

# Musculoskeletal Training for Orthopaedists and Nonorthopaedists

## Experiences in India

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**Abstract** In India, health policies, services, health indices, and medical education are improving despite the country's enormous population and limited resources. Orthopaedic training in India should be geared to serve the predominantly rural population (72% of total population) living in some 550,000 villages, but unless the basic amenities improve in villages and towns, orthopaedists will remain averse to serving in these areas. Traditional practitioners play an important role in musculoskeletal trauma care in villages and even some town and city areas, and hence cannot be ignored. We suggest a stratified system of orthopaedic training for medical graduates, postgraduates, and paramedics with a well-defined need-based curriculum, and a clear cut division of labor, terms, and conditions to suit the stratified social and demographic structure of India. This stratified system is intended to provide appropriate musculoskeletal trauma care services to the rural population, reduce neglected and mismanaged trauma, consequently

avoiding subsequent orthopaedic disability, and reduce the financial burden of managing these cases. This system also intends to prevent overloading of teaching hospitals and apex institutes and ensure availability of subspecialized orthopaedic services in the country at designated centers. Traditional practitioners shall be periodically educated regarding safe orthopaedic practices, which are anticipated to yield improved trauma care services.

## Introduction

There is a vast difference between the orthopaedic care in developed and developing countries. In developed countries, well-organized health services have led to early diagnosis and prompt treatment of fractures and other orthopaedic ailments. Many institutions have systematic computerized data collection and followup routines. Generally road traffic and domestic accidents have dropped due to well-established safety norms [44]. First aid and patient evacuation is considered a top national priority and taken on an emergent basis. The population of many of these countries is relatively small and consequently fewer patients and a high doctor-patient ratio have made good treatment available to everyone. An effective insurance system is in place in these countries and has allowed even the most specialized surgery to be accessible to virtually all citizens.

The scenario is different in developing countries like India [24]. Though the Indian economy is developing at a great rate, unfortunately Indian health services cannot keep pace with it. The government-run healthcare system, though it provides free treatment to the underprivileged poor and needy, has not been put to its maximum use in rural areas and remains overburdened in urban areas because of lack of resources, long-term planning, and

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commitment. The medical services in India are largely provided by a large and unregulated private sector [9]. These factors have led to inequitable access to quality care. Orthopaedic training and services are not uniform in this vast and overpopulated country with rural predominance.

### Current Orthopaedic Care in India

Training should be need-based and directed towards the demands of the local population. It would be prudent to discuss the current scenario of clinical care before discussing orthopaedic training in India. Although India occupies only 2.4% of the world's land area, it supports over 16% of the world's population [49]. Seventy-two percent of the people live in more than 550,000 villages (3976 have a population more than 10,000 people, 236,004 have a population less than 1000, and the rest have fewer than 500 residents each), and the remainder in more than 2000 towns and cities [49, 50]. Current orthopaedic services and training are directed more towards the urban population. Seventy-five percent of healthcare services are provided by the private sector in India [33]. Due to the commercialization of orthopaedic care, private insurers focus on the urban elite and upper-middle class patients who can pay out of pocket, as India lacks any uniform insurance or social security system. The government has provisions for free treatment in public hospitals. Patients without financial resources have opportunities to receive medical treatment based on the national healthcare system. In view of the federal nature of the constitution, areas of operation pertaining to health have been divided between Union and state governments [10]. Health is largely the responsibility of states, but the union government finances national public health programs, which have higher social returns or which are characterized as national goods [9].

One of the major advantages of this system is that healthcare facilities, though with very limited resources, are universally available to all its citizens irrespective of their socioeconomic status. Limited diagnostic facilities (sometimes at a nominal fee), life-saving drugs, and basic essential drugs are usually available in these places. On the other hand, because of overpopulation in the face of limited resources, these healthcare facilities fall short of desirable standards. The national health policy document of the government of India states that "The existing public health infrastructure is far from satisfactory. As a result, it has been estimated that less than 20 percent of the population, which seek OPD services, and less than 45 percent of that which seek indoor treatment, avail of such services in public hospitals. This is despite the fact that most of these patients do not have the means to make out-of-pocket payments for private health services except at the cost of

