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# **Decolonizing Global Surgery**

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**Abstracts**

**Overcoming barriers to pediatric trauma education in low- and middle-income countries.** *Fabio Botelho, Karen Gripp, Natalie Yanchar, Abbie Naus, Dan Poenaru, Robert Baird.* From the Cirurgia Pediátrica, Universidade Federal de Minas Gerais, Minas Gerais, Brazil (Botelho); the Harvey E. Beardmore Division of Pediatric Surgery, Montreal Children's Hospital, Montréal, Canada (Botelho, Poenaru); the Department of Pediatrics, University of Manitoba, Winnipeg, Canada (Gripp); Pediatric General Surgery, Alberta Children's Hospital, Calgary, Canada (Yanchar); the Program in Global Surgery and Social Change, Harvard Medical School, Boston, USA (Naus); the Division of Pediatric Surgery, British Columbia Children's Hospital, Vancouver, Canada (Baird).

**Background:** Trauma remains a leading cause of child mortality and disability worldwide, taking the lives of 1 million children annually. Of all deaths from pediatric trauma, 95% occur in low- and middle-income countries (LMICs). To improve quality of care, the Royal College of Physicians and Surgeons of Canada has developed and validated the Trauma Resuscitation in Kids (TRIK) course. While initially designed for North American settings, TRIK has potential for global educational utility, yet the costs of required adaptation and international instructor training impede its globalization. Our objective was to describe the process of designing a feasible and sustainable global training course for pediatric trauma, using a limited budget and respecting key ethical principles. **Methods:** Stakeholders from high-income countries and LMICs were assembled to pilot a TRIK course in Brazil, designed using a nominal group technique. Cost-effectiveness analysis was undertaken, comparing virtual and in-person instructor training options. **Results:** Three main phases were considered essential for this TRIK course: (1) selection and training of Brazilian champions as instructors to maintain the course, (2) course adaptation to local trauma epidemiology and resources, and (3) accurate translation of all material. Estimated instructor training budgets were CAD \$5800 using an in-person modality and CAD \$1800 using virtual training. **Conclusion:** Adaptation of a training course to a lower-income country presents several challenges. Our panel of experts identified key steps for an effective Brazilian course adaptation: involvement of local experts, adaptation to local context and resources while maintaining overall course effectiveness, and translation of course materials. In view of the cost barriers to broader globalization, virtual training of local champions may be a feasible option to cost-effectively increase the number of local course instructors. Equitable training adapted to local provider-directed needs is crucial to addressing disparities in pediatric trauma care worldwide while promoting the decolonization of global health.

**Taskforce on minor dermatological surgeries: an experience in a small Brazilian city.** *Eliane Reis, Leonildo Farias, Ana Gabriely Silva, Francisco Viana, José Armando Pessoa Neto, Sidney Silva.* From the Aquiraz Municipal Health Department, Aquiraz, Brazil (Reis, Farias, S. Silva) and Fortaleza, Brazil (A.G. Silva, Viana, Armando), Brazil.

**Background:** The Unified Health System (SUS) in Brazil is known for its free and universal access. People living in rural or indigenous communities in Aquiraz, a small city in northeastern

Brazil, who needed less complex dermatological surgical procedures faced difficulties in accessing the service owing to the centralization of care in a single medium-sized hospital in the region, which led to the formation of a waiting list of 300 people. With the COVID-19 pandemic, elective procedures were suspended, increasing this queue. In this context, a multidisciplinary team was created and travelled to the health units in these communities and adapted the place to carry out the procedures to meet this demand. We aimed to analyze the effectiveness of an accessibility strategy for the population of a small city in the Brazilian northeast regarding the performance of minor dermatologic procedures, within the scope of primary health care through the SUS. **Methods:** We conducted a retrospective analysis of minor surgeries performed between February and December 2021 in a Brazilian municipality through primary health care. We included SUS users referred for elective procedures. We excluded those with injuries that required another level of health care (secondary or tertiary). Lesions suspected of malignancy were referred for biopsy. Results suggestive of atypia or neoplasia were referred to specialized care. **Results:** We analyzed 901 procedures, of which approximately 200 samples required investigation by biopsy, and about 50 exhibited atypia or malignancy. Most of the patients performed work activities with high sun exposure, like fishing and farming. The queue for procedures has cleared. **Conclusion:** The proposal proved to be resolute owing to the greater access of rural and indigenous users to minor dermatologic procedures because of the migratory nature of the initiative. Furthermore, the initiative made it possible to prevent diseases through early diagnosis and access to specialized care.

**Vasospasm and delayed cerebral ischemia management after subarachnoid hemorrhage in an underdeveloped country: Hustle or nightmare?** *Karen Ribeiro, Luana Gatto.* From the School of Medicine, Federal University of Paraná, Curitiba, Brazil (Ribeiro); the Department of Neurosurgery, Cajuru University Hospital, Curitiba, Brazil (Gatto).

**Background:** Vasospasm occurs in up to 40% of aneurysmal subarachnoid hemorrhage (aSAH) cases, leading to delayed cerebral ischemia (DCI) in almost 30% of these episodes. Still, in underdeveloped countries, there is no consensual approach to its diagnosis, interventions and treatment, mostly because of the lack of resources. Our objectives were to compare the techniques employed in vasospasm management in both developed and underdeveloped countries, seeking for differences in treatments and their respective outcomes. **Methods:** We performed a comprehensive literature review using MEDLINE and SciELO databases. Data on locally widespread techniques were collected in a tertiary hospital of a city in the south of Brazil with 2 million inhabitants. **Results:** Although the most specific diagnosis method for DCI is based on clinical symptomatology, digital subtraction angiography (DSA) and transcranial Doppler (TCD) have been widely used and recommended. DSA is considered the gold standard; however, TCD is regarded as highly specific and sensitive for observing the middle cerebral and internal carotid arteries. Whether having a clinical or imaging diagnosis, both DCI prophylaxis and treatment are based on a potent calcium channel blocker, nimodipine (high

quality of evidence, strong recommendation). However, in Brazil, there is no such endovenous medication, leaving treatment options to oral nimodipine, surgical interventions and hypertensive drugs only. Also, the public health insurance does not cover TCD monitoring, narrowing the chances of adequate diagnosis and therapeutic procedures. **Conclusion:** In an underdeveloped country, low financial and technological resources impact doctors' and patients' daily lives. However, new, low-cost solutions can arise. More investment is needed in research toward budgetary and scientific accessibility.

**Regional disparities in access and death rate of exploratory laparotomy in Brazil.** *Matheus Daniel Faleiro, Miguel Godeiro Fernandez, Lucas Sousa Salgado.* **From the International Students Surgical Network (InciSioN), Brazil (Faleiro, Fernandez, Salgado).**

**Background:** Exploratory laparotomy is a Bellwether procedure — operations that have been identified as indicators of a health care system's efficiency to provide essential and emergency surgical care. The aim of this study was to evaluate regional differences in access and death rates for exploratory laparotomy among the 5 geographical regions of Brazil. **Methods:** Data about the number of procedures and in-hospital perioperative mortality between 2008 and 2021 were collected from the national database of the Brazilian public health system (DATASUS). Statistical analyses were performed using 1-way analysis of variance (ANOVA), followed by the Tukey post hoc test. **Results:** In all, 559033 procedures were registered in the study period. Regarding the number of procedures, all regions showed significant differences, except when comparing the north with the central-west region. The southeast region, the most economically developed region of the country, accounted for 35% of exploratory laparotomies and had the highest amount of procedures in the whole study period owing to the presence of referral centres. In contrast, the central-west and north regions each accounted for only 10% of procedures. Concerning the death rate, all regions showed significant differences, except when comparing the northeast with the central-west region. As expected, the southeast region had the highest (14.52%) and the north had the lowest (6.7%) death rate. However, when comparing the number of deaths with the progression of procedures across time, discrepancies were noted. The mean amount of procedures related to the north region surpassed that of the central-west in 2015 ( $p < 0.001$ ), even though the death rate in the central-west remained higher throughout the whole study period. **Conclusion:** Access to exploratory laparotomy is essential for ensuring global surgery principles. To reduce regional disparities, referral centres must be better distributed across the country, promoting equal access to all citizens in need of exploratory laparotomy.

**The access of the riverside population in the Amazon region to emergency health care: a narrative review.** *Natália Zaneti Sampaio, Matheus Daniel Faleiro, Anna Luiza Mendes, Rodrigo Vaz Ferreira.* **From the Department of Surgery, State University of Amazonas, Manaus, Brazil; and International Students Surgical Network (InciSioN), Araraquara, Brazil (Sampaio), Belo Horizonte, Brazil (Faleiro, Mendes) and Manaus, Brazil (Ferreira).**

**Background:** The riverside dwellers are a marginal population that lives around the Amazon River in Brazil. They go through many barriers in order to access emergency health care services, and overcoming those barriers is essential to promote equal access to emergency care for all Brazilian citizens. The purpose of this narrative review was to examine and summarize studies about the barriers that riverside populations in the Amazon region have to access emergency health care services. **Methods:** Based on the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA-ScR), we performed a comprehensive search in April 2022 through PubMed, BVS, ScienceDirect, SciELO and Cochrane, using the following keywords: “riverside dwellers,” “Amazon,” and “emergency care.” **Results:** The access to emergency care for riverside dwellers is limited, especially by geographical barriers. In Amazonas, 100% of intensive care unit beds, 97.7% of urgent and emergent care centres, and 76.1% of medical professionals are concentrated in the state's capital, Manaus. To access these services, 54.9% of the riverside population use small wooden boats. For example, the riverside citizens of Manaués sail an average of 60 km in 4.2 h to receive emergency care. The use of speedboats as ambulances is common, but there are not enough of them. Furthermore, there are many programs for improving the health care access of this population, but it needs to be amplified. With no sanitation, parasitosis affects 94.5% of this population. Also, when seeking care, the riverside dwellers don't differentiate between types of care, such as urgent/emergent care or obstetrical services, which causes an overload of the system. **Conclusion:** The main barriers to accessing health care among riverside dwellers are the transport; lack of specialized professionals; and weaknesses in assistance, supplies and educational actions. Overcoming these barriers is essential to promote equal access to emergency care for all Brazilian citizens.

**Peas: from Mendel's table to the surgical field.** *Luiz Marcião, Gabriel Canto, José Borges, Victor Araújo, Gabrielly Andrade, Joyce Braga, Lívia Bentes, Luís Pinto.* **From the Laboratory of Experimental Surgery at the University of the State of Pará, Belém, Brazil (Marcião, Canto, Borges, Araújo, Andrade, Braga, Bentes, Pinto).**

**Background:** Microsurgery is an increasingly important area of medicine. With the tendency to perform less invasive surgeries, several of these, previously performed in a conventional way, have been adapted to the microsurgical model. For this, it is necessary to create training models, so that the effectiveness of these surgeries can be increased. Our objective was to develop a microsurgery training model using peas. **Methods:** Peas from a 500g package were exposed over a surgical field. A 6 mm incision was made in their outer membrane using a video magnification system developed by the laboratory (Sony Handycam HDR-XR160 camera connected to a 55' Full HD Curve TV through an HDMI cable). Using the same magnification system, the incision was sutured with a 10-0 monofilament nylon thread. Four equidistant stitches were placed by residents in hand surgery using a set of microsurgical materials. The parameters analyzed included the costs and time taken for preparing the model and for finishing the simulation, the difficulty in suturing and the learning curve. Collected data were organized in Microsoft Word 2016 and Microsoft Excel 2016 software. **Results:** The value spent on making each

simulator was CAD \$10.01, the average time for getting the model ready for the simulation was  $30 \pm 7$  seconds, and the time taken for finishing the suture was 4 minutes 31 seconds  $\pm 48$  seconds, with each stitch taking 1 minute 7 seconds  $\pm 13$  seconds. The success rate of the stitches was  $76\% \pm 5\%$  on the first try, with an improvement of  $6\% \pm 4\%$  after 4 training sessions. **Conclusion:** With its low cost and easy access, the simulator is affordable, reliable and effective, based on its results and steep learning curve.

**The utility of low-cost negative pressure wound therapy in Cameroon.** *Henry T. Ndasi, Labin M. Amlani, Gbislain Aminake, Xavier Penda, Serge Tima, Aron Lechtig, Kiran J. Agarwal-Harding.* From the Harvard Global Orthopaedics Collaborative, Baltimore, USA (Amlani) and Boston, USA (Lechtig, Agarwal-Harding); and the Baptist Hospital Mutengene, Cameroon (Ndasi, Aminake, Penda, Tima).

