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Review Article

Optimizing orthopedic education in resource-limited settings: A strategic review of current practices and reforms

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ABSTRACT

This narrative comparative review analyzes the current structure, challenges, and potential reforms in orthopedic education in Vietnam. Using a structured literature review and expert-informed synthesis, we examine Vietnam's dual-track training pathways, including undergraduate medical education, residency programs, specialty certifications (Specialty Certification Level 1 and Specialty Certification Level 2), and academic degrees (Master's and PhD). The ky challenges include variability in training quality, limited access to surgical technology, geographic disparities in workforce distribution, and insufficient research integration. To contextualize Vietnam's experience, we compare it with orthopedic education models in China, India, Saudi Arabia, and Côte d'Ivoire (Africa). These countries share common issues such as regional inequities, inconsistent clinical exposure, and gaps in standardized curricula, while also offering unique strategies for improvement, such as competency-based training, national fellowship programs, and international partnerships. The review recommends establishing a national certification board, investing in technological infrastructure, expanding fellowship opportunities, and implementing financial support schemes to ensure equitable access. These findings provide relevant insights for policymakers and educators aiming to enhance orthopedic training in low- and middle-income countries.

Keywords: Fellowship programs, Medical technology, Orthopedic education, Residency training, Surgical training, Vietnam

INTRODUCTION

Orthopedics plays a crucial role in Vietnam's healthcare system, addressing the increasing prevalence of musculoskeletal disorders, trauma, and congenital deformities. With a growing and aging population, the demand for highly skilled orthopedic surgeons is expected to continue rising.[1]

Vietnam's orthopedic education system consists of both clinical training (emphasizing hands-on surgical experience) and academic education (focused on research and theoretical knowledge).[2] Despite recent improvements, the system faces challenges such as inconsistent training quality, inadequate access to advanced surgical technologies, and limited exposure to global best practices.[3] Given these complexities, this study aimed to evaluate the current structure of orthopedic education in Vietnam critically, identify key systemic challenges, and propose strategic reforms. Furthermore, by drawing comparisons with orthopedic training models in

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China, India, Saudi Arabia, and Côte d'Ivoire, we seek to offer contextually grounded recommendations that can inform national policy and educational development.

STRUCTURE OF ORTHOPEDIC EDUCATION IN VIETNAM

Undergraduate medical education

The journey to becoming an orthopedic surgeon in Vietnam begins with a 6-year undergraduate medical program. Students complete foundational courses in the basic sciences, clinical medicine, and surgical skills, while also participating in clinical rotations, including those in orthopedics. The orthopedic rotation typically lasts from four to six weeks and is considered a core rotation for all medical students. During this period, students gain basic exposure to musculoskeletal evaluation, common fractures, and surgical principles. Those who are particularly interested in orthopedics can then pursue specialization through two pathways as illustrated in Table 1.

CLINICAL TRAINING PATHWAY (SPECIALTY EDUCATION)

Residency in orthopedics

Upon completing medical school, individuals aspiring to become orthopedic surgeons must enter a highly competitive 3-year residency program in orthopedic surgery. Each year, approximately 500–700 applicants compete for around 100–150 available residency positions nationwide, making the acceptance rate roughly 15–20%. This opportunity is available only once, as unsuccessful candidates must pursue alternative career paths. During the residency, trainees receive comprehensive, hands-on experience in various areas, including trauma surgery, joint replacement, spinal surgery, pediatric orthopedics, and other subspecialties. The majority of the training occurs in hospital settings, under the supervision of seasoned orthopedic surgeons at leading teaching hospitals.

- Strengths: The residency program offers extensive clinical exposure, allowing residents to gain practical experience and develop proficiency in a wide range of orthopedic procedures.
- Challenges: Residency opportunities are highly limited, with only 100–150 orthopedic residency slots available annually for 500–700 applicants nationwide an acceptance rate of approximately 15–20%. Moreover, the quality of training varies significantly between institutions, with leading hospitals in major cities offering structured subspecialty exposure, while rural and provincial centers often lack essential surgical resources and experienced faculty.

SPECIALTY CERTIFICATION – BASIC AND ADVANCED LEVELS

After completing residency, orthopedic surgeons receive both a Residency in Orthopedics Certification and the Specialty Certification Level 1 (SC1). However, for medical graduates who are unable to secure a residency position, since residency

Table 1: Structure of orthopedic education in Vietnam.

