



Research Article

A decade of global health partnership to advance obstetric anesthesia practices in the Balkans: a retrospective analysis of neuraxial anesthesia and analgesia use at a major teaching hospital in Serbia (2012–2025)

Borislava P. Pujic^a, Ivan A. Velickovic^b, Curtis L. Baysinger^c, Craig M. Palmer^d, Aleksandra T. Vejnovic^{e,1}, Ferne R. Braveman^f, Nada Z. Pejic^g, Slavica B. Krusic^h, Mirjana L. Kendrisicⁱ, Sebnem F. Ucer^j, Medge D. Owen^{k,*}

^a Department of Anesthesia, University Clinical Center Vojvodina, Gynecology and Obstetrics Hospital, Novi Sad, Serbia

^b Department of Anesthesiology, New York City Health + Hospitals, Kings County Hospital, Brookland, New York, United States of America

^c Department of Anesthesiology, Vanderbilt University Medical Center, Nashville, TN, United States of America

^d Department of Anesthesiology, University of Arizona College of Medicine, Tucson, AZ, United States of America

^e Department of Gynecology and Obstetrics, University Clinical Center Vojvodina, Gynecology and Obstetrics Hospital, Novi Sad, Serbia

^f Department of Anesthesiology, Yale University School of Medicine, New Haven, CT, United States of America

^g Clinic of Anesthesiology and Intensive Therapy, University Clinical Center Nis, Nis, Serbia

^h Gynecology and Obstetrics Hospital Narodni Front, Belgrade, Serbia

ⁱ General Hospital Sremska Mitrovica, Serbia

^j Kybele, Inc., Winston-Salem, NC, United States of America

^k Department of Anesthesiology, Wake Forest University School of Medicine, Winston-Salem, NC, United States of America

¹ University of Novi Sad, Faculty of Medicine, Novi Sad, Serbia

ARTICLE INFO

Keywords:

Obstetric anesthesia
Global health
Neuraxial anesthesia
Neuraxial labor analgesia
Cesarean delivery

ABSTRACT

Background: Neuraxial anesthesia use for cesarean delivery and neuraxial labor analgesia in the Balkans is low due to previous regional conflict and long-standing traditions. In 2012, Serbian anesthesiologists at the University Clinical Center of Vojvodina initiated collaboration with Kybele, Inc. to improve obstetric anesthesia practices. A unique training experience was offered to anesthesiologists from Serbia and surrounding countries, facilitated by international experts. This study describes the intervention and changes in neuraxial anesthesia use from 2012 to 2025.

Methods: A one to two week hands-on and didactic obstetric anesthesia school was conducted annually or biannually from 2012 to 2025; in-person activities were interrupted from 2020 to 2022. Training included spinal, epidural and combined-spinal epidural techniques for cesarean delivery and labor analgesia, and truncal nerve blocks for postoperative pain control. Participant demographics and longitudinal trends in neuraxial anesthesia use for cesarean delivery and neuraxial labor analgesia were collected.

Results: 130 anesthesiologists from 41 hospitals across five countries attended the hands-on school; 36.2% participated multiple times. At University Clinical Center of Vojvodina, neuraxial anesthesia use for cesarean delivery increased from 13.8% in 2011 to 79.9% in 2025 (4.7% average annual rate of change; t value = 3.24; P = 0.006). Labor analgesia use increased from 2.0% to 14.1% (P < 0.001).

Conclusion: A longitudinal global health partnership supported obstetric anesthesia education and local training capacity. During this period, use of neuraxial anesthesia for cesarean delivery and neuraxial labor analgesia increased at University Clinical Center of Vojvodina.

Introduction

The use of neuraxial anesthesia for cesarean delivery (CD) and

neuraxial labor analgesia has become common in the United States (US), United Kingdom and in Western Europe^{1–3} but its use remains limited in many Eastern European countries, including the Balkans.⁴ Neuraxial

* Corresponding author at: Department of Anesthesiology, Wake Forest University School of Medicine, Medical Center Blvd., Winston-Salem, NC 27157.

E-mail address: medge.owen@advocatehealth.org (M.D. Owen).

<https://doi.org/10.1016/j.ijoa.2026.105270>

Accepted 22 August 2026

Available online 26 August 2026

0959-289X/© 2026 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

anesthesia is known to be safer than general anesthesia (GA) for CD, in both high-resource and low- and middle-income countries (LMIC), and is the preferred anesthetic method in most clinical situations.^{5,6} In the Balkan countries, comprising former Yugoslavia, a decade of political unrest in the 1990s had detrimental effects on healthcare, resulting in variation in the quality and continuity of services. In Serbia, for example, GA has been used for CD almost exclusively and neuraxial labor analgesia was non-existent, except in one Belgrade hospital.⁴ Joint efforts of several Serbian anesthesiologists to improve obstetric anesthesia standards in the region were limited by the engrained cultural and medical preferences for GA use for CD among obstetricians, patients, and anesthesiologists. These preferences, in addition to anesthesia workforce shortages, also restricted the administration of neuraxial labor analgesia.⁴ Furthermore, obstetric anesthesia residency education was limited. During a four-year anesthesiology training program in Serbia, residents spend only six weeks in a maternity hospital, where their experience is largely observational.⁴ Residents were only required to perform two neuraxial anesthetics and 10 GA techniques for CD and five neuraxial labor analgesia procedures. Limited faculty experience in providing obstetric neuraxial anesthesia hampered resident education, perpetuating the status quo.

