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The Isolated Surgeon

By

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Thesis submitted to the Faculty of the Health Professions Education Graduate Program, Center for Health Professions Education, Uniformed Services University of the Health Sciences, in partial fulfillment of the requirements for the degree of Master's in Health Professions Education

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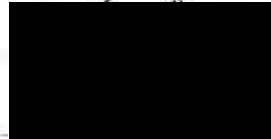
DEDICATION

This thesis is dedicated to my wife, Kellie, and our children, Elizabeth and Liam. Your strength, love, and patience with me throughout this journey are unending. I certainly would have no success without you.

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October 23, 2020

ABSTRACT

The Isolated Surgeon

Matthew D. Nealeigh, DO, 2020

Thesis directed by Holly S. Meyer, PhD, Assistant Professor and Associate Director of Student Affairs, Center for Health Professions Education, Uniformed Services University of the Health Sciences, Bethesda, MD; and Anthony R. Artino, Jr., PhD, Professor of Health & Human Function, George Washington University School of Medicine & Health Sciences.

Purpose: This thesis examines the identity and practice of the isolated surgeon. Rooted in the Professional Social Construct theory of autonomy and self-regulation, we characterize the unique role of isolated surgeons. With this characterization, individual surgeons and healthcare organizations may focus professional development resources more efficiently, with the ultimate goal of improved patient care.

Methods: We performed a scoping review of the isolated surgeon, reviewing 25 years of literature regarding U.S. civilian and military surgeons. We examined emerging themes regarding the definition of an isolated surgeon, the scope of surgical practice beyond current training norms, and training gaps identified by surgeons in an isolated role.

Results: From an initial pull of 904 articles, we included 91 for final review. No prior definition exists for the isolated surgeon; we propose an initial definition from consistent themes in the

literature. Authors across myriad practice settings identified cases and training gaps in orthopedic, obstetric & gynecologic, urologic, and vascular surgery subspecialties.

Conclusion: The scoping review in this thesis represents the largest examination of the isolated surgeon in the current literature. Viewed through the lens of the Professional Social Contract, supporting this unique group of surgeons becomes an obligation to both the surgeon and their at-risk patients. Clarifying the identity, practice, and training gaps of the isolated surgeon represents the first step in formalizing support for this small but critical group of surgeons.

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CHAPTER 1: Introduction

BACKGROUND

The crucible of general surgery training is among the most physically and mentally intense academic programs in the medical world. Programs require a minimum of five years and at least 850 surgeries in 10 major operative content areas, with many residents also adding years of research and hundreds of extra cases to these requirements^{1,2}. Even with this vast experience, general surgeons who practice in low-resource settings—civilian surgeons in underserved and remote hospitals or military surgeons deployed around the globe—may be called upon to treat rare-but-real surgical emergencies in orthopedic, urologic, gynecologic, neurosurgical, and other specialties until life-threatening conditions are stabilized and transport is arranged³⁻⁵. Even more common is the general surgeon offering elective care outside the typical training of a general surgeon because the patient will not, or cannot, travel to see the required specialist. Previous explorations of military surgery suggest this is not simply a civilian “country surgeon” phenomenon⁶. Military surgeons operate aboard ships, in host-country hospitals, and even far-forward near the battle lines, in tents and houses. Frequently the general surgeon deploys with only essential support staff, which may not include peer surgeons from other specialties. The isolated general surgeon must handle those varied surgical cases, whatever they may be. While the location may differ, common surgical skill needs may exist across these various civilian and military settings. Thus far, the isolated surgeon’s scope of practice and practice patterns have not been fully elucidated. A broader evaluation of these needs is required before tailored education can be developed for these surgeons.

THEORETICAL AND CONCEPTUAL FRAMEWORKS

This scoping review is conducted in the constructivist paradigm⁷. The American medical profession, and surgeons in particular, collectively build knowledge by collaboratively evaluating and establishing requirements and norms within the profession of surgery. Those requirements and norms serve as the self-regulation and self-governance which society expects from a highly technical profession like medicine. Sylvia and Richard Cruess's discussion of a Professional Social Contract outlines medicine's societal responsibility to provide expert care, even in high-need, low-resource areas like that of the isolated surgeon, and to self-regulate and determine professional development pathways^{8,9}. The medical Professional Social Contract is the underpinning tacit agreement between society and physicians that, among other tenets, the medical field will provide the best medical care available and society will empower medicine to maintain our autonomy as a group. Physician autonomy is an important component of this contract because of the complexity and depth of information of any medical specialty, but particularly surgery. The Cruess's Professional Social Contract proposes that a technical field is best understood by those within the profession; and therefore, it is best regulated by those with that specialized knowledge. Surgery's professional social contract with society allows the autonomy to shape the practice of surgeons in varied roles, and provides an obligation to understand what each surgeon needs to continually grow as a physician. Delineating the isolated surgeon's scope of practice is the first step in the specific professional development for those physicians. Defining the breadth and depth of the isolated surgeon's societal role begins to address the obligation these surgeons have to their constituents, for only after defining the need can we address how to fill that need.

METHODOLOGY: A SCOPING REVIEW

We conducted a scoping review to examine the current understanding of the isolated surgeon's practice paradigm and explore any training gaps that may impact the care they provide^{10, 11}. Arksey and O'Malley published the seminal methodological definition of scoping reviews in 2005, proposing four main reasons that scoping reviews may be the knowledge synthesis method of choice:

- “1. To examine the extent, range and nature of research activity
2. To determine the value of undertaking a full systematic review
3. To summarise [*sic*] and disseminate research findings
4. To identify research gaps in the existing literature”¹²

Generally similar to a systematic review, a scoping review examines the available literature on a topic of interest to synthesize current knowledge on the subject. However, there are important methodological differences. First, systematic reviews intend to answer specific, data-driven questions in fields with multiple studies providing similar types of data; these data are then pooled and examined for emerging trends or particular numeric differences not discoverable with smaller, individual data sets. When considering topics with few existing studies, or when available data comprise heterogeneous genres of information (e.g. qualitative studies (interviews), quantitative studies (surgical case volume), and mixed-methods research) the structure of a scoping review promotes incorporation of these differences to elicit emerging themes or areas for future research. This type of study proves exceptionally helpful when establishing a new line of research, providing “What is known about this concept?” insight for the researcher and/or practitioner¹¹.

