

plan for evidence-based diabetes management.^[8] However, the existing status of diabetes care quality services is far from satisfactory level in both urban as well as in rural areas.^[9-11]

Moreover, the quality care of diabetes depends on the knowledge, expertise, attitude, and practice of health care professionals.^[12] In India, majority of initial diagnosis is made by primary care physicians (PCPs) due to uneven distribution of specialists, where over 80% of whom practice in urban areas while 72% of the population lives in rural areas.^[13] On the other hand, the quality of care provided by PCPs remains suboptimal because of a lack of knowledge and facilities to screen for diabetes and its complications.^[10] This underscores the need to build capacity of PCPs for better disease management.^[14]

Capacity building is the process by which organizations change and improve how individuals within an organization develop and retain the competencies (knowledge, skills, and attitudes) needed to carry out their duties at least competently and ideally beyond the minimum standard.^[15] Diabetes education and capacity-building programs are essential for handling the growing burden of diabetes in resource constraint countries.^[16-18] Therefore, this narrative review article aims to describe the emergence of diabetes education and capacity-building programs for PCPs and its current situation in India.

Diabetes in India

Diabetes, which has now emerged as an epidemic, is a well-described disease in *Ayurveda*.^[19] The estimation of the extent of diabetes in ancient India was impossible due to the lack of epidemiological records at that time.^[20] However, the first epidemiological study recorded in India was by Chakravarthy A., who assessed and documented the prevalence of glycosuria in a hospital-based study in Kolkata in 1938.^[21]

Indian Council of Medical Research conducted the first national level, multicentric study to assess the prevalence of diabetes in urban (2%–3%) and rural (1%–1.5%) parts of the country during 1972–75.^[22] Thereafter, many studies were undertaken by various researchers to estimate the prevalence and incidence of diabetes to identify the various risk factors associated with diabetes. These studies range from small-city surveys to metacentric large-scale surveys, case-control studies, cross-sectional studies and various surveys covering different geographical areas.^[23]

Diabetes Education in Pre-independence Era

Bhore Committee laid the foundation of health care services in India before independence. In 1946, the committee reported that 19 medical colleges with an annual intake of 1200 students were not sufficient to tackle the healthcare needs of 400 million people. The facilities for post-graduation (MD, MS, and diploma) in different medical colleges were few and there was no governing body to coordinate and foster post-graduate education in the then-existing universities. Also, governments and universities did

not put any effort to start refresher courses for physicians. Though certain universities and colleges provided specialization (in anatomy, physiology, bacteriology, ophthalmology, orthopedics, psychological medicine, obstetrics and gynecology, radiology, dermatology, pediatrics, tuberculosis, oto-rhino-laryngology, anesthesia, and venereology), diabetes was not in focus at that time.^[24]

Diabetes Education in Post-independence Era

Post-independence, the planning commission had the responsibility of development, execution, and monitoring of all the developmental plans, including the healthcare delivery system in the country. In the initial five-year plans, the priority areas were population control, maternal and child health, and communicable diseases in the health sector. Re-orientation of medical education was initiated in the sixth plan but the focus was on rural health. The noncommunicable diseases (cancer, coronary heart diseases, hypertension, diabetes and traffic, and other accidents) were considered as the emerging health problems for the first time only in the seventh plan. Hence, development of need-based, problem-centered, and community-oriented medical training and education for doctors and paramedical personnel for the prevention and control of NCD was stressed. As a result, National Diabetes Control Program was launched in 1987 as a central sector health program in the districts of Salem and South Arcot in Tamil Nadu, and Jammu and Kashmir, on a pilot basis, and learning resource materials were developed for the training of nurses and primary health care workers.^[25]

In subsequent five-year plans, policymakers gave more importance to NCDs as the WHO estimates showed that morbidity and mortality due to communicable diseases will decrease by 15% whereas noncommunicable diseases would increase by 18% and that for diabetes by 35%. This resulted in the development of an integrated National Program for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases, and Stroke (NCPDCS) through improving infrastructure, up-gradation of health care providers' skills, and creation of an epidemiological database of noncommunicable diseases. In this integrated program, priority was given to cancer, cardiovascular diseases, stroke, and mental health.^[26]

