

REVIEW ARTICLE

COMPETENCY-BASED SURGICAL TRAINING THROUGH THE LENS OF YOGYA VIDHI: A SCOPING REVIEW

Amit A Paliwal^{1*}, Vasudha G Asutkar², Yash Trivedi³

¹Professor, ³P.G. Scholar, Department of Shalyatantra, Dr. D. Y. Patil College of Ayurved & Research Centre, Dr. D. Y. Patil Vidyapeeth (deemed to be University), Pimpri, Pune-411018, India.

²Associate Professor, Department of Samhita Siddhant Evam Sanskrit, Bharati Vidyapeeth (Deemed to be University) College of Ayurved, Pune, India.

*Corresponding author: Email address: dramitpaliwal@gmail.com

ABSTRACT

Background: Safe and effective surgical practice requires more than theoretical knowledge; it demands training, competence and ethical preparedness. The concept of Yogya Vidhi described in the Sutrasthana of Sushruta Samhita represents earliest systematic approaches to surgical training. Its relevance in the context of modern surgical education warrants critical evaluation. **Methods:** This narrative critical review was conducted through systematic literature search of PubMed/MEDLINE, Scopus, Web of Science and Google Scholar (2000–2024), supplemented by analysis of Ayurvedic texts including Sushruta Samhita and Dalhana's Nibandhasangraha commentary. Search terms included "Yogya Vidhi," "competency-based medical education," "simulation-based surgical training," "Entrustable Professional Activities" and "deliberate practice." A total of 19 sources were included after screening. **Results:** The principles of Yogya Vidhi — including simulation-based practice on tissue-analog models (Sādharmya), stepwise skill acquisition, deliberate repetition (Abhyasa), supervised mentorship (Guru–Shishya paradigm), and ethical discipline — demonstrate conceptual alignment with contemporary frameworks including simulation-based surgical training, Entrustable Professional Activities (EPAs), competency-based progression and patient safety protocols. These principles reflect advanced understanding of psychomotor skill development, neuromuscular learning and risk minimization that predates modern surgical pedagogy by centuries. **Conclusion:** Yogya Vidhi offers conceptually robust and educationally relevant framework for surgical training whose principles align with evidence-based modern methodologies. However, its direct applicability is constrained by the absence of standardized outcome metrics and empirical validation studies. Integrating Yogya Vidhi with contemporary simulation technologies and competency frameworks within a hybrid training model may enhance surgical proficiency, reduce errors, and strengthen ethical practice with implications for both Ayurvedic and mainstream surgical education systems.

KEYWORDS: Ayurveda Surgery, Competency-Based Education, Simulation, Surgical Training, Sushruta Samhita, Yogya Vidhi.

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INTRODUCTION

Surgery is a discipline where precision, decision-making, and experiential learning converge. Unlike purely theoretical sciences, surgical competence demands repeated practice, observation, and guided execution. In this context, the teachings of Acharya Sushruta remain unparalleled. The Yogya Vidhi Adhyaya of Sushruta Samhita provides a meticulously structured framework for preparing a trainee prior to performing surgery on a living patient¹.

In the contemporary era—characterized by increasing surgical complexity, rising medico-legal accountability, and heightened emphasis on patient safety—the relevance of these classical principles has become even more pronounced. The traditional apprenticeship model of "see one, do one, teach one" is no longer considered adequate for safe surgical training, and modern paradigms have shifted decisively toward competency-based medical education (CBME), simulation-based training, and structured mentorship.^{2,3,4} Entrustable Professional Activities (EPAs), deployed by the American Board of Surgery in 2023, now represent a formal

competency-based evaluation framework providing a structured path to independent surgical practice.⁵ Simulation has a demonstrated effect on patient safety for both technical and non-technical skills training, with interprofessional simulation showing a consistent record of improved patient outcomes.⁶

The foundational concepts described in Yogya Vidhi — including simulation on tissue-analog models, deliberate repetition, supervised progression, and ethical grounding — closely parallel these contemporary frameworks, suggesting that classical Ayurvedic surgical pedagogy anticipated principles that modern surgical education is only now formalizing.