PURPOSE AND RESEARCH QUESTIONS

This thesis reviews recent literature to define and examine the isolated surgeon's breadth of practice, and to identify training gaps noted in the literature. This thesis provides a basis for future curricula to prepare surgeons for resource-limited medical care.

While prior small studies explored the isolated surgeon's needs, articles typically describe limited settings, and report using heterogeneous data^{3-6, 13-15}. Harris, et al, published a quantitative analysis of rural versus metropolitan surgeon case logs in North and South Dakota. Drs. Amy Halverson and Ajit Sachdeva, working on behalf of the American College of Surgeons, conducted surveys of rural surgeons' desired topics for professional development, without quantitative analysis of surgical procedures by those physicians. We have previously examined trends of surgeries performed aboard U.S. Navy ships, though notably using an incomplete, convenience sample of data, and without examining reports from ground-based hospitals in Iraq and Afghanistan. Each of these studies provides a sliver of insight into the isolated surgeon paradigm, but with marked limitations. Our research questions employ the multi-genre format of a scoping review to elicit common themes across varying geographic and practice paradigms, improving the relevance of educational efforts aimed at mitigating the training gaps we identified:

- 1) What defines an isolated surgeon?
- 2) What cases do these surgeons perform beyond the general surgeon's typical scope?
- 3) What training gaps have been identified in this surgeon population?

CHAPTER 2: The Isolated Surgeon: A Scoping Review

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ABSTRACT

Introduction: Surgeons in resource-limited environments often provide care outside the expected scope of current general surgery training. Geographically-isolated patients may be unwilling or unable to travel for subspecialty care. These same patients also present with life-threatening emergencies beyond the typical breadth of a general surgeon's practice, in hospitals with limited professional and materiel support. This review characterizes the unique role of isolated surgeons so individual surgeons and healthcare organizations may focus professional development resources more efficiently, with the ultimate goal of improved patient care.

Methods: We performed a scoping review of the isolated surgeon, reviewing 25 years of literature regarding isolated U.S. surgeons. We examined emerging themes regarding the definition of an isolated surgeon, the scope of surgical practice beyond current training norms, and training gaps identified by surgeons in an isolated role.

Results: From 904 articles identified, we included 91 for final review. No prior definition exists for the isolated surgeon, though multiple definitions describe rurality; we propose an initial definition from consistent themes in the literature. Authors across varied practice settings performed cases and identified training gaps in orthopedic, obstetric & gynecologic, urologic, and vascular surgery subspecialties.

Conclusion: This represents the largest examination of the isolated surgeon in the current literature. Clarifying the identity, practice, and training gaps of the isolated surgeon represents

the first step in formalizing support for this small but critical group of surgeons and their patients.

INTRODUCTION

General surgery residency comprises a minimum of five years of intensive training including many hours in the operating room, typically logging over 1,000 surgeries^{1,2}. Even with this intensive experience, surgeons in isolated locales—civilian surgeons in underserved and remote hospitals or military surgeons deployed around the globe—require an expanded skillset beyond standard training⁶. Whether military or civilian, the “isolated surgeon” must be prepared to treat rare-but-real surgical emergencies until life-threatening conditions are stabilized and transport is arranged^{4, 5, 14}. With each new patient presentation, the Isolated Surgeon must critically evaluate the healthcare system’s capability for the care that patient requires. A key concept in surgical training is contingency planning; that is, answering questions such as: “How can this operation fail, and can I handle that complication? Will the hospital blood bank be overwhelmed? Does the operating room stock the required equipment or implants for this condition or its complications? Do I have sufficient knowledge and competence with this condition to care for my patient appropriately, without easy access to consultants? Conversely, what is the impact to the patient if I delay care by transferring to my referral center?” Dr. Moshe Schein’s firsthand anecdote, “The Rural Surgeon and Ivory Towers,” illustrates this train of decisions in gripping detail:

I put on my scrubs and jump into the pickup. In my mind I already see the liver adenoma or carcinoma, bleeding into the peritoneal cavity, and I know I will have to operate. I find the patient pale and sweating; his abdomen is distended and tender. The ultrasound technician is already scanning him: “lots of free fluid”...now, after a liter of Ringer’s Lactate his systolic pressure is 70. I tell the nurses “Get the OR team ready; we

will have to open and pack and then ship to the University...get the chopper standby...and let me talk with the surgeon on call at the University... ”¹⁶

Many isolated surgeons also offer basic non-emergent surgical care beyond typical general surgery procedures to improve access to care for their patients. Thus far, however, the isolated surgeon’s scope of practice and educational requirements have not been fully elucidated. A broader evaluation of these needs is required before tailored education can be developed for these surgeons.

The scope of practice for U.S. surgeons is heavily influenced by residency training standards, governed by the Accreditation Council for Graduate Medical Education (ACGME) and the American Board of Surgery (ABS)^{1,2}. The ACGME publishes minimum general surgery categorical case numbers within specific disciplines or procedures (e.g. alimentary tract or endocrine cases). Achieving these requirements reflect more on residency programs than the residents themselves, and bears no direct impact on licensing or evaluation of individual surgeons. The ABS, which establishes education, evaluation, and certification standards governing surgical practice in the United States after residency graduation, defines the scope of general surgeons quite broadly. Specifically-listed disease categorical examples include conditions of the abdomen and alimentary tract, breast and endocrine system, trauma, and others. General surgical subspecialties (e.g. vascular or transplant surgery) are also included, as is a provision for care of conditions in obstetrics and gynecology, urology, and other non-general surgery specialties under “unusual circumstances.” The ABS requires a minimum of 850 cases throughout a 5-year residency but does not stipulate minimum case numbers in any specific disease category, only “experience” in ten major operative content areas. Several leading surgical organizations, including the ABS and ACGME, formed a national consortium, the Surgical

Council on Resident Education (SCORE), “to improve the education of trainees in general surgery and related specialties through the development of a national curriculum.” SCORE publishes a booklet detailing “core” disease processes and procedures expected of graduating residents; however, this list is only a suggested curriculum and does not explicitly establish a standard scope of practice¹⁷.