Education level	Duration	Focus areas	Strengths	Challenges
Undergraduate medical education	6 years	Basic sciences, clinical medicine, surgical skills, clinical rotations (including orthopedics)	Provides foundational medical knowledge and clinical exposure	Limited exposure to specialized orthopedic procedures
Residency in orthopedics	3 years	Trauma surgery, joint replacement, spinal surgery, pediatric orthopedics, and sub-specialties	Extensive hands-on surgical experience	Limited residency positions and regional disparities in training quality
SC1	2 years	Advanced surgical skills for independent practice	Enhances surgical competency for specialized procedures	Some hospitals lack resources for comprehensive training
SC2	2 years	Leadership roles and sub-specialization (e.g., spine surgery, sports medicine, orthopedic oncology)	Provides structured pathways for specialization	Unequal training quality across institutions
Master's Degree in Orthopedics	2 years	Research, theoretical knowledge, academic development	Suitable for research and teaching careers	Limited hands-on surgical training
Doctoral (PhD) Degree in Orthopedics	3–5 years	Original research, scientific contributions to orthopedics	Develops leaders in orthopedic research and innovation	Heavily research-focused with limited clinical applicability

SC1: Specialty certification level 1, SC2: Specialty certification level 2.

entry is granted through a one-time competitive examination immediately after graduation, an alternative pathway exists. These graduates can work in surgical departments for 18 months to qualify for a national license in general surgery. After fulfilling this clinical experience requirement, they may take a separate examination to enroll in the SC1 program in orthopedics. Although this route provides a path to specialization, it typically offers less structured training compared to the formal residency program.

SC1

This 2-year program enhances surgical skills, enabling surgeons to perform more specialized procedures independently.

Specialty Certification Level 2 (SC2)

This 2-year, more advanced training program prepares surgeons for leadership roles or subspecialization in areas such as spine surgery, sports medicine, or orthopedic oncology. To enter the SC2 program, a surgeon must either hold an SC1 or a Master's degree in orthopedics.

- Strengths: These certification programs provide structured pathways for advanced clinical training and specialization.
- Challenges: The quality of training varies among institutions, with some hospitals lacking the necessary resources or specialized cases to offer a comprehensive advanced training experience.

ACADEMIC TRAINING PATHWAY (MASTER'S AND DOCTORAL DEGREES)

Master's degree in orthopedics

For individuals pursuing careers in research or academia, a 2-year Master's degree in orthopedics is available. The program emphasizes scientific research, theoretical knowledge, and academic development. Typically, students spend approximately 70–80% of their time on research activities, including conducting clinical studies, reviewing scientific literature, and completing a thesis project. The remaining 20–30% is devoted to limited clinical exposure, such as participating in case discussions, attending surgical observations, and assisting in outpatient clinics. Compared to specialty training pathways like residency or specialty certification, the Master's program places far less emphasis on developing independent surgical skills.

- Strengths: The Master's degree is ideal for those seeking academic careers, medical research, or teaching roles.
- Challenges: The program lacks sufficient hands-on surgical training, limiting graduates' ability to perform complex procedures independently.

Doctoral degree in orthopedics

The doctoral (PhD) degree represents the highest academic qualification in orthopedic education, with a primary emphasis on original research and scholarly contribution to the field. Typically pursued after completing a Master's degree, the PhD program generally spans 3–5 years. Candidates focus extensively on research activities such as study design, data collection and analysis, scientific writing, and dissertation development comprising approximately 90–95% of the program. Clinical exposure is limited, accounting for roughly 5–10% of the training, and is often observational or integrated into research-related clinical collaborations. While PhD graduates gain substantial expertise in academic investigation and research methodology, their opportunities for direct surgical training may be less extensive compared to those in clinically focused specialization tracks.

- Strengths: PhD graduates often become leaders in orthopedic research and innovation.
- Challenges: The program is heavily research-oriented, with limited clinical applicability.

