

Trends in Surgical Volume in the Military Health System—A Potential Threat to Mission Readiness

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ABSTRACT

Introduction:

The Military Health System (MHS) is tasked with a dual mission both to provide medical services for covered patients and to ensure that its active duty medical personnel maintain readiness for deployment. Knowledge, skills, and attitudes (KSA) is a metric evaluating the transferrable skills incorporated into a given surgery or medical procedure that are most relevant for surgeons deployed to a theatre of war. Procedures carrying a high KSA value are those utilizing skills with high relevance for maintaining deployment readiness. Given ongoing concerns regarding surgical volumes at MTFs and the potential adverse impact on military surgeon mission readiness were high-value surgeries to be lost to the civilian sector, we evaluated trends in the setting of high-value surgeries for beneficiaries within the MHS.

Methods:

We retrospectively analyzed inpatient admissions data from MTFs and TRICARE claims data from civilian hospitals, 2005–2019, to identify TRICARE-covered patients covered under “purchased care” (referred to civilian facilities) or receiving “direct care” (undergoing treatment at MTFs) and undergoing seven high-value/high-KSA surgeries: colectomy, pancreatectomy, hepatectomy, open carotid endarterectomy, abdominal aortic aneurysm (AAA) repair, esophagectomy, and coronary artery bypass grafting (CABG). Overall and procedure-specific counts were captured, MTFs were categorized into quartiles by volume, and independence between trends was tested with a Cochran–Armitage test, hypothesizing that the proportion of cases referred for purchased care was increasing.

Results:

We captured 292,411 cases, including 7,653 pancreatectomies, 4,177 hepatectomies, 3,815 esophagectomies, 112,684 colectomies, 92,161 CABGs, 26,893 AAA repairs, and 45,028 carotid endarterectomies. The majority of cases included were referred for purchased care (90.3%), with the proportion of cases referred increasing over the study period ($P < .01$). By procedure, all cases except AAA repairs were increasingly referred for treatment over the study period (all $P < .01$, except esophagectomy $P = .04$). On examining volume, we found that even the highest-volume-quartile MTFs performed a median of less than one esophagectomy, hepatectomy, or pancreatectomy per month. The only included procedure performed once a month or more at the majority of MTFs was CABG.

Conclusion:

On examining volume and referral trends for high-value surgeries within the MHS, we found low surgical volumes at the vast majority of included MTFs and an increasing proportion of cases referred to civilian hospitals over the last 15 years. Our findings illustrate missed opportunities for maintaining the mission readiness of military surgical personnel. Prioritizing the recapture of lost surgical volume may improve the surgical teams’ mission readiness.

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doi:<https://doi.org/10.1093/milmed/usaa543>

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INTRODUCTION

The Military Health System (MHS) provides surgical treatment and coverage for millions of active duty U.S. service members, retirees, and dependents.¹ The MHS is tasked both with the medical directive to provide surgical services for covered patients, and also with the strategic and operationally crucial directive to ensure military surgeons perform a sufficient volume and variety of surgeries to maintain the skills for future deployments.^{2,3} Recognizing the unique dual role of surgical services within the MHS, the Military Health System Strategic Partnership with the American College of Surgeons (MHSSPACS) identified the components of the knowledge, skills, and attitudes (KSAs) most relevant for surgeons deployed to the theater of war in an effort to aid

future evaluations of whether these KSAs were being maintained by MHS surgical practices.⁴

When creating KSAs, MHSSPACS consultants and specialty leaders deployed subject matter experts to develop a list of surgical abilities required to succeed in an expeditionary environment. A draft list was created after interviewing surgeons returning from deployments, reviewing the literature, and examining surgical case logs and then vetted via multiple rounds of review by the broader civilian and military clinical community. Once a composite list was established, surgical skills were mapped to peacetime workloads. This enabled the military to identify high-value/high-KSA surgical procedures, i.e., those that offer surgeons the opportunity to practice the most directly transferable skills needed to maintain readiness for deployment.⁵ KSAs supplement traditional metrics of surgical volume that focus on the total number of surgeries performed or the number of conditions treated, allowing the military to examine the translatable skills practiced during an aggregate of procedures performed by a given surgeon or an institution, with the goal of ensuring readiness for deployment.