To overcome local barriers, a School of Obstetric Anesthesia was established in 2012 at the University Clinical Centre of Vojvodina (UCCV) in Novi Sad, Serbia-largest city, in collaboration with Kybele, Inc., a US based non-profit organization dedicated to improving childbirth safety in LMIC through healthcare partnerships (www.kybeleworldwide.org). UCCV is a tertiary obstetric referral hospital in Northern Serbia, conducting approximately 10% of Serbia's 60,000 births per year.⁷ The hospital provides inpatient and outpatient obstetric,

gynecologic, and neonatal services with 230 beds, two obstetric operating theatres, six labor and delivery rooms, six first stage labor beds, an obstetric ICU, and a neonatal unit. The School of Obstetric Anesthesia provided hands-on training targeting anesthesiologists at UCCV and the surrounding region. This work describes the evolution of the School of Obstetric Anesthesia in Serbia from 2012 to 2025. The primary objective of this study was to evaluate change in neuraxial anesthesia use for cesarean delivery at UCCV from 2012 to 2025.

Methods

In September 2012, four physicians representing Kybele (two anesthesiologists, one obstetrician, and one neonatologist) were invited to UCCV, to understand local healthcare practices. A two-day medical conference and five days of clinical observations and teaching demonstrations of neuraxial anesthesia techniques for childbirth were conducted. A multi-year collaboration began to increase neuraxial anesthesia use for CD and neuraxial labor analgesia; a memorandum of understanding was signed between parties committing to annual training programs. A UCCV anesthesiologist was identified as the country host and liaison between stakeholders. In 2015, the country host attended the Society for Obstetric Anesthesia and Perinatology (SOAP) annual meeting and observed obstetric anesthesia practices in two US-based academic institutions (Wake Forest School of Medicine and Duke University Medical Center). The program timeline and implementation framework are shown in Fig. 1.

Annual (2013–2025) or biannual (2015–2016) visits comprised five to ten days of hands-on clinical instruction and two days of didactic lectures on mutually determined topics. The School of Obstetric

