



Focus on identifying and closing knowledge gaps in acute appendicitis

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Surgical science that informs patient care has evolved along two principal pathways: retrospective review of what has already occurred, and trials that test interventions designed to improve outcomes. The current environment of evidence-based practice favors rigorous investigations such as the prospective, randomized and controlled trial. These studies are tightly focused and intensely investigate only patients who fulfill entry criteria. As valuable as those investigations are in advancing science and patient care, they may not reflect the breadth of current practice that includes patients with characteristics that would prevent inclusion in a prospective randomized controlled trial (RCT). Indeed, for any given surgical condition, there are broad variations in approaches to care, delivery methods and outcomes that merit investigation. These variations are important to recognize and explore as they may disclose the question that a prospective RCT is ideally suited to answer. This special issue of the European Journal of Trauma and Emergency *Surgery* is devoted to a method of inquiry that bridges the gap between retrospective database review and RCT—the snapshot audit.

Snapshot audits are prospective, observation and time-constrained assessments of current care practices for specific clinical conditions [1]. All patients with the condition of interest are included in the analysis, thereby capturing a “snapshot” of care including outcomes during a specified follow-up period. Suitable for virtually any condition of interest, the snapshot audit identifies the spectrum of delivered care and provides an “environmental scan” across care settings, patient populations and geographic locations. While this issue curates snapshot audit analyses into the management of a common surgical condition—acute appendicitis—the spectrum of analyses highlights the vast body of

knowledge that is collectable using this unique approach. Of course, the snapshot audit approach has been used in a variety of other settings, including most recently, in COVIDSurg, to garner a global perspective into the excess post-operative morbidity and mortality associated with surgical intervention for patients with active COVID-19 infection [2–4] and inform practice [5]. Similarly, ESTES has supported other snapshot audits into key emergency general surgery conditions, and more are under development or ready to launch. Your participation is invited!

In this issue of the European Journal of Trauma and Emergency Surgery, Bass, Kaplan, Mohseni and their ESTES colleagues describe the “snapshot audit” as a pragmatic approach to observational inquiry in surgical disease [1] that complements retrospective registry analysis and prospective RCTs. They also catalog their experience in applying this approach to achieve two specific goals: (1) identifying knowledge gaps regarding the optimal treatment for appendicitis as a hypothesis-generating launchpad for future interventional RCTs, and (2) describing the gap between evidence-based practice guidelines [6] and “real world” selective application as a lens through which to assess the variability in surgical outcomes. Tackling some of the controversies in current care of the patient with acute appendicitis, the ESTES SnapAppy collaborative explores technical aspects of surgical management (including the use of staplers and energy devices at key portions of the operation), operating surgeon experience, mentorship and graded trainee autonomy, and contemporary surgical outcomes following appendectomy across Europe, North America and the Middle East, particularly in the context of an evolving COVID pandemic [7–10].

Despite nearly a century of surgical investigation, several knowledge gaps and clinical management controversies remain (Table 1). Ongoing debate explores operative timing, antibiotic duration and surgical technique, where appendectomy fits in the spectrum of graded autonomy that is central to surgical training and even whether surgical intervention is mandatory.

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Table 1 Knowledge gaps and controversies in the current management of acute appendicitis

Knowledge gap or controversy	References
Decision making: Operative versus nonoperative	
Optimal timing of appendectomy and implications of in-hospital delay	[11–13]
Safety and efficacy of nonoperative management of acute appendicitis	[14–20]
Indications for interval appendectomy following successful nonoperative management	[21–23]
Operative techniques	
Technical modifications such as methods of handling the mesoappendix and appendiceal base	[24, 25]
Intraoperative peritoneal saline lavage versus aspiration of periappendiceal/pelvic fluid/abscess	[26, 27]
Perioperative medicine	
Need for postoperative antibiotics and the route of their administration	[18]
System logistics and their implications for surgical care	
Optimal management of acute appendicitis during and after the SARS-CoV-2 pandemic	[28–30]
The place of appendicitis in core surgical training	
Operating surgeon experience and surgical outcomes following emergency appendectomy	[31–33]

These interwoven inquiries may serve as a template for how professional medical organizations and individuals collaborate around relevant clinical issues to help assess current care, and design future investigations to improve outcomes. For those unfamiliar with the snapshot audit, consider this issue an introduction to it and the breadth of questions that may be asked and answered. For those already accustomed, consider this issue an invitation to design a collaborative snapshot audit focused on a topic relevant to ESTES members as well as our colleagues around the globe.

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Declarations

Conflict of interest HK—no conflict of interest to disclose; JT—no conflict of interest to disclose.