Concerns have previously been raised that MHS beneficiaries are increasingly referred for major surgery at civilian hospitals under “purchased care” as opposed to undergoing the surgery at their MTF within the MHS under “direct care.”⁶ More recently, reports have emerged that the DoD is exploring incentivizing such referrals as part of an effort to increase the role of the private sector in military medicine as part of a push to “civilianize” the MHS.⁷ If a direct-to-purchased shift occurred, it could potentially impact mission readiness by decreasing KSA practice opportunities within MTFs for MHS surgeons. This would be detrimental both to the surgeons and surgical personnel whose deployment readiness would be affected and to their eventual patients and could therefore be detrimental to the MHS at large.

With this context in mind, we identified surgeries with high KSA value and evaluated whether they occurred within the MHS at MTFs under “direct care” or were referred to civilian hospitals under “purchased care,” and whether a trend existed for a shift in surgical care setting. Our hypothesis, informed by anecdotal evidence from on-the-ground practitioners, was that an increasing proportion of surgical care is being referred for purchased care.

METHODS

Data Source

To assess trends in referral patterns for high-value surgeries, we performed a retrospective analysis of MTF inpatient admissions data and TRICARE health insurance claims data from civilian hospitals from the Military Health System Data Repository. As one of the United States’ largest national health insurers, TRICARE covers active duty military personnel, retirees from the military, and their collective dependents. If TRICARE beneficiaries are also enrolled in

other health insurance (e.g., Medicare), the other entity is generally required to pay for all or part of the cost of the claim before TRICARE. Therefore, the Military Health System Data Repository includes all patient encounters occurring in direct care and purchased care encounters where TRICARE is the sole insurer or cost-shares with other insurers.

Study Population

Prioritizing high-value surgeries, we identified patients undergoing colectomy, pancreatectomy, hepatectomy, open carotid endarterectomy, abdominal aortic aneurysm (AAA) repair, esophagectomy, and coronary artery bypass grafting (CABG) between fiscal years 2005 and 2019 (October 2004 to September 2019). Unless otherwise noted, laparoscopic, endoscopic, and open procedures were included, but diagnostic procedures were not included.

Data Extraction

Included procedures were identified using ICD-9 and ICD-10 codes, (see online [Appendix](#)) and care setting was extracted (direct vs. purchased). As this was a descriptive study of trends, we had no explicit outcome of interest beyond the occurrence of the index surgery.

Statistical Analysis

Overall and procedure-specific counts were described via both raw numbers and proportions. MTFs were categorized into quartiles by volume; medians and ranges for each quartile were calculated. Independence between trends was tested with a Cochran–Armitage test, hypothesizing that the proportion of cases referred for purchased care was increasing. All analyses were conducted using SAS 9.4 (SAS Institute Inc., SAS Campus Drive, Cary, NC 27513, USA). A two-sided test with alpha of $<.05$ was set for statistical significance. The study protocol was reviewed and approved by the USU institutional review boards, and permission to access data was granted by the Defense Health Agency.

RESULTS

We analyzed 292,411 cases over the study period: 7,653 pancreatectomies, 4,177 hepatectomies, 3,815 esophagectomies, 112,684 colectomies, 92,161 CABGs, 26,893 AAA repairs, and 45,028 carotid endarterectomies. Of these, 25,803 surgeries (9.7%) were performed at MTFs under direct care, with the remainder referred to civilian hospitals under purchased care. In 2005, 10.9% of analyzed surgeries were performed in direct care, but the proportion declined over the period to 8.3% of cases in 2019 (Fig. 1). Total direct care case numbers decreased from 2,423 in 2005 to 1,720 in 2019.

