World Journal of Emergency Surgery

REVIEW

Open Access

Integrating acute care surgery in South Korea: enhancing trauma and non-trauma emergency care

Jin Young Lee[1,2], Seheon Kim[1,2], Jin Bong Ye[1], Jin Suk Lee[1,2] and Younghoon Sul[1,2*]

Abstract

Background Trauma surgery is a fundamental aspect of medicine. According to the 2023 mortality report from Statistics Korea, external factors such as intentional self-harm and transportation incidents are leading causes of death among individuals aged 10 to 30, accounting for 7.9% of overall mortality. Despite advances in the field, specialization has hindered comprehensive trauma care.

Main body In South Korea, regional trauma centers have been established to meet critical trauma management needs; however, challenges remain, including a shortage of trauma surgeons and inefficient resource utilization. The reluctance of surgical residents to pursue trauma training exacerbates the scarcity of qualified specialists. Trauma surgeons often bear extensive responsibilities, which limits their ability to perform prompt interventions. Acute Care Surgery (ACS) offers a model to integrate trauma and non-trauma surgical care, enabling hospitals to implement effective protocols for urgent cases and improving patient outcomes. Research indicates that ACS enhances emergency surgical management, increases training opportunities for residents, and improves job satisfaction among participating surgeons.

Conclusion Integrating ACS into South Korea's healthcare system is essential to optimize resource allocation and improve emergency care, ultimately leading to enhanced public health outcomes.

Keywords Acute Care surgery, Trauma Management, Emergency Surgical Care, Surgical Education, Public Health

Introduction

Among the various fields in medicine, trauma surgery is one of the oldest disciplines established. According to the 2023 mortality report from Statistics Korea, the leading cause of death for individuals aged 10–30 years is attributed to external factors, including intentional self-harm, whereas fatalities resulting from transportation accidents rank third. Additionally, deaths due to accidents account for approximately 7.9% of all fatalities [1]. However, as the field of surgery has evolved and specialized to address specific diseases affecting individual organs, the focus has shifted from holistic patient care to segmented organ-specific treatments. Consequently, difficulties remain in the management of trauma patients [2]. In response to the need for the education of specialists who primarily treat patients with multiple types of trauma and to increase preventable mortality rates to levels comparable to those in developed countries, the government has announced plans for the establishment

*Correspondence:
Younghoon Sul
ssulyh@gmail.com
[1]Department of Trauma Surgery, Chungbuk National University Hospital, Cheongju, South Korea
[2]Department of Trauma Surgery, Chungbuk National University College of Medicine, Cheongju, South Korea

and operationalization of regional trauma centers [3]. Despite governmental support, the trauma care system in South Korea continues to face several challenges, including a shortage of trauma surgeons and inefficiencies in resource allocation [4]. These issues are not exclusive to trauma patients, as various nontrauma surgical patients requiring urgent operations are similarly affected [5]. Rapid and efficient interventions are crucial for patients suffering from conditions such as peritonitis and intestinal ischemia or necrosis [6]; however, there is a notable scarcity of specialized teams to address these needs. Acute care surgery (ACS), a newly developed surgical specialty originating in the United States, has emerged as a collaborative model aimed at bridging the gaps in trauma care and nontrauma emergency surgery [7]. As surgical residents are increasingly reluctant to pursue trauma surgical training and specialized surgeons lose interest in emergency surgeries, the gaps in both trauma and nontrauma emergency surgical care are expanding. This collaborative model has gained traction, with many American hospitals actively implementing acute care surgery [8].

This paper aims to provide an in-depth discussion of the current status of the trauma care system in South Korea, the prevailing conditions of nontrauma emergency surgical care, and the necessity for the introduction of ACS.

Current status of the trauma care system in South Korea

Until the early 2010s, South Korea lacked formally operating trauma centers and a systematic trauma care system, which significantly hindered timely and specialized treatment for severely injured trauma patients. As a result, the preventable mortality rate for trauma patients was as high as 35.2% as of 2010, significantly exceeding the rates of less than 5% reported in developed countries, illustrating the critical need for improvement in trauma care [9]. Following the Aden Gulf Operation in 2011, there was a surge in national awareness regarding trauma care, prompting the government to recognize the necessity of establishing trauma centers. In 2012, the government announced a plan to establish one regional trauma center in each of the 17 districts nationwide and began operationalizing these facilities (Fig. 1). Regional trauma centers are institutions dedicated to the treatment of severely injured patients suffering from multiple types of trauma and massive hemorrhage. These centers are equipped with advanced facilities and equipment and are supported financially by the government, which also contributes significantly to the salaries of trauma specialists [10]. As a result of these policies, South Korea's preventable mortality rate successfully decreased from 35.2% in 2010 to less than 15.7% in 2019 [11].