**Background:** The burden of musculoskeletal injuries is increasing in low- and middle-income countries like Cameroon. Negative pressure wound therapy (NPWT) is an effective adjuvant treatment method to manage wounds and open fractures. In Cameroon, the high cost and unavailability of NPWT prevents its widespread use. We sought to evaluate the feasibility and efficacy of a low-cost NPWT device — VATARA (Vacuum-Assisted wound Therapy Affordable foR All) — in Cameroon. **Methods:** We performed a prospective case series including all patients with musculoskeletal injuries managed with VATARA at Baptist Hospital Mutengene, Cameroon, from Mar. 15, 2021, to Mar. 15, 2022. Patient demographics, wound characteristics and photographs of the wounds were collected at intake and at each dressing change (routinely performed every 3 days). All treatment was provided in the inpatient setting, and outcomes were recorded before hospital discharge. **Results:** Thirty-two patients (mean age 37 yr, 63% male) received NPWT during the study period; 12 had road traffic-related injuries (42%), 7 had other mechanisms of injury (25%), and 6 had gunshot injuries (21%). Wound characteristics were recorded for 16 wounds, of which 7 (44%) were reportedly contaminated/dirty and 7 (44%) were infected. All patients received antibiotics upon hospital presentation. The average duration of NPWT was 5.9 days, with 19% of patients undergoing serial irrigation and débridement. No patients developed a systemic infection or became septic. Outcomes were recorded for 15 patients; VATARA was successful in achieving wound closure in 12 (80%) wounds, with 9 (50%) receiving a skin graft. NPWT was unsuccessful in 4 patients, with 3 receiving amputations and 1 dying during the hospital admission. A total of 15 of 18 (83%) providers reported VATARA was effective in managing patients' wounds. **Conclusion:** VATARA is an effective, reliable and affordable NPWT device for managing open fractures and contaminated and/or complex wounds in a resource-limited setting.

**Sacred sharing circles: urban Indigenous Manitobans' experiences with bariatric surgery.** *Marta Whyte, Melinda Fowler-Woods, Amanda Fowler-Woods, Geraldine Shingoose, Andrew Hatala, Felicia Daeninck, Ashley Vergis, Kathleen Clouston, Krista Hardy.* From the University of Manitoba Department of Surgery, Winnipeg, Canada (Whyte, Vergis, Hardy); the University of Manitoba Faculty of Community

Health Sciences, Winnipeg, Canada (M. Fowler-Woods, A. Fowler-Woods, Shingoose, Hatala); and the University of Manitoba, Winnipeg, Canada (Daeninck, Clouston).

**Background:** Obesity and type 2 diabetes mellitus (T2DM) are growing global health concerns that disproportionately affect Indigenous Peoples in many countries. Bariatric surgery offers superior weight loss and comorbidity resolution compared with medical management. The literature describing the experiences of Indigenous Peoples undergoing bariatric surgery is sparse. The objective of this study was to employ a decolonizing methodology to explore the experiences of urban Indigenous Peoples undergoing bariatric surgery. **Methods:** Study conception and design was guided by an Indigenous Advisory Committee (IAC), which included a community Elder. Urban Indigenous Manitobans with obesity and T2DM were recruited to participate in 2 sacred sharing circles and individual interviews. Audio transcripts were analyzed for themes using inductive thematic analysis. **Results:** Sacred sharing circles were led by an Elder with 4 participants and the IAC. Themes generated included experiencing hardship/challenges, reflecting on the importance of supports, understanding relationships with food and healing/recovering. The participants described an overall supportive and positive experience with the bariatric pathway. Participants expressed interest in more culturally diverse supports in the clinic itself, as well as Indigenous peer mentorship. **Conclusion:** Indigenous Peoples have strong motivators for pursuing bariatric surgery, and we found an overall positive experience with the bariatric pathway. Suggestions for improvement of the clinic pathway included culturally relevant supports and Indigenous peer mentorship. This study is the first to qualitatively explore the bariatric experience of Indigenous Peoples in Canada. Further research will continue to explore the health care encounter in detail and will provide the opportunity for development of culturally relevant materials and interventions.

**Urological complications following gynecological procedures in Cameroon: a cross-sectional study.** *Laure Djadje, Olga Mbougo Djoutsop, Adrien Tangmi Djabo, Ulrich Sidney Kanmounye.* From the Faculty of Medicine, Higher Institute of Health Sciences, Université des Montagnes, Bangangte, Cameroon (Djadje); the Faculty of Medicine and Biomedical Sciences, University of Yaoundé I, Yaoundé, Cameroon (Djadje); the Faculty of Medicine, Bel Campus Technological University, Kinshasa, Democratic Republic of Congo (Djoutsop, Djabo); the Research Department, Association of Future African Neurosurgeons, Kinshasa, Democratic Republic of Congo (Kanmounye).

**Background:** One essential pillar of global surgery is increased access to safe surgery. Unfortunately, African women undergoing obstetrical-gynecological procedures are 50 times more likely to die than their counterparts in high-income countries. Moreover, there is little information on the safety of obstetrical-gynecological procedures in Africa. Our objective was to describe the prevalence of urological complications following gynecological procedures in Cameroon. **Methods:** This cross-sectional study was conducted from January 2010 to December 2020. The charts of women who had gynecological operations

at the Central Hospital of Yaoundé were retrospectively reviewed to identify postoperative urological complications. The  $\chi^2$  test was used to assess bivariate data relationships, odds ratios (ORs) were calculated when appropriate, and results were considered significant at  $p < 0.05$ . **Results:** Eighteen women were identified: 17 had had a hysterectomy and 1 had had a cesarean section. Only 3 (16.7%) patients had had abdominal surgeries in the past, 16 (88.9%) had an American Society of Anesthesiologists score of 2 or less, and 7 (38.9%) presented urological symptoms before postoperative day 7. Five patients (27.8%) could not afford imaging and 5 others had bilateral hydronephrosis. Most patients (55.6%) were managed more than a month after their diagnosis, and 7 (38.9%) had a hospital stay longer than 7 days following treatment of the urological complication. Hysterectomy patients were more likely to have poor outcomes (OR 1.2, 95% confidence interval 1.0–1.5). **Conclusion:** As we advocate for increased access to surgery worldwide, it is essential that we do not compromise safety and quality of care for our patients. This study highlights the need for quality improvement in low-resource settings.

**Access to routine otolaryngology–head and neck surgery care in the Democratic Republic of Congo: a cross-sectional study.** *Vanessa Nono Youmbi, Patricia Kakobo, Olga Mbougo Djoutsop, Adrien Tangmi Djabo, Ulrick Sidney Kanmounye.* From the Faculty of Medicine, Bel Campus Technological University, Kinshasa, Democratic Republic of Congo (Youmbi, Kakobo, Djoutsop, Djabo); and the Research Department, Association of Future African Neurosurgeons, Kinshasa, Democratic Republic of Congo (Kanmounye).

**Background:** Allergic rhinitis (AR) is one of the most common disorders amenable to otolaryngology care worldwide. Globally, it affects 505 million, and 10%–20% of those affected present severe symptoms. Our objective was to assess access to routine otolaryngology care in the Democratic Republic of Congo. We used AR as a proxy of routine care based on its prevalence and straightforward diagnosis and management. **Methods:** We conducted a retrospective chart review of patients with AR admitted between 2015 and 2020 at Centre Hospitalier Mère et Enfant Monkole in Kinshasa. Sociodemographic, clinical, therapeutic and prognostic data were collected. Summary descriptive and bivariable ( $\chi^2$ ) data analyses were performed using SPSS v. 26. **Results:** During the study period, 120 patients, mostly female (65.8%), were admitted with AR. The patients were aged  $30.2 \pm 15.1$  years, and 54 (45.0%) were uneducated. The majority (81.7%) reported having symptoms more than 4 days per week, 9 (7.5%) had sleeping disorders, 16 (13.3%) reported their symptoms prevented them from exercising, 17 (14.2%) reported their hobbies were affected by the AR symptoms, and 64 (53.3%) reported their symptoms adversely affected their professional life. On average, patients waited  $4.2 \pm 3.4$  years to consult a specialist. Instead, patients self-medicated because they lacked health insurance and wanted to avoid the financial burden of getting specialized care. **Conclusion:** Access to routine otolaryngology care is limited in the Democratic Republic of Congo because patients face significant hurdles when seeking care. Our study findings highlight the need for further research and intervention by the global otolaryngology community.

**Reducing surgical site infection among mothers who underwent cesarean section at Zewditu Memorial Hospital.** *Surafeal Tafesse, Bisrat Tamene, Zelalem Chimdesa, Eden Alemayehu, Birhanu Abera, Dawit Yifru.* From the Zewditu Memorial Hospital, Addis Ababa, Ethiopia (Tafesse, Tamene, Chimdesa, Alemayehu, Abera); and Jhpiego Ethiopia, Addis Ababa, Ethiopia (Yifru).

**Background:** A surgical site infection (SSI) is an incision or organ/space infection that occurs within 30 days of surgery if there was no implant or within 90 days if there was an implant. It is a type of safety mishap that is commonly recorded. During baseline assessment for diagnosing SSI at Zewditu Memorial Hospital, 23.5% of mothers who had cesarean sections showed evidence of an SSI emerging from the wound. **Methods:** Following baseline data gathering, the quality improvement team devised a plan to reduce SSI rates from 23.5% in August 2021 to less than 7% by March 2022 by implementing selected change ideas and closely monitoring the outcomes. First, the team looked into the causes of SSI and used the model for improvement. Next, the team identified vital drivers and implemented several low-cost interventions, using plan–do–study–act cycles to test change ideas, during which data were collected and monitored every week. **Results:** We studied 1400 mothers who had undergone cesarean section between August 2021 and March 2022. The SSI rate decreased from 23.5% to 6%, evidenced by a shift of 8 data points from the mean on the control chart. **Conclusion:** The SSI rate among mothers who had a cesarean section was lowered to 6% at the end of our quality-improvement effort, which was even lower than our goal. According to our findings, implementing vaginal cleanliness, reducing traffic flow in the operating room, and increasing staff awareness and practice of infection prevention and control are the modification concepts that resulted in a lower SSI rate. Therefore, we urge that other hospitals adopt and employ these approaches to combat SSI as a surgical complication.

**Addressing priorities for surgical research in Africa: implementation of a multicentre cloud-based perioperative registry in Ethiopia.** *Fitsum Kifle Belachew.* From the Network for Perioperative and Critical Care, Addis Ababa, Ethiopia; and the Division of Global Surgery, University of Cape Town, Cape Town, South Africa.

**Background:** Improving global surgical capacity and quality requires data-driven, evidence-based interventions and collaborations. Low-resource settings, where disparities in access to and quality of surgical treatment led to excess mortality, have few surgical data, and most of the available data come from developed nations with little involvement from the data owner countries. The purpose of this study was to implement a perioperative registry in Ethiopia to generate continuous surgical data and examine whether this would help address African perioperative research priorities. Ethiopia is the second-most populous country in Sub-Saharan Africa and the headquarters of the African Union. **Methods:** A south–south collaboration supported the implementation of a context-specific, clinician-led, multicentre real-time perioperative registry in Ethiopia. Data from perioperative care, including the Ethiopian Ministry of Health's national Saving Lives Through Safe Surgery initiative was

linked to real-time dashboards, which provided clinicians and administrators with reports on service utilization, surgical access, and national surgical performance indicators. A total of 285 beds were sourced from 4 hospitals in the Amhara, Southern Nations, Nationalities, and Peoples regions, and Addis Ababa. **Results:** A total of 1748 consecutive surgical cases were recorded from April 2019 to April 2020, and compliance with the World Health Organization's Surgical Safety Checklist was 1595 (92.1%). Thirty-three patients (3.1%) experienced adverse events during anesthesia, and 21 (2.0%) developed surgical site infections. **Conclusion:** The collaboration has successfully implemented a multicentre surgical registry that can assess key performance indicators for surgery and evaluate perioperative outcomes of patients. This can be scaled and is capable of interconnecting different African countries and implementing a minimal data set registry.

**Prospective study of surgery for traumatic brain injury in Addis Ababa, Ethiopia: surgical procedures, complications and postoperative outcomes.** *Abenezer Tirsit, Negussie Deyassa, Bente E. Moen, Terje Sundström, Morten Lund-Johansen.* From the Surgery Department, Neurosurgery Unit, College of Health Sciences, Addis Ababa University, Addis Ababa, Ethiopia (Tirsit); the Department of Clinical Medicine, Faculty of Medicine, University of Bergen, Bergen, Norway (Deyassa); the School of Public Health, Addis Ababa University, College of Health Sciences, Addis Ababa, Ethiopia (Moen); the Center for International Health, Department of Global Public Health and Primary Care, Faculty of Medicine, University of Bergen, Bergen, Norway (Sundström); and the Department of Neurosurgery, Haukeland University Hospital, Bergen, Norway (Lund-Johansen).