other essential expenditure for items such as basic nutrition" [30]. This document further states that "the current annual per capita public health expenditure in the country is no more than Indian Rupees 200" [17, 30]. Per capita government expenditure on health at average exchange rate is US\$ 5.4 (data for year 2004) [6]. Some institutions/departments have their individual health services, eg, railway employees have railway dispensaries and hospitals, industry employees have Employees State Insurance; central government employees have hospitals and dispensaries under the Central Government Health Scheme, etc. Another arrangement is the "panel system" in which services of a private hospital are utilized by a government or autonomous department/institution and the cost of the services is paid by the employee's institution. One of the Indian government documents also states that only 10% of Indians have some form of health insurance, hospitalized Indians spend on an average 58% of their total annual income, over 40% of hospitalized Indians borrow heavily or sell assets to cover expenses, and over 25% of hospitalized Indians fall below the poverty line because of hospital expenses [33]. Specialized orthopaedic operations, requiring technically up-to-date infrastructure and costly implants, are practically out of reach of the common man.

The rural health system is a three-tier system comprising sub centers (SC), primary health centers (PHC), and community health centers (CHC). There were 144,988 SCs, 22,669 PHCs, and 3910 CHCs in India as of March 2006. There were also 9923 hospitals with 480,306 beds in the country: 6909 hospitals in rural areas (152,736 beds) and 3014 in urban areas (327,570 beds) [31].

Medical education infrastructure in the country has shown rapid growth during the last 15 years. The country has 266 medical colleges, 268 colleges for BDS courses, and 104 colleges to conduct MDS courses [31]. The SC, PHC, and CHC mainly serve rural areas and are distributed on population norms. However, urban hospitals and medical colleges are distributed districtwide and statewide, respectively [1]. The total budget allocation under the health sector in India during the 10th 5-year plan (2002–2007) is just 1.63% of its total expenditure in the social sector compared to 21% in United States and 15% in United Kingdom [51].

The number of registered allopathic medical practitioners in India is approximately 580,000, providing a ratio of 56 per 100,000 people. The ratio of nurses is 78 per 100,000 [18]. In 2004, the government of India established a National Commission on Macroeconomics and Health (NCMH), co-chaired by the Health and Family Welfare Minister and the Finance Minister [47]. It presented its elaborate report on Disease Burden in India and Financing and Delivery of Health Care Services in India in 2005 [42]. The report points out that the Indian government policies

on healthcare failed because of serious omissions in public policy including absence of a surveillance and epidemiological system resulting in poorly designed health interventions and inadequate investments in developing skilled human resources [19].

Though there is a well-defined three-tier system of rural health services, because of the financial and resource deficits, the facilities in these centers are inadequate. Hence, a rural patient must often travel to the nearest district or metropolitan hospital for orthopaedic services or seek alternative treatment in the form of traditional practices or by visiting a traditional bone setter. The number of traditional bone setters in India is not known with certainty, but it is estimated that there are about 70,000 traditional healers and bone setters in India, who treat perhaps 60% of all trauma patients [5]. They are usually local individuals who gain skills through family training or apprenticeship. They tend to handle all sorts of trauma cases. However, they do not handle multiple trauma or life-threatening trauma. Not uncommonly their treatments cause complications.

### Current Scenario of Orthopaedic Education in India

Currently there are 174 medical institutions recognized by the Medical Council of India (MCI) and 78 additional medical institutions permitted by the MCI to grant undergraduate medical degrees (MBBS degree) [22].

#### Undergraduate Orthopaedic Training (MBBS)

The undergraduate course in India is a nine-semester system followed by 1 year of compulsory rotating internship in broad medical specialties. During MBBS training the undergraduates are taught 100 hours of orthopaedic theory. During the third to ninth semester, clinical postings of 3 hours daily are scheduled for different specialties. There is orthopaedic clinical posting of a total of 10 weeks in three installments. These postings include exposure to rehabilitation and physiotherapy. The learning goals set at this stage include diagnosis and management of common orthopaedic conditions. Undergraduate education aims to prepare the candidate to perform certain orthopaedic tasks and provide sound advice for skeletal and related conditions at the primary or secondary healthcare level [45]. During internship, a student is posted for 15 days in the orthopaedics department.

