprehensive surgical areas of care from 2010-2019 fiscal years, inclusive

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Area of Care	Percentage change in the proportion of early-career ophthalmologists from 2010-2019 fiscal years	Percentage change in the proportion of middle-career ophthalmologists from 2010-2019 years	Percentage change in the proportion of late-career ophthalmologists from 2010-2019 years
Overall	+1.2%	-7.6%	+6.4%
General Medical Ophthalmologists	+2.0%	-13.1%	+11.1%
Subspecialty Ophthalmologists	-1.2%	-9.6%	+9.5%
Low-Volume Comprehensive Cataract Surgeons	+4.8%	-3.7%	-1.0%
Moderate-Volume Comprehensive Cataract Surgeons	+0.8%	+1.8%	-2.6%
High-Volume Comprehensive Cataract Surgeons	-5.5%	-20.2%	+25.8%

Table 3: Change in the proportion of early, middle and late-career ophthalmologists practicing overall, in subspecialty areas, general medical and comprehensive surgical areas of care from 2010-2019 fiscal years, inclusive

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Area of Care	Number of ophthalmologists/100,000 people in 2010	Percentage change in the number of ophthalmologists/100,000 people from 2010-2019 fiscal years	Number of ophthalmologists/100,000 people 65 years of age and older in 2010	Percentage change in number of ophthalmologists/100,000 people 65 years of age and older from 2010-2019 fiscal years
All Comprehensive Cataract Surgeons	1.49	-8.9%	10.69	-26.2%
Low-Volume Comprehensive Cataract Surgeons	0.24	+18.4%	1.75	-4.2%
Moderate-Volume Comprehensive Cataract Surgeons	0.99	-20.2%	7.09	-35.4%
High-Volume Comprehensive Cataract Surgeons	0.26	+8.7%	1.86	-12.0%
General Medical Ophthalmologists	0.68	-0.7%	4.86	-19.6%
Retinal Surgeons	0.27	+3.1%	1.91	-16.6%
Corneal Surgeons	0.16	+5.4%	1.15	-13.1%
Paediatric Ophthalmologists	0.16	+7.4%	**	**
Retina Medical Ophthalmologists	0.18	+9.8%	1.25	-11.1%
Oculoplastic Surgeons	0.13	+11.4%	0.93	-9.8%
Low Vision Rehabilitation Ophthalmologists	*	+27.5%	*	+5.4%
Glaucoma Surgeons	0.08	+47.6%	0.60	+19.5%
Neuro-Ophthalmologists	0.05	+65.3%	0.33	+33.9%

Table 4: Number of ophthalmologists/100,000 people in the 2010 fiscal year and change from 2010-2019 fiscal years in each area of care (overall population and population 65 years of age and older)

*the number of low vision rehabilitation ophthalmologists for the 2010 fiscal year was <5 and cannot be reported for privacy reasons. Percentage change in this area of care is from 2011 to 2019

**Given the nature of the analysis, the change in the number of paediatric ophthalmologists/100,000 people 65 years of age and older was not calculated.

