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# Medical Physics Education and Training in South Asia: A Literature-Based Comparative Study

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**Abstract:** ***The availability of trained and qualified medical physicists is essential to delivering high-quality healthcare services, particularly in radiation therapy and diagnostic imaging. However, medical physics education and training across South Asia remain heterogeneous across countries. This study evaluates the status of medical physics education, clinical training, accreditation, and certification across South Asia through a structured literature-based comparative review of publicly available academic and institutional sources up to August 2025. Significant disparities are identified across the eight countries. India demonstrates the most comprehensive system, including accredited academic programs and structured clinical training, whereas Bangladesh, Pakistan, and Sri Lanka provide established educational pathways but still lack formal residency and certification frameworks. Nepal and smaller states rely largely on external training opportunities or lack formal systems. Compared with Southeast Asia and the Middle East, regional progress remains uneven. The study proposes a coordinated South Asian framework for accreditation, harmonized curricula, and shared clinical training hubs. Such measures could strengthen workforce capacity, promote professional recognition, and support sustainable expansion of cancer care services.***

**Keywords:** Medical physics, education, clinical training, accreditation, certification, health workforce, radiotherapy capacity, clinical residency, regional policy, human resource development in oncology, South Asia.

## 1. Introduction

Medical physics is internationally recognized as a distinct health profession where physics is applied to prevent, diagnose, and treat disease. The International Labor Organization (ILO) lists “Medical Physicist” in ISCO-08; the International Organization for Medical Physics (IOMP) provides global leadership and advocacy for the profession; and the International Atomic Energy Agency (IAEA) codifies safety, QA, and optimization requirements and the role of medical physicists [1], [2], [3], [4].

As medical physicists contribute to patient care, their knowledge and competence are paramount and are developed through specialist education and training. Foundational standards and curricula are provided by the IAEA, including the International Basic Safety Standards and dedicated guidance on the roles, education, and clinical training of medical physicists [3], [4], [5], [6], [7], [8]. Complementary regional guidance from the European Federation of Organizations for Medical Physics (EFOMP), Asia–Oceania Federation of Organizations for Medical Physics (AFOMP), and American Association of Physicists in Medicine (AAPM) further specifies graduate curricula, clinical competencies, and program expectations [9], [10], [11].

Although international organizations have developed well-established guidelines and standards for medical physics education and training, gaps persist in their practical implementation, particularly in low- and middle-income countries [12] . This implementation gap is particularly evident in South Asia [13]. This review assesses the status of medical physics education, clinical training, accreditation, and certification in South Asia, identifying gaps and opportunities for harmonization.

## 2. Methods

This study presents a structured literature-based comparative review of medical physics education, training, and certification in South Asia. Data were collected from publicly available sources, including peer-reviewed journal articles (Scopus-indexed and PubMed-indexed), reports from international organizations (IAEA, IOMP, AFOMP), and official institutional and regulatory documents, published up to August 2025.

A targeted search strategy was applied using keywords such as “medical physics education,” “clinical training,” “residency,” “certification,” and “South Asia.” Inclusion criteria comprised studies and reports describing academic programs, clinical training, accreditation, certification systems, and professional activities related to medical physics in South Asia. Articles not directly addressing education or training structures, or lacking verifiable sources, were excluded.

Extracted data were categorized into five analytical themes: academic structure, clinical training, accreditation and certification, professional societies, and international cooperation. A comparative synthesis approach was used to identify regional patterns, disparities, and gaps.

This study is limited by reliance on publicly available literature and the absence of primary data or institutional surveys, which may result in incomplete representation for countries with limited published information.

## 3. Findings

This review includes Afghanistan, Bangladesh, Bhutan, India, the Maldives, Nepal, Pakistan, and Sri Lanka, consistent with UNICEF South Asia’s country coverage [14]. The region accounts for nearly one-quarter of the world’s population, and faces rapidly growing demand for cancer care—particularly radiotherapy—over the coming decades [15], [16]. South Asia's eight countries (population ≈ 1.96 billion) have an equipment density of approximately 0.65 machines per million population [17]. This is substantially below the IAEA planning guideline of approximately 5.6 machines per million population [18], highlighting the high workload and unmet demand for radiotherapy services in the region. In parallel with infrastructure limitations, academic programs in medical physics across South Asia exhibit significant variations in availability, structure, and accreditation [12], [13]. The following sections summarize current education and training opportunities in the region.

