



## Editorial

### Health services research and anaesthesia

Health Services Research (HSR) is critically important to the development of anaesthesia as a specialty for three reasons: first, there is a paucity of high-quality clinical data against which to benchmark clinical practice; second, there are the limitations to the clinical measures available to us; and third, we must consider the often complex and confounded nature of the interventions that we seek to evaluate. This notion is not novel: a similar conclusion was recently reached by the UK Intensive Care Foundation, which identified HSR as one of three areas of strategic research focus [1]. In fact, the UK's Intensive Care National Audit & Research Centre (ICNARC: see <https://www.icnarc.org/>) is already a global leader in applying HSR to critical care.

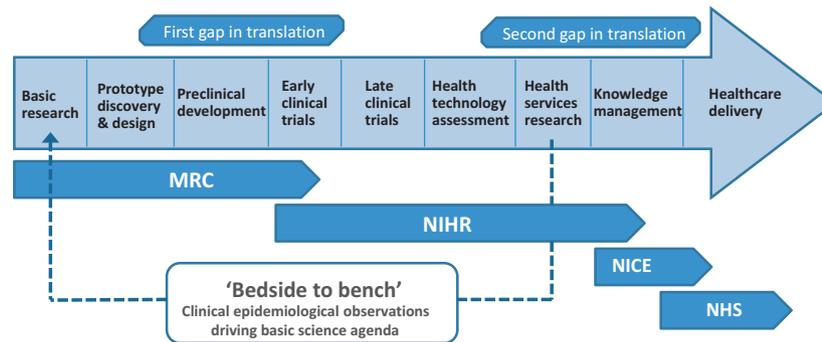
Anaesthesia is the largest hospital speciality within the National Health Service, and yet, arguably, our profession is served by the poorest quality data of any discipline. This is a remarkable paradox, given the time and effort invested by individual anaesthetists intensively recording individual patients' observations during anaesthesia. Sadly, in most cases these data immediately become practically unavailable for systematic evaluation. At the same time, the epidemiological data we need at a specialty level is of limited breadth

and depth, and difficult to access. By contrast with our surgical peers, who can call on data from a number of high-quality, condition-specific, national clinical audits such as the National Bowel Cancer Audit (see [www.ic.nhs.uk/bowel](http://www.ic.nhs.uk/bowel)) and National Hip Fracture Database (see <http://www.nhfd.co.uk/>), we have very little with which to benchmark care and outcome. Bluntly, we are more than 25 years behind the cardiothoracic surgeons, and we need to catch up fast. It is ironic that our specialty counts John Snow, the founding father of clinical epidemiology, amongst its alumni.

#### What is Health Services Research?

Health Services Research is the study of the provision of healthcare to the population. Unlike public health research or health economics research, HSR is focused on the institutions that provide healthcare and their services. It examines their processes and outcomes, harnessing economic, organisational, statistical and medical knowledge in order to evaluate scientifically the quality and efficiency of the healthcare service being provided. Health Services Research is the glue that should bind clinical practice to developments in basic medical science. As well as assessing the treatments that

have made it from the bench to the bedside, it should examine what is missing at the bedside in order to inform the bench. Ultimately, HSR is simply defined as research with the aim of improving patient outcomes at better cost. To clarify the relationship of HSR with other areas of research, we note that it conceptually encompasses 'classical' descriptive clinical epidemiology as well as research with a focus on the effectiveness of healthcare interventions, including late-stage clinical trials and health technology assessments. The boundary between HSR and what is now referred to as 'experimental medicine' (the patient end of the bench-to-bedside innovation pathway) is blurred (Fig. 1). However, whereas studies such as clinical trials may evaluate efficacy under ideal conditions, HSR more usually focuses on the effectiveness of the treatment within the complex real-world setting. This often means considering the impact of health systems factors beyond simple patient-intervention interactions. Characteristically, HSR evaluations are of complex innovations such as care pathways and organisational changes. This also means that the 'real' data are often retrospective and messy, in that the patient allocations are confounded – rather than the randomised and blinded studies that one would preferably



**Figure 1** The research-to-healthcare pathway. Darker blue arrow-boxes beneath the main pathway diagram indicate public sector bodies supporting development of the corresponding part of the pathway. MRC, Medical Research Council; NIHR, National Institute for Health Research; NICE, National Institute for Health and Clinical Excellence; NHS, National Health Service. Adapted from: Cooksey D. *A Review of UK Health Research Funding*. London: The Stationery Office, 2006.