COMPARATIVE OVERVIEW

China offers 5- and 8-year tracks in medical school, followed by a 5-year orthopedic residency. Advanced degrees (Master's/PhD) can be integrated with clinical practice. Challenges include rural-urban disparities and a lack of national standardization.[4]

India provides MBBS followed by MS (Orthopedics), DNB, or diploma programs. Training emphasizes hands-on experience, although variations in clinical exposure and lack of a national certification framework persist.[5,6]

In Saudi Arabia, orthopedic residency is a structured 5-year program modeled after the North American system. Despite improvements, trainees report dissatisfaction due to limited surgical exposure, insufficient structured feedback, and inconsistent teaching across hospitals. Expansion of training programs and greater emphasis on surgical skills development have been recommended.[7]

In Côte d'Ivoire (Africa), orthopedic surgery residency faces different systemic challenges. A study revealed a high prevalence (57%) of burnout syndrome among residents, attributed to long working hours, lack of mentorship, workplace harassment, and limited leisure time. Training quality is often compromised by heavy workloads, limited structured support, and psychological stress, which can negatively impact both resident well-being and patient care.[8]

Overall, across Vietnam, China, India, Saudi Arabia, and parts of Africa, earlier literature highlights recurring themes of urban-rural disparities, inconsistent clinical exposure,

Table 2: Comparative analysis of orthopedic training systems (Vietnam, China, India, Saudi Arabia, Africa).

Aspect	Vietnam (2025)	China (2017)	India (2014)	Saudi Arabia (2018)	Africa (e.g., Cote d'Ivoire) (2025)
Medical school duration and structure	6-year MBBS, includes orthopedic rotations	5-year or 8-year tracks (Bachelor or Doctorate)	5.5-year MBBS including CRRI (internship)	6-year MBBS (preclinical+clinical) followed by internship	6–7 years general medical education
Entry into orthopedic training	National exam+competitive selection	Postgrad year+licensing exam	Postgrad entrance exam (NEET-PG)	Postgraduate selection exam by SCHS	Highly competitive; limited structured pathways
Residency duration	3 years (Residency), followed by SC1 and SC2	5 years (3 years general+2 years subspecialty)	3 years (MS Orthopedics), alternative DNB/Diploma	5 years (structured North American model)	4–6 years depending on country; often under-resourced
Advanced clinical certification	SC1 (2 years), SC2 (2 years)	No unified national certification; varies by hospital	MS, DNB pathways; no SC1/SC2 equivalent	SCHS Board Certification after residency	No standardized advanced certification
Academic degrees	Master's (2 years), PhD (3–5 years)	Master's and PhD often integrated with clinical work	MS+optional thesis, PhD rare in clinical track	Academic research during residency	Very limited; mostly informal training with few research pathways
Subspecialty fellowships	Limited, not standardized nationally	Growing number; often with global exposure	Available in major centers, competitive entry	Limited, currently expanding rapidly	Rare; subspecialization limited to major cities only
Research emphasis	Emerging, but underfunded and mentor-limited	Strong emphasis on English publications	Moderate focus, growing with thesis requirements	Weak; research often self-initiated and under-supported, but is a requirement	Minimal; few opportunities for structured research
Training uniformity	Highly variable between urban and rural centers	Inconsistent across regions, reforms underway	Varied by state/university, national standards lacking	Variable across regions and hospitals	Highly inconsistent; major urban-rural gap
Distribution of specialists	Concentrated in major cities	Urban-focused, rural areas underserved	Uneven, rural-urban disparities common	Mainly urban-based, shortage in remote areas	Severe urban bias; rural access extremely limited
Use of technology in training	Limited access; investment in VR/simulation beginning	Selective adoption of robotics, VR, AI	Developing slowly; resource constraints persist	Moderate; increasing interest in simulation centers	Very limited; reliance on traditional methods

MBBS: Bachelor of medicine and bachelor of surgery, CRRI: Compulsory rotating residential internship, NEET-PG: National eligibility cum entrance test for postgraduate, SCHS: Saudi commission for health specialties, SC1: Specialty certification level 1, SC2: Specialty certification level 2, MS: Master of surgery, DNB: Diplomate of national board, PhD: Doctor of philosophy, VR: Virtual reality.

absence of standardized national curricula, and psychological stress among trainees [Table 2]. Although some data are dated, it is reasonable to assume that reforms have been implemented over time. Nonetheless, these comparative insights remain valuable in guiding Vietnam's strategic efforts toward certification reform, standardized surgical training, mental health integration, and equitable resource allocation, especially in underserved regions.

