

Uptake of opportunistic salpingectomy for ovarian cancer prevention across Canada

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Abstract (250 words)

Background Opportunistic salpingectomy (OS), the removal of fallopian tubes during hysterectomy or instead of tubal ligation, is recommended practice in Canada to prevent ovarian cancer. This surgical practice change has been shown to be safe and cost effective. We examine uptake of OS across Canada between fiscal years 2011 and 2016.

Methods With data from CIHI's Discharge Abstract Database and National Ambulatory Care Reporting System, we examined the proportion of people having OS at the time of hysterectomy and as tubal sterilization and compared with the proportion having hysterectomy alone, hysterectomy with bilateral salpingo-oophorectomy and tubal ligation.

Results The proportion of hysterectomies that included OS increased from 15.4% in 2011 to 35.5% by 2016. With respect to OS for sterilization, rates increased from 6.5% of all tubal sterilizations in 2011 to 22.0% in 2016. There was considerable variation across jurisdictions with a high of 53.2% hysterectomies including OS in BC in 2016 while four provinces did less than 30% of their hysterectomies with OS (PEI, Manitoba, Ontario, and Newfoundland). BC also led the way in OS for sterilization (74%), with New Brunswick, Manitoba, PEI, and Newfoundland having a rate of less than 10% of tubal sterilizations.

Interpretation The uptake of OS is improving. Still, this study identified ~180,000 opportunities to prevent deadly ovarian cancers were missed in Canada between fiscal years 2011 and 2016. This could translate to one to three thousand ovarian cancers that could have been prevented.

Introduction

In 2020, approximately 3100 people in Canada were diagnosed with ovarian cancer.(1) If they have the same experience as past patients, fewer than 50% of these people will be alive five years later. There remains no effective screening method for ovarian cancer. The most recent evidence from the UK CTOCs trial of ovarian cancer screening revealed that after a median of 16.3 years of follow-up among 202,562 randomized participants, there was no statistically significant reduction in ovarian cancer or tubal cancer deaths in the screening groups.(2) However, our recent understanding that the most common and lethal form of ovarian cancer, high-grade serous (HGSC) often originates in the fallopian tube, has introduced a prevention opportunity. (3-6)

In September of 2010, BC's Ovarian Cancer Research team (OVCARE) recommended that all BC gynecologic surgeons discuss bilateral salpingectomy with their patients prior to undergoing hysterectomy, and instead of tubal ligation. These procedures are collectively referred to as opportunistic salpingectomy (OS). The OVCARE recommendations were followed in 2011 by a similar recommendation from the Society of Gynecologic Oncology of Canada(7), and by the Society of Obstetricians and Gynecologists of Canada in 2015.(8) This is a strategy aimed solely at those of general population risk for ovarian cancer, as risk-reducing bilateral salpingo-oophorectomy remains the recommended prevention strategy among people with hereditary breast and ovarian cancer syndrome.

Multiple publications have illustrated that OS does not increase risk of perioperative adverse outcomes (9, 10), nor does it increase the risk for minor complications.(11) Finally, there are no indicators of an earlier age of onset of menopause following OS, which is particularly important as earlier age at menopause was a serious concern given its association with increased

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3 mortality,(12-16) While we know that uptake of OS has been high in British Columbia, where it
4 was first recommended,(17) no national data have been published since the Society of Obstetrics
5 & Gynaecology of Canada recommended OS in 2015. The last national data that were published
6 examined uptake of OS at the time of hysterectomy across Canada until the end of 2011, and
7 uptake was less than 15% in all provinces except for British Columbia.(18) Herein we present
8 national data on rates of OS, both at the time of hysterectomy and for tubal sterilization, across
9 all Canadian provinces and territories except for Quebec between the fiscal years 2011 and 2016.

19 **Methods**

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21 This large retrospective study was conducted using data from the Canadian Institute of
22 Health Information's Discharge Abstract Database and National Ambulatory Care Reporting
23 System. These databases include all surgeries performed both as inpatient care and as day
24 surgeries across all Canadian provinces and territories (except Quebec). We requested data on all
25 people who had undergone any, or any combination, of the following surgical procedures
26 between the fiscal years 2011 to 2016: hysterectomy, salpingectomy oophorectomy and tubal
27 ligation. We excluded people who were less than 15 years old and anyone whose records
28 included a diagnostic code for ovarian, uterine, cervical, or fallopian tube cancer (*International*
29 *Classification of Diseases code 10-CM ICD-CM C53-C57*).

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31 We identified people undergoing each of the relevant procedures using Canadian
32 Classification of Health Intervention (CCI) codes. We grouped people according to their
33 procedures and stratified into five groups: 1) those who had undergone a hysterectomy with no
34 concomitant oophorectomy or salpingectomy (referred to as hysterectomy alone); 2) those who
35 underwent a hysterectomy and a bilateral salpingectomy (hysterectomy with OS); 3) those who
36 underwent a hysterectomy with a bilateral salpingo-oophorectomy (hysterectomy with BSO); 4)
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3 those who underwent a tubal ligation; and, 5) those who had a bilateral salpingectomy alone. We
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5 did not include women undergoing hysteroscopic tubal occlusion.
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8 The rates of OS between 2011 and 2016, which include the numbers of hysterectomies
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10 that were performed with and without bilateral salpingectomy or salpingo-oophorectomy and the
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12 number of sterilizations that were performed by bilateral salpingectomy or tubal ligation, were
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14 examined across each year of our study period across all included Canadian provinces and
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16 territories. The data from the Northwest Territories, Nunavut and Yukon were combined to meet
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18 privacy requirements and are referred to as the “territories” in this manuscript. We also examined
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20 whether rates of OS differed according to patient age group at the time of surgery, neighborhood
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22 income quintile and rural, rural-remote, rural-very remote, or urban residence. No 95%
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24 confidence intervals or measures of statistical significance are reported as data are population-
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26 based.
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30 31 **Results**

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33 There were 413,889 people who had one of the relevant surgeries in Canada between
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35 April 1st, 2011 and March 31st 2017 at age 15 and older between April 1st, 2011 and March 31st,
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37 2017. After eliminating those with a record of an invasive cervical, uterine, ovarian or fallopian
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39 tube cancer (*ICD-CM-10 C53-C57*) (n=34,171), and 61,190 records that did not represent a
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41 surgery of interest (i.e. bilateral salpingo-oophorectomy without corresponding hysterectomy;
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43 hysterectomy with a unilateral salpingectomy, unilateral salpingo-oophorectomy) we had a final
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45 cohort of 318,528 people. In this study population, 76,848 underwent hysterectomy alone,
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47 47,672 underwent hysterectomy with opportunistic salpingectomy, and 53,608 underwent
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49 hysterectomy with bilateral salpingo-oophorectomy. Among those undergoing tubal sterilization,
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51 121,583 underwent tubal ligation and 18,817 had OS for tubal sterilization. Given that all tubal
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3 ligations could have been OS and ~80% of hysterectomies could have included OS without
4 altering surgical approach,(9) this represents ~180,000 missed cancer prevention opportunities.
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8 Figure 1a illustrates the increased uptake of OS at the time of hysterectomy in Canada
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10 between fiscal years 2011 and 2016. While only 15.4% of hysterectomies include salpingectomy
11 in 2011, this had increased to 35.5% by 2016, representing a 130% increase in the proportion of
12 people having OS at hysterectomy. The rate of hysterectomy alone (without removal of ovaries
13 or fallopian tubes) decreased from 54.8% to 33.5% between 2011 and 2016. Rates for
14 hysterectomy with BSO stayed relatively stable across the study period, varying between an
15 annual low of 29.5% in 2013 to an annual high of 31.1 in 2015. Figure 1b illustrates that the
16 proportion of people getting OS for sterilization also increased from 6.5% of all tubal
17 sterilizations in 2011 to 22.0% in 2016, representing a 238% increase in the proportion of people
18 having OS at tubal sterilization. However, 78% of tubal sterilizations were by tubal ligation in
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33 Figure 2 illustrates that all jurisdictions in Canada increased their uptake of OS across the
34 study period, but these proportions are highly variable across the country. In British Columbia,
35 where OS has been recommended practice since 2010, most hysterectomies included
36 opportunistic salpingectomy (53.2% in 2016) with concomitant declines in the proportion of
37 people getting hysterectomy alone (Figure 2a). The proportion of people getting hysterectomy
38 with BSO changed very little across the study period (supplemental Figure 1). The territories had
39 the next largest uptake of OS at the time of hysterectomy with 44.6% of hysterectomies
40 including OS by 2016. Provinces that were performing OS in over 40% of people who have
41 hysterectomies included Alberta, Saskatchewan, and New Brunswick. Other provinces fell
42 somewhere between 23.5% (PEI) and 33.9% (Nova Scotia). Figure 2b illustrates that British
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3 Columbia was the only Canadian province doing more than half (74%) of its tubal sterilizations
4 by OS by 2016. The territories were doing 48.6% of tubal sterilizations by OS, with the next
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6 highest rate of uptake being 16.1% in Saskatchewan and 16.0% in Alberta. The lowest rate of
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8 uptake was in PEI (5.6% in 2015/2016) followed closely by New Brunswick (5.8%).
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12 When examining the distribution by age categories (Figure 3), those in the 25-54 age
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14 groups had the highest rates of OS at the time of hysterectomy, with the highest distribution
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16 being in the 35-44 age group. There were very few people getting hysterectomy with OS over the
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18 age of 55, and many were having hysterectomy alone (Figure 3.a). The opposite was true with
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20 tubal sterilization, where rates of OS were higher among those in the highest age group (45-54
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22 years of age). Only 11.9% of people aged 15-25 seeking tubal sterilization received OS (Figure
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24 3b). Figure 4 shows minimal variation by geographic region of residence and increasing uptake
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26 across all geographic regions. Figure 4a shows similar rates of OS at the time of hysterectomy
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28 across urban, rural, rural-remote and rural-very remote by 2016 (Figure 4a). By 2016, the lowest
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30 proportion of hysterectomy with OS occurred in rural areas (31.6%) compared with the highest
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32 in rural-very remote areas (36.5%). Figure 4b also shows increased uptake of OS for sterilization
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34 across all regions during our study period, with the highest rates of sterilization by OS in urban
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36 areas by 2016 (23.9%) and the lowest in rural areas (14.9%).
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42 **Ethics approval**