### 3.1 Academic Programs

Academic programs in medical physics across South Asia show considerable variation in scope, availability, and institutional support. India has a dual-path academic system for medical physics: MSc in Medical Physics and Post-MSc Diploma (DipRP/DipMP) [19], [20], [21] while Bangladesh has developed both B.Sc. and M.Sc. programs [22], [23], [24], [25]. Pakistan and Sri Lanka each host limited but established MSc programs [26], [27], [28], while Nepal lacks formal postgraduate training [29], [30]. No published information specific to medical physics education was identified for Bhutan, the Maldives, or Afghanistan. National cancer control strategies from Bhutan and the Maldives, as well as a recent oncology report from Afghanistan, also fail to mention medical physics capacity [31], [32], [33].

**Table 1:** Availability of Academic Programs in Medical Physics and associated details in South Asia

| Country | Program Name | Duration | Starting year | Number of Universities/ Institutions | Types of Universities/ Institutions | Students/ Year | References |
|---|---|---|---|---|---|---|---|
| Bangladesh | B.Sc. in Medical Physics and Biomedical Engineering. | 4 Years | 2005 | 1 | Private | - | [22], [23], [24], [25] |
| | M.Sc. / MS in Medical Physics | 1-2 Years | 2000 | 3 | Both | 15 | [13], [22], [23], [24], [25] |
| India | Post MSc Diploma in Radiological/Medical Physics | 1 Year | 1962 | 7 | Govt. | - | [19], [20], [21] |
| | MSc Degree in Medical Physics | 2 Years | 1982 | 22 | Both | 250 | [13], [19], [20], [21] |
| Nepal | No | N/A | N/A | N/A | N/A | NA | [13], [24], [29], [30] |
| Pakistan | M.Sc. in Medical Physics | 2 Years | 2001 | 1 | Govt. | 12-14 | [24], [26] |
| Sri Lanka | M.Sc. in Medical Physics | 02 Years | 1996 | 2 | Govt. | 15 | [13], [27], [28] |

Note: No published information on academic programs was identified for Bhutan, the Maldives, and Afghanistan; these countries are excluded from this table.

Overall, India and Bangladesh maintain the most extensive academic pathways for medical physicists in South Asia, while Pakistan and Sri Lanka provide smaller but established MSc programs. Nepal remains without a formal postgraduate program, and no published information is available for Bhutan, the Maldives, or Afghanistan. These disparities underscore the absence of regional standardization and highlight the need for harmonized academic frameworks to ensure consistent preparation of medical physicists across South Asia.

### 3.2 Residency/Clinical Training

While academic programs provide the theoretical foundation, clinical training is essential to develop clinically qualified medical physicists, as emphasized by the IAEA guidelines [3], [6], [7], [8]. It provides practical competencies required for safe and effective patient care in radiation oncology, diagnostic radiology, and nuclear medicine. The IAEA has developed structured clinical training frameworks in these areas, which serve as widely recognized international benchmarks. In South Asia, however, clinical training programs vary widely in structure, duration, and recognition. India has the most formalized pathway, with a mandatory one-year internship based on a competency-based framework implemented since 2013[19], [20], [21]. Bangladesh integrates clinical exposure into BSc and MSc projects, complemented by accredited workshops and in-service training [22], [23], [24], [34]. In contrast, Nepal lacks structured residency programs, with physicists often seeking training abroad [24], [29], [30]. In Pakistan, clinical training is provided through the MS program at PIEAS, PAEC centers, and a two-year structured program at AKU, but there is no standardized national residency framework [24], [26]. In Sri Lanka, medical physicists complete a two-year Master of Science (MSc) program. They are then recruited into the Sri Lanka Scientific Service, where they undergo approximately one year of supervised on-the-job clinical training. However, no formal residency or certification system exists [13], [24], [27], [28]. For Bhutan, the Maldives, and Afghanistan, the situation remains unchanged, with no published information available, consistent with the findings in Section 3.1.