In rural or “isolated” settings, surgical scope of practice—including cases not required by the ACGME/ABS—is often dictated by need rather than surgeon preference. “Unusual circumstances,” that is, the needs of local patients combined with lack of access to other surgical specialties, may require that surgeons exercise their full scope of practice, even with minimal formal training in non-general surgery procedures. Exploring one regional example, Harris, et al, noted that in one year alone, rural surgeons in the Dakotas performed more than 5,500 procedures; more than one-third of these included orthopedic or obstetric/gynecologic cases not emphasized by the ACGME general surgery requirement or through the ABS⁴.

The small-town surgeon in a rural area represents just one aspect of isolated surgery. Our country’s military has long demanded flexibility and resourcefulness of surgeons when isolated by deployment. A recent review noted requirements for expanded surgical proficiency when operating on a ship in the middle of the ocean. Navy surgeons operating afloat consistently treated urologic, orthopedic, or gynecologic conditions without the aid of an in-person specialty consultant⁶. The need for surgeons in isolated settings continues, both in uniformed and civilian settings, as does the need to train these surgeons for the conditions and procedures their patients require.

As isolated patients continue to require treatment both stateside and abroad, the isolated surgeon’s scope of practice requires examination so they are prepared when the need arises.

Small, survey-driven studies examined practice patterns to delineate the isolated surgeon's scope of practice^{3, 4, 13, 15}. These studies, however, were limited by small sample size and possible regional differences. As such, the lack of broad, evidence-based insights into the isolated surgeon's training and practice requirements is a critical gap in the surgical literature. Bridging this gap will inform future decisions in surgical education, career progression, and organizational leadership across numerous civilian and military settings.

This scoping review examines the available literature germane to isolated U.S. civilian and military surgeons, with the goal of defining the Isolated Surgeon, and qualifying the practice gap--and associated training gap--between standard surgical training and the isolated surgeon's practical requirements.

METHODS

We performed a scoping review to answer the broad question, "What is known about Isolated Surgeons?" by integrating multiple literature genres and data types. We posed three primary questions to guide our review:

- 1) What defines an isolated surgeon?
- 2) What cases do these surgeons perform beyond the general surgeon's typical scope?
- 3) What training gaps have been identified in this surgeon population?

This scoping review follows the reporting guidelines as set forth in the Preferred Reporting Items for Systematic Reviews and Meta-analysis Extension for Scoping Reviews¹¹.

Inclusion Criteria

Our review comprised articles reporting on "isolated surgeons," which we categorized as those in rural, critical-access, or underserved practices; deployed military settings; or similar

situations. We used inclusion/exclusion criteria based on timeframe, geography, and context. We included articles from 1994-2019, as the widespread integration of minimally invasive surgery (laparoscopy, robotics, etc.) into surgical residency during the mid-1990s represents the last major shift in training content over the past 25 years. Literature representing practicing surgeons in this timeframe should describe surgeons with grossly homogeneous training, and gaps identified in this group should be generalizable to most currently practicing surgeons.

We focused on surgeons operating in the United States or in deployed settings with the U.S. military to increase the relevance of findings for our population of interest. Surgeons operating in U.S. healthcare systems, including the military, all fall under the same educational program accreditation standards and thus may be assumed to have taken part in similar training, and are practicing within healthcare systems subject to a unified set of regulations.

Lastly, we excluded reports on civilian and some military medical missions that we considered task-organized groups, which recruit and transport specific capabilities into underserved areas. (e.g. *Doctors Without Borders*, military humanitarian missions, military hospital ships). While these groups may provide care in austere environments, the resourcing and in-country support, to include the broadly-staffed hospital ships themselves, often comprise an intrinsically different environment than the resource-limited “country surgeon” we aimed to examine.

A research librarian assisted in drafting search strategies for the MEDLINE database from 1994-2019 (Appendix 1). After eliminating duplicate entries, we exported results to a spreadsheet for evaluation. Relevant bibliographies were examined for germane articles not revealed in prior searches. Two authors separately reviewed each article and abstract for inclusion/exclusion criteria prior to full-text review. For data extraction and charting, a *de novo*

tool was tested on 10 targeted articles, then reviewed and revised by the author team. The articles selected for full-text review underwent data extraction in duplicate using the revised extraction tool.

We examined articles for common and applicable definitions of an “isolated surgeon.” Gaps in applicability of current definitions were noted. When analyzing cases reported in our search results, we placed particular emphasis on the practice setting and surgeries performed outside of “core” general surgery. We defined “core general surgery procedures” as those listed in both the ACGME categorical requirements AND listed as “core” in the SCORE curriculum bulletin for 2020-2021^{1, 17}. This intersection of procedures was deemed realistic considering both the educational intent of the requirements and the real-world practice of attending general surgeons (Appendix 2). We extracted training gaps reported by individual authors, which we then collated into themes.

RESULTS

Initial test searches completed in March 2019 iteratively informed the final literature selection, which yielded 904 articles for possible inclusion. Title and abstract review identified 133 articles for full-text review. Following full-text review, we eliminated 42 additional articles for either failure to meet inclusion criteria or absence of the *a priori* data fields germane to isolated surgeon definitions, non-core cases, and training gaps, leaving 91 articles for data extraction (Figure 1).