**Background:** Traumatic brain injury (TBI) is an important cause of trauma-related mortality and morbidity in Ethiopia. Many patients do not have access to surgical treatment, and there are significant deficits along the entire continuum of care. Little is known about surgical activity and patient outcomes. The objectives of the study were to determine the common procedures done for TBI patients and to identify postoperative complications and treatment outcomes of surgically treated patients. **Methods:** All surgically treated TBI patients at the 4 teaching hospitals in Addis Ababa, Ethiopia, were prospectively registered from October 2012 to December 2016. Data registration included types of surgical procedures, complications, reoperations, discharge outcomes and mortality. **Results:** A total of 1087 patients were included in the study. The most common surgical procedures were elevation of depressed skull fractures (DSF; 49.5%) and craniotomy (47.9%). Epidural hematoma was the most frequent indication for a craniotomy (74.7%). Most (77.7%) patients underwent surgery within 24 hours of admission. Patients undergoing elevation of a DSF or a craniotomy stayed a median of 4 days in hospital. Decompressive craniectomy was done in only 10 patients. Postoperative complications were seen in 17% of patients, and only 3% were reoperated. Cerebrospinal fluid leak was the most common complication (7.9%). Only 5.6% of craniotomy patients and 0.4% of patients undergoing elevation of a DSF required blood trans-

fusion. The overall mortality was 8.2%. Age, admission Glasgow Coma Scale (GCS) score and length of hospital stay were significantly associated with mortality ( $p \leq 0.005$ ). Diagnosis, admission GCS score, surgical procedure and complications were significant predictors of discharge GCS score ( $p < 0.01$ ). **Conclusion:** The injury panorama, surgical activity and outcome are significantly influenced by patient selection due to deficits within both prehospital and hospital care. Still, the neurosurgical services benefit a large number of patients in the greater Addis Ababa region and are qualitatively comparable to reports from high-income countries.

**Neurosurgery training in a low-income country: an evaluation of neurosurgical residents' and graduates' perspectives following completion of an international partnership.** *Mersha Abebe, Rabia Khan, Amba Mekasha, Sophie Soklaridis, Faizal Haji.* From the departments of Neurosurgery (Abebe) and Pediatrics and Child Health (Mekasha), College of Health Sciences, Addis Ababa University, Addis Ababa, Ethiopia; the Wilson Centre for Health Professions Education Research, University of Toronto, Toronto, Canada (Khan); the Department of Psychiatry, University of Toronto, Toronto, Canada (Soklaridis); Pediatric Neurosurgery, BC Children's Hospital, Vancouver, Canada (Haji); and the Department of Surgery, University of British Columbia, Vancouver, Canada (Haji).

**Background:** The first of its kind in Ethiopia, the neurosurgery residency program at the Addis Ababa University College of Health Sciences (AAUCHS) was established in 2006 in partnership with the Foundation for International Education for Neurological Surgery (FEINS) and the University of Bergen (UoB). Upon completion of the international partnership in 2016, AAUCHS faculty assumed full responsibility for the program. Our objective was to investigate the experiences of neurosurgical residents and graduates of the program following withdrawal of international support. **Methods:** Residents currently in training and graduates who completed training after 2016 were invited to participate in semistructured interviews in Amharic. The interviews were audio-recorded, transcribed verbatim, then translated into English. Using qualitative descriptive content analysis, data were organized into themes based on an inductive coding approach. **Results:** Sixteen residents and 7 graduates participated. Five themes were identified: (i) motivation to enrol in the neurosurgery program, (ii) accessibility to learning opportunities, (iii) resource limitation effects on operative exposure, (iv) feeling "undertrained," and (v) need for curriculum revision. While prior exposure to the program motivated many participants to pursue neurosurgery training, most stated that the program failed to provide adequate exposure to complex pathologies and a breadth of procedures owing to resource limitations and the absence of neurosurgical subspecialty attachments. Thus, participants felt "undertrained" and ill-equipped for independent practice. Trainees recommended curriculum revision to increase time spent on subspecialty cases, introduce skills laboratories, and provide training-level-specific and competency-based assessment. Opportunities for mentorship and reduction in resident numbers were also

suggested. **Conclusion:** While AAUCHS faculty are successfully maintaining the neurosurgery residency, there is a gap between the training provided and participants' expectations. Support from local government to improve resource provision and international support for curriculum revision is needed. These findings provide insights regarding challenges in sustainability and long-term support necessary in global surgical partnerships.

**The specialist anesthesiology workforce in East, Central and Southern Africa: a cross sectional study.** *Juventine Asingei, Eric P. O'Flynn, Diarmuid T. O'Donovan, Sophia C. Masuka, Doreen Mashava, Faith V. Akello, Mpoki M. Ulisubisya.* From the Centre for Public Health, Institute of Clinical Sciences, Royal Victoria Hospital, Queen's University Belfast, Belfast, Northern Ireland (Asingei, O'Donovan); the Institute of Global Surgery, Royal College of Surgeons in Ireland, Dublin, Ireland (O'Flynn); the College of Anaesthesiologists of East, Central and Southern Africa, Arusha, Tanzania (Masuka, Mashava, Ulisubisya); and the Association of Anesthesiologists of Uganda, Kampala, Uganda (Akello).

**Background:** The populations of East, Central and Southern Africa receive only a fraction of the surgical procedures they require, and their likelihood of dying after surgery is higher than the global average. An insufficient anesthesiology workforce, both physicians and nonphysicians, is a key barrier to safe surgery. A detailed understanding of the workforce is necessary to devise strategies for its scale-up, retention and distribution. This cross-sectional study aimed to produce a detailed description of the demographics of the anesthesiologist workforce in the 8 member countries of the College of Anaesthesiologists of East, Central and Southern Africa (CANECSA). **Methods:** Data collection took place between May and September 2020 using existing databases and was validated through direct contact with anesthesiologists and other hospital staff. Primary outcomes included total number of anesthesiologists and their gender, age, country of practice, current work location, country of origin, and country where they received their initial anesthesia qualification. **Results:** We identified 411 qualified anesthesiologists (0.19 per 100 000 population). The median age was 41. One-third were female, with younger anesthesiologists more likely to be female. The majority (67.5%) were based in urban areas with a population greater than 1 million people, and most were employed by government institutions (61.6%). Most anesthesiologists in the region were trained (89.1%) and currently work (95.1%) in their home country. The numbers of anesthesiologists in CANECSA member countries are extremely low — about 5% of minimum recommended numbers. The workforce is expanding, although population growth reduces the impact of this expansion. Challenges include the maldistribution of anesthesiologists relative to the population. Opportunities include the increasing percentage of women in the anesthesiology workforce and increasing numbers of female medical school graduates. **Conclusion:** Our findings suggest that an expansion of high-quality anesthesiology training across the region is required.

**Scaling surgical resources: a preliminary analysis of orthopedic surgical care and C-arm baseline capacity analysis following the 2021 Haitian earthquake.** *Helena Franco, Abdoulie Njai, Samuel Simister, Micelle Joseph, Pierre Woolley.* From the Department of Global Health and Social Medicine, Harvard Medical School, Boston, USA (Franco, Joseph); the Harvard T.H. Chan School of Public Health, Boston, USA (Njai); the University of Utah School of Medicine, Salt Lake City, USA (Simister); the Program in Global Surgery and Social Change, Harvard Medical School, Boston, USA (Joseph); the University of Warwick, Clinical Trials Unit, Coventry, UK (Joseph); the University of Notre Dame School of Medicine Haiti, Department of Orthopaedics, Port-au-Prince, Haiti (Woolley).

**Background:** In August 2021, a 7.2-magnitude earthquake struck Haiti, resulting in multiple casualties. The surge in operative demand, particularly for orthopedic trauma, presented an opportunity for capacity building while simultaneously responding to the immediate need. Safe and efficient operative management of orthopedic trauma injuries requires intraoperative fluoroscopy (C-arm machines). At the time of the earthquake, Haiti Health Network (HHN), which was founded when the Cap Haitien Health network merged with the Dalton Foundation, identified a capacity of only 3 operational C-arm machines. Our objective was to perform a baseline capacity analysis (BCA) of the 12 HHN hospitals by determining clinical need (orthopedic trauma operative caseload requiring C-arm) and hospital readiness (ability to operate and maintain this equipment). **Methods:** The senior surgeon or hospital administrator of each of the 12 hospitals were asked to complete a BCA survey. The survey included free text, multiple choice and scale questions on medical personnel, orthopedic equipment availability, number and type of orthopedic operations performed, and adverse outcomes associated with the lack of C-arm access. **Results:** Ten hospitals completed the survey. Three hospitals had current functional C-arm machines; however, 5 additional hospitals reported C-arm operational skills and maintenance capabilities. The median number of full-time orthopedic surgeons was 2.5 (interquartile range [IQR] 2.5–3, standard deviation [SD] 0.886), and 24 (IQR 22.6–55, SD 64.56) orthopedic trauma operations were conducted per month, of which 22 (IQR 7–24, SD 21.62) operations required intraoperative fluoroscopy. The most common adverse outcome secondary to lack of fluoroscopy was incorrect hardware placement requiring corrective surgery and, therefore, delayed care. **Conclusion:** The survey results confirmed the critical need for more C-arm machines in Haitian hospitals and identified the network hospitals with sufficient capabilities to receive this equipment. Furthermore, this research method and evidence provide data for philanthropic groups engaging in further scaling to provide additional equipment, which would considerably benefit the local community.

**Delivering essential surgical care for lower-limb musculoskeletal disorders in the low-resource setting.** *Deeptiman James, Faye M. Evans, Ekta Rai, Nobhojit Roy.* From the Paediatric Orthopaedic Unit, Department of Orthopaedics, Christian Medical College Vellore, Vellore, India (James); the Department of

**Anesthesiology, Critical Care and Pain Medicine, Boston Children's Hospital, Harvard Medical School, Boston, USA (Evans); the Department of Anesthesia, Pediatric and ObGyn Anesthesia unit, Christian Medical College Vellore, Vellore, India (Rai); and the Department of Global Public Health, Karolinska Institutet, Stockholm, Sweden (Roy).**

**Background:** Mismatched surgeon:anesthesiologist ratios often exist in low-resource settings, making safe essential and emergency surgical care challenging. We performed an audit of essential and emergency procedures performed for lower-limb (LL) musculoskeletal disorders (MSDs) when an anesthesiologist was unavailable. Our objective was to identify options for the delivery of safe essential and emergency orthopedic/trauma surgical care in austere settings lacking anesthesiologist support, with emphasis on resource optimization, audit and risk mitigation. **Methods:** We conducted a 5-year retrospective audit of emergency and essential LL orthopedic procedures performed at a remote mission hospital in central India. Out of necessity, a regional anesthesia (RA) protocol was developed in collaboration with anesthesiologists familiar with the setting. The incidence of intraoperative surgical and perioperative anesthesia complications when RA was administered by a surgeon was evaluated. **Results:** During the study period, 766 emergency and essential procedures were performed for LL MSDs. An anesthesiologist was available for only 6 of 766. RA was administered by a surgeon for 283 of 766. This included spinal anesthesia (SA) for 267 of 283 patients, and peripheral nerve blocks for 16 of 283. Local infiltration and/or sedation was administered to 477 of 766 patients. There were 17 intraoperative surgical complications. Anesthesia-related complications included multiple attempts to localize subarachnoid space in 37 of 267 patients and SA failure in 9 of 267 patients, all of whom had successful readministration of anesthesia. Additional sedation and infiltration of local anesthetic was required in 5 of 267 patients. **Conclusion:** In health care facilities where there are no trained anesthesia providers, surgeons can be upskilled to deliver safe anesthesia services. The highest-yield procedures for emergency orthopedic care are spinal anesthesia and local anesthesia with sedation. Orthopedic surgery training programs should consider including those skills in their curriculum.

**Risk factors associated with mortality following geriatric trauma in urban India: a multicentre cohort study.** *Varun Bansal, Jyoti Kamble, Anna Aroke, Siddarth David, Deepa Veetil, Kapil Dev Soni, Martin Gerdin Wärnberg.* From the Department of General Surgery, Seth G.S. Medical College and KEM Hospital, Mumbai, India (Bansal); Doctors For You, India (Kamble, Aroke, David); the Department of Public Health, Tata Institute of Social Science, Mumbai, India (Kamble); the Department of Global Public Health, Karolinska Institutet, Stockholm, Sweden (David, Wärnberg); Department of Minimal Access Surgery, Gastrointestinal and Bariatric Surgery, Manipal Hospitals, New Delhi, India (Veetil); Critical & Intensive Care, Jai Prakash Narayan Apex Trauma Center, All India Institute of Medical Sciences, New Delhi, India (Soni); and Function Perioperative Medicine and Intensive Care, Karolinska University Hospital, Solna, Sweden (Wärnberg).