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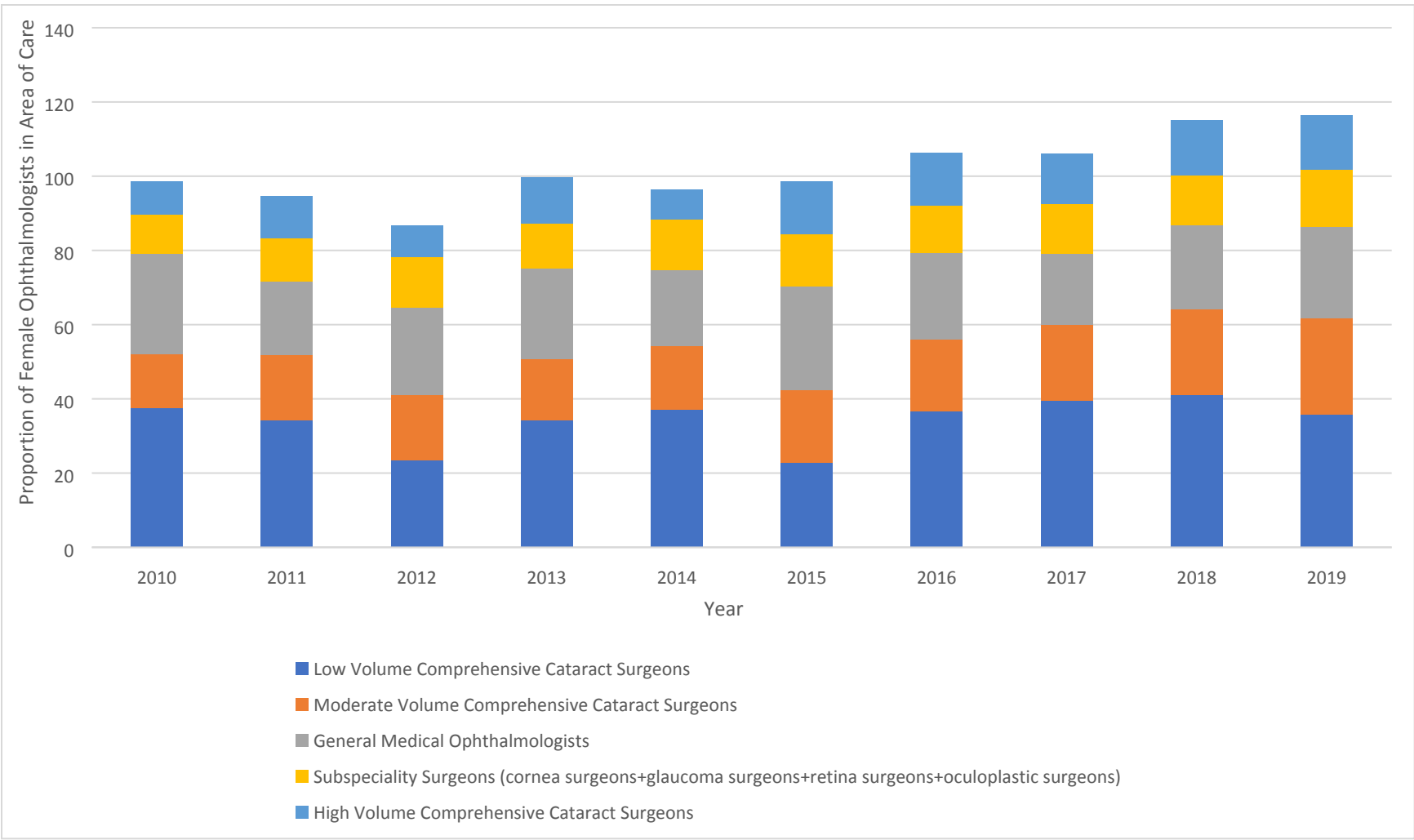


Figure 1: Trends in the proportion of female ophthalmologists practicing in subspecialty surgical areas, general medical and comprehensive surgical areas of care from 2010-2019 fiscal years, inclusive
 *Paediatric ophthalmology was not considered as a surgical subspecialty because non-surgical paediatric ophthalmologists were also included in this cohort