design. It is a characteristic of HSR that studies may involve both mixed (quantitative and qualitative) and multiple methods. For example, a clinical trial of the introduction of a new care package in emergency surgery might involve semi-structured interviews with practitioners, consensus development through a Delphi process, implementation science, health economics and physiological measurement, as well as expertise in trial design and conduct from a clinical trials unit. The important point is that all evaluations of treatments and processes are viewed within the context of the healthcare system. Although the HSR label may be relatively new within the speciality of anaesthesia, the academic discipline of HSR is well established within our major universities and national funding streams, and HSR researchers have a significant impact on national healthcare policy. Recent landmark HSR publications relevant to anaesthetic practice include the evaluation of the WHO Surgical Safety Checklist by Atul Gawande's group [2], Shukri Khuri's report of the

relationship between short-term postoperative complications and long-term mortality [3] and Amir Ghaferi's 'failure to rescue' papers examining variation in hospital mortality following major surgery [4, 5]. Notable contributions in the UK context include Rupert Pearse's description of the high-risk surgical population in the UK [6], the risk-adjusted comparison of mortality rates after surgery between patients in the USA and the UK by Monty Mythen's group [7], and the recent publications of audit data from the Hip Fracture Perioperative Network [8] and the Emergency Laparotomy Network [9]. Studies evaluating the cost and 'profitability' of peri-operative care are of increasing interest in an environment where the NHS is under pressure to improve efficiency while maintaining safety and effectiveness [10, 11].

### High-quality data in anaesthesia

Large, high-quality datasets are the foundations on which much of HSR is built. Strictly, the systematic collection of data about healthcare

within databases, registries and audits is not a research activity: there is often no specific research question being addressed. However, the data obtained permit novel observations of clinical phenomena (e.g. the relationship between short-term and long-term outcomes) as well as providing important information on feasibility and design, e.g. for sample size calculations for interventional studies. As a consequence, HSR researchers are often central to the development and management of clinical audits. Some clinical audits have developed out of small observational studies; for example the ICNARC Case Mix Programme developed from the initial UK validation of a US-developed critical care scoring system [12, 13]. High-quality clinical audits incorporate descriptions of structure, process and outcome to provide a comprehensive picture of the impact of healthcare delivered to the patients. Within the UK, outcomes are currently classified according to the 'Darzi' domains of safety, effectiveness and experience [14]. Casemix adjustment is a vital

element of any analysis in order to account for the effect of variation in patient-specific input variables (e.g. age, comorbidities, socio-economic status) on output variables (clinical outcomes), and thereby separates out the effect of variation in delivered care. However, it is important to be aware that casemix adjustment may be imperfect due to the effect of residual confounding from unmeasured and unanticipated variables: a case of the 'known and unknown unknowns'.

The data within such audits are critically dependent on the quality of the clinical measures used. The types of measures available and the methods underlying the development and validation of such measures are beyond the scope of this article, but are covered in depth elsewhere [15]. Important characteristics to consider are reliability, validity and the burden imposed on data collectors. Some of these measures may also have utility in clinical practice. For example, Clinical Risk Prediction Rules (e.g. those including ASA physical status [16] or the Surgical Risk Scale [17]) may have dual utility in that they not only retrospectively provide casemix adjustment within a clinical audit, but also may prospectively characterise risk before surgery and thereby guide subsequent management and communication with patients. However, this dual role can introduce a paradox whereby the evaluation of a casemix adjustor may be confounded by the changes in practice induced by clinicians' knowledge of the measures: so-called 'confounding by indication' [18]. In anaesthesia, these clinical measures are in

their infancy: there are limitations in both the breadth and depth of coverage. We have major deficiencies in casemix/risk and outcomes measures in several areas of anaesthetic clinical practice and the development and validation of the measures to fill this unmet need are important research priorities within our profession.

