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Editorial

Effectiveness of emergency general surgery – some answers, more questions

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In this issue of *Anaesthesia*, Hutchings et al. report outcomes after emergency surgery and compare them with non-emergency surgery strategies for patients admitted to UK National Health Service (NHS) hospitals from 2010 to 2019, with the stated goal of evaluating relative effectiveness of either management strategy [1]. Five common surgical conditions were evaluated (appendicitis; gallbladder disease; symptomatic diverticular disease; abdominal wall hernia; and small or large bowel intestinal obstruction) with data obtained from the Hospital Episodes Statistics dataset. Emergency surgery was defined as surgery within 3 days for a hernia, 7 days for appendicitis, gallstone disease or intestinal obstruction, or any time while admitted for diverticulitis. The authors reported that days alive and out of hospital for all five conditions were equivalent between those who underwent surgery and those who did not. Frail patients undergoing emergency surgery stayed longer in hospital than their non-frail counterparts across all five conditions. Patients who were not frail and suffered from diverticular disease and intestinal obstruction were out of hospital and alive longer after undergoing emergency surgery compared with their non-emergency surgery counterparts, while the number of days alive and out of the hospital were equivalent for non-frail patients with appendicitis, gallstone disease and hernia. The authors conclude that emergency surgery and non-emergency surgery strategies lead to "*similar days alive and out of the hospital at 90 days*" and that for frail adults, emergency surgery strategies "*led to worse outcomes that non-emergency surgery strategies*" [1]. The authors' conclusions, while valid based on the data evaluated, must be interpreted with caution.

The authors are to be commended for leveraging instrumental variable analysis in their investigation. Instrumental variable analysis is a statistical technique, historically more commonly used in economics, used to address selection bias in observational studies [2–4]. Selection bias, a type of susceptibility bias, is inherent to any observational study comparing patients undergoing surgery with those who did not receive surgery [5]. The gold standard method to minimise selection bias is randomisation, assuming that it is impossible to recognise or test for all potentially recognised or unrecognised prognostic variables [5]. Yet, prospective randomised trials in surgery are notoriously challenging [5, 6], and instrumental variable analysis is one statistical tool used to help address these challenges [3, 4]. In addition to the authors' study, this methodology has been applied to other national-level assessment of the effectiveness of emergency surgery [7].

The analysis uses an 'instrument' to balance unmeasured confounding between comparison groups – when two patients have the same measured covariates a treatment decision may be based on rational but unrecorded reasons. The authors used a hospital's tendency to operate, which they defined as the proportion of emergency admissions in a given hospital receiving surgery [1]. This instrument was chosen based on a paper

investigating whether physicians' preference for operative care is a valid instrumental variable for studying the effect of emergency general surgery outcomes [7]. Certainly, the tendency to operate as an instrument may help mitigate the effect of non-randomisation, and superficially meets the three criteria outlined for an adequate instrumental variable [4]. Yet, the authors' findings remain disquieting, particularly for surgeons, for two primary reasons.

First, understanding decision-making in surgery is complex, particularly when using administrative data in an observational fashion. The authors' study utilises population-level data from a national healthcare system. Yet, the complexity of surgical decision-making must sometimes take place at the level of n = 1. Just as the natural history of infection can be viewed through the lens of the epidemiological triad, so too can the natural history of a surgical decision be viewed (although tetrad would be more appropriate for both entities) (Fig. 1). The authors chose to use an instrument representing the environment portion of the triad which may, or may not, be the most reasonable instrument to use. What about surgeon-level preference? Or patient preference for emergency surgery vs. non-emergency surgery management, particularly given the range of pathologies included? It is quite possible that a hospital's tendency to operate is the most effective instrument, yet the authors present no other possible instruments. The lack of patient-oriented outcomes in the dataset arguably makes it impossible to determine which course of action is truly best for the patient. In the most difficult situations, often many parties are involved such as the patient, caregiver, surgeon, anaesthetist, palliative care physician and intensivist. Additionally and increasingly, studies are recognising the critical role social determinants of health have on access, physician and patient choices, and health services even in systems with universal health access.

A second and important limitation is the authors did not solely assess conditions for which equanimity exists about treatment or disease presentation. For example, while there is debate on the benefits of surgical vs. medical management of uncomplicated appendicitis [8] or recurrent diverticulitis without peritonitis [9], all five of the conditions included by the authors can present with a broad spectrum of disease severity [10], with clear-cut indications for emergency surgery – typically < 24 h from emergency admission. The extended time from 3 days (hernia) to any day within an admission (diverticulitis) as well as the more stringent definition used in their sensitivity analysis results in inclusion of an overly broad spectrum of pathology. It would be interesting to see this same analysis performed with exclusion of patients whose time to surgery was < 12 h. For example, consider two patients in the emergency department with diverticulitis. Patient 1 has diffuse peritonitis from a free perforation with significant abdominal fluid and distant free gas (WSES Grade 4); patient 2 has localised tenderness with pericolic air bubbles (WSES Grade 1A) [11]. For patient 1, there is no non-operative management strategy that would be within standards of care and they should undergo emergency surgery, whereas patient 2 should not undergo emergency surgery during the hospitalisation as long as their clinical condition improves with antibiotics. The difficulty in interpreting the results from this study are that both patients are considered to have equivalent underlying pathology due to lack of more granular clinical data. Use of instrumental variable analysis for population-level data may offer advantages when a randomised clinical trial is not feasible. However, in this case, heterogeneity in the conditions may lead to overly broad conclusions.

The authors are correct in that days alive and out of hospital seems equivalent between patients undergoing emergency surgery and those receiving non-emergency surgical treatment – but the discussion about 'effectiveness' of performing emergency surgery vs. not, particularly with the spectrum of conditions evaluated by the authors, is more nuanced than described. A better understanding of

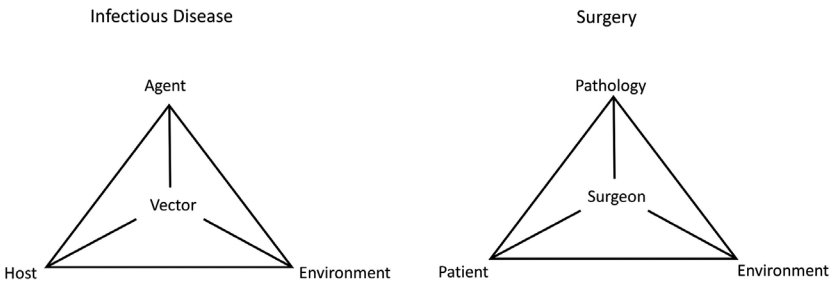

Figure 1 Epidemiological 'triads'.

the outcomes that matter most to patients, factors influencing the decision by patients and their healthcare teams to proceed with surgery and stratification of disease states will be important in any analysis designed to answer the research question. We look forward to their application of this elegant analysis in further work.

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