

# Globalization of Medical Education: Current Trends and Opportunities for Medical Students

Muhammad Rizwan, Nicole J. Rosson, Sean Tackett and Heitham T. Hassoun\*

Johns Hopkins University School of Medicine and Johns Hopkins Medicine International Baltimore, Maryland

\*Corresponding author: Heitham T. Hassoun, Email: hhassou1@jhmi.edu

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## Abstract

**Introduction:** The global healthcare market is expanding and advances in the globalization of education are having an unprecedented impact on medical education around the world. A number of trends have emerged in medical education including an increase in the number of medical schools and medical students, increased privatization of medical schools, migration of medical students and new collaborative models between medical schools around the world. The goal of this paper is to discuss the current trends in international medical education with an eye towards the quality and accreditation standards.

**Methods:** We conducted a review of the literature in PubMed and Google Scholar using the following keywords “international medical schools,” “international medical graduates,” “accreditation of medical schools” and “quality of medical graduates.” The World Directory of Medical Schools was used for medical school demographic data.

**Findings:** We identified a total of 3043 medical schools in the world of which 2881 are operational. India has the highest number of recognized medical schools (382), followed by Brazil (211) and China (186). Countries with the most rapid growth of medical schools are those within the Caribbean, India, and China. A large number of foreign medical students attend medical schools in the Caribbean, Latin America, China, Russia and Eastern Europe.

**Conclusion:** This review found that while there is a global need for an increase in the number of physicians, assessing the quality of medical education remains a challenge due to the variability in accreditation standards. In addition, trends towards migration of students is likely to continue.

**Keywords:** Globalization; Medical education; International education; Healthcare

## Introduction

Globalization has impacted nearly every aspect of modern life. While patients have long traveled for complex clinical care and innovative treatments that are not available in their home countries, healthcare and education have lagged behind other industries, in terms of globalization [1]. Emerging economies are now investing in healthcare infrastructure in order to expand access and improve quality of services [2]. The increased demand has led to increased opportunities for trans-national partnerships within the framework of global collaborative healthcare [3,4]. Furthermore, an observed outcome has been an increase in demand for healthcare services, and as a result, an increased need for healthcare professionals and education and training opportunities.

The migration of medical professionals is a well-known phenomenon where health professions students and practitioners travel

across borders for educational and employment opportunities [5-8]. Recently, the number of medical students who attend international medical schools, meaning schools in countries other than the student's country of origin, is increasing and has been noted in both sending and receiving countries. The number of citizens from the United States (U.S.) who completed undergraduate medical education outside the U.S. increased by 62% between 1999 and 2006, based on the number of applications for certification by the Educational Commission for Foreign Medical Graduates (ECFMG) [9]. Countries in Eastern Europe such as Poland, Hungary and the Czech Republic have had an increase in international medical students, with these students accounting for 30% of the Czech Republic's total medical graduates [10]. While the reasons for this increase are multifactorial, the need by countries to address their physician shortages remains a key driving force.

According to data from the World Health Organization report, there is a global shortage of physicians which is worse in developing countries [11]. While recruiting foreign graduates to practice in one's country can be effective at addressing physicians shortages, immigration policies are unlikely to provide long term solutions and can exacerbate shortages in lower resource settings [12,13]. Rather to overcome physician shortages around the world, there has been a rapid expansion in the number of medical schools, nearly doubling in the past two decades.<sup>14</sup> Based on the World Directory of Medical Schools listings in 2016, over one-third of all medical schools are located in one of five countries (India, U.S., China, Brazil, and Pakistan) and 10 countries account for nearly half of all medical schools in the world [14]. As reflected in the heat map (Figure 1), there are also approximately 13 countries with no medical schools at all and a preponderance of African countries with large populations and significant physician shortages, with zero or only one medical school [14].