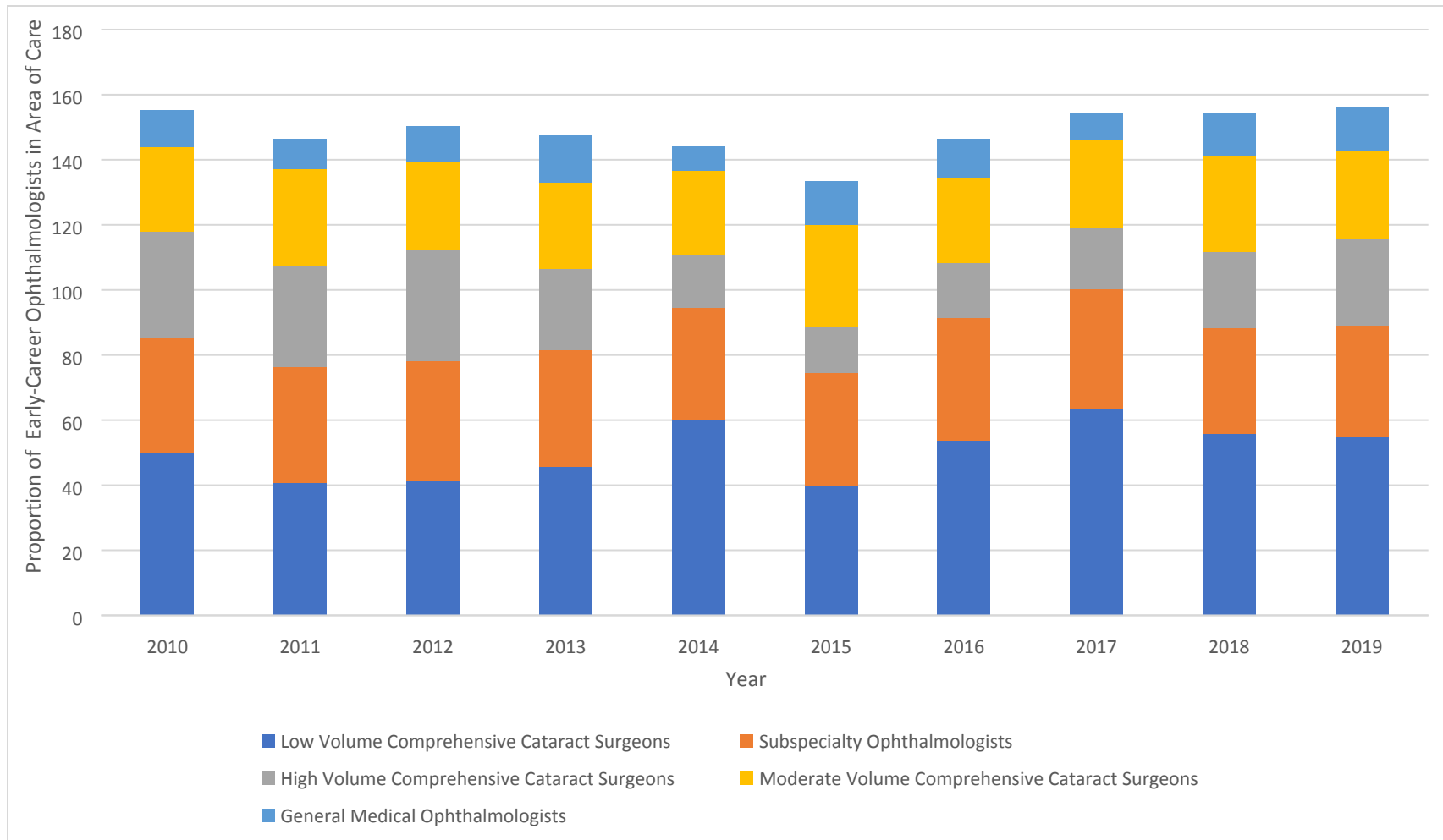


Figure 2: Trends in the proportion of early-career ophthalmologists practicing in subspecialty areas, general medical and comprehensive surgical areas of care from 2010-2019 fiscal years, inclusive