**Background:** More than 90% of trauma-related deaths occur in low- and middle-income countries (LMICs), with elderly individuals being more susceptible to trauma-associated mortality. With increasing life expectancies, the mortality and morbidity burden of trauma among elderly individuals is going to rise. This study aimed to assess the risk factors for mortality among injured geriatric patients ( $\geq 50$  yr) in a multicentre urban Indian trauma registry. **Methods:** This study included patients who arrived alive at 4 tertiary care hospitals with a history of trauma. The study outcome was in-hospital mortality, and the variables included demographics, injury etiology and severity, and vital parameters on hospital arrival. Multivariable logistic regression was performed to assess the factors affecting mortality. **Results:** A total of 1740 patients were included, most of whom were male (74.7%). The predominant mechanisms of injury were road traffic accidents in the 50- to 64-year age-group (52.3%) and falls in patients older than 65 years (54.7%). In-hospital mortality was 31.2% and was significantly associated with age 65 years or older (odds ratio [OR] 1.4, 95% confidence interval [CI] 1.1–1.9,  $p = 0.009$ ), railway injuries (OR 2.6, 95% CI 1.1–6.2,  $p = 0.026$ ), systolic blood pressure  $< 90$  mm Hg (OR 4.8, 95% CI 2.7–8.8,  $p < 0.001$ ), moderate (OR 2.4, 95% CI 1.7–3.3,  $p < 0.001$ ) and severe (OR 11.0, 95% CI 8.3–14.8,  $p < 0.001$ ) Glasgow Coma Scale (GCS) scores, and profound Injury Severity Score (ISS; OR 2.7, 95% CI 1.5–4.9,  $p < 0.001$ ). **Conclusion:** The in-hospital mortality in injured elderly patients in our cohort was more than twice than that reported in high-income countries and was associated with age 65 years or older, hypotension and moderate and severe GCS scores on arrival, and profound ISS.

**Multi-methods modelling and construction of a novel access to surgical care index for rural India.** *Siddhesh Zadey, João Ricardo Nickenig Vissoci.* From the Association for Socially Applicable Research (ASAR), Pune, Maharashtra, India (Zadey); the Department of Surgery, Duke University School of Medicine, Durham, USA (Zadey, Nickenig Vissoci); and the Duke Global Health Institute, Duke University, Durham, USA (Nickenig Vissoci).

**Background:** The Lancet Commission on Global Surgery (LCoGS) estimated that 98% of people in India lack timely access to safe and affordable surgical care. Solving India's surgical access issues can have high returns on investment. Our objective was to construct a novel Zadey–Vissoci Access to Surgical Care Index (ZVASCI) to be estimated at state and district levels for rural regions in India. **Methods:** Secondary analysis of data from 12 different sources with a diverse geospatial and statistical toolbox was used to create state- and district-level estimates for 4 surgical care access dimensions: timeliness (proportion of population within 2 hours of a surgical care facility), capacity (met surgical need for major surgery operative volumes), safety (proportion of postoperative surgical site infections), and affordability (proportion of surgery-seeking households facing catastrophic expenses). ZVASCI (0 = worst, 100 = best) was defined as the normalized composite of these dimensions synthesized using adjusted Mazziotta–Pareto Index (AMPI) methodology. We undertook extensive sensitivity analyses with several proxy variables for



access dimensions, investigated spatial autocorrelations across districts using the Moran  $I$  statistic and checked for associations between ZVASCI and SDG Index for 90 aspirational districts needing developmental push. **Results:** ZVASCI was estimated for rural regions of 587 districts and 36 states/union territories (UTs). Among districts, Bhopal in Madhya Pradesh had the highest index value of 92.68, while North and Middle Andaman in Andaman and Nicobar Islands had the lowest value of 0. Most districts had ZVASCI below 60. Among states/UTs, Chandigarh had the highest value of 77.29, while Andhra Pradesh had a null value. Most states had values in the 0–20 range. The sensitivity library consisted of 123 977 ZVASCI estimates. ZVASCI showed significant spatial correlation across districts (Moran  $I = 0.22$ ,  $p < 0.05$ ) with clusters of low access. ZVASCI had a small nonsignificant correlation with SDG Index for aspirational districts ( $R = 0.18$ ,  $p = 0.095$ ). **Conclusion:** ZVASCI can encourage buy-in from policy-makers and raise rural surgical care on the national agenda. Our methods have high translational value for global surgery research in low- and middle-income countries. For India, these are, to our knowledge, the first such findings that can direct surgical planning.

**Understanding equity in surgical care uptake and provision in underprivileged communities in India under Pradhan Mantri Jan Arogya Yojana (PMJAY).** *Himanshu Iyer, Siddhesh Zadey.* From the Association for Socially Applicable Research (ASAR), Pune, Maharashtra, India (Iyer, Zadey); and the Department of Surgery, Duke University School of Medicine, Durham, USA (Zadey).

**Background:** Pradhan Mantri Jan Arogya Yojana (PMJAY) is the largest publicly funded health insurance scheme, covering more than 107 million Indian households, that was formulated to ensure financial risk protection against health care expenses among the socioeconomically disadvantaged (bottom 40%) Indian population. While surgical care provision has expanded under PMJAY, equity assessment has been neglected. Our study objective was to understand surgical equity among PMJAY beneficiaries. **Methods:** We conducted a retrospective document analysis of policy briefs and working papers published by the National Health Authority on early implementation years of PMJAY from 2018 to 2022. We included 7 policy briefs and 6 working papers that included data on surgical packages in our analysis. We assessed various attributes of surgical care and uptake across 5 dimensions to determine equity: public versus private health sectors, gender, age, surgical specialties and geographical distribution. **Results:** As of 2021, 12 863 of the 27 000 hospitals under PMJAY offer surgical packages. Of these, 6737 were privately owned, while 5794 were public. Of the overall 1393 packages offered under PMJAY, 1083 were surgical. Men submitted 2 673 251 claims (51.5%) while women submitted 2 517 899 claims. Most of the claims by women came from obstetrical and gynecological hospitalizations. Most cataract, oncology and cardiothoracic claims were made by people aged 40–65, 45–55 and 51–70, respectively. General surgical claims accounted for 11% of total claims, while hysterectomy services accounted for 1%. Cardio-

thoracic vascular surgery was the single largest specialty contributing the high-value claims, costing INR 3225 crore (USD \$424 million) billed for 480 000 claimants. Patients' overall portability, the ability to seek care at any approved hospital across the country, was 5.4% for surgical patients compared with 0.7% for all patients. Geographic variations in surgical uptake were present across districts owing to the developmental status of their parent states. **Conclusion:** While broadening total surgical care is requisite, equity must not be overshadowed. Equity focus and monitoring needs to be strengthened for important large-scale programs that provide surgical care to people in poor and remote areas. PMJAY needs to do more to fulfill the needs of children and young people from socioeconomically disadvantaged areas.

**Prioritization of surgical care in national policies of India: a quantitative document analysis.** *Ritika Shetty, Siddhesh Zadey, Anushka Jindal, Himanshu Iyer.* From the Association for Socially Applicable Research (ASAR), Pune, Maharashtra, India (Shetty, Zadey, Jindal, Iyer); the Terna Medical College, Navi Mumbai, Maharashtra, India (Shetty); the Department of Surgery, Duke University School of Medicine, Durham, USA (Zadey); and King's College Hospital, Denmark Hill, London, UK (Jindal).

**Background:** Improving surgical access is tied directly to policies, implementation efforts and political commitment. The Lancet Commission on Global Surgery (LCoGS) and research thereafter on policies in Africa and low- and middle-income countries have shown low prioritization of surgical care. With more than 1 billion people without surgical access and no National Surgical, Obstetric and Anaesthesia Plan (NSOAP) on the horizon, policy prioritization for surgical care remains unknown in India. We aimed to assess the importance given to surgical, obstetrics, trauma and anesthesia (SOTA) planning in India's national policy documents. **Methods:** Forty major health policy and planning documents, national committee reports, planning commission reports, health mission and public health standard guidelines released from 1946 to 2017 were included in the document analysis. These documents were electronically searched for a list of 52 surgically relevant and 7 nonsurgical (control) keywords adapted from LCoGS and previous studies. The number of mentions obtained for each entry was used as a proxy for prioritization. The surgical mentions were further classified by 2 assessors into 5 domains provided in the LCoGS report: infrastructure, workforce, service delivery, financing and information management. The mentions were classified under 1 or more domains, depending on the criteria they fulfilled, and validation was conducted for all steps by a third assessor. **Results:** The total number of surgical mentions was 4891 and nonsurgical mentions was 2324. The number of mentions per keyword was 94 for surgical keywords compared with 332 for nonsurgical keywords. Older committee reports (1946–1986) showed higher weightage to surgery than recent documents (post-2010). Across domains, there were most mentions for service delivery (909), followed by infrastructure (590), workforce (518), financing (108) and information management (49). Interestingly, the recent

National Health Policy 2017 had limited focus on SOTA, with no mentions for financing. **Conclusion:** Surgical care and SOTA planning more broadly have been chronically underprioritized in India's policies and programs. Efforts need to be made specifically toward focusing on information management and surgical financing. The low prioritization in broader health policy context calls for the development of NSOAP to ensure adequate resource allocation for surgical care delivery.

**The provision of labour pain management and its related barriers among maternal health care providers in a tertiary hospital in Kenya.** *Gabriel Ouma.* From the Department of Reproductive Health, Moi University School of Medicine, Moi, Kenya.

**Background:** Although pain relief is a key component of modern obstetrical care, it remains a poorly established service in Sub-Saharan countries such as Kenya. There is, therefore, a need to examine the practice of labour pain relief and its deterrents among Kenyan maternal health care providers. We sought to assess the provision of labour pain management and its related barriers among providers working at Moi Teaching and Referral Hospital (MTRH). **Methods:** We conducted an institution-based, cross-sectional descriptive survey among maternal health care providers working at the second largest referral hospital in Kenya. The survey was conducted from Jan. 1 to Mar. 31, 2021. **Results:** The structured, self-administered questionnaire was completed by 117 maternal health care providers, for a response rate of 97.5%. The prevalence of routine labour analgesia provision was 61.5%. The most common pharmacological method prescribed was non-opioids (13.4%). Regional analgesia was provided by 4 (3.6%) of the respondents. Most maternal health care providers (53%) had poor knowledge of labour pain management. Almost all (94%) of the respondents had a positive attitude toward the provision of labour analgesia. Nonavailability of drugs and equipment (58.1%), lack of clear protocols and guidelines (56.4%), and absence of adequate skilled personnel (55.6%) were reported as the health system factors that hindered the provision of labour analgesia. Being of female gender (crude odds ratio [COR] 0.33, 95% confidence interval [CI] 0.14–0.71) and midwifery profession (COR 4.32, 95% CI 1.33–14.9) were significantly associated with the provision of labour analgesia, while practitioners with more than 10 years of experience (adjusted odds ratio 9.85, 95% CI 1.52–1.96) were almost 10 times (9.82) as likely to provide labour analgesia. **Conclusion:** The routine provision of labour analgesia among maternal health care providers at MTRH is above average (61.5%). Epidural analgesia is still underutilized.

**Safety, cost and regulation of re-used orthopedic devices.** *Sayed Shab Nur Hussein Shab, Carrie Hinchman, Isaiah Michael Rayel, Myles Dworkin, Kiran J. Agarwal-Harding.* From the Aga Khan University Hospital, Nairobi, Kenya (Shah); the New York Medical College, Valhalla, USA (Hinchman); the National University of Ireland Galway School of Medicine, Galway, Ireland (Rayel); the Department of Orthopaedic Surgery, Warren Alpert Medical School, Brown University, Providence, USA (Dworkin); and the Harvard Global Orthopaedics Collaborative, Boston, USA (Agarwal-Harding).

**Background:** In many low- and middle-income countries (LMICs), where the burden of musculoskeletal injuries is high, hospitals are re-using devices such as external fixators in an attempt to mitigate costs and manage musculoskeletal injuries that may otherwise go untreated. There is evidence that these devices may be re-used; however, the safety of re-use is unknown, especially in the absence of formal regulation or monitoring. This study sought to examine the existing literature around the re-use of orthopedic devices, specifically regarding the safety and efficacy of their re-use, the cost of re-usable versus single-use devices and legal or ethical considerations around the globe. **Methods:** We searched MEDLINE for studies relevant to the re-use of orthopedic devices, including clinical trials, biomechanical studies and cost analyses. **Results:** Of 48 manuscripts reviewed, 34 were included in the analysis. Of 6 studies that examined the costs associated with re-using external fixators, all identified significant savings. Eleven studies included laboratory testing, and all but 1 of them showed that devices may carry biochemical contaminants even after reprocessing, indicating the critical need for formalized and rigorous resterilization procedures. Although multiple manuscripts called for regulation of orthopedic device reprocessing, there is currently a lack of literature addressing legislation and guidelines surrounding their re-use. Additionally, 21 manuscripts (62%) originated in the US and only 5 (15%) originated in LMICs, highlighting a lack of perspective from LMICs, where re-use of orthopedic devices often plays a key role in care delivery. **Conclusion:** The existing literature provides evidence that orthopedic devices can be safely re-used, which may lead to financial savings. Clear guidelines on device reprocessing and re-use would allow hospitals to safely re-use devices such as external fixators, and improve the availability of essential musculoskeletal trauma care in resource-limited settings.

**Outcomes of nonoperatively treated pediatric supracondylar humeral fractures at the Nkhotakota District Hospital, Malawi.** *Elijah Mlinde, Labin M. Amlani, Collin J. May, Leonard N. Banza, Linda Chokotho, Kiran J. Agarwal-Harding.* From the Department of Orthopedics, Nkhotakota District Hospital, Nkhotakota, Malawi (Mlinde); the Harvard Global Orthopaedics Collaborative (Amlani, May, Agarwal-Harding); the Department of Orthopedics, Kamuzu Central Hospital, Lilongwe, Malawi (Banza); the Department of Surgery, Queen Elizabeth Central Hospital, Blantyre, Malawi (Chokotho).