Diabetes Education in National Health Policies

In 1983, the first national health policy came into existence in response to the Alma Ata declaration to achieve “Health for All” by 2000. Nutrition, prevention of food adulteration, maintenance of quality of drugs, water supply and sanitation, environment protection, immunization program, maternal and child health services, family planning, communicable diseases, school health program, and occupational health services were given priority in the national health policy. Public health educational programs also focused on nutrition, family planning, and maternal and child health.^[27]

In the next twenty years, lifestyle disorders and noncommunicable diseases such as diabetes, cardiovascular diseases cancer, and others increased due to rapid epidemiological transition.^[22] This compelled the policymakers to review policies and assess the current health needs of the population. As a result, the second national health policy was formulated in 2002. The main objective of the policy was to provide an equitable and acceptable standard of good health via establishing new infrastructure in deficient areas and upgrading of the existing infrastructure, involvement of the private sector, and decentralization of the public health system. A need-based skill-oriented syllabus with more significant component of practical training and periodic skills up-gradation of working health professionals through a system of continuing medical education was recommended. School health program, IEC activities for mass education, worksite wellness programs, strengthening of medical colleges, and integrated NCD clinics in medical colleges and district hospitals were recommended for prevention and control of NCD^[28] but very little emphasis was given to improve and upgrade of knowledge and skills of primary health care providers.

Diabetes Education in Indian Guidelines for Management of Type 2 Diabetes Mellitus

India's first guideline for the management of type 2 diabetes mellitus was developed as a result of the national workshop on guidelines for management of type 2 diabetes mellitus conducted by the Indian Council of Medical Research (ICMR) and the World Health Organization (WHO) in Chennai in May 2003. The objectives behind the development of these guidelines were to establish a standard diagnostic criterion for diabetes, glucose intolerance and gestational diabetes, self-monitoring and annual follow-ups, screening of asymptomatic and high-risk individuals, various treatment modalities including diet and lifestyle modification, medical interventions, and early detection of complications with appropriate measures to arrest and reverse them. Emphasis was given on diabetes education for people living with diabetes which, by definition means empowering people with diabetes with knowledge and providing tools crucial for making them an active partner in the diabetes management team^[29], but the guidelines did not address strategies to train and build the capacity of PCPs and general practitioners who bear the majority of the burden of diabetes management in India. As a result, the need for proper strategies for evolution and implementation of national guidelines on diabetes and related disorders was felt by several researchers.^[30] In recent years, various Indian scientific bodies and diabetes research groups have developed diabetes treatment guidelines and clinical practice recommendations for better patient outcomes but these too are clinically oriented.

Diabetes Education in National Programs

The “National Diabetes Control Program” was launched during the seventh five-year plan in 1987 in some districts of Tamil Nadu, J and K, and Karnataka. The main thrust during the

seventh plan was to develop an appropriate model for care and control of diabetes mellitus at the district level. The objectives of the program were 1) prevention of diabetes through identification of high-risk subjects and early intervention in the form of health education; 2) early diagnosis of disease and appropriate treatment morbidity and mortality with reference to high-risk group; 3) prevention of acute and chronic metabolic, cardiovascular, renal, and ocular complication of the disease; 4) provision of equal opportunity for physical attainment and scholastic achievement for the diabetic patients; and 5) rehabilitation of those partially or totally handicapped diabetes people. However, due to shortage of funds, this program could not be expanded further in subsequent years.^[31]

On the other hand, due to rapidly increasing NCD burden and recommendations of National Health Policy 2002 for the development of integrated strategies, the “National Program for Prevention and Control of Diabetes, Cardiovascular diseases and Stroke” was launched as pilot in 10 districts of 10 states on January 4, 2008. The objectives of the program are risk reduction for prevention of NCDs and early diagnosis and appropriate management of diabetes, cardiovascular diseases, and stroke via health promotion for the general population and disease prevention for the high-risk groups. Now, the program has been expanded to include cancer and is being implemented across all the states in the country and operational guidelines for implementation of the program are in place.^[32]

Diabetes Education in Medical Education

In India, the first medical institution named Medical College, Bengal was established by the British East India Company in 1835 at Kolkata with an annual intake of 49 students. Currently, the numbers have increased to nearly 83000 students and there are 554 medical colleges including both government and private all across the country.^[33] Very little attention is paid to endocrinology or diabetology during their undergraduate study.^[34] More focused and specialized post-graduate courses are providing a more detailed description of endocrinology, including diabetes, but the intake/seats are very limited. These courses include MD medicine, DM endocrinology, Diploma in diabetology^[33], and DNB endocrinology/general medicine.^[35] The specialization-wise colleges and seat distribution are shown in Table 1.

