

Review Article

Medical education in China: painting on a large canvas

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Abstract: The Chinese medical education enterprise is facing an incredible challenge of providing high quality healthcare to an increasingly aging urban as well as rural populace approaching the 1.4 billion mark. Meeting these national imperatives head on will require nothing less than a multiplicity of innovative solutions to assure adequate numbers of highly-trained physicians in both the primary care and specialty arenas such as Obstetrics and Gynecology. The objective of this communication is to trace the history of medical education in China, delineate its current circumstance and detail the future aspirations thereof. We conducted a comprehensive literature review resulting in 794 records identified through Pub Med search of: (“education, medical” [MeSH Terms] OR “medical education” [tiab] OR “medical schools” [tiab] OR “schools, medical” [mesh]) AND (“china” [MeSH Terms] OR “china” [tiab])) OR (“Chinese medical school” OR “Chinese medical schools” OR “Chinese medical education”). We further undertook an extensive review of multiple relevant health and education surveillance systems, including but not limited to the National Bureau of Statistics of China, National Health and Family Planning Commission, World Health Organization, and Ministry of Education of the People’s Republic of China. We concluded that the Chinese medical system has evolved rapidly to keep with extant needs while borrowing and modifying insights of other nations near and far. The pace of change has substantially accelerated in recent years replete with governmental edicts in the arenas of medical school accreditation, physician licensure, and residency training. In the past 100 years, medical education in China has been the subject of multiple changes, many politically motivated. At other times, social necessities ruled the day. Present day policies stand out as pragmatic and as striving for excellence in both undergraduate and graduate medical education. Overall, the constant state of flux and change has created a befuddling system where many of it’s own physicians are unclear of the requirements, but what is being developed is a Chinese solution to a unique health care challenge for which no foreign recipe will do. By every account, medical education will remain a prominent national policy topic in China for some time to come.

Keywords: Medical education, China, residency, health policy, obstetrics and gynecology

Introduction

The provision of high quality healthcare to an increasingly aging urban as well as rural populace approaching the 1.4 billion mark is no small feat [1, 2]. And yet, this is precisely the challenge that is presently facing the Chinese medical education enterprise. Meeting these national imperatives head on will require nothing less than assuring adequate numbers of highly-trained physicians in both the primary care and specialty arenas especially Obstetrics and Gynecology. As recently as 2013, apart and distinct from traditional caregivers, China was home to a total of 2,138,836 practicing physicians [1]. However, the number of physicians per 10,000 population in China stood at 14.6 as compared with 24.2 and 27.7 in the US and UK, respectively [3, 4]. It follows that the

future of quality health care in China is contingent, in large measure, on an expanded as well as internally balanced physician workforce buttressed by state-of-the-art undergraduate as well as graduate medical education. It is the objective of this communication to trace the history of medical education in China, delineate its current circumstance, and detail the future aspirations thereof. An understanding of the medical education system of China has strong implications for all physicians globally, as new systems are necessary to address the growing populations and it’s evolving requirements.

History of undergraduate medical education

By all accounts, the seeds of contemporary medical education in China were sown by missionaries of European extraction at the dawn of

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the 19th century [5-7]. In this regard, the historic record suggests that American missionaries in the city of Guangzhou established the very first medical school in China in 1886. The school in question, Boji Medical College, has since evolved to constitute the present day Sun Yat-sen College of Medical Sciences [8]. Subsequent non-missionary input proved to be of equal importance. A notable European-inspired example is the Shanghai-based Medical School of Tongji University, which was founded in 1907 by Dr. Erich Paul, a German naval surgeon [9]. An early prominent American entry, one represented by the Yale-China Association, led in 1914 to the establishment of the Hsingya Medical College, which has since been renamed the Xiangya School of Medicine [10]. Another notable American entry, represented by the China Medical Commission (later to be known as the China Medical Board) of the Rockefeller Foundation, established in 1915, led to the founding of Peking Union Medical College in 1917 which to this day constitutes one of China's most enduring and influential educational institutions.

In the wake of the Chinese Revolution of 1949 and the founding of the People's Republic of China, the oversight of medical education in China has been firmly assumed by the central government. Accordingly and in short order, governmental edicts have led to the establishment of more than 200 new free-standing medical schools inspired by educational models developed in the Soviet Union. However, by 1961 the *status quo* changed yet again in the face of centrally driven consolidation, which gave rise to a medical education universe of no more than 59 medical schools wherein the duration of undergraduate medical education was limited to 5 years [7, 10].

