Defining the Canadian rural general surgeon

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Background: A total of 18%–30% of Canadians live in a rural area and are served by 8% of the country's general surgeons. The demographic characteristics of Canada's population and its geography greatly affect the health outcomes and needs of the population living in rural areas, and rural general surgeons hold a unique role in meeting the surgical needs of these communities. Rural general surgery is a distinct area of practice that is not well understood. We aimed to define the Canadian rural general surgeon to inform rural health human resource planning.

Methods: A scoping review of the literature was undertaken of Ovid, MEDLINE, and Embase using the terms "rural," "general surgery," and "workforce." We limited our review to articles from North America and Australia.

Results: The search yielded 425 titles, and 110 articles underwent full-text review. A definition of rural general surgery was not identified in the Canadian literature. Rurality was defined by population cut-offs or combining community size and proximity to larger centres. The literature highlighted the unique challenges and broad scope of rural general surgical practice.

Conclusion: Rural general surgeons in Canada can be defined as specialists who work in a small community with limited metropolitan influence. They apply core general surgery skills and skills from other specialties to serve the unique needs of their community. Surgical training programs and health systems planning must recognize and support the unique skill set required of rural general surgeons and the critical role they play in the health and sustainability of rural communities.

Contexte : En tout, 18 %–30 % de la population canadienne vit en milieu rural et est desservie par 8 % des effectifs en chirurgie générale au pays. Les caractéristiques démographiques de sa population et la géographie du Canada influent grandement sur l'état de santé et les besoins de la population rurale, et la chirurgie générale en milieu rural joue un rôle central en répondant aux besoins chirurgicaux de ces communautés. La chirurgie générale en milieu rural est un domaine de pratique à part, et elle n'est pas bien comprise. Nous avons voulu définir la chirurgie générale en milieu rural au Canada pour en faciliter la planification des ressources humaines.

Méthodes : Nous avons procédé à une synthèse exploratoire de la littérature auprès des bases de données Ovid, MEDLINE, et Embase à partir des termes anglais « rural », « general surgery », et « workforce ». Nous avons limité notre interrogation aux articles provenant de l'Amérique du Nord et de l'Australie.

Résultats : L'interrogation a généré 425 titres, et 110 articles ont fait l'objet d'une revue du texte intégral. Nous n'avons trouvé aucune définition de la chirurgie générale en milieu rural dans la littérature canadienne. La ruralité était définie par des seuils de population ou le rapport entre la taille d'une communauté et sa proximité d'un grand centre. La littérature a fait ressortir les défis particuliers et la portée du champ de pratique de la chirurgie générale en milieu rural.

Conclusion : La chirurgie générale en milieu rurale au Canada peut se définir comme un champ de spécialité qui dessert une petite communauté et qui subit peu l'influence de la métropole. Elle applique les techniques fondamentales de la chirurgie générale et emprunte certains actes médicaux à d'autres spécialités pour répondre aux besoins particuliers des communautés. Les programmes de formation en chirurgie et la planification des systèmes de santé devraient reconnaître et soutenir l'ensemble unique des habiletés requises pour exercer en chirurgie générale en milieu rurale et son rôle dans la santé et la préservation des communautés rurales.

According to the Canadian Institute for Health Information, 8% of general surgeons in Canada work in a rural setting, whereas 18%–30% of the population lives in rural areas, which are dispersed over 95% of the total land mass.[1–3] Rural Canadians are a socially diverse and culturally distinct population of Canada, who often face inequities in health care access. Indigenous people are more highly represented within rural Canada, as are people with increased comorbidities, reduced overall income, and a poor level of health compared with urban Canada.[4,5] Physicians and surgeons who serve this population face challenges when it comes to meeting the health care needs of rural Canadians. Often having to do more with less, they play a crucial role in their communities.

Rural surgeons positively affect their communities by providing expert-level care close to home. They improve trauma outcomes and provide access to maternity care in their community, which would otherwise be unavailable without surgical back-up.[6–11] To better understand the unique role rural general surgeons play in their communities, we aimed to assess the existing surgical literature for definitions and descriptions of rural surgeons and rural surgery practice, particularly in the areas of scope of practice, training, workforce, clinical outcomes, and recruitment and retention. We sought to develop a unifying definition of a Canadian rural general surgeon to guide future health human resource decisions and define training needs to support the sustainability of rural surgical care in Canada.

Methods

We undertook a scoping review of the literature, searching Ovid, MEDLINE, and Embase databases for primary research studies using the following terms: "general surgery," "rural," and "workforce." These terms were further expanded with appropriate Medical Subject Headings. Two authors (M.D. and E.F.) used Covidence to complete the title and abstract review, and a third author (L.G.) reviewed disagreements.[12] Inclusion criteria were general surgeons, Canada, Unites States, and Australia. Australia is frequently compared with Canada, as its population is similarly dispersed and comparable in characteristics, and care provision is equally challenging. The year of publication was not restricted. Studies from other geographic areas and conference proceedings were excluded, as were commentary and grey literature articles.

Full article reviews were undertaken, and searching for a definition of rural surgery was the primary objective. We further assessed articles for the definition of rurality used by authors, as well as data regarding rural scope of practice, workforce, training, clinical outcomes, and barriers to rural surgery. Bibliographies were reviewed to identify any further relevant literature. We used these data to develop a unifying definition of a rural surgeon in Canada.

Results

Literature review

The initial literature search identified 426 titles, and 315 were excluded. The remaining 112 articles underwent a full-text review and bibliography review, and 83 were considered relevant (Figure 1). Publications included 9 Canadian, 64 American, and 11 Australian studies (Table 1). Relevant topics identified in rural surgery literature included scope of practice, surgical workforce, surgical training, clinical outcomes, and recruitment and retention (Table 2). Articles regarding rural surgery topics outside of these 5 topics are included in Table 3.