#### Postgraduate Orthopaedic Training

To choose orthopaedic surgery as a career, a candidate needs to undergo an orthopaedic residency program. In

India, one needs to complete and qualify any one of the following three to be an orthopaedic surgeon: (1) a degree course in orthopaedics leading to award of MS (Orthopaedics), a 3-year orthopaedic residency program; (2) diploma course in orthopaedics leading to award of D.Orth (Diploma), a 2-year orthopaedic residency program; or (3) diplomate of National Board Course leading to award of DNB (Orthopaedics) degree, a 3-year orthopaedic residency program [35].

The MS (Orthopaedics) and D.Orth courses are governed by the Medical Council of India [22]. However the DNB (Orthopaedics) course is governed by the National Board of Examinations [35]. All three are granted by government as well as private institutions and recognized by appropriate supervisory and regulatory bodies. To join a degree or diploma course in orthopaedics, the candidate usually has to appear for an entrance examination at the national or state level [23, 38]. Several other autonomous institutions hold a separate entrance examination individually at the national level for their postgraduate courses.

#### Degree Course in Orthopaedics—MS (Orthopaedics)

There are 394 degree seats in postgraduate orthopaedic courses in government, trust, and society medical institutions all over India [22]. The duration of the degree course is 3 years. The Medical Council of India directs the training of postgraduate students to be derived from or targeted to the needs of the community. It is assumed that following postgraduate education for the MS (Orthopaedics) degree, the candidate will have mastered most of the complexities pertaining to the specialty required to practice at the secondary and the tertiary levels of the healthcare delivery system. The 3-year residency program for MS (Orthopaedics) consists of the first year for clinical clerkship, ward duties, record keeping, plaster room work, and outdoor postings [44]. During the last quarter of the first year or at the beginning of the second year, candidates are required to submit a topic for a thesis/dissertation along with protocols. The duration for thesis/dissertation usually is 12 to 18 months. At the end of 3 years, candidates undergo theory and practical examination to obtain the MS (Orthopaedics) degree.

#### Diploma Course in Orthopaedics—D.Orth

There are 225 diploma seats in postgraduate orthopaedic courses in medical institutions all over India [22]. The duration of the diploma course is 2 years. Candidates undergoing diploma courses are not required to submit a thesis/dissertation. Once they clear the theory and practical

exams, they have the same rights as a degree candidate to practice orthopaedics. However, diploma holders cannot enter the teaching profession (ie, are not eligible to become medical teachers).

All the institutions awarding the above-mentioned postgraduate orthopaedic degree or diploma course are affiliated to a university. The theory examinations for diploma and degree courses are held at the University level, while the practical examinations for the award of degree or diploma are held at the local level (ie, the institution where the candidate is undergoing training, in almost all cases except few exceptions).

#### Diplomate of National Board Course—DNB (Orthopaedics) Degree

The National Board of Examination (NBE) was established in 1975 by the government of India to provide a common standard and mechanism of evaluation of minimum level of attainment of the objective(s) for which postgraduate courses were started in medical institutes. The board at present conducts postgraduate examinations in approved disciplines in orthopaedics leading to the award of Diplomate of National Board (DNB) (Orthopaedics) [11, 35]. There are over 450 accredited institutions recognized by the National Board (NBE) for training [27]. There are 194 DNB orthopaedic seats at present in India [12]. The residency program is 3 years. The examination is in two stages, theory and practical. The Diplomate qualification awarded by the National Board of Examination is equivalent to the recognized postgraduate degree of MS (Orthopaedics) awarded by Indian universities [35]. A candidate holding a university-granted MCI-recognized postgraduate orthopaedic qualification (MS Orthopaedics degree or a Diploma in Orthopaedics) can subsequently obtain an additional DNB degree of NBE, after taking requisite theory and practical exams. Those who hold a Diploma need to undergo a further 2-year residency program in an NBE-recognized center and write a thesis/dissertation before they are eligible to take exams for DNB (Orthopaedics). However, those candidates who already hold an MS Orthopaedics degree need not undergo any further residency to obtain the DNB degree. The latter can take the DNB exams directly to obtain an additional DNB (Orthopaedics) degree. DNB is considered an alternative route to orthopaedic postgraduate training because there are fewer numbers of MS Orthopaedics degree seats in government medical colleges in comparison to the aspiring candidates. As the exam is held at national level, there is uniformity of assessment and it is considered a better-recognized degree in the eyes of policymakers.