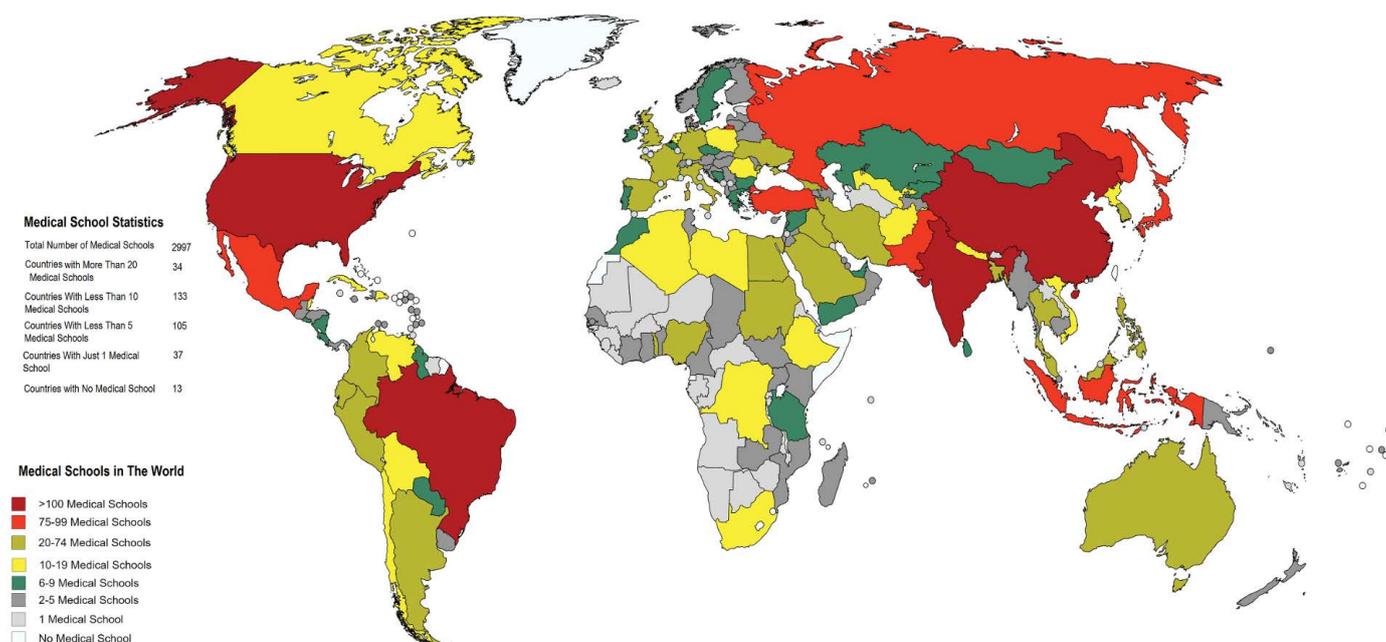
While it is important to increase the number of physicians, it is also important to focus on the quality and competency of these physicians. From a quality perspective, it is also essential to know how, and with whom, the expanded medical education capacity is filled. For instance, not all countries have medical licensing exams for students who have completed their undergraduate medical education in another country—whether or not this should be a requirement remains a valid question. The purpose of this article is to review the current trends in international medical education including the increase in the number of schools and students, privatization, transnational collaborations and the development of new, non-traditional migration patterns of students with an eye towards the quality of education provided.

## Methods

In this article, we summarize a narrative review of the literature based on our experience and knowledge of peer-reviewed literature and supplemented our efforts with a literature search conducted in PubMed and Google Scholar using the following keywords: “international medical schools,” “international medical graduates,” “accreditation of medical schools,” and “quality of medical graduates.” An additional search of webpages and Google was performed for the current trends and quality-related articles in medical education. References for these articles were searched to further explore the topic under discussion. The World Directory of Medical Schools was used to obtain the required information about the medical schools.

## Globalization's impact on medical education

Many students are seeking higher education outside of their country of citizenship, attributed in part to the increase in access to higher education globally and ease and reduced costs of travel. According to the Organization for Economic Cooperation and Development (OECD)



**Figure 1:** Global Distribution of Medical Schools.

from a survey of its 35 member countries, the number of students enrolled outside their country of citizenship has risen from 0.8 million worldwide in 1975 to 4.1 million in 2010 [15]. Medical education too is impacted by globalization, and a number of trends have emerged within medical education in the last two decades as a result of globalization of healthcare and education including: 1) an increase in the number of medical schools, including the development of “English” or “U.S.-style schools,” 2) an increase in the number of medical students, 3) increased privatization of medical schools, and 4) new collaborative models between medical schools and international schools of higher learning.

**Increasing medical schools and medical students**

For as long as it has been recorded, there has been an increase in the world’s medical schools.<sup>14</sup> In the first edition of the World Health Organization’s World Directory of Medical Schools in 1953, there were 566 schools [16]. The growth in schools was initially at pace with population growth but over the last 20 years has increased dramatically [17]. In 2009, Boulet et al conducted a comprehensive analysis of the FAIMER International Medical Education Directory (IMED) and found there were 1,935 schools [9]. A similar analysis conducted in 2013 by Duvivier et al, found that there were 2,600 medical schools in

the world, an increase of 34% [18]. Both studies noted that there is an uneven distribution of medical schools and that the distribution does not reflect the dispersal of the population or the demand for healthcare services [9,18]. Our current review of the World Directory of Medical Schools identified 3043 total schools and 2881 operating medical schools in the world. India has the most recognized medical schools (382), Brazil (211), China (186), and the U.S. (182) [14]. According to data from World Directory of Medical Schools, one third of all medical schools are located in five countries and nearly half are located in ten countries (Table 1). In addition, there are a number of countries that do not have any medical school [14]. Recently, the countries or regions with the most rapid growth of medical schools, based on percent change, are the Caribbean (40%), India (25%), and China (10%) [14].