The countries selected for comparison China, India, Saudi Arabia, and Côte d'Ivoire were chosen for their relevance as low- and middle-income countries or emerging economies with diverse yet instructive approaches to orthopedic training. While regional, cultural, and economic contexts vary, these countries share common challenges, including geographic disparities in access to care, variable clinical exposure, and evolving national education frameworks. The inclusion of these systems offers insights into scalable strategies and potential pitfalls relevant to Vietnam's own reform efforts, particularly as it seeks to balance rapid development with equitable and high-quality training nationwide.

This comparative analysis underscores both shared challenges and divergent solutions across Vietnam, China, India, Saudi Arabia, and Côte d'Ivoire. While we acknowledge the potential value of incorporating quantitative data (e.g., orthopedic graduate volumes and specialist-to-population ratios), such data were inconsistently available across countries. To maintain consistency and avoid selective representation, we have retained a qualitative comparative format supported by the structured tables. Future studies may consider a quantitative meta-comparison once standardized international datasets are available.

CHALLENGES IN ORTHOPEDIC EDUCATION IN VIETNAM

Variability in training quality

Training quality remains highly variable across Vietnam, with major disparities between urban teaching hospitals and rural or provincial facilities. While residents in tertiary centers benefit from structured mentorship and exposure to diverse surgical cases, trainees in less-resourced hospitals often report inconsistent supervision and fewer learning opportunities. For example, in some provincial hospitals, residents may rotate through orthopedic wards without direct surgical involvement due to staffing or infrastructure limitations.[9]

A key factor contributing to this discrepancy is the unequal distribution of experienced faculty members. In well-established teaching hospitals, students and residents benefit from mentorship by highly skilled orthopedic surgeons with years of practical experience. These mentors provide hands-on training, guiding residents through complex surgeries and ensuring they acquire the necessary skills to manage a wide range of musculoskeletal conditions. However, in provincial and rural hospitals, there is often a shortage of qualified teaching staff, leading to a lower standard of training.[10]

Additionally, teaching methodologies vary significantly across institutions. Some hospitals emphasize a more structured, standardized approach to residency training, ensuring residents receive comprehensive exposure to all subspecialties within orthopedics. Others, particularly in less-resourced areas, rely on an apprenticeship-style model where residents learn primarily through observation and sporadic hands-on opportunities. This lack of consistency in training methodologies results in significant variations in skill levels among newly trained orthopedic surgeons.[11]

Another issue is the accessibility of diverse clinical cases. Major teaching hospitals in urban centers handle a high volume of patients with a broad spectrum of orthopedic conditions, providing residents with ample opportunities to gain experience and learn. In contrast, smaller hospitals may not see the same diversity of cases, limiting the learning experience of trainees. On the other side, major tertiary care hospitals usually do not see a good number of common cases and usually see more complicated cases. In Saudi Arabia, the training program mandates that trainees from the major tertiary hospitals spend some time in secondary care hospitals to cover that shortcoming, and during that time, trainees from the smaller hospitals spend some time in the tertiary hospitals, which is a win-win situation.[12]

Limited access to advanced surgical technologies

Modern orthopedics increasingly relies on innovations such as minimally invasive surgery, robotic-assisted procedures, 3D imaging, computer-assisted navigation, and artificial intelligence (AI).[13,14] These technologies enhance surgical precision and outcomes. However, their absence does not universally compromise training; many global centers, including in Africa, effectively train orthopedic surgeons without routine access to robotics or VR simulation. Access to essential technologies such as fluoroscopy (C-arm) remains inconsistent, significantly hindering trauma training. While robotic or virtual reality (VR) platforms are emerging in select academic centers, the absence of basic imaging tools in many regions presents a more urgent concern. Thus, while the absence of cutting-edge tools may not hinder fundamental orthopedic education, inconsistent access to basic surgical infrastructure like fluoroscopy directly impacts both training quality and patient outcomes. Prioritizing investment in essential technologies should precede the integration of advanced innovations.

Budget constraints are a primary reason for this disparity. Advanced surgical equipment and imaging tools require significant investment, which may not be feasible for hospitals operating on limited financial resources. While larger hospitals in major cities may have access to these technologies, the majority of Vietnam's healthcare facilities still rely on conventional surgical methods, limiting the exposure of residents and trainees to modern techniques.[15]

Furthermore, even when hospitals acquire advanced surgical tools, they often lack trained personnel to operate

them effectively. Surgeons and residents require specialized training to utilize robotic-assisted surgery systems, perform arthroscopic procedures, and accurately interpret 3D imaging data. Without proper training and hands-on experience, the presence of advanced technology alone does not translate into improved surgical outcomes.