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44 Ethics approval was obtained from the University of British Columbia's Clinical Research Ethics
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46 Board. Approval by the Ethics Board for use of deidentified administrative data files includes a
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48 waiver of informed consent from participants.
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51 **Interpretation**

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3 Our results reveal that an increasing proportion of hysterectomies in Canada include an
4 OS for the prevention of high grade serous ovarian cancer. In fact, by the end of our study
5 period, more hysterectomies included OS (35.5%) than did not (33.5%). As expected, rates of
6 hysterectomies with bilateral salpingo-oophorectomy did not change over the study period, as
7 these surgeries were not targeted by any of the opportunistic salpingectomy practice
8 recommendations and tend to occur for other indications. We presented these data to show a
9 complete picture of hysterectomy in Canada. There was also an increase in tubal sterilizations
10 that were done by OS over the study period. However, there were many missed opportunities for
11 ovarian cancer prevention in Canada across our study period, and considerable variation in the
12 proportion of people having OS across jurisdictions in Canada.
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26 While there were very high rates of OS in British Columbia (>70% of all eligible
27 patients), nearly 50% of people were still having hysterectomy alone in PEI by the end of our
28 study period. We hypothesize that people may not be uniformly aware of the option, and
29 surgeons may not be discussing OS with their patients prior to hysterectomy or tubal
30 sterilization. Jurisdictional variation also points to physician training as an important factor in
31 uptake of OS. The territories had the second highest rate of uptake of OS, which likely reflects
32 the fact that many physicians in the territories train in British Columbia. Research examining
33 why the 2010 educational campaign succeeded in British Columbia revealed that that thought
34 leader support, along with exposure to OS from many different information sources were
35 important in explaining differences in adoption. The OVCARE knowledge translation campaign
36 exposed gynecologic surgeons to recommendations through a popular conference, the media, and
37 local rounds.(19)
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3 While the jurisdiction with the lowest rate of uptake of OS at the time of hysterectomy
4 was doing nearly a quarter of all hysterectomies with OS by the end of our study period, uptake
5 at the time of tubal sterilization was considerably lower. There were four provinces (Manitoba,
6 New Brunswick, PEI, and Newfoundland) where fewer than 10% of tubal sterilizations were
7 done by OS by the end of the study period. This represents thousands of people each year who
8 are missing opportunities for ovarian cancer prevention. We expect that this differential rate of
9 uptake at the time of tubal sterilization reflects concern around higher rates of complications in
10 these younger people. Research has revealed that nearly half of those undergoing tubal
11 sterilization do so during the same hospital stay as a live birth, and often following a caesarean
12 section.(9) Further considerable research, including a randomized controlled trial, has illustrated
13 no increased rate of complications following OS at the time of caesarean section.(20-22)

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28 In a national survey of Canadian Obstetrician gynecologists that was undertaken at the
29 same time as the educational campaign in British Columbia, physicians reported that concerns
30 around early age of onset of menopause were a barrier to implementation of OS at the time of
31 sterilization.(23) Thus, we also hypothesize that lower rates of OS at sterilization may reflect
32 these concerns. Given that an earlier age at menopause has been associated with increased
33 mortality,(16, 24, 25) this is an important concern. However, all studies to date, including those
34 examining ovarian sonographic parameters and hormonal assays have been reassuring, with one
35 including up to 5 years of follow-up data.(13, 14, 26-29) While a Swedish Registry study
36 reported an increased risk of menopausal symptoms 1 year after hysterectomy among those who
37 underwent hysterectomy with bilateral salpingectomy compared with hysterectomy alone
38 (RR=1.33, 95%CI 1.04, 1.69),(30) recent work in BC reported no difference in time to initiation
39 on HRT or in time to first physician visit for a menopausal concern among any OS groups (both
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3 at the of hysterectomy or for tubal sterilization, compared with the relevant comparator
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5 groups).(12)
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8 Although a large prospective observational study of the effectiveness of opportunistic
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10 salpingectomy for cancer prevention is urgently needed, historical studies lead us to hypothesize
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12 that OS will be effective in preventing high grade serous ovarian cancer.(31-34) OS has a very
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14 good safety profile with no differences in major surgical outcomes, including overall hospital
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16 readmission rates, blood transfusions, and post-operative complications (9, 10), as well as no
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18 difference in minor complications, except for a small increased likelihood of filling a
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20 prescription analgesic medication in the immediate two weeks post discharge, which disappears
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22 by one-month post discharge.(11) We, and others, have also reported no indications of earlier
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24 onset of menopause in those undergoing OS.(12-14, 26-29)
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28 **Limitations**

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30 Like all studies relying on administrative data, there is a risk of imprecision given our
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32 dependence on database accuracy of coding. However, we have no reason to think that database
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34 accuracy would vary significantly across Canadian provinces and territories or during our study
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36 period. We are also only able to analyze uptake of OS using surgeries performed, so we cannot
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38 provide information on what is leading to high or low rates of uptake of OS across jurisdictions.
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40 Future research should investigate barriers to uptake of OS in provinces where rates are very
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42 low, and with respect to tubal sterilization.
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46 **Conclusion**

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48 The high rates of people in some Canadian provinces that are still having hysterectomy
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50 alone and tubal ligation are missed opportunities to potentially prevent a deadly high grade
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52 serous ovarian cancer. We have also not dramatically improved survival rates from ovarian or
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3 tubal cancer in the past thirty years.(1) Thus, primary prevention is our best approach against
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5 high grade serous ovarian cancer. The data presented herein show that we missed ~180,000
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7 opportunities to prevent an ovarian cancer in Canada between 2011 and 2016. At a lifetime risk
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9 of ovarian cancer of 1.4%, this could translate into thousands of lives lost unnecessarily. The
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11 apparent success of the BC OVCARE initiative suggests that Knowledge Translation can be
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13 successful in this area. Active efforts should be taken by cancer funders and organizations in
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15 every jurisdiction and nationwide.
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References