DEFINITIONS

Eighty-one articles reported some type of rural or isolated definition, and some used multiple designations (Table 1). Definitions overwhelmingly relied on population or hospital

characteristics (e.g., number of beds, Critical Access Hospital designation,) to define rurality. The most common designations labeled rural areas by population size (e.g. <10,000 population,) or employed the U.S. Department of Agriculture's Rural-Urban Commuting Area (RUCA) or Rural-Urban Continuum codes, which categorize the degree of urbanization in a county or region¹⁸. A single civilian article used Health Service Areas, a purely geographical definition¹⁹. All military articles with definitions (19 articles) codified their settings according to defined doctrinal roles (e.g. Combat Support Hospital or NATO Roles)²⁰. This focus reflects intrinsic unit capabilities such as staffing and equipment, instead of location, as these organizations typically deploy in a mobile capacity.

CASES

Forty-three articles reported non-general surgery cases by the subject surgeons (Table 2). The most commonly-reported specialties were orthopedics (24 articles, 56%), OB/GYN (22, 51%), urology (21, 49%), and vascular (20, 47%); authors frequently reported multiple specialties. Only 17 papers (7 civilian, 16%; 10 military, 23%) listed surgical caseload in sufficient granularity to analyze the volume of non-general surgery procedures in the surgeon's practice, overall accounting for an average of 21% of the Isolated Surgeon's practice (Table 3). Here again, orthopedic (10.4% of reported cases), OB/GYN (7.8%), vascular (5.0%), and urologic (4.6%) cases predominated. The non-general surgery proportion of a surgeon's overall practice was similar between civilian and military reports (20.7% and 21.6%, respectively), though the individual specialty composition differed slightly. Notably, and perhaps expectedly, military surgeons reported more orthopedic procedures, while rural civilian general surgeons noted a higher proportion of OB/GYN cases. Categorically, orthopedics cases frequently

comprised permanent or temporary fixation of long-bone fractures, or hand/finger trauma procedures. Authors reporting OB/GYN cases--chiefly cesarean section--noted this as a significant portion of their caseload, over >25% of annual cases in two civilian articles^{21, 22}. Vascular procedures varied widely, from elective carotid endarterectomy to emergency cases, including aneurysm repair. Military articles reported high volumes of vascular trauma, commonly vessel ligation, shunts, and vessel anastomosis or repair. Of note, emergency craniotomy comprised almost all reported neurosurgical cases, and was reported by authors in both military and civilian settings.

TRAINING GAPS

Thirty articles reported perceived training gaps between general surgery training and the makeup of the surgeon's current practice (Table 4). The most frequently-reported gaps included orthopedics (external fixator placement, hand trauma), urology (nephrectomy/renal hilum, circumcision--both primary and revision), and OB/GYN (cesarean section, uterine hemorrhage, hysterectomy, ovarian pathology). Ten civilian authors expressed interest in more otolaryngology (ENT) training. Other requested topics included: ultrasound skills, burn care, and emergency surgical care of military working dogs.

DISCUSSION

This scoping review represents the largest examination of the important role isolated surgeons play in the American healthcare system. To date, most discussions of rural or isolated surgery have been limited to region-specific case reviews or military deployment reports, small survey-based needs assessments, or "my perspective"-style editorials. The 91 articles examined

in this study demonstrated the impressive breadth of care provided by isolated surgeons. They are, at times, urologist, neurosurgeon, intensivist, and primary care physician, among many other roles. The many ways authors categorize their isolation makes it obvious that no clear definition yet exists to identify who is an “isolated surgeon.” However, we found consistent trends across 25 years of literature and varied practice settings that show general surgeons must be ready to operate well beyond the bounds of their initial surgical training. With these surgeons and their surgical roles clarified, educational planning can now focus on the specific needs of the isolated surgeon.

We reviewed 82 articles which defined a rural surgeon; none used the term “isolated” in a definition. Civilian articles heavily relied on population-based definitions, while military authors--reflecting the mobile nature of deployed medicine--based definitions on doctrinal unit staffing and echelons of care. The multiple definitions reflect the imperfect nature of characterizing surgeons in diverse geographic and professional settings.

Population-derived categorizations hint at a surgeon’s isolation on the premise that small towns typically have fewer services available. Drs. D. C. Lyng and Charles Rinker, writing in 2003 for the newly-created American College of Surgeons’ Rural Subcommittee of the Advisory Council for General Surgery, proposed a population classification of Urban (>50,000), Large Rural (10,000-50,000) and Small Rural (<10,000) to describe rural surgeons’ locations²³. This quickly became popular in rural surgery literature, both for its simplicity and its increasing citation list. The Lyng-Rinker classification, however, like the RUCA system, represents only a moderately-successful proxy when describing the isolated surgeon by simply counting the number of people nearby. When using population or geography as the defining characteristic, no consideration is given for the type or quality of support infrastructure available.

Partially bridging that population-capability definition gap, 15 authors used Critical Access Hospital labeling as their definition of rural. The U.S. Congress created the Critical Access Hospital (CAH) designation in the Balanced Budget Act of 1997 after noting the frequent closure of small, rural hospitals that were frequently the only source of emergency care to geographically isolated, low-density populations²⁴. CAHs must be located more than 35 miles from a tertiary referral center (15 miles in rugged terrain) and maintain 24-hour emergency care--including surgery--among numerous other requirements. Designation as a Critical Access Hospital primarily affects the Medicare and Medicaid reimbursement for the hospital itself, rather than individual physicians. Using CAH labels to define rurality goes further than pure population stratification in illustrating the isolation of that hospital's surgeon, but still omits consideration of the individual surgeon's practice. Vail, Colorado, provides an anecdotal example: the registered population of this world-renowned ski resort town is just over 5,000 people--small rural by the above definition. Denver, the nearest metropolitan center, is nearly 100 miles away through mountain roads. However, the local Vail hospital provides remarkably more subspecialty services than towns several times its size, largely owing to the enormous tourist throughput of the area.