In addition to the increase in the number of medical schools, there has been an increase in the number of medical students. The increase in medical students is a result of both the number of new schools and also the result of countries expanding class sizes in established medical schools. The U.S. has a goal to increase the number of its physicians by 30% by 2019 to address physician shortage. Roughly one-third of the growth will be achieved through the opening of new medical schools and two-thirds through increased class sizes, and it appears that this

**Table 1:** Medical schools in the world.

	Country	Number of Medical Schools	Country’s opulation (Million)	Schools/Population*	% Global Medical Schools	Cumulative Percent of Schools
1	India	382	1300	0.29	12 %	13%
2	Brazil	211	209	1.01	7%	20%
3	China	186	1400	0.13	6%	26%
4	United States of America	182	324	0.56	6%	32%
5	Pakistan	99	192	0.52	3%	35%
6	Mexico	88	52	1.69	3%	38%
7	Japan	83	162	0.51	3%	41%
8	Russian Federation	81	144	0.61	3%	44%
9	Turkey	79	79	1.00	3%	46%
10	Indonesia	75	259	0.29	3%	49%

\*Number of medical schools per million population.

World Directory of Medical Schools. Updated June 1, 2016. Top 10 countries with most number of Medical Schools. % of global medical schools uses a total of 2997 schools as the denominator.

model has resulted in an increase in medical school graduates [19,20]. In addition, China has embarked on reforming their education system for health professionals by merging schools, expanding enrollment and increasing class sizes, which has resulted in an increase in the number of medical school graduates [21]. While these initiatives are proving to be successful in increasing the number of medical school graduates, it does create new challenges, especially with the availability of post-graduate education such as residency and fellowship opportunities, as well as strains in government funding for training [22]. In addition to development of new schools or increased class sizes, some countries, such as the Netherlands and Canada have adjusted their national quotas that determine the number of students that will be admitted to medical schools.<sup>23</sup> For some countries, such as Australia, Belgium, the Czech Republic and Hungary, the growth is in the attracting foreign students to pursue their medical education abroad [23].

### Private and For-Profit Medical Schools

Over the past several decades, there has been an increase in the number of private medical schools, in part to address physician shortages by increasing the number of medical schools and to alleviate the governments' burden of funding public institutions [24-28]. According to a study published in 2014, India has led with the largest number of private medical schools, with 194 of the 356 recently commissioned medical schools in India being private.<sup>24</sup> In Brazil, the effort to address shortages included expanding the number of medical schools affiliated with federal universities and providing incentives for the creation of new programs at private universities.<sup>28</sup> From the data abstracted from the official government database of 241 medical schools in Brazil in 2014, approximately 50% were enrolled in private institutions [28]. In India and Brazil as well as in other countries, the increase in privatization is often coupled with "for-profit" models of business. Since the main driver is to generate a profit from student enrollment, it may come at the expense of the quality of education [29]. Furthermore, many of these medical schools are unrecognized by their governments or accrediting bodies and therefore are of uncertain quality. This model of privatization has caused concerns in the overall quality of the education and "non-traditional" educational practices, such as an absence of examination requirements for admission, lack of formal testing or exams, and unconventional practices for granting credit hours [29,30].

### Medical schools developed to attract foreign medical students

Another impact of globalization is the development of schools actively recruiting international medical students and in some instances developing English-taught and U.S. curriculum style schools. Some countries, including those in Eastern Europe, Russia, Ukraine and China, have developed and offer undergraduate medical education programs that are taught entirely in English in order to attract international students and to allow graduates greater mobility across European borders and to practice in other English-speaking areas [31-35]. With the language barrier removed, medical students often seek these opportunities as admission may be less competitive or tuition costs lower than medical schools in their home country. Additionally, some medical schools, most notably in the Caribbean, have modeled and developed their admission process and curricula after U.S. medical schools in an effort to attract international students, particularly those from the U.S. and Canada [31].

### Trans-national Collaborations

Over the past fifteen years, a number of leading U.S. medical schools have entered into collaborations with governments and other institutions of higher learning. Weill Cornell Medical College in Qatar (WCM-Q) was established in 2001 as a partnership between Cornell University and the Qatar Foundation for Higher Education, Research

and Community Development. In doing so, Cornell became the first U.S. university to offer its medical degree overseas [36]. Although students are from more than 30 countries, the majority of students are from the Middle East with many students securing post-graduate training in the U.S. The program is six-years in length: the first two years are focused on pre-medical studies and the following four years follow the Weill Cornell medical curriculum.