References

- Bass GA, Kaplan LJ, Ryan ÉJ, Cao Y, Lane-Fall M, Duffy CC, et al. The snapshot audit methodology: design, implementation and analysis of prospective observational cohort studies in surgery. *Eur J Trauma Emerg Surg.* 2022. <https://doi.org/10.1007/s00068-022-02045-3>.
- STARSurg and COVIDSurg. Death following pulmonary complications of surgery before and during the SARS-CoV-2 pandemic. *Br J Surg.* 2021;108:1448–64.
- COVIDSurg Collaborative. Effects of pre-operative isolation on postoperative pulmonary complications after elective surgery: an international prospective cohort study. *Anaesthesia.* 2021;76:1454–64.
- COVIDSurg Collaborative. Mortality and pulmonary complications in patients undergoing surgery with perioperative SARS-CoV-2 infection: an international cohort study. *Lancet.* 2020;396:27–38.
- Coimbra R, Edwards S, Kurihara H, Bass GA, Balogh ZJ, Tilsed J, et al. European Society of Trauma and Emergency Surgery (ESTES) recommendations for trauma and emergency surgery preparation during times of COVID-19 infection. *Eur J Trauma Emerg Surg.* 2020;46:505–10.
- Saverio SD, Podda M, Simone BD, Ceresoli M, Augustin G, Gori A, et al. Diagnosis and treatment of acute appendicitis: 2020 update of the WSES Jerusalem guidelines. *World J Emerg Surg.* 2020;15:27.
- Bass GA, Kaplan LJ, Forrsten MP, Walsh TN, Cao Y, Mohseni S. Techniques for mesoappendix transection and appendix resection. Insights from the ESTES SnapAppy study. *Eur J Trauma Emerg Surg.* 2020. <https://doi.org/10.1007/s00068-022-02191-8>.
- Young N, AhlHulme R, Forssten MP, Kaplan LJ, Walsh TN, Cao Y, Mohseni S, Bass GA, for the ESTES SnapAppy Group. Graded operative autonomy in emergency appendectomy mirrors case-complexity – surgical training insights from the SnapAppy prospective observational study. *Eur J Trauma Emerg Surg.* 2022. <https://doi.org/10.1007/s00068-022-02142-3>.
- Bass GA, Mohseni S, Ryan EJ, Forssten MP, Tolonen M, Cao Y, Kaplan LJ, for the ESTES SnapAppy Group. Clinical practice selectively follows acute appendicitis guidelines. *Eur J Trauma Emerg Surg.* 2022. <https://doi.org/10.1007/s00068-022-02208-2>.
- Forssten MP, Kaplan LJ, Tolonen M, Martinez-Casas I, Cao Y, Walsh TN, Bass GA, Mohseni S, for the ESTES SnapAppy Group. Surgical management of acute appendicitis during the European COVID-19 second wave: safe and effective. *Eur J Trauma Emerg Surg.* 2022. <https://doi.org/10.1007/s00068-022-02149-w>.
- Kim JW, Shin DW, Kim DJ, Kim JY, Park SG, Park JH. Effects of timing of appendectomy on the risks of perforation and postoperative complications of acute appendicitis. *World J Surg.* 2018;42:1295–303.
- van Dijk ST, van Dijk AH, Dijkgraaf MG, Boermeester MA. Meta-analysis of in-hospital delay before surgery as a risk factor