**Background:** Displaced supracondylar humeral fractures (SCHFs) benefit from closed reduction and percutaneous pinning. In Malawi, many SCHFs are treated nonoperatively because of limited surgical capacity. We sought to assess clinical and functional outcomes of nonoperatively treated SCHFs in a resource-limited setting. **Methods:** We retrospectively reviewed all patients with SCHFs treated at Nkhotakota District Hospital (NKKDH) in Malawi between January 2014 and December 2016. Patients subsequently underwent clinical and functional follow-up assessment. **Results:** We identified 182 children (54% male, mean age 7 yr) with an SCHF; 151 (83%) of the fractures were due to a fall,

and 178 (98%) were extension-type (Gartland class distribution: 63 [35%] type I, 52 [29%] type II, and 63 [35%] type III). Four patients with type I fractures were treated with an arm sling alone, and 59 were treated with straight-arm traction to reduce swelling and then splint immobilization until union. All 119 of the patients with Gartland type II and III or flexion-type injuries were treated with straight-arm traction, manipulation under anesthesia without fluoroscopy and then splint immobilization until union. A total of 137 (75%) of the patients were available for follow-up, at a mean of 3.9 years after injury. Controlling for sex, delayed presentation, medical comorbidities, injury mechanism and skin blistering/superinfection during traction, patients with type II fractures were 5.82 times more likely (95% confidence interval [CI] 1.71–19.85) and those with type III fractures were 9.81 times more likely (95% CI 3.00–32.04) to have a clinical complication or functional limitation than patients with type I fractures. **Conclusion:** Nonoperative treatment of type III SCHFs resulted in a high risk of clinical complications or functional impairment. These results illustrate the urgent need to increase surgical capacity in low-income countries like Malawi to improve pediatric fractures.

**Predicting hospital of presentation for fracture management in Malawi.** *Myles Dworkin, Foster Mbomuwa, Paul Chidothi, Claude Martin Jr., William James Harrison, Kiran J. Agarwal-Harding, Linda Chokocho.* From the Department of Orthopaedics, Brown University, Providence, USA (Dworkin); the Beit CURE International Hospital, Blantyre, Malawi (Mbomuwa, Chidothi); the AO Alliance Foundation, Blantyre, Malawi (Mbomuwa, Chidothi, Martin Jr., Harrison, Chokocho); the Harvard Global Orthopaedic Collaborative, Harvard School of Medicine, Boston, USA (Agarwal-Harding); and the Department of Surgery, College of Medicine, University of Malawi, Malawi (Chokocho).

**Background:** Musculoskeletal (MSK) trauma is a leading cause of nonfatal injuries worldwide. Low-income countries such as Malawi are disproportionately affected, placing significant strain on limited resources. The purpose of this study was to determine factors associated with MSK trauma patient presentation to district and central hospitals. **Methods:** A fracture database collected from 2 district and 2 central hospitals was retrospectively reviewed. **Results:** The database recorded information on 23 734 patients, of whom 19 195 (89.5%) presented to a central hospital. Patient-related variables associated with presentation to a district hospital included age younger than 20 years; animal bites and sporting activities; patients who were farmers, students, and housewives; and patients with less than a secondary level of education. Patients with proximal radius, midshaft radius, proximal humerus, midshaft humerus, scapula, clavicle, femoral shaft, distal femur and distal tibial fractures were more likely to present to a district hospital. Patients presenting to a central hospital had greater than 5 times the odds of undergoing surgical management and 50% lower odds of being managed definitively with immobilization than patients at district hospitals. Patients initially evaluated at a central hospital also had increased odds of being admitted, whereas patients managed at the district level had increased

odds of receiving treatment and being sent home. **Conclusion:** Our data support previous findings that patients presenting to district hospitals have limited access to surgical care. However, patients with injuries that are commonly managed surgically, such as femoral shaft, distal femur and distal tibial fractures, are more likely to present to these facilities. The establishment of a formal triage system could help streamline patient care. Patients with nonoperative injuries and those not requiring admission should be encouraged to present to district hospitals to reduce the burden of care at central hospitals.

**Factors associated with surgical treatment of hip fractures in Malawian central hospitals.** *Samuel Paek, Labin Amlani, Foster Mbomuwa, Paul Chidothi, Claude Martin Jr., William James Harrison, Kiran J. Agarwal-Harding, Linda Chokocho.* From the Harvard Global Orthopaedic Collaborative, Harvard School of Medicine, Boston, USA (Paek, Amlani, Harrison, Agarwal-Harding); the AO Alliance Foundation (Mbomuwa, Chidothi, Martin Jr., Harrison, Chokocho); the Massachusetts General Hospital/Harvard Combined Orthopaedic Residency Program, Boston, USA (Harrison); and the Department of Surgery, Queen Elizabeth Central Hospital, Blantyre, Malawi (Chokocho).

**Background:** Hip fractures are common, debilitating injuries with substantial risk for death and disability. Surgical treatment is unavailable to most patients in low-income countries like Malawi. Our objective was to examine the patient- and injury-related factors associated with operative treatment of hip fractures in 2 of the largest Malawian central hospitals. **Methods:** From the Malawi Fracture Registry, we identified adults with intra-articular or extra-articular metaphyseal proximal femoral fractures treated between September 2016 and March 2020. We compared patient- and injury-specific variables between patients treated with and without surgery. **Results:** During the study period, 288 patients (178 men, 110 women) with a mean age of  $58.7 \pm 18.4$  years had hip fractures. Of these, 228 (79%) patients were treated nonoperatively, most commonly with skin (125 patients) and skeletal traction (56 patients). Surgery was performed for 60 (20.8%) patients, most commonly open reduction and internal fixation (39 patients) and intermedullary nailing (11 patients). Compared with nonoperatively treated patients, those who received surgery were significantly younger (mean age 44.1 v. 62.6 yr,  $p < 0.001$ ), more often male (82% v. 57%,  $p < 0.001$ ), more commonly had road injuries (48% v. 22%,  $p < 0.001$ ) and were more often polytraumatized (17% v. 6%,  $p = 0.005$ ). Frequency of operative treatment was similar for intra-articular and extra-articular hip fractures (18% v. 22%,  $p = 0.46$ ). All open fractures (4 patients) were treated surgically. **Conclusion:** Most hip fractures are treated nonoperatively in Malawi. Older patients, women and patients with low-energy injuries were less likely to receive surgery. Our findings demonstrate a need to improve care standardization and equity and to increase surgical capacity, especially for management of intra-articular hip fractures.

**Anal disorders in pregnant and postpartum women: epidemiological, diagnostic and therapeutic aspects in 10 maternity hospitals in Bamako, Mali.** *Togo Adégné, Poudiougo*

*Abdoulmouinou, Traoré Amadou, Traoré Youssouf, Konaté Madiassa, Dicko Moussa Younoussa, Samaké Moussa, Bab Amadou, Touré Hawa, Abramowitz Laurent. From the CHU Gabriel Touré, Bamako Commune III, Bamako, Mali.*

**Background:** Anal disorders are rarely evoked by patients in Mali, making it difficult to diagnose them and often late to manage them. Our objective was to study the diagnostic and therapeutic aspects of anal pathologies during gravido-puerperality in hospitals of Bamako. **Methods:** This was a prospective, multicentre analytical study carried out in 10 maternity hospitals in Bamako between June 1, 2019, and May 31, 2020). We included all consenting pregnant people admitted during the first trimester of pregnancy and who were followed during pregnancy and postpartum. All participants underwent a proctological examination that consisted of a rectal examination. An anoscopy was performed in people who had an anal symptom. The diagnosis of hemorrhoidal disease was made on external examination (hemorrhoid thrombosis, hemorrhoid prolapse) or on anoscopy (internal hemorrhoids). **Results:** During the study period, we followed 1422 patients, of whom 546 (38.4%) developed anal pathology. The different pathologies encountered were hemorrhoidal disease (192 cases [18.0%]), anal fissure (150 cases [11.6%]) and anal incontinence (123 cases [11.1%]). The risk factors found were age 30 years or older, chronic constipation, multiparity, newborn weight greater than 3500 g, and fetal expulsion time longer than 20 minutes. The clinical signs found were directed by constipation, anal pain, anal bleeding and anal pruritus. The treatment was based on hygienic-dietary advice, laxatives, local topicals, analgesics and perineal rehabilitation. **Conclusion:** Anal pathologies are common during the gravido-puerperal period. Their detection must be systematic in pregnant women. Early treatment would reduce complications.

**The challenges faced by female surgeons in Africa: a narrative review of the existing literature.** *Damilola Alexander Jesuyajolu, Charles Arinze Okeke, Otomi Obuh. From the Surgery Department, First Graceland Hospitals, Abijo, Lagos (Jesuyajolu); the Surgery Department, EYN Primary Healthcare Center Mubi, Kwarhi, Hong, Adamawa State, Nigeria (Okeke); and Vascular Surgery, Imperial College Healthcare NHS Trust, London, UK (Obuh).*

**Background:** There has not been any comprehensive analysis of the challenges faced by female surgeons in Africa on a continental scale. These challenges, when brought to the forefront, can be tackled by the necessary stakeholders to increase the participation of women in surgery. Our objective was to review the existing literature across the African continent to bring to light the challenges experienced by women currently practising as surgeons. **Methods:** We conducted a search using the keywords “challenges,” “female,” “surgeon,” “Africa” and “bias” on PubMed, Google Scholar and AJOL from inception to Jan. 21, 2022. We then searched the same keywords on the Google search engine in addition to the names of each of the 54 African countries. Ten papers satisfied the eligibility criteria by discussing the challenges female surgeons face from the perspectives of the surgeons. **Results:** Out of the 10 pub-

lished papers, half ( $n = 5$ ) originated from South Africa. Work-life balance was the most common challenge ( $n = 5$  articles), with underrepresentation of the female gender being second ( $n = 3$  articles). Harassment, disrespect from colleagues and stereotypes were also challenges identified in these articles. **Conclusion:** Unfavourable work environment, harassment, insufficient support, disrespect, exclusion from departmental activities, cultural gender stereotypes, problems with work-life balance and the underrepresentation of women in surgery are contributors to the challenge of societal pressure experienced by female surgeons. Together, these constitute problems that need to be tackled from the grassroots to encourage more female participation in surgery. This narrative review serves as a stimulant for major health stakeholders in global surgery to promote gender inclusivity in the African surgical workforce — a feat that will ultimately benefit access to quality surgical care.

**Factors affecting the utilization of antenatal services among women of reproductive age in a rural area in West Africa.** *Damilola A. Jesuyajolu, Peace E. Ebizibue, Nnamdi E. Ikemefula, Jamike O. Ekennia-Ebeb, Abdulqudus A. Ibrahim, Obinna E. Ikegwuonu. From the College of Medicine and Health Sciences, Afe Babalola University, Ado-Ekiti, Ekiti State, Nigeria.*

**Background:** There were 303 000 maternal deaths in 2015, representing an overall global maternal mortality ratio of 216 maternal deaths per 100 000 live births. Of all maternal deaths, 99% occur in developing countries. The knowledge of antenatal care (ANC) is an important factor affecting maternal mortality rates. This study aimed to assess the extent of knowledge of antenatal care services among women of reproductive age in Ido Ekiti, a rural town in southwestern Nigeria. **Methods:** A cross-sectional study was conducted among 299 women of reproductive age. The data were collected using a set of self-administered questionnaires and analyzed using International Business Machines Corporation (IBM) and SPSS v. 25 statistical packages. This study was conducted in Ido Ekiti, a town in the Ido-Osi local government area. **Results:** Most of the respondents were aged 31–40 years. Most of the respondents were educated (96%) and were aware of antenatal care services (95.6%). Nearly all (98.7%) of the respondents acknowledged that weight and height measurements, abdominal examination, blood tests and administration of folic acids were carried out during antenatal care visits, and most (97.3%) had an excellent knowledge of the service. **Conclusion:** Most of the respondents were aware of antenatal care services and had excellent knowledge of its components. This is indeed a positive finding, likely because of the high literacy levels, access to electronic media and the location of 3 public health facilities in the town.

**Impact of intravenous access on sepsis and death among surgical neonates in Kigali, Rwanda.** *Thomas M. Diehl, Gisèle Juru Bunogerane, Dan Neal, Alain Jules Ndibanje, Robin T. Petroze, Edmond Ntaganda. From the Department of Surgery, University of Wisconsin, Madison, USA (Diehl); the Department of Surgery, University Teaching Hospital of Kigali, Kigali, Rwanda (Bunogerane, Ndibanje,*

Ntaganda); the Department of Surgery, University of Florida, Gainesville, USA (Neal); and the Division of Pediatric Surgery, Department of Surgery, University of Florida, Gainesville, USA (Petroze).