The ever-accelerating evolution of medical education in China came to an abrupt halt in 1966 with the institution of the "Cultural Revolution". Indeed, throughout the decade in question (1966-1976), all extant medical schools were effectively shuttered and their faculty disbanded. It was only in the aftermath of the Cultural Revolution and the passing of Chairman Mao Zedong in 1976 that the medical education enterprise embarked on a slow recovery process during which some of the schools affected were allowed to reopen. However, for the next 5 years (1976-1981), most medical schools

remained under obligation to limit the duration of undergraduate medical education to 3 years with an eye towards rapidly rebuilding the national healthcare work force.

It was not until 1978 and the initiation of the economic reforms commonly known as the "open-door policy" that the 3-year course of undergraduate medical education fell out of favor at a point in time characterized by a series of consecutive centrally directed initiatives. In particular, note must be made of the launch of the 7-year curriculum in 1988 with an eye toward affording medical students with the opportunity to explore other fields of knowledge including the humanities [11]. Moreover, by 1999, a total of ten free-standing medical colleges have been progressively integrated into established degree-granting universities. By all accounts, this reorganization enhanced the quality of medical education and amplified interdisciplinary research in the institutions in question. Leading examples of this transition included but were not limited to Zhejiang, Peking, and Fudan Universities [12]. Concurrently, these developments likely fostered further centralization of the allocation of governmental resources. Finally, pursuant to yet another central directive, oversight of undergraduate medical education - heretofore the responsibility of the Ministry of Health (MOH)- was assumed by the Ministry of Education (MOE) [9].

By 2004, in the wake of a central policy brief issued by the MOE, growing emphasis was being placed on the 8-year curriculum long embraced by the Peking Union Medical College [13]. Viewed as excellence-enhancing, the "long" curriculum was to propel medical education in China forward while establishing a cadre of elite educational enterprises. In keeping with this new imperative, seven additional 8-year medical programs have sprouted by 2006 at Tianjin, Tsinghua, Fudan, Sun Yatsen, Zhejiang, Central South, and Huazhong Universities [14]. More recently, beginning in 2009, new efforts were yet again underway to resurrect the 3-year curriculum with an eye toward rebuilding the ranks of rural practitioners. Concurrently, growing emphasis was being placed on the revival and expansion of the 5-year curriculum and its likely establishment as the dominant national medical education paradigm. With the parallel phasing out of the 7-year option, indications are

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Figure 1. Distribution of medical schools in the People's Republic of China in 2014.

that the future medical education universe in China will likely be comprised of 3-, 5-, and 8-year curricular options. To the extent that this vision stands to be modified, such will likely follow the lead of the “*China Commission on Health Professional Education for the 21st Century*”. The latter, inspired by the 2010 launching of the international “*Health Professionals for the New Century*” commission, is tasked with guiding medical education in China into the future. As such, this latest development leaves little doubt as to the deep commitment of the People's Republic of China to fostering excellence in its far-flung medical education system.

In the past 100 years, medical education in China has been the subject of multiple changes, many politically motivated. At other times, social necessities ruled the day. In this regard, present day policies stand out as pragmatic and as striving for excellence. It therefore must be assumed that given time, medical education in China will do its part to undergird an evolving and ever improving health care system.

Undergraduate medical education: scope and distribution

At the time of this writing, China is home to 167 medical schools duly listed with the MOE of the People's Republic of China. Of those, 135 medical schools are deemed public in nature as distinct from a complement of 32 medical schools the governance of which remains private. Excluded from this listing are 51 resident international medical schools, 4 military medical schools, as well as 32 traditional medicine educational enterprises [15]. Cluster analysis (**Figure 1**) reveals the current medical school complement to aggregate in coastal regions as well as in areas characterized by high population density. Still, each and every one of China's 31 provinces is presently home to at least two medical schools of the public variety.

Absent objective rankings by the MOE, the relative quality scale of the medical education enterprise cannot be fully ascertained. Still, some relative quality insights can be derived from the 2012 report of the *China Academic*

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Table 1. Student Enrollment Figures by Curricular Pathway and Province in 2013

Province	8 Year Pathway	7 Year Pathway	5 Year Pathway
Anhui	0	240	3277
Beijing	220	237	248
Chongqing	0	400	1051
Fujian	0	300	1774
Gansu	0	0	887
Guangdong	217	180	2948
Guangxi	0	220	1385
Guizhou	0	0	2655
Hainan	0	0	343
Hebei	0	0	3506
Heilongjiang	0	150	2267
Henan	0	290	3918
Hubei	202	2	2583
Hunan	180	0	2563
Mongolia	0	0	1062
Jiangsu	70	587	1739
Jiangxi	0	0	2541
Jilin	0	118	656
Liaoning	0	900	2935
Ningxia	0	0	271
Qinghai	0	0	258
Shaanxi	0	30	2198
Shandong	0	268	3961
Shanghai	156	27	343
Shanxi	0	90	1890
Sichuan	70	0	3937
Tianjin	0	152	609
Tibet	0	0	241
Xinjiang	0	120	1501
Yunnan	0	0	1563
Zhejiang	37	0	3153