While digital learning tools and surgical simulation technologies such as VR simulators are emerging in surgical education, they remain under development and are not yet widely adopted, even in many developed countries. Although VR training holds promise for enhancing surgical skills, it remains largely experimental and is not yet standard across most orthopedic programs. In Vietnam, adoption remains minimal, primarily due to financial and infrastructural barriers, with greater focus needed first on strengthening fundamental clinical training.[16]

Unequal distribution of orthopedic specialists

The uneven geographic distribution of orthopedic specialists compounds disparities in care and training. Many experienced surgeons remain concentrated in Hanoi and Ho Chi Minh City, leaving peripheral hospitals dependent on less specialized staff.[17]

This disparity creates multiple challenges. First, patients in rural areas often experience delayed or inadequate orthopedic care, leading to worsened health outcomes. Many patients must travel long distances to major cities for treatment, which increases their financial burdens and potentially delays necessary surgical interventions.

Although Vietnam has made strides in pediatric orthopedic research, engagement in research across other orthopedic subspecialties remains limited. Junior doctors frequently cite a lack of dedicated time, mentors, and funding support as barriers to producing publishable work.

Additionally, financial incentives and career opportunities contribute to this imbalance. Most highly trained orthopedic surgeons prefer to work in well-equipped hospitals with access to advanced technology and research opportunities. Rural hospitals, which may offer lower salaries, limited career advancement, and fewer resources, find it challenging to attract and retain top talent.[18]

Insufficient emphasis on research and academic development

Research plays a crucial role in advancing medical knowledge and improving patient care. However, in Vietnam, orthopedic training programs often prioritize clinical practice over research, leading to a lack of scientific inquiry and innovation in the field.

Several factors contribute to this issue. First, medical schools and hospitals often lack dedicated research funding and infrastructure. Conducting high-quality research requires financial resources for laboratory equipment, clinical trials, and data analysis. Many orthopedic trainees find it challenging to engage in meaningful research projects without adequate support.[19]

Second, there is a shortage of mentors who can guide trainees in academic research. Experienced orthopedic surgeons often focus on their clinical workload, leaving little time to mentor residents in research methodology, scientific writing, and data interpretation. As a result, many young surgeons lack the necessary skills and motivation to contribute to the global body of orthopedic research.

In addition, Vietnamese medical journals and research publications have limited international visibility. While local studies are conducted, they are often published in domestic journals that lack a global reach. However, in recent years, Vietnamese orthopedic doctors have made significant strides in academic research, contributing to the international literature with studies on congenital deformities, trauma management, and surgical innovations.[20-22] Collaborative research projects with global institutions have further elevated the presence of Vietnamese orthopedic research, leading to increased citations and recognition in international academic circles.[23] These efforts are gradually improving Vietnam's academic footprint and fostering a stronger research culture within the orthopedic community.

International collaborations that improved orthopedic education

International collaborations have contributed significantly to the advancement of orthopedic education in Vietnam. While the Vietnam Pediatric Orthopaedic Association has led many impactful initiatives, including workshops supported by the North American and European Pediatric Orthopaedic Societies, similar partnerships have also emerged in general orthopedics and trauma surgery. Humanitarian missions led by Non-Governmental Organizations and university hospitals from France, South Korea, and the United States have facilitated short-term fellowships, case-based teaching, and cadaveric skills labs in areas such as joint replacement, fracture fixation, and sports medicine. These exchanges have also created opportunities for Vietnamese surgeons to participate in observerships abroad, fostering bidirectional learning.[24,25]

Technological advancements that could benefit training

Integrating VR and simulation-based surgical training is an emerging trend that could significantly enhance orthopedic education in Vietnam. International collaborations have already introduced minimally invasive techniques for spinal deformity correction and advanced imaging solutions,

thereby improving precision in surgical procedures. Expanding access to digital learning platforms, telemedicine consultations, and AI-assisted diagnostics could further enhance training outcomes and bridge the knowledge gap between urban and rural trainees.