**Background:** Long-term intravenous (IV) access is necessary for surgical neonates. Unfortunately, peripheral IVs (PIVs) require frequent replacement, and peripherally inserted central catheter (PICC) lines, which are standard of care in high-income settings, are prohibitively expensive for most low-income settings. We sought to understand how the frequency of IV replacement affects sepsis and death among surgical neonates in Rwanda. **Methods:** We completed a 6-month prospective analysis of surgical neonatal admissions at a tertiary hospital in Kigali, Rwanda, from August 2021 to February 2022. Included variables were surgical diagnosis, daily IV access log, blood culture data and survival outcomes. Descriptive and univariate analyses were performed using R statistical software. **Results:** During our study period, 116 neonates were admitted with surgical conditions. The most common diagnoses were gastroschisis (61 of 116 [53%]), intestinal atresia (18 of 116 [16%]) and Hirschsprung disease (9 of 116 [8%]). Overall survival was 51.7%. Mean length of stay was  $16.4 \pm 13.0$  days. PIVs were inserted on arrival for all patients and replaced  $5.9 \pm 1.5$  times per week, equivalent to  $14.8 \pm 12.2$  times per hospitalization. Those with a higher number of new PIVs were more likely to have culture-proven sepsis (20 v. 12,  $p < 0.001$ ) and death (18 v. 12,  $p = 0.003$ ). Central lines were used infrequently (7 of 116) and had an average duration of  $1.7 \pm 0.9$  days. The proportion of hospital stay without IV access (of any type) did not predict mortality ( $p = 0.47$ ). **Conclusion:** The frequency of PIV replacement is strongly associated with sepsis and death for surgical neonates in Rwanda. Innovative and affordable solutions for reliable, long-term IV access are essential to reduce the incidence of line-associated infections and death. These data will support future studies on alternative methods for durable IV access in Rwandan neonates.

**Breast cancer surgical services in South Africa.** *Laurie Milligan, Lydia Cairncross, Francois Malherbe, Liana Roodt.* From the Division of Global Surgery, University of Cape Town, Cape Town, South Africa.

**Background:** Female breast cancer has become the most frequently diagnosed cancer globally. The breast cancer survival rate in Sub-Saharan Africa is the lowest in the world. The incidence of cancer in South Africa is projected to double by 2030, and services to address the burden of disease are urgently needed. The distribution and capacity of existing breast cancer surgical services in South Africa is unknown. This study aimed to provide an overview of the distribution and capacity of breast cancer surgical services and describe barriers to standard of care within the public health care sector in South Africa. **Methods:** A descriptive analysis of breast cancer surgical services was performed, including the burden of disease, stage of presentation, available diagnostic and therapeutic modalities, waiting times to intervention and barriers to standard of care. Clinicians at every public sector health care facility providing surgical care to breast cancer patients were approached to complete a quantitative survey for the

year 2019. **Results:** Data from 43 hospitals across all 9 provinces were included. Clinicians reported a greater proportion of late breast cancer (67%) than early breast cancer (33%) at presentation. The less urban provinces had poorer access to diagnostic and staging modalities. Mastectomy was available at all facilities, while some were able to provide breast-conserving surgery (79%) and sentinel lymph node biopsy (53%), and relatively few offered breast reconstruction (35%). Nationally, the average waiting time to surgery was 4.5 weeks, which is longer than recommended in national guidelines. Clinicians cited the foremost barriers to standard of care as advanced disease at presentation, inadequate surgical expertise and lack of access to essential equipment. **Conclusion:** There is a need to strengthen the health care facilities providing breast cancer services in South Africa.

**Unreamed intramedullary nailing versus external fixation for the treatment of open tibial shaft fractures in Uganda: a randomized clinical trial.** *Daniel K. Kyengera, Nathan N. O'Hara, David Stockton.* From the Department of Orthopaedics, Mbarara University of Science and Technology, Mbarara, Uganda (Kyengera); the University of Maryland School of Medicine, Baltimore, USA (O'Hara); and the Department of Orthopaedics, University of British Columbia, Vancouver, Canada (Stockton).

**Background:** In low-income countries, external fixation is often the standard of care for the definitive treatment of open tibial shaft fractures. In contrast, intramedullary (IM) nailing is the standard in most high-income countries. We performed a parallel-group, randomized clinical trial at a regional hospital in Uganda to compare unreamed IM nailing and external fixation to treat open tibial shaft fractures. **Methods:** We screened all skeletally mature patients presenting to the study location with open tibial shaft fractures. Patients were included if they presented with Gustilo–Anderson type II or IIIA open tibial shaft fractures and received definitive treatment within 24 hours. Our primary outcome was function, measured with the Function Index for Trauma (FIX-IT) score at 6 weeks, 3 months, 6 months and 12 months after randomization. Secondary outcomes included quality of life (EQ-5D-3L), malunion, nonunion and deep surgical site infection. We calculated treatment effects using Bayesian models informed by prior meta-analysis data, which suggest a medium treatment benefit with IM nailing. In these analyses, we estimate if the probability of treatment benefit in our study population continued to favour IM nailing at levels consistent with prior high-income country data. **Results:** The trial enrolled 55 patients ( $n = 31$  to IM nailing and  $n = 24$  to external fixation) with a mean age of  $39 \pm 12$  years, and 65% were male. IM nailing improved the 1-year average FIX-IT score by 1.4 points (95% credible interval [CrI] 0.7 to 2.1) compared with external fixation. Given these results, the probability of any improvement in the FIX-IT score with IM nailing was 99%, but the probability of the difference exceeding previously reported effects was only 38%. IM nailing also increased 1-year quality of life by 0.05 points (95% CrI 0.00 to 0.10) and decreased rates of malunion (difference -14%, 95% CrI -27% to -2%) and nonunion (difference -5.3%, 95% CrI

–18% to 5%). The rates of deep infection did not differ between groups (difference 0%, 95% CrI –18% to 19%). **Conclusion:** Our findings suggest that IM nailing has broad treatment benefits compared with external fixation for the treatment of open tibial shaft fractures in low-resource settings. However, it is unlikely that these treatment benefits exceed the minimal clinically important differences necessary to justify the additional costs and resources required for IM nailing, given the economic constraints in many low-income country hospitals.

**Surgical simulation training for medical students: strategies and implications in Botswana.** *Alemayehu Bedada, Marvin Hsiao, Unami Chilisa, Brianna Yarranton, Nkbabe Chinyepi, Georges Azzie.* From the Department of Surgery, Faculty of Medicine, University of Botswana, Gaborone, Botswana (Bedada, Chilisa, Chinyepi); the Division of General Surgery, Royal Columbian Hospital, New Westminster, Canada (Hsiao); the Temerty Faculty of Medicine, University of Toronto, Toronto, Canada (Yarranton); the Division of General and Thoracic Surgery, Hospital for Sick Children, Toronto, Canada (Azzie); and the Princess Marina Hospital, Gaborone, Botswana (Bedada, Chilisa, Chinyepi).

**Background:** The role of simulation in teaching skills to medical students is ill-defined. Strategic approaches are relevant where teachers, time and resources are limited, as in low- and middle-income countries. Our study objective was to evaluate the effectiveness of simulation in teaching surgical skills to medical students in Botswana. The study assesses the impact and effectiveness of the seniority of the teachers, potentially decreasing the dependence on expatriate educators and creating a self-sufficient educational system. **Methods:** Sixty-seven third-year and 67 fifth-year medical students at the University of Botswana were taught surgical skills by a peer medical student, a medical officer with no specialty training or a staff surgeon. Pre- and post-intervention performance of 2 basic tasks (simple interrupted suture and laparoscopic peg transfer) and 1 complex task (laparoscopic intracorporeal suture) were assessed. Subjective measures of self-perceived performance, preparedness for internship, and interest in surgery were also measured. **Results:** The simulation program decreased the time to complete the 2 basic tasks and improved the objective score for the complex task. Performance of the basic skills improved regardless of the seniority of the instructor, whereas performance of the advanced skill improved more when taught by a staff surgeon. All students had similar improvements in their self-reported confidence to perform the skills, preparedness for internship and to assist in an operation, regardless of the seniority of their instructor. **Conclusion:** With careful planning, simulation-based teaching of defined surgical skills can be effectively conducted. Local stakeholders can be empowered to engage peers and near-peers, without compromising the quality of education. The implications are widespread and may be most relevant where time, resources and experienced teachers are limited, allowing the creation of self-sufficient programs that do not depend on external parties.

**Disparities in trauma outcomes for Indigenous Peoples in Canada: a systematic review and meta-analysis.** *Jeongyoon Moon, Zachary Rebany, Mehrshad Bakhshi, Amy Bergeron, Nathalie Boulanger, Larry Watt, Evan G. Wong.* From the Department of Surgery, McGill University, Montreal, Canada (Moon, Rehany, Bakhshi, Bergeron, Wong); the Régie Régionale de la Santé et des Services Sociaux du Nunavik, Kuujjuaq, Canada (Boulanger); and the Tulattavik Health Centre, Kuujjuaq, Canada (Watt).

**Background:** The Indigenous Peoples of Canada experience higher incidences of traumatic injuries, yet suffer from significant disparities in access to health care. To date, the existing literature on trauma outcomes for this patient population has not been synthesized. The main objective of this systematic review was to summarize the existing literature comparing differences in outcomes following traumatic injuries between the Indigenous and non-Indigenous populations of Canada. **Methods:** The review protocol was registered a priori with the International Prospective Register of Systematic Reviews (PROSPERO) (CRD42021261479). MEDLINE, Embase, and the Cochrane library, including CENTRAL, were systematically searched from inception to September 2021 to identify studies comparing injury outcomes between Indigenous and non-Indigenous populations of Canada. Two independent reviewers extracted data and assessed risk of bias. The primary outcome was mortality. Injury mortality rate ratios were pooled across studies using a random-effects model. Secondary outcomes included length of stay and years of potential life lost (YPLL). **Results:** The search strategy yielded 1499 articles, of which 45 were retrieved for full-text review. Twelve studies met the criteria for our systematic review. The meta-analysis included a total of 904 487 Indigenous and 55 956 841 non-Indigenous people. The injury mortality rate ratio was 2.95 (pooled 95% confidence interval 2.18–3.98) for Indigenous Peoples as compared with the rest of the population. Significant heterogeneity was observed ( $I^2 = 95\%$ ). Indigenous status was also associated with an increase in length of stay ( $42.3 \pm 39.9$  d v.  $25.4 \pm 30.6$  d,  $p < 0.05$ ) and YPLL ( $+292.90/100\,000$  person-years). **Conclusion:** The Indigenous Peoples of Canada experience higher rates of death and overall poorer outcomes following traumatic injuries than the non-Indigenous population. The explanation for the major discrepancy in trauma outcomes is multifactorial, including delays in transfer to definitive care and systemic marginalization of Indigenous people from mainstream health care. This study should serve as an impetus to address these health disparities.

**Development of universal academic competencies for the global surgeon: a modified Delphi consensus study.** *Natalie Pawlak, Christine Bierema, Emmanuel Ameh, Abebe Bekele, Maria F. Jimenez, Kokila Lakshoo, Nobhojit Roy, Hernan Sacato, Girma Tefera, Doruk Ozgediz, Sudha Jayaraman.* From the Tufts University School of Medicine, Boston, USA (Pawlak); Virginia Commonwealth University Health System Department of Surgery, Richmond, USA (Bierema); Ahmadu Bello University, Zaria, Nigeria (Ameh); the University Teaching Hospital Division of Pediatric Surgery, Addis Ababa University Department of

Surgery, Addis Ababa, Ethiopia (Bekele); Hospital Universitario Mayor Mederi, Department of Surgery, Bogotá, Colombia (Jimenez); Great Ormond Street Children's Hospital, Department of Pediatric Surgery, London, UK (Lakhoo); BARC Hospital, Department of Surgery, Mumbai, India (Roy); the Universidad del Azuay Facultad de Medicina, Cuenca, Ecuador (Sacato); the University of Wisconsin School of Medicine and Public Health, Department of Surgery, Madison, USA (Tefera); the University of California San Francisco, Department of Surgery, San Francisco, USA (Ozgediz); and the University of Utah, Department of Surgery, Salt Lake City, USA (Jayaraman).

**Background:** Global surgery is a new, rapidly growing field within global health that aims to improve access to safe surgical care worldwide. However, no standardized universally accepted curriculum exists to ensure that trainees gain the necessary competencies to engage in equitable and sustainable global surgery work. A consensus-based approach, with input from experts in both high-income countries (HICs) and low- and middle-income countries (LMICs) is needed to develop curricula on global surgery for trainees worldwide. The aim of this project was to develop consensus on the fundamental competencies in academic global surgery to enable curriculum development and formalization of the field. **Methods:** A multidisciplinary taskforce of experts across different geographic regions was convened by a logistics team from the American College of Surgeons to gather a list of experts in global surgery and education for participation in the survey. A list of competencies and objectives was created based on published literature and existing competencies in medical education and global health. Two rounds of surveys were conducted with Likert and open text responses that were synthesized by the logistics and taskforce members. A threshold of 80% consensus was used to determine whether a competency or objective could be included. **Results:** A total of 64 individuals from 22 countries took part in building this universal framework; 59 respondents participated in both rounds, of whom 37 (63%) were from LMICs. Consensus was reached on 9 core competencies and 31 subcompetency objectives that were further divided into novice and advanced curricula. The greatest consensus pertained to competency in the global burden of surgical disease and ethics and professionalism in global surgery. **Conclusion:** This Delphi process, with input from HIC and LMIC experts, produced 9 competencies to guide global surgery curricula development and provide an equitable approach to defining the field of academic global surgery.