1. Brenner DR, Weir HK, Demers AA, Ellison LF, Louzado C, Shaw A, et al. Projected estimates of cancer in Canada in 2020. *CMAJ*. 2020;192(9):E199-E205.
2. Menon U, Gentry-Maharaj A, Burnell M, Singh N, Ryan A, Karpinskyj C, et al. Ovarian cancer population screening and mortality after long-term follow-up in the UK Collaborative Trial of Ovarian Cancer Screening (UKCTOCS): a randomised controlled trial. *Lancet*. 2021. [https://doi.org/10.1016/S0140-6736\(21\)00731-5](https://doi.org/10.1016/S0140-6736(21)00731-5)
3. Gao FF, Bhargava R, Yang H, Li Z, Zhao C. Clinicopathologic study of serous tubal intraepithelial carcinoma with invasive carcinoma: is serous tubal intraepithelial carcinoma a reliable feature for determining the organ of origin? *Human pathology*. 2013;44(8):1534-43.
4. Kindelberger DW, Lee Y, Miron A, Hirsch MS, Feltmate C, Medeiros F, et al. Intraepithelial carcinoma of the fimbria and pelvic serous carcinoma: Evidence for a causal relationship. *The American journal of surgical pathology*. 2007;31(2):161-9.
5. Karst AM, Levanon K, Drapkin R. Modeling high-grade serous ovarian carcinogenesis from the fallopian tube. *Proc Natl Acad Sci U S A*. 2011;108(18):7547-52.
6. Singh N, Gilks CB, Wilkinson N, McCluggage WG. Assessment of a new system for primary site assignment in high-grade serous carcinoma of the fallopian tube, ovary, and peritoneum. *Histopathology*. 2015; 67(3):331-337.
7. The Society of Gynecologic Oncology of Canada. GOC Statement regarding salpingectomy and ovarian cancer prevention. 2011. https://g-o-c.org/wp-content/uploads/2015/09/7GOCStmt_2011Sep_SalpOvCa_EN.pdf Accessed June 30, 2021.
8. Salvador S, Scott S, Fancis JA, Agrawal A, Giede C. No.344-Opportunistic salpingectomy and other methods of risk reduction for ovarian/fallopian tube/ peritoneal cancer in the general population. *Journal of Obstetrics and Gynaecology Canada*. 2017;39(6):480-93.
9. McAlpine JN, Hanley GE, Woo MM, Tone AA, Rozenberg N, Swenerton KD, et al. Opportunistic salpingectomy: uptake, risks, and complications of a regional initiative for ovarian cancer prevention. *American journal of obstetrics and gynecology*. 2014;210(5):471 e1-11.
10. Hanley GE, McAlpine JN, Pearce CL, Miller D. The performance and safety of bilateral salpingectomy for ovarian cancer prevention in the United States. *Am J Obstet Gynecol*. 2017;216(3):270 e1- e9.
11. Hanley GE, Kwon JS, Finlayson SJ, Huntsman DG, Miller D, McAlpine JN. Extending the safety evidence for opportunistic salpingectomy in prevention of ovarian cancer: a cohort study from British Columbia, Canada. *Am J Obstet Gynecol*. 2018;219(2):172 e1- e8.
12. Hanley GE, Kwon JS, McAlpine JN, Huntsman DG, Finlayson SJ, Miller D. Examining indicators of early menopause following opportunistic salpingectomy: a cohort study from British Columbia, Canada. *Am J Obstet Gynecol*. 2020;223(2):221 e1- e11.
13. Morelli M, Venturella R, Mocciano R, Di Cello A, Rania E, Lico D, et al. Prophylactic salpingectomy in premenopausal low-risk women for ovarian cancer: primum non nocere. *Gynecol Oncol*. 2013;129(3):448-51.
14. Venturella R, Lico D, Borelli M, Imbrogno MG, Cevenini G, Zupi E, et al. 3 to 5 Years Later: Long-term Effects of Prophylactic Bilateral Salpingectomy on Ovarian Function. *J Minim Invasive Gynecol*. 2017;24(1):145-50.
15. Findley AD, Siedhoff MT, Hobbs KA, Steege JF, Carey ET, McCall CA, et al. Short-term effects of salpingectomy during laparoscopic hysterectomy on ovarian reserve: a pilot randomized controlled trial. *Fertility & Sterility*. 2013;100(6):1704-8.

16. Hu FB, Grodstein F, Hennekens CH, Colditz GA, Johnson M, Manson JE, et al. Age at natural menopause and risk of cardiovascular disease. *Arch Intern Med*. 1999;159(10):1061-6.
17. Hanley G, McAlpine J, Kwon J, Mitchell G. Opportunistic salpingectomy for ovarian cancer prevention. *Gynecol Oncol Res Prac*. 2015;2(1):1-9.
18. Sandoval C, Fung-Kee-Fung M, Gilks B, Murphy KJ, Rahal R, Bryant H. Examining the use of salpingectomy with hysterectomy in Canada. *Current Oncol*. 2013;20(3):173-5.
19. Lander B, Wilcox E, McAlpine JN, Finlayson SJ, Huntsman DG, Miller D, et al. Changing Clinical Practice: Evaluation of Implementing Recommendations for Opportunistic Salpingectomy in British Columbia and Ontario. *Int J Gynecol Cancer*. 2018;28(6):1101-7.
20. Garcia C, Moskowitz OM, Chisholm CA, Duska LR, Warren AL, Lyons GR, et al. Salpingectomy Compared With Tubal Ligation at Cesarean Delivery: A Randomized Controlled Trial. *Obstet Gynecol*. 2018;132(1):29-34.
21. Duncan JR, Jones HL, Hoffer SO, Schenone MH, Mari G. Bilateral salpingectomy versus bilateral partial salpingectomy during cesarean delivery. *Int J Women's Health*. 2018;10:649-53.
22. Roeckner JT, Sawangkum P, Sanchez-Ramos L, Duncan JR. Salpingectomy at the Time of Cesarean Delivery: A Systematic Review and Meta-analysis. *Obstet Gynecol*. 2020;135(3):550-7.
23. Reade CJ, Finlayson S, McAlpine J, Tone AA, Fung-Kee-Fung M, Ferguson SE. Risk-reducing salpingectomy in Canada: a survey of obstetrician-gynaecologists. *JOGC*. 2013;35(7):627-34.
24. de Kleijn MJ, van der Schouw YT, Verbeek AL, Peeters PH, Banga JD, van der Graaf Y. Endogenous estrogen exposure and cardiovascular mortality risk in postmenopausal women. *Am J Epidemiol*. 2002;155(4):339-45.
25. Jacobsen BK, Nilssen S, Heuch I, Kvale G. Does age at natural menopause affect mortality from ischemic heart disease? *J Clin Epidemiol*. 1997;50(4):475-9.
26. Findley AD, Siedhoff MT, Hobbs KA, Steege JF, Carey ET, McCall CA, et al. Short-term effects of salpingectomy during laparoscopic hysterectomy on ovarian reserve: a pilot randomized controlled trial. *Fertility and sterility*. 2013;100(6):1704-8.
27. Venturella R, Morelli M, Lico D, Di Cello A, Rocca M, Sacchinelli A, et al. Wide excision of soft tissues adjacent to the ovary and fallopian tube does not impair the ovarian reserve in women undergoing prophylactic bilateral salpingectomy: results from a randomized, controlled trial. *Fertility and sterility*. 2015;104(5):1332-9.
28. Naaman Y, Hazan Y, Gillor M, Marciano G, Bardenstein R, Shoham Z, et al. Does the addition of salpingectomy or fimbriectomy to hysterectomy in premenopausal patients compromise ovarian reserve? A prospective study. *Eur J Obstet Gynecol Reprod Biol*. 2017;210:270-4.
29. Tehranian A, Zangbar RH, Aghajani F, Sepidarkish M, Rafiei S, Esfidani T. Effects of salpingectomy during abdominal hysterectomy on ovarian reserve: a randomized controlled trial. *Gynecol Surg*. 2017;14(1):17.
30. Collins E, Strandell A, Granasen G, Idahl A. Menopausal symptoms and surgical complications after opportunistic bilateral salpingectomy, a register-based cohort study. *Am J Obstet Gynecol*. 2019;220(1):85.e1-.e10.
31. Yoon SH, Kim SN, Shim SH, Kang SB, Lee SJ. Bilateral salpingectomy can reduce the risk of ovarian cancer in the general population: A meta-analysis. *Eur J Cancer*. 2016;55:38-46.