Definition of a rural surgeon

One group put forth a definition; Nealeigh and colleagues[18] defined an "isolated surgeon," which encompassed both rural US and deployed military surgeons. Their definition was derived from strictly American literature based in civilian rural America and the American military. They set out 8 criteria, 5 of which were required for a surgeon to be considered an "isolated surgeon." The criteria were based on size of community; availability of resources, such as imaging and blood bank capabilities; distance to more complex care; and availability of local and nearby medical and surgical specialties.[18]

Defining rurality

A total of 50 studies used a specific definition of rurality; authors defined rurality in many ways. Most frequently used were population cut-off values (< 2500 to < 150 000 people), metropolitan influence, and health authority (Table 4 and Table 5).[24,25,27,29,30,34,35,40,41,44,45,47,48,53,57,58,60,61,63,66] An

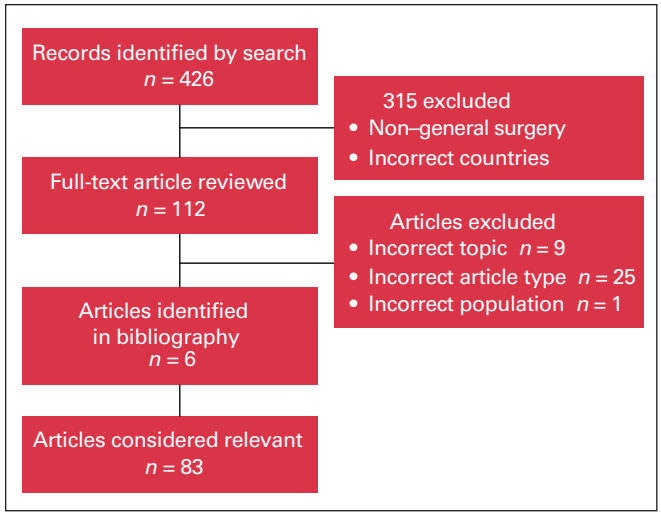

Fig. 1. Flow chart showing the inclusion and exclusion of articles.

example of metropolitan influence is the American Rural–Urban Commuting Area code used frequently in American studies, whereas Canadian groups more often used census data stratified by metropolitan influence.[18,23,32,36–38,43,46,50,52,55,59,64,65] The third most common definition is based on government or health authority definitions, for example, the Canadian census definition.[17,19,26,28,31,39,49,62] Other authors use a unique definition that is specific to the context of the hospital, region or question that is being answered. For example, a study assessing the use of surgical resources in Manitoba defines rural as any county outside of 2 provincial metropolitan areas.[20–22,51,54]

Rural surgery scope of practice

Thirty-two articles assessed the scope of practice of rural surgeons (Table 6). Up to one-third of their scope of practice falls outside of traditional general surgery core competencies, excluding endoscopy.[29,41,51,70] Many authors investigated the details of nontraditional procedures that a rural surgeon performs; most frequently identified were urology, orthopedic surgery, and obstetrics and gynecology (Appendix 1, available at www.canjsurg.ca/lookup/doi/10.1503/cjs.002123/tab-related-content).[23,29,41,46,47,57,60,65,68,70,72,73,77]

Table 1. Country of publication

Country of publication	No. of articles
Canada	9
United States	64
Australia	11

Table 2. Literature topics

Definition	No. of articles
Scope of practice	32
Surgical workforce	21
Surgical training	22
Clinical outcomes	13
Recruitment and retention	6
Other	5

Table 4. Definitions of rurality

Definition	No. of articles
Population cut-off	21
Metropolitan influence	15
Government or health authority	9
Other	5

It was found that rural surgeons play an important role in the treatment of trauma. They are routinely the surgical provider of thoracoabdominal trauma, consistent with larger centres but without the support of surgical specialties, such as neurosurgery and vascular surgery.[6,11,67,69,71] The scope of rural general surgery practice extends beyond procedural care alone, including workup and management of medical conditions. For example, rural general surgeons are often responsible for endoscopic gastrointestinal workup, as gastroenterologists are not commonly present in rural communities.[28] In addition to other specialty procedures, endoscopy typically comprises a significant proportion of a rural general surgeons' workload, up to 50% of all procedures.[19,23,28,29,46,47,49,61,64,66,68,70–72,76]

Rural surgical outcomes

Thirteen studies assessed the clinical outcomes of rural surgeons (Table 7). Additionally, several authors reviewed the outcomes of emergency procedures not usually within general surgery practice, including vascular surgery and neurosurgery.[11,67,75,82] These authors focused on rural and remote areas where delays in intervention would likely result in increased morbidity or mortality. In general, these patients had good clinical outcomes regardless of the fact that the specialty procedures were completed by general surgeons. Others assessed clinical outcomes of frequently completed procedures and found the complication rates of rural surgeons to be comparable to those of their higher-volume urban counterparts in both adult and pediatric patient populations.[31,42,56,76,80] One study of a Canadian trauma system found the presence of a surgeon in the community improved trauma outcomes and effective

Table 3. Summary of findings for other topics in rural surgery

Publication	Country	Context	Primary findings
Cofer and Burns, 2008[13]	United States	Estimation of the economic value of a rural surgeon	A general surgeon was estimated to be worth $1.05 million to $2.4 million to a rural hospital
Doty et al., 2007[14]	United States	Case report of initiation of a surgical program at a critical access hospital	Description of implementation of a surgical program at a critical hospital
Doty et al., 2008[15]	United States	Perception of rural hospital administrators on the importance of general surgery	111 surveys completed 82% of administrators viewed general surgery services as important to the financial viability of the hospital
Musgrove et al., 2020[16]	United States	Survey of rural hospitals emergency resources in nonteaching hospitals in West Virginia	In assessment of 45 hospitals, all had access to cross-sectional imaging, ventilator, operating rooms (ORs), and laboratory Not all critical access hospitals had access to OR teams 24/7 and full blood bank capabilities; increasing these resources would decrease the number of patients transferred
Wong and Petchell, 2004[17]	Australia	Assessment of rural trauma management in New South Wales, Australia	14 hospitals identified; 43% had a permanent surgeon