**Table 2:** Status and Development of Residency / Clinical Training in Medical Physics in South Asia

| *Country* | *Residency/Clinical Training Availability* | *Present Implementation / Structure* | *Duration* | *Fields of Training* | *References* |
|---|---|---|---|---|---|
| Bangladesh | No formal program; partial implementation | University programs include limited clinical attachments and research projects. THE DU MS program offers a 3-month internship in radiotherapy and nuclear medicine. Hands-on experience mainly gained through an IAEA-supported pilot in Nuclear Medicine (2011–2013) and IAEA AMPLE e-learning. | B.Sc./M.Sc. Project: 6 months; DU internship: 3 months; IAEA pilot: 2 years. | RT and NM are the main areas; DR is covered partially through attachments and workshops. | [23], [24], [34] |

| | | | | | |
|---|---|---|---|---|---|
| | | SCMPCR conducts in-service and hands-on training workshops (2–3 times annually). | | | |
| India | Yes | A one-year internship program, to be completed after the academic course, is mandatory for certification, as per AERB requirements. | 1 year | Comprehensive training in RT, NM, and DR, emphasizing clinical dosimetry and equipment QA. | [19], [20], [21] |
| Nepal | No | No structured residency; relies on IAEA fellowships and attachments abroad (mainly India) | N/A | RT (mainly) | [13], [24], [29], [30] |
| Pakistan | Partial | Clinical exposure integrated in the PIEAS MS program; training at PAEC and Aga Khan University Hospital (AKU); no national residency framework | 6–12 months (varies) | RT, NM, DR | [24], [26] |
| Sri Lanka | No structured residency program | Graduates receive on-the-job clinical training after recruitment. After recruitment through the Sri Lanka Scientific Service (SLSS), new physicists are trained under senior physicists at government radiotherapy centers. | ~1 year (supervised on-the-job) | Primarily focused on RT planning, dosimetry, QA, and radiation protection. | [13], [27], [28] |

Note: RT-Radiotherapy, NM- Nuclear Medicine, DR- Diagnostic Radiology. Countries without verifiable data (Bhutan, Maldives, and Afghanistan) are excluded.

Overall, India remains the only country in South Asia with a nationally mandated, competency-based clinical training program of appropriate duration. At the same time, Sri Lanka provides MSc graduates with approximately one year of supervised on-the-job training under the Sri Lanka Scientific Service, as reported by AFOMP. Bangladesh offers limited clinical exposure through academic projects and workshops. Pakistan, on the other hand, combines institutional training at PIEAS, PAEC, and AKU with international support, while Nepal relies primarily on external opportunities. No structured clinical training programs were identified for Bhutan, the Maldives, or Afghanistan, consistent with their absence of academic programs noted in Section 3.1. These disparities underscore the need for harmonized residency frameworks and competency-based clinical training across the region.

### 3.3 Accreditation and Certification

Accreditation of academic programs and certification or registration of medical physicists are essential to ensure consistent professional standards, protect patients, and align with international best practices. [3], [9], [10], [11]. The importance of such mechanisms has been emphasized in other regions as well, for example, through the IAEA/RCA project in the East Asia and Pacific region, which recommended accredited training centers and nationally recognized certification pathways for medical physicists [35]. In South Asia, however, accreditation and certification mechanisms remain limited in most South Asian countries. India remains the only South Asian country with a functioning accreditation and certification system for medical physicists, ensuring a recognized pathway for professional qualification [13], [19], [20]. In contrast, Bangladesh [13], [23], [24], Pakistan [24], [26], Sri Lanka [13], [24], [27], and Nepal [13], [29], [30] lack nationally standardized systems for accreditation or professional certification. Bhutan, the Maldives, and Afghanistan are not considered here, as they lack academic and clinical training infrastructure.

**Table 3:** Availability of Accreditation and Certification Systems in South Asia

| *Country* | Accreditation | Certification/Registration |
|---|---|---|
| Bangladesh | No | No |
| India | Yes | Yes |
| Nepal | No | No |
| Pakistan | No | No |
| Sri Lanka | No | No |

The absence of accreditation and certification across most of South Asia underscores the urgent need for harmonized regulatory frameworks to strengthen the medical physics profession and safeguard patient care, drawing on lessons from regional initiatives such as the RCA project.