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3 32. Lessard-Anderson CR, Handlogten KS, Molitor RJ, Dowdy SC, Cliby WA, Weaver AL,
4 et al. Effect of tubal sterilization technique on risk of serous epithelial ovarian and primary
5 peritoneal carcinoma. *Gynecol Oncol*. 2014;135(3):423-7.
6
7 33. Madsen C, Baandrup L, Dehlendorff C, Kjaer SK. Tubal ligation and salpingectomy and
8 the risk of epithelial ovarian cancer and borderline ovarian tumors: a nationwide case-control
9 study. *Acta Obstet Gynecol Scand*. 2015;94(1):86-94.
10 34. Falconer H, Yin L, Gronberg H, Altman D. Ovarian cancer risk after salpingectomy: a
11 nationwide population-based study. *J Natl Cancer Inst*. 2015;107(2).
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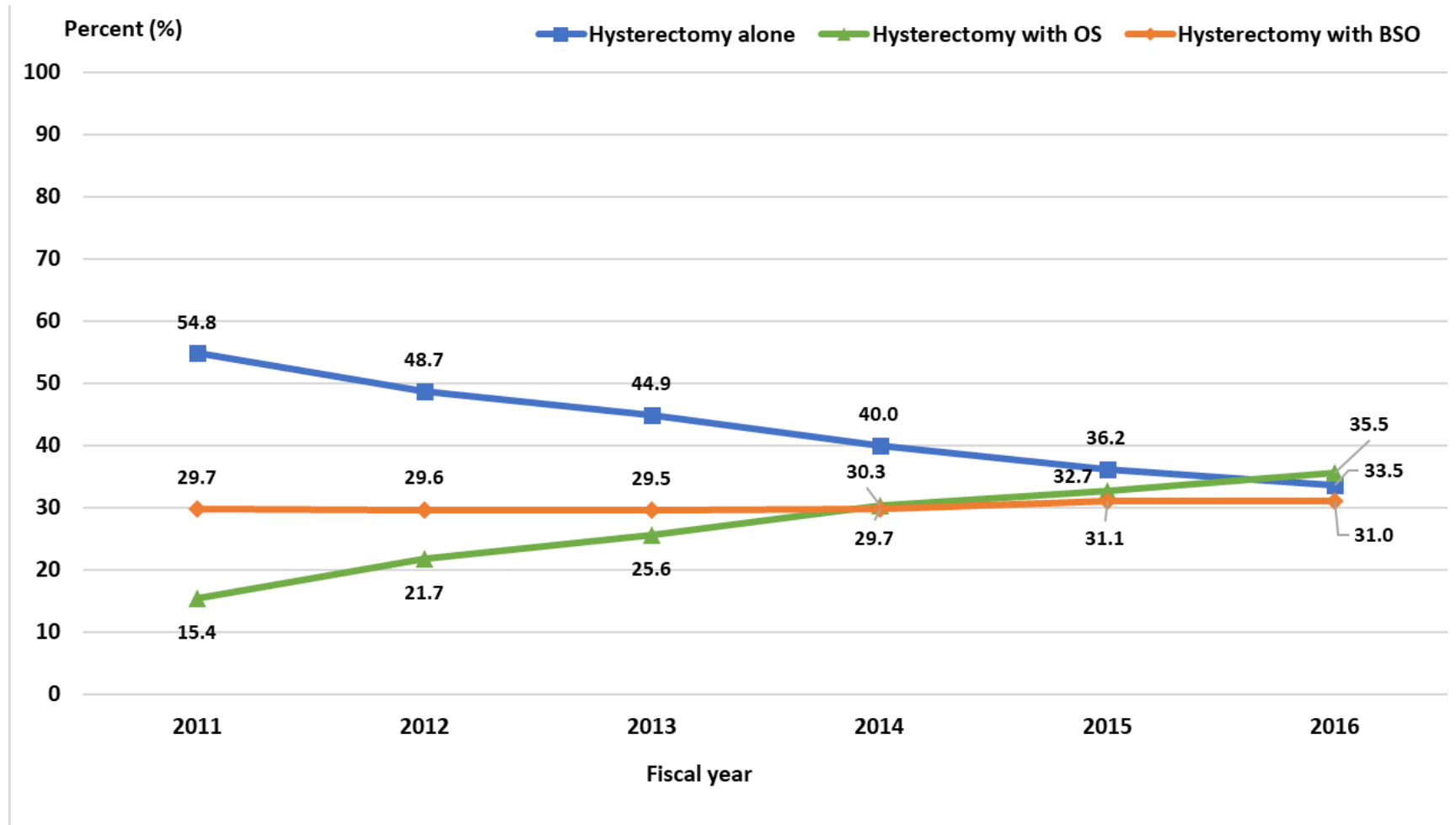


Figure 1a. Proportion of hysterectomies according to concomitant procedures across all Canadian provinces and territory (except Quebec) between 2011 and 2016.

Proportion of people who underwent hysterectomy alone, hysterectomy with opportunistic salpingectomy and hysterectomy with bilateral salpingo-oophorectomy.