Table 5. Summary of rurality definitions

Publication	Country	Definition of rurality
Hilsden et al., 2007[19]	Canada	Canadian census
Micieli et al., 2015[20]	Canada	Population cut-off; Local Health Integration Network population < 600 000
Roos, 1983[21]	Canada	All areas outside of the only 2 metropolitan areas in the province of Manitoba
Rourke, 1998[22]	Canada	Community population < 2000; < 100 acute care beds
Schroeder et al., 2020[23]	Canada	Statistics Canada: community outside of a commuting area of an urban centre with > 10 000
Bruening and Maddern, 1998[24]	Australia	Population cut-off < 50 000
O'Sullivan et al., 2017[25]	Australia	Population cut-off < 50 000
Shanmugakumar et al., 2017[26]	Australia	Western Australian Health Department rural and remote designated hospitals
Wong and Petchell, 2004[17]	Australia	New South Wales Department of Health hospital designation
Ahmed et al., 2012[27]	United States	Population cut-off < 150 000
Baldwin et al., 1999[28]	United States	Washington State Office Rural Health
Breon et al., 2003[29]	United States	Population cut-off < 25 000
Burkholder and Cofer, 2007[30]	United States	Population cut-off < 25 000
Chaudhary et al., 2017[31]	United States	National Inpatient Sample coding; rural included micropolitan and noncentre hospitals
Cofer et al., 2011[32]	United States	Rural–urban commuting codes
Cook et al., 2019[33]	United States	Population cut-off < 50 000
Deveney and Hunter, 2009[34]	United States	State of Oregon definition: < 30 000
Deveney et al., 2013[35]	United States	Population cut-off < 50 000
Doty et al., 2006[36]	United States	Rural–urban commuting codes
Doty et al., 2009[37]	United States	Rural–urban commuting codes
Doty et al., 2009[38]	United States	Rural–urban commuting codes
Ellison et al., 2021[39]	United States	United States Census Bureau: area that is outside of urban areas
Etzioni et al., 2010[40]	United States	Population cut-off < 2500
Gates et al., 2003[41]	United States	Population cut-off < 10 000
Gadzinski et al., 2013[42]	United States	Critical access hospitals
Germack et al., 2019[43]	United States	Department of Agriculture Rural–Urban Continuum Codes
Glenn et al., 2017[44]	United States	Population cut-off < 50 000
Gruber et al., 2015[45]	United States	Office of Management and Budget Definition (county population < 10 000)
Harris et al., 2010[46]	United States	Rural–urban commuting codes
Heneghan et al., 2005[47]	United States	Office of Management and Budget Definition (county population < 10 000)
Jarman et al., 2009[48]	United States	Population cut-off < 50 000
Komaravolu et al., 2019[49]	United States	United States Census Bureau: area that is outside of urban areas
Kwakwa and Jonasson, 1997[50]	United States	Rural–urban commuting code
Landercasper et al., 1997[51]	United States	Hospital network designation of rural
Lynge, 2008[52]	United States	Rural–urban commuting codes
Mercier et al., 2019[53]	United States	Population cut-off < 50 000
Moesinger and Hill, 2009[54]	United States	Non-urban counties of Utah
Moore et al., 2016[55]	United States	Rural–urban commuting codes
Natafgi et al., 2017[56]	United States	Rural–urban commuting codes
Nealeigh et al., 2021[18]	United States	Population < 10 000; nearest tertiary referral centre > 100 miles or 2-hour commute
Ritchie et al., 1999[57]	United States	Population cut-off < 50 000
Shively and Shively, 2005[58]	United States	Office of Management and Budget Definition (county population < 10 000)
Sticca et al., 2012[59]	United States	Rural–urban commuting codes
Stiles et al., 2019[60]	United States	Office of Management and Budget Definition (county population < 10 000)
Stinson et al., 2021[61]	United States	Population cut off < 50 000
Stringer et al., 2020[62]	United States	Population density determined by the Kansas Department of Health and Environment
Thompson et al., 2005[63]	United States	Population cut-off < 50 000
Valentine et al., 2011[64]	United States	Rural–urban commuting codes
VanBibber et al., 2006[65]	United States	Rural–urban commuting codes
Zuckerman et al., 2007[66]	United States	Office of Management and Budget Definition (county population < 10 000)

transfers to tertiary care, their patients being more likely to arrive hemodynamically stable. These patients also had a high likelihood of requiring multidisciplinary management across several surgical disciplines, suggesting that many trauma patients treated in centres with general surgeons are obtaining appropriate care within the capabilities of their local centre.[6]

One trend identified in the literature is a lower rate of laparoscopic colectomies completed at rural hospitals. Colon and rectal procedures are less likely to be performed