#### Training in Orthopaedics after Postgraduate Education

Though after obtaining either a degree or diploma in orthopaedics one is labeled a qualified orthopaedic surgeon and is fully authorized to practice orthopaedics, one may opt for further training in orthopaedics and apply for a 3-year senior residency program. This course is paid and is offered at both government and private institutions. In a teaching medical institution, the senior resident is supposed to participate in undergraduate training, teaching ward rounds, case conferences, and journal clubs in addition to routine clinical work.

There are no orthopaedic subspecialty degree courses available in India, except a few run by the National Board of Examinations. The latter offers a 2-year full-time residency program of fellowship in three orthopaedic subspecialties: hand and microsurgery, trauma care, and spine [15]. However, the total number of seats in the three fellowships combined is only nine for the entire country. There is an entrance test for the fellowship every year and on completion of fellowship, the trainee is awarded the fellow of National Board of Examination certificate.

#### Discussion

India has substantial achievements to its credit. Longevity has doubled from 32 years in 1947 to 66 years in 2004. The infant mortality rate (IMR) has fallen by over 70% points between 1947 and 1990. Malaria has been contained at 2 million cases, smallpox and guinea worm have been completely eradicated, and leprosy and polio are nearing elimination. In the last 5 years over 500,000 deaths have been averted due to the upscaling of Directly Observed Treatment Short-course (DOTS). Intervention has led to these achievements. However, these achievements should not mask India's failures [14].

Due to its demographic peculiarities, heavy demands are placed on the healthcare system by the predominance of a rural population, sociocultural peculiarities, low per capita income, inadequate transport facilities, overcrowding, illiteracy, short supply of resources, lack of supporting services such as orthopaedic nursing, unstructured referral practice, and absence of a health insurance system [4, 33, 39, 52]. Although India accounts for 16.5% of the global population, it contributes to  $\frac{1}{5}$  of the world's share of diseases:  $\frac{1}{3}$  of the diarrheal diseases, TB, respiratory and other infections and parasitic infestations, and perinatal conditions;  $\frac{1}{4}$  of maternal conditions,  $\frac{1}{5}$  of nutritional deficiencies, diabetes, cerebrovascular diseases, and the second largest number of HIV/AIDS cases after South Africa [14]. The third National Family Health Survey document states that India is grappling with major adult

health problems such as infectious diseases [28]. Unfortunately, this document does not acknowledge trauma as major adult health issue.

India is experiencing a rapid health transition, with large and rising burdens of chronic noncommunicable diseases, which are estimated to account for 53% of all deaths and 44% of disability-adjusted life-years (DALYs) lost in 2005. Policymakers have been impeded until recently by inadequacy of data on the burdens of chronic noncommunicable diseases. Perceptions that these diseases mainly affect the rich, who can purchase private healthcare, also prevented public sector resources from flowing into chronic disease prevention and control. The limited health budgets were not ready to take on the additional costs of treating chronic diseases at state expense [41]. In an effort to assess the disease burden, the National Commission on Macroeconomics and Health has brought out documents on Disease Burden in India and Financing and Delivery of Health Care Services in India [48].

Trauma is yet to be identified as a major issue by government officials, possibly because of inadequate data from which the government can formulate policies. The national health policy document acknowledges the latter fact [29]. It states that the absence of a systematic and scientific health statistics database is a major deficiency in the current scenario. This makes it difficult to understand trends and levels of health spending by private and public providers of healthcare in the country and, consequently, to address related policy issues and to formulate future investment policies [29].

