

Jun 29, 2025

Scoping Review Protocol: Artificial Intelligence in Anesthesia Education

DOI

<https://dx.doi.org/10.17504/protocols.io.5qpvodxy9g4o/v1>



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Protocol Citation: Nabil Zary 2025. Scoping Review Protocol: Artificial Intelligence in Anesthesia Education. **protocols.io**
<https://dx.doi.org/10.17504/protocols.io.5qpvodxy9g4o/v1>

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Protocol status: Working

We use this protocol and it's working

Created: June 29, 2025

Last Modified: June 29, 2025

Protocol Integer ID: 221264

Keywords: Artificial intelligence, anesthesia education, medical education, simulation training, perioperative care, machine learning, intelligent tutoring systems, ai in anesthesia training program, ai in anesthesia training, ai into anesthesia education, artificial intelligence in anesthesia education introduction, current ai applications in anesthesia, anesthesia training program, anesthesia education introduction, anesthesia training, anesthesia education program, training requirements in anesthesia, anesthesia medical education, intelligent tutoring systems for airway management, anesthesia resident, anesthesia practice, changing anesthesia practice, predictive analytics for perioperative risk evaluation, anesthesia, airway management, incorporating ai, implementing ai, perioperative risk evaluation, facilitators for ai integration, ai applications address competency, training program, enhancing diagnostic accuracy training, ai integration, ai, ai application, based training requirement, diagnostic accuracy traini

Abstract

Introduction: Artificial intelligence (AI) is quickly changing anesthesia practice and education, with uses that include intelligent tutoring systems for airway management and predictive analytics for perioperative risk evaluation. AI-enabled simulators create realistic training environments where anesthesia residents can practice complex procedures safely, without risking patients. Incorporating AI into anesthesia education shows great promise for improving learning results, enhancing diagnostic accuracy training, and offering personalized educational experiences that suit each learner's needs.

Purpose: This scoping review aims to systematically chart current AI applications in anesthesia medical education, identify key educational outcomes and effectiveness metrics, and explore the challenges and opportunities for implementing AI in anesthesia training programs.

Method: A scoping review will follow the Arksey and O'Malley framework and JBI methodology. Studies published in English between 2020 and 2025 will be included. The literature search will cover MEDLINE, EMBASE, IEEE Xplore, ACM Digital Library, and educational databases. This review will use the six-step framework: identifying research questions, finding relevant studies, selecting studies, charting data, collating and summarizing results, and consulting stakeholders.

Research Questions:

1. What AI applications are currently used in anesthesia medical education?
2. What educational outcomes and effectiveness measures are reported for AI in anesthesia training?
3. What are the implementation challenges and facilitators for AI integration in anesthesia education programs?
4. How do AI applications address competency-based training requirements in anesthesia?



Image Attribution

Created by Laila Bihmidine (LelleDesigns) for the NeuroInk initiative

Guidelines

- PRISMA Extension for Scoping Reviews (PRISMA-ScR) Checklist
- JBI Guide for Scoping Review
- Arksey and O'Malley Scoping Review Framework

Materials

Computers, Internet Connection, MS Word, MS Excel, Reference Manager (Mendeley/EndNote/Zotero), Covidence (optional)

Safety warnings

- ! There are no specific safety warnings for this protocol.



Objectives

- 1 Catalogue AI applications used for teaching, assessment, or curriculum management in Anesthesia education.
- 2 Describe educational outcomes, implementation contexts, and learner populations.
- 3 Identify evidence gaps and priority areas for future research.

Review Questions

- 4 Types of AI technologies are employed in Anesthesia education
 - 4.1 What artificial intelligence applications are currently implemented in anesthesia medical education and training programs?
- 5 Which competencies or outcomes
 - 5.1 What educational outcomes, effectiveness measures, and learning assessments are reported for AI applications in anesthesia education?
- 6 Evidence regarding effectiveness, feasibility, and acceptability
 - 6.1 What implementation challenges, barriers, and facilitating factors influence the integration of AI in anesthesia educational settings?

How do AI applications support competency-based medical education (CBME) requirements in anesthesia training?

Methodology Overview

- 7 Step 1: Protocol Registration

8 Step 2: Stakeholder Consultation

8.1 Participants: Undergraduate, postgraduate, or continuing Anesthesia learners.

- 8.2
- Medical students receiving anesthesia education
 - Anesthesia residents and fellows in training
 - Practicing anesthesiologists in continuing education programs
 - Faculty involved in anesthesia education

8.3 Concept: AI-enabled educational tools (e.g., ML algorithms, intelligent tutoring, predictive analytics).

8.4 Artificial intelligence applications in anesthesia education, including but not limited to:

- Intelligent tutoring systems for anesthesia procedures
- AI-powered simulation training for airway management
- Machine learning algorithms for perioperative risk assessment training
- Virtual reality and augmented reality systems for anesthesia education
- AI-assisted assessment and feedback systems
- Predictive analytics for educational outcomes
- Natural language processing for anesthesia documentation training

8.5 Context: Any learning environment or modality.

- 8.6
- Medical schools with anesthesia curricula
 - Anesthesia residency programs
 - Continuing medical education programs for anesthesiologists
 - Simulation centers and training facilities
 - Hospital-based training programs

8.7 Exclusions: Purely clinical AI without educational focus; non-English abstracts prior to 2015.

- 8.8
- Studies focusing solely on clinical AI applications without educational components
 - Studies in languages other than English
 - Opinion pieces and editorials without empirical data
 - Studies published before 2020