Table 6. Summary of scope of practice findings

Publication	Country	Context	Primary findings
Ang et al., 2020[67]	Australia	Remote Australian base hospital; single institutional review of vascular emergencies	Rural surgeons located at base hospitals were required to complete emergency vascular surgery
Baldwin et al., 1999[28]	United States	Comparison of rural physician practice with urban practice	Rural general surgeons were more likely to be referred patients requiring gastrointestinal workup
Bappayya et al., 2019[68]	Australia	Review of procedures completed at a rural hospital by general surgeons	Endoscopy 35.9%; 5.4% of all procedures non–general surgery, including urology, vascular, and orthopedics
Bintz et al., 1996[69]	United States	Rural American hospital review of traumas; Injury Severity Score 8–43	84 traumas reviewed; surgeons partook in trauma team resuscitations, procedures, or stabilization for transport, or provided local definitive treatment of patients
Breon et al., 2003[29]	United States	Scope of practice of surgeons in rural Iowa	Endoscopy comprises a significant proportion of a rural surgeon's practice Rural surgeons were more likely to complete cesarean deliveries, hip fracture, tonsillectomies, and urologic procedures than urban surgeons
Campbell et al., 2011[70]	Australia	Assess the scope of practice of 2 practising surgeons in a rural hospital	8336 procedures performed Traditional general surgery 44.3%, endoscopy 27.4%, other specialties: orthopedics, head and neck, neurosurgery, and obstetrics
Campbell et al., 2013[71]	Australia	Assessment of the caseload of outreach surgeons	18029 procedures; 32% endoscopies; emergency procedures included vascular and neurosurgery
Cogbill and Bintz, 2017[72]	United States	Assessment of scope of practice for a network of rural general surgeons	Colonoscopies account for 52% of rural surgeons' practice, cesarean delivery 3.9%, and gynecology 2.2%
Etzioni et al., 2010[40]	United States	Assess the proportion of emergency and elective colorectal cases being performed by a certified colorectal surgeon	In low population-density areas, emergency colorectal procedures are more likely to be performed by non–colorectal surgeons
Gates et al., 2003[41]	United States	Survey of West Virginia rural surgeons	27% of practice included obstetrics, urology, and orthopedics; also treated many medical problems
Gruber et al., 2015[45]	United States	Assessment of laparoscopic v. open colectomy for colorectal cancer in Nebraska	Rural patients were 40% less likely to receive a laparoscopic colectomy
Harris et al., 2010[46]	United States	Assessment of scope of practice for North and South Dakota general surgeons	Rural surgeons' practice composed of 39.8% endoscopy and 25.6% general surgery procedures Surgeons in smaller centres performed more endoscopy and non–general surgery procedures (obstetrics, orthopedics, urology, and vascular)
Heneghan et al., 2005[47]	United States	Assessment of practice and motivations of rural compared with urban surgeons	Rural surgeons were more likely to perform cesarean deliveries and gynecologic procedures Endoscopy accounts for a greater proportion of rural practice
Hilsden et al., 2007[19]	Canada	Determine provincial and regional differences in endoscopy providers	Canadian rural surgeons completed 51% of all endoscopic procedures v. 35% by gastroenterologists
Komaravolu et al., 2019[49]	United States	Assessment of the proportion of colonoscopies completed by general surgeons on rural patients	In rural areas, general surgeons performed 21.9% of all colonoscopies, whereas urban surgeons performed 3.1% of all urban colonoscopies
Kozhimannil et al., 2015[73]	United States	Rates of births being attended by general surgeons	In low-volume centres, births were more likely to be attended by a general surgeon than by an obstetrician–gynecologist
Luck et al., 2015[11]	Australia	Completion of emergency neurosurgical procedures by rural surgeons	Rural centres with resident general surgeons who completed all emergency neurosurgical procedures needed before transfer
Micieli et al., 2015[20]	Canada	Assessment of temporal artery biopsies by region in Ontario	Surgeons were more often the provider in less populated regions
Moore et al., 2016[55]	United States	Assessment of the frequency of laparoscopic colectomies performed by rural surgeons	Rural surgeons did not complete a high volume of colectomies; they were not frequently performed laparoscopically
Nealeigh et al., 2021[18]	United States	Scoping review of literature surrounding American rural and deployed military surgeons	Approximately 20.7% of rural civilian surgical case volume is non–core general surgery, excluding endoscopy
Reynolds et al., 2003[74]	United States	Assessment of training procedures in a rural community training centre	Graduating residents completed a high volume of advanced laparoscopic procedures in a rural setting
Rinker et al., 1998[75]	United States	Assessment of local surgery training in emergency craniotomy	Based on need, a group of general surgeons completed training for emergency craniotomy by a neurosurgeon Over a follow-up period, 7 performed due to instability
Ritchie et al., 1999[57]	United States	Assessment of scope of practice between rural and urban surgeons	Rural surgeons completed more endoscopy procedures, laparoscopy, and non–general surgery procedures
Sariego, 2000[76]	United States	Review of a single rural surgeon's endoscopic practice	Endoscopy accounted for 24% total procedures
Schroeder et al., 2020[23]	Canada	Assessment of scope of practice of all rural Canadian surgeons	Rural surgeons were more likely to perform procedures outside of core general surgery, including endoscopy, orthopedics, and obstetrics
Sticca et al., 2012[59]	United States	Evaluation of North Dakota rural surgeons' scope of practice	46 052 procedures completed by rural surgeons, 12.3% were non–general surgery procedures
Stiles et al., 2019[60]	United States	Survey of rural surgeons, assessing scope of practice and preparedness	43 of the rural surgeons surveyed frequently performed procedures from other specialties, including gynecology, otolaryngology, urology, and vascular surgery
Stinson et al., 2021[61]	United States	Assessment of procedures most frequently performed by a rural surgeon	38 958 procedures were assessed; 61.6% were endoscopic, cholecystectomy, or hernia repair related
Tulloh et al., 2001[77]	Australia	Assessed the caseload of 3 rural general surgeons	Practice patterns varied between the 3 surgeons; frequently performed types of procedures included endoscopy, urology, vascular, and obstetrics
Valentine et al., 2011[64]	United States	Examination of the scope of practice of American general surgeons between 2007 and 2009	Rural surgeons performed significantly more endoscopic procedures; urban surgeons performed more laparoscopic procedures and abdominal procedures
VanBibber et al., 2006[65]	United States	Comparison of rural with urban general surgery scope of practice	Rural surgeons were less likely to perform procedures on the stomach, pancreas, liver, or esophagus; they performed a greater number of obstetric and gynecologic, vascular, and head and neck procedures, which accounts for a greater proportion of inpatient procedures
Zuckerman et al., 2007[66]	United States	Telephone survey of rural and urban surgeons assessing endoscopy volume	74% of rural surgeons performed more than 50 endoscopic procedures in a year v. 33% of urban surgeons; 42% of rural surgeons completed > 200 procedures compared with 12% of urban surgeons