This review critically analyses each component of Yogya Vidhi and interprets its applicability within contemporary surgical education, with emphasis on its alignment with CBME frameworks, simulation-based training, and EPAs, while also acknowledging the limitations of direct translational application

AIM AND OBJECTIVES

- To critically review Yogya Vidhi described in Sushruta Samhita.
- To correlate classical surgical training

methodologies with modern practices.

- To highlight the scientific and educational relevance of ancient surgical pedagogy.

MATERIALS AND METHODS

This narrative critical review was conducted through a systematic search of PubMed/MEDLINE, Scopus, Web of Science, and Google Scholar (January 2000–December 2024), supplemented by classical Ayurvedic text repositories including the Digital Library of India and AYUSH Research Portal.

Search terms included "Yogya Vidhi," "Sushruta Samhita," "competency-based medical education," "simulation-based surgical training," "Entrustable Professional Activities," "deliberate practice," "surgical mentorship," and "robotic surgery training," used individually and in Boolean

combinations.

Articles were included if indexed in PubMed/MEDLINE or Scopus and relevant to surgical education, simulation training, or competency-based frameworks. Non-peer-reviewed publications, grey literature, and unrelated studies were excluded. A total of 25 sources were included comprising indexed peer-reviewed articles and classical Ayurvedic primary texts.^{1,7}

Primary analysis of Sushruta Samhita was based on the Chaukhambha Sanskrit Sansthan edition with Dalhana's Nibandhasangraha commentary,¹ cross-referenced with Sharma PV's English translation.⁷ Transliteration follows the IAST standard throughout. As a narrative review, quantitative synthesis was not performed and literature selection involved author judgment.

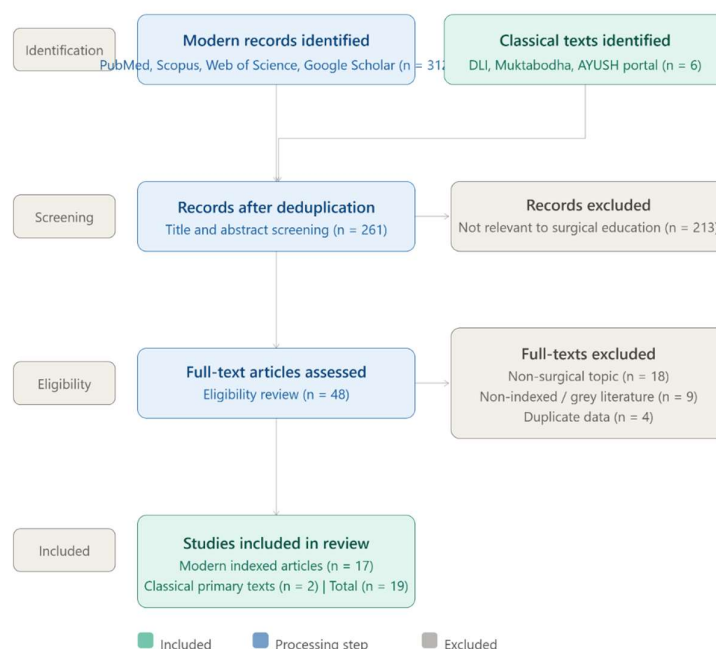


Figure 1 — PRISMA flow diagram (n = 19 final included: 17 modern indexed + 2 classical texts)

CONCEPT OF YOGYA VIDHI

The term Yogya denotes "competent" or "fit," while Vidhi signifies "method" or "systematic procedure." Together, Yogya Vidhi represents a structured methodology for transforming a surgical trainee into a competent and ethically grounded practitioner.¹ Acharya Sushruta explicitly emphasizes that no physician should operate on a living patient without adequate prior training. Repeated practice on anatomical models and tissue-analog simulators is mandated before any real-life surgical application.¹ Dalhana, in his Nibandhasangraha commentary, defines Yogya as "Samyak Karma Abhyāsa" —

systematic and appropriate practice — underscoring that competence arises not from knowledge alone but from disciplined, repeated execution of skills.¹

Classical doctrine clearly establishes a dual requirement: a physician possessing theoretical knowledge alone becomes confused in clinical scenarios, while a practitioner with technical skill but lacking theoretical grounding is considered unsafe and socially unacceptable.⁷ Thus, Yogya Vidhi ensures the inseparable integration of Śāstra (theoretical knowledge) and Karma (practical skill), forming the foundational cornerstone of surgical competence in Ayurvedic surgical education.