### 3.4 Professional Societies

While accreditation and certification ensure formal recognition of the profession, professional societies play a complementary role in advancing education, training, research, and advocacy. At the international level, organizations such as IOMP, AFOMP, EFOMP, and AAPM provide policy guidance and set educational standards. At the national level, several South Asian countries have established professional bodies recognized as National Member Organizations (NMOs) of the IOMP, though their capacity and activity levels vary. Table 4 presents the professional societies in medical physics across South Asia.

**Table 4:** Professional Societies in Medical Physics (South Asia)

| *Country* | *Society / Body* | *Established* | *Members* | *Affiliation* |
|---|---|---|---|---|
| Bangladesh | Bangladesh Medical Physicists Association (BMPA) | 1998 | 153 | AFOMP member |
| | Bangladesh Medical Physics Society (BMPS) | 2009 | 350 | IOMP NMO and AFOMP member |
| India | Association of Medical Physicists of India (AMPI) | 1976 | 1050 | IOMP NMO and AFOMP member |
| Nepal | Nepal Association of Medical Physicists (NAMP) | 2009 | 22 | IOMP NMO and AFOMP member |
| Pakistan | Pakistan Organization of Medical Physicists (POMP) | 2010 | NA* | IOMP NMO and AFOMP member |
| Sri Lanka | Sri Lanka Medical Physics Society (SLMPS) | 2019 | 40 | IOMP NMO and AFOMP member |

Note: Data compiled from IOMP and AFOMP membership listings [36], [37]. For Bhutan, the Maldives, and Afghanistan, No professional society identified. Membership data for Pakistan is not reported on the AFOMP website.

Overall, most South Asian countries maintain at least a nominal professional society for medical physics, with several of these societies being members of the IOMP. India's AMPI stands out as one of the most established, with active scientific meetings and a peer-reviewed journal, and plays a role in promoting education, training, research, and professional development [20]. At the same time, CMPI plays a distinct role by offering certification examinations and working toward accreditation standards [20], [38]. In Bangladesh, both BMPS (IOMP-recognized) and BMPA (an older, nationally active organization) operate in parallel, reflecting a fragmented professional landscape through professional advocacy, education awareness, and national training events [22]. Pakistan, Sri Lanka, and Nepal also maintain small but recognized societies. By contrast, Bhutan, the Maldives, and Afghanistan have no professional societies. The uneven development of professional organizations across the region underscores the need to strengthen national institutions and foster regional collaboration through AFOMP and IOMP, thereby enhancing advocacy, training, and professional recognition.

Beyond national professional societies, the South Asia Center for Medical Physics and Cancer Research (SCMPCR), established in Bangladesh with international support, has emerged as a regional hub for education, training, and collaborative research. SCMPCR regularly organizes accredited workshops and short-term training programs, particularly in radiation oncology and medical physics, and serves as a platform for building professional capacity across South Asia. While not a professional society, SCMPCR complements the activities of BMPS, BMPA, and AFOMP by providing practical training opportunities, fostering regional collaboration, and helping to bridge existing gaps in human resource development [22], [39].

### 3.5 International Cooperation

International cooperation has played a crucial role in advancing medical physics across South Asia, where national capacity remains limited. Since the 1960s, the WHO and the IAEA have jointly supported postgraduate education and training in radiation sciences [40]. The IAEA's Regional Cooperative Agreement (RCA) now provides the primary framework for regional collaboration. The IAEA report emphasized the need for harmonized curricula and certification systems [13], [41].

Building on this foundation, two ongoing RCA projects are particularly relevant:
RAS6087 – Strengthening Education and Clinical Training of Medical Physicists (2020–2025), involving India, Pakistan, Bangladesh, Nepal, and Sri Lanka [42].
RAS6088 – Enhancing the Quality and Safety of Radiotherapy (2020–2025), which includes Afghanistan, Bangladesh, Nepal, and Pakistan [43].
RAS6087 focuses on workforce development, while RAS6088 addresses service quality and safety in radiotherapy. Their scope reflects broad South Asian participation while highlighting persistent gaps, as Bhutan and the Maldives are not included [41], [44], [45].

**Participation by Country**
India and Pakistan are active participants in regional projects, integrating RCA frameworks into national structures [41], [44].