Degrees and Graduate Education Development Center (CDGDC). Reliant on performance measures promulgated by the MOE (*Discipline Catalogue of Degree Awarding and Talent Training*), the CDGDC report in question, the 3rd edition of the *China Discipline Ranking (CDR)*, sheds a measure of light on matters of quality. Limited in scope to the evaluation of 50 medical schools, the 3rd edition of the CDR offers a rich pallet of observations on institutional resources, teaching quality measures such as faculty to student ratio, full time professorships, research funding, and much more [16]. Additional relative quality insights may be

derived from key MOE funding initiatives. In this context, special note must be made of the 1995 MOE initiative known as Project 211 wherein “21” stands for the 21st century and “1” stands for the 100 “key universities” (e.g. Fudan, Hunan, Jinan, Peking, and Soochow Universities) whose funding was to be substantially augmented [12]. Mention must also be made of the 1998 MOE funding initiative known as Project 985 wherein “9” stands for the number of leading schools selected and “85” stands for the start date of the project (May 8, 1998). The nine schools in question (8 of which are home to medical schools), later to be known as the C9 or the “Ivy League” of China included Peking, Tsinghua, Fudan, Nanjing, Shanghai Jiao-tong, and Xi’an Jiao Tong Universities as well as the Harbin Institute of Technology [17]. In its second phase, Project 985 was to add thirty additional beneficiaries such as Tianjin, Wuhan, Sichuan, Tongji, and Lanzhou Universities, 13 of which are home to a medical school [18].

Undergraduate medical education: admission to medical school

As a condition for admission, aspiring medical students must first take and pass the *National College Entrance Examination (NCEE)* or “Gaokao”. Developed by the MOE, the NCEE is administered nation-wide at the county level on the same three days in June each and every year [19]. At the time of this writing, the NCEE tests for competence in a select number of exact and life sciences disciplines. Chinese and English language skills are similarly evaluated. No limitations have been placed on the number of times the NCEE can be retaken. The above notwithstanding, the NCEE constitutes a national examination in name only in that each and every province may and will modify the MOE-derived template in accordance with local standards and aspirations. It follows that the NCEE scores attained by students are province-specific and as such non-comparable on a national scale.

Above and beyond the aforementioned provincial variance, it is the responsibility of the MOE to set NCEE score admission thresholds for each and every one of the medical schools under its jurisdiction. As a practical matter, admission to 8-year medical education pro-

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Table 2. Plurality of Curricular Pathways and Terminal Degrees in 2013

Pathway (Years)	Schools (#)	Students Enrolled (#)	Preclinical (Years)	Residency (Years)	Additional Degree Requirement	Terminal Degree
5	162	58263	3	3	N/A	Bachelor
7	24	4311	3	3	Master Thesis	Master
8	11	1152	3	1	Doctoral Dissertation	Doctorate