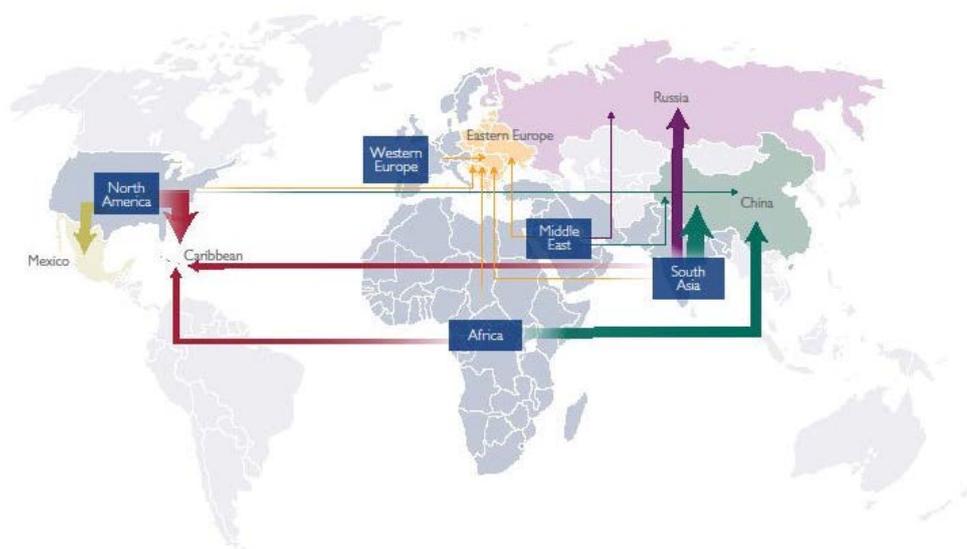
Duke University and National University Singapore established the Duke-NUS Medical School in Singapore in 2005 and was Singapore's first graduate medical school [37]. The curriculum is closely aligned with the Duke University School of Medicine curriculum and students graduate with a joint doctor of medicine degree from Duke University and National University of Singapore. Sixty percent of the Duke-NUS student body are from Singapore and the remaining are from more than 20 countries [38].

There are examples of non-U.S. based medical schools developing collaborations as well through a variety of models. University of Queensland Australia and Ochsner Health System developed a hybrid approach for U.S. citizens in which the first two years of preclinical work is completed in Brisbane, Australia and the third and fourth year, which focuses on clinical rotations, are based in New Orleans, Louisiana. This collaboration is unique in that an Australian medical school established a U.S. presence and graduates would be eligible to practice in Australia, New Zealand and/or the U.S [39]. In an effort to address the physician shortage in Sweden, a new undergraduate medical school was started in 2011 at Örebro University. It was developed in close collaboration with the University of Glasgow in Scotland and Maastricht University in the Netherlands [40]. The Royal College of Surgeons, based in Dublin, Ireland, has two international medical collaborations, in Bahrain and Malaysia. Students spend time in Ireland as well as the country in which their medical school is based and receive a National University of Ireland medical degree [41].

### Trends in Medical Student Migration

Healthcare professionals, primarily physicians and nurses, have long moved from one country to another for education and training purposes or to seek employment opportunities [42,43]. This migration has typically been from developing countries to resource rich countries. The same is true for students from developing countries seeking medical education and training opportunities in the U.S., often electing to stay in the U.S. upon conclusion of their education or training programs in part due to the availability of employment [42]. This practice potentially leads to a phenomenon referred to as "brain drain," [27,44,45] where physician emigration exacerbates shortages and uneven distribution of healthcare professionals undermines the advancement in healthcare infrastructure and services in these developing countries. However, studies have also suggested that the influence of brain drain on health may be modest [46].

Globalization has also ushered in new patterns and trends in medical student migration (Figure 2). Data show that North America, South Asia, and Africa are the largest sending regions and the Americas, Eastern Europe, China and Russia are the most common receiving areas of international medical students worldwide [9,10,18,31,32,47,48]. Another trend that has emerged is a greater number of U.S. students attending medical school outside the U.S., with cost and increased competition being cited as the main contributing factors [49]. Further, there has been a decrease in the number of international medical students opting to study in "resource rich" countries. Between 2000 and 2010, the percent of international medical students who chose to study in the United States decreased from 23% to 17%. Similarly, the percent of international medical students who chose to study in Germany decreased by more than two percent during the same period. Meanwhile, the percent of international medical students who chose Australia, New Zealand and the Russian Federation increased during



**Figure 2:** Migration Trends of International Medical Students.

the same time period [50].

