Review

Training and accrediting international surgeons

S. P. Stawicki[1], B. C. Nwomeh[3], G. L. Peck[5], Z. C. Sifri[6], M. Garg[2], J. V. Sakran[7], T. J. Papadimos[4], H. L. Anderson III[9], M. S. Firstenberg[10], V. H. Gracias[5] and J. A. Asensio[8,11], on behalf of the American College of Academic International Medicine Consensus Group on International Medical Programs

[1]Department of Surgery, St Luke's University Health Network, Bethlehem, and [2]Department of Emergency Medicine, Temple University School of Medicine, Philadelphia, Pennsylvania, [3]Department of Surgery, Nationwide Children's Hospital, Columbus, and [4]Department of Anesthesiology, College of Medicine and Life Sciences, University of Toledo, Toledo, Ohio, [5]Department of Surgery, Rutgers Robert Wood Johnson University Hospital, New Brunswick, and [6]Department of Surgery, Rutgers New Jersey Medical School, Newark, New Jersey, [7]Department of Surgery, Johns Hopkins University School of Medicine, Baltimore, and [8]Department of Surgery, Uniformed Services University of the Health Sciences, Bethesda, Maryland, [9]Department of Surgery, St Joseph Mercy Health System, Ann Arbor, Michigan, [10]Department of Cardiovascular and Thoracic Surgery, Medical Center of Aurora, Aurora, Colorado, and [11]Department of Surgery, Creighton University Medical Center, Omaha, Nebraska, USA

Correspondence to: Dr S. P. Stawicki, Department of Research and Innovation, St Luke's University Health Network, 801 Ostrum Street, Bethlehem, Pennsylvania 18015, USA (e-mail: stawicki.ace@gmail.com)

Background: **Formal international medical programmes (IMPs) represent an evolution away from traditional medical volunteerism, and are based on the foundation of bidirectional exchange of knowledge, experience and organizational expertise. The intent is to develop multidirectional collaborations and local capacity that is resilient in the face of limited resources. Training and accreditation of surgeons continues to be a challenge to IMPs, including the need for mutual recognition of competencies and professional certification.**

Methods: **MEDLINE, Embase and Google Scholar™ were searched using the following terms, alone and in combination: 'credentialing', 'education', 'global surgery', 'international medicine', 'international surgery' and 'training'. Secondary references cited by original sources were also included. The authors, all members of the American College of Academic International Medicine group, agreed advice on training and accreditation of international surgeons.**

Results and conclusion: **The following are key elements of training and accrediting international surgeons: basic framework built upon a bidirectional approach; consideration of both high-income and low- and middle-income country perspectives; sourcing funding from current sources based on existing IMPs and networks of IMPs; emphasis on predetermined cultural competencies and a common set of core surgical skills; a decentralized global system for verification and mutual recognition of medical training and certification. The global medical system of the future will require the assurance of high standards for surgical education, training and accreditation.**

Paper accepted 3 October 2018

Published online in Wiley Online Library (www.bjs.co.uk). **DOI:** 10.1002/bjs.11041

Introduction

Healthcare inequities persist around the globe, with critical need for the development of sustainable, long-term solutions for ensuring high-quality and self-sufficient local service delivery, governance, finance, workforce and a durable infrastructure[1]. Efforts involving Academic International Medicine (AIM) to address these needs have exposed important opportunities for improvement that academic institutions, administrative leadership and clinicians can use to prioritize the agenda for change[2]. The value of AIM to academic organizations has been difficult to quantify[3]. Consequently, the relationship between AIM clinicians and their institutions has been somewhat tenuous, requiring continuous dialogue, transparency and a focus on the development of tangible performance metrics[4]. Historical evidence shows limited effectiveness of short-term, one-way, medical missions, thus prompting new initiatives to emerge in which two-way multidisciplinary international medical programmes (IMPs) provide sustainable structural and functional support[5,6]. Within the IMP model, there exists an acute need for a universally accepted and interchangeable global system of provider education, training and accreditation[7]. Such a system, grounded in predefined core competency and curricular milestones, is within reach; however, implementation will require a great deal of goodwill by all participants and regulatory agencies. The aim of

this paper is to describe a logical framework for incremental implementation of an International Medical Training and Credentialling Network (IMTCN) that may serve as a foundation for a constructive dialogue and harmonization of IMP efforts around the globe.