DETAILED ANALYSIS OF YOGYA VIDHI

Yogya Vidhi represents a structured, experience-oriented training system aimed at converting theoretical understanding into safe surgical practice. Surgery inherently involves controlled tissue injury (dhatu-himsa), and therefore, inadequate skill directly translates into patient harm.¹

1. Simulation-Based Training

Acharya Sushruta mandates that even a well-versed student (bahuśruta) must undergo structured hands-on training before performing surgery on living patients.¹ This training is grounded in the principle of Sādharmya — the use of materials analogous to human tissues. Plant structures such as gourd and cucumber, animal tissues including skin and urinary bladder, and natural hollow structures like lotus stem and bamboo were employed as training models, each offering variable tactile feedback, resistance, and elasticity to facilitate development of precision, depth control, and instrument handling.⁷

Modern surgical education closely mirrors this approach through virtual reality (VR) and augmented reality (AR) simulators, high-fidelity manikins, and synthetic tissue models. These platforms provide standardized, reproducible environments for psychomotor skill acquisition without risk to patients.² Immersive virtual reality simulation has been utilized for both technical and non-technical skills training in surgery, offering low-cost and accessible platforms for structured surgical education.⁸ Simulation enhances cognitive, psychomotor, and affective learning domains through deliberate practice and neuromuscular learning principles, thereby reducing operative errors and shortening the learning curve.²

The Sādharmya principle thus represents a conceptual predecessor to contemporary simulation-based surgical training, demonstrating that the pedagogical value of pre-clinical model-based practice was recognized in Ayurvedic surgical education centuries before its formal adoption in modern curricula.

2. Procedural Training in Yogya Vidhi

Yogya Vidhi delineates eleven specific procedural training exercises; each assigned a carefully selected tissue-analog model that mimics the biomechanical properties of the intended surgical target. This systematic procedural mapping reflects a sophisticated understanding of tissue behaviour, instrument handling, and skill progression. Each model was selected not arbitrarily but for its specific ability to replicate the tactile, mechanical, and spatial demands of the corresponding clinical procedure.¹

Contemporary surgical training mirrors this approach through structured task-specific simulation modules. Proficiency-based progression on laparoscopic box trainers and fundamentals of laparoscopic surgery (FLS) platforms has demonstrated significant improvement in operative performance and reduction of intraoperative errors.⁹ With the evolution of robotic-assisted surgery, dedicated simulation curricula using platforms such as the da Vinci Skills Simulator have emerged as essential tools for structured psychomotor skill acquisition prior to operating room exposure.¹⁰ Table 1 presents the classical Yogya procedures alongside their training models, skills developed, and modern surgical correlates.

Table 1: Classical Yogya Procedures and Modern Correlation

Classical Procedure	Training Model	Skills Developed	Modern Correlation
Chedana (incision)	Pumpkin, cucumber	Depth control, incision precision	Laparoscopic cutting modules, FLS ⁹
Bhedana (puncture)	Bladder, leather bags	Controlled penetration	Trocar insertion simulation
Lekhana (scraping)	Hairy skin	Surface precision, tissue handling	Debridement, dermabrasion training
Vedhana (probing)	Veins, lotus stalk	Vascular access, needle precision	IV cannulation, vascular simulation
Eshana (exploration)	Bamboo, worm-eaten wood	Tract navigation, tactile sensitivity	Fistula probing, endoscopy simulation
Aharana (extraction)	Fruits, teeth	Controlled extraction technique	Calculus/tooth extraction simulation
Visrāvana (drainage)	Wax surfaces	Fluid drainage control	Abscess drainage, paracentesis training
Sivana (suturing)	Cloth, leather	Suturing technique, knot tying	Suturing labs, FLS suturing modules ⁹
Bandhana (bandaging)	Models	Dressing and wound care technique	Wound care management simulation
Agnikarma/Ksharakarma	Meat tissue	Energy application, tissue response	Electrocautery, laser surgery training
Advanced (Basti, Karnabandha)	Fluid-filled pots	Fluid dynamics, instrument navigation	Endoscopy, catheterization, robotic simulation ¹⁰

3. Role of Repetition (Abhyasa)

Abhyasa — repetitive, deliberate practice constitutes a fundamental pillar of Yogya Vidhi. Acharya Sushruta emphasizes that surgical competence

cannot be achieved through theoretical knowledge alone; sustained and structured repetition under guided conditions is indispensable.¹ Repeated execution allows the trainee to internalize procedural steps, progressively reduce performance variability, and develop neuromuscular coordination that enables complex surgical movements to become automated and efficient.