DISCUSSION

This study highlights the dual-track structure of orthopedic education in Vietnam and identifies critical challenges impacting the consistency and effectiveness of training nationwide. By drawing comparative insights from China, India, Saudi Arabia, and Côte d'Ivoire —four countries with similar demographic and economic contexts—this analysis proposes targeted strategies to enhance Vietnam's orthopedic training system. The key areas of concern include training quality disparities, technological access, workforce distribution, research engagement, regulatory gaps, and financial barriers. These are summarized in Table 3 to provide a visual reference for cross-country benchmarking.

Training quality and regional disparities

A persistent issue across Vietnam's orthopedic education system is the marked variability in training quality between urban and rural institutions. Major hospitals in Hanoi and Ho Chi Minh City offer comprehensive subspecialty exposure and senior mentorship, whereas many provincial centers lack essential resources. This pattern is consistent with disparities observed in both China and India, where regional inequalities in education quality stem from uneven hospital funding and faculty distribution. National reforms such as a centralized curriculum, standardized surgical rotations, and inter-hospital training exchanges are urgently needed to address this imbalance.

This reform approach is informed by the emerging models of competency-based orthopedic training. As proposed by Taha in "A guide to developing a competency-based curriculum for a residency training program," orthopedic curricula should be designed with clearly defined learning objectives, skill acquisition benchmarks, and formative assessment

Table 3: Challenges in orthopedic education across Vietnam, China, India, Saudi Arabia, and Africa.

Challenge area	Vietnam (2025)	China (2017)	India (2014)	Saudi Arabia (2018)	Africa (e.g., Cote d'Ivoire) (2025)
Training quality variability	High variability between urban and rural centers; limited rural mentorship	Regional inconsistencies; ongoing national reforms	Training varies across institutions; no strong national enforcement	Quality varies across regions and institutions; mentorship gaps noted	Very high variability; often poor outside major cities
Access to advanced technology	Limited adoption; pilot VR/simulation centers	Selective use in major hospitals	Slow adoption; resource constraints	Moderate; growing simulation use but uneven access	Very limited; basic surgical methods still common
Geographic specialist distribution	Specialists clustered in cities; rural areas underserved	Urban-focused; rural incentive policies in progress	Rural-urban imbalance; mandatory rural postings exist	Shortage in remote areas; urban concentration dominates	Severe rural-urban disparity; rural areas critically underserved
Research and academic output	Low publication rates; few mentors	Strong focus on research and international publications	Moderate integration via mandatory theses	Weak research infrastructure; self-driven efforts	Extremely low research output; minimal infrastructure
Fellowship and subspecialty training	Lacks structured national fellowships	Growing number; hospital-based	Available but unstandardized nationally	Emerging but limited fellowship options	Rare fellowships; only in few major hospitals
National regulation and standardization	No unified certification authority	Reforms underway; partial standardization	Medical Council provides limited oversight	SCHS oversees training but variation persists	Largely absent; minimal centralized regulation
Financial barriers to training	Postgraduate training costly; limited aid	Basic costs covered; disparities remain	Cost varies; limited scholarships available	Training funded, but living costs burden residents	Major financial barriers; self-funded

VR: Virtual reality, SCHS: Saudi Commission for Health Specialties.

tools.[26] These principles have guided the development of our short- and long-term recommendations for Vietnam's orthopedic education reform.

Access to advanced technology

Vietnamese trainees often have limited access to fundamental tools such as fluoroscopy, with advanced technologies such as VR simulators and robotic-assisted surgery available only in select centers. Table 3 shows that similar gaps exist in India and China, although both have made recent efforts to pilot technology-enhanced learning environments in partnership with international institutions. Vietnam should prioritize investment in simulation centers as part of a national strategy, focusing first on trauma and arthroscopy training modules.

Geographic distribution of specialists

The concentration of orthopedic specialists in major urban areas has left rural provinces underserved, both in terms of patient care and training capacity. India's approach of mandatory rural service postings and China's regional incentive programs offer scalable models. Vietnam should explore rural bonding programs, targeted scholarships for underserved areas, and inter-regional faculty exchanges to improve equity in workforce distribution and training quality.

Research integration and academic support

Despite recent progress in pediatric orthopedics, research output in other orthopedic fields remains limited in Vietnam due to a lack of funding, mentorship, and protected academic time. In contrast, both China and India have institutionalized research through mandatory theses, dedicated research blocks, and publication incentives during postgraduate training. Vietnam can adopt similar measures by embedding research modules within residency curricula, assigning academic advisors, and supporting competitive research grants.