While no article explicitly designated "isolated surgeons," two articles focused more directly on the surgeon's professional isolation rather than the setting of population or hospital bed size. Traverso, et al., and Broughan, et al., noted the Rural-Urban Commuting Area designation, but also incorporated the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) Rural Surgery Task Force definition--surgeons operating >20mi from the nearest gastroenterology consultant and >50miles from a tertiary care referral center, among other factors^{25, 26}. This definition accentuates the close relationship between consultants

and surgeons, reinforces the security of surgical partner availability, and acknowledges the decision-making impact of referral center accessibility on surgical care. Including geographical, hospital, and professional or “capability gap” components in the definition truly illustrates the unique role of the isolated surgeon, as surgeons must rely on the support system around them in addition to their own technical expertise. Defining which surgeons are isolated allows doctors, hospitals, and organizations to identify individuals who should expect to operate in a breadth beyond the current ACGME/ABS training paradigm.

SCOPE OF SURGICAL PRACTICE

Establishing that breadth, our review compiles 43 articles, reporting more than 40,000 cases across the country, plus the categorical reports of individuals self-identifying as rural surgeons. Numerous previous articles demonstrated regional characteristics for surgeons’ caseloads, such as small hospitals in Wisconsin or in the Dakotas, or deployments of military units²⁷⁻³⁰. Our review reinforces these authors’ experiences, suggesting a commonality to most isolated surgical practices across the country. The civilian rural surgeons frequently reported both elective and emergency OB/GYN cases as standard in their practice. Cesarean section was frequently reported, but ovarian pathology, benign and malignant uterine conditions, and gynecologic minor procedures also fell within their scope. The OB/GYN proportion was much lower in military reports, as might be expected. Obstetric or gynecologic cases do arise for military surgeons, however, whether that be in humanitarian outreach for a local population or treating deployed personnel.

When viewing the results, we propose that volume not be the sole determinant for continued education topics. The “rare-but-real,” life-saving cases found here, i.e. craniotomy,

permeate both the military and civilian literature for surgeons in multiple low-resource environments. If, as Pasteur said, “Chance favors the prepared mind,” identifying isolated surgeons, who then prepare for their true scope of practice, prepares their mind to potentially save another life.

A NEW DEFINITION

Moving forward, we propose formally defining the Isolated Surgeon, not simply the rural surgeon, rural hospital, or deployed surgeon. More than semantics, this reflects the professional and clinical implications of the care setting through the lens of the individual surgeon. Our review demonstrates the multiple factors to be considered in this definition. First, at its core, the isolated surgeon label should reflect the geographic isolation of both patient and physician, yielding a preference--and indeed sometimes a requirement--for care in the current location. Next, the host hospital’s capabilities should be considered, notably the imaging, intensive care unit (ICU), and blood bank capacities. Also, as a critical consideration, professional isolation is reflected through the integral role of specialist consultants and surgical partners. Lack of immediate patient and surgeon access to orthopedic, gynecologic, urologic, vascular, and neurosurgical subspecialists reflects a surgical island where the general surgeon must truly be versatile.

Based on emerging themes in our review, and recognizing that not every criterium will apply to every surgeon or location, we propose the presence of five or more of the following criteria as a starting point to define the isolated surgeon:

1. local metropolitan population of <10,000
2. nearest tertiary referral center >100 miles or 2-hour commute

3. local hospital <50 acute care beds, or <5 ICU beds without intensivist coverage
4. lack of 24-hour on-site radiologist coverage
5. blood bank inability to support a massive transfusion protocol (i.e. >10 units packed red blood cells and accompanying component therapy)
6. sole-surgeon private practice, or <3 partners in group practice
7. lack of 24-hour on-call coverage by >1 of these common surgical subspecialties:
 1. orthopedics
 2. obstetrics & gynecology
 3. urology
 4. vascular surgery
8. commute >25 miles to >1 of these common medical subspecialties, including:
 1. cardiology
 2. gastroenterology
 3. nephrology

Specific components formally defining the isolated surgeon should reflect consensus among an appropriately-composed committee from relevant stakeholders nationally. This should include representatives from government, surgical associations, hospital leadership, and patient advocacy.

Recognizing settings of isolation identifies to both surgeon and hospital that patients will require care outside the surgeon's usual training. The articles reviewed here present a cogent call for educational support across several well-delineated training gaps. Individual surgeons approaching these roles should actively seek professional development for orthopedic, OB/GYN, and other specialties with commonly-encountered conditions. Military surgeons would markedly

benefit from programmed training in orthopedic emergencies, in particular, as almost one in six cases reviewed here involved some sort of orthopedic intervention. Similarly, familiarity with “rare-but-real” lifesaving procedures such as craniotomy--as well as established relationships with relevant subspecialty consultants in these critical cases--should be routine in isolated settings.

Isolated surgeons face multiple barriers to continuing education or skills maintenance, including difficulty finding call coverage and financial barriers to the significant travel often involved³. Small rural hospitals see significant financial benefit from access to surgical services, and therefore bear some responsibility for supporting the surgeon in facilitating adequate flexibility for training, as well as equipping the OR suite appropriately³¹. National surgical societies are well-positioned to provide their constituents with modular, on-demand training. Collaboration with close-to-home academic centers would ease the burden of call coverage and travel to national conferences, which sometimes host skills fairs or professional development sessions.

In one example of a collaboration filling the need, the American College of Surgeons partnered with the U.S. military’s Uniformed Services University of the Health Sciences to produce “ASSET+”, an expansion of the popular Advanced Surgical Skills for Exposure in Trauma (ASSET) course, after a NATO working group outlined multiple non-general surgery skills required by military surgeons^{32, 33}. The expanded form of this course includes a half-day of experience in external fixator placement, craniotomy, emergency cesarean section and uterine hemorrhage management, and other life-saving skills outside the general surgeon’s typical scope. Opportunities like ASSET+ should be funded and expanded, targeted at isolated surgeons in the military and civilian settings alike.