So what will the collection and analysis of such data achieve? First, it will allow rational management of resource-intensive structures and processes that currently function in a relative information vacuum. Second, there is a substantial evidence base supporting the notion that, in and of itself, collecting data seems to improve outcome [19]. Third, such data provide a vital benchmarking resource to facilitate the identification of best processes and outcomes, thereby driving convergence towards best practice by all providers. Fourth, they provide the infrastructure to support both quality improvement initiatives and primary research, thereby driving progress in the development of new and better standards of care. Finally, and importantly, they provide high-quality information to patients and doctors, enabling shared decision making of the highest quality [20]. Such data allow the weighing of competing harms, for example the likelihood of short-term postoperative harm following elective aortic aneurysm repair weighed against the long-term likelihood of aneurysm rupture. Whilst such decisions are often framed as binary (death from surgery vs cancer survival), improved epidemiological data allow better

communication of the range of possible outcomes, including prolonged hospital stay and ongoing physical and mental impairment. Limitations in the epidemiological data describing anaesthetic practice are also linked to scepticism about the magnitude of harm following surgery. This scepticism is of concern because it is a commonly voiced reason for not innovating or adopting evidence-based interventions, e.g.: "I do not see that level of morbidity/mortality in our practice". The landmark publication of the European Surgical Outcomes Study (EuSOS) provides valuable data in this respect [21]. The UK was the largest contributor to EuSOS and enrolled around 50% of eligible patients during the recruitment week in April 2011. However, whilst these data are an invaluable resource, there is little substitute for ongoing systematic data collection within a national registry/audit.

## A Health Services Research Centre for Anaesthesia

The Royal College of Anaesthetists' (RCoA's) *A National Strategy for Academic Anaesthesia* ('Pandit Report') of 2005 led directly to the development of the National Institute of Academic Anesthesia (NIAA) [22]. The NIAA was constituted in order to develop the academic profile of anaesthesia nationally, to facilitate high-profile influential research and to support training and continuing professional education in academic anaesthesia (see <http://www.niaa.org.uk/>). The funding partners of the NIAA are the Association of Anaesthetists of

Great Britain and Ireland, the RCoA, the journals *Anaesthesia* and the *British Journal of Anaesthesia*, and the anaesthetic specialist societies (e.g. Difficult Airway Society).

Upon this foundation, the NIAA Health Services Research Centre (HSRC) was established to address the unmet need for coordinated HSR within anaesthesia (see <http://www.niaa-hsrc.org.uk/>). The HSRC remit encompasses anaesthesia, peri-operative medicine, pain and the anaesthetic subspecialties, but not critical care as ICNARC meets that need within the UK. The aims of the HSRC are to initiate and coordinate large clinical audits relevant to the practice of anaesthesia, to lead innovation in clinical measurement methods, and to facilitate and conduct research for patient benefit. Subsidiary aims include contributing to the training of HSR researchers within anaesthesia and helping to develop the portfolio of major UK clinical anaesthetic studies. We seek to achieve these goals through an open and collaborative model of working and welcome approaches from anyone with an HSR challenge or with an interest in becoming involved. Current HSRC projects include a programme of systematic reviews of risk and outcome measures, a national survey recording the use of such measures, and a working group to synthesise these inputs into recommendations for clinical departments. An early success has been the commissioning of the National Emergency Laparotomy Audit by the Health Quality Improvement Partnership (HQIP)

(see <http://www.hqip.org.uk/>), the result of a productive collaboration between the HSRC and the Emergency Laparotomy Network (see <http://www.networks.nhs.uk/laparotomy>). We are also collaborating with several groups on developing clinical trials. Finally, the HSRC has also taken on the oversight of the National Audit Projects (NAPs; see <http://www.nationalauditprojects.org.uk/>). The NAPs are distinct from the clinical audits in that they are discrete fixed-duration projects (rather than ongoing audits) focusing in general on the incidence and consequences of rare phenomena (e.g. accidental awareness under anaesthesia). The aim of the NAPs is to identify factors that can be used to improve patient care and they are usually conducted in partnership with the relevant specialist society. Future HSRC work may focus on evaluating the impact of NAP reporting in routine clinical practice, and developing strategies to improve and evaluate the implementation of NAP recommendations.