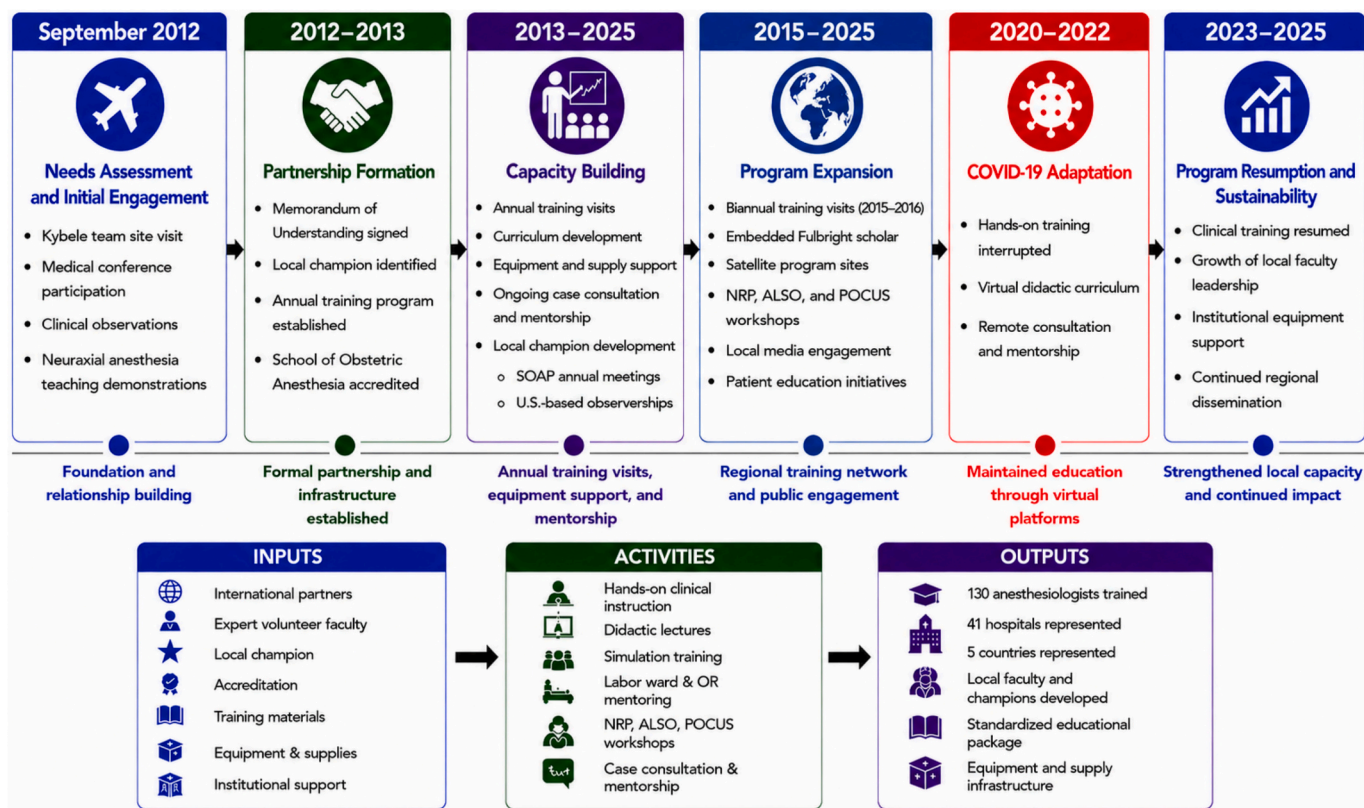


Fig. 1. Program development timeline and implementation framework (2012–2025).

The figure represents the program development timeline (top panel) and the implementation framework (bottom panel) for the Serbian School of Obstetric Anesthesia at the University Clinical Center of Vojvodina (UCCV). The figure illustrates the progression from initial needs assessment and partnership formation through longitudinal capacity building, regional expansion, adaptation during the COVID-19 pandemic with the associated implementation inputs, activities, and outputs. SOAP=Society for Obstetric Anesthesia and Perinatology, OR = operating room, NRP = newborn resuscitation program, ALSO = advanced life support in obstetrics, POCUS = point of care ultrasound.

Anesthesia was accredited by the Serbian Medical Council in 2013, and approved by the UCCV hospital administration, allowing anesthesiologists throughout Serbia and surrounding countries to participate. From 2020 to 2022, the COVID-19 pandemic interrupted the hands-on component, but the didactic program continued virtually. Didactic lectures increasingly included local presenters and were modified each year based on local input and institutional progress. Over time, offerings included neonatal resuscitation program (NRP) training, Advanced Life Support in Obstetrics (ALSO), and point of care ultrasound (POCUS) utilizing manikins or volunteers.

Hands-on clinical instruction began with simulation models and transitioned to patients in the labor ward and operating room. Initially, clinical instruction targeted UCCV faculty before expanding training to physicians from other Serbian cities and surrounding countries. Course participation was limited to maximize individual learning and patient privacy; each patient provided informed consent prior to neuraxial anesthesia or nerve block administration. Training included spinal anesthesia for CD, labor epidural analgesia, combined spinal-epidural for labor analgesia and CD, quadratus lumborum and transverse abdominis block administration for postoperative pain control, and managing the complications thereof. Local medical licensure was unnecessary for short term visiting clinicians provided patient care was conducted alongside a local physician; however, one visiting expert received a six-month US Fulbright International Exchange scholarship in 2015 and obtained local licensure.

An obstetric anesthesiology manual (Supplement 1) was developed in 2013–2014, derived from evidence-based practices at established US training institutions, to provide instructional continuity. The manual guided visiting training teams and served as a reference to the local physicians between visits. Initially, Kybele provided an epidural cart, two synthetic models for practicing epidural placement, and consumable epidural and airway supplies. Later, the hospital administration provided a sustained supply of pencil point needles, disposable epidural kits, monitoring devices, and syringe infusion pumps.

Briefings with the obstetric department chairman and hospital administrators were regularly held to discuss program effectiveness and to advocate for system-level change including personnel utilization, staffing schedules and resources for neuraxial anesthesia. Local media highlighted the international collaboration and the Obstetric Anesthetists' Association's (OAA) patient brochure on anesthetic choices for vaginal and CD was translated to Serbian.

Data was collected retrospectively from paper-based hospital records on obstetric neuraxial anesthesia and analgesia use at UCCV from 2012 to 2025. After UCCV Ethics Committee approval (reference # 00-59; January 31, 2025), data was extracted from logbooks, de-identified, entered in Microsoft Excel (Microsoft, Redmond, WA), and verified by a research assistant unaffiliated with the training program. Logbooks, kept in designated locations in the obstetrics unit, were recorded upon each day by providers following completion of CD or neuraxial labor analgesia. Data completeness and accuracy were dependent on the provider entering the correct details. Individual patient folders were not reviewed and informed consent was not required for secondary-level data analysis. Delivery numbers were obtained from a separate obstetric registry.

Data included the number and mode of deliveries, number and type of anesthesia for elective and non-elective CDs, number of neuraxial labor analgesia procedures, and number of postoperative truncal nerve blocks. The procedural inclusion criteria were all patients undergoing CD and all patients administered neuraxial labor analgesia. The sample sizes were determined by data availability. The School of Obstetric Anesthesia and Kybele provided attendee data on country and city of residence, hospital affiliation, sex, specialty, and training level.