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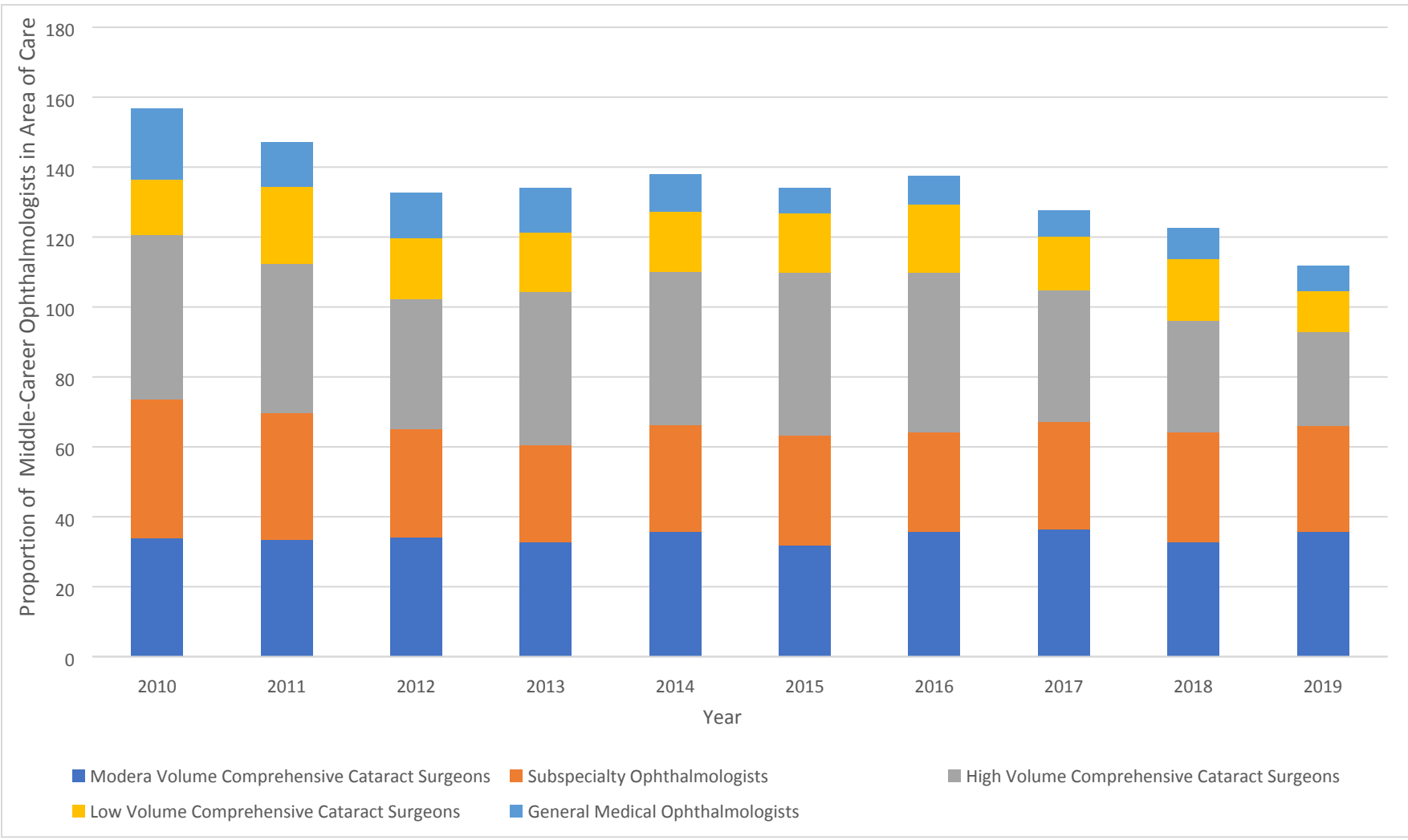


Figure 3: Trends in the proportion of middle-career ophthalmologists practicing in subspecialty areas, general medical and comprehensive surgical areas of care from 2010-2019 fiscal years, inclusive