Though the government relentlessly promotes its health services, one of the greatest challenges facing India is to provide (orthopaedic) health services to its rural people who make up almost  $\frac{3}{4}$  of the country's population in an era where musculoskeletal trauma is rapidly becoming the major cause of morbidity and mortality. An urban doctor trained in an urban environment for 8 or 9 years to achieve an orthopaedic postgraduate degree tends to be unwilling and disinclined to serve the rural population because of deficient infrastructure and amenities at primary health centers, children's education, power supply, sanitation, etc. As a result, primary health centers in India are practically devoid of any orthopaedic services. In rural areas there are no qualified doctors. Healthcare is mainly delivered by so-called "Registered Medical Practitioners" (RMPs) and traditional practitioners. The former do not undergo any formal medical training, learn by apprenticeship, and obtain the RMP degree by becoming a member of a society by paying a required fee. There is plethora of neglected trauma. Most sufferers take it as their destiny and live with it. Usually the wage earners and marriageable-age females of a family are brought for treatment at higher centers.

District hospitals, next in the hierarchy, are equipped to provide bare minimum basic orthopaedic services like casting, and routine orthopaedic procedures such as management of open fractures, draining of abscesses, open fixation of long bones, etc.

Orthopaedic training in medical colleges is also extremely dissimilar in various parts of this vast and highly populated country. The National Health Policy document of India points out that medical colleges are not evenly spread across various parts of the country, the quality of education is highly uneven, and the syllabi excessively theoretical, making it difficult for the fresh graduate to effectively meet even the primary healthcare needs of the population. It also points out that the current curriculum in the graduate and postgraduate courses is outdated and unrelated to contemporary community needs [29]. General surgery training for the orthopaedic postgraduate was eliminated long ago. Thus, trauma training in India no longer includes training in general surgery. As a result the comprehensive nature of trauma care is lost and we have to depend upon referral consultation for general surgical care and consultation.

The high-tech surgery performed in developed countries has always fascinated the residents from developing countries. Unknowingly, many orthopaedic residents in developing countries consider these modern orthopaedic procedures such as total hip replacement, total knee replacement, or arthroscopy as benchmarks for wholesome and modern orthopaedic training, despite the fact that the majority never get an opportunity to perform these surgeries during their professional career. In an attempt to "keep up with" their peers, orthopaedic surgeons with substandard infrastructure and poor technical knowledge also attempt these specialized orthopaedic surgeries, producing disasters. It comes from the temptation of a small amount of information regarding specialized orthopaedic surgeries picked up during postgraduate orthopaedic training, which is a maximum of 3 years in India. The postgraduate often forgets that most of his patients would like to squat or sit cross-legged given a choice. This thought process is leading to the precedence of technology over biology in this country. What we need is a "population need-based curriculum" rather than a curriculum teaching needless details of specialized orthopaedic surgical procedures to all postgraduates. The latter policy is leading to the production of half-baked orthopaedic specialists serving this vastly populated country.

The majority of MS (Orthopaedics) seats and Diploma (D.Orth) seats, managed by Medical Council of India and universities, are available in government-run institutions. On the other hand, most DNB (Orthopaedics) seats, managed by National Board of Examinations, are available in private and trust institutions.

A medical college in a metropolitan area, on an average, handles from 300 to 500 patients in the outpatient department and another 50 to 90 patients in orthopaedic emergency each working day. These medical colleges serve as tertiary centers serving the community where all sorts of complex and complicated orthopaedic cases are treated either free or at nominal expense. An advantage of this situation is that the trainees are usually exposed to a wide spectrum of orthopaedic disease in all stages of natural history in government institutions. Another advantage is that the clinicians rely more on clinical acumen and quickly develop the skills to perform good and rapid clinical examinations guiding them to decision making, with the help of basic and bare minimum investigations, without resorting to costly sophisticated investigations. The latter are out of the reach of the common person, and hence requested by clinicians only when absolutely essential. The trainees have a voluminous clinical and surgical exposure. Moreover, research output predominantly comes from these medical colleges only. However, excessive patient load also results in poor documentation, record keeping, and followup. Because of limited resources within the government medical colleges, most do not have state-of-the-art equipment. The government policy of free consultation to all in the majority of government institutes without a proper referral system has overburdened the orthopaedic trainers and trainees with relatively minor trauma patients and those with degenerative disorders of knee and spine.