Subspecialty fellowship development

Vietnam currently lacks structured national fellowships in orthopedic subspecialties. Table 3 highlights that India has already established fellowships in spine, hand, oncology, and sports medicine, although regulation remains inconsistent. China's emphasis on international clinical-scientist training further illustrates the benefits of subspecialization. Developing accredited fellowships in high-priority fields, such as trauma, spine, and joint replacement, would enhance both surgical competency and leadership potential among Vietnamese orthopedic surgeons.

Regulatory framework and certification

Vietnam's orthopedic education is not governed by a unified certification body, creating inconsistencies in training standards and evaluation. Table 3 shows that India and China are advancing national oversight mechanisms to strengthen education quality and accountability. Vietnam could benefit from establishing a centralized certification board responsible for accrediting institutions, certifying graduates, and maintaining uniform evaluation metrics.

Strengthening the academic pathway

The academic pathway (Master's and PhD programs) in Vietnam is heavily research-oriented but lacks sufficient clinical exposure. Graduates often complete their programs without having achieved procedural competency. Structured clinical rotations and skill acquisition benchmarks should be integrated into academic tracks to ensure that graduates are both scientifically and surgically proficient.

Financial barriers to training

The cost of orthopedic training including tuition, certification programs (SC1/SC2), and living expenses can be prohibitive for students from rural or disadvantaged backgrounds. India's government-subsidized seats and China's health system-linked educational funding provide models that Vietnam could adapt. Proposals include income-based tuition waivers, low-interest educational loans, rural service-linked scholarships, and monthly stipends for residents, all of which would improve access and help redistribute the workforce equitably.

Summary of comparative challenges

To contextualize these issues, Table 3 presents a comparative overview of key challenges faced by Vietnam, China, and India in orthopedic education. This table synthesizes insights on training quality, technology, workforce distribution, research output, fellowship availability, regulation, and financial equity.

Framing of short- and long-term goals with measurable outcomes

To guide orthopedic education reform in Vietnam, a phased implementation strategy is proposed, encompassing clearly defined short- and long-term goals with measurable outcomes. In the short term (1–3 years), priorities include establishing a national orthopedic education task force, developing a unified competency-based residency curriculum, piloting simulation-based trauma training modules in selected hospitals, and expanding research mentorship linked to SC1/SC2 pathways. Over the longer

term (4–8 years), goals include implementing a nationwide certification and rotation accreditation system, launching standardized subspecialty fellowships with international partnerships, integrating tele-education platforms across teaching hospitals, and monitoring specialist distribution through annual training reports. Progress can be measured through indicators such as SC1/SC2 pass rates, retention of rural-based specialists, research participation among residents, and the number of institutions meeting accreditation standards.

Limitations

This study is primarily descriptive, relying on secondary literature and expert analysis. Data inconsistencies and limited availability of quantitative indicators (e.g., resident-to-population ratios) restrict the scope of direct comparison. Furthermore, cultural and policy differences between countries may limit the generalizability of certain strategies. Nevertheless, this comparative framework highlights universally relevant principles such as standardization, access, and integration that can guide reforms in Vietnam and other similar contexts.

CONCLUSION

Vietnam's orthopedic education system has evolved significantly but still faces critical challenges, including uneven training quality, limited access to technology, geographic maldistribution of specialists, underdeveloped research capacity, and financial barriers. Comparative insights from China, India, Saudi Arabia, and Côte d'Ivoire reveal shared struggles and effective strategies, including national certification frameworks, structured fellowships, competency-based curricula, and incentives for rural workforce development. By adapting these approaches and implementing targeted reforms, Vietnam can strengthen its orthopedic training infrastructure and develop a more competent, equitable, and resilient surgical workforce aligned with both national needs and global standards.

Recommendations

To advance orthopedic education in Vietnam, it is recommended that the Ministry of Health and academic institutions implement an integrated national strategy focused on standardization, equity, and innovation. This includes establishing a national certification and accreditation board, developing structured fellowship programs in key subspecialties, and mandating uniform residency curricula across all training centers. Investments should prioritize simulation-based learning infrastructure and incentivize rural workforce deployment through financial support and service-linked scholarships. In addition, integrating research training into clinical education and expanding international collaborations, beyond pediatric orthopedics to include trauma, spine, and sports medicine, will be essential for cultivating a well-rounded, future-ready orthopedic workforce.

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