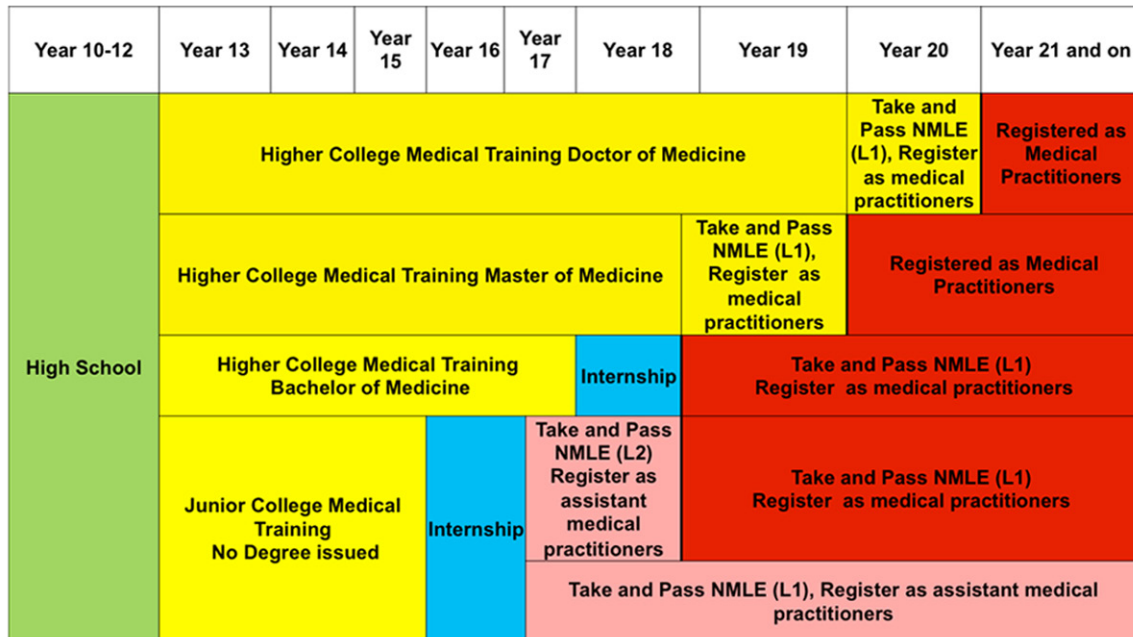


Figure 2. Schematic depiction of the pathway to medical licensure in 2013.

grams entails a higher NCEE score than that required by 5- and 3-year counterparts. The same holds true for schools of substantial repute whose selectivity of which exceeds that of lesser-known counterparts [19]. The mechanics of pairing eligible student applicants with prospective medical schools entails a “matching” process, which in its present form has yet to be digitized.

The aforementioned notwithstanding, further exceptions to the medical school admission process abound [20]. One prominent exception to the conventional admission process - the “residence exception” - affords applicants preferential admission to their provincial medical schools in the hope of improving the local retention of medical professionals. This exception to the admission process is mostly but not exclusively apparent in medical schools serving rural provinces wherein the shortage of trained medical professionals may well be substantial [12,

21, 22]. However, the “residence exception” is also operational in some of China’s leading medical schools (e.g. Peking, Tsinghua or Fudan). It might be worth noting that the “residence exception” is in large measure a vestige of the “hukou” or China’s national household registration system which was instituted in the 1950s with an eye toward preventing wholesale transient migration to urban centers [22].

Another leading exception to the medical school admission process - the “excellence exception” - makes special allowances for uniquely qualified local applicants. The latter, selected by a local *Provincial Committee of Education* are in effect exempted from taking the NCEE. Yet another exception to the medical school admission process - the “service exception” - is exercised with an eye toward addressing the needs of medically underserved areas or institutions [12, 23]. In this case, facilitated admission is granted (often in the face of lower NCEE scores)

in return for a multi-year (≥ 6) commitment to serve in health professional shortage areas [24]. Moreover, the tuition costs of the students in question are assumed by the “*National Development and Reform Commission of China*”, a central governmental agency entrusted with economic development. Collectively, a total of 5,000 students per annum are presently the beneficiaries of this arrangement [25].

Yet another exception to the medical school admission process - the “undergraduate degree exception” - caters to medical school applicants who have attained a Bachelor degree in the sciences. Inspired by the American medical education model, this exception permits successful applicants to enter a 4-year accelerated medical education program with an eye toward fostering more mature trainees. In this instance, the admission process places significant weight on the academic record, entry interviews, and letters of reference separate and apart from the NCEE score. Only two schools: Shanghai Jiao Tong and Zhejiang offer this pathway.

Undergraduate medical education: diverse curricular pathways

Political, social, and medical imperatives have conspired to evolve a highly diverse and indeed unique undergraduate medical education establishment across China (**Table 1**). Characterized by a plurality of curricular pathways and terminal degrees (**Table 2**), China is presently home to a range of undergraduate medical education pathways of 5-, 7-, or 8-year duration. In yet another departure, a contingent of four medical schools offer a 6-year program (leading to a Bachelor of Medicine degree) focused on the study medicine in languages such as French, German, Korean, or Japanese.

At present, the 5-year curricular pathway constitutes the dominant undergraduate medical education paradigm. Indeed, a total of 162 (out of 167) medical schools presently offer the 5-year curricular pathway the general requirements of which have been officially laid out by the MOE and MOH. Indeed, as per a 2008 brief - Standards for Basic Medical Education of 5-year programs - required course material must include the natural sciences, behavioral sciences, medical ethics, public health, physiology, clinical chemistry, diagnostic imaging, and psychiatry. The brief further offers that each

and every medical student must complete ≥ 48 weeks of clerkship rotations in the disciplines of Internal Medicine, Surgery, Obstetrics and Gynecology, Pediatrics, Family Medicine, and Emergency Medicine [26]. Graduates boast a Bachelor level degree in Medicine.