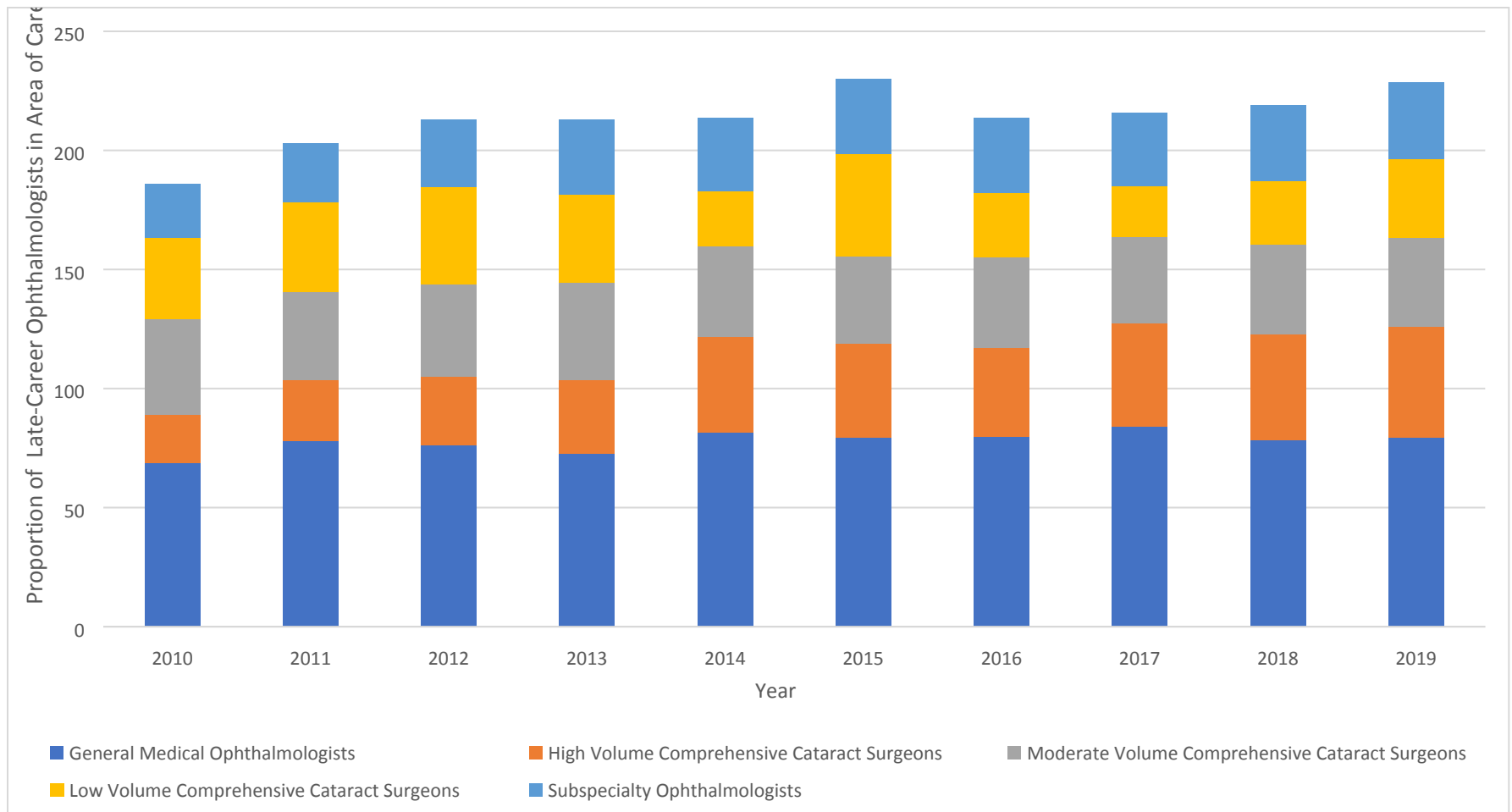


Figure 4: Trends in the proportion of late-career ophthalmologists practicing in subspecialty areas, general medical and