LIMITATIONS

Limitations of this study lie within the nature of reviews; namely that relevant information may exist that our search terms and limits did not identify. We limited articles to those discussing U.S. surgeons, to improve relevance for this group of physicians. Canada, Australia, and multiple other developed countries have similar geographic variety, though their healthcare systems are structured differently. We found significant heterogeneity of data, as expected as a strength of a scoping review to examine the breadth of information available. However, this heterogeneity does make detailed analysis difficult, particularly when attempting to draw conclusions regarding case proportions within rural surgeons' practices. Frequently, cases were listed only categorically (e.g. "orthopedic") without procedure-level detail, possibly resulting in incorrect inclusion or exclusion relative to our case list. When similar data reporting among articles was noted, the low volumes found could not be presumed to be representative, nor was this study structured to make specific volumetric conclusions.

CONCLUSIONS

When the convenience of a consultant is not an option, the isolated surgeon must become the comprehensive surgeon, facile in procedures reaching well beyond the general surgeon's current training paradigm. All stakeholders, including hospitals, surgical societies, and particularly the surgeons themselves, should proactively identify the Isolated Surgeons among us. This group should expect elective and emergency cases in disciplines not emphasized during training, and actively prepare for such, so that the patient, who bears the burden of risk, may rest at ease in the hands of their Isolated Surgeon.

FIGURE 1. FLOW DIAGRAM FOR SCOPING REVIEW

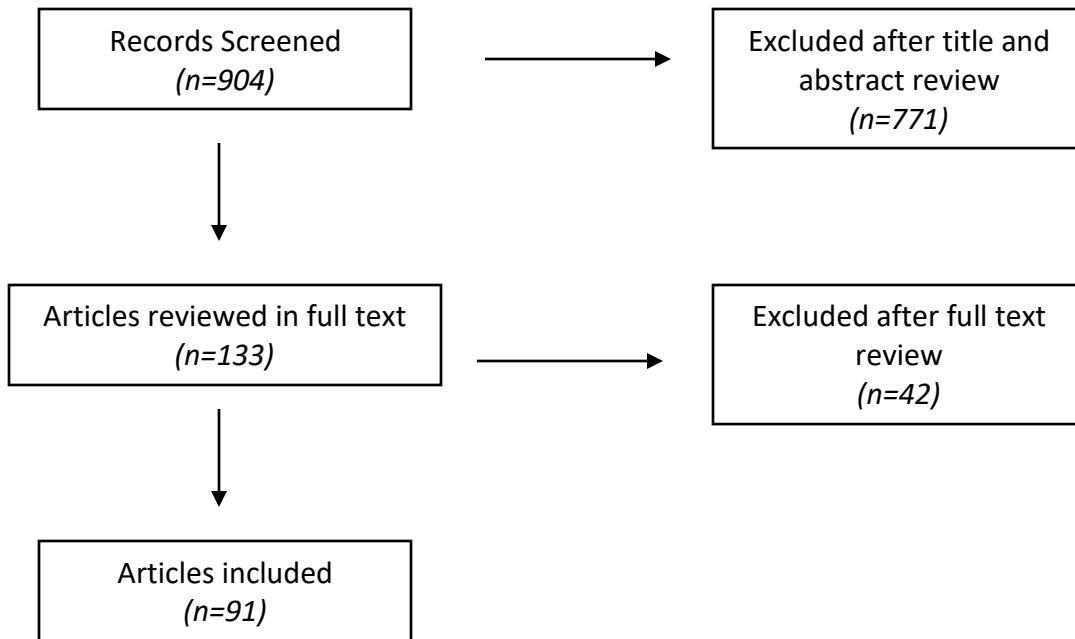


TABLE 1. DEFINITIONS USED FOR ISOLATED SURGEONS

| Definition Used | No. of Military Articles | No. of Civilian Articles | Total No. of Articles |
|--------------------|-------------------------------------|--|-----------------------|
| RUCC or RUCA Code | 0 | 12 ^{25, 30, 31, 34-42} | 12 |
| Population | 0 | 23 ^{3, 22, 26, 28, 43-58} | 23 |
| Lynge-Rinker | 0 | 6 ^{21, 23, 59-62} | 6 |
| CAH | 0 | 15 ^{41, 63-76} | 15 |
| Hospital Size | 4 ⁷⁷⁻⁸⁰ | 9 ^{22, 40, 43, 56, 61, 80-83} | 13 |
| NATO Echelon | 15 ^{14, 27, 29, 78, 84-94} | 0 | 16 |
| U.S. Military Unit | 5 ^{6, 77-80} | 0 | 4 |
| Other | 0 | 2 ^{19, 95} | 2 |

(RUCC—Rural-Urban Continuum Code; RUCA—Rural-Urban Commuting Area Code; CAH—Critical-Access Hospital; NATO—North Atlantic Treaty Organization)

TABLE 2. NON-CORE GENERAL SURGERY CASE CATEGORIES REPORTED

| Case Category | No. of Military Articles | No. of Civilian Articles | Total No. of Articles |
|---|---|---|-----------------------|
| OB/GYN | 3 ^{6, 78, 87} | 19 ^{21, 22, 30, 34, 37, 46, 50, 57-59, 64, 69, 73, 83, 96-100} | 22 |
| Neurosurgery | 5 ^{27, 84, 90, 91, 94} | 5 ^{30, 34, 69, 81, 95} | 10 |
| Vascular | 6 ^{27, 80, 85, 86, 90, 91} | 14 ^{22, 30, 34, 35, 47, 57-59, 69, 73, 82, 83, 97, 98} | 20 |
| Urology | 6 ^{6, 29, 78, 79, 87, 91} | 15 ^{30, 34, 46, 50, 58, 59, 64, 69, 83, 96-101} | 21 |
| Orthopedics | 8 ^{6, 27, 29, 86, 90, 91, 94, 102} | 16 ^{21, 22, 30, 34, 50, 57-59, 69, 82, 83, 95-99} | 24 |
| Gastroenterology | 0 | 2 ^{96, 103} | 2 |
| Plastics | 1 ⁹¹ | 5 ^{57, 59, 96, 97, 99} | 6 |
| Thoracic | 2 ^{90, 91} | 8 ^{30, 34, 57, 59, 69, 97, 98, 100} | 10 |
| Otolaryngology | 3 ^{14, 29, 90} | 11 ^{22, 30, 34, 50, 57, 59, 69, 83, 96, 97, 99} | 14 |
| Pediatric | 0 | 1 ⁶¹ | 1 |
| Advanced General Surgery (Bariatrics, Oncology, etc.) | 0 | 1 ⁹⁷ | 1 |
| Ophthalmology | 2 ^{90, 91} | 3 ^{30, 34, 69} | 5 |
| Other | 1 ⁸⁸ | 0 | 1 |