Unlike the ubiquitous and highly structured 5-year curricular pathway, the more heterogeneous 7-year variety is presently limited to a total of 24 medical schools. Established in 1988, the 7-year curricular pathway was designed with an eye toward grooming physicians-scientists. At the time of this writing, most of the 7-year programs dedicate 3-4 years to preclinical educational modules, 2-4 years to clinical educational rotations (clerkships), and 1 year to a research-training elective. Graduates boast a Master level degree in Medicine [27]. However, the future of the 7-year curricular pathway remains uncertain. Indeed, no mention was made of the 7-year curricular pathway in the 2009 and 2012 MOE reports on medical education. Moreover, the 7-year curricular pathway was excluded from the 2012 MOE policy statement titled “Opinion on Strengthening Medical Education and Enhancing Quality” [28]. All told, the aforementioned omissions may be taken to mean that the 7-year curricular pathway may in time be phased out by order of the MOE.

At the time of this writing, only 11 of 167 medical schools embrace the 8-year curricular pathway. As such, this pathway, first offered by the Peking Union Medical College in 1917, remains a mark of excellence to which top academic performers are drawn. Though free of formal MOE dictates, the 8-year curricular pathway maintains a measure of consistency across the medical schools in question. In general, 3 years are devoted to preclinical educational modules, 3 years to clinical educational rotations (clerkships) and 2 years to translational research training. Graduates boast a doctorate degree in medicine.

Accreditation of undergraduate medical education

With an eye toward assuring uniform quality undergraduate medical throughout China, a newly designed accreditation system was piloted in 2006 at the Harbin Medical University [31]. By 2008, at the direction of the MOE, a

Committee on Medical Education was established to initiate and complete the accreditation of all extant 5-year programs by 2020. As of December 2014, only 28 of the extant 5-year undergraduate medical programs have in effect gone through the accreditation process [32]. No comparable accreditation process has as yet been established for the 3-year, 7- or 8-year curricular pathways [11, 26].

The current accreditation process entails a thorough self-study followed by a detailed application process at the conclusion of which a review is conducted in the course of a site visit by an independent team of experts. A report follows suit with one of the following outcomes: full unconditional accreditation for 3-8 years or the absence thereof [33, 34]. Deficiencies listed are to be addressed replete with biennial progress reports.

Medical licensure

The licensing of physician graduates in China via the *National Medical Licensing Examination* (NMLE) dates back to 1998 [35]. The NMLE is administered once every year by the *National Medical Examination Center* via local testing centers under the aegis of the *National Health and Family Planning Commission* (NHFPC, formerly the MOH) [36, 37]. NMLE eligibility is curricular pathway-dependent (**Figure 2**). Successful graduates of the 5-year curricular pathway are required to complete one year of additional in-hospital clinical training (Internship) prior to sitting for the NMLE. In contrast, graduates of the 7- and 8-year curricular pathways qualify for the NMLE in their final year of training.

The 2-part NMLE evaluates applicants for both clinical knowledge and clinical skill components. The 10-hour long clinical knowledge evaluation comprises multiple-choice questions relevant to the basic biomedical sciences as well as to Internal Medicine, Surgery, Obstetrics and Gynecology, and Pediatrics. In contrast, the clinical skill evaluation, conducted by way of an Objective Structured Clinical Examination (OSCE), is comprised of multiple stations designed to evaluate the conduct of a physical examination, the assembly of a medical history, the analysis of the information gathered, and the interpretation of diagnostic tests [38]. Typically, the student must pass the clinical skill examination prior to taking the written

clinical knowledge test. No limit has been placed on the number of times that the NMLE can be retaken.

Graduate medical education (GME)

By many accounts, the first residency-training program in China was established at the PUMC hospital in 1921 [39]. Prior to that time, the general (non-specialty-specific) “residency” training programs in China featured many of the hallmarks of the apprenticeship model akin to the North American and European models of the late 19th century and the early part of its 20th counterpart. In the years that followed, centrally issued guidelines called for reform, most notably, the establishment of structured, standardized, specialty-specific residency training programs [28, 40-42]. In 1962, in the wake of a MOH-convened summit, a decision had been reached to pilot a 2-year residency training program tantamount to an expanded “rotating internship”. This early effort at reforming GME was not to be having been doomed by the impending Cultural Revolution.

Beginning in 1979, the MOE and MOH resumed their reform efforts through pilot residency training programs in the provinces of Shanghai and Tianjin. Informed by the latter, the MOH issued in 1993 an interim brief on the matter of “Standardized Training of Resident Physicians” followed by a national conference on the same [43]. In 1995, MOH also established the Council for Graduate Medical Education to help set the standards for residency training and give accreditation to residency training centers [11]. All told, the latest initiatives also faltered due to vaguely articulated standards and absent quantitative metrics.