The annual number and proportion of neuraxial anesthesia techniques administered for CD were summarized overall and by elective and non-elective indications. Techniques included spinal, labor epidural top-ups, and combined-spinal epidural anesthesia. Failed neuraxial

techniques were categorized as GA. Labor epidural analgesia extended for CD was counted in both labor analgesia and neuraxial anesthesia categories. The secondary study objective was to evaluate use of neuraxial labor analgesia, therefore, the annual proportion of deliveries using these techniques was also summarized. Data were analyzed with SPSS (version 29.0.1). Auto-Regressive Integrated Moving Average (ARIMA) assessed the annual rate of change in neuraxial anesthesia use for CD. Chi-square assessed change in neuraxial labor analgesia with $p < 0.05$ considered statistically significant. This quality improvement based study adhered to SQUIRE 2.0 reporting guidelines.⁸

Results

From 2012 to 2025, 130 individuals attended the hands-on School of Obstetric Anesthesia. Of these, 109 (83.8%) were female and 47 (36.2%) attended more than once. The average number of attendees per course was 18.4 (range 9–32) with 69 (53.1%) anesthesiology specialists and 61 (46.9%) resident physicians. Attendees represented 41 hospitals across Serbia, Montenegro, Bosnia and Herzegovina, Croatia, and Kosovo. Following training, attendees initiated obstetric anesthesia schools at other institutions in Bosnia and Herzegovina, Serbia, and North Macedonia, supported by hands-on mentoring from Kybele and local trainers. Fig. 2 depicts the geographic distribution of participation.

During the hands-on workshops, procedures included 230 spinal anesthetics for CD, 229 epidural or combined-spinal epidural procedures for labor analgesia, and 89 truncal nerve blocks for postoperative pain control. There were four (1.7%) inadvertent dural punctures, managed as spinal catheters, without post-dural puncture headache.

From 2012 to 2019, 60–70 individuals per year attended the in-person didactic training component; however, during the COVID-19



Fig. 2. Geographic spread of participants and obstetric anesthesia schools. The red stars represent the cities from which participants originated to attend the School of Obstetric Anesthesia in Novi Sad. The yellow circles represent the locations of all the Schools of Obstetric Anesthesia. The yellow circles with red stars represent both.

pandemic (2020–2021), virtual meetings were held. This yielded greater participation, therefore, hybrid learning sessions (in-person and virtual) were conducted thereafter. Table 1 shows the demographic distribution of the attendees since 2020.

Between 2012 and 2025, 25 Kybele teams visited the Balkans. The faculty included 94 individuals of whom 62 (65.9%) were female and 32 (34.0%) participated more than once. Faculty comprised of 66 anesthesiologists (including 18 anesthesiology fellows and 11 residents), 12 family medicine physicians (including six residents), four obstetricians, three neonatologists, and nine participants from other disciplines. They represented 47 academic institutions across six countries (US, Canada, England, Scotland, Austria, and Poland). Kybele faculty taught at UCCV and at hospitals in 11 other Balkan cities where hands-on and didactic obstetric anesthesia workshops were conducted (Fig. 2).

The annual number of deliveries at UCCV was relatively consistent over time. The mean number and range of deliveries was 6553 (range 6184–6883), including 4284 (4127–4539) vaginal deliveries and 2268 (1889–2625) CDs. The CD rate increased from 30.5% to 38.0%. UCCV had 22 anesthesiology faculty, of whom 16 (72.7%) were female, and 33 anesthesiology residents, of whom 27 (81.8%) were female.

At UCCV, the use of neuraxial anesthesia for CD increased over time. In 2011, 261 neuraxial anesthetics were administered for 1889 CD (13.8%) compared to 1939 for 2428 CD (79.9%) in 2025, with a 4.7% average annual rate of increase (t value = 3.24; P = 0.006) (Fig. 3). Neuraxial anesthesia use increased in both elective and non-elective CD (Fig. 3). The average annual rate of increase was 4.9% (t value = 3.23, P = 0.007) for elective and 4.6% (t value = 3.28, P = 0.006) for non-elective CD. In 2011, the highest neuraxial anesthesia rate for any UCCV faculty was 20.2%, whereas in 2025, 58.1% was the lowest.

The use of neuraxial labor analgesia followed a non-linear pattern (Fig. 4). There was an increase from 2011 to 2015 and again from 2021 to 2025, with decreasing use from 2016 to 2020. Comparing 2011 to 2025, there was an increase in the use of neuraxial labor analgesia from 2.0% to 14.1% (P < 0.001).

Discussion

Over the 14 year project period, neuraxial anesthesia use for CD at UCCV increased from 13.8% to 79.9%, with increases for both elective and non-elective procedures. Neuraxial labor analgesia also increased, although its use remained lower and varied over time. Concurrently, the School of Obstetric Anesthesia developed into a regional training hub attended by 130 anesthesiologists from five countries. These findings describe sustained changes in anesthesia practice and training capacity but do not establish improvements in care quality or patient outcomes.

The increase in neuraxial anesthesia use for CD extends a previous report from UCCV which found that after four years, the use of neuraxial anesthesia for CD increased from 13.8% to 25.0%.⁹ In contrast, the present study found that neuraxial anesthesia use for CD increased to 79.9%, suggesting that system-level adoption may require additional time for local experience, staffing, supplies, and institutional support

mechanisms to gradually develop. Among providers, the 14-fold increase in neuraxial anesthesia use for non-elective CD is encouraging and may have been related to more frequent use of the technique during elective procedures.