From a neurophysiological perspective, repetition facilitates procedural memory consolidation and refinement of depth perception, force modulation, and hand–eye coordination — all critical determinants of intraoperative precision. Modern surgical education validates this principle through the framework of deliberate practice, defined as structured, goal-directed repetition with immediate feedback. Deliberate practice integrated into simulation-based surgical training has been consistently associated with improved psychomotor skills, reduced operative errors, and shortened learning curves across multiple surgical specialties.¹¹ Importantly, studies demonstrate that deliberate practice not only enhances technical proficiency but also builds trainee confidence and reduces performance anxiety during clinical exposure.²

Critically, inadequate repetition remains a major contributor to surgical errors among early-stage trainees. Sushruta's insistence on repeated model-based practice before clinical exposure reflects a timeless pedagogical principle: surgical mastery is achieved through disciplined, continuous refinement of technique rather than isolated attempts — a principle that modern competency-based frameworks are only now formally institutionalizing.

4. Supervised Training (Guru–Shishya Model)

The Guru–Shishya paradigm described in Yogya Vidhi represents a structured mentorship model wherein the trainee acquires surgical skills under direct observation of an experienced teacher, with immediate error correction and progressive responsibility.¹ This framework integrates technical instruction with clinical judgment, ethical conduct, and professional identity formation — ensuring holistic development of the surgical trainee.

Contemporary surgical residency programs closely mirror this model through structured mentorship, graded autonomy, and competency-based assessment. Effective mentorship in surgical training has been associated with improved technical skills, enhanced clinical performance, greater trainee autonomy, and reduced burnout.¹² Absence of adequate supervision, conversely, has been linked to increased complication rates and consolidation of

incorrect technique — underscoring the enduring relevance of Sushruta's guided learning framework in modern surgical education.¹³

5. Patient Safety and Ethical Foundation

Yogya Vidhi places patient safety at the core of surgical training by mandating that no trainee operates on a living patient until competence is established on models. This precautionary principle — rooted in the ethical obligation of Ahimsa (non-injury) — mirrors the contemporary patient safety movement, which recognizes inadequate surgical training as a primary contributor to preventable operative errors.¹ Patient safety is defined as the absence of preventable harm and the reduction of risk of unnecessary harm associated with healthcare to an acceptable minimum. Structured pre-clinical training, checklists, and supervised progression have been shown to significantly reduce intraoperative complications and adverse events¹⁴. The ethical imperative articulated by Sushruta — that harm to a patient through inadequate preparation is morally unacceptable — thus finds a direct parallel in modern medico-legal and institutional patient safety frameworks.

6. Comparison with Modern Simulation-Based Education

The Yogya Vidhi framework systematically targets psychomotor skill acquisition through graded procedural complexity — beginning with simple incision and progressing to advanced fluid dynamics and tract navigation.¹ This mirrors current evidence that psychomotor skills in surgery must be trained progressively and outside the operating room before clinical application. Higher surgical skill levels are associated with lower gaze motion entropy, greater spatial coordination between gaze and instrument motion — measurable parameters that reflect progressive neuromuscular refinement with training.¹⁵ Extended reality platforms including virtual reality and augmented reality simulators have further demonstrated efficacy in supporting all phases of psychomotor learning by allowing repetitive practice with immediate feedback, facilitating the transition from conscious effort to automatic execution.⁸

7. Relevance in Laparoscopic and Robotic Surgery

Yogya Vidhi prescribes a clear competency-based progression model — the trainee advances only upon demonstrated mastery at each level, with the Guru determining readiness for the next stage.¹ This principle directly anticipates the modern framework of Entrustable Professional Activities (EPAs), which

formalizes the transition from supervised to independent practice based on observable, task-specific competence rather than time served. EPAs were launched by the American Board of Surgery for general surgery residency programs in July 2023, providing a structured outcomes-based pathway to independent surgical practice.⁵ A scoping review of EPAs in surgical residency programs confirmed their validity as assessment tools across curriculum design, trainee feedback, and competency certification.¹⁶