### Migration of medical students within the Americas

A large number of foreign medical students opt to go to the Caribbean and Latin America to acquire medical education. There are more than 70 medical schools in the Caribbean and a major portion of their students are from the U.S. and Canada [9,14], many of whom are unable to make it into the limited number of medical school slots. The majority of American students who choose to study medicine abroad select one of the Caribbean medical schools. According to Boulet et al, from 1992-2006, there were 28,931 medical graduates who applied for Educational Commission for Foreign Medical Graduates (ECFMG) certification who attended medical schools outside the U.S., and more than 50% of these graduates had attended Caribbean medical schools. Moreover, there has been a steady increase in the number of ECFMG applicants attending medical schools in the Caribbean. In 1992, 321 U.S. International Medical Graduates (USIMG) applicants attended a medical school located somewhere in the Caribbean, representing 42% percent of the USIMG applicant pool in that year. In 2006, this percentage increased to 71%, or 1,966 applicants, who did so [9].

In another study by Young et al, in 2014, the top 3 international medical schools providing licensed physicians in the U.S. were in Grenada, Dominica and Mexico [51]. Smaller than the numbers above, but still a considerable number of the medical students in medical schools located in Caribbean are from Canada and South Asian and African countries. It is estimated that the number of Canadians studying medicine outside of Canada is approximately 3,500, which represent 25% of the total Canadian medical student population. Of these students, the majority attend medical schools in the Caribbean with Ireland and Australia as the second and third most common destination [52].

### Migration of medical students within Asia

China is another popular destination for medical students from around the globe, and in fact, China receives a large number of foreign students for higher education in many science and arts fields [48,53]. In 2009, a total of 238,000 foreign students from 190 countries came to China, and among them, the number of medical students exceeded 32,000 [48]. Health professional students accounted for the third largest group among the foreign students studying in China and this number continues to increase every year [48,53]. In 2013, the number of foreign medical students studying medicine in China had exceeded 50,000. The majority of these international medical students are from South Asian

countries (e.g. Pakistan, India, Sri Lanka, Bangladesh) and African countries such as Kenya, Ghana, Cameroon, and Ethiopia [34,48].

The Foreign Medical Graduate Exam (FMGE) in India reports that approximately 12,000 Indian students with medical degrees from China took the FMGE between 2012 to 2014, and as of September 2012, there are over 5,000 Pakistani medical students in China [34,54]. Although the majority of the students in China are from the countries mentioned, China has a more diverse population of medical students based on country of origin than, for example, medical schools located in Caribbean countries [31,34,53].

### Migration within Europe and Russia

Countries from the Eastern Europe and Russian Federation (e.g. Belarus, Ukraine, Georgia and Kyrgyzstan) also receive a significant number of medical students from other countries [35,51,55]. There were 5,950 Indian students who graduated from a medical school in Russia and took the FMGE between 2012 to 2014 and 3,520 Indian students who graduated from medical schools in Ukraine [54]. In addition, Poland attracts approximately 6,000 international medical students, which accounts for 8.7% of its total medical student population [56]. The majority of these students are from other European countries, notably, Norway (1,493 students) and Sweden (1,043 students), followed by the U.S. and Saudi Arabia [56].

Migration of medical students have not spared EU countries where students have traveled from non-EU countries to EU countries and migration of students within EU countries. Border proximities and automatic recognition of medical degrees by EU countries, has made the migration of medical students within EU countries easier. Ireland has the highest level of medical student migration in the EU countries [57]. In a study on medical school students in Ireland by Kitt et al, out of 2273 study participants, 5.3% were from other EU countries and 27.8% were from non-EU countries [58].

### Trends in Quality and Accreditation

The increase in new medical schools and medical students, and migration of medical students has drawn greater attention to assessing the quality of individual graduates and undergraduate medical education programs. While several large studies have suggested that international medical graduates (IMGs) provide similar clinical care quality, others have found that IMGs are at greater risk for disciplinary action from specialty boards than locally trained physicians, which could speak to the need for more robust regulation [59-62]. How quality is assured in

medical education varies considerably from country to country, as do training models. However, traditionally there have been two ways to assure quality, assessment of the individual practitioner (e.g. licensure examinations) and accreditation of a school or educational program. The globalization of the medical workforce is leading to interest in more uniform ways to conduct each quality assurance (QA) process [63].

### Assessing Quality of Medical Students: Performance Exams

While some countries, such as the U.S., have had systems of national licensing exams (NLEs) in place for over 100 years, others which have a long history of high quality medical education, such as the U.K., have only recently decided to adopt these exams [64]. The National Board of Medical Examiners, which administers the series of licensing exams in the U.S. has partnered with international groups for decades and has created the International Foundation of Medicine exams which are being increasingly used for assessment throughout the world, and especially in South America and the Middle East [65,66]. These developments have raised the potential of having uniform assessments and licensure processes which allow individuals to cross borders to practice medicine thus creating a truly global physician workforce [67].