Neuraxial labor analgesia increased less consistently than neuraxial anesthesia for CD. Several contextual factors may explain this difference. A government-funded incentive for providing labor analgesia ended in 2017, and anesthesia providers were reassigned to COVID-19 treatment centers from 2020 to 2022. Neuraxial anesthesia for CD was increasingly perceived as a safer anesthetic option enhancing the uptake, whereas neuraxial labor analgesia continued to be viewed as elective in a setting where labor pain was often considered “normal.” Staffing also remained a consistent constraint: anesthesiologists had competing operating-theater responsibilities, particularly at night, and Serbia had the lowest anesthesia-provider density (10.7/100,000) among countries included in a recent Eastern European workforce report.⁴

The World Federation of Societies of Anaesthesiologists' declaration on labor analgesia identifies childbirth pain relief as a fundamental right and calls for broader global availability.¹⁰ Anesthesia involvement on the labor ward can support multidisciplinary care, and neuraxial labor analgesia has been associated with lower maternal morbidity in observational studies.^{11–13} Nevertheless, the provision of neuraxial labor analgesia remains low in several Eastern European middle-income countries.^{4,14–16}

Drawing upon implementation science and quality improvement research, the differing patterns of clinical adoption for neuraxial anesthesia use for CD and neuraxial labor analgesia were likely influenced by individual, cultural, organizational, and health-system factors.^{17–19} Within this framework, key barriers and facilitators impacting obstetric anesthesia capacity building in LMIC can be constructed from the literature (Table 2).^{4,9,20–23} Various barriers were addressed through this partnership, for example, hands-on training and bedside coaching in neuraxial anesthesia administration built local confidence. As lead clinicians changed their practice patterns, negative attitudes shifted to interdisciplinary acceptance. The initial equipment support from Kybele transitioned to host hospital administrators, who consistently supplied spinal needles, epidural kits, and infusion pumps. Finally, patient awareness campaigns and counseling may have fostered demand. In contrast, staffing shortages, competing clinical duties, financial disincentives, and cultural attitudes toward labor pain likely remained as barriers in regard to neuraxial labor analgesia.

The School of Obstetric Anesthesia was initiated by Serbian anesthesiologists who sought external collaboration to expand local obstetric anesthesia expertise. Hosted at a high-volume referral hospital, it combined repeated hands-on instruction with local leadership and participation from anesthesiologists across multiple countries. Over time, participants became trainers and established additional programs, extending an earlier report from UCCV⁹ and demonstrating the reach of a hub-based educational model.

Longitudinal global health collaborations have been associated with an increased use of obstetric neuraxial techniques in other settings.^{14–16,24,25} Although single, short-term educational efforts can increase performance,¹⁴ longer ongoing collaborations have achieved better results.^{15,16,24,25} Kybele and others have found that on-site visits and in-person training are critical for building relationships and strengthening local capacity,^{9,26,27} while emerging implementation science literature suggests that training without ongoing mentorship is unlikely to yield sustained impact.²⁸ Features described as important to equitable and sustainable global health partnerships include having engaged local champions, culturally appropriate teaching, adaptable visiting faculty, shared decision-making, and continued reinforcement.^{29–31} These features were incorporated into this initiative, while responsibility for teaching, equipment, and supplies progressively shifted toward local clinicians and hospital leadership.

Several important limitations need consideration in interpreting the

Table 1
School of Obstetric Anesthesia didactic training participation per year.

Participant profile	2020	2021	2022	2023	2024	2025
Number of participants	71	100	108	105	133	92
Sex (Male/Female)	19/ 52	27/ 73	24/ 84	n/a	30/ 103	25/ 67
Number of institutions represented	30	41	47	n/a	38	49
Number of cities	27	34	40	n/a	49	33
Number of countries	8	8	5	n/a	7	10

Didactic training was virtual in 2020–2021, and hybrid (virtual and in-person) 2022–2025. In 2023, data was not available (n/a) due to an internet failure with subsequent data loss. From 2012 to 2019, 60–70 individuals per year participated in-person didactic sessions.