All cases except AAA repairs were increasingly referred for civilian treatment over the study period (all significant trends with $P < .01$ except esophagectomy $P = .04$) (Fig. 1). Relative reductions in percent of cases performed at MTFs

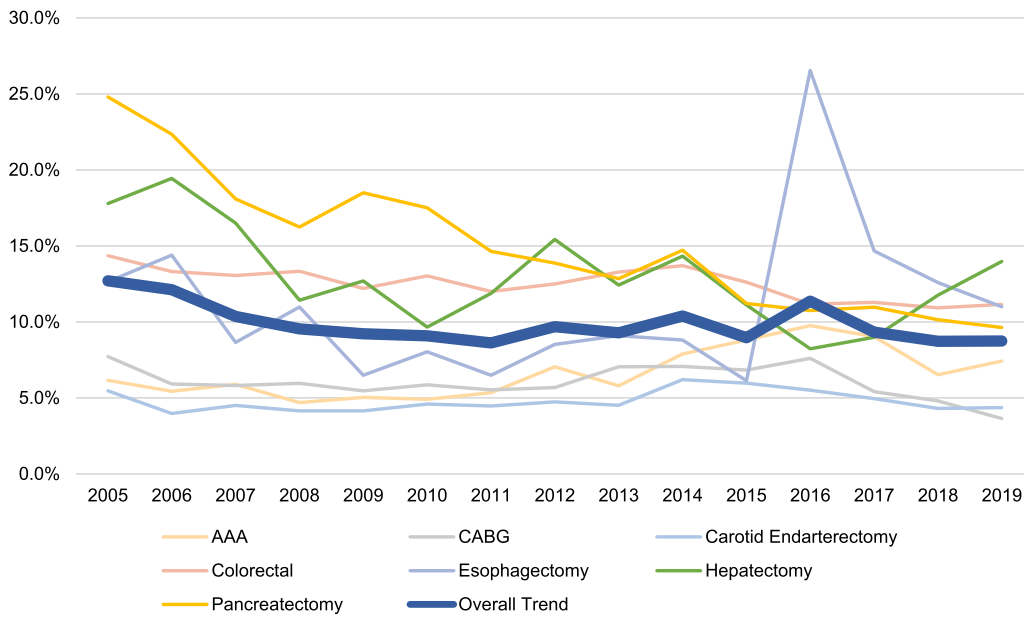


FIGURE 1. Proportion of cases performed under direct vs. purchased care.

TABLE I. Proportion of Specific Surgeries Performed Under Direct vs. Purchased Care

	AAA repair	CABG	Carotid endarterectomy	Colectomy	Esophagectomy	Hepatectomy	Pancreatectomy
2005	6% (119/1,813)	8% (702/8,389)	5% (248/4,290)	14% (1,183/7,060)	13% (33/221)	18% (45/208)	25% (94/285)
2006	5% (103/1,791)	6% (480/7,634)	4% (163/3,934)	13% (1,089/7,093)	14% (39/232)	19% (55/228)	22% (82/285)
2007	6% (113/1,807)	6% (454/7,349)	5% (179/3,791)	13% (1,089/7,255)	9% (25/264)	16% (49/248)	18% (74/335)
2008	5% (91/1,849)	6% (426/7,349)	4% (152/3,518)	13% (1,087/7,067)	11% (28/227)	11% (36/279)	16% (77/397)
2009	5% (98/1,847)	5% (375/6,487)	4% (144/3,326)	12% (1,005/7,233)	6% (15/216)	13% (40/275)	18% (86/379)
2010	5% (91/1,764)	6% (375/6,019)	5% (147/3,055)	13% (1,043/6,962)	8% (18/206)	10% (37/346)	18% (83/391)
2011	5% (99/1,754)	6% (331/5,660)	4% (137/2,928)	12% (961/7,046)	6% (17/245)	12% (38/282)	15% (70/408)
2012	7% (122/1,609)	6% (315/5,227)	5% (135/2,713)	12% (948/6,639)	9% (19/204)	15% (54/296)	14% (67/416)
2013	6% (107/1,738)	7% (379/5,001)	5% (120/2,541)	13% (973/6,355)	9% (21/210)	12% (40/282)	13% (70/475)
2014	8% (132/1,540)	7% (366/4,810)	6% (165/2,495)	14% (1,023/6,443)	9% (20/207)	14% (47/281)	15% (73/423)
2015	9% (147/1,522)	7% (355/4,841)	6% (150/2,362)	13% (892/6,180)	6% (13/199)	11% (36/288)	11% (60/475)
2016	10% (179/1,656)	8% (394/4,791)	6% (128/2,096)	11% (758/6,031)	27% (69/191)	8% (14/156)	11% (76/631)
2017	9% (161/1,622)	5% (266/4,649)	5% (109/2,096)	11% (749/5,890)	15% (44/256)	9% (16/162)	11% (80/649)
2018	7% (102/1,462)	5% (228/4,517)	4% (84/1,867)	11% (699/5,698)	13% (36/250)	12% (18/135)	10% (57/505)
2019	7% (108/1,347)	4% (168/4,449)	4% (81/1,778)	11% (695/5,538)	11% (32/259)	14% (26/160)	10% (53/497)

Percent (direct/purchased care) of cases performed at MTFs vs. civilian hospitals.