However, none of the 17 regional trauma centers currently operate with a fully staffed roster of dedicated specialists. Owing to governmental regulations mandating that trauma specialists can treat only trauma patients,

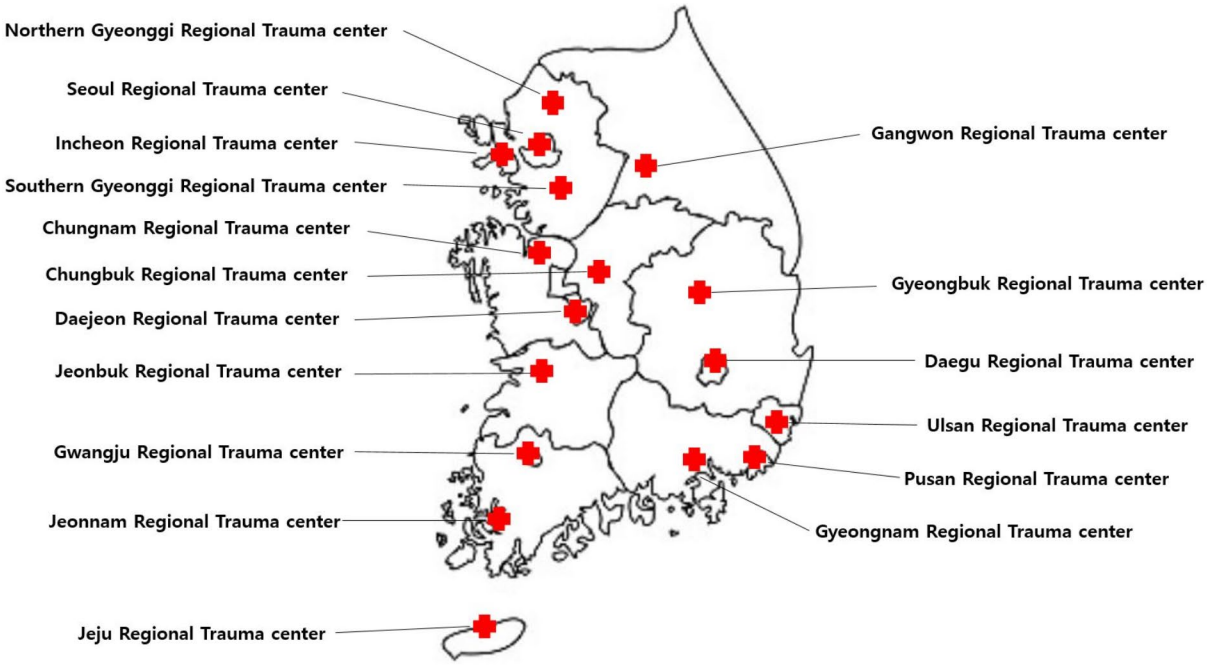

Fig. 1 Korean regional trauma centers

trauma centers face a shortage of specialized personnel, in addition to a lack of specialists capable of performing emergency surgeries [12]. Furthermore, trauma surgeons often find themselves responsible not only for managing critically ill patients in intensive care units but also for patients in emergency rooms, operating rooms, and general wards. Trauma surgeons face numerous challenges on a global scale, including a shortage of qualified personnel and inadequate training programs. Similar issues have been reported in countries across North America and Europe, where the decreasing interest in trauma surgery among surgical residents has led to significant workforce imbalances [13]. This trend is notably mirrored in South Korea, where emerging surgeons also demonstrate a preference for more predictable surgical specialties [14]. This expanded responsibility frequently necessitates that trauma surgeons provide outpatient care, thereby intensifying their workload. Consequently, the increasing demands of managing severely injured patients, coupled with a low surgical volume, contribute to a detrimental cycle that limits training opportunities [15, 16]. Issues such as overnight shifts without adequate compensation further exacerbate recruitment challenges for trauma surgeons, increasing their risk of exposure to infectious diseases and medical accidents [17].