Studies from the U.S. and Switzerland have suggested that medical school graduates trained abroad may not do as well on standardized exams as compared to the graduates who were trained domestically [31,54,68,69]. U.S. citizens who returned to the U.S. with medical degrees from other countries tend to perform lower on examination boards as compared to U.S. medical graduates or international medical graduates. According to Boulet et al. during 2002–2006, non-USIMGs consistently outperformed USIMGs in basic science exams (USMLE), although the differences were small [9]. Average performance of USIMGs was inferior relative to medical students and non USIMGs. According to van Zanten et al, there was significant variability in the performance of students who attended medical schools in Caribbean nations. They reported that the first-time pass rate on the USMLE ranged from 19 percent to 84 percent [31]. Similarly, India has had to face poor performance in licensing exams from the graduates of other countries upon their return to India. According to a report published by FACTLY in India, there were approximately 12,000 Indian students with medical degrees from China, 5,950 from Russia, 3,520 from Ukraine and 3,163 from Nepal that took the FMGE from years 2012-2014 [54]. The pass percentage in the FMGE has declined continuously from 2012-16. While 28.3% medical students passed in 2012-13, this went down to 16.7% in 2013-14. The pass percentage further reduced to 13.1% in 2014-15, while the pass percentage was just 10.4% in 2015-16 [54].

Whether a country should have a national licensing exam (NLE) is hotly debated due to limitations in the evidence available to show that these exams improve clinical practice and protect public safety. For example, while there is robust evidence for most NLEs regarding their psychometric properties, and there is evidence showing correlations between exam scores and clinical metrics, including inpatient mortality, all studies have been observational in nature [59,64]. No studies have demonstrated that introduction of NLEs into medical education systems has caused the quality of care to improve, and many remain critical of the growing implementation of NLEs around the world [70,71].

### Assessing Quality of Medical Schools: Accreditation

Driven primarily by the rapid growth in schools, accreditation of medical education programs or schools is drawing great interest from the international community. The first set of global standards was published by the World Federation for Medical Education in 2003 [72]. In 2010, the ECFMG announced that by 2023 all applicants will need to have graduated from a program accredited by an authority that met WFME or other global criteria for an accrediting body [73]. Since

then accreditation for all health training programs was recommended by 2020 as part of the World Health Organization's Global Strategy on Human Resources for Health: Workforce 2030 and endorsed by the World Medical Association [74]. Despite this momentum, there is presently uncertainty regarding medical school accreditation internationally, as a minority of accrediting agencies have been formally recognized by the WFME and there are over 60 independent countries without accreditation mechanisms. India, which is currently reforming its accrediting processes after concerns about corruption within the Medical Council of India, one of the world's oldest medical school regulatory bodies, is one of the largest suppliers of IMGs to foreign countries and it is unclear when it will have functional accreditation. In Africa, there were 7 authorities in 2007. Over 10 years later, there are 11 authorities, covering less than a third of Africa's independent states with medical schools, which could indicate challenges when establishing accreditation systems in low-resource settings. While it seems unlikely that accreditation systems will be functioning worldwide by the 2020 target recommended by the WHO or by the ECFMG's 2023 target, how much progress will be made and whether momentum behind accreditation will be sustained remain to be seen. Certainly, the growth in medical schools shows no signs of slowing, so that some mechanism of formal external peer review for medical schools is likely to benefit medical education internationally.

Interestingly, while there is active debate regarding the validity of NLEs as described above, there is apparently less debate about implementing accreditation systems, despite the limited evidence base that supports medical school accreditation. Most studies have focused on properties and content of accreditation standards.<sup>75-81</sup> Two studies have shown higher passing rates on the United States Medical Licensing Exam (USMLE) for IMGs from accredited vs. non-accredited schools [82,83]. While these studies have touched on important aspects of accreditation, these have likewise been observational in design and there has been no clear evidence that accreditation improves clinical practice or patient outcomes, nor whether it is cost-effective.

### Conclusion

Medical education and the development of physicians has been greatly impacted by globalization, and the international landscape is likely to become ever more complex. A number of trends have emerged over the past several decades including an increase in the number of medical schools, increased medical school class size, increased privatization and new models of transnational collaborations. As a result of the increased demand for physicians and an increased ease, willingness and opportunity for students to travel for medical education, these trends create opportunities for those wishing to become physicians and for countries in need of producing or attracting physicians. While medical education and the development of physicians are benefiting in many ways from globalization, we believe vigilance is needed to ensure quality and competency of these physicians remains a high priority while ramping up the supply of physicians.