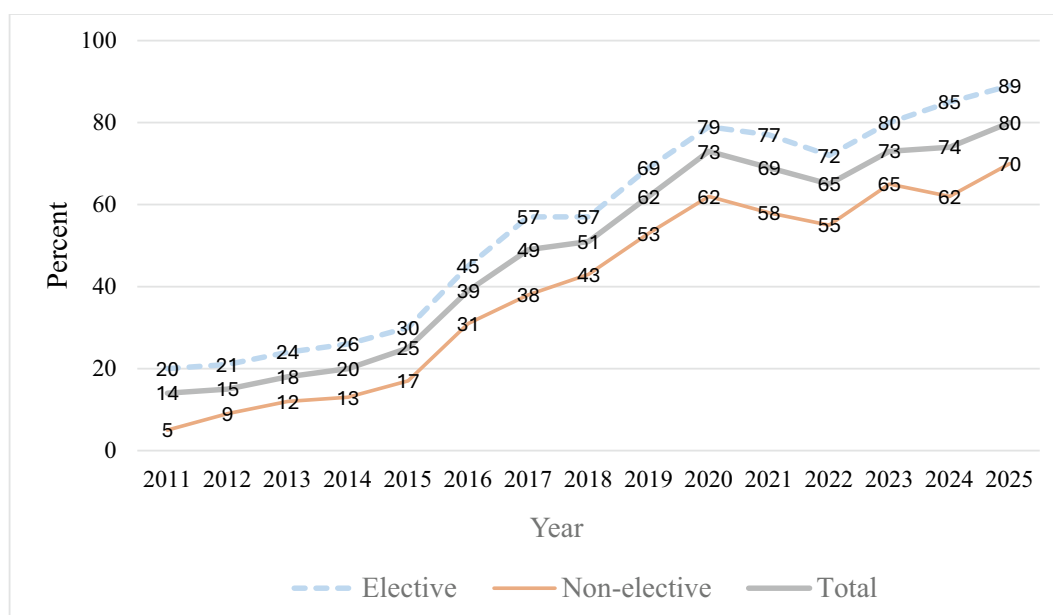


Fig. 3. Percent use of neuraxial anesthesia for elective and non-elective cesarean delivery at University Clinical Centre Vojvodina. Data represent the percentage neuraxial anesthesia (NA) use for elective, non-elective and all cesarean deliveries at University Clinical Centre Vojvodina over time. There was a significant increase in NA use from 2011 to 2025 ($P < 0.001$).

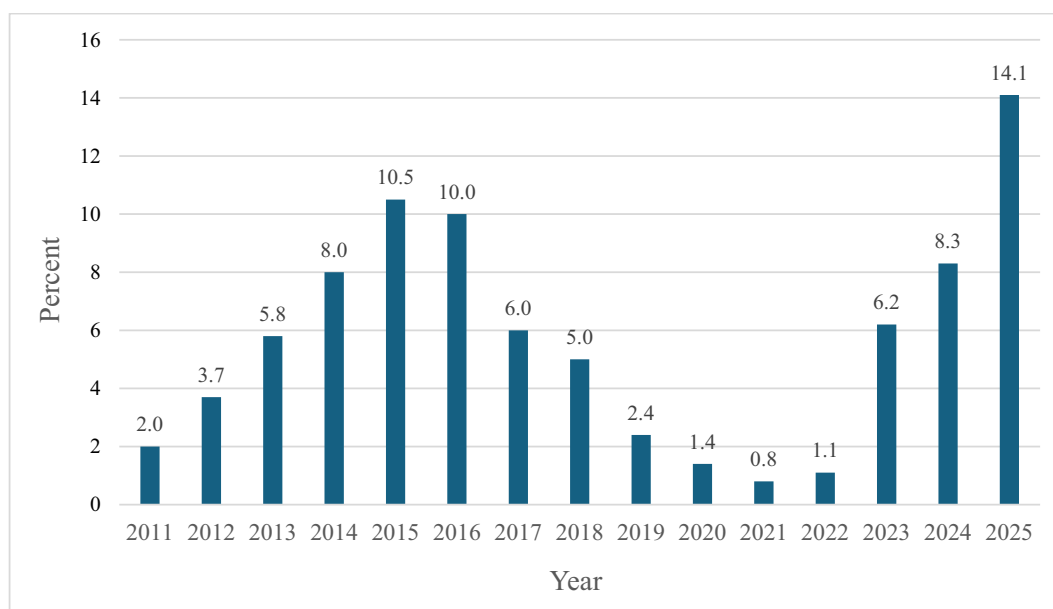


Fig. 4. Percent use of neuraxial labor analgesia at University Clinical Centre Vojvodina. Data represents percent of patients who received neuraxial labor analgesia from 2011 through 2025. There was a significant increase in neuraxial labor analgesia use from 2011 to 2025 ($P < 0.001$).

findings. First, this was quality improvement-based, single-center study without a comparison group, thus limiting attribution of the observed changes to the intervention. It is unknown whether factors such as national policy change or regional trends in obstetric anesthesia practice across Eastern Europe may have influenced results at UCCV and other hospitals in the region. Data are available from several hospitals; however, we are unable to report findings due to ethical clearance limitations. Beyond the training activities, other factors may have contributed to the adoption of neuraxial techniques, such as anesthesia staffing, supply procurement, faculty turnover, sex, COVID-related disruptions, and post-pandemic recovery. Finally, there is the potential for recording bias in a setting that was actively promoting neuraxial anesthesia use.

Conclusion

Neuraxial anesthesia use for CD and neuraxial labor analgesia increased over the 14-year study period. These findings are consistent with the goals of a long-term global health partnership that supported local training capacity and obstetric anesthesia education.

Declaration of generative AI and AI-assisted technologies in the manuscript preparation process

During the preparation of this work, the authors used ChatGPT for assistance in creating Fig. 1. After using this tool, the authors reviewed

Table 2

Barriers and facilitators to behavioral change in promoting obstetric anesthesia in low-and middle-income countries.