comprehensive surgical areas of care from 2010-2019 fiscal years, inclusive

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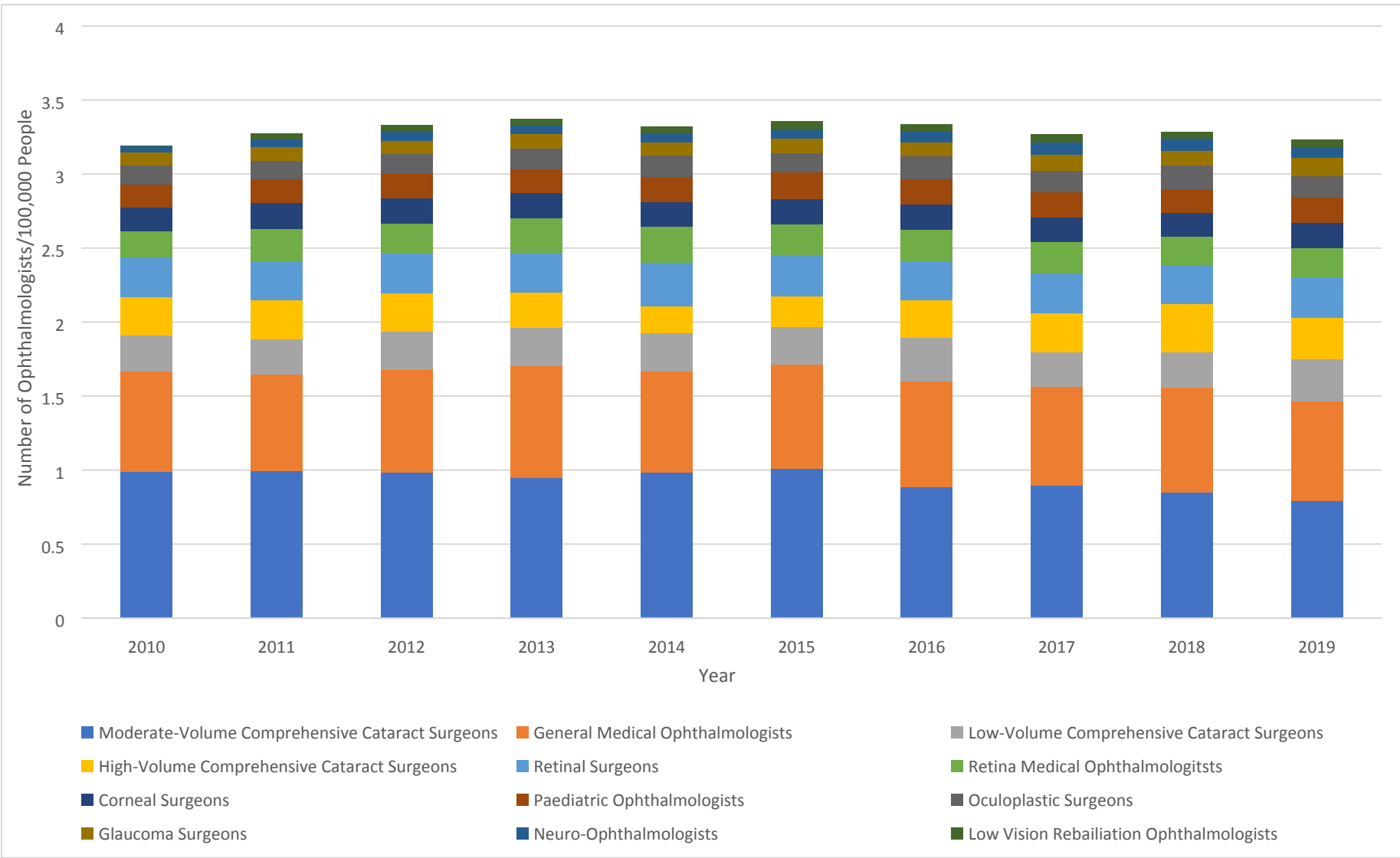