Another contributing factor to the shortage of trauma surgeons is that only approximately 20–25% of trauma patients require surgical intervention, resulting in limited opportunities for surgery. Most trauma care increasingly relies on nonsurgical interventions, contributing to a growing disconnection from surgical training [15, 16, 18]. This perception leads trauma surgeons to be regarded as "surgeons who do not operate" and "surgeons with limited operating opportunities," generating anxiety about being perceived as "second-tier surgeons" among their peers [17]. According to reports from one regional trauma center in South Korea, the number of trauma-related emergency abdominal surgeries remained steady at 107 cases in 2015, 136 cases in 2016, and 126 cases in 2017, whereas the number of nontrauma emergency surgeries dramatically increased from 488 cases in 2015 to 522 in 2016 and 697 in 2017. As a result, the average number of abdominal trauma surgeries performed by each trauma surgeon was approximately 20 in 2017, suggesting that trauma surgeons may struggle to maintain their surgical skills because of the limited number of surgeries performed annually [19].

Thus, the current realities of trauma care present significant challenges for trauma surgeons, necessitating comprehensive improvements in the overall trauma care system.

Table 1 Trends in the scale of emergency surgical operation by region and year

Region	Year				
	2016	2017	2018	2019	2020
A	5872	6453	6520	6852	6595
B	5322	5770	5836	6399	6654
C	2327	2483	2392	2638	2492
D	883	1133	1169	1270	1361
E	689	971	953	1081	1183
F	332	572	565	664	764
G	1423	1574	1683	1764	1403
H	2364	2629	2561	2527	2271

A : Seoul B: Gyeonggi C: Daejeon, Chungnam, Chungbuk D: Jeonbuk E: Jeonnam, Gwangju F: Gangwon G: Daegu, Gyeongbuk H: Pusan, Ulsan, Gyeongnam

Current status of non-trauma emergency surgical care systems in South Korea

An analysis of data from 2016 to 2020 revealed a continuous increase in the incidence of non-trauma emergency surgical procedures across national and regional emergency medical institutions in South Korea, even excluding surgeries for acute appendicitis. In 2020, there were notable discrepancies in the number of emergency surgeries performed by region, with Seoul reporting 6,595 procedures, Gyeonggi-do (excluding the capital area) reporting 6,654, Gangwon-do reporting 764, Chungcheong-do reporting 2,492, Jeollabuk-do reporting 1,361, Jeollanam-do reporting 1,183, Gyeongsangbuk-do reporting 1,403, and Gyeongsangnam-do reporting 2,271 procedures [20] (Table 1). The unequal distribution of medical infrastructure and human resources overnight surgical emergencies and intensive surgical care can significantly hinder access to treatment for emergency patients [20].

A 2022 analysis of the status of surgical residents by region revealed a severe shortage of surgical trainees in certain areas, exacerbating the imbalance in medical infrastructure (Fig. 2). Notably, only 20% of emergency medical institutions have dedicated emergency surgical teams, and shortages in necessary resources (hospital beds, operating rooms, and intensive care units) are prevalent, irrespective of the presence of such teams. This scarcity of resources has been identified as a major cause of delays in the treatment and surgical care of emergency patients [20].

Hospitals that operate emergency surgical teams implement a 24-hour monitoring system alongside dedicated medical staff, whereas institutions lacking such personnel frequently assign residents a range of duties, including routine surgeries and outpatient care. This arrangement significantly diminishes the prioritization of emergency patient treatment, potentially leading to situations where urgent care is delayed. The causes of these care delays can be attributed to various factors, including the aforementioned infrastructural deficiencies, the presence or absence of dedicated personnel, surgical delays, and the reasons for patient transfer to other hospitals [20].