Drivers	Barriers	Facilitators
Individual	• Low self-confidence - Hesitation to perform new techniques (i.e., neuraxial anesthesia) • Fear of complications and loss of professional credibility • Entrenched habits – “This is how it has always been done”	• Practical, context specific training • Perceived benefit - Improved patient satisfaction and outcomes • Confidence built by hands-on practice and early “wins”
Social/cultural	• Hierarchy - Junior staff and anesthesiologists unable to challenge established norms • Resistance - Senior leaders oppose change (i.e., male obstetricians dictate anesthesia care) • Labor pain considered “normal”	• Visible champion and peers are adopting the change • Peer-to-peer mentorship and coaching • Multidisciplinary alignment (i.e., nurses, anesthesiologists, and obstetricians on board)
System/structural	• Insufficient staffing • Lack of equipment, medication and supplies	• Easy access to required tools or protocols • Workflow integration — change feels seamless, not added work • Data feedback loops (showing improvement in outcomes or performance)
Organizational	• Administrative burden prevents adoption of new workflows • Lack of leadership endorsement or enforcement • Payment structure for services not established	• Leadership endorsement and consistent messaging • Protected time for training or transition • Recognition/reward systems reinforcing desired behavior
Patient/external pressure	• Patient expectations or demand (preference for general anesthesia due to status quo or fear of being awake during surgery)	• Supply chain establishment • Patient expectations or demand (rising requests for neuraxial anesthesia) • National or international guidelines / accreditation standards

and edited the content as needed and take full responsibility for the content of the published article.

CRedit authorship contribution statement

Borislava P. Pujic: Writing – review & editing, Validation, Supervision, Project administration, Data curation, Conceptualization. **Ivan A. Velickovic:** Writing – review & editing, Supervision, Project administration, Methodology, Investigation, Data curation. **Curtis L. Baysinger:** Writing – review & editing, Methodology, Formal analysis, Data curation. **Craig M. Palmer:** Writing – review & editing, Supervision, Project administration, Methodology, Data curation. **Aleksandra T. Vejnovic:** Writing – review & editing, Validation, Project administration, Formal analysis. **Ferne R. Braveman:** Writing – review & editing, Supervision, Project administration. **Nada Z. Pejic:** Writing – review & editing, Supervision, Investigation. **Slavica B. Krusic:** Writing – review & editing, Investigation, Data curation. **Mirjana L. Kendrisic:** Writing – review & editing, Project administration, Investigation. **Sebnem F. Ucer:** Writing – review & editing, Validation, Formal analysis, Data curation. **Medge D. Owen:** Writing – original draft, Validation, Project administration, Formal analysis, Conceptualization.

Funding

CMP was sponsored through the US Fulbright International

Exchange Program. IAV, CLB, FRB, SFU, MDO report support by Kybele for local accommodation in the Balkans.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgment

Funding was provided by the World Federation Societies of Anesthesiology, the International Association for the Study of Pain, and the Society for Obstetric Anesthesia and Perinatology. The authors gratefully acknowledge financial support of the Fulbright U.S. International Scholar Exchange Program, sponsored by the U.S. Department of State, for its contribution to these educational efforts. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the Fulbright Program, or the Government of the United States. The authors would like to thank the physicians who volunteered their time and expertise to conduct this work, Kimber Whanger for graphic design, and Amit Kumar Saha, pH.D. for support with statistical analysis.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ijoa.2026.105270>.

References

1. Bucklin BA, Hawkins JL, Asdigian NL, Kennerley V, Pattee J, Traynor AJ. Obstetric anesthesia workforce survey: forty-year update. *Anesthesiology*. 2025;143:330–344.
2. Bamber JH, Lucas DN, Plaat F, Russell R. Obstetric anaesthetic practice in the UK: a descriptive analysis of the National Obstetric Anaesthetic Database 2009–14. *Br J Anaesth*. 2020;125:580–587.
3. Guasch E, Ioscovich A, Brogly N, et al. Obstetric anaesthesia manpower and service provision issues (introduction and European perspective). *Int J Obstet Anesth*. 2023;55, 103647.
4. Golubovska I, Palmer C, Ronenson A, et al. Where is obstetric anesthesiology heading in the next decade? An eastern European perspective. *Int J Obstet Anesth*. 2023;56, 103931.
5. Abe H, Sumitani M, Uchida K, et al. Association between mode of anaesthesia and severe maternal morbidity during admission for scheduled caesarean delivery: a nationwide population-based study in Japan, 2010–2013. *Br J Anaesth*. 2018;120(4): 779–789.
6. Sobhy S, Zamora J, Dharmarajah K, et al. Anaesthesia-related maternal mortality in low-income and middle-income countries: a systematic review and meta-analysis. *Lancet Glob Health*. 2016;4(5):e320–e327.
7. Statistical Office of the Republic of Serbia. Available from: <https://publikacije.stat.gov.rs/G2025/HtmlE/G20251174.html>. Accessed 2025 Oct 19.
8. Ogrinc G, Davies L, Goodman D, Batalden P, Davidoff F, Stevens D. SQUIRE 2.0 (Standards for QALity Improvement Reporting Excellence): revised publication guidelines from a detailed consensus process. *BMJ Qual Saf*. 2016;25(12):986–992.
9. Baysinger CL, Pujic B, Velickovic I, et al. Increasing regional anaesthesia use in a Serbian teaching hospital through an international collaboration. *Front Public Health*. 2017;5:134.
10. Declaration on Patients’ Rights to Labour Analgesia. World Federation of Societies of Anaesthesiologists. Available from: <https://wfsahq.org/wp-content/uploads/WFSA-Declaration-on-Patients-Rights-to-Labour-Analgesia-2.pdf>. Accessed 2025 Oct 19.
11. Kodali BS, Jagannathan DK, Owen MD. Establishing an obstetric neuraxial service in low-resource areas. *Int J Obstet Anesth*. 2014;23:267–273.
12. Guglielminotti J, Landau R, Daw J, Friedman AM, Chihuri S, Li G. Use of labor Neuraxial analgesia for vaginal delivery and severe maternal morbidity. *JAMA Netw Open*. 2022;5, e220137.
13. Kearns RJ, Kyzayeva A, Halliday LOE, Lawlor DA, Shaw M, Nelson SM. Epidural analgesia during labour and severe maternal morbidity: population based study. *BMJ*. 2024;385, e077190.
14. Kopic D, Sedensky M, Owen M. The impact of a teaching program on obstetric anesthesia practices in Croatia. *Int J Obstet Anesth*. 2009;18:4–9.
15. Ninidze N, Bodin S, Ivester T, Councilman L, Clyne B, Owen M. Advancing obstetric anesthesia practices in Georgia through clinical education and quality improvement methodologies. *Int J Gynaecol Obstet*. 2013;120:296–300.
16. Yuill G, Amroyan A, Millar S, Vardapetyan E, Habib AS, Owen MD. Establishing obstetric anesthesiology practice guidelines in the Republic of Armenia: a Global Health collaboration. *Anesthesiology*. 2017;127:220–226.