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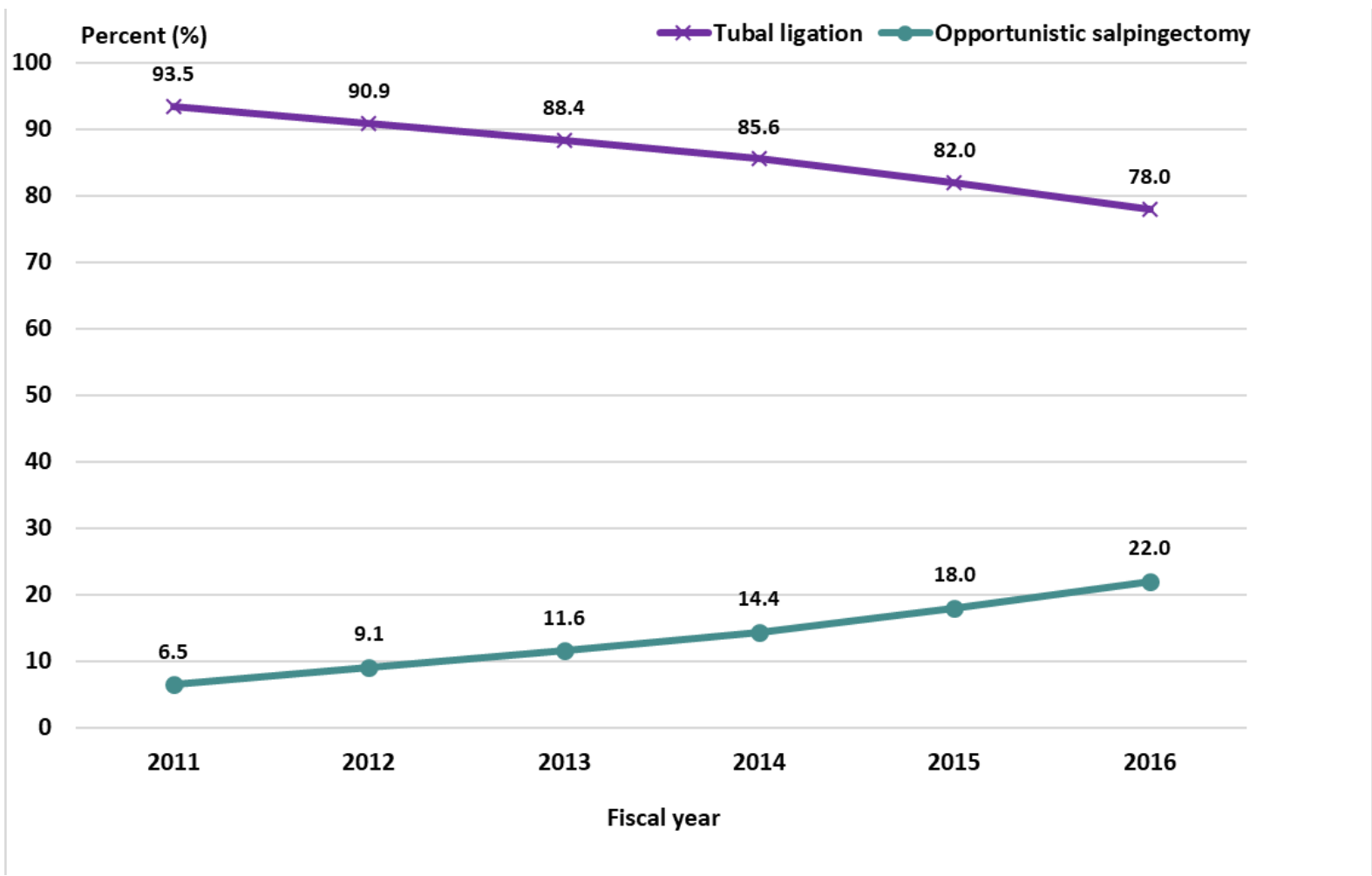
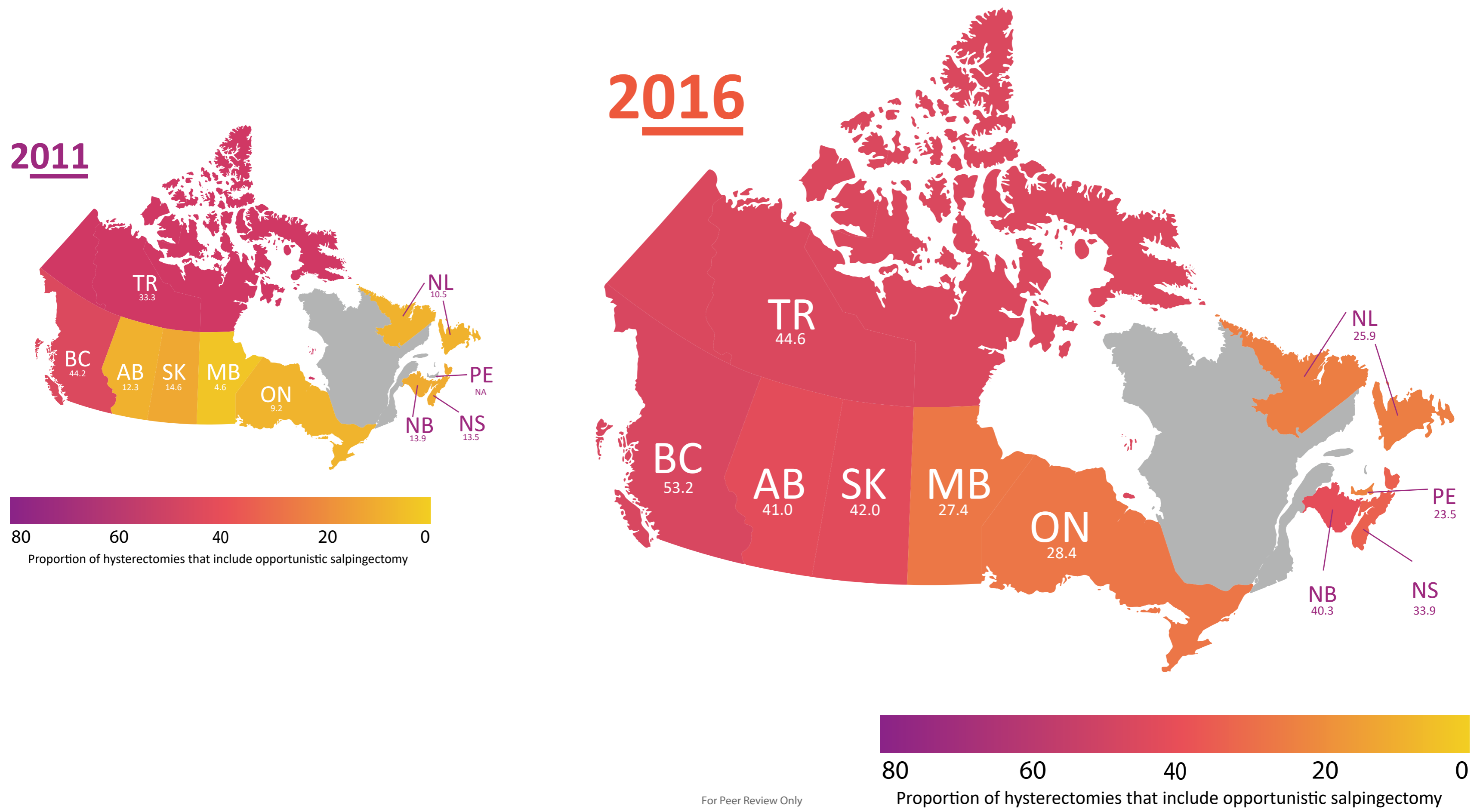


Figure 1b. Proportion of tubal sterilizations through opportunistic salpingectomy or tubal ligation across all Canadian provinces and territory (except Quebec) between 2011 and 2016.

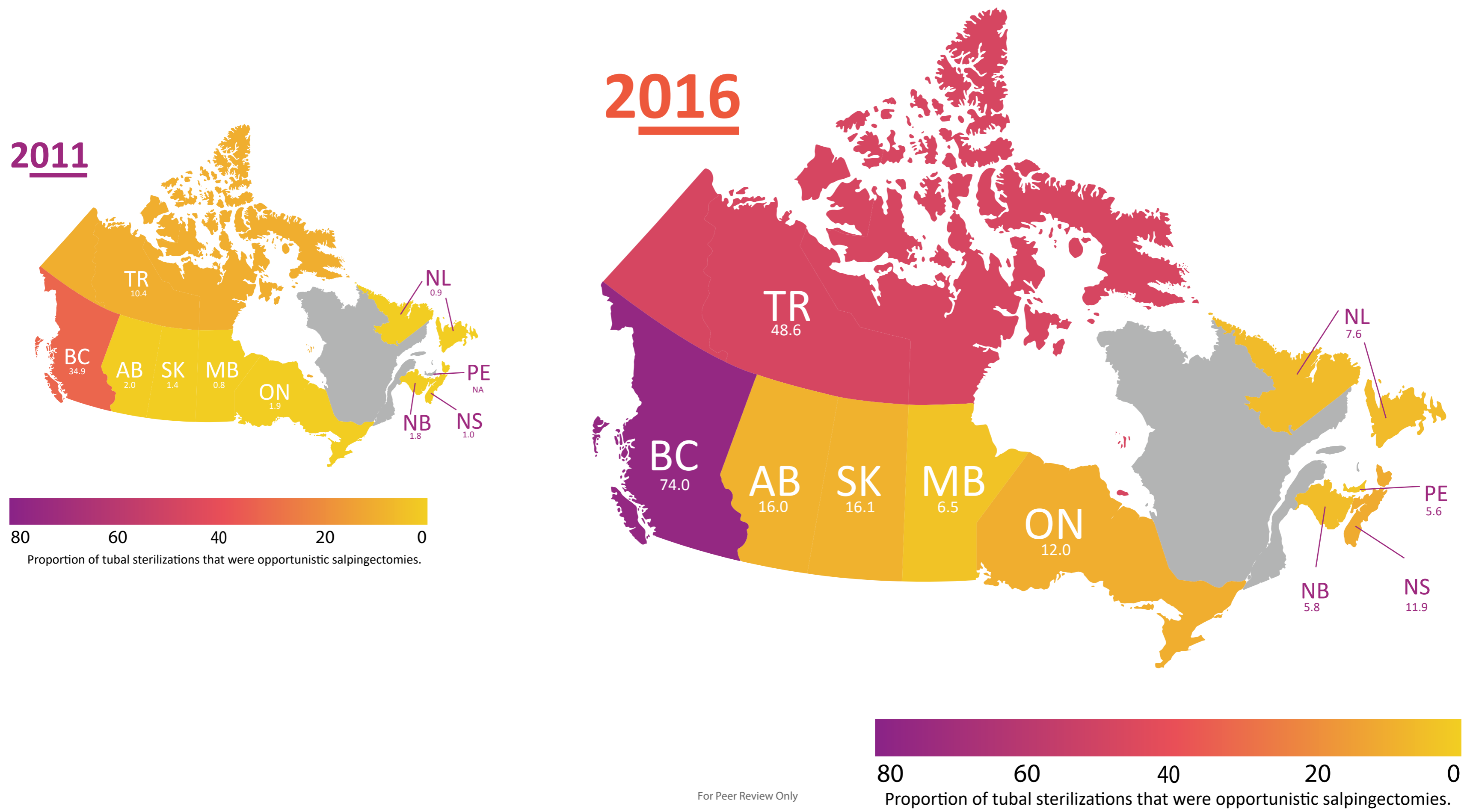
Proportion of people who underwent tubal ligation, or opportunistic salpingectomy for sterilization.

Figure 2a. Proportion of hysterectomies in 2011 and 2016 that included an opportunistic salpingectomy by Canadian province or territory (except Quebec).