The benefit of meeting half-way

The traditional model of collaboration between low- and middle-income countries (LMICs) and high-income countries (HICs) features an inherent resource gradient. Despite the advent of bidirectional agreements, these disparities are likely to persist, creating an ongoing challenge and potential barrier to mutual efforts. Similar arguments can be made about education, skills acquisition, verification and accreditation. Put simply, the wide variety of expectations at all levels, combined with lack of alignment around training requirements and educational competencies and accreditation, provides an opportunity for improvement. As two-way collaborations mature, it is clear that all stakeholders can benefit from mutually respectful, constructive and collaborative interactions that facilitate the delivery of optimal patient care, regardless of the setting.

The American College of Academic International Medicine (ACAIM)[8] supports the concept of a universal and standard process for training and accrediting international surgeons that is neutral and unbiased. The key is to define what is included in such a training and accreditation programme. Although a simplified, basic framework may seem restrictive to some, yet overly broad to others, it is nevertheless a starting point that could be agreed by multiple parties, and could be expanded later. The implementation of an IMTCN should be based on activities that are either ongoing or being piloted, and should use these efforts to catalyse the process of integration, consensus building and, ultimately, global adoption.

Simultaneous consideration of both LMIC and HIC perspectives is at the centre of an IMP-based two-way programme, and will be critical to the meeting half-way when shaping it. Subsequent sections of this review will discuss both LMIC and HIC perspectives in the optimization of education/training and accreditation of international surgeons.

The LMIC perspective

The discussion begins with the perspective of those parties that stand to be most affected by implementation of more structured IMPs. The arguments revolve around evaluation of advantages and disadvantages[9,10]. All too often, financial considerations and short-term political agendas introduce uncertainty into already complex and unique social-medical-economic equations[11]. This is compounded by the time and resources needed to accomplish necessary preparatory work and to set appropriate and feasible expectations[12]. The HIC–LMIC relationship is dynamic, characterized by constant evolution, including the desire for LMICs to grow and improve their infrastructure and workforce with the ultimate goal of reaching parity with HICs[13,14]. Thus, the bilateral relationship should be based on the principle that IMPs are designed to attain global healthcare parity by strengthening existing capacity in a sustainable, and eventually permanent, fashion.

Without adequate preparation, sustainable change can be difficult to implement. For example, the introduction of processes that took an entire generation of HIC physicians to accept and master, such as healthcare quality improvement or structured peer review, may be viewed as intrusive without setting up the proper context[15,16]. An important aspect of introducing new concepts is the need to identify and support physician-leaders who will serve as champions and change-agents in their institutions[17]. This may also be an effective approach to re-enlist LMIC healthcare professionals who have disengaged from clinical work[18,19].

Appropriate cultural and social training, preferably incorporating lectures and immersive approaches, is a key requirement for bilateral or multilateral team interactions[20]. The highly nuanced nature of different cultures, superimposed on the inflexible definitions of HICs or LMICs, may complicate preparation for discussion. The sensitive integration of IMPs should include a team approach, including anthropologists, sociologists, political scientists and other key stakeholders, with the goal of building mutual respect and understanding that will produce the readiness to learn from bilateral circumstances and experiences[20–22].

Surgeons must maintain patient safety standards that are comparable to those of their parent institutions and professional societies, ensuring that all team members practise within their scope of training. While trainees can be of significant value in enhancing access to care in low-resource areas, the service provided must represent adequate training and upholding of ethical standards[23]. The most pertinent ethical practices should align with the customs, culture and values of the host communities. Visiting health teams should understand that application of non-local norms may be inappropriate. International surgeons should offer a much broader range of expertise than traditionally employed, such as administration, policy-making, negotiation and research. Targeted solutions to long-term management of surgical

diseases, competency-based accreditation, innovation and technology solutions, and sustainable collaboration are priorities[15].

The HIC perspective

Although many issues will be different when viewed from the HIC perspective, some important commonalities remain. A major concern regarding two-way interactions within IMPs is the risk of brain drain. Although the consequences of emigration are greater for LMICs, surgeons from virtually every country can choose to emigrate for a variety of reasons. For example, the expressed intent to emigrate among medical students in certain HICs may actually be higher than typically seen among LMIC peers[24,25].