Table 7. Summary of findings for clinical outcomes

Publication	Country	Context	Primary findings
Ang et al., 2020[67]	Australia	Assessment of emergency vascular procedures completed at a rural Australian hospital	16 patients were unable to be transferred and received emergency vascular procedures; 69% survived with limb salvage
Ball et al., 2009[6]	Canada	Assessment of outcomes of level III trauma centres in Alberta, Canada	Patients who arrived from a level III trauma centre more often had a surgical assessment, 13% required laparotomy alone, and 87% required assessment from other surgical specialists These patients were less likely to arrive unstable compared with level IV centres Rural surgeons were appropriately treating and transferring trauma patients
Chaudhary et al., 2017[31]	United States	Comparison of outcomes in emergency general surgery and trauma between rural and urban centres	Rural patients had higher odds of mortality, were less likely to have major complications, and remained in hospital an average of 0.5 days longer at a cost of $98/d more; the authors concluded that despite statistical significance, they were not clinically significant
Gadzinski et al., 2013[42]	United States	Comparison of postoperative outcomes among surgical patients treated at a critical access hospital compared with other hospitals	Among general surgery patients, there were no statistically significant increased adverse postoperative outcomes among patients treated in critical access hospitals; patients on average were discharged earlier, but their care did cost 9.9%–30.1% more
Galandiuk et al., 2006[78]	United States	Comparison of quality indicators between rural and urban surgeons	Higher volume rural colorectal surgeons have comparable outcomes compared with urban surgeons in cases of colectomy Rural surgeons had similar outcomes compared with urban surgeons when assessing cholecystectomy and endoscopy
Luck et al., 2015[11]	Australia	Assessment of emergency neurosurgical procedures completed in rural Australia	161 patients required emergency neurosurgical procedures in a rural setting with general surgery Poor outcomes were attributed to distance of patient transfer and the remote location of trauma; outcomes reviewed as acceptable based on those factors
Natafgi et al., 2017[56]	United States	Comparison of adverse events surgical patients in critical access hospitals compared with larger centres	Surgical patients at critical access hospitals had similar rates of reported adverse events compared with larger centres
Pandit et al., 2016[79]	United states	Assessment of rural v. urban surgical management of ulcerative colitis	Patients with ulcerative colitis managed in urban centres with colorectal surgery were less likely to have complications than when managed in rural settings
Quinn and Read, 2017[80]	Australia	Assessment of pediatric surgical outcomes managed at rural sites in Australia	Complication rates of orchidopexy under the age of 5 years and inguinal hernia under the age of 1 year had the same or nearly the same complication rates as the published gold standard
Rinker et al., 1998[75]	United States	Outcomes of locally performed craniotomy by general surgeons at a level III trauma centre	Based on need, a group of general surgeons completed training for emergency craniotomy by a neurosurgeon In the follow-up, 7 patients required emergency craniectomy as deemed appropriate by a remote neurosurgeon; good clinical outcomes resulted in patients deemed too unstable to transfer to specialized neurosurgical care
Rossi et al., 2011[81]	United States	Assessment of complication rates of procedures completed in critical access hospitals	Review of 100 consecutive carotid endarterectomy, laparoscopic cholecystectomy, laparoscopic Nissen fundoplication, hysterectomy, and inguinal hernia; overall complication rate of 4%
Sariego, 2000[76]	United States	Review of a single rural surgeon's endoscopic practice	276 endoscopic procedures were completed; 75% pertinent diagnosis were identified; no complications
Treacy et al., 2005[82]	Australia	Assessment of emergency neurosurgical procedures performed in remote Australia	305 emergency neurosurgical procedures were completed; overall outcomes were acceptable

by a specialist colorectal surgeon, and patients in rural centres are less likely to receive a laparoscopic procedure.[45,55] Another study identified patients with ulcerative colitis treated by non–colorectal specialists as more frequently experiencing complications.[79]

Rural surgical workforce characteristics

Twenty-five papers discussed the characteristics of the rural surgical workforce (Table 8). In the US and Canada, several authors observed that rural surgeons tend to be male, internationally trained, and older than their urban counterparts.[23,41,48,52,63] The literature also identified a decrease in the number of general surgery graduates entering rural surgical practice, as well as the loss of rural surgical programs.[22,29,39,43,50,85] Studies reviewing advertised surgical position vacancies identified service gaps more frequently in rural positions, often with long-standing vacancies and reliance on locum tenens surgeons as the primary surgical workforce.[26,29,38,62] Several studies have been conducted to understand what factors help predict a general surgeon's decision to practise in a rural setting. The most frequently cited predictor for choosing rural surgical practice is having grown up in a rural area or having a partner who grew up in a rural area.[24,36,41,48,66] Rates of rural clerkship and resident rotations were higher among surgeons who chose rural practice settings than those working in urban settings.[48]

Rural surgical training

A total of 22 studies assessed the training of rural surgeons (Table 9). Rural surgical training literature focused on the need for a broad-based general surgery training program