Diabetes Capacity-Building Programs in India

In the last ten years, few public and private institutions have developed diabetes education and training programs for PCPs independently or in collaboration with other like-minded institutions. These programs include 16 fellowships [Table 2], 4 diplomas [Table 3], 12 certificate programs [Table 4], and 6 other diabetes training programs [Table 5]. These programs are meant for medical graduates only. The mode of delivery of these programs varies from institution to institution; some are full-time, while others are offered through different modes such as regular, distance, online, and contact session-based.

Discussion

Considering the chronic nature of noncommunicable diseases and similar prevention strategies, primary healthcare continues to be the cornerstone in the prevention and management of diabetes.^[64] However, most physicians are unable in providing evidence-based care because of inadequate attention to diabetes during their undergraduate programs and they need to invest almost 11.5 years to become a specialist of the subject.^[34] The majority of these specialists are concentrated in urban areas or metro cities. Estimates from studies indicate that there are about four times as many allopathic doctors per 10,000 population in urban areas as compared to rural areas.^[65] Thus PCPs become the key care providers for patients suffering from diabetes in the country especially in rural areas.

It is evident that tight glycaemic control and early initiation of insulin can delay the onset of diabetes-related complications; yet, PCPs delay insulin initiation due to poor or limited knowledge about insulin therapy.^[14] Furthermore, the doctor-to-patient

ratio in India is less than the WHO-prescribed limit where each government allopathic doctor serves 11000 people.^[66] In such a situation, it becomes very difficult for the physicians to give proper care and counseling about lifestyle, diet, physical activity, health communication, and other methods of prevention to the patients and their caretakers for better disease management.^[17] Hence, capacity building of primary care physicians becomes imperative to halt the rising burden of diabetes.

Recognizing these issues and challenges, few organizations/institutes both government and private started diabetes education and capacity-building programs for PCPs in India. These pioneer initiatives need to be encouraged and appreciated. Most of these programs are full-time and consist of regular fellowships or diplomas in diabetes. Such programs provide deep insights toward the subject and practical exposure, but one has to leave his/her clinical practice to receive the benefit and to get enrolled in these programs. Additionally, the number of institutions as well as the annual intake capacity of these programs is very low.

Some of these organizations offer online capacity-building programs. These online programs either adopt prerecorded lectures or live streaming of the sessions as teaching methodology. Online courses can result in greater educational opportunities but require a certain level of human and infrastructural resources.^[67] In a country like India, the online mode of education has its own limitations because of poor Internet connectivity, limited access to digital media, and electricity cuts in rural and remote areas. Moreover, online sessions are time-bound and there is little scope

Table 1: Medical colleges and seat distribution

Degree	No. of colleges	Annual intake
MBBS	554	82950
MD general medicine	333	4076
DNB general medicine	254	674
DM endocrinology	32	102
DNB endocrinology	10	19
Diploma in diabetology	2	4

Table 2: Fellowship programs in diabetes

Institute	Course name	Eligibility	Mode	Duration
M V Hospital for Diabetes and The Tamil Nadu Dr. MGR University ^[36]	Post Doc Fellowship in Diabetology	MD/DNB	Full time	1 year
M V Hospital for Diabetes and The Tamil Nadu Dr. MGR University ^[36]	Post Doc Fellowship in Podiatry	MS	Full time	1 year
M V Hospital for Diabetes and The Tamil Nadu Dr. MGR University ^[36]	Post Graduate Fellowship in Medical Science (Clinical Diabetology)	MBBS	Full time	2 year
Dr. Mohan's Diabetes Education Academy & The Tamil Nadu Dr. MGR Medical University ^[37]	Post-Doctoral Fellowship in Diabetology	MD/DNB	Full time	1 year
Dr. Mohan's Diabetes Education Academy ^[37]	Fellowship in Diabetology	MBBS	Full time	2 years
Dr. Mohan's Diabetes Education Academy ^[37]	Fellowship in Eye Disorder of Diabetes	MBBS with PG Ophthalmology	Full time	1 year
Dr. A. Ramachandran's Diabetes Hospitals & The Tamil Nadu Dr. MGR Medical University ^[38]	Fellowship in clinical diabetology	MBBS	Full time	2 year
CMC Vellore ^[39]	Distance Fellowship in Diabetes Management	MD/DNB	Distance	1 year
CMC Vellore ^[40]	Post Doc Fellowship in Diabetology	MD/DNB	Full time	1 year
CMC Vellore ^[40]	Post graduate Fellowship in diabetes	MBBS	Full time	2 year
Maharashtra University of health sciences, Nasik ^[41]	Fellowship Course in Diabetology	MD	Full time	1 year
Kanungo Institute of Diabetes Specialities ^[42]	Fellowship in Diabetology	MBBS	Full time	1 year
Dr. Mayur Patel Swasthya Diabetes Care, All India Institute of Diabetes and Research & Yash Diabetes Specialities Center ^[43]	Fellowship in Diabetology	MBBS	Full time	2 years
Apollo & MeDvarsity ^[44]	Fellowship in Diabetes Mellitus	MBBS	Online	1 year
Indian Medical Association - TNSB ^[45]	Fellowship certification in diabetology	MBBS	Contact classes and hands-on experience	1 year
Indian Medical Association - CGP ^[46]	Fellowship in Diabetes Mellitus	MBBS	Online	1 year