Reasons for physician migration are generally similar; they include opportunities for greater career satisfaction, recognition and, at times, financial compensation. Understandably, lack of career opportunities and poor physician compensation are more prevalent in LMICs, and these are the primary factors that must be mitigated[26]. A potential intervention could be to strengthen the healthcare systems through provision of material and non-material resources. Programmes that increase physician compensation and also provide non-monetary incentives (such as work–life balance, respect/responsiveness from leadership, presence of a collegial support network) have been shown to be effective in reducing emigration[27].

Beyond advocacy, a direct role for IMPs could be to support training, career development, physician satisfaction and innovation in LMICs. Approaches for addressing critical issues, such as physician satisfaction, must be evidence-based. Research is needed to identify strategies that help LMICs retain physicians to serve their populations and train others. Physicians from LMICs who emigrate to HICs often engage in organizing charitable donations, arranging medical missions, assisting with training, as well as helping develop clinical and research programmes[28,29]. IMPs are encouraged to include these physicians, who possess cultural and language skills, and reconnect them with the healthcare system of their country of origin.

There is a perceived lack of recognition of IMP-related academic efforts compared with similar efforts at a parent institution[4]. This can lead to gradual attrition of talented and experienced researchers, who become disillusioned with lack of acknowledgement of their efforts. Initiatives that facilitate accreditation and recognition among international surgeons are an important step. International IMP participants (and governments) should invest in developing talent, including active promotion of international surgery as a career path[28,30].

HIC-to-HIC and LMIC-to-LMIC exchanges: a forgotten opportunity?

In the HIC-centred model, the tremendous opportunity to learn from others may be missed. The IMP-based policy encourages multilateral interaction, regardless of resource-based considerations. For an optimized solution to emerge, the entire globe must be engaged and participate actively on an equal footing; change process must be independent of financial bias.

The existing approach can be improved through cooperative educational and development agreements (CEDAs). These can be time-based and delineate responsibilities of participants (such as expectations/deliverables). LMIC participants are aware of their needs for improvement in education and training, and are more likely to benefit from collaborative exchanges involving educational methods, products and concepts[31]. HICs have the means to develop educational programmes that they can share through web-based technologies[32]. Because both LMIC and HIC requirements for effective educational methodologies are similar in many respects, one way to bridge existing gaps is to promote joint development of solutions that can be shared across cloud-based/web platforms[33]. With incremental implementation of CEDAs, it will become evident that not only has the HIC–LMIC relationship devolved or become obsolete, but the dispersal of information may reverse to involve transfer of innovative ideas from LMIC to HIC, resulting in a balanced world for medical education[34].

Reverse innovation, where HIC participants learn from LMIC surgeons, is an important concept supported by the US National Institutes of Health, and reflects how far international collaboration has evolved[35,36]. In one recent example, interchangeability of operative experience and mentorship roles facilitated LMIC surgeons to proctor HIC surgeons in a way that satisfied accreditation requirements for both, while incorporating specific educational and competency-based objectives[37].

Another example is the Visiting Scholars and Research Fellowship Programme described by Asensio[38]. Designed to bring together selected senior residents or fellows from HICs and LMICs for 1–3 years, the programme uses clinical, didactic and research experiences to forge future academic surgeons from around the globe. One prerequisite for participation is a pledge to return to the participant's respective country as an academic, committed to improving patient care, within a strong frame of social conscience.

Most participants have indeed returned as academic surgeons to practise in local university hospitals.

Common threads

Participants from both HICs and LMICs in IMPs have the same goals: high-quality and safe care, for more people, that is readily accessible, affordable, timely and locally sourced. The assurance of recognition of faculty efforts from HICs should provide a stable platform for sustainability and development, while, at the same time, similar resources should be dedicated to reducing physician emigration. Training and accreditation processes should involve input from all stakeholders, with focus on integrated and collaborative approaches[39]. The stakeholders need to identify health disparities; create and implement policies to promote, maintain and improve health outcomes; distribute resources to address inequities; and re-evaluate team efforts, progress and impacts. All members of the global community should be sensitive to these issues, and identify the resources and expertise needed to contribute[40]. Using these key principles, it should be possible for international surgeons to design and implement mechanisms for accreditation.

Framework for training and accreditation of international surgeons

The training of surgeons to work in low-resource settings requires investment in people and local relationships. As the infrastructure develops, and visiting faculty begin to understand the culture and patterns of care, they can become active participants. To achieve the intended impact, and maintain the highest quality of care, participants should be board-certified and appropriately accredited. There should be mutual recognition of accreditation awarded by local, regional and national authorities. A formal approach will ensure that participating trainees are informed, assessed and supervised[41].