8. Contemporary Gap and Need for Revival

While Yogya Vidhi was conceived in the context of classical open surgical techniques, its foundational principles of model-based pre-clinical training, graded skill acquisition, and supervised progression are directly applicable to minimally invasive and robotic surgical education.⁷ Robotic-assisted surgery introduces unique psychomotor demands — including fulcrum effect elimination, three-dimensional visualization, and haptic feedback interpretation — that necessitate dedicated simulation-based curricula before operating room exposure.¹⁰ The Sādharmya principle, wherein the training model must replicate the key biomechanical properties of the surgical target, remains equally valid for high-fidelity robotic simulators such as the da Vinci Skills Simulator. Recent systematic reviews confirm that structured robotic simulation training significantly improves operative performance metrics and reduces the learning curve across surgical specialties.¹⁰ The integration of Yogya Vidhi principles into contemporary minimally invasive and robotic surgical training curricula thus represents a natural and pedagogically sound extension of classical Ayurvedic surgical education.

DISCUSSION

Alignment with Contemporary Evidence

The principles of Yogya Vidhi demonstrate robust conceptual alignment with contemporary evidence-based surgical education. The Sādharmya model of tissue-analog simulation, Abhyāsa (deliberate repetition), and the Guru–Śiṣya supervised progression framework collectively anticipate the three pillars of modern surgical training: simulation, deliberate practice, and competency-based assessment.¹ The integration of simulation technologies in surgical education marks a transformative shift from traditional apprenticeship-based models to technology-driven approaches, with VR, AR, and physical simulators demonstrating significant benefits in enhancing technical

proficiency and procedural competence.¹⁷ That Ayurvedic surgical education articulated these principles centuries before their modern formalization underscores the enduring pedagogical validity of Yogya Vidhi.

Comparison with Modern Simulation Frameworks

Modern simulation systems offer measurable, reproducible training environments with objective performance metrics. However, they possess inherent limitations — high cost, limited availability in low-resource settings, and inability to replicate the full spectrum of biological tissue variability encountered in clinical practice.¹⁷ In contrast, the Sādharmya models prescribed in Yogya Vidhi are low-cost, naturally available, and specifically selected to replicate the biomechanical properties of surgical targets — an approach that retains practical relevance particularly in resource-limited healthcare systems. Surgical training has evolved from the apprenticeship model through the Halstedian paradigm to contemporary competency and outcome-based models, with simulation-based training emerging as the foundation for pre-clinical skill acquisition outside the operating room.¹⁸

Proposed Hybrid Training Model

A critical synthesis of Yogya Vidhi and contemporary surgical education suggests that neither system is independently sufficient. Modern simulation provides technological precision and objective assessment but lacks the holistic integration of ethics, professional identity, and adaptive clinical reasoning that the Guru–Śiṣya framework offers. Conversely, Yogya Vidhi, while conceptually comprehensive, lacks standardized outcome metrics and empirical validation through clinical trials. We therefore propose a hybrid competency-based surgical training model integrating the following elements: (1) Sādharmya-based low-fidelity model training in early skill acquisition phases; (2) high-fidelity VR/AR simulation for advanced procedural rehearsal; (3) EPA-based competency assessment for objective entrustment decisions; and (4) structured mentorship informed by the Guru–Śiṣya paradigm for professional and ethical development. Surgical training programmes are evolving from time-based to competency-based schedules, and an integrative process-driven, outcomes-based model incorporating multiple theories of motor skill acquisition offers the most comprehensive pathway to surgical mastery.¹⁹ Such integration would be particularly valuable for Ayurvedic surgical

education, where classical frameworks can be modernized without compromising their

philosophical integrity.