Table 3: Diploma programs in diabetes

Institute	Course name	Eligibility	Mode	Duration
Madras Medical College ^[47]	Diploma in Diabetology	MBBS	Full time	2 years
Topiwala National Medical College & B. Y. L. Nair Charitable Hospital, Mumbai ^[48]	Diploma in Diabetology	MBBS	Full time	2 years
The Tamilnadu Dr. MGR Medical University ^[49]	Post Doc Diploma in Diabetology	MD	Full time	1 year
Apollo & MeDvarsity ^[44]	Diploma in Diabetes Management	MBBD or MD	Online	6 months

Table 4: Certificate programs in diabetes

Institute	Course name	Eligibility	Mode	Duration
BMJ/Royal College of Physicians/Fortis C-DOC ^[50]	Certification course in diabetes	MBBS	Online	6 months
PHFI/DMDEA ^[51]	Certificate course in evidence-based diabetes management	MBBS	Online Contact sessions	1 year
PHFI/DMDEA ^[52]	Certificate course in gestational diabetes mellitus	MBBS	Online Contact sessions	4 months
PHFI/DMDEA/Arvind Eye Care System ^[53]	Certificate course in evidence management of diabetic retinopathy	MBBS	Online sessions	4 months
PHFI/CDI ^[54]	Advanced certificate course in prevention and management of diabetes and cardiovascular disease	MBBS	Online Contact sessions	6 months
Indian Academy of Diabetes & Boolean Education ^[55]	Certificate Course in Diabetes Management	MBBS	Online	4 months
Apollo & MeDvarsity ^[44]	Certificate in diabetes management	MBBS	Online	3 months
RSSDI ^[56]	Certificate Course in diabetology	MBBS/MD	Full time	1 year for MD and 2 years for MBBS
IMA AKN Sinha Institute ^[57]	Post Graduate Certificate Course in Clinical Diabetes	MBBS	Distance	6 months to 2 years
Nizam institute of Medical Sciences and WHO Collaborating Center for Diabetes in Developing Countries ^[58]	Post Graduate Certificate of Competences in Diabetology/WebCME	MBBS	Online	
Cleveland Clinic ^[59]	Advanced Certificate Course in Diabetes	MBBS	Regular	2 days
Kokilaben Dhirubhai Ambani Hospital ^[60]	Certificate Course in Diabetology	MBBS	Regular	1 year

Table 5: Other diabetes training programs

Institute	Course name	Eligibility	Mode	Duration
Coimbatore Diabetes Foundation & ADA ^[61]	Clinical diabetology course & training Program	MBBS	Contact sessions	6 months
Nizam institute of Medical Sciences ^[56]	P G Course in Diabetes	MBBS		1 year
CMC Vellore ^[40]	Short course for doctors in Diabetes Mellitus	MBBS	Regular	6 days
The Tamilnadu Dr. MGR Medical University ^[49]	Refresher course in Diabetology	MBBS	Distance	6 months
University of South Wales, UK ^[62]	Post Graduate Diploma in Diabetes	MBBS	Online	6 weeks
Cardiff University ^[63]	Postgraduate Diabetes Diploma	MBBS	Online	2 years

for participants to clarify their doubts and discuss their queries with the tutor/faculty alongside their clinical responsibilities.