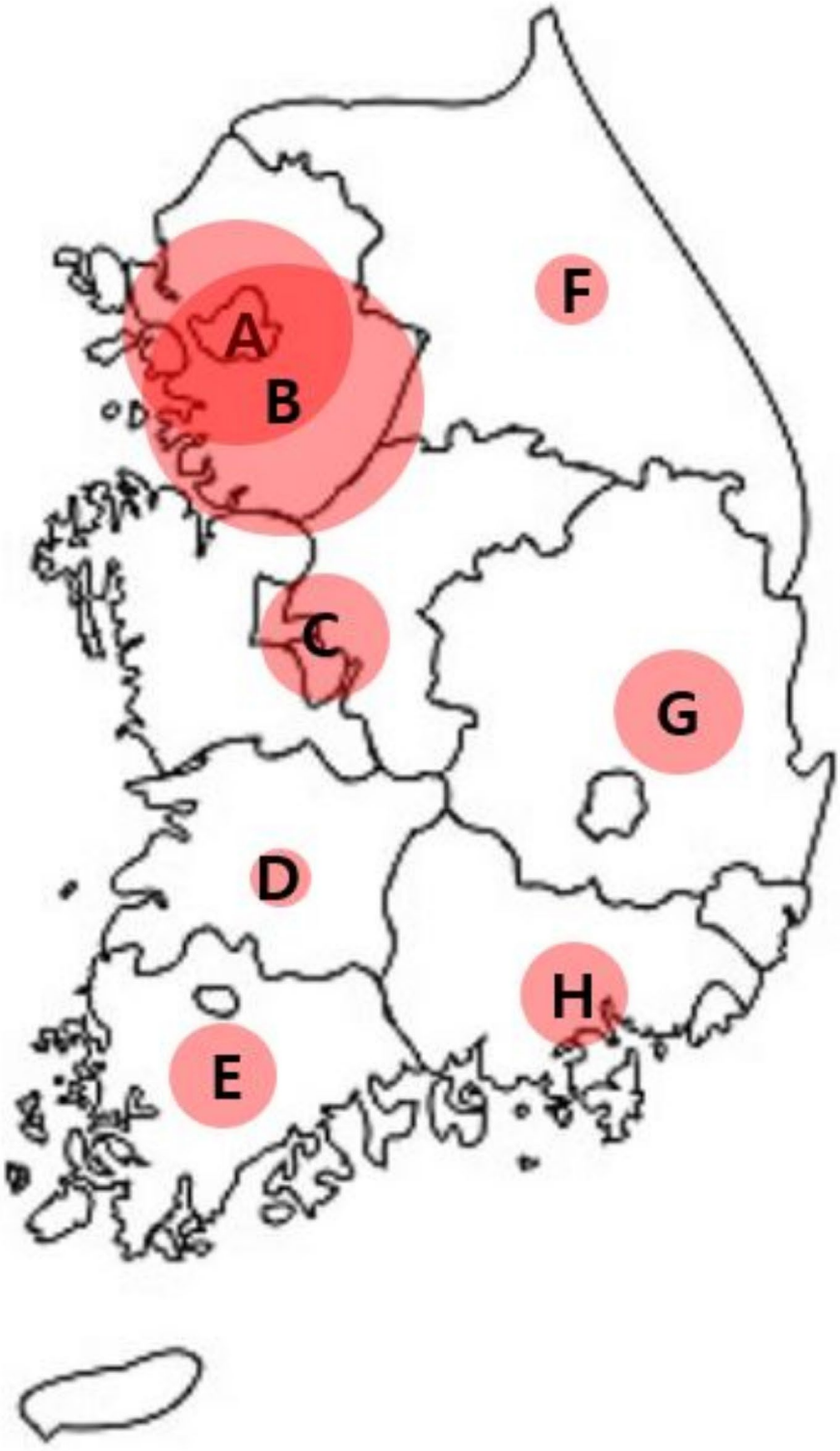

Fig. 2 Regional distribution of surgical resident: **A**: Seoul **B**: Gyeonggi **C**: Daejeon, Chungnam, Chungbuk **D**: Jeonbuk **E**: Jeonnam, Gwangju **F**: Gangwon **G**: Daegu, Gyeongbuk **H**: Pusan, Ulsan, Gyeongnam)

Additionally, there is a deficit in the institutional framework required for the definitive treatment of emergency patients. In South Korea, the implementation of a dedicated intensivist system in intensive care units was initiated in 2013, beginning with select university hospitals. As of January 2015, a government policy mandated that each tertiary hospital's intensive care unit employ at least one dedicated intensivist. The adequacy of intensive care units was subsequently subjected to evaluation criteria, with one intensivist recommended for every twenty patients admitted, establishing this as a quality assessment metric. Notably, intensivists are required to focus solely on their intensive care responsibilities without engaging in other clinical tasks [21, 22]. This regulation poses significant challenges for establishing efficient connections that would facilitate rapid and effective surgical intervention for emergency patients. Considering the current state of non-trauma emergency surgical care in South Korea, a recent study conducted at a major medical center indicates that the implementation of the ACS model has a positive impact on the management of emergency surgery patients. Specifically, the study found that the application of the ACS model resulted in a significant reduction in the time taken from the emergency department (ED) to the operating room (OR) and a decrease in complication rates [23]. These findings highlight the potential for the ACS model to enhance the quality of non-trauma emergency surgical care and mitigate unnecessary delays in treatment.