International accreditation is a complicated process; different jurisdictions have inherently variable expectations of training and competency. Bilateral accreditation relationships between individual IMP institutional participants need to be constructed. Only after a sufficient number of connections has developed can the international surgical community align and further refine the various core competencies that will become foundational components.

The World Bank has published a summary of the global burden of disease in the third edition of *Disease Control Priorities*[42]. Within this greater work, *Volume 1: Essential Surgery* features a listing of surgical disorders from around the world, ranked according to the societal burden and the ability of surgery to provide effective and economical treatment[42]. In the context of LMICs, this includes an analysis of conditions under which certain surgical procedures (for example inguinal hernia repair) yield the greatest benefit. Although the discussion of operative experience requirements is beyond the scope of this article, it is important to recognize a small number of immutable competencies that will be required by any surgical provider, regardless of the setting or resource availability (*Table 1*). This proposed list could be expanded and widened across a range of bilateral and multilateral IMP-based collaborations.

Table 1 Suggested set of added competencies for accrediting international surgeons

Have valid board certification in surgery and a local medical licence to practise
Obtain additional training for surgeries one does not see or perform routinely
Learn about the local healthcare system
Be familiar with the local medical–legal system (obtain coverage if applicable)
Understand the ethical principles related to working in a low- (or high-) resource environment
Learn about the local disease burden and complete a surgical needs assessment (if applicable)
Be familiar with the strengths and limitations of local health delivery and hospital infrastructure and processes
Build global/public health and surgical systems literacy related to international/global surgery
Be familiar with local cultural customs and language

Training and accreditation of international surgeons must begin with well rounded general surgical education, attaining key competencies as outlined by appropriate regional/national graduate medical education authorities[43–45]. Beyond the above-referenced non-procedural competencies, certain procedural considerations must be observed by IMPs during the process of determining suitability for independent practice across a broad range of operative procedures. Many of these may be out of the comfort zone for a typical HIC-trained surgeon (*Table 2*). Specific training can be provided to ensure that the surgeons have the required procedural skills, which can be facilitated at either the home institution, the IMP or the hosting institution[16,46–49]. Once proficiency is determined, a record of acquired skills, as well as any maintenance-of-certification activities, should be available for anyone to view and verify[13,16,46–52].

One method of facilitating a universal global system of provider accreditation is to use the consensus-based, open-source, blockchain technology[53]. This allows permanent storage of relevant accreditation data and

Table 2 Suggested surgical skills for accrediting international surgeons*

Elective cases
Abdominal/inguinal hernia repair (with and without mesh)
Hydrocelectomy
Hysterectomy (e.g. bleeding fibroid)
Open cholecystectomy (including common bile duct procedures)
Basic laparoscopy (resources permitting)
Breast surgery (procedural spectrum from biopsy to mastectomy)
Trauma surgery
Completion of Advanced Trauma Life Support Curriculum
Stabilization of closed and open fractures (e.g. external fixation device, possibly internal fixation device placement)
Burr hole, potentially simple craniotomy
Splenectomy and liver repair, including haemostatic techniques
Fasciotomy, split-thickness skin grafting
Basic procedural vascular access/control approaches
Emergency airway placement
Burns care, including escharotomy, excision, skin grafting and subsequent follow-up
Obstetric surgery
Caesarean section
Basic obstetric and gynaecological procedures (e.g. episiotomy, oophorectomy, management of ectopic pregnancy, pelvic tumour debulking, fistula management)
Management of peripartum haemorrhage
Emergency surgery
Open appendicectomy
Incision and drainage
Management of small/large bowel perforation (infectious and non-infectious, including ostomy placement)
Management of bowel obstruction (including incarcerated hernia)
Peptic ulcer disease with perforation
Hand-sewn bowel anastomosis
Suprapubic tube placement (for urinary obstruction)
Tube thoracostomy (for drainage of pneumothorax, haemothorax or empyema)
Miscellaneous
Basic paediatric procedures (applicable to settings without paediatric surgeon coverage)
Surgical approaches to thorax and mediastinum
Surgical approaches to common head/neck problems (e.g. thyroid nodules, goitre)
Basic endoscopy (primarily diagnostic, limited therapeutic applications)
Extremity amputations and subsequent management
Skin and soft tissue conditions (from laceration repair to excision of skin lesions)
Percutaneous drainage procedures (including ultrasound-guided aspiration and drainage catheter placement)
Wound debridement and subsequent management