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Figure 2b. Proportion of tubal sterilizations in 2011 and 2016 that were opportunistic salpingectomies by Canadian province or territory (except Quebec).



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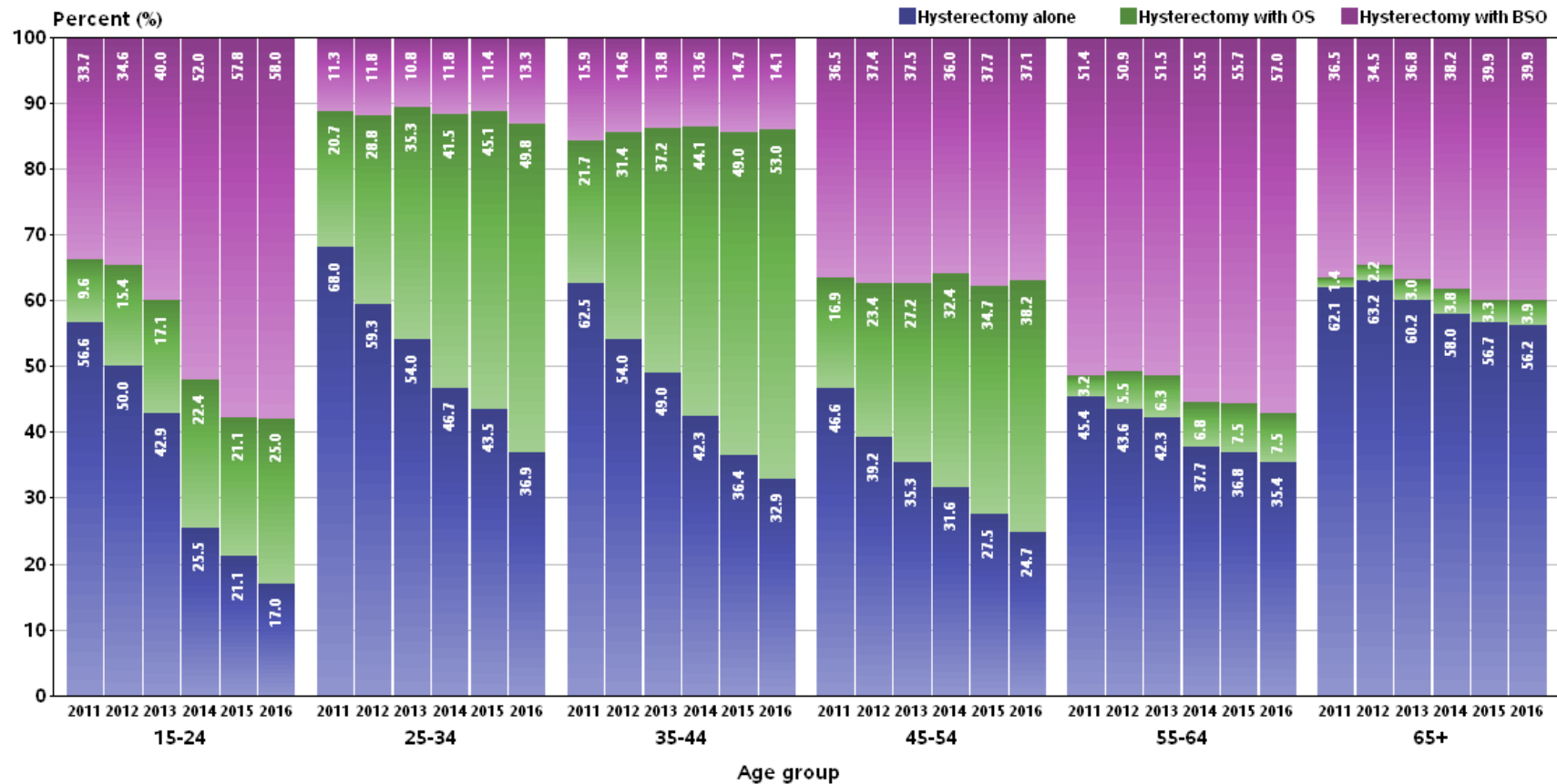


Figure 3a. Proportion of hysterectomies between 2011 and 2016 in Canada (except Quebec) according to concomitant procedures by age group.

Proportion of people who underwent hysterectomy alone, hysterectomy with opportunistic salpingectomy and hysterectomy with bilateral salpingo-oophorectomy.

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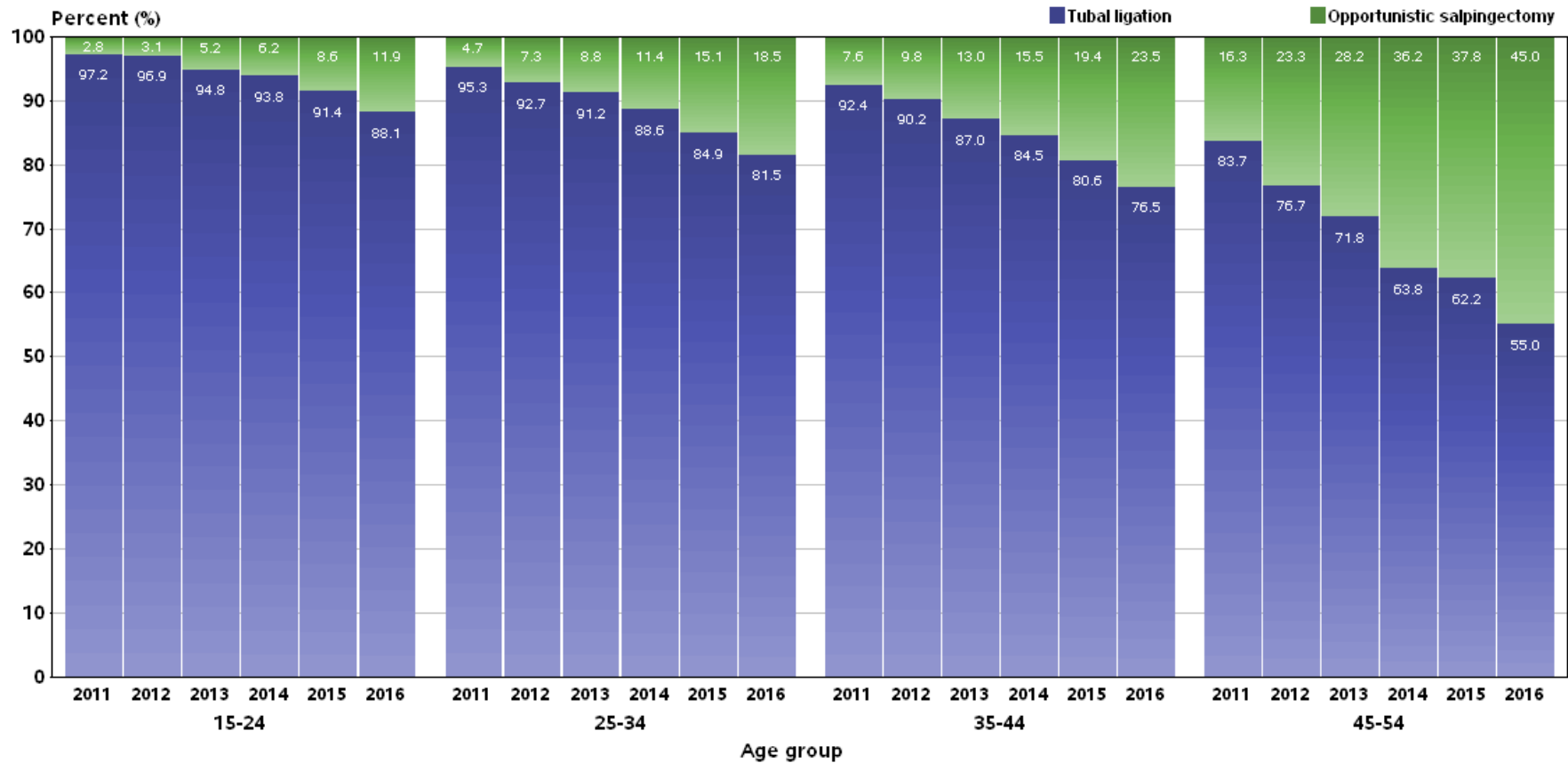


Figure 3b. Figure 2b. Proportion of tubal sterilizations that were done by OS and by tubal ligation between 2011 and 2016 in Canada (except Quebec) according to age.