In contrast, orthopaedic trainees in private institutions may have exposure to state-of-the-art technology and procedures but clinical material in terms of volume and spectrum of diseases is limited. Almost all orthopaedic surgeries are performed by the consultants, resulting in less hands-on training. Often the students in these centers are trained mainly in selected fields (superspecialties like arthroplasty, arthroscopy, spine, or trauma), but less exposed to general orthopaedics, such as pediatrics, infection, or metabolic and nutritional disorders, that cater more to the general population. Hence, private institutes tend to produce macrospecialists in microfields of orthopaedics.

However, both types of institutes (government and private), knowingly or unknowingly, tend to use the orthopaedic trainees as “workers” rather than “learners under supervision.”

Regrettably, there is a widespread belief that the Indian economy, already the world’s largest recipient of remittances from overseas workers, will benefit from sending abroad more white-collar professionals who have high savings potential [25]. Unfortunately, there has been no effort on the part of government to curb brain drain. Vast outflows of highly skilled health professionals are

among the prime examples: 49% of graduates of the All-India Institute for Medical Sciences, the country’s best medical school, emigrated in the 1990s [10]. But in the last few years, there has been a decline in the number of Indian students leaving the country for higher studies and better paying jobs abroad. Many domestic corporate hospitals with excellent medical equipment and infrastructure and handsome salaries now attract some of these doctors [54].

#### Where Do We Need To Go?

In India, we need to provide musculoskeletal trauma care services in the most remote hamlet or village, to reduce neglected and mismanaged trauma and the resulting expenses, reduce orthopaedic disability and handicaps, avoid the economic burden of unnecessary trips to apex institutes by routine orthopaedic trauma cases, and prevent overloading teaching hospitals and apex institutes. Another important area to improve is prehospital care, which is practically nonexistent in India. We should ensure timely referral and transportation. All basic-level orthopaedic surgery should be available at district-level hospitals. At the same time we also need to ensure availability of subspecialty orthopaedic services in the country at designated centers to handle complicated cases and cases requiring specialized surgeries. Orthopaedic training should suit the needs of the community. Teaching institutions, which are going to produce the orthopaedists of tomorrow, should be properly equipped and have proper investigative facilities. There is a strong need to start interdepartmental and interinstitutional rotations for postgraduate trainees. The residents should be provided exposure to general surgery and other surgical branches. A close collaboration and partnership between private and government setups with exchange programs is highly desirable for the better training of the candidates. Superspecialty fellowships or apprenticeship under expert orthopaedic surgeons should be developed in-country for those aspiring to higher expertise.

#### How Do We Get There?

We suggest a stratified system of orthopaedic training for medical graduates, postgraduates, and paramedical personnel with well-defined need-based curriculum, clear-cut division of labor, terms, and conditions to suit the stratified social and demographic structure of India. This system is intended to produce three levels of orthopaedic primary care providers/practitioners and specialists [40].

### *Level I*

On the first level should be the medical graduate who is a family practitioner with 6 to 12 months training in common musculoskeletal conditions and trauma, basic splinting of fractures, training in life saving measures for polytraumatized patients and their transportation, primary care of open fractures, etc. As an alternative to a Level I medical graduate, we can consider trained and experienced nursing personnel, and possibly even a trained science graduate (BSc) from a local village or district. After screening these individuals, they should be trained for few years to provide primary and elementary orthopaedic care in villages. Level I service providers will have to practice in a village by law. One of the methods to generate more Level I orthopaedic service providers after medical graduation would be to have reserved seats in MBBS for candidates hailing from rural backgrounds.