- for complications in patients with acute appendicitis. *Br J Surg*. 2018;105:933–45.
13. Jalava K, Sallinen V, Lampela H, Malmi H, Leppäniemi A, Mentula P. Role of delay and antibiotics on PERForation rate while waiting appendectomy (PERFECT): a protocol for a randomized non-inferiority trial. *Bjs Open*. 2021. <https://doi.org/10.1093/bjsopen/zrab089>.
 14. Sippola S, Haijanen J, Grönroos J, Rautio T, Nordström P, Rantanen T, et al. Effect of oral moxifloxacin vs intravenous ertapenem plus oral levofloxacin for treatment of uncomplicated acute appendicitis: the APPAC II randomized clinical trial. *JAMA*. 2021;325:353–62.
 15. Salminen P, Paajanen H, Rautio T, Nordström P, Aarnio M, Rantanen T, et al. Antibiotic therapy vs appendectomy for treatment of uncomplicated acute appendicitis: the APPAC randomized clinical trial. *JAMA*. 2015;313:2340–8.
 16. O’Leary DP, Walsh SM, Bolger J, Baban C, Humphreys H, O’Grady S, et al. A randomized clinical trial evaluating the efficacy and quality of life of antibiotic-only treatment of acute uncomplicated appendicitis: results of the COMMA trial. *Ann Surg*. 2021;274:240–7.
 17. Flum DR, Davidson GH, Monsell SE, Shapiro NI, Odom SR, Sanchez SE, et al. A randomized trial comparing antibiotics with appendectomy for appendicitis. *New Engl J Med*. 2020;383:1907–19.
 18. Saverio SD, Sibilio A, Giorgini E, Biscardi A, Villani S, Coccolini F, et al. The NOTA Study (Non Operative Treatment for Acute Appendicitis): prospective study on the efficacy and safety of antibiotics (amoxicillin and clavulanic acid) for treating patients with right lower quadrant abdominal pain and long-term follow-up of conservatively treated suspected appendicitis. *Ann Surg*. 2014;260:109–17.
 19. Harnoss JC, Zelenka I, Probst P, Grummich K, Müller-Lantzsch C, Harnoss JM, et al. Antibiotics versus surgical therapy for uncomplicated appendicitis: systematic review and meta-analysis of controlled trials (PROSPERO 2015: CRD42015016882). *Ann Surg*. 2017;265:889–900.
 20. Sallinen V, Akl EA, You JJ, Agarwal A, Shoucair S, Vandvik PO, et al. Meta-analysis of antibiotics versus appendectomy for non-perforated acute appendicitis. *Br J Surg*. 2016;103:656–67.
 21. Cheng Y, Xiong X, Lu J, Wu S, Zhou R, Cheng N. Early versus delayed appendectomy for appendiceal phlegmon or abscess. *Cochrane Db Syst Rev*. 2017;6:cd011670.
 22. Hall NJ, Jones CE, Eaton S, Stanton MP, Burge DM. Is interval appendectomy justified after successful nonoperative treatment of an appendix mass in children? A systematic review. *J Pediatr Surg*. 2011;46:767–71.
 23. Senekjian L, Nirula R, Bellows B, Nelson R. Interval appendectomy: finding the breaking point for cost-effectiveness. *J Am Coll Surg*. 2016;223:632–43.
 24. Delibegović S, Mehmedovic Z. The influence of the different forms of appendix base closure on patient outcome in laparoscopic appendectomy: a randomized trial. *Surg Endosc*. 2018;32:2295–9.
 25. Mannu GS, Sudul MK, Bettencourt-Silva JH, Cumber E, Li F, Clark AB, et al. Closure methods of the appendix stump for complications during laparoscopic appendectomy. *Cochrane Db Syst Rev*. 2017;11:cd006437.
 26. Burini G, Cianci MC, Coccetta M, Spizzirri A, Saverio SD, Coletta R, et al. Aspiration versus peritoneal lavage in appendicitis: a meta-analysis. *World J Emerg Surg*. 2021;16:44.
 27. Oweira H, Elhadedy H, Reissfelder C, Rahberi N, Chaouch MA. Irrigation during laparoscopic appendectomy for complicated appendicitis increases the operative time and reoperation rate: a meta-analysis of randomized clinical trials. *Updat Surg*. 2021;73:1663–72.
 28. Kamil AM, Davey MG, Marzouk F, Sehgal R, Fowler AL, Corless K, et al. The impact of COVID-19 on emergency surgical presentations in a university teaching hospital. *Ir J Med Sci*. 2021;191:1–7.
 29. Somers K, Elwahab SA, Raza MZ, O’Grady S, DeMarchi J, Butt A, et al. Impact of the COVID-19 pandemic on management and outcomes in acute appendicitis: should these new practices be the norm? *Surgery*. 2021;19:e310–7.
 30. Javanmard-Emamghissi H, Hollyman M, Boyd-Carson H, Doleman B, Adiamah A, Lund JN, et al. Antibiotics as first-line alternative to appendectomy in adult appendicitis: 90-day follow-up from a prospective, multicentre cohort study. *Br J Surg*. 2021;108:1351–9.
 31. Siam B, Al-Kurd A, Simanovsky N, Awesat H, Cohn Y, Helou B, et al. Comparison of appendectomy outcomes between senior general surgeons and general surgery residents. *Jama Surg*. 2017;152:679–85.
 32. Baumgarten HD, Brown EG, Russell KW, Adzick NS, Laje P. Laparoscopic appendectomy - outcomes of senior trainees operating without supervision versus experienced pediatric surgeons. *J Pediatr Surg*. 2019;54:276–9.
 33. Lee W, Park SJ, Park MS, Lee KY. Impact of resident-performed laparoscopic appendectomy on patient outcomes and safety. *J Laparoendosc Adv S*. 2018;28:41–6.