*These are intended to supplement existing surgical training and regional board certification requirements, with focus on the core competencies most relevant across diverse geographical and resource settings. Note: The recent trend towards subspecialization creates important gaps in procedural skills and providers. Structured programmes intended to restore proficiency across key procedural areas may be needed to ensure the uniform presence of required knowledge and skills.

structured additions to each surgeon's record, as well as stakeholder-controlled access to information based on unique encryption access. Current blockchain technology, especially when augmented with additional protection features, is extremely secure. Because blockchain technology is not proprietary, its implementation would be affordable across all participating locations and providers, and could be linked to other applications (for instance faculty/trainee activity trackers, performance evaluations and basic global electronic medical record)[53].

Conclusion

International surgery is integral to long-term success and sustainability of IMPs. The authors recognize that unique knowledge, skills, beliefs and attitudes are required within current two-way international surgical engagement. It is therefore proposed that acquisition of predefined skills must be incorporated into existing education and training programmes, that appropriate competency-based accreditation should be introduced, and that multilateral agreements be formalized, building on existing IMP programmes and pilot initiatives. Accreditation of international surgeons should be backed by secure global technology that will offer encryption-based, unique key-enabled sharing of information between providers and institutions. Finally, ACAIM believes that efforts to train and accredit international surgeons should serve the ultimate purpose of developing, implementing and evaluating sustainable programmes that lead to global healthcare parity.

Acknowledgements

The authors acknowledge the following individuals who participated in this work in the capacity of non-author contributors, and thank them for support, expertise, wisdom and inspiration: B. Arquilla (Brooklyn, New York), C. Bloem (Brooklyn, New York), D. C. Evans (Columbus, Ohio), S. C. Galwankar (Jacksonville, Florida), W. A. Guo (Buffalo, New York), C. L. Ramirez (Bethlehem, Pennsylvania), R. L. Ricca Jr (Norfolk, Virginia), R. P. Sharpe (Phillipsburg, New Jersey), S. Soghoian (New York), M. Swaroop (Chicago, Illinois), F. S. Yanagawa (Phillipsburg, New Jersey).

Disclosure: The authors declare no conflict of interest.

References

1 Meara JG, Leather AJ, Hagander L, Alkire BC, Alonso N, Ameh EA *et al.* Global Surgery 2030: evidence and solutions for achieving health, welfare, and economic development. *Lancet* 2015; **386**: 569–624.