Bangladesh participates in both projects, benefiting from fellowships and regional training through RCA [41], [44].

Sri Lanka is engaged in RAS6087 for postgraduate training and exchanges, though it is not a participant in RAS6088 [41], [42], [43], [44].

Nepal participates in projects and receives training and technical missions; however, it lacks a national certification framework [45].

Afghanistan has nominal participation in RAS6088; implementation limited by infrastructure [43], [45].

Bhutan and the Maldives are not participating due to a lack of radiotherapy services and trained physicists [41], [43], [44].

Overall, the RCA projects illustrate both the achievements and continuing limitations of international cooperation. Larger countries have been able to institutionalize RCA benefits within national systems, whereas smaller states remain dependent or excluded. In the absence of coordinated accreditation and regional certification mechanisms, international initiatives alone are insufficient to secure sustainable progress in medical physics.

## 4. Discussion

The findings reveal clear disparities in the development of medical physics across South Asia. Three key patterns emerge. First, a regional imbalance exists: India maintains a fully structured framework for education and training, whereas Bangladesh, Pakistan, and Sri Lanka have developed academic programs with limited clinical training capacity. Nepal, Bhutan, the Maldives, and Afghanistan lack national infrastructure. Second, international cooperation- particularly through IAEA RCA projects (RAS6087 and RAS6088)- has been a major driver of progress, although its impact is uneven across countries. Third, a regulatory gap persists, with India as the only country having accredited programs and formal certification systems, while others lack standardized professional recognition.

These disparities are illustrated in Figure 1 and Figure 2. Figure 1 compares academic training, clinical training, accreditation, and certification across South Asian countries, highlighting uneven resource distribution. Figure 2 presents a regional map summarizing the overall status of medical physics development, indicating varying levels of progress across countries.

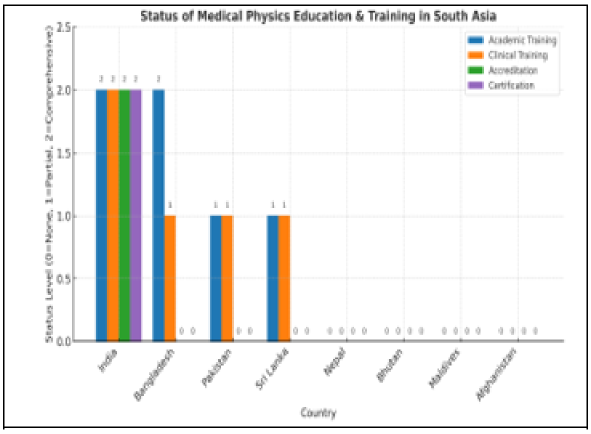


**Figure 1:** Status of Medical Physics Education and Training in South Asia

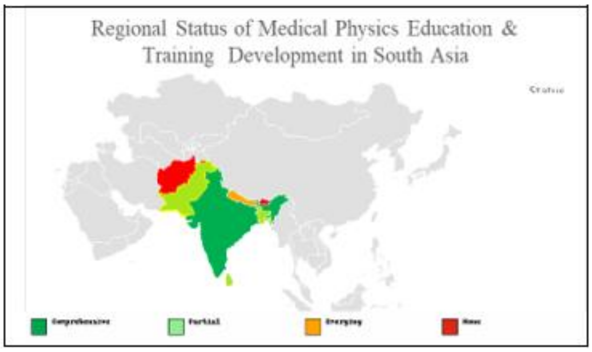


**Figure 2:** Regional status of medical physics development in South Asia

In this figure, Green indicates comprehensive (structured education, clinical training, accreditation, certification); Yellow is partial (some training and education, but no national certification); Orange represents emerging (Nepal, limited academic activity and early training initiatives), and Red stands for none (no national infrastructure).

Together, these figures underscore that while South Asia has greatly benefited from international cooperation, sustainability depends on integrating accredited education, structured clinical training, and nationally recognized certification into domestic systems. Without harmonized regulatory frameworks, disparities between countries will persist, and the region's collective ability to ensure safe and effective cancer management will remain constrained.