Figure 5: The number of ophthalmologists/100,000 people practicing in all areas of care from 2010-2019 fiscal years, inclusive.
 *The number of low vision rehabilitation ophthalmologists for the 2010 fiscal year was <5 and cannot be reported for privacy reasons

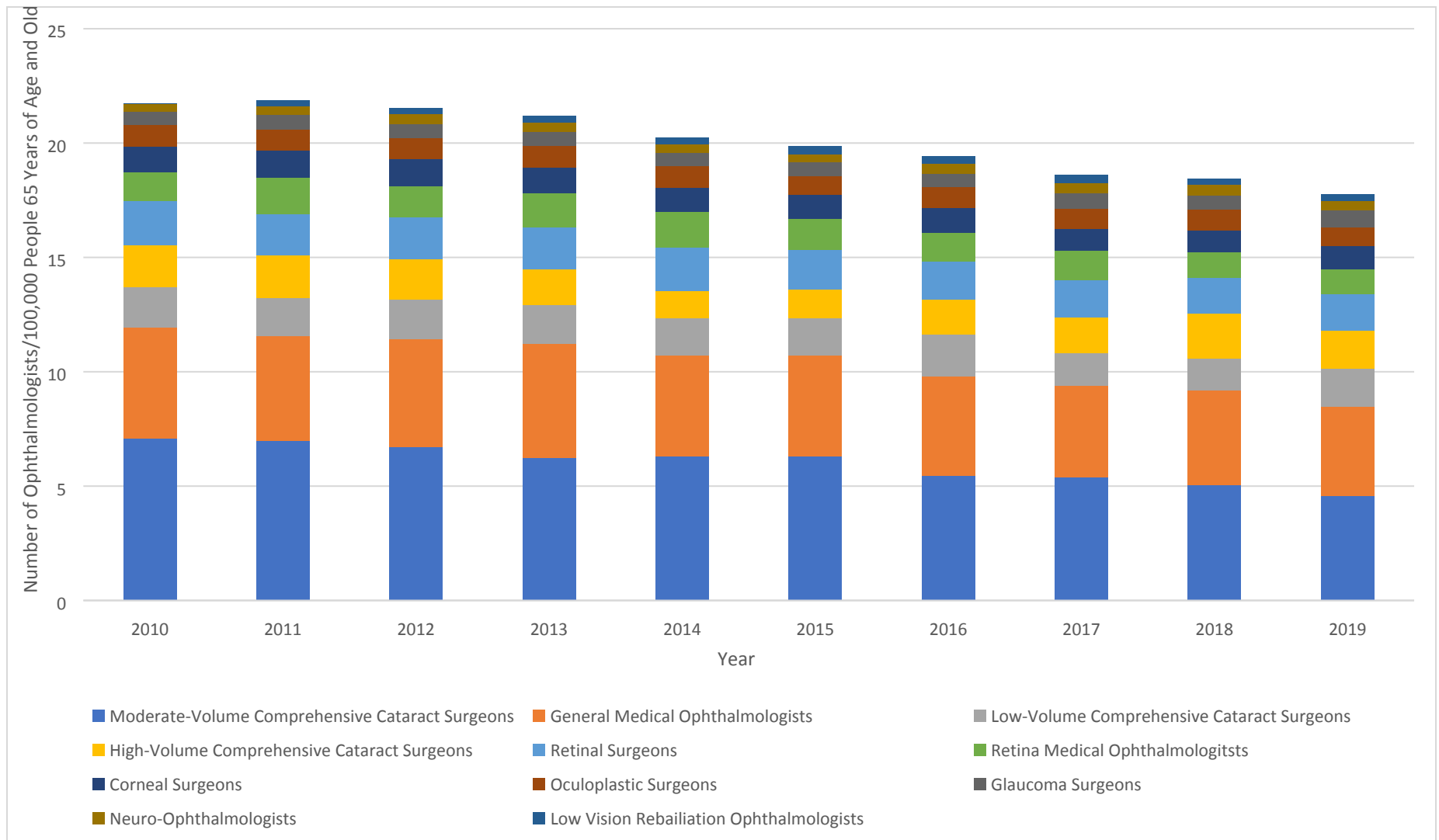


Figure 6: The number of ophthalmologists/100,000 people 65 years of age and older practicing in all areas of care from 2010-2019 fiscal years, inclusive
 *the number of low vision rehabilitation ophthalmologists for the 2010 fiscal year was <5 and cannot be reported for privacy reasons
 **given the nature of this analysis, paediatric ophthalmology was not analysed

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Neuro-ophthalmologist	≥ 50 A/C/W231
Corneal surgeon	≥ 10 E121, E122, E124 (any combination)
Glaucoma surgeon	≥ 50 E132
Retina medical ophthalmologist	≥ 300 E147, E149 (any combination) AND ≥ 100 E154, EXCLUDING those who bill ANY ONE of the following retinal surgery codes E148, E142, E152
Retinal surgeon	≥15 E142, E148, E152 (any combination)
Oculoplastic surgeon	≥ 20 E166, E167, E172, E168, E165, E169, E170, E160, E163, E176, E177, E178, E179, E180, E215, E216, E217, E218, E219 (any combination)
Pediatric ophthalmologist**	≥50 E159, E158, E162, E949, E952 OR ≥ 50% of all following code submissions A/C236, C235, A/C233, A/C234 conducted on pediatric patients AND does not meet the criteria of any of the above categories
Low vision rehabilitation ophthalmologist	≥50 A252, A254 (any combination)

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Low-volume comprehensive cataract surgeon	≥1 but <200 E140 AND does not meet the criteria of any of the above categories
Moderate-volume comprehensive cataract surgeon	200-800 E140 AND does not meet the criteria of any of the above categories
High-volume comprehensive cataract surgeon	>800 E140 AND does not meet the criteria of any of the above categories
General medical ophthalmologist	≥100 A235, C235, W535, A233, C233, A234, C234, A253, A256, A236, C236, W536 (any combination), EXCLUDING THOSE WHO BILLED ANY one of the following surgical codes E132, E214, E940, E142, E148, E152, E121, E122, E124, E159, E158, E162, E140, E166, E167, E172, E168, E165, E169, E170, E160, E163, E176, E177, E178, E179, E180, E215, E216, E217, E218, E219 AND no fit into any above category

Supplementary Table 1: Ontario Health Insurance Plan (OHIP) coding details of the classification criteria for the inclusion of ophthalmologists to an area of care in each fiscal year for 2010-2019 fiscal years, inclusive

*All fee-for-service (FFS) and shadow billing professional claims were considered to capture ophthalmologists under different payment plans

** Pediatric population considered patients younger than 18 years old

≥ means “Greater than or equal to”