Table 8. Summary of findings for rural surgical workforce characteristics

Publication	Country	Context	Primary findings
Breon et al., 2003[29]	United States	Assessment of need for rural surgeons in Iowa	64% of rural surgeons were recruiting a partner compared with 50% of urban surgeons 77% of rural surgeons felt that there was a shortage in the rural workforce
Bruening and Maddern, 1998[24]	Australia	Characterizing the rural Australian workforce	134 male surgeons; 3 female surgeons; 41% of rural surgeons were raised in a rural setting
Decker et al., 2013[83]	United States	Assessment of the available general surgery positions in Wisconsin and Oregon	71 positions available; 46% were rural, and only 18% required fellowship training; 67% of graduates enter fellowships
Doty et al., 2006[36]	United States	Survey to determine the characteristics of graduates from a New York general surgery program	Surgeons raised in a rural area were more likely to choose a career in rural surgery
Doty et al., 2009[38]	United States	Survey of rural hospitals recruitment of general surgeons and use of locum tenens surgeons	56% of surveyed hospitals recruited for a general surgeon; 30% have been unable to fill the position and 20% used locum tenens surgeons
Ellison et al., 2021[39]	United States	Estimation of the American general surgeon work force needs	Population growth in the US will outpace the number of trained general surgeons; the increased need in urbanized areas will negatively affect rural recruitment
Gates et al., 2003[41]	United States	Survey of West Virginia rural surgeons	Only 5 female rural surgeons Average age of rural surgeons was 57; rural surgeons were more likely to have been raised in a rural community
Germack et al., 2019[43]	United States	Assessment of the impact from the closure of rural hospitals on local communities	In the years before a hospital closure, there is a loss of general surgery capability; at the time of closure there is a substantial loss of all specialties remaining in the community
Glenn et al., 1988[84]	United States	Defining the community requirements to support a general surgeon	To support a general surgeon, a population base of 15 000 and 11 referring physicians is required
Ingraham et al., 2021[85]	United States	Survey of all US acute care hospitals, outlining emergency general surgery coverage gaps	2811 hospitals responded; 279 hospitals are unable to provide 24/7 emergency surgical services Rural hospitals and nonteaching hospitals were less likely to provide 24/7 emergency surgical coverage
Kwakwa and Jonasson, 1997[50]	United States	Characteristics of the American general surgical workforce	19 791 general surgeons were identified; only 6.9% of surgeons work in a rural area
Jarman et al., 2009[48]	United States	Factors correlating to a resident's choice of rural practice	Rural surgeons were more likely to be male Completing high school or university in a rural setting correlated to selecting a rural career Completion of a rural clerkship was also correlated to pursuing a career in rural general surgery
Lynge, 2008[52]	United States	Defining the rural general surgery workforce	Rural surgeons were more likely to be male, female surgeons were less likely to work in a rural setting, and, on average, rural surgeons were older
Roos, 1983[21]	Canada	Defining the impact of rural surgeons in local utilization of surgical services	Arrival of a surgeon in a rural area increased the utilization of surgical services in that area, and decreased the number of procedures completed outside of the home centre Departure of a surgeon increased the workload of their surgical colleagues but did not decrease the local utilization of surgical services
Roos et al., 1996[86]	Canada	Determining optimal workforce planning in rural general surgery	Defined 3 methods of determining the number of surgeons The first model was based on an optimal ratio of surgeons to population The second assessed the number of procedures where patients travelled out of their home communities to receive care The third model analyzed recruitment needs based on an assessment of the proportion of the population requiring surgery compared with other areas
Rourke, 1998[22]	Canada	Assessment of surgical services in small Ontario hospitals	Between the years 1988 and 1995 there was a decrease in 24/7 coverage for general surgery, but the number of procedures completed increased; there were fewer general surgeons practising in these smaller communities
Schroeder et al., 2020[23]	Canada	Assessment of the scope of practice of all rural Canadian surgeons	Rural surgeons were older on average, there were fewer female surgeons, and rural surgeons were more likely to be international graduates
Shanmugakumar et al., 2017[26]	Australia	Characterizing the rural general surgery workforce in Western Australia	18 hospitals completed the survey; 89% were serviced by fly-in and fly-out surgical services, and 2 hospitals had a resident general surgeon
Stringer et al., 2020[62]	United States	Description of the loss of surgical workforce at rural hospitals in Kansas	Most rural sites in Kansas did not have a permanent surgeon Lack of surgical services at rural and frontier hospitals leads to a higher amount of patient transfers
Thompson et al., 2005[63]	United States	Characterizing the American general surgery workforce	Rural surgeons were more likely to be male and older, and were more likely to be international medical graduates
Zuckerman, 2007[66]	United States	Telephone survey of rural and urban surgeons, assessing endoscopy volume and training needs	51% of rural surgeons were from a rural background v. 38% of urban surgeons

Table 9. Summary of findings for rural surgical training

Publication	Country	Context	Primary findings
Burkholder and Cofer, 2007[30]	United States	Assessment of rural training perceptions and availability of rural training opportunities in American general surgical residency programs	36% of training programs have a rural track Research-based programs were less likely to have a rural track; program directors were less likely to indicate rural training as a part of their program's mission, and they were less likely to indicate that there is a shortage of rural surgeons Opinions were divided on the adequacy of a broad general surgery training program in preparation for rural surgery practice Program directors stated that orthopedics and gynecology are important aspects of a rural training program
Cofer et al., 2011[32]	United States	Survey of rural surgeons' attitudes toward training	20% of the 237 respondents completed fellowship training; reasons included to obtain additional skills or increase in comfort 81% indicated that there would be benefit to rural track residency programs; 80% indicated that their ideal candidate would not need subspecialty training
Deal et al., 2018[87]	United States	Needs assessment of skills in rural surgery	237 rural surgeons responded; 82% stated that rural surgery opportunities during residency training is important The following training needs were identified: endoscopy, advanced laparoscopy, trauma management, wound care, and basic non–general surgery procedures (cesarean delivery, carpal tunnel, amputation)
Deveney and Hunter, 2009[34]	United Stated	Description of the rural training model in Oregon and its outcomes	One-year training program in a rural setting with formal training rotations in non–general surgery specialties (obstetrics and gynecology; urology; ear, nose, and throat) 10 graduates completed the program; 5 were working in rural or small community practices
Deveney et al., 2013[35]	United States	Outcomes of a rural training model in Oregon	Residents who completed the rural track were more likely to remain in general surgery, as opposed to subspecialty training regardless of career goals at the start of residency; they were also more likely to enter rural practice
Doty et al., 2006[36]	United States	Survey of graduates from a rural-based training program on practice setting and demographics; assessment of procedure logs compared with national average	Graduates of a rural broad-based training program were more likely to enter rural practice; 83% of practising graduates reported working in a rural setting, and 71% reported that they were raised in a rural community Assessment of procedure logs indicated that graduates performed significantly more non–general surgery procedures compared with the national average
Fader and Wolk, 2009[88]	United States	Description of a residency program's rural surgery track	Dedicated training year at a rural hospital in preparation for rural or international practice Hospital characteristics including limited number of trainees outside of general surgery Additional areas of training in the sixth year were tailored to the needs of the hospital
Giles et al., 2009[89]	United States	Assessment of a general surgery program's rural rotation	The rural rotation was well received and educational according to a resident survey Improved endoscopy exposure for residents; the rotation increased resident interest in rural surgery as a career choice
Gillman and Vergis, 2013[90]	Canada	Survey of graduating residents comfort level when performing general surgery and non–general surgery procedures	Most residents were comfortable with breast, gallbladder disease, and colorectal procedures; few were comfortable with more advanced procedures, including gastrectomy, advanced laparoscopy, and procedures outside of core general surgery
Glenn et al., 2017[44]	United States	Tele-mentoring interest in rural surgery	78.9% of survey respondents indicated that tele-mentoring was useful for acquiring new skills, or dealing with unexpected intraoperative findings
Halverson et al., 2014[91]	United States	Evaluation of a multidisciplinary skills course for rural surgeons	Mentoring and teaching of skills beyond the normal scope of general surgery; overall, it was felt to be beneficial to practising surgeons
Heneghan et al., 2005[47]	United States	Assessment of practice and motivations of rural compared with urban surgeons	In a survey of 421 surgeons, rural surgeons indicated that they would have benefited from non–general surgery training in residency and would have equally benefited from advanced laparoscopy training
Jarman et al., 2009[48]	United States	Assessment of the characteristics of general surgery graduates	79% of practising rural surgeons had completed a rural clerkship, compared with 37% of urban surgeons
Kent et al., 2015[92]	United States	Description of rural training program	Developed a rural training program with broad surgical specialty exposure, including exposure to rural mentorship and an emphasis on endoscopy, obstetrics, and orthopedics; 18 months of rural rotations
Landercasper et al., 1997[51]	United States	Comparison of procedure logs from practising rural surgeons compared with graduating residents	Residents completed fewer gynecologic and orthopedic procedures than practising rural surgeons
Milligan et al., 2009[93]	United States	Assessment of a rural surgical rotation in senior general surgery residency	Resident case logs from participating residents more similar to caseload of rural surgeon Following implementation of rotation, more graduates selected rural practice as a career
Mercier et al., 2019[53]	United States	Assessment of rural training opportunities and description of new rural track	27 programs required rural rotations, 10 offered rural electives, and 4 had designated rural track match positions Designed program for residents to complete training at rural sites throughout their 5-year program
Moesinger and Hill, 2009[54]	United States	Description of 1-year rural residency program	One-year fellowship to be completed in postgraduate year 4 for residents interested in rural practice; rotations within general surgery and non–general surgery specialties
Reynolds et al., 2003[74]	United States	Assessment of training procedures in a rural community training centre	Graduating residents completed a high volume of advanced laparoscopic procedures in a rural training setting and reported confidence with those procedures
Stiles et al., 2019[60]	United States	Survey of rural surgeons assessing scope of practice and preparedness	43 rural surgeons surveyed frequently performed procedures from other specialties, including gynecology, otolaryngology, urology, and vascular, and reported preparedness to perform these procedures on graduation
Undurraga Perl et al., 2015[94]	United States	Assessment of procedures performed by general surgeons in critical access hospitals, compared with those performed by residents Compared the procedure logs of residents who completed a rural rotation with those who did not	Practising general surgeons performed a significantly higher proportion of endoscopy, hernia, biliary, and gynecology than residents; residents completed more cardiothoracic, vascular, liver, and pancreas procedures Residents who completed a rural rotation completed more procedures than nonrural residents
Zuckerman, 2007[66]	United States	Telephone survey of rural and urban surgeons, assessing endoscopy volume and training needs	63% of rural surgeons wanted additional endoscopy training in their residency compared with 43% of urban surgeons