(OB/GYN, Obstetrics & Gynecology)

TABLE 3. NON-CORE CASE VOLUME (% OF TOTAL REPORTED CASES)

| Case Specialty | Civilian Reports ^{21, 22, 30, 34, 64, 83, 99} | Military Reports ^{6, 14, 27, 29, 69, 85-87, 90, 91} | Overall |
|----------------|--|--|---------|
| OB/GYN | 10.6% | 1.2% | 7.8% |
| Neurosurgery | 0.5% | 2.3% | 1.7% |
| Vascular | 3.2% | 5.8% | 5.0% |
| Urology | 3.2% | 5.6% | 4.6% |
| Orthopedics | 5.7% | 14.5% | 10.4% |
| Plastics | NR | 3.4% | 3.4% |
| Thoracic | 1.4% | 2% | 1.7% |
| Otolaryngology | 1.7% | 1.7% | 1.7% |
| Ophthalmology | 0.1% | 1.2% | 0.7% |
| Other | 0 | 0.6% | 0 |
| Total | 20.7% | 21.6% | 21.3% |

Non-core general surgery cases, presented as percentage of overall cases reported. (OB/GYN, Obstetrics & Gynecology; NR, none reported)

TABLE 4. TRAINING GAPS REPORTED FOR ISOLATED SURGEONS

| Training Gap | No. of Military Articles | No. of Civilian Articles | Total Articles |
|--------------------------|---------------------------------|--|----------------|
| OB/GYN | 1 ⁶ | 15 ^{3, 13, 21, 22, 30, 34, 40, 55, 58, 59, 83, 96, 104-106} | 16 |
| Neurosurgery | 2 ^{14, 91} | 2 ^{81, 95} | 4 |
| Vascular | 3 ^{14, 85, 89} | 4 ^{30, 40, 58, 82} | 7 |
| Urology | 4 ^{6, 14, 79, 87} | 14 ^{13, 21, 30, 34, 40, 55, 58, 59, 83, 96, 101, 104-106} | 18 |
| Orthopedics | 5 ^{6, 14, 89, 91, 102} | 15 ^{3, 13, 22, 30, 34, 55, 58, 59, 82, 83, 95, 96, 104-106} | 20 |
| Gastroenterology | 0 | 3 ^{3, 13, 96} | 3 |
| Plastics | 0 | 5 ^{13, 59, 96, 104, 106} | 5 |
| Thoracic | 1 ⁸⁹ | 1 ⁵⁹ | 2 |
| Otolaryngology | 0 | 10 ^{21, 30, 34, 55, 58, 83, 96, 104-106} | 10 |
| Pediatric | 1 ⁹¹ | 0 | 1 |
| Advanced General Surgery | 1 ¹⁴ | 0 | 1 |
| Other | 3 ^{88, 89, 91} | 4 | 7 |

(OB/GYN, Obstetrics & Gynecology)

APPENDIX 1. SEARCH TERMS

((isolated or isolation or remote or rural or deployed or non-metropolitan or underserved community) adj3 (surgeon\$)).mp. OR ((rural or deployed or underserved community) adj3 (surgical OR surgery)).mp.

APPENDIX 2. CORE GENERAL SURGERY PROCEDURES

Abdominal Exploration

Peritoneal Dialysis Catheter Insertion

Diaphragmatic Hernia – Repair

Inguinal and Femoral Hernia – Repair

Miscellaneous Hernias – Repair

Ventral Hernia – Repair

Cholecystectomy with or without Cholangiography

Cholecystostomy

Choledochoenteric Anastomosis

Common Bile Duct Exploration and Choledochoscopy

Hepatic Abscess – Drainage

Hepatic Biopsy

Pancreatectomy – Distal

Pancreatic Debridement

Pancreatic Pseudocyst – Drainage

Splenectomy

Antireflux Procedures

Gastrectomy – Partial/Total

Gastroduodenal Perforation – Repair

Gastrostomy Vagotomy and Drainage

Adhesiolysis

Crohn Disease – Surgical Management

Ileostomy and Ileostomy Closure

Small Intestinal Resection

Appendectomy

Colectomy – Partial

Colectomy – Total and Subtotal

Colostomy and Colostomy Closure

Ulcerative Colitis – Surgical Management

Anal Sphincterotomy

Anorectal Abscess – Drainage

Anorectal Fistula – Repair

Hemorrhoids – Management

Perianal Condylomas – Excision

Bronchoalveolar Lavage and Bronchoscopy

Esophagogastroduodenoscopy

Lower GI Endoscopy

Axillary Sentinel Lymph Node Biopsy and Lymphadenectomy

Duct Excision

Excisional Breast Biopsy and Partial Mastectomy

Mastectomy – Simple, Modified Radical, and Radical

Percutaneous Breast Biopsy and Cyst Aspiration

Parathyroidectomy

Thyroidectomy – Partial or Total

Skin/Soft Tissue Lesions – Excisional and Incisional Biopsy

Soft Tissue Infections – Incision, Drainage, Debridement

Intubation and Difficult Airway

Nutritional Support

Ultrasound Use for Intravascular Access

Vascular Access

Abdominal Exploration for Trauma

Cardiac Injury – Repair

Duodenal and Pancreatic Injury – Operations

Esophageal Injury – Repair

Fasciotomy

Focused Assessment with Sonography for Trauma (FAST)