When viewed alongside other developing regions, South Asia's progress in medical physics education and training appears uneven. In Southeast Asia, the establishment of SEAFOMP in 2000 catalyzed regional cooperation, leading to the expansion of postgraduate programs, structured clinical training centers, and IAEA-supported competency-based initiatives [46]. Similarly, the Middle East has advanced through coordinated postgraduate education and cross-border collaboration, steadily building a more standardized pathway for professional recognition [47]. Drawing lessons from these regions, South Asia could benefit from a federated approach to accreditation, standardized curricula, and coordinated clinical training programs.

## 5. Recommendations

Based on the findings of this study, the following recommendations are proposed to strengthen medical physics education, training, and regulation in South Asia:

1) **Establish a South Asian Regional Framework for Medical Physics:** A regional accreditation and certification framework, coordinated through AFOMP in collaboration with the IAEA, should be developed to ensure uniform professional standards across South Asia. This framework could serve as a platform to link national societies, facilitate regional conferences and training initiatives, and promote harmonized educational and clinical guidelines across the subcontinent—similar to cooperative models established in Southeast Asia and the Middle East. The framework should also facilitate shared clinical and academic training placements for countries currently lacking local programs, thereby ensuring equitable regional capacity-building.
2) **Develop National Certification Boards in Each Country:** Countries with established academic programs- such as Pakistan, Sri Lanka, and Bangladesh- should prioritize the development of national certification boards for medical physicists, guided by the IAEA clinical training standards (TCS-37 and TCS-56). In contrast, India's existing certification and accreditation framework, coordinated through the Atomic Energy Regulatory Board (AERB), may serve as a model for regional adaptation and harmonization.
3) **Expand Academic Programs:** South Asian countries with existing academic programs- such as Bangladesh, Sri Lanka, Pakistan—should focus on strengthening clinical training components and aligning curricula with IAEA-recommended competency frameworks. For countries where medical physics education is still emerging, efforts should prioritize establishing foundational programs and fostering regional partnerships to share expertise, faculty resources, and clinical training opportunities.
4) **Mandatory Clinical Training and Residency:** All academic programs in medical physics should include a minimum of two years of structured clinical training or residency, aligned with IAEA guidelines and competency standards, as a prerequisite for independent professional practice in radiotherapy, nuclear medicine, and diagnostic imaging.
5) **Integrate Medical Physics into National Health Systems and Quality Frameworks:** Relevant national authorities and professional bodies should formally recognize medical physics as a distinct health profession, adopting appropriate staffing norms, structured career pathways, and fair remuneration that reflect its essential role in ensuring patient safety and quality of care. Embedding medical physics within national health frameworks would strengthen professional recognition,

workforce sustainability, and quality assurance in radiation-based services.

## 6. Summary

This comparative review demonstrates substantial disparities in medical physics education, clinical training, and regulatory recognition across South Asia. While India has established an integrated system of accredited education and certification, other countries show fragmented or emerging structures with limited clinical training capacity. International cooperation has contributed to workforce development, yet sustainable progress requires nationally embedded accreditation frameworks and coordinated regional strategies. Future policy efforts should prioritize harmonized curricula, structured residency pathways, and integration of medical physics into national health workforce planning. Addressing these gaps is essential for strengthening radiation safety, improving cancer care quality, and ensuring equitable regional healthcare development.

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**List of Abbreviations**

1) AAPM- American Association of Physicists in Medicine
2) AERB- Atomic Energy Regulatory Board (India)
3) AFOMP- Asia–Oceania Federation of Organizations for Medical Physics
4) AMPI- Association of Medical Physicists of India
5) DIRAC- Directory of Radiotherapy Centers (IAEA database)
6) EFOMP- European Federation of Organizations for Medical Physics
7) IAEA- International Atomic Energy Agency
8) ILO- International Labor Organization
9) IMPCB- International Medical Physics Certification Board
10) IOMP- International Organization for Medical Physics
11) PAEC- Pakistan Atomic Energy Commission
12) PIEAS- Pakistan Institute of Engineering and Applied Sciences
13) POMP- Pakistan Organization of Medical Physicists
14) RCA- Regional Cooperative Agreement (IAEA)
15) SCMPCR- South Asia Center for Medical Physics and Cancer Research
16) SEAFOMP- Southeast Asian Federation of Organizations for Medical Physics
17) SLMPS- Sri Lanka Medical Physics Society
18) WHO - World Health Organization

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