Necessity for the introduction of acute care surgery

Given the unique demographic profile of South Korea, which harbors a population of approximately 50 million within a geographic area of 100,000 square kilometers, recent findings from two systematic reviews and multiple relevant studies underscore the significant advantages of adopting the ACS model. These findings emphasize the urgency for understanding and endorsing the ACS model within the Korean healthcare system. By contextualizing the Korean situation within a global framework, we can better appreciate the potential enhancements in emergency surgical care and outcomes that the ACS model may offer [24–33].

Surgeons at regional trauma centers are restricted to treating only trauma patients, leading to a situation where the management of non-trauma emergency patients relies heavily on general surgeons who primarily perform elective surgeries during their off-hours, thus compromising timeliness in emergency care. This structural limitation may hinder the provision of rapid and specialized treatment for nontrauma emergency patients [34]. Patients requiring urgent surgical intervention are exposed to various acute surgical situations that necessitate prompt care; thus, an integrated approach to managing such patients across the 17 regional trauma centers evenly distributed throughout the country is likely to yield significant benefits [19].

In this context, a recent study from a major medical center in South Korea demonstrates that the implementation of the ACS model positively influences the management of emergency surgery patients. Specifically, the research revealed that the adoption of the ACS model led to a notable reduction in the time from ED admission to OR arrival, as well as a decrease in complication rates. These outcomes suggest that the ACS model can significantly improve the quality of non-trauma emergency surgical care and help alleviate unnecessary delays in treatment [35].

While the ACS system and training processes in the United States serve as valuable references, they have been documented in detail in numerous trauma forums and manuscripts [36–39]. Thus, it is critical that we focus on adapting these frameworks to the unique context of South Korea to maximize the benefits of such a model. The American Association for the Surgery of Trauma has proposed the concept of ACS to increase surgical interest in trauma and surgical critical care among surgeons, effectively integrating trauma, surgical critical care, and emergency general surgery [36] (Fig. 3). To that end, a two-year training program for the certification of ACS specialists was developed, producing its first graduates in 2008, with over 20 institutions currently operating ACS programs [37, 38]. Various studies have reported positive outcomes associated with such training programs. Research seeking to assess the educational impact on residents has indicated that exposure to diverse nontrauma emergency surgeries significantly enhances their decision-making abilities regarding complex surgical procedures and improves their technical skills [39]. Furthermore, the ACS model offers attending surgeons opportunities to maintain their competencies in emergency surgical procedures, whereas residents benefit from a well-rounded training experience that encompasses both elective and emergency surgeries, achieving optimal combinations of surgical training [39].

Conditions for the introduction of acute care surgery

The establishment of an adequate workforce is essential for the successful implementation of ACS. Currently, interest in surgical residency programs is decreasing, and the average age of specialists is increasing, exacerbating the already significant workforce imbalance across regions. Consequently, it is imperative to develop a surgical emergency medical system that aligns with the medical infrastructure available in each locality. To efficiently utilize the limited essential surgical workforce, it is crucial to designate and support hospitals capable of