Gastrointestinal Tract Injury – Repair

Hepatic Injury – Packing and Repair/Resection

Neck Injuries – Management
Splenectomy/Splenorrhaphy
Urinary Tract Injuries – Operations
Vascular Injuries – Operations
Wounds, Major – Debride/Suture
Amputations – Lower Extremity
Embolectomy/Thrombectomy – Arterial
Venous Insufficiency/Varicose Veins – Operation
Arteriovenous Graft/Fistula
Vascular Exposure – Principles
Venous Access Devices – Insertion
Exploratory Thoracotomy – Open and Thoracoscopic
Partial Pulmonary Resections – Open and Thoracoscopic
Tube Thoracostomy and Thoracentesis
Pediatric Inguinal Hernia – Repair
Pediatric Intussusception – Operation
Pediatric Malrotation – Operation
Pediatric Meckel Diverticulum – Excision
Pediatric Pyloromyotomy
Pediatric Umbilical Hernia – Repair
Complex Wound Closure
Skin Grafting
Nephrectomy
Lymph Node Biopsy
Tracheostomy

CHAPTER 3: Discussion

General surgeons fill a critical role in the care of rural or isolated patients, who make up nearly 20% of the U.S. population³. However, with only 10% of general surgeons practicing in these areas, and U.S. military surgeons often working in austere environments, many surgeons incorporate procedures into their practice which are not emphasized by the American Board of Surgery residency training requirements². Several works examined here, across the 25-year timeframe of our review, note further training requests for rural surgeons, though many of these represent single-surgeon pleas rather than national-level analysis¹⁰⁴⁻¹⁰⁶. Through a constructivist lens, we worked to identify consistent themes for surgical educational needs which transcend local traditions or individual surgeon practice choices. Framed by the Cruess's theory of the Professional Social Contract, the isolated surgeon discussion represents not just an opportunity but truly a responsibility for surgical support and physician development. Professional development by these isolated surgeons is difficult, as cost and practice coverage represent significant barriers to training¹³.

Proposing a standard definition for isolated surgeons enables hospitals and surgeons alike to identify those who need further training. Interestingly, most definitions we encountered in the civilian literature focused on population. As this impacted hospital reimbursement more than surgeon development, this focus is understandable, though unfortunate. Our proposal that any definition include components of geography or population, hospital capabilities, and professional isolation, focuses the discussion on the ability of the surgeon to provide care, rather than purely a location.

After defining the isolated surgeon, we elicited which non-core procedures and published training gaps these surgeons reported. Cases in orthopedics, obstetrics & gynecology, urology,

and vascular surgery consistently appeared throughout our review, regardless of geographic or resource setting. These most-common areas, plus a handful of “rare-but-real” life-saving emergency procedures, represent professional development demand areas for a critical surgical population. Our review makes a first step in curriculum development for accessible and pragmatic training to address an access-to-care gap for isolated surgeons and their patients.

MILITARY RELEVANCE

Expeditionary medicine in general, and the battlefield surgeon in particular, epitomize the paradigm of the isolated surgeon. Using almost any proposed definition, deployed military surgeons qualify as isolated. The requirement to diagnose and treat casualties and elective cases alike, without easy access to advanced imaging or robust support systems, means these surgeons require skills beyond the norm. Training for these situations during residency is not practical. However, en route pre-deployment training or gated professional development training, particularly in the junior surgeon ranks, would broaden the skill set of multiple surgical specialties, thereby increasing interoperability and improving mission capability. By rigorously reviewing 25 years of literature, we identified existing training gaps for the isolated surgeon, and particularly the isolated military surgeon. This review examines several thousand expeditionary surgical cases, supporting findings from earlier works which underline the daunting surgical breadth encountered while deployed^{6, 29, 90, 107}. While further case-specific volume analysis will specifically mold any training plans, the qualitative and quantitative training gaps found here--particularly in orthopedics, gynecology, vascular surgery, and urology--call for a focused needs assessment towards improving deployed surgical capabilities.

LIMITATIONS

This project's limitations lie mainly in the nature of literature reviews. We intentionally limited our review to U.S. subjects in an effort to increase the relevance to our target audience, U.S. surgeons. For example, we did not include Canadian or Australian literature, even though the "bush surgeon" and similar roles are well-described. While their healthcare training and standards nearly mirror those of the U.S., their medical systems function fundamentally differently, so the isolated surgeon paradigm may not translate to U.S. healthcare. As in any review, literature germane to our review certainly may not be included in our search results because our search terms did not match article keywords. Finally, formal stakeholder engagement as suggested by Tricco, et al, was not included in this exploratory review¹¹. As we note below, key representation by numerous stakeholders in this process, will be critical to the success of any effort to support the isolated surgeon.

FUTURE RESEARCH AND PRACTICE IMPLICATIONS

Formalizing our proposed isolated surgeon definition by consensus among stakeholders (i.e. patients, surgeons, surgical societies, hospitals, government (both civilian and military)), will strengthen support for training gap mitigation and will clarify further any immediate- and long-term educational goals. The next step in this longitudinal effort will use this review's information as a foundation for a formal needs assessment to build an isolated surgeon curriculum¹⁰⁸. Stakeholder involvement is again key in this step for both support and content refinement. We previously discussed possible avenues for this curriculum delivery, primarily surgical simulation⁶. Numerous pragmatic hurdles exist to course delivery, so an emphasis on modular, simulation-based content will improve usability for the surgeon consumer³.

CONCLUSIONS

Our review represents the largest examination of the isolated surgeon's unique and critical role in American military and civilian healthcare. These surgeons perform an impressive, expanded range of surgical procedures in resource-limited settings, with associated professional development needs outside the current surgical training paradigm. By identifying broad-based training gaps, we as a surgical profession can now target support for this small but critical group of isolated surgeons.

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