2 Fallah PN, Bernstein M. Barriers to participation in global surgery academic collaborations, and possible solutions: a qualitative study. *J Neurosurg* 2018; **6**: 1–9.
3 Rickard J, Onwuka E, Joseph S, Ozgediz D, Krishnaswami S, Oyetunji TA *et al.*; Academic Global Surgery Taskforce. Value of global surgical activities for US Academic Health Centers: a position paper by the Association for Academic Surgery Global Affairs Committee, Society of University Surgeons Committee on Global Academic Surgery, and American College of Surgeons' Operation Giving Back. *J Am Coll Surg* 2018; **227**: 455–466.e6.
4 Peck GL, Garg M, Arquilla B, Gracias VH, Anderson III HL, Miller AC *et al.*; ACAIM Consensus Group on International Medical Programs. The American College of Academic International Medicine 2017 Consensus Statement on International Medical Programs: establishing a system of objective valuation and quantitative metrics to facilitate the recognition and incorporation of academic international medical efforts into existing promotion and tenure paradigms. *Int J Crit Illn Inj Sci* 2017; **7**: 201–211.
5 Garg M, Peck GL, Arquilla B, Miller AC, Soghoian SE, Anderson III HL *et al.*; ACAIM Consensus Group on International Medical Programs. A comprehensive framework for international medical programs: a 2017 consensus statement from the American College of Academic International Medicine. *Int J Crit Illn Inj Sci* 2017; **7**: 188–200.
6 Sykes KJ. Short-term medical service trips: a systematic review of the evidence. *Am J Public Health* 2014; **104**: e38–e48.
7 Krishnaswami S, Stephens CQ, Yang GP, Nwomeh BC, Swaroop M, Nadler EP *et al.* An academic career in global surgery: a position paper from the Society of University Surgeons Committee on Academic Global Surgery. *Surgery* 2018; **163**: 954–960.
8 ACAIM. *The American College of Academic International Medicine*; 2018. http://www.acaim.org [accessed 3 September 2018].
9 Green T, Green H, Scandlyn J, Kestler A. Perceptions of short-term medical volunteer work: a qualitative study in Guatemala. *Global Health* 2009; **5**: 4.
10 Nthumba PM. 'Blitz surgery': redefining surgical needs, training, and practice in sub-Saharan Africa. *World J Surg* 2010; **34**: 433–437.
11 Shawar YR, Shiffman J, Spiegel DA. Generation of political priority for global surgery: a qualitative policy analysis. *Lancet Glob Health* 2015; **3**: e487–e495.
12 Wall AE. Ethics in global surgery. *World J Surg* 2014; **38**: 1574–1580.
13 deVries CR, Price RR. *Global Surgery and Public Health: a New Paradigm*. Jones and Bartlett: Sudbury, 2012.
14 Stöhr W, Taylor DRF (eds). *Development From Above or Below? The Dialectics of Regional Planning in Developing Countries*. John Wiley: New York, 1981.
15 Roy N. Global surgery: a view from the south. *J Pediatr Surg* 2017; **52**: 203–206.
16 Mock CN, Donkor P, Gawande A, Jamison DT, Kruk ME, Debas HT, DCP3 Essential Surgery Author Group. Essential surgery: key messages from *Disease Control Priorities*, 3rd edition. *Lancet* 2015; **385**: 2209–2219.
17 Tolentino JC, Martins N, Dweeney J, Maarchionni C, Valenza P, McGinely TC *et al.* Introductory chapter: developing patient safety champions. In *Vignettes in Patient Safety* (Vol. 2), Firstenberg MS, Stawicki SP (eds). InTech: Chicago, 2018; 1–23.
18 Ozgediz D, Kijjambu S, Galukande M, Dubowitz G, Mabweijano J, Mijumbi C *et al.* Africa's neglected surgical workforce crisis. *Lancet* 2008; **371**: 627–628.
19 Luboga S, Hagopian A, Ndiku J, Bancroft E, McQuide P. Satisfaction, motivation, and intent to stay among Ugandan physicians: a survey from 18 national hospitals. *Int J Health Plann Manage* 2011; **26**: 2–17.
20 Campbell A, Sullivan M, Sherman R, Magee WP. The medical mission and modern cultural competency training. *J Am Coll Surg* 2011; **212**: 124–129.
21 Ott BB, Olson RM. Ethical issues of medical missions: the clinicians' view. *HEC Forum* 2011; **23**: 105–113.
22 Martiniuk AL, Manouchehrian M, Negin JA, Zwi AB. Brain gains: a literature review of medical missions to low and middle-income countries. *BMC Health Serv Res* 2012; **12**: 134.
23 Ferrada P, Sakran JV, Dubose J, Vergis A, Peck G, Alseidi A *et al.* Above and beyond: a primer for young surgeons interested in global surgery. *Bull Am Coll Surg* 2017; **102**: 33–38.
24 Gouda P, Kitt K, Evans DS, Goggin D, McGrath D, Last J *et al.* Ireland's medical brain drain: migration intentions of Irish medical students. *Hum Resour Health* 2015; **13**: 11.
25 Hossain N, Shah N, Shah T, Lateef SB. Physicians' migration: perceptions of Pakistani medical students. *J Coll Physicians Surg Pak* 2016; **26**: 696–701.
26 Krishnaswami S, Nwomeh BC, Ameh EA. The pediatric surgery workforce in low- and middle-income countries: problems and priorities. *Semin Pediatr Surg* 2016; **25**: 32–42.
27 Okeke EN. Do higher salaries lower physician migration? *Health Policy Plan* 2014; **29**: 603–614.
28 Wernick B, Wojda TR, Wallner A, Yanagawa F, Firstenberg MS, Papadimos TJ *et al.* Brain drain in academic medicine: dealing with personnel departures and loss of talent. *Int J Acad Med* 2016; **2**: 68–77.
29 Nwadiuko J, James K, Switzer GE, Stern J. Giving Back: a mixed methods study of the contributions of US-based Nigerian physicians to home country health systems. *Global Health* 2016; **12**: 33.
30 Pang T, Lansang MA, Haines A. Brain drain and health professionals. *BMJ* 2002; **324**: 499–500.
31 Hall CS, Fottrell E, Wilkinson S, Byass P. Assessing the impact of mHealth interventions in low- and middle-income countries – what has been shown to work? *Glob Health Action* 2014; **7**: 25606.