**PAPSEP — Pan-African Paediatric Surgery E-Learning Programme.** *Ines Peric, George Youngson, Emmanuel Ameh, Eric Borgstein, Eric O'Flynn.* From the Royal College of Surgeons in Ireland Institute of Global Surgery, Dublin, Ireland (Peric, O'Flynn); Kids Operating Room, Aberdeen, UK (Youngson); the West African College of Surgeons, Abuja, Nigeria (Ameh); and the College of Surgeons of East, Central and Southern Africa, Blantyre, Malawi (Borgstein).

**Background:** In most of the world's poorest countries children account for more than half of the population, and many will require a surgical intervention. The majority of children

in these environments do not have access to surgical care. One of the reasons for that is the inadequate pediatric surgical workforce. In order to scale up that workforce in a geographically dispersed training environment across Sub-Saharan Africa, a distributed model of learning has been created in line with the needs of local training partners. The Royal College of Surgeons in Ireland Institute of Global Surgery and Kids Operating Room partnered with the West Africa College of Surgeons (WACS) and the College of Surgeons of East, Central and Southern Africa (COSECSA) to launch the first Pan-African Paediatric Surgery E-Learning Programme. The objective of this study was to analyze the first year of the program usage and to identify strengths and weaknesses of the program using trainees' feedback. **Methods:** Data relating to trainee usage during the first year was collated in collaboration with WACS and COSECSA via the Moodle platform and analyzed using descriptive statistics. **Results:** In the first year the trainee engagement was satisfactory, with more COSECSA than WACS trainees engaging with the program. Trainees were asked for quantitative and qualitative feedback on modules, with their responses being largely positive. Online discussions were moved from asynchronous to live as a response to trainees' engagement and feedback. **Conclusion:** The data show that this resource is well integrated with the needs of local training partners and is welcomed by both trainees and trainers. The program is a model of intercollegiate African collaboration, and it ensures that all trainees, across different training environments, have access to a structured academic program and context-appropriate material. This program has the potential to create a connected pediatric surgery community and to contribute to scaling up the pediatric surgical care workforce in Sub-Saharan Africa.

**Catastrophic expenditure and treatment attrition in patients seeking colorectal cancer treatment in India: a prospective multicentre study.** *CROCODILE study group, Joana Simoes, Pamela A. Kingsley.* From the University of Birmingham, Birmingham, UK (CROCODILE study group, Simoes); and the Christian Medical College and Hospital, Ludhiana, India (Kingsley).

**Background:** Although the incidence of colorectal cancer is increasing in India, the cost of comprehensive treatment and its consequences for patients and households are unknown. This study aimed to describe catastrophic expenditure and treatment attrition in patients with a treatment plan for colorectal cancer. **Methods:** A prospective, multicentre cohort study was conducted in 5 tertiary hospitals in India from December 2020 to March 2022. Consecutive patients with a new treatment plan for colorectal cancer were followed-up for 6 months. From the total cost of treatment, out-of-pocket payments (OOPPs; paid by patients at the time of service use) and covered by third parties (insurance, public funds) were reported. The primary outcome was catastrophic expenditure, defined OOPPs higher than 25% of the patient's annual household income, and the secondary outcome was treatment attrition, defined as unplanned interruption of the treatment course not recommended by the clinical team. OOPPs in patients with and without catastrophic expenditure and treatment attrition were compared. **Results:** Of 226 patients included, 20 died within 6 months of being

offered a treatment plan and 4 were lost to follow-up. The median total cost of colorectal cancer treatment was INR 407 508 (USD \$5340), to which the biggest contributor was the patient's OOPs (median INR 330 277 [USD \$4328]). Surgery and anesthesia costs (median INR 85 944 [USD \$1126]) were higher than radiotherapy (median INR 55 525 [USD \$728]) and chemotherapy (median INR 14 780 [USD \$194]). The overall catastrophic expenditure rate was 90.1% (182/202) and the treatment attrition rate was 9.4% (19/202). Patients with treatment attrition made lower OOPs than those who completed treatment (median INR 205 926 v. INR 349 398,  $p < 0.01$ ) but had a similar risk of catastrophic expenditure (odds ratio 0.23, 95% confidence interval 0.03–2.28,  $p = 0.186$ ). **Conclusion:** Most of the colorectal cancer treatment costs were paid out-of-pocket by patients, and catastrophic expenditure was common. Treatment attrition rates at tertiary centres were low, suggesting greater attrition at previous stages of care. Better financial protection may allow more patients to receive comprehensive cancer treatment while avoiding household financial catastrophe.

**Access to pediatric cardiac care in Tanzania.** *Lior Sasson, Hagi Dekel, Alona Raucher Sternfeld, Sagi Assa, Racheli Sion Sarid, Naizibijwa Joel Mnong'one, Godwin Godfrey Sharau, Stella Mibayo Mongella, William Goldstein Caryl, Bernard Goldman.* From the Departments of Cardiac Surgery, Cardiology and Intensive Care, Sylvan Adams Children's Hospital and Save a Child's Heart International Pediatric Cardiac Care Center at the Wolfson Medical Center, affiliated with Tel Aviv University, Holon, Israel (Sasson, Dekel, Sternfeld, Assa, Sarid); the Departments of Cardiac Surgery and Cardiology, Jakaya Kikwete Cardiac Institute, Dar es Salaam, Tanzania (Mnong'one, Sharau, Mongella); and the Division of Cardiac Surgery, Sunnybrook Health Sciences Centre and Save a Child's Heart Canada, Toronto, Canada (Caryl, Goldman).

**Background:** Pediatric cardiac care resources are inadequate in most countries. Children with congenital or acquired heart disease are either referred to Western centres or depend on intermittent visits (missions) to local hospitals. Save a Child's Heart (SACH) has brought more than 6000 children from 63 countries to Israel for surgery since 1995; of these, 735 came from Tanzania and Zanzibar. Since 2011, SACH has conducted 13 surgical and interventional missions in Tanzania (total of 197 children treated), with 17 screening (diagnostic) missions in Tanzania and 8 in adjacent Zanzibar. Our study objective was to assist in the development of an independent, sustainable pediatric cardiac centre of competence in Tanzania. **Methods:** SACH embarked on a stand-alone pediatric cardiac service in Tanzania after the central government expressed support for a cardiac institute (Jakaya Kikwete Cardiac Institute [JKCI]) in the capital. Over a 12-year interval, SACH trained the core persons needed: surgeons, anesthetists, cardiologists, intensivists, interventionalists, technicians, perfusionists and operating room and intensive care unit nurses (24 in total). Performance reviews were routinely conducted. Trainees spent 3 months to 5 years in Israel, depending on previous experience. SACH missions to JKCI continued during the training period. SACH Canada assumed responsibility for salary support, new equipment and

disposables plus mission costs; board members attended 2 missions as observers. **Results:** Surgical volumes for 2020 (121 patients) and 2021 (240 patients) reflected increased capacity with satisfactory outcomes. A JKCI screening mission to Zanzibar resulted in children referred to both Israel and JKCI. There is a significant backlog of patients in a Tanzanian population of more than 61 million. **Conclusion:** The goal of a functional, stand-alone, sustainable pediatric cardiac care service is possible in a low- to middle-income country. Government and other support from an expert Western centre for training and ongoing oversight is essential. Transition to a fully independent centre is in process.

**An evaluation of obstetrical data collection at health institutions in Mbarara region, Uganda, and Benue State, Nigeria.** *Rajan Bola, Joseph Ngonzi, Fanan Ujob, Raymond Bernard Kikumuro, Ronald Lett.* From the Canadian Network for International Surgery, Canada (Bola, Lett); the Mbarara University of Science and Technology, Mbarara, Uganda (Ngonzi, Kikumuro); and the London South Bank University, London, UK (Ujob).

**Background:** Obstetrical decision-making relies on comprehensive data sources. The breadth and completion of obstetrical data at health institutions in low- to middle-income countries (LMICs) is not well documented. Likewise, minimal data sets, which can be used to guide sufficient obstetrical data collection in LMICs, have not been proposed in the literature. The Community Maternal Danger Score (CMDS) is a validated 7-domain digital assessment tool that can be repurposed as a minimal data set. We evaluated and compared obstetrical data collected at health centres in Mbarara, Uganda, and Benue State, Nigeria, to the 7 domains of the CMDS data set. **Methods:** The study was conducted at 9 health institutions, where a needs assessment demonstrated inconsistent documentation of obstetrical data. We examined forms used to record patients' obstetrical information. The percent completion for each variable was calculated and mapped to the 7 domains of the CMDS: age, parity, patient size, obstetrical history, fundal height, coexisting conditions and signs of preeclampsia. Completion of a variable for 80% of patients or more was considered adequate. **Results:** The number of collected variables ranged from 23 to 45 at Ugandan institutions, and from 9 to 18 at Nigerian institutions. In total, 69 unique variables were collected. The variables from Ugandan institutions were reflective of the scope of the CMDS but had low completion rates. The average proportion of CMDS variables that exceeded the 80% threshold from the 4 Ugandan institutions was 44.6% (range 9%–76%). The variables recorded at Nigerian institutions were less comprehensive, but more complete. The average proportion of CMDS variables that exceeded the 80% threshold from the 5 Nigerian institutions was 76.5% (range 50%–100%). **Conclusion:** We recommend that obstetrical data collection be standardized. The 7 domains of the CMDS can form the basis of a minimal data set that will reduce missingness for important variables and promote timely analysis and dissemination of obstetrical data.

**Association of socioeconomic vulnerability among pregnant women with death rate by postpartum hemorrhage in Minas Gerais, Brazil.** *Amanda Torquato, Clara Tavares, Gabriele*



**Lech.** From the University of Vale do Rio Doce, Faculty of Medicine, Governador Valadares, Brazil (Torquato); Salvador University, Faculty of Medicine, Salvador, Brazil (Tavares); and Pontifical Catholic University of Rio Grande do Sul, Faculty of Medicine, Porto Alegre, Brazil (Lech).

**Background:** Postpartum hemorrhage is an important risk factor for maternal mortality, and the lack of obstetrics centres in some vulnerable regions in developmental countries could be related to its associated death rate. We aimed to correlate maternal socioeconomic vulnerability with the death rate from postpartum hemorrhage in Minas Gerais, Brazil. **Methods:** Using the database from the Brazilian Health Ministry, DATASUS, we collected data for the death rate from postpartum hemorrhage from 2016 to 2022 for all health regions in the state of Minas Gerais. We also looked out for the gross domestic product (GDP) per capita and the Human Development Index (HDI) in these same regions on the Brazilian Geographic and Statistical Institute. **Results:** The average death rate from postpartum hemorrhage among all health regions was 0.62. The second-highest death rate was from Araçuaí (14.29); the highest death rate was not included in the study owing to the small number of cases, which could distort the analysis. The capital of Minas Gerais, Belo Horizonte, included in the most populous health region, had a death rate of 0.25. When analyzing socioeconomic parameters, the region with the second-highest death rate also had an HDI of 0.663 compared with an HDI of 0.810 in Belo Horizonte; regarding the GDP, the same region showed a cost of R\$12 588.17 (USD \$2368.82) compared with R\$38 695.31 (USD \$7281.63) for Belo Horizonte. Therefore, access to adequate obstetrics referral centres may be correlated with the cause of death studied. **Conclusion:** The association between socioeconomic status and maternal deaths is a concerning health issue, since there is a significant difference in access to efficient health care among the regions analyzed. Those disparities show the importance of the global surgery struggle for equitable access to these procedures in middle-income countries.

**The efficiency of digital midwifery training: a randomized controlled trial in Benue State, Nigeria.** *Anja Džunic, Fanan Ujoh, Victoria Gusa, Rosemary Apeaii, Rafat Noor, Rajan Bola, Isaac Obene Guyan, Jan Christilaw, Stephen Hodgins\*, Ronald Lett\*.* From the School of Public Health, University of Alberta, Edmonton, Canada (Džunic, Hodgins); the Canadian Network for International Surgery, Vancouver, Canada (Ujoh, Bola, Guyan, Christilaw, Lett); the School of Nursing and Midwifery, Makurdi, Nigeria (Gusa); the School of Midwifery, Mkar, Nigeria (Apeaii); and the Faculty of Medicine and Dentistry, University of Alberta, Edmonton, Canada (Noor). \*Joint senior authors.