In 1999, the MOE decreed that medical school graduates must complete a 1-year residency and that residents-in-training constitute temporary employees of the MOH-run public hospitals. Permanent employment would be contingent on graduates meeting licensure requirements. In so doing, the MOE embraced modern GME models as its guide to reform. By the end of 2002, 20 out of the 31 provinces of China had implemented the MOE plan. The above notwithstanding, ill-defined standards and absent metrics continued to hamper the nationwide GME program in its quest to assure quality graduates.

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Beginning in 2004, the MOH undertook additional development of the GME standards for leading specialties such as Internal Medicine, Surgery, Obstetrics and Gynecology, and Pediatrics to name a few [44]. By 2012, most provinces had implemented elements of this latest policy initiative though there is significant variation between hospitals. Specifically, the Obstetrics and Gynecology residency construct is comprised of rotating general residency with time that ranges from ½ year to 1 year, followed by 1-2 years of more specific obstetrics and gynecology. The duration of the rotating internship hinged on the preceding curricular pathway. Graduates of the 5-year pathway are required to complete a 3-year internship prior to embarking on specialty-specific residency training as per the *China Standardized Residency Training System Development Report* [45]. Graduates of the 7- and 8-year pathways in turn, require 3- and 1-year of internship training, respectively. Additional training for obstetrics and gynecology is required in a status that is similar to the United States medical system's fellow.

Although the core educational requirements for most specialties have been delineated by the NHFPC, the evaluation of competence remains a local matter in the absence of a uniform national format [46, 47]. The 1112 hospitals presently serving as training sites are the subject of accreditation by the NHFPC [48, 49]. Most recently, the MOE proceeded to launch a new pilot program entailing a total of six residency-training programs. The latter stand out by virtue of their formal application process and - in a departure from the Hukou system - their extra provincial reach.

At the time of this writing, the establishment of a functional national GME program constitutes the lead priority of the NHFPC. In its most recent policy statement, the NHFPC calls for early adoption by leading hospitals by 2015 to be followed by nationwide implementation in 2020 [50]. As such, these public policies serve as yet another indication of the growing commitment of the Chinese government to medical education as a key element in its evolving national health care system.

Future aspirations and challenges

Going forward, it is the hope and aspiration of the Chinese government to establish a nation-

wide health care system second to none, one that is firmly anchored in excellence in both undergraduate and graduate medical education. At the time of this writing, progress towards the aforementioned goals is ongoing and slow-paced. The challenges involved are complex and multiple. Short on infrastructure and on a health care provider base to match, China is further weighed down by its vast expanse, its rural provinces, and its burgeoning elderly population [1]. Many of its own medical "residents" and attending physicians are unable to articulate the "standardized" pathway to become a medical physician in China. What is called for is a Chinese solution to a unique health care challenge for which no foreign recipe will do. Inevitably then, medical education will remain a prominent national policy topic for some time to come. Not only is there a need for more medically educated physicians, but such physicians also need to be able to comprehend how their system has evolved. What construct will ultimately emerge cannot be precisely foretold and as such remains to be seen.

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Disclosure of conflict of interest

None.

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References

- [1] National Bureau of Statistics of China. Communiqué of the National Bureau of Statistics of People's Republic of China on Major Figures of the 2013 Population Census. <http://www.stats.gov.cn/tjsj/ndsj/2014/indexeh.htm>.
- [2] The World Bank. Directions in Development. Human Development. Cai F, Giles J, O'Keefe P, Wang D. The Elderly and Old Age Support in Rural China: Challenges and Prospects.