Considering the busy schedule of practicing doctors and following the *guru-shishya* system of education, few organizations developed contact-based capacity-building programs. PCPs can continue their clinical practices and attend the contact sessions at their nearest center on the day of the contact session. During the contact session, enrolled participants get the opportunity to interact with the faculty and discuss their doubts about specific situations. Similarly, the Public Health Foundation of India (PHFI) has developed the capacity of more than 15000 primary care physician with its various diabetes-related capacity-building programs since 2010 in collaboration with

leading world-renowned academic partners like Dr. Mohan's Diabetes Education Academy (DMDEA).^[68]

Another issue with these programs is recognition or affiliation from councils or universities. The Medical Council of India accredits all the courses offered in medical colleges. Most of the fellowships and diplomas, no matter how extensive and efficient the curriculum and modality is, have not received recognition or affiliation of medical councils or universities which needs to be addressed as this is a long-felt need in the community. As none of the online and contact session-based capacity-building programs are accredited, this raises the question on the quality of their program delivery. Participating physicians are also looking for some recognition or affiliation while entering into these

programs and often misuse the training received and claimed they are specialized.

According to the DAWN2 study, healthcare professionals strongly feel that the curriculum at the graduation level is not adequate to build the capacity of these medical graduates to efficiently manage diabetes at the community level. It is evident that these short-term capacity-building programs are effective in improving the knowledge and skills of PCPs in diabetes management.^[69,70] So, these capacity-building initiatives can play a major role in building the capacity and skills of newly graduated professionals for better patient outcomes. These initiatives have high potential for scaling up while optimally addressing the scarcity of trained mental health professionals in high population density settings like India. These can prove to be a sustainable model while strengthening the linkages between community and existing government programs.

Apart from this, the Indian health system is currently more designed to tackle communicable diseases and maternal and child health issues. However, due to rapid epidemiological transition, the disease burden has shifted from communicable to noncommunicable diseases. Building the capacity of PCPs in NCD prevention and control along with community awareness generation programs is the need of an hour to manage lifelong diseases like diabetes. Therefore, it is necessary to shift the focus of health planning, policies and programs in India and then keep it to achieve the Sustainable Development Goal target 3.4, which calls for reducing premature death from NCDs, including diabetes, by 30% by 2030.^[71]

Conclusion

As medical science is changing very rapidly, medical professionals need to upgrade their skills and knowledge regularly to manage diseases in more effective and efficient ways. This can be possible only if scientific and evidence-based capacity-building programs are provided to the healthcare workforce. This becomes more imperative in the case of noncommunicable diseases like diabetes which require lifelong and continuous care.

Although a range of diabetes education and capacity-building initiatives are available for PCPs in India, there is a need to keep a check on the quality of the program both in terms of content and delivery. The organizations should develop and/or upgrade their respective programs as per the physicians' need as capacity building is one of the key strategies to enable and empower the healthcare workforce to go on consistently performing at a larger scale and to have a greater impact.

Therefore, a customized training program—if conceptualized, designed, and implemented meticulously while considering the need of the community and the physicians' clinical settings—can help in bridging the gap of trained healthcare specialists among the densely and diversely populated community setting like India. If continuous efforts are put in, the knowledge and skills gained

can be sustained for a long time. The learning from these training programs can be used in the development and implementation of similar programs in other low- and middle-income countries that face an alarming burden of noncommunicable diseases and a shortage of trained physicians.

A major target of the WHO global action plan for prevention and control of noncommunicable diseases is to “halt the rise in diabetes and obesity.” To achieve this, several measures to strengthen primary care are imperative. We believe that the comprehensive list of diabetes education and capacity-building programs in this article will help PCPs in accessing the appropriate program and thereby enhancing their knowledge and skills for better diabetes management and patient outcome in resource-limited countries.

Key Messages

As medical science is changing rapidly, PCPs need to upgrade their skills and knowledge regularly to manage NCDs such as diabetes more effectively and efficiently. The comprehensive list of diabetes education and capacity-building programs in this article will help PCPs in accessing the appropriate program as per their need. The article will also help academicians, researchers and policymakers to access the comprehensive information on the educational programs launched so far in the field of diabetes and endocrinology in the country. This will further help in modifying and develop the necessary training programs for the healthcare workforce in the respective field in future.

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