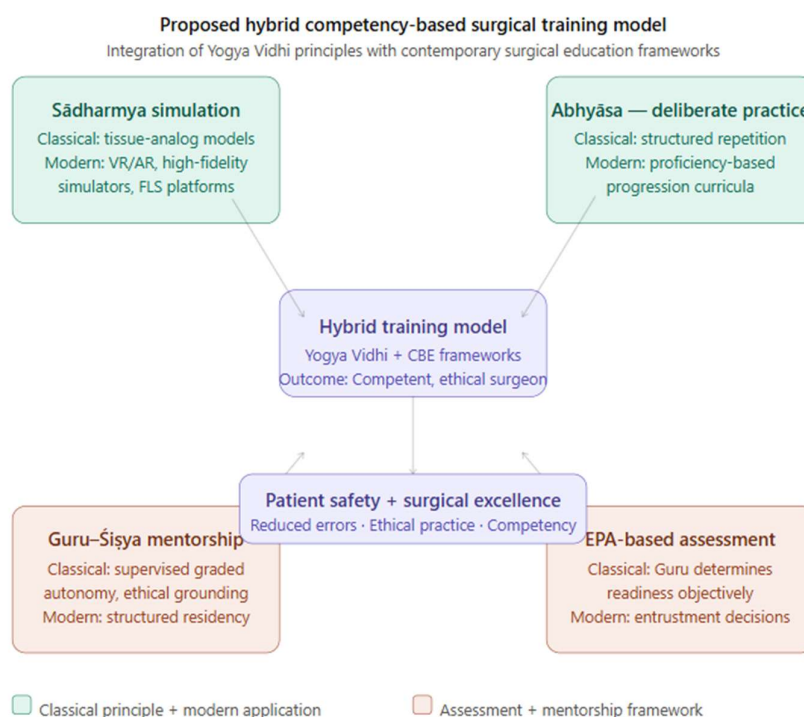


Figure 2 - Hybrid competency-based surgical training model (4 pillars: Sādharmya simulation, Abhyasa, Guru–Shishya mentorship, EPA-based assessment → Patient safety + surgical excellence)

Relevance to Minimally Invasive and Robotic Surgery

The transition toward minimally invasive and robotic surgical techniques places additional psychomotor demands on trainees that classical open surgical training does not address. The Yogya Vidhi principle of pre-clinical model-based training before patient exposure is, however, directly transferable to these contexts. Dedicated robotic simulation curricula have demonstrated significant improvement in operative performance metrics, and the Sādharmya principle of selecting models that replicate the key biomechanical properties of the target tissue remains conceptually valid for high-fidelity robotic simulators.¹⁰

Limitations

This review carries several limitations that must be acknowledged. As a narrative critical review, it does not employ systematic meta-analytic methodology, and literature selection involved an element of author judgment despite defined inclusion criteria. The conceptual parallels drawn between Yogya Vidhi and modern surgical education frameworks are largely interpretive and have not been empirically validated through prospective trials or outcome studies. Classical Ayurvedic texts do not lend

themselves to standardized quality appraisal tools such as GRADE, and translation from Sanskrit introduces inherent variability in interpretation. Furthermore, the proposed hybrid model, while conceptually robust, requires prospective evaluation to establish its efficacy in contemporary surgical training programs. These limitations notwithstanding, the conceptual contribution of this review lies in formally documenting the alignment between a classical pedagogical framework and evidence-based modern surgical education — an exercise that may inform curriculum development in both Ayurvedic and mainstream surgical training institutions.

CONCLUSION

Yogya Vidhi, as described in the Sushruta Samhita, represents a conceptually rich and pedagogically sophisticated framework for surgical training whose core principles — simulation-based pre-clinical practice, deliberate repetition, supervised mentorship, and ethical grounding — demonstrate strong alignment with contemporary competency-based surgical education, EPAs, and patient safety frameworks.^{1,7} However, direct translational application of Yogya Vidhi into modern curricula is constrained by the absence of standardized outcome

metrics, empirical validation through clinical trials, and adaptations for minimally invasive and robotic surgical contexts.

The proposed integration of Yogya Vidhi within a hybrid competency-based training model — combining classical tissue-analog simulation with high-fidelity VR platforms, EPA-based assessment, and structured mentorship — offers a viable pathway to bridging classical Ayurvedic surgical pedagogy with evidence-based modern practice.¹⁹ Future interdisciplinary research through prospective outcome studies and curriculum development initiatives is warranted to formally evaluate this integration, both within Ayurvedic surgical education and mainstream surgical training programs.

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