### *Level II*

The second tier of training will produce an orthopaedic postgraduate with 3 years of training who is competent performing routine orthopaedic surgeries and procedures such as plaster techniques, management of open fractures, fixation of closed fractures. Level II providers, to be called basic orthopaedic surgery specialists (BOSS), will know the principles of orthopaedic damage control to handle polytrauma and a few specialized safe orthopaedic surgeries. The BOSS will not be taught theory or be trained in specialized orthopaedic surgeries, such as microsurgery, spine fixation, acetabular fixation, or arthroscopy. The BOSS trainee should be given the option, by choice, to undergo training in basic research methodology and to write a thesis. Undoubtedly, those who have an aptitude for research will opt for the latter and contribute to the literature. BOSS graduates would be prepared to practice in towns and districts using basic orthopaedic procedures and surgeries. Hence sophisticated equipment would not be necessary for their skill level. Most of today's medical colleges in India are equipped to prepare only Level II orthopaedic surgeons. In an attempt to emulate developed countries, these institutes do not hesitate to produce improperly trained specialists, who at times can do more harm than good in attempting complex surgeries which require a certain level of expertise and a full array of instrumentation.

### *Level III*

The third level provider would be an outstanding BOSS who pursues further training (2–3 years) in advanced

surgeries (such as arthroscopy, acetabular fixation, reconstructive surgery, arthroplasty) and basic research methodology at designated centers. Level III-trained orthopaedic specialists will be labeled Advanced Orthopaedic Surgery Specialist (AOSS). The AOSS will also undertake a rotation in general surgery to learn the principles and procedures required for the comprehensive care of polytraumatized patients, such as thoracotomy, laparotomy, urinary bladder repair, splenectomy, etc. Unlike in the West, the orthopaedic residents, who will be the trauma surgeons of future, are not trained in general surgical discipline during postgraduate study under the existing system of orthopaedic training in India [37].

The doctors of the different levels will serve in stratified areas (ie, village, town, city, metropolitan areas, teaching and research institutes, medical colleges, etc). A trained higher-level orthopaedist can serve in a lower stratum area, but the reverse would not be permissible. Strict legislation, careful licensing, and stringent practicing policies will enforce this concept. Another method of ensuring stratified practice is to register orthopaedic service providers at each level, ie, Village, District, Metropolitan, and Big Cities. Regular CME attendance after training will be obligatory for BOSS and AOSS. Level I and II orthopaedic service providers would be trained in data collection relevant to the decision making of policy makers. Currently India needs more Level I orthopaedic service providers than level II or III. The national health policy (2002) document of the government of India acknowledges the point that in any developing country with an inadequate availability of health services, the need for experts in the area of “family medicine” is markedly greater than for other clinical specialities [29].

Though there is well-defined curriculum and training for physiotherapists, orthotists, and prosthetists in India, there is no structured training for orthopaedic theatre personnel, plaster technicians, and orthopaedic assistants. The orthopaedic aspect of paramedical training is generally learned from peers and gradually by experience.

Concomitant stratified training of paramedical personnel is also suggested. In India training of local village paramedics (dais) to serve in villages for safe childbirths has saved many lives [36]. On the same lines, we will integrate local villagers, traditional practitioners, and paramedical personnel, teach them safe orthopaedic practices, and let them carry out well-defined work under legislation. A few of them may already be involved in implementation of various health-related national programs of the government at the village and town level. We need to have outreach programs from district hospitals and preventive and social medicine departments of various medical colleges. A few villages could be adopted by a particular institute or hospital and provide training

for safe orthopaedic practices. In our opinion, training individuals for as little as 1 or 2 days, even at 6 month intervals, will yield good results, as has been observed in the past by other authors [13, 46]. The government of India in its rural health mission intends to integrate informal rural practitioners to ensure availability of quality service to citizens at reasonable cost [34].

The national health policy of India also recognizes the need to establish, over a longer timeframe, baseline estimates for noncommunicable diseases like accidental injuries, and communicable diseases, to generate adequate statistical data, to address related policy issues, and to formulate future investment policies in an attempt to move closer to the objective of evidence-based policy making [29]. The Government of India has the Integrated Disease Surveillance Project (IDSP) to establish a decentralized state-based system of surveillance for communicable and noncommunicable diseases, enabling timely and effective public health actions in response to health challenges in the country at the state and national level. The project aims to improve the efficiency of the existing surveillance activities of disease control programs and facilitate sharing of relevant information with the health administration, community, and other stakeholders so as to detect disease trends over time and evaluate control strategies. This surveillance includes road traffic accidents [20]. The WHO in India, under its country cooperation strategy (2006–2011), intends to scale up its efforts to reduce the burden of communicable and emerging diseases by enhancing surveillance and response capacities and scale up prevention and control of noncommunicable diseases through support for development of new policies and programs [9]. One of the core programs of WHO India is surveillance of non-communicable diseases which include injury, disability and rehabilitation [7, 53].