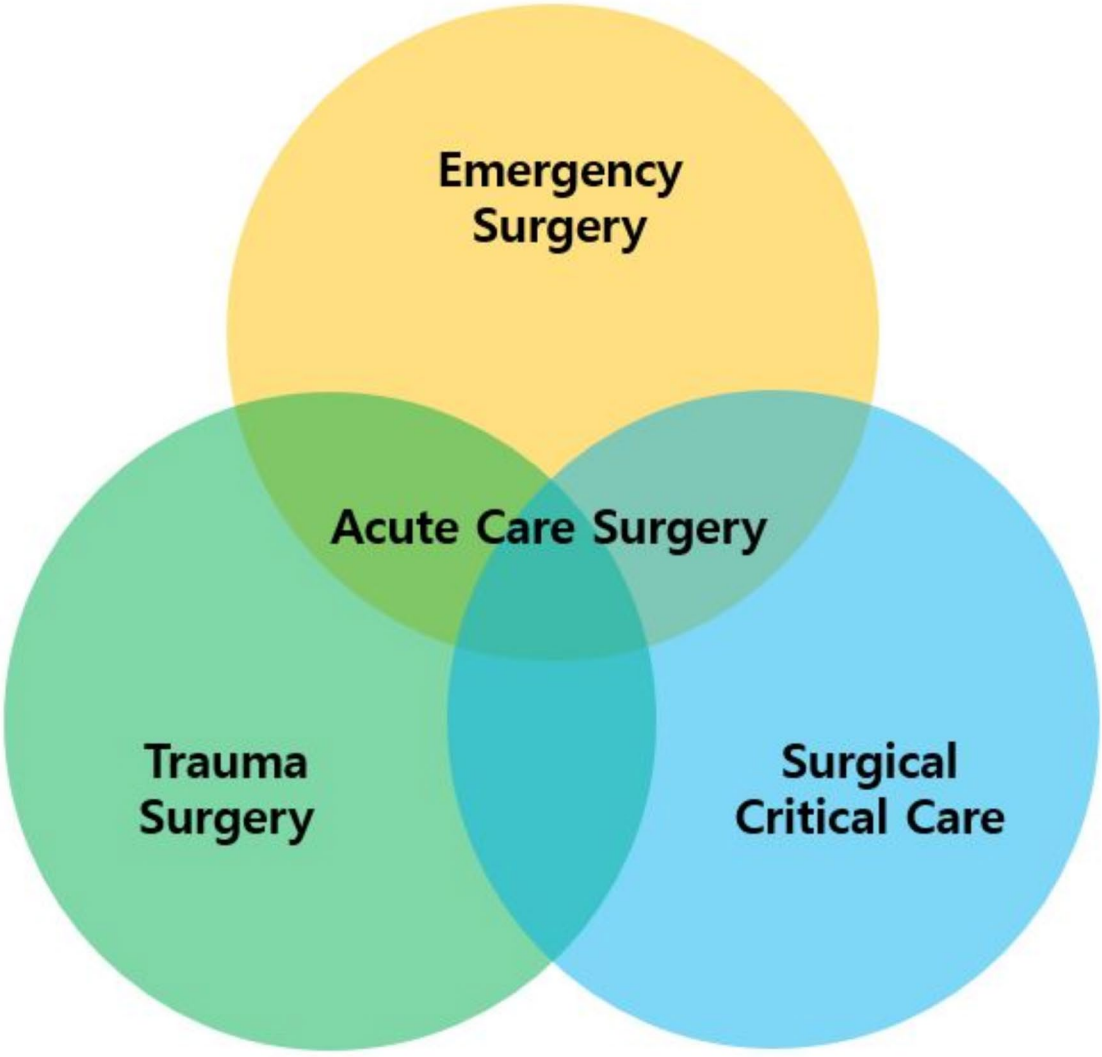

Fig. 3 Concept of acute care surgery

providing emergency care on the basis of the volume of severe surgical emergencies within each region, thereby forming and operating an integrated surgical emergency medical network [21].

For the systematic and stable operation of the ACS framework, ample support for personnel, facilities, and equipment necessary for emergency surgeries is critical. Simply increasing reimbursement rates will not suffice to sustain the system; rather, there should be additional rate increases for higher-risk and more complex surgical procedures. This approach will lay the foundation for securing the resources necessary for ACS to deliver high-quality healthcare services to patients [21].

The successful integration of ACS requires both policy support and enhancements to educational programs. Once the domestic trauma system is sufficiently structured and stabilized, discussions may arise regarding the allowance for trauma specialists to perform a limited range of nontrauma emergency surgeries without compromising the care of trauma patients. Such an arrangement would aid in maintaining the skills of existing trauma specialists while also benefiting the education of newly trained trauma fellows [39].

ACS plays a crucial role not only in performing surgeries but also in postoperative care and the management of trauma patients within intensive care settings. As leaders in surgical critical care, ACS specialists should exercise direct influence over trauma and critical patient management. However, owing to the specific characteristics of this subspecialty, exposure to surgical procedures may be

infrequent. Therefore, institutional reinforcement, such as the deployment of specialists during critical surgeries, is necessary to address this issue. By accommodating the needs of acute care surgeons in this manner, it is possible to increase specialization within surgery while securing an efficient emergency care system [40].

Conclusion

The introduction of ACS is poised to facilitate a comprehensive enhancement of South Korea's trauma and non-trauma emergency surgical care systems, playing a pivotal role in providing improved treatment outcomes for patients. Furthermore, this development will contribute to the overall enhancement of the national emergency medical system, thereby promoting public health. It is anticipated that ongoing research related to policies will continue to support the successful establishment of the ACS model, ultimately leading to a society where more patients can receive timely medical services.