Table 10. Summary of findings for rural surgery recruitment and retention

Publication	Country	Context	Primary findings
Ahmed et al., 2012[27]	Canada	Survey of Canadian general surgeons assessing career satisfaction	Rural surgeons cited on-call burden and volume of patients as causes for career dissatisfaction
Bruening and Maddern, 1998[24]	Australia	Survey of rural Australian surgeons	137 surveys completed 85 reported dissatisfaction with the amount of time on call, 74 reported peer isolation, and 62 stated that they had challenges with their children's schooling
Gates et al., 2003[41]	United States	Survey of West Virginia surgeons	88 surveys completed 23% of rural surgeons would leave medicine; 32% stated that rurality had an adverse effect on their practice
Heneghan et al., 2005[47]	United States	Assessment of practice and motivations of rural surgeons compared with urban surgeons	Rural surgeons were more likely to experience professional isolation, felt a lack of local surgical and medical support, were less likely to report adequate vacation coverage, had an unacceptable call schedule, and had difficulty recruiting colleagues
Ricketts, 2010[95]	United States	Assessment of the migration of rural general surgeons	General surgeons who moved over the course of the study period were more likely to move to areas with more physicians and improved economics
Shively and Shively, 2005[58]	United States	Assessment of threats to rural surgery at a single Kentucky hospital	Rural surgeons report difficulty in finding employment for their spouse and professional isolation as barriers to pursuing a career in rural surgery

to ensure practice-ready surgeons. Multiple studies identified surgical residents graduating with insufficient confidence in performing procedures outside of core general surgery but most often required in rural settings.[47,66,90] A Canadian survey of surgery residents in their final year of training found that 37% of residents planned to move directly into practice, and many indicated they did not feel comfortable with orthopedic, plastic surgery, obstetric or gynecologic procedures.[90]

The American training literature identified several pilot programs aimed at providing additional rural-oriented training; these included a rural year for fourth-year students, and a rural rotation with an emphasis on endoscopy exposure.[34,35] Results of those programs include more analogous caseloads of residents and practising surgeons, increased likelihood of selecting rural surgery as a career, and increased self-reported preparedness for rural practice, including those procedures that fall outside of general surgery.[30,34,35,37,53,54,60,74,88,89,92–94] Canadian literature is lacking regarding general surgery training.

Beyond residency training, continuing education was consistently noted as an important aspect of upgrading and maintaining skills, including laparoscopic colon surgery and others not within core general surgery. Programs were well received by rural surgeons, with participants indicating these programs would broaden the care they would be able to provide to local patients.[91] Telementoring was also identified as an educational approach that could benefit rural surgeons in learning new skills or managing unexpected intraoperative findings.[44]

Rural surgery recruitment and retention

Six studies examined barriers to selecting rural surgery as a career and rural surgeon retention (Table 10). These studies identified on-call burden and professional isolation as common areas leading to career dissatisfaction. A Canadian study by Ahmed and colleagues[27] identified difficulty in accessing resources, with perceived impediments in providing high-quality patient care leading to reduced career satisfaction and negatively affecting rural surgeon retention. Family considerations were also found to affect rural retention, particularly surgeon's concerns regarding their children's education and finding spousal employment. Studies also identified positive retention aspects of rural practice, including the sense of community, the ability to establish long-lasting relationships with their patients, and rural settings being noted to provide a positive and preferable environment for raising a family.[48,72]

Discussion

Defining rurality in a health care context

In Canada, the low population density and distribution of population, with few large metropolitan areas, make the definition of rurality difficult to delineate in the context of health care. For example, a community of 5000 people in southern Ontario is often not more than 1 hour from a tertiary care centre; however, a community of 5000 in Nunavut is thousands of kilometres from a tertiary care centre. Because of the unique features of Canadian geography, numerous institutions have worked to define rurality.