Abbreviations: AAA, abdominal aortic aneurysm; CABG, coronary artery bypass grafting.

ranged from 12% (carotid endarterectomy; 1% absolute difference) to 39% (pancreatectomy; 15% absolute difference), excepting an 8% increase in cases performed in direct care for AAA repairs (<1% absolute increase). All procedures suffered from drops in the absolute number of cases performed in direct care over the study period (Table I).

On examining volume, we found that even the highest-volume-quartile MTFs performed a median of less than one esophagectomy, hepatectomy, or pancreatectomy per month (Table II). The only procedure performed once a month or more at the majority of MTFs was CABG.

DISCUSSION

In this study, we aimed to describe temporal trends for procedures previously identified as being of critical strategic and medical value to the MHS via their designation as high-value surgeries. We found that the proportion of high-value surgeries being performed within the MHS at military hospitals was low and decreased significantly from 2005 to 2019. Our findings raise questions as to whether efforts to “civilianize” the MHS and refer an increasing number of procedures to non-MTFs under purchased care may affect mission readiness for surgical personnel within the MHS.

TABLE II. Annual Case Volumes at MTFs by Quartile

	First quartile	Second quartile	Third quartile	Fourth quartile
AAA repair	2 (1-3)	5 (4-7)	9 (8-11)	17 (12-41)
CABG	6 (1-23)	31 (25-36)	45 (37-51)	61 (52-124)
Carotid endarterectomy	3 (1-5)	7 (6-8)	11 (9-14)	18 (15-60)
Colectomy	2 (1-3)	7 (4-10)	16 (11-24)	48 (25-121)
Esophagectomy	1 (1-1)	1 (1-1)	2 (2-3)	5 (4-27)
Hepatectomy	1 (1-1)	3 (2-3)	4 (4-5)	8 (6-17)
Pancreatectomy	1 (1-1)	2 (2-2)	5 (3-7)	11 (8-21)

Median (range) of annual case counts at MTFs by volume quartile.

Abbreviations: AAA, abdominal aortic aneurysm; CABG, coronary artery bypass grafting.

Our study covers a period during which demand for mission-ready surgical personnel has remained high owing to ongoing combat operations in Iraq and Afghanistan.⁸ Advances in medicine on the battlefield such as Tactical Combat Casualty Care and the courageous military medical evacuation units have resulted in statistically more casualties making it to surgical levels of care. This increase in demand and the complexity of injuries sustained on the battlefield test the skills of the most seasoned surgeons and reinforce the need for effective home station preparation to develop the skills and confidence required in a deployed setting.

One possible explanation for a trend of decreasing proportion of cases being performed at MTFs would be that military hospitals have a fixed capacity, are at capacity, and may be experiencing an increasing volume of surgical cases and would therefore be referring any over-capacity cases. MTFs operating at full capacity would presumably be performing enough procedures to maintain adequate KSAs for their medical personnel. Our results, however, show that the number of surgical procedures being covered for our captured TRICARE population is actually decreasing over the study period, from 24,689 in 2005 to 15,191 in 2019. If military facilities were attempting to maintain surgical volumes, one would expect the proportion of cases performed under direct care at MTFs to increase over the period studied, the opposite of what we observed. It is also notable that this decrease in surgical volumes has not been accompanied by a decrease in treatment costs for the covered population.⁶ This drop in case load warrants further investigation to better understand the demands placed on military medical personnel.