17. Grol R, Grimshaw J. From best evidence to best practice: effective implementation of change in patients' care. *Lancet*. 2003;362:1225–1230.
18. Damschroder LJ, Aron DC, Keith RE, Kirsh SR, Alexander JA, Lowery JC. Fostering implementation of health services research findings into practice: a consolidated framework for advancing implementation science. *Implement Sci*. 2009;4:50.
19. Means AR, Kemp CG, Gwayi-Chore MC, et al. Evaluating and optimizing the consolidated framework for implementation research (CFIR) for use in low- and middle-income countries: a systematic review. *Implement Sci*. 2020;15:17.
20. White MC, Ahuja S, Peven K, et al. Scaling up of safety and quality improvement interventions in perioperative care: a systematic scoping review of implementation strategies and effectiveness. *BMJ Glob Health*. 2022;7, e010649.
21. Dharni N, Byrne-Davis LMT, Sanga E, et al. Using behavioural science to explore impact and implementation of obstetric anaesthesia training in Tanzania, Nepal and Bangladesh: a qualitative evaluation study with obstetric anaesthesia providers. *Psychol Health*. 2024;39:1451–1465.
22. Lilaonitkul M, Mishra S, Pritchard N, et al. Mixed methods analysis of factors influencing change in clinical behaviours of non-physician anaesthetists in Kenya following obstetric anaesthesia training. *Anaesthesia*. 2020;75:1331–1339.
23. Epiu I, Wabule A, Kambugu A, Mayanja-Kizza H, Tindimwebwa JVB, Dubowitz G. Key bottlenecks to the provision of safe obstetric anaesthesia in low-income countries; a cross-sectional survey of 64 hospitals in Uganda. *BMC Pregnancy Childbirth*. 2017;17:387.
24. Hu LQ, Flood P, Li Y, et al. No Pain Labor & Delivery: a Global Health initiative's impact on clinical outcomes in China. *Anesth Analg*. 2016;122:1931–1938.
25. Olufolabi AJ, Atito-Narh E, Eshun M, Ross VH, Muir HA, Owen MD. Teaching neuraxial anesthesia techniques for obstetric care in a Ghanaian referral hospital: achievements and obstacles. *Anesth Analg*. 2015;120:1317–1322.
26. Ramaswamy R, Kallam B, Kopic D, Pujic B, Owen MD. Global health partnerships: building multi-national collaborations to achieve lasting improvements in maternal and neonatal health. *Glob Health*. 2016;12:22.
27. Lundeg G, Baric A, Pescod DC, Pescod K. Anesthesia development in Mongolia: strengthening anesthesia practice in Mongolia through education and continuing professional development. *Anesth Analg*. 2018;126:1287–1290.
28. Rowe AK, Rowe SY, Peters DH, Holloway KA, Chalker J, Ross-Degnan D. Effectiveness of strategies to improve health-care provider practices in low-income and middle-income countries: a systematic review. *Lancet Glob Health*. 2018;6: e1163–e1175.
29. Howell PR. Supporting the evolution of obstetric anaesthesia through outreach programs. *Int J Obstet Anesth*. 2009;18:1–3.
30. Prasad S, Aldrink M, Compton B, et al. Global health partnerships and the Brocher declaration: principles for ethical short-term engagements in Global Health. *Ann Glob Health*. 2022;88:31.
31. Fernandes NL, Lilaonitkul M, Subedi A, Owen MD. Global obstetric anaesthesia: bridging the gap in maternal health care inequities through partnership in education. *Int J Obstet Anesth*. 2023;55, 103646.