### The future

Perhaps the most renowned public health physician of the modern era is Avedis Donabedian, who first described the 'structure-process-outcome' model that is used to describe and evaluate the delivery of healthcare [23]. Despite his pivotal role in developing health services research, he also recognised the importance of individual clinician engagement in providing quality healthcare: *"Systems awareness and systems design are important for health professionals, but are not*

*enough. They are enabling mechanisms only. It is the ethical dimension of individuals that is essential to a system's success. Ultimately, the secret of quality is love."* It could be argued that anaesthesia as a profession has no shortage of ethics or love, but is limited by lack of systems development and evaluation. Looking forward, we should aspire to see comprehensive audit of peri-operative care, using reliable, validated and precise measures [24]. We will achieve this through a combination of anaesthetic-led audits focusing on peri-operative care (such as the National Emergency Laparotomy Audit) and the collation of relevant data from established condition- and procedure-specific audits (e.g. National Bowel Cancer Audit, National Adult Cardiac Surgery Audit (see <http://www.ucl.ac.uk/nicor/audits/Adultcardiacsurgery>)). We should use such data to benchmark all aspects of our practice against the very best achievable, nationally and internationally, and to drive quality improvement within our specialty. Finally, we need to use the tools of HSR to explore important research themes in anaesthesia and peri-operative medicine: defining more precisely the relationship between short- and long-term outcomes [3]; exploring the basis of 'failure to rescue' in the peri-operative context [4]; and understanding the pathophysiological basis of postoperative harm through better understanding the contributing risk factors and processes [25]. In this way, HSR can be a fundamental tool in our common aim: to improve the safety and effectiveness of care, and the

quality of experience we deliver to our patients.

## Acknowledgements

MPWG holds the British Oxygen Company Chair of Anaesthesia at the RCoA. MPWG is funded in part by the University Hospitals Southampton NHS Foundation Trust – University of Southampton Respiratory Biomedical Research Unit which received a portion of its funding from the UK Department of Health's National Institute of Health Research (NIHR) Biomedical Research Unit funding scheme. SRM is funded in part by the University College London Hospital–University College London Biomedical Research Centre which received a portion of its funding from the UK Department of Health's NIHR Biomedical Research Centre funding scheme.

## Competing interests

MPWG is Director and MJG Health Services Researcher, NIAA HSRC. MPWG, MJG and SRM serve on the Executive Board of the HSRC. MPWG and SRM serve on the Board and MPWG serves on the Research Council of the NIAA. MPWG and SRM have received funding from the NIHR, the NIAA and the Frances and Augustus Newman Foundation to conduct HSR. The views expressed are those of the authors and not necessarily those of the bodies named.

### M. P.W. Grocott

*Professor of Anaesthesia and Critical Care Medicine  
University of Southampton  
Southampton, UK  
Consultant in Critical Care Medicine*

*University Hospital Southampton  
NHS Foundation Trust  
Southampton, UK  
Director, NIAA Health Services  
Research Centre & BOC Professor of  
Anaesthesia  
Royal College of Anaesthetists  
London, UK*

*Email: mike.grocott@soton.ac.uk*

### M. J. Galsworthy

*Health Services Researcher  
NIAA Health Services Research  
Centre  
Royal College of Anaesthetists  
London, UK*

*Research Associate in Health  
Services Research  
UCL/UCLH Surgical Outcomes  
Research Centre (SOuRCe)  
Department of Applied Health  
Research  
University College London  
London, UK*

### S. R. Moonesinghe

*Director  
UCL/UCLH Surgical Outcome  
Research Centre (SOuRCe)  
Department of Applied Health  
Research  
University College London  
London, UK  
Consultant in Anaesthesia and  
Critical Care Medicine  
University College London Hospitals  
NHS Foundation Trust  
London, UK*

## References

- Ridley S. Intensive Care Foundation: update. *Journal of the Intensive Care Society* 2009; **10**: 316–7.
- Haynes AB, Weiser TG, Berry WR, et al. A surgical safety checklist to reduce morbidity and mortality in a global population. *New England Journal of Medicine* 2009; **360**: 491–9.
- Khuri SF, Henderson WG, DePalma RG, et al. Determinants of long-term survival after major surgery and the adverse effect of postoperative complications. *Annals of Surgery* 2005; **242**: 326–41.
- Ghaferi AA, Birkmeyer JD, Dimick JB. Variation in hospital mortality associated with inpatient surgery. *New Eng-*

*land Journal of Medicine* 2009; **361**: 1368–75.