Author contributions

JY Lee and Y Sul performed the literature search, extracted the data and wrote the manuscript. S Kim helped with figure images and table. JB Ye and JS Lee all helped in writing different subsections of the review. All authors contributed to the manuscript, and all read and approved the final version.

Funding

This research was supported by a grant from the Regional Trauma Center, Ministry of Health and Welfare, Republic of Korea.

Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethics approval

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Received: 14 October 2024 / Accepted: 11 January 2025
Published online: 20 January 2025

References

1. Ellis H. A history of surgery. Cambridge: Cambridge University Press; 2001. pp. 3–40.
2. Office KNS. Annual report on the causes of death statistics in 2023. 2023.
3. Lee KJ. The necessity for a trauma surgeon and the trauma surgeon's role in the trauma care system. J Trauma Inj. 2008;21:1–7.
4. Im J, Seo EW, Jung K, Kwon J. Understanding regional trauma centers and managing a trauma care system in South Korea: a systematic review. Ann Surg Treat Res. 2023;104:61–70.
5. Nelson BV, Talboy GE Jr. Acute care surgery: redefining the general surgeon. Mo Med. 2010;107(5):313.
6. Kim M, Kim JH, Kim SJ, Cho HJ. Ideal time to surgery for acute abdomen. J Acute Care Surg. 2016;6:7–10.
7. Fuchshuber P, Solis C. Acute care surgery in the US–A review and personal experience. South–East Eur Endo-Surg J. 2023;2(1):100–10.
8. Park DJ, Park CY, Cho HM, Lee KH, Han HS. Current status and future prospects of trauma centers in Korea. J Korean Med Assoc. 2017;60(7):530–2.
9. Kim H, Jung KY, Kim SP, Kim SH, Noh H, Jang HY, et al. Changes in preventable death rates and traumatic care systems in Korea. J Korean Soc Emerg Med. 2012;23(2):189–97.
10. Welfare MoHa. Administrative guidelines for regional trauma center. National Emergency Medical Center; 2020.
11. Kwon J, Lee M, Kim Y, Moon J, Huh Y, Song S, et al. Trauma system establishment and outcome improvement: a retrospective national cohort study in South Korea. Int J Surg. 2023;109(8):2293–302.
12. Lee M, Lee G, Lee J, Yu B. Surgical volumes in a regional trauma center: is it enough? J Acute Care Surg. 2020;10(1):10–2.
13. Smith RN, Freedberg M, Bailey J, DeMoya M, Goldberg A, Staudenmayer K. The importance and benefits of defining full-time equivalence in the field of acute care surgery. Trauma Surg Acute Care Open. 2024;9(1):e001307. https://doi.org/10.1136/tsaco-2023-001307. eCollection 2024.
14. Kim BY, Yoon I, Han SJ, Hong SK, Choi S, Kwon HJ. Specialty impact on residents' perceived quality of life, stress, and job satisfaction: a comparative study. Ann Surg Treat Res. 2023;105(4):188–97. https://doi.org/10.4174/astr.2023.105.4.188.
15. Cohn SM, Price MA, Stewart RM, Pruitt BA Jr, Dent DL. Perceptions and attitudes of critical care training and careers among United States surgical residents: who wants to be a surgical intensivist? Am Surg. 2007;73(5):433–7.
16. Hadzikadic L, Burke PA, Esposito TJ, Agarwal S. Surgical resident perceptions of trauma surgery as a specialty. Arch Surg. 2010;145(5):445–50.
17. Tisherman SA, Kaplan L, Gracias VH, Beilman GJ, Toevs C, Byrnes MC, et al. Providing care for critically ill surgical patients: challenges and recommendations. JAMA Surg. 2013;148(7):669–74.
18. Esposito TJ, Leon L, Jurkovich GJ. The shape of things to come: results from a national survey of trauma surgeons on issues concerning their future. J Trauma Acute Care Surg. 2006;60(1):8–16.
19. Jang JY, Shim H, Kim JH, Hong SK, Bae KS. Current status of the Korean acute care surgery system for nontraumatic abdominal emergency surgery: a single-regional trauma center study. J Korean Med Assoc. 2019;62(2):130–4.
20. Hong SK, Ko MJ, Bae J, Yoo K, Lee H, Kim EY et al. Korean emergency surgery system for patients with acute abdomen requiring emergency surgery. Seoul: National Evidence-based Healthcare Collaborating Agency; 2023 [cited 2023 Oct 10]. Available from: https://www.neca.re.kr/lay1/program/S1T11C145/report/view.do?seq=338
21. Park S, Suh GY. Intensivist physician staffing in intensive care units. Acute Crit Care. 2013;28(1):1–9.
22. Lee JW, Moon JY, Youn SW, Shin YS, Park SI, Kim DC, et al. Major obstacles to implementing a full-time intensivist in Korean adult ICUs: a questionnaire survey. Korean J Crit Care Med. 2016;31(2):111–7.
23. Yoo S, Jun YH, Hong SK, Ko MJ, Shin H, Lee N, Lee HJ. Outcomes in emergency surgery following the implementation of an acute care surgery model: a retrospective observational study. Ann Surg Treat Res. 2024;107(5):284–90. Epub 2024 Oct 29.
24. Koea JB, Srinivasa S, Hundal H. January. Provision of acute general surgery: A systematic review of models of care. Journal of Trauma and Acute Care Surgery 76(1):p 219–225, 2014. | https://doi.org/10.1097/TA.0b013e3182a92481
25. van der Wee MJL, van der Wilden G, Hoencamp R. Acute Care surgery models Worldwide: a systematic review. World J Surg. 2020;44(8):2622–37. https://doi.org/10.1007/s00268-020-05536-9.
26. Coccolini F, Kluger Y, Ansaloni L, et al. WSES worldwide emergency general surgery formation and evaluation project. World J Emerg Surg. 2018;13:13. https://doi.org/10.1186/s13017-018-0174-5.
27. Pearce L, Smith SR, Parkin E, et al. Emergency general surgery: evolution of a subspecialty by stealth. World J Emerg Surg. 2016;11:2. https://doi.org/10.1186/s13017-015-0058-x.
28. Bruns BR, Tesoriero RB, Narayan M, et al. Acute care surgery and emergency general surgery: addition by subtraction. J Trauma Acute Care Surg. 2016;81:131–13626891159.
29. Tian BW. The rise of ACS and its importance. World J Emerg Surg. 2024;19:9. https://doi.org/10.1186/s13017-024-00538-7.
30. Sweeting RS, Carter JE, Meyer AA, et al. The price of acute care surgery. J Trauma Acute Care Surg. 2013;74:1239–124223609273.
31. Page DE, Dooreemeah D, Thiruchelvam D. Acute surgical unit: the Australasian experience. ANZ J Surg 2014 Jan-Feb;84(1–2):25–30. https://doi.org/10.1111/ans.12473