Proportion of people who underwent tubal ligation for sterilization, and opportunistic salpingectomy for sterilization.

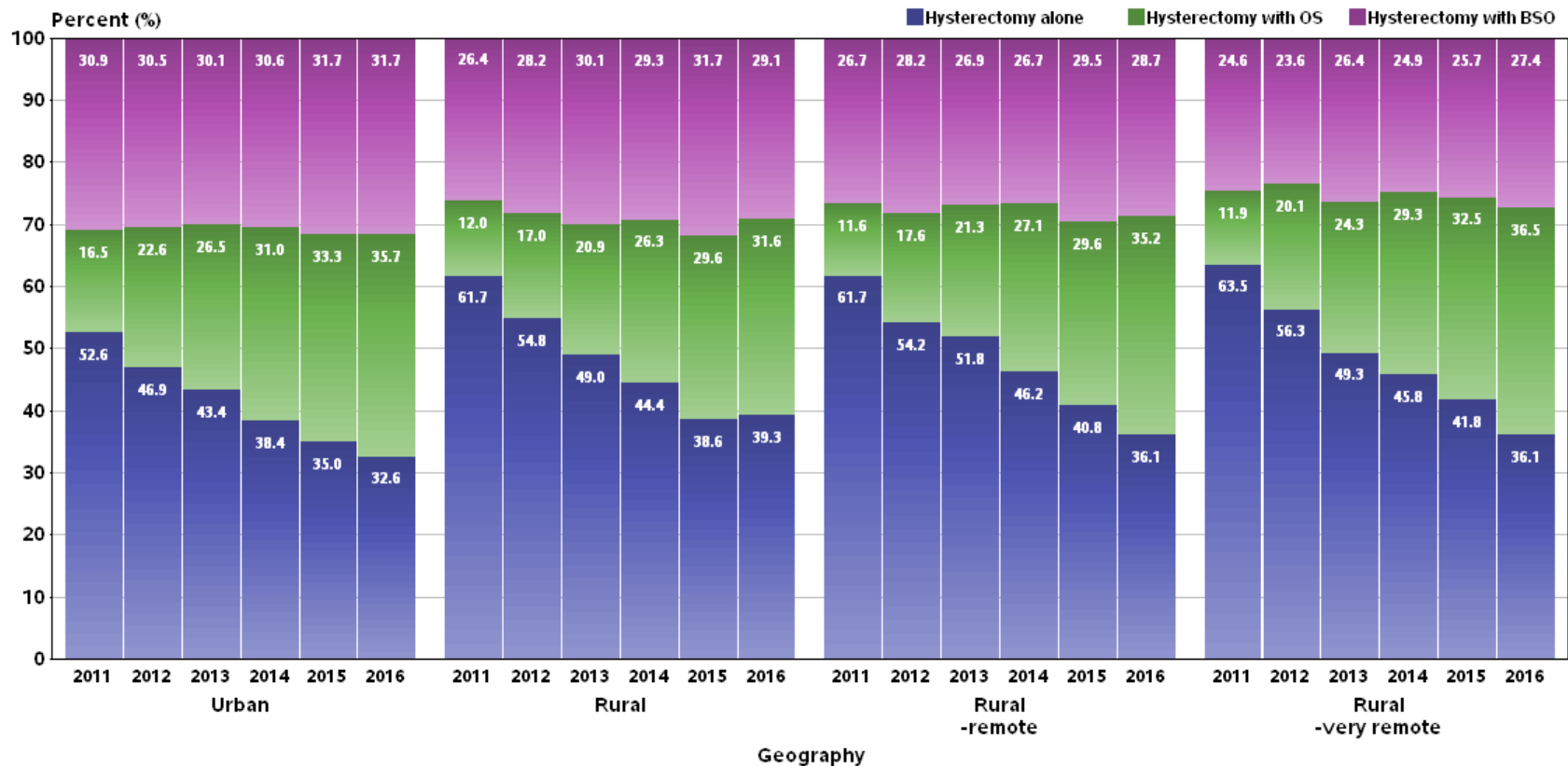


Figure 4a. Proportion of hysterectomies between 2011 and 2016 in Canada (except Quebec) according to geographical region of residence. Proportion of people who underwent hysterectomy alone, hysterectomy with opportunistic salpingectomy and hysterectomy with bilateral salpingo-oophorectomy.

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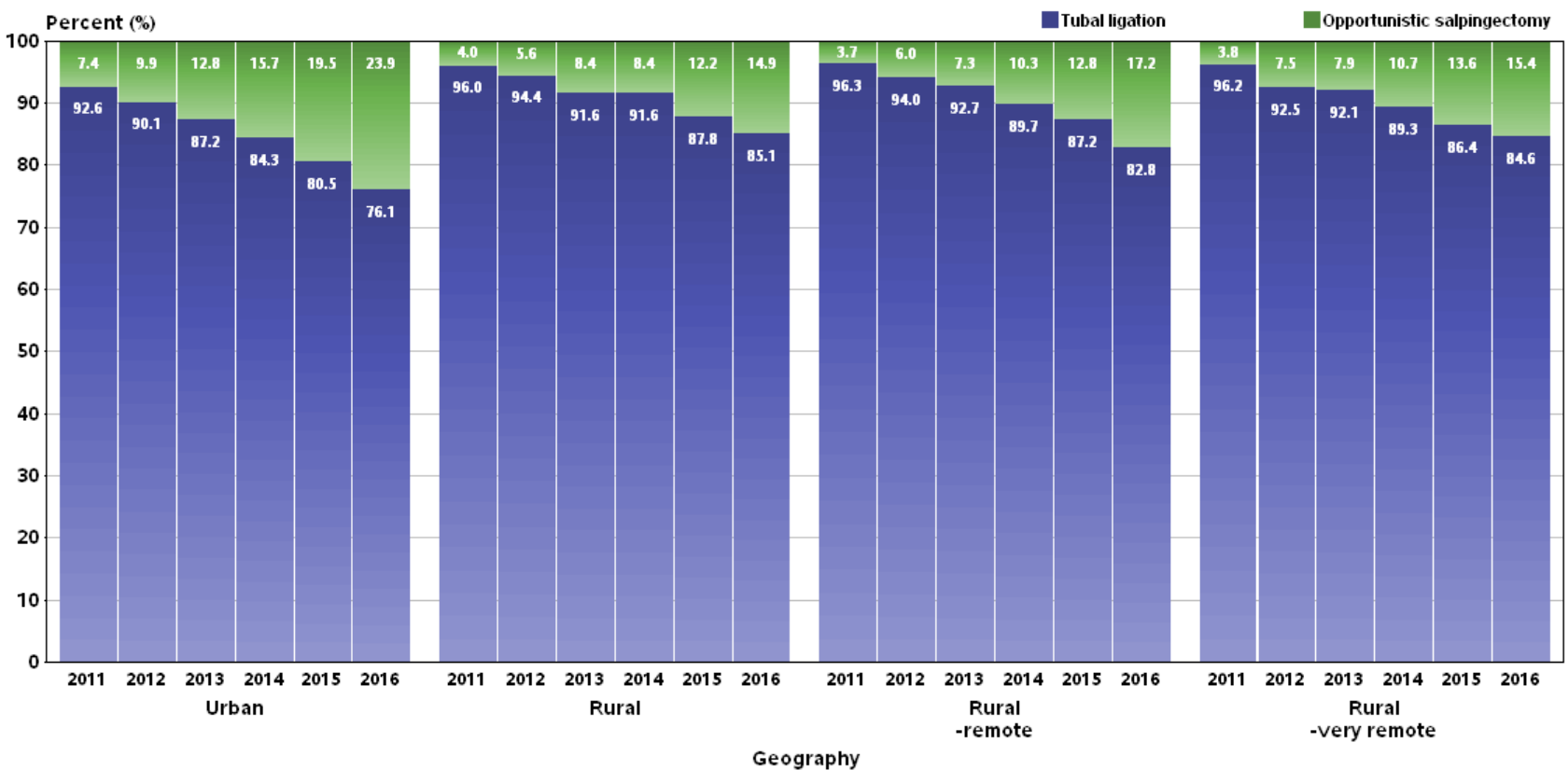
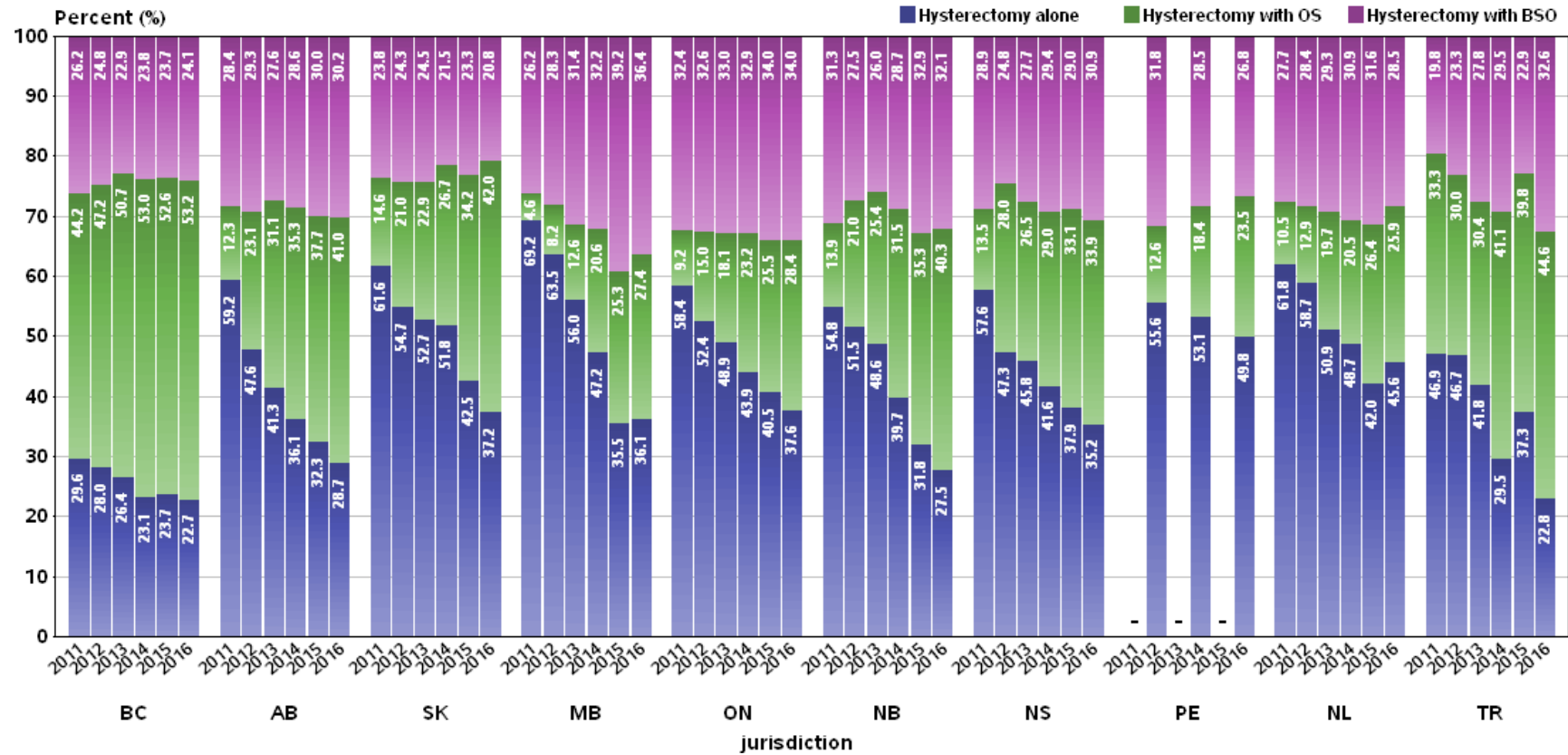