Statistics Canada defines rurality as the area that remains after the delineation of population centres (small towns with a 1000–29 999 population, medium urban centres with a 30 000–99 999 population, and large urban centres with a population > 100 000) with a population density of less than 400 people per square kilometre.[96] In a health care context, this definition is unable to capture the nuances and impacts of proximity that larger tertiary care centres have on the delivery of health care. Statistics Canada has worked to develop a "remoteness index" to try to capture this nuance by developing a score based on proximity to other centres.[96] Other population cut-offs have been used by provinces to

set out criteria for rural retention programs. In Ontario, researchers use the Rural Index for Ontario, which stratifies communities based on their size and distance to secondary and tertiary care.[97] The Canadian Institute for Health Information employs a hybrid model that uses a population cut-off of 10 000 and further stratifies communities by metropolitan influence, based on the percentage of residents who commute to and from a metropolitan area for work.[98] The literature identified in this review highlights and emphasizes the importance of including metropolitan influence in defining rurality in surgical care.

Defining the rural general surgeon's role and scope of practice

Most of the current literature on rural surgery is American, and Canada's population distribution and physical geography are vastly different. Some of the challenges faced by rural surgeons in Canada are similar to those experienced by their American counterparts; however, it is clear that additional population distribution and geographic factors substantially affect rural Canadian surgeons. This review identified a single pre-existing definition of a rural or isolated surgeon in an American military context. Although this definition was robust and specific, it did not address key elements that are required in a Canadian context, such as the scope of practice and the unique role that a Canadian rural surgeon plays within their community. The definition was further limited by its applicability to Canada, the exclusion of Canadian literature, and the inclusion of deployed military surgeons. The definition of a Canadian rural surgeon must also include the role of the surgeon in the local health care system, the unique scope of practice, and the community characteristics.

Canadian rural surgeons are not only the primary surgeon but also act as an important critical service access point in both emergency and elective practice settings. In the example of trauma care resource access and utilization, Canadian surgeons provided appropriate care in their home community and effectively transferred patients requiring a higher level of care, referring multisystem trauma cases and caring for single-system trauma patients locally.[6] Other studies have suggested that general surgeons in rural settings are more likely to perform endoscopy and complete diagnostic workup for gastrointestinal disorders than their urban counterparts.[28] In this role, rural surgeons are an important initial access point to subspeciality surgery and medicine, acting as gatekeepers and facilitators of surgical referral to higher-level complex tertiary and quaternary care. Our literature review identified a lower rate of laparoscopic colectomies in the rural setting, which likely represents the older demographic of general surgeons, and this trend may shift as new graduates enter rural practice. Further, our review did identify advanced laparoscopic training as a suggested skill when training rural surgeons, and this can be adequately addressed in rural streams. Within the literature, the most frequently addressed theme of rural surgery is the extended scope of practice, with orthopedics, obstetrics and gynecology, and urology being the most frequently included specialties outside of general surgery. Within Canada, the distribution and diversity of procedures performed by rural surgeons is dependent on the needs of the community and allocation of other local surgical and health care resources as opposed to a one-size-fits-all model. Finally, characteristics of the community that a rural surgeon serves can also affect their extended scope of practice, particularly the influence and access to higher-level care in nearby metropolitan centres. Patient preference also plays a critical role, as rural patients may identify a strong preference for surgery close to home regardless of their knowledge of surgical outcomes. Quality of life issues, including proximity to family and social supports, and capacity and expense for medical travel are critically important and often overlooked aspects of surgical care in rural communities.[99,100]

Rural general surgery training, recruitment, and retention considerations

The literature clearly identifies a gap in the surgical care needs of rural patients and the accessibility of trained providers. An aging and shrinking rural surgical workforce combined with decreased confidence of new graduates pursuing rural practice inevitably results in a widening of the access gap among rural surgical patients. Rural general surgeons provide critical services, with improvements in trauma patient outcomes and equivalent surgical care outcomes to those of their high-volume urban counterparts in core general surgery procedural competencies. Recruitment of rural-oriented surgical trainees combined with training opportunities targeted to build rural surgical skill sets with an extended scope of practice may encourage trainees to pursue a career in rural general surgery.

Practice isolation, call burden, and burnout are challenges in rural communities. Communicating these issues in the medical community and the public at large is critical. Authors discussing equitable care distribution and access within the surgical community have called for a shift to group practice and networked care models in rural communities.[101,102] Considering shifts in remuneration models for rural surgeons away from fee-for-service models to salaried or other alternative payment models may also support recruitment to communities with lower practice volumes, as well as a shift to team-based care models. Smaller communities with insufficient case volumes to support multiple general surgeons may also extend the surgical workforce by including Family Physicians with Enhanced Surgical Skills (FP-ESS) training working alongside and in collaboration with general surgeons, ensuring appropriate access to specialist and generalist care in smaller rural and remote communities.[101,103] Supporting healthy multisurgeon rural surgical

programs may improve the work–life balance of rural surgeons and build continuing medical education opportunities for surgeons to provide the high-quality care rural communities deserve. Implementing these models of care in rural communities may help overcome practice isolation and burnout challenges affecting retention of rural general surgeons and support the sustainability of rural surgical programs.

Conclusion

A rural general surgeon in Canada is defined as a surgical specialist who works in smaller (population < 30 000) or remote communities with limited metropolitan influence. Rural general surgeons apply the foundational principles of surgery, combining core general surgery training with additional surgical skills to serve the unique surgical needs of their community. In addition to providing emergent and elective general surgical services, they provide care beyond what is considered the core scope of general surgery practice and optimize care access close to home for rural patients. They act as a surgical care access point for more complex subspecialty surgical presentations. Rural general surgeons provide critical access to emergency and elective surgical expertise to positively affect patient outcomes. Training programs and health systems must support the unique needs and roles of these providers to provide high-quality equitable care access to rural Canadians.

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