32. Britt RC, Weireter LJ, Britt LD. Initial implementation of an acute care surgery model: implications for timeliness of care. J Am Coll Surg. 2009;209:421–42419801314.
33. Roy JD, Hardy WJ 3rd, Roberts ME, Stahl JE, Butts CC, Simmons JD, et al. Reducing health care burden of emergency general surgery with a 24-hour dedicated emergency general surgery service. Am Surg. 2022;88:922–8. https://doi.org/10.1177/00031348211056283.
34. Park CI, Kim JH, Park SJ, Kim SH, Kim HH, Hong S, et al. Acute Care surgery: implementation in Korea. J Acute Care Surg. 2018;8:51–8.
35. Yi GH, Lee HJ, Lee S, Yoon JH, Hong SK. Impact of an Acute Care surgery model on the management of Acute Appendicitis in South Korea: a retrospective cohort study. Emerg Med Int. 2021;2021:5522523. https://doi.org/10.1155/2021/5522523.
36. Committee to Develop the Reorganized Specialty of Trauma SCC, Surgery E. Acute care surgery: trauma, critical care, and emergency surgery. J Trauma. 2005;58(3):614–6.
37. Trauma CoACSAAftSo. The acute care surgery curriculum. J Trauma Acute Care Surg. 2007;62(3):553–6.
38. Trauma AAftSo. Chicago: American Association for the Surgery of Trauma; 2014 [cited 2024 Oct 10]. Available from: http://www.aast.org/AcuteCareSurgery.aspx
39. Cherry-Bukowiec JR, Miller BS, Doherty GM, Brunsvold ME, Hemmila MR, Park PK, et al. Nontrauma emergency surgery: optimal case mix for general surgery and acute care surgery training. J Trauma Acute Care Surg. 2011;71(5):1422–7.
40. Hong KS. Intensivist as a surgeon: the role of a surgeon in critical care medicine. Ewha Med J. 2017;40(2):61–5.

Publisher's note