Figure 4b. Proportion of tubal sterilizations that were done by OS and by tubal ligation between 2011 and 2016 in Canada (except Quebec) according to geographical region of residence.

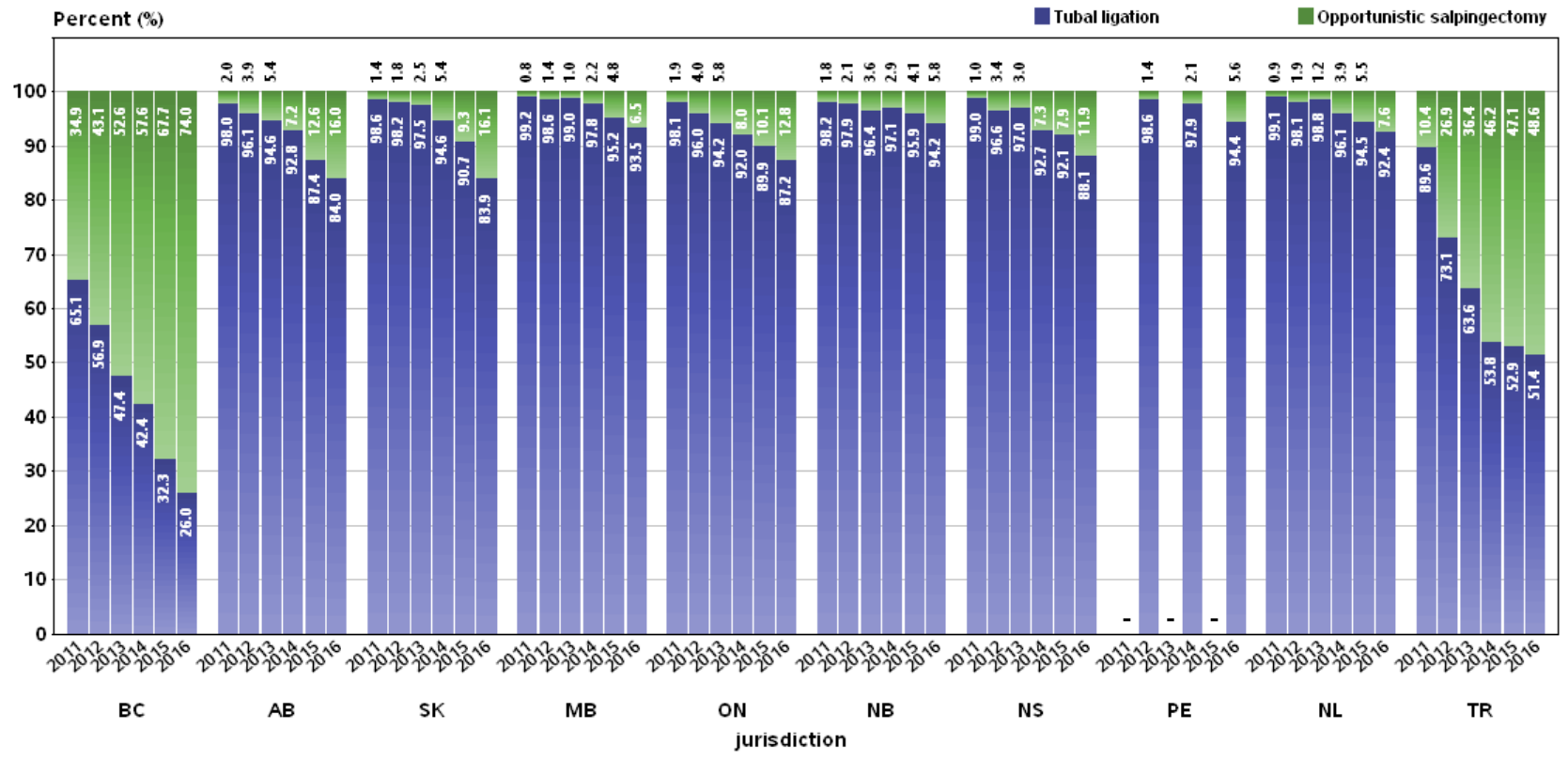
Proportion of people who underwent tubal ligation for sterilization, and opportunistic salpingectomy for sterilization.



Supplemental Figure 1a. Proportion of hysterectomies between 2011 and 2016 according to concomitant procedures by Canadian province or territory (except Quebec).

Proportion of people who underwent hysterectomy alone, hysterectomy with opportunistic salpingectomy and hysterectomy with bilateral salpingo-oophorectomy.

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Supplemental Figure 1b. Proportion of tubal sterilizations that were done by OS and by tubal ligation between 2011 and 2016 by Canadian province or territory (except Quebec).

Proportion of people who underwent tubal ligation for sterilization, and opportunistic salpingectomy for sterilization.