- Ghaferi AA, Osborne NH, Birkmeyer JD, Dimick JB. Hospital characteristics associated with failure to rescue from complications after pancreatectomy. *Journal of the American College of Surgeons* 2010; **211**: 325–30.
- Pearse RM, Harrison DA, James P, et al. Identification and characterisation of the high-risk surgical population in the United Kingdom. *Critical Care* 2006; **10**: R81.
- Bennett-Guerrero E, Hyam JA, Shaefer S, et al. Comparison of P-POSSUM risk-adjusted mortality rates after surgery between patients in the USA and the UK. *British Journal of Surgery* 2003; **90**: 1593–8.
- White SM, Griffiths R, Holloway J, Shannon A. Anaesthesia for proximal femoral fracture in the UK: first report from the NHS Hip Fracture Anaesthesia Network. *Anaesthesia* 2010; **65**: 243–8.
- Saunders DI, Murray D, Pichel AC, Varley S, Peden CJ, on behalf of the members of the UK Emergency Laparotomy Network. Variations in mortality after emergency laparotomy: the first report of the UK Emergency Laparotomy Network. *British Journal of Anaesthesia* 2012; **109**: 368–75.
- Abbott T, White SM, Pandit JJ. Factors affecting the profitability of surgical procedures under Payment by Results. *Anaesthesia* 2011; **66**: 283–92.
- Shapter SL, Paul MJ, White SM. Incidence and estimated annual cost of emergency laparotomy in England: is there a major funding shortfall? *Anaesthesia* 2012; **67**: 474–8.
- Rowan KM, Kerr JH, Major E, McPherson K, Short A, Vessey MP. Intensive Care Societys APACHE II study in Britain and Ireland – I: variations in case mix of adult admissions to general intensive care units and impact on outcome. *British Medical Journal* 1993; **307**: 972–7.
- Rowan KM, Kerr JH, Major E, McPherson K, Short A, Vessey MP. Intensive Care Societys APACHE II study in Britain and Ireland– II: outcome comparisons of intensive care units after adjustment for case mix by the American APACHE II method. *British Medical Journal* 1993; **307**: 977–81.
- UK Department of Health. NHS Next Stage Review, June 2008. [http://www.dh.gov.uk/prod\\_consum\\_dh/groups/dh\\_digitalassets/@dh/@en/documents/digitalasset/dh\\_085828.pdf](http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/@dh/@en/documents/digitalasset/dh_085828.pdf) (accessed 29/08/2012).

15. Moonesinghe SR, Mythen MG, Grocott MP. High-risk surgery: epidemiology and outcomes. *Anesthesia and Analgesia* 2011; **112**: 891–901.
16. Dripps RD, Lamont A, Eckenhoff JE. The role of anesthesia in surgical mortality. *Journal of the American Medical Association* 1961; **178**: 261–6.
17. Sutton R, Bann S, Brooks M, Sarin S. The Surgical Risk Scale as an improved tool for risk-adjusted analysis in comparative surgical audit. *British Journal of Surgery* 2002; **89**: 763–8.
18. Grocott MP, Pearse RM. Prognostic studies of perioperative risk: robust methodology is needed. *British Journal of Anaesthesia* 2010; **105**: 243–5.
19. Khuri SF, Henderson WG, Daley J, et al. Successful implementation of the Department of Veterans Affairs National Surgical Quality Improvement Program in the private sector: the Patient Safety in Surgery study. *Annals of Surgery* 2008; **248**: 329–36.
20. Barry MJ, Edgman-Levitan S. Shared decision making – pinnacle of patient-centered care. *New England Journal of Medicine* 2012; **366**: 780–1.
21. Pearse RM, Moreno RP, Bauer P, Pelosi P, Metnitz P, Spies C, Vallet B, Vincent JL, Hoelt A, Rhodes A; European Surgical Outcomes Study (EuSOS) group for the Trials groups of the European Society of Intensive Care Medicine and the European Society of Anaesthesiology. *Lancet* 2012; **380**: 1059–65.
22. Pandit JJ. The national strategy for academic anaesthesia. A personal view on its implications for our specialty. *British Journal of Anaesthesia* 2006; **96**: 411–4.
23. Donabedian A. Evaluating the quality of medical care. *Milbank Memorial Fund Quarterly* 1966; **44**: 166–206.
24. Grocott MPW. Improving outcomes after surgery. *British Medical Journal* 2009; **339**: b5173.
25. Mythen M. Fit for surgery? *Anesthesia and Analgesia* 2011; **112**: 1002–4.