### References

1. Crone RK. Flat Medicine? Exploring Trends in the Globalization of Healthcare. *Acad Med.* 2008; 83:117-121.
2. Sexton J. A measure of the creativity of a nation is how well it works beyond its borders. *Scientific American.* 2012; 307:36-40.
3. Merritt Jr. MG, Railey CJ, Levin SA, Crone RK. Involvement abroad of US academic health centers and major teaching hospitals: the developing landscape. *Acad Med.* 2008; 83:541-549.
4. Ackerly DC, Udayakumar K, Taber R, Merson MH, Dzau VJ. Perspective: global medicine: opportunities and challenges for academic health science systems. *Acad Med.* 2011; 86:1093-1099.
5. Brown RP, Connell J. The migration of doctors and nurses from south pacific island nations. *Soc Sci and Med.* 2004; 58:2193-2210.

6. Robinson V, Carey M. Peopling skilled international migration: Indian doctors in the UK. *International Migration Journal*. 2000; 38:89-108.
7. Jenkins R, Kydd R, Mullen P, Thomson K, Sculley J, Kuper S, et al. International migration of doctors, and its impact on availability of psychiatrists in low and middle-income countries. *PLOS One*. 2010; 5:e9049.
8. Kanchanachitra C, Lindelow M, Johnston T, Hanvoravongchai P, Lorenzo FM, Huong NL, et al. Human resources for health in southeast Asia: Shortages, distributional challenges, and international trade in health services. *Lancet*. 2011; 377:769-781.
9. Boulet JR, Cooper RA, Seeling SS, Norcini JJ, McKinley DW. U.S. citizens who obtain their medical degrees abroad: An overview, 1992-2006. *Health Aff*. 2009; 28:226-233.
10. Organisation for Economic Co-operation and Development. *Medical Graduates in Health at a Glance 2015: OECD Indicators*. 2015; 84-85.
11. World Health Organization. *The world health report 2006: Working together for health*. WHO. 2006.
12. Moullan Y, Chojnicki X. Is there a "Pig Cycle" in the labour supply of doctors? How training and immigration policies respond to physician shortages. *Working Papers*. Oxford. 2017.
13. Bhargava A, Docquier F, Moullan Y. Modeling the effects of physician emigration on human development. *Econ Hum Biol*. 2011; 9:172-183.
14. FAIMER. *World Directory of Medical Schools*.
15. OECD. *Education at a Glance 2012: Highlights*, OECD Publishing. 2012.
16. World Health Organization. *World Directory of Medical Schools*. 1st Ed. Geneva: WHO; 1953.
17. Karle H. How do we Define a Medical School: Reflections on the occasion of the centennial of the Flexner Report. *Sultan Qaboos University Medical Journal*. 2010; 10:160-168.
18. Duvivier RJ, Boulet JR, Opalek A, Zanten M, Norcini J. Overview of the world's medical schools: An update. *BMC Med Educ*. 2014; 48:860-869.
19. Association of American Medical Colleges. *Medical School Enrollment to Approach 30 Percent Increase by 2019*. Washington, D.C., 2015.
20. Mullan F, Salsberg E, Weider K. Why a GME squeeze is unlikely. *N Engl J Med*. 2015; 373:2397-9.
21. Hou J, Michaud C, Li Z, Dong Z, Sun B, Zhang J, et al. Transformation of the education of health professionals in China: progress and challenges. *Lancet*. 2014; 384:819-27.
22. Burdick, WP, van Zanten, M, Boulet, JR. The shortage of clinical training sites in an era of global collaboration. *Acad Med*. 2016; 91:615-617.
23. Organisation for Economic Co-operation and Development. *Health Workforce Policies in OECD Countries*. 2016.
24. Davey S, Davey A, Srivastava A, Sharma P. Privatization of medical education in India: A health system dilemma. *Int J Med Pub Health*. 2014; 4:17-22.
25. Walsh K. Medical Schools for Profit? *Ann Med Health Sci Res*. 2015; 5:155-156.
26. Sood R. Medical education in India - Problems and Prospects. *Med Teach*. 2008; 30:585-591.
27. Frenk J, Chen L, Bhutta ZA, Cohen J, Crisp N, Evans T, et al. The Lancet Commission. Health professionals for a new century: transforming education to strengthen health systems in an interdependent world. *Lancet*. 2010; 376:1923-1958.
28. Scheffer M, Dal Poz M. The privatization of medical education in Brazil: trends and challenges. *Human Resources for Health*. 2015; 13:96.
29. Karle H. Global Standards and Accreditation in Medical Education: A View from the WFME. *Acad Med*. 2006; 80:S43-S48.
30. Johnson D. Establishing a National Clearinghouse on International Medical Education Programs: An Idea Whose Time Has Finally Come. *Acad Med*. 2008; 83:305-308.
31. Marta van Zanten, Boulet JR. Medical Education in the Caribbean: Variability in Education Commission for Foreign Medical Graduate in Certification Rates and United States Medical Licensing Examination Attempts. *Acad Med*. 2009; 84(10 Suppl):S13-S16.