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- <https://openknowledge.worldbank.org/bitstream/handle/10986/2249/675220PUB0EPI0067882B09780821386859.pdf?sequence=1>.
- [3] China National Health and Family Planning Committee of People's Republic of China. Section 3-1-1: Medical Professionals. China Health and Family Planning Statistical Yearbook 2013: <http://www.nhfpc.gov.cn/htmlfiles/zwgkzt/ptjnj/year2013/pdf/t-2.pdf>.
- [4] World Health Organization (WHO). Section 6: Health Systems. World Health Statistics 2013. http://www.who.int/gho/publications/world_health_statistics/EN_WHS2013_Full.pdf.
- [5] Cheng TO. Medicine in modern China. *J Am Geriatr Soc* 1973; 21: 289-313.
- [6] Walls PD, Walls LH, Langsley DG. Medical education in the People's Republic of China. *J Med Educ* 1975; 50: 371-383.
- [7] Wen CP, Hays CW. Medical Education in China in the Postcultural Revolution Era. *N Engl J Med* 1975; 292: 998-1005.
- [8] Deng YZ. Development of medical education in China. *Acad Med* 1990; 65: 512-514.
- [9] Yang R. Internationalizing Chinese Higher Education: A Case Study of a Major Comprehensive University. In: Ninnes P, Hellstén M, eds. *Internationalizing Higher Education: Critical Explorations of Pedagogy and Policy*. Springer Netherlands 2005: 16: 97-118.
- [10] Chinese Educational Commission. Foreign Missions Conference of North America. Committee of Reference and Counsel. *Christian Education in China: A Study Made by an Educational Commission Representing the Mission Boards and Societies Conducting Work in China*. New York: Committee of Reference and Counsel of the Foreign Missions Conference of North America; 1922.
- [11] Wu L, Wang Y, Peng X, Song M, Guo X, Nelson H and Wang W. Development of a medical academic degree system in China. *Med Educ Online* 2014; 19: 23141.
- [12] Schwarz MR, Wojtczak A and Zhou T. Medical education in China's leading medical schools. *Med Teach* 2004; 26: 215-222.
- [13] Li YP FX, Liang L, Deng SL and Hu WF. Comparison of eight-year program medical education between China and USA. *J Cent South Univ* 2010; 16: 118-121.
- [14] Wang QL, Yingqing. Medical Education Reforms in China. *Asia Pac Biotech News* 2006; 10: 805-808.
- [15] Education Mo. Circular of the Ministry of Education On Interim Provisions for Quality Control Standards on Undergraduate Medical Education in English for Undergraduate Medical Education in English for International Students in China. In: Education Mo, ed. Beijing, China 2007. http://www.moe.gov.cn/publicfiles/business/htmlfiles/moe/moe_307/200707/92-29.html.
- [16] China Degrees and Graduate Education Development Center. Third China Discipline Ranking. 2012; Beijing. <http://www.cdgd.edu.cn>.
- [17] Zhang X. *China's Education Development and Policy, 1978-2008*. Leiden: Brill; 2011.
- [18] Ministry of Education. China Academic Degrees and Graduate Education Development Center. Project 985. Beijing 2015. <http://www.cdgd.edu.cn/xwyyjsjyxx/xwbl/zdjs/985gc/index.shtml>.
- [19] Dello-Iacovo B. Curriculum reform and 'Quality Education' in China: An overview. *Int J Educ Dev* 2009; 29: 241-249.
- [20] International AE. Research on China's National College Entrance Examination (the Gaokao) In: Department of Education EaWR, ed. Barton, Australia: Commonwealth of Australia 2009: 44.
- [21] Kipnis A. The Disturbing Educational Discipline of "Peasants". *China J* 2001; 1-24.
- [22] Qi L. Easing Gaokao Restrictions: A New Year's Gift. *The Wall Street Journal*. 2013. <http://blogs.wsj.com/chinarealtime/2013/01/01/easing-gaokao-restrictions-a-new-years-gift/>.
- [23] Chinese National Development and Reform Commission. Policy on Implementation of Free Rural Medical Students Program. In: 2009 Health Care Reform Topics, ed. Beijing 2010. http://www.gov.cn/ztlz/ygzt/content_1674-644.htm.
- [24] Hou J, Michaud C, Li Z, Dong Z, Sun B, Zhang J, Cao D, Wan X, Zeng C, Wei B, Tao L, Li X, Wang W, Lu Y, Xia X, Guo G, Zhang Z, Cao Y, Guan Y, Meng Q, Wang Q, Zhao Y, Liu H, Lin H, Ke Y and Chen L. Transformation of the education of health professionals in China: progress and challenges. *Lancet* 2014; 384: 819-827.
- [25] Dai H, Fang L, Malouin RA, Huang L, Yokosawa KE and Liu G. Family medicine training in China. *Fam Med* 2013; 45: 341-344.
- [26] Ministry of Health and Ministry of Education. Standards for Basic Medical Education of 5-year program. In: Ministry of Education PRC, ed. Beijing 2008. http://govinfo.nlc.gov.cn/gtfz/zfgb/jyb/200811/201010/t20101012_456813.html?classid=423.
- [27] The Centre People's Government of the People's Republic of China. The Centre People's Government of the People's Republic of China Chinese Government's Opinions On Deepening the Medical and Health Care System reform. 2009; http://www.gov.cn/gongbao/content/2009/content_1284372.htm.
- [28] Ministry of Education. Opinions on Medical Education Reform. In: China MoEotPsRo, ed. Beijing 2012. <http://www.moe.edu.cn/public>