- 9 Databases: MEDLINE, EMBASE, CINAHL, IEEE Xplore, ACM DL, Web of Science, and ERIC. Grey literature via ProQuest Dissertations, conference proceedings, and protocols.io.
- 9.1 Initial Keyword development
 - Artificial intelligence: "artificial intelligence", "machine learning", "deep learning", "neural networks", "AI", "ML", "natural language processing", "computer vision"
 - Anesthesia: "anesthesia", "anaesthesia", "anesthesiology", "anaesthesiology", "perioperative", "airway management", "sedation"
 - Education: "medical education", "training", "curriculum", "simulation", "learning", "teaching", "competency", "assessment", "skill development"
- 9.2 Similar search strategies will be adapted for:
 - EMBASE
 - IEEE Xplore Digital Library
 - ACM Digital Library
 - CINAHL
 - ERIC (Education Resources Information Center)
 - Web of Science
- 9.3 Grey literature search:
 - Conference proceedings from anesthesia and medical education societies
 - Institutional repositories
 - Government reports
 - Thesis and dissertation databases
- 10 PRESS-peer-reviewed strategy combining AI terms ("artificial intelligence", "machine learning", "deep learning") with education and Anesthesia MeSH headings. Example MEDLINE syntax provided in Appendix A.
- 10.1 MEDLINE (via PubMed) - Draft

((("artificial intelligence"[MeSH Terms] OR "machine learning"[MeSH Terms] OR "artificial intelligence"[Title/Abstract] OR "machine learning"[Title/Abstract] OR "deep learning"[Title/Abstract] OR "neural networks"[Title/Abstract] OR "AI"[Title/Abstract] OR "ML"[Title/Abstract] OR "natural language processing"[Title/Abstract] OR "computer vision"[Title/Abstract]))

AND

("anesthesia"[MeSH Terms] OR "anesthesiology"[MeSH Terms] OR "anesthesia"[Title/Abstract] OR "anaesthesia"[Title/Abstract] OR "anesthesiology"[Title/Abstract] OR "anaesthesiology"[Title/Abstract] OR "perioperative"[Title/Abstract] OR "airway management"[Title/Abstract] OR "sedation"[Title/Abstract]))

AND

("education, medical"[MeSH Terms] OR "curriculum"[MeSH Terms] OR "simulation training"[MeSH Terms] OR "medical education"[Title/Abstract] OR "training"

[Title/Abstract] OR "curriculum"[Title/Abstract] OR "simulation"[Title/Abstract] OR "learning"[Title/Abstract] OR "teaching"[Title/Abstract] OR "competency"[Title/Abstract] OR "assessment"[Title/Abstract] OR "skill development"[Title/Abstract])) AND ("2020"[Date - Publication] : "2025"[Date - Publication]) AND "english"[Language])

- 11 Dual independent screening in Covidence with kappa ≥ 0.8 . Conflicts resolved by a third reviewer. Record reasons for exclusion at full-text stage.

- 11.1
- Two independent reviewers will conduct title and abstract screening
 - Full-text screening will be performed by two independent reviewers
 - Disagreements will be resolved through discussion or third reviewer consultation
 - Covidence may be used to facilitate the screening process
 - PRISMA-ScR flow diagram will document the selection process

- 12 Use a REDCap form with compulsory fields for study, population, AI taxonomy, instructional design framework, outcomes (Kirkpatrick levels 1-4), and implementation details. Pilot on 5 studies.

- 12.1 Data will be extracted using a standardized form developed based on JBI guidance and piloted on a subset of studies. The following data will be extracted:

Study characteristics:

- Citation details (authors, title, journal, year, country)
- Study design and methodology
- Setting and context
- Sample size and participant characteristics
- Study objectives and research questions

AI application details:

- Type of AI technology used (machine learning, neural networks, NLP, etc.)
- Specific anesthesia educational application
- Technical specifications and requirements
- Integration with existing educational systems

Educational intervention characteristics:

- Target learner population
- Learning objectives and competencies addressed
- Duration and format of intervention
- Assessment methods used

Outcomes and results:

- Educational outcomes measured
- Effectiveness and performance metrics
- Learner satisfaction and acceptance
- Skill acquisition and retention measures
- Knowledge transfer outcomes

Implementation factors:

- Facilitating factors for AI adoption
- Barriers and challenges encountered
- Cost considerations
- Faculty training requirements
- Technical infrastructure needs

Quality and validity:

- Study limitations and biases
- Validation methods for AI systems
- Reliability and accuracy measures

13 If $\geq 30\%$ of included studies are experimental, apply MERSQI or ROBINS-I as appropriate. Not a mandatory scoping review element but increases interpretability.

14 Narrative synthesis supplemented by visual evidence maps showing AI categories versus educational outcomes. Identify clusters and gaps.

14.1 Data analysis approach:

- Descriptive statistical analysis of study characteristics
- Thematic analysis of qualitative findings
- Mapping of AI applications across anesthesia education domains
- Synthesis of educational outcomes and effectiveness evidence

14.2 Reporting:

- Tabular presentation of extracted data
- Visual mapping of AI applications in anesthesia education
- Narrative summary addressing each research question
- Identification of knowledge gaps and future research directions
- Recommendations for AI implementation in anesthesia education

15 Prepare PRISMA-ScR flow diagram, submit manuscripts to specialty education journals, and deposit dataset and code on GitHub under CC-BY 4.0.

Timeline

16 Month 1: Registration & stakeholder meeting

17 Months 2-3: Search execution & import

18 Months 4-5: Screening



- 19 Months 6-7: Data extraction
- 20 Month 8: Synthesis workshop
- 21 Month 9: Draft manuscript
- 22 Month 10: Peer review & protocols.io publication

Quality Assurance Locks

- 23 Locks embedded at Steps 1, 2, 5, 6, 7, and 10 require dual-reviewer sign-off to proceed.

Protocol references

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