Our description of annual trends in MTF surgical volumes reveals pervasively low volumes. One high-value procedure that has been previously studied is colectomy, wherein surgeons were grouped by tertiles of 30-99, 100-199, or 200+ annual colectomies, with a finding that higher volume was associated with more efficient usage of operating room resources and shorter hospital stays.⁹ All but the top quartile of MTFs in our study would have fallen below the lowest volume surgeon in this study. Similarly, a large national study of CABG split hospitals into tertiles of <100, 100-250, and >250 CABG surgeries per year, finding an association between performing fewer than 100 surgeries and worse adjusted in-hospital morbidity, mortality, cost, and 30-day

readmission.¹⁰ As with colectomy, all but the top quartile of MTFs captured by our study would qualify as low volume by this definition. Similar findings exist for esophagectomy,¹¹ hepatectomy,^{12,13} and pancreatectomy.¹⁴ By literature-based definitions, a great majority of MTFs studied would be considered low volume in the years studied.

Our study assesses the volume of surgical procedures performed, and we make no assertion as to the quality of the captured surgeries or their outcomes. This is a critical distinction. Although historically higher volumes of procedures for a given surgeon or hospital have been associated with better outcomes,¹⁵⁻¹⁷ whether this is an associative or a causal factor remains to be conclusively proven (and may never be given the difficulty in truly randomizing surgical populations, both logistically and ethically).¹⁸ The MHS has specifically abstained from signing on to initiatives such as the Surgical Volume Pledge initiated by Johns Hopkins, focusing instead on quality initiatives such as the National Surgical Quality Improvement Program, commonly known as NSQIP.¹⁸ We emphasize, however, that we focus on volume not necessarily as a surrogate for quality but as a critical marker of whether military surgeons and surgical staff are getting the opportunities to perform high-value procedures enough to maintain mission readiness.

How to recapture the surgical volume currently leaking out of the MHS is a matter of ongoing debate. One unique avenue of inquiry takes note of the fact that medical centers and commanders in war zones have license to extend their reach beyond military personnel, treating the local civilian population to engender goodwill and support. Domestically, however, MTFs exist separately from the civilian population. The MHS could increase MTF volumes via policy changes by encouraging MTFs to participate in their state's trauma systems (only two MTFs do so at present), by encouraging any Veterans Affairs hospital with a wait-list to refer its patients to the closest military facility, and by selectively stationing military physicians at civilian hospitals as needed to supplement their skills and provide for underserved communities.^{6,19,20} Alternatively, if it is not an issue of volume being lost but of MTFs lacking the resources to adequately treat the volume of patients within the MHS, then better deployment of the existing resources and potentially allocating more resources to the MHS may be required. Before doing so, however, work

processes within the MHS must be better understood, as the existing costing and resource models at use in the MHS and most civilian hospitals are opaque.^{21,22} One approach would be to implement time-driven activity-based costing, which has allowed other healthcare systems to better understand their professional workflows and resource utilization, eventually improving efficiency and quality, while containing cost.²³ Future study is needed to determine the best ways to recapture the lost surgical volume while ensuring the MHS is adequately resourced to provide the care required.

We acknowledge that our study is limited by several factors, including the fact that patients with both TRICARE and other insurance may be missed in the purchased care setting, so purchased care volumes are almost certainly higher. The actual share of direct care surgeries among all TRICARE beneficiaries is thus likely underestimated, which would exacerbate the trends we describe. In addition, our study period covered the conversion from ICD-9 and ICD-10, which could introduce questions regarding claims validity, although it is unclear in which direction this would bias.

CONCLUSION

We assessed volume and referral trends for “high-value” surgeries—those identified by the military as most critical to maintain readiness of nondeployed military surgeons. We found low surgical volumes at the vast majority of military facilities and an increasing proportion of cases referred to civilian hospitals over the last 15 years. Our findings suggest that these referrals deprive military surgical teams of opportunities to practice high-value procedures and maintain mission readiness. Prioritizing the recapture of lost surgical volume may improve surgical teams’ mission readiness.

SUPPLEMENTARY MATERIAL

Supplementary material is available at *Military Medicine* online.

FUNDING

Q.-D.T. had received research funding from the Health Services Research pilot test grant from the Defense Health Agency (HU0001-18-2-0018) and an unrestricted educational grant from the Vatikuti Urology Institute. Q.-D.T. reported personal fees from Astellas, Bayer, and Janssen as well a research grant from Intuitive Surgical. This project was funded by the Defense Health Agency (HU0001-18-2-0018).

CONFLICT OF INTEREST STATEMENT

None declared.

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