**Background:** Health education institutions in African countries like Nigeria are experiencing major increases in the number of students enrolled, but lack sufficient instructors to train them. Digital learning could improve efficiency in health education if proven to successfully augment knowledge and skills. A needs assessment with midwifery students confirmed that digital learning could be feasible and welcomed. Our study objective was to determine if digital delivery of the Fundamental Interventions, Referral and Safe Transfer (FIRST) course is at least

equally effective for training midwifery students as small-group delivery of the same program. **Methods:** A noninferiority crossover randomized controlled trial was conducted with 130 second-year students from 2 midwifery schools in Benue State, Nigeria. Students were randomly assigned into 6 cohorts. Each cohort received half of the course on a mobile phone Learning Management Platform, and the other half through standard small-group teaching. Students' knowledge, thinking and technical skills were assessed using a pre-test and post-test, Objective Structured Clinical Exam (OSCE) and daily modular quizzes. A difference-in-difference analysis was used. **Results:** Students' knowledge and thinking skills in the digital learning arm (75.26%) did not significantly differ from that in the small-group learning arm (75.02%,  $p = 0.404$ ). Students in both groups significantly improved their knowledge by 20% compared with pre-test results. Some differences were observed between digital and small-group learning, disaggregating by module and midwifery school. Although there was a trend in small-group teaching of technical skills being more effective, no significant differences between groups were observed in the OSCE ( $p = 0.06$ ). Students in both learning groups learned equally well regardless of age, gender and entrance score. **Conclusion:** Digital learning is as effective as small-group learning to augment knowledge, thinking and technical skills in midwifery, and more efficient as it requires fewer human resources. The finding of noninferiority of digital learning may be relevant to other disciplines and should be evaluated across clinical education programs.

**Creating concise reference videos for a low-resource Essential Surgical Skills Training Program: a MSF-UBC Global Surgery Laboratory Collaboration.** *Catherine Binda, Kayoung Heo, Samuel Cheng, Hannah Foggin, Nina Maerkl, Grace Hu, Sbeila Lam, Lydia Feng, Alisha Labinaz, Jayd Adams, Rachel Livergant, Sacha Williams, Tamilarasy Vasanthakumaran, Youcef Lounes, Juan Mata, Philip Hache, Christian Schamberg-Bahadori, Adaw Monyтуil, Emmanuel Mayom, Shabrzad Joharifard, Émilie Joos.* From the Faculty of Medicine, University of British Columbia, Vancouver, Canada (Binda, Heo, Cheng, Foggin, Labinaz, Mata, Joharifard, Joos); the Department of Obstetrics and Gynaecology, University of British Columbia, Vancouver, Canada (Maerkl); the Faculty of Science, University of British Columbia, Vancouver, Canada (Hu, Lam, Feng, Adams); the Faculty of Medicine and Dentistry, University of Alberta, Edmonton, Canada (Livergant); the Department of Experimental Surgery, McGill University, Montréal, Canada (Williams); the Global Clinical Scholars Research Training Program, Harvard Medical School, Boston, USA (Vasanthakumaran); the Vancouver General Hospital, University of British Columbia, Vancouver, Canada (Lounes, Joos); the Department of Medicine, McMaster University, Hamilton, Canada (Hache); the Johannes Gutenberg University of Mainz, Mainz, Germany (Schamberg-Bahadori); the Main-Klinik Ochsenfurt Teaching Hospital, Ochsenfurt, Germany (Schamberg-Bahadori); the Aweil State Hospital, Aweil, South Sudan (Monyтуil, Mayom); and the BC Children's Hospital, Vancouver, Canada (Joharifard).

**Background:** The University of British Columbia (UBC) Global Surgery Laboratory and Médecins Sans Frontières (MSF) piloted an Essential Surgical Skills Training Program

(ESSTP) for nonsurgeon physicians in low-resource settings in South Sudan (2020–2022). Responding to trainees' feedback, educational surgical skills videos were created to augment the curriculum. Our objective was to create short educational videos featuring essential surgical procedures that can be used as "just-in-time" reference guides in the field and to increase the availability of surgical training materials in low-resource settings. **Methods:** Consultation with stakeholders, including ESSTP trainees, MSF surgeons and UBC educators, prioritized high-yield procedures relevant to the local context. Video footage from MSF (Dusseldorf, September 2020) and the UBC Cadaver Laboratory (November 2021 to April 2022) was paired with original graphics created using Procreate, Microsoft PowerPoint and Adobe Illustrator. A multidisciplinary team of 4 undergraduate students, 6 medical trainees and 10 content experts collaborated to identify the goal, indications and key steps of each procedure. Videos were scripted and assembled using iMovie, Resolve and Apple Voice Memos. A cue-card summarizing each procedure was created with an accompanying QR code. Using the plan–do–study–act cycle, videos were reviewed by trainees and content experts and adjusted based on qualitative feedback. Project outcomes included qualitative feedback from stakeholders and the number of videos produced. **Results:** Videos featuring fasciotomies, chest tubes and B-Lynch sutures were identified as high-yield procedures. Between February 2021 and April 2022, 7 videos and cue cards were completed. Completed videos averaged 3.6 minutes in length and were well received by stakeholders, including the South Sudanese trainees who have used them twice to perform fasciotomies. **Conclusion:** Concise educational videos can augment essential surgical skills training programs for nonsurgeon physicians. Hosting videos on accessible platforms like Google Drive, storing videos at lower resolutions and creating cue cards increase the accessibility of video resources in low-resource settings.

**Surgical outcomes for women in Africa: an international risk-adjusted analysis of prospective observational cohorts.** *Amy Paterson\**, *Salome Maswime*, *Anneli Hardy*, *Rupert M. Pearce*, *Bruce M. Biccard*; *in collaboration with the African Surgical Outcomes (ASOS) group and International Surgical Outcomes (ISOS) group.* From the Global Surgery Division, Department of Surgery, University of Cape Town, Cape Town, South Africa (Paterson, Maswime, Biccard); the Global Surgery Group, Nuffield Department of Surgical Sciences, University of Oxford, Oxford, UK (Paterson); the Department of Statistical Sciences, University of Cape Town, Cape Town, South Africa (Hardy); the Critical Care and Perioperative Medicine Research Group, Queen Mary University of London, London, UK (Pearce); and the Department of Anaesthesia and Perioperative Medicine, Groote Schuur Hospital and University of Cape Town, Cape Town, South Africa (Biccard).

**Background:** Improving women's health is a critical component of sustainable development goals. While there is an ongoing need to increase access to surgical care for women in African countries, it is important that this surgery is safe and that excess postoperative complications and deaths are prevented. Although obstetric outcomes in Africa have begun to

receive significant focus, nonobstetric surgical outcomes for women in Africa remain underexamined. This study's objective was to compare the nonobstetric and nongynecological surgical outcomes for women in Africa to international outcomes using a risk-adjusted analysis of severe postoperative complications. **Methods:** We did a secondary analysis of the African Surgical Outcomes Study (ASOS) and International Surgical Outcomes Study (ISOS), both 7-day prospective observational cohort studies of outcomes following elective adult inpatient surgery. This substudy focuses specifically on the analysis of the female, nonobstetric and nongynecological surgical data collected during these 2 large multicentre studies. The African data from both cohorts are compared with international (non-African) outcomes in a risk-adjusted logistic regression analysis. The primary outcomes were in-hospital postoperative complications and an adjusted odds ratio (aOR) for developing severe postoperative complications. **Results:** A total of 1698 African participants and 18 449 international participants met our inclusion criteria. The African cohort was younger than the international cohort and had a lower preoperative risk profile. Severe complications occurred in 2.9% (48 of 1671) and 2.3% (431 of 18 449) of patients in the African and international cohorts, respectively, with in-hospital mortality following severe complications of 47.9% (23 of 48) in Africa and 18.1% (78 of 431) internationally. Women in Africa had an aOR 2.214 (95% confidence interval 1.568–3.125,  $p < 0.00001$ ) of developing a severe postoperative complication following elective nonobstetric, nongynecological surgery, compared with the international cohort. **Conclusion:** Women in Africa have double the odds of severe postoperative complications following elective nonobstetric, nongynecological surgery compared with the international incidence.

**Update on the evaluation of a surgical task-sharing program in South Sudan.** *Mina Salehi*, *Irena Zivkovic*, *Sukhdeep Jatana*, *Shabrizad Joharifard*, *Émilie Joos.* From the Division of Trauma and Acute Care Surgery, Department of Surgery, University of British Columbia, Vancouver, Canada (Salehi, Joos); the School of Medicine, University of British Columbia, Vancouver, Canada (Zivkovic); the Faculty of Medicine and Health Sciences, McGill University, Montréal, Canada (Jatana); and the Division of Pediatric Surgery, Department of Surgery, BC Children's Hospital, Vancouver, Canada (Joharifard).

**Background:** Globally, Sub-Saharan Africa is the region with the most limited access to surgical care. Growing the surgical workforce is crucial to closing this gap in care accessibility. In 2019, the University of British Columbia collaborated with Médecins Sans Frontières (MSF) to create the Essential Surgical Skills (ESS) program, launched at Aweil State Hospital, South Sudan, in order to increase local surgical capacity. Our objective was to evaluate the progress and surgical competencies of trainees enrolled in the ESS program. **Methods:** This is a mixed-method prospective cohort study evaluating trainee progress in the ESS program. Quantitative data include pre- and post-training outputs (procedure logbooks, morbidity and mortality rates) and surgical proficiency (quizzes, Entrustable Professional Activities [EPAs]). Qualitative data include

trainee semistructured interviews. **Results:** From May 2019 to December 2021, trainees performed 416 procedures. The most common procedures were skin grafting (15.6%), abscess drainage (13.1%) and reduction and splinting (12.3%). A total of 327 EPAs were completed, out of which 254 (77.6%) showed that the trainee could independently perform the procedure. Trainees have demonstrated full competency in the burn management and safe surgery modules. The pass rate for all quizzes was 100%. Surgical mortality rates recorded during the implementation of the ESS program remained unchanged from preimplementation rates (pretraining: 0.6%; during training: 0.1%;  $p = 0.0541$ ). Surgical morbidity rates demonstrated a decline from 17% preimplementation to 12% postimplementation ( $p = 0.1767$ ). Semistructured interviews indicated that trainees felt the program was empowering and key to their career development. **Conclusion:** Our study suggests that providing ESS training to general practitioners in under-resourced settings via a virtual platform is feasible. The COVID-19 global pandemic highlighted the need to make low- and middle-income countries independent from fly-in trainers and traditional apprenticeship models. Future work includes the expansion of this program to the MSF project in Bangui, Central African Republic.

**Estimating the indirect economic impact of fracture-related infection and/or nonunion: a secondary analysis of the Pilot Local Gentamicin for Open Tibial Fractures in Tanzania (pGO-Tibia).** *Michael J. Flores, Kelsey E. Brown, Heather J. Roberts, Claire A. Donnelley, Ericka P. von Kaeppler, Edmund Eliezer, Billy Haonga, Saam Morshed, David W. Shearer.* From the Institute for Global Orthopaedics and Traumatology, University of California San Francisco, San Francisco, USA (Flores, Brown, Roberts, Donnelley, von Kaeppler, Morshed, Shearer); and the Muhimbili Orthopaedic Institute, Dar es Salaam, Tanzania (Eliezer, Haonga).

**Background:** Tibial fractures contribute significantly to global disability. These fractures have high risk for complications, as they are often open fractures resulting from high-energy mechanisms. Although the direct economic impact of tibial fractures and their complications are high, their indirect economic impact is less understood, especially in low-resource settings. The aim of the current study was to estimate the indirect economic impact of tibial fractures and their complications in Tanzania. **Methods:** We identified the economic impact of an adverse event (AE), defined as a fracture-related infection and/or nonunion, using data collected during the Pilot Local Gentamicin for Open Tibial Fractures in Tanzania (pGO-Tibia) trial conducted in Dar es Salaam, Tanzania. Indirect economic impact was analyzed from the perspective of return to work (RTW), lost productivity and other indirect costs. RTW was analyzed using a survival analysis model. Lost productivity included paid and unpaid work hours, which were integrated and compared between groups. A weighted-average hourly wage was calculated using published Tanzanian data. Costs were converted into purchasing power parity-adjusted US dollars. Statistics were performed using Stata 17. **Results:** Fifty percent of patients worked at 1-year follow-up. AEs were significantly associated with longer rates of RTW. Lost productivity was nearly double with AEs, losing 86% of 1-year productivity (\$2224). Outside health care costs differed significantly with AEs. Total mean indirect cost was \$2385 with an AE, representing 92% of annual income and an increase of \$1195 in indirect costs. Additionally, significantly more patients with AEs reported difficulty affording household expenses postinjury and borrowing money for medical expenses. **Conclusion:** To our knowledge, this is one of the first studies estimating the indirect economic impact of tibial fractures and their complications in a low-resource setting. This study identified serious economic burdens following tibial fractures, with AEs leading to significantly higher indirect costs.