WHO India published an important document on National Perspective on Injuries in India and a detailed report on road traffic injury prevention in India in collaboration with the government of India and stressed the need for data collection to formulate future policies [8, 16, 43]. The Central Bureau of Health Intelligence of India is another important agency providing ready information on the national health profile of India and involved in need-based operational research for an efficient health information system [3]. Lately the knowledge commission of India, recognizing that a reliable, swift, real-time health data collection system is essential to enhance the quality of healthcare delivery in India, has constituted a working group on health information networks, which will address issues such as the required IT and clinical standards, and the regulatory framework needed to facilitate a secure national Web-based electronic health information system [32].

The government of India has launched a national rural health mission, which aims to empower rural and district health centers, as well as reorient medical education to support rural health issues including regulation of medical care and medical ethics [26, 33, 34]. The national health policy of India also has plans to decongest the tertiary referral hospitals by setting up a well-dispersed network of comprehensive primary healthcare services, intermediation through “health volunteers” with appropriate knowledge, simple skills, and requisite technologies, establishment of a well-defined referral system, and an integrated network of evenly distributed specialty and superspecialty services [29].

Financial assistance for secretarial support and research can go a long way towards improving the training environment of residents in the developing world [5]. In India, the biggest bottleneck in our opinion is lack of appropriate baseline data. A governmental report on “Injuries in India” states that the precise number of deaths and injuries due to specific causes or any scientific estimates of injury deaths in India are not available from any single source [16]. In India, health information exists at various levels, forms, and systems. There is a wide variety of data collected by several agencies, mainly government, both at the central and the state levels through routine data collection and periodic sample surveys. There is a plethora of information concerning the health sector but in a highly fragmented manner. The health management information system at the ground level especially tends to be duplicated by various agencies. A major problem of health information is the reliability of data and consequent utilization for decision making [2, 8, 16, 43].

Financial assistance from developed countries could be used in India to fund projects to research injury prevalence data, financial implications of injuries, and injury and road traffic accidents prevention. The funding could also be cost effectively spent on well-organized health education and health information dissemination campaigns to effectively use the mass media to promote that injury and accidents are largely preventable and hence would be able to modify public behavior. However, in other countries with inadequate orthopaedic care facilities, overseas volunteers could be involved in training the local doctors and paramedics, as well as providing direct orthopaedic curative and rehabilitative services for short durations.

There are other initiatives that can help in the training of orthopaedic surgeons from developing countries like India. It is commonly agreed that surgeons from developing countries should obtain their primary and postgraduate training in their own countries, instead of developed countries, so that they can understand the regional peculiarities and serve their country better [21]. The developed countries can contribute by deploying experienced senior

teachers overseas to teach in the countries they are helping. The period of their stay may vary from few months to several years [21].

With its rapidly developing economy and technology, India is undergoing major sociodemographic changes. An enormous population, limited resources, varied topography, and inequalities in healthcare have led to poor healthcare infrastructure. Injuries are a major public health problem. Lack of reliable and good-quality national or regional data has undermined the recognition of this problem. Undergraduate training in general and orthopaedic training in particular are still not geared to serve India's predominant rural population. In the absence of efficient trauma care services in rural and peripheral areas, local practitioners and traditional bone setters thrive. We still do not have actual data on the number of these practitioners. Until the time major policy changes make efficient orthopaedic and trauma care services available to all, we need to educate paramedics and traditional practitioners to provide safe trauma care. India needs to have a national policy on injury prevention and control with a single nodal agency that can coordinate a range of activities like injury surveillance and research to identify crucial and target areas for intervention. However, with the increasing focus and commitment of governmental agencies on rural health, increased efforts towards reliable data generation pertaining to disease burden in India, and application of good management principles by the Indian government, the future of health services in India looks bright.

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