32 Sultan N. Making use of cloud computing for healthcare provision: opportunities and challenges. *Int J Inform Manag* 2014; **34**: 177–184.

33 Shanahan H, Harrison A, May ST. Teaching data science and cloud computing in low and middle income countries. *Adv Tech Biol Med* 2015; **3**: 150.

34 Darling-Hammond L. *The Flat World and Education: How America's Commitment to Equity will Determine our Future*. Teachers College Press: New York, 2015.

35 Govindarajan V, Ramamurti R. Reverse innovation, emerging markets, and global strategy. *Global Strategy Journal* 2011; **1**: 191–205.

36 DePasse JW, Lee PT. A model for 'reverse innovation' in health care. *Global Health* 2013; **9**: 40.

37 Blitzer DN, Scott EM, Schroeder M, Gupta R, Gracias VH, Ordonez C *et al.* Competency-based goals and objectives for global surgery and injury burden education. *Am Surg* 2018; **84**: 457–460.

38 Asensio JA. Visiting Scholars/Research Fellowship Program: an Institutional Experierience. *Panamerican Trauma Society Meeting*. Cartagena: Colombia, 1996.

39 Vasan A, Hudelson CE, Greenberg SL, Ellner AE. An integrated approach to surgery and primary care systems strengthening in low- and middle-income countries: building a platform to deliver across the spectrum of disease. *Surgery* 2015; **157**: 965–970.

40 Braveman P, Arkin E, Orleans T, Proctor D, Plough A. *What is Health Equity?*; 2017. https://www.rwjf.org/en/library/research/2017/05/what-is-health-equity-.html [accessed 30 August 2018].

41 Sakran JV, Kaafarani HM, Prabhakaran S, Nitzschke S, Casey K. Enhancing American surgical training: meeting the challenge of a globalizing world. *Bull Am Coll Surg* 2012; **97**: 20–26.

42 Debas HT, Donkor P, Gawande A, Jamison DT, Kruk ME, Mock CN (eds). In *Disease Control Priorities. Volume 1: Essential Surgery* (3rd edn). World Bank: Washington, 2015.

43 Mery CM, Greenberg JA, Patel A, Jaik NP. Teaching and assessing the ACGME competencies in surgical residency. *Bull Am Coll Surg* 2008; **93**: 39–47.

44 Batalden P, Leach D, Swing S, Dreyfus H, Dreyfus S. General competencies and accreditation in graduate medical education. *Health Aff (Millwood)* 2002; **21**: 103–111.

45 Dumon KR, Traynor O, Broos P, Gruwez JA, Darzi AW, Williams NN. Surgical education in the new millennium: the European perspective. *Surg Clin North Am* 2004; **84**: 1471–1491.

46 Wong EG, Trelles M, Dominguez L, Gupta S, Burnham G, Kushner AL. Surgical skills needed for humanitarian missions in resource-limited settings: common operative procedures performed at Médecins Sans Frontières facilities. *Surgery* 2014; **156**: 642–649.

47 Cipriano A, Hoey BA, Stawicki SP, Sharpe RP. International rotation for the 4th-year surgical residents: productive, nondisruptive, and a residency recruitment tool. *Int J Acad Med* 2017; **3**: 295–324.

48 Ginwalla RF, Rustin RB. The 'global surgeon': is it time for modifications in the American surgical training paradigm? *J Surg Educ* 2015; **72**: e100–e103.

49 Chao TE, Mandigo M, Opoku-Anane J, Maine R. Systematic review of laparoscopic surgery in low- and middle-income countries: benefits, challenges, and strategies. *Surg Endosc* 2016; **30**: 1–10.

50 Stanford Medicine. *International Humanitarian Aid Skills Course*; 2018. https://med.stanford.edu/cme/courses/2017/ihum.html [accessed 30 August 2018].

51 Meara JG, McClain CD, Rogers SO Jr, Mooney DP (eds). *Global Surgery and Anesthesia Manual: Providing Care in Resource-Limited Settings*. CRC Press: Boca Raton, 2014.

52 Swaroop M, Krishnaswami S (eds). *Academic Global Surgery*. Springer: Cham, 2015.

53 Stawicki SP, Firstenberg MS, Papadimos TJ. What's new in academic medicine? Blockchain technology in health-care: bigger, better, fairer, faster, and leaner. *Int J Acad Med* 2018; **4**: 1.