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- files/business/htmlfiles/moe/s7952/201-404/xxgk_166951.html.
- [29] Ministry of Education. National Listing of Vocational Institutions. Beijing 2014. <http://www.zyyxzy.cn/mssSgzAction.fo>.
- [30] National Medical Examination Center. List of 2002-2014 Annual Approved Junior Medical College for Annual Examination by Ministry of Education In: Medical Licensing Education Committee, ed. Haidan District, Beijing: NMEC; 2014. <http://www.nmec.org.cn/Pages/Article-Info-0-10757.html>.
- [31] Frenk J, Chen L, Bhutta ZA, Cohen J, Crisp N, Evans T, Fineberg H, Garcia P, Ke Y, Kelley P, Kistnasamy B, Meleis A, Naylor D, Pablos-Mendez A, Reddy S, Scimshaw S, Sepulveda J, Serwadda D and Zurayk H. Health professionals for a new century: transforming education to strengthen health systems in an interdependent world. *Lancet* 2010; 376: 1923-1958.
- [32] Working Committee for the Accreditation of Medical Education. Directory of Accredited Schools 2014. In: Ministry of Education PRC, ed. Beijing 2014. http://renzheng.bjmu.edu.cn/lcyxrz2.0/index!queryMenuXwx_en.action.
- [33] Geffen L, Cheng B, Field M, Zhao S, Walters T and Yang L. Medical school accreditation in China: a Sino-Australian collaboration. *Med Teach* 2014; 36: 973-977.
- [34] Working Committee for the Accreditation of Medical Education of Ministry of Education. Certified Institutions 2013; <http://renzheng.bjmu.edu.cn/lcyxrz2.0/index!queryMenuXwx.action>.
- [35] Standing Committee of the Ninth National People's Congress. Law of the People's Republic of China on Medical Practitioners. In: China. TCPsGotPsRo, ed. 5. Beijing 1999. <http://www.lawinfochina.com/display.aspx?lib=law&id=1117&CGid=>.
- [36] Ren X, Yin J, Wang B and Schwarz R. A descriptive analysis of medical education in China. *Med Teach* 2008; 30: 667-672.
- [37] Anand S, Fan VY, Zhang J, Zhang L, Ke Y, Dong Z and Chen LC. China's human resources for health: quantity, quality, and distribution. *Lancet* 2008; 372: 1774-1781.
- [38] National Medical Examination Center. National Medical Examination Center Examination Guidelines 2014; 2014. <http://www.nmec.org.cn>.
- [39] Andrews B and Bullock MB. Medical Transitions in Twentieth-Century China. Indiana: Indiana University Press; 2014.
- [40] Zhang Q, Lee L, Gruppen LD and Ba D. Medical education: Changes and perspectives. *Med Teach* 2013.
- [41] Centre People's Government of the People's Republic of China. Outline of China's National Plan for Medium and Long-term Education reform and Development. In: China TCPsGotPsRo, ed. Beijing: Xinhua News Agency 2010. http://www.gov.cn/jrzg/2010-07/29/content_1667143.htm.
- [42] Wang XY, Rodriguez AC and Shu MR. Challenges to implementation of medical residency programs in China: a five-year study of attrition from West China hospital. *Acad Med* 2010; 85: 1203-1208.
- [43] Yunnan National Health and Family Planning Commission. Standardized Training of Resident Doctors. In: Ministry of Health, ed. Yunnan 2013. http://www.ynjky.com/SHOW_XX.aspx?id=1824.
- [44] Bo H, Zhang DH, Zuo TM, Xue DB Guo JS, Liu MN, Dong JZ, Sun BZ and Zhou J. Survey and analysis of the current state of residency training in medical-school-affiliated hospitals in China. *BMC Medical Education* 2014; 14: 111.
- [45] Ministry of Education. The list of the first batch of Excellent Physician Education Programs. Ministry of Education of the People's Republic of China. 2012 <http://www.moe.edu.cn/publicfiles/business/htmlfiles/moe/s6548/2012-11/144809.html>.
- [46] Shen BY and Zhan Q. Surgical education in China. *World J Surg* 2008; 32: 2145-2149.
- [47] National Health and Family Planning Commission. Guidelines on standardised training of clinical residents. Beijing 2014. <http://www.nhfpc.gov.cn/qjjys/s3593/201401/032c8cdf2eb64a369cca4f9b76e8b059.shtml>.
- [48] Office of Science and Education. Notice on Residency Training Locations. In: National Health and Family Planning Commission, ed. Beijing; 2014. <http://www.nhfpc.gov.cn/qjjys/s3593/201412/93162d05c9344c19ac75edf0ed9eb031.shtml>.
- [49] Xu D, Sun B, Wan X and Ke Y. Reformation of medical education in China. *Lancet* 2010; 375: 1502-1504.
- [50] Xinhua. China to implement standardized training for medical graduates in 2015. *Global Times* 2014.