32. Schuetze C. *Medical Students Head to Eastern Europe*. *The New York Times*. 2013.
33. Eckhart N. Perspective: Private Schools of the Caribbean: Outsourcing Medical Education. *Acad Med*. 2017; 85:622-630
34. *World Education China*. *Study Medicine in China*.
35. *International School of Medicine*.
36. Hajjar DP, Gotto Jr A. Launching of an American Medical College in the Middle East: Educational Challenges in a Multicultural Environment. *International Journal of Higher Education*. 2013; 2:67-75.
37. Williams RS, Casey PJ, Kamei RK, Buckley EG, Soo KC, Merson MH, et al. A global partnership in medical education between Duke University and the National University of Singapore. *Acad Med*. 2008; 83:22-127.
38. *Duke NUS Medical School*. *Fast Facts about Duke-NUS*. 2016.
39. Jones PD, Seoane L, Deichmann R, Kantrow C. Differences and Similarities in the Practice of Medicine between Australia and the United States of America: Challenges and Opportunities for The University of Queensland and the Ochsner Clinical School. *Ochsner J*. 2011; 11:253-258.
40. Lindgren S, Brannstrom HE, Ledin T, Nilsson G, Sandler S, Tidfelt U, et al. Medical education in Sweden. *Med Teach*. 2011; 33:798-803.
41. *Royal College of Surgeons in Ireland*. *RCSI International*.
42. Stilwell B, Diallo K, Pascal Z, Vujcic M, Adams O, Dal Poz M. Migration of health-care workers from developing countries: strategic approach to its management. *Bulletin of the World of the Health Organization*. 2004; 82:595-600.
43. Mejjia A, Pizurki H, Royston E. Physician and Nurse Migration Analysis and Policy Implications. *World Health Organization*. 1979.
44. Mullan F. The metrics of the physician brain drain. *N Engl J Med*. 2005; 353:1810-8.
45. Crisp N, Chen L. Global supply of health professionals. *New Eng J Med*. 2014; 370:950-957.
46. Bhargava A, Docquier F, Moullan Y. Modeling the effects of physician emigration on human development. *Econ Hum Biol*. 2011; 9:172-183.
47. Kumar S. *Higher Studies in Russia | Medical Education in Russia - Study Mbbs in Russia*. 2017.
48. *Education I of I*. *International students in china*.
49. Crone RK, Samaan JS. The globalization of medical education. *Innovations in Global Medical and Health Education* 2013:2.
50. Organisation for Economic Co-operation and Development. *Education at a Glance 2014: OECD Indicators*. 2014; 303-366.
51. Young A, Humayun C, Pei X, Halbesleben K, Polk D, Dugan MA. A Census of Actively Licensed Physicians in the United States, 2014. *J Med Reg*. 2015; 101:8-23.
52. *Canadian Resident Matching Service*. *Canadian Students Studying Medicine Aboard*. October 2010.
53. Number of foreign students studying in China from 2009 to 2015, by source of funding.
54. Dubbudu R, Dodda TP. Only 19% Indian graduates with foreign medical degrees are fit (eligible) to practice. *Education*. 2015.
55. *Medical Doctor International Studies*. *Foreign Medical Schools that Teach Courses in English - Medical Doctor International Studies*. 2017.
56. *IREG Observatory on Academic Ranking and Excellence*. *Perspektywy Report on International Students in Poland*. October 28, 2014.
57. García-Pérez MA, Amaya C, Otero Á. Physicians' migration in Europe: an overview of the current situation. *BMC Health Services Research*. 2007; 7:201.
58. Kitt K, Gouda P, Evans DS, Goggin D, McGrath D, Last J, et al. Investigating

- the Irish brain drain: factors influencing migration intentions among medical students. *BMC Proceedings*. 2015; 9(Suppl 7):A12.
59. Norcini JJ, Boulet JR, Dauphinee WD, Opalek A, Krantz ID, Anderson ST. Evaluating the quality of care provided by graduates of international medical schools. *Health Aff*. 2010; 29:1461-1468.
60. Alam A, Matelski J, Goldberg H, Liu J, Klemensber J, Bell C. The Characteristics of International Medical Graduates Who Have Been Disciplined by Professional Regulatory Colleges in Canada: A Retrospective Cohort Study. *Acad Med*. 2017; 92:244-249.
61. Tsugawa Y, Jena AB, Orav EJ, Jha AK. Quality of care delivered by general internists in US hospitals who graduated from foreign versus US medical schools: observational study. *BMJ*. 2017; 356:j273.
62. Zaheer S, Pimentel SD, Simmons KD, Kuo, LE, Datta J, Williams N, et al. Comparing International and United States Undergraduate Medical Education and Surgical Outcomes Using a Refined Balance Matching Methodology. *Ann Surg*. 2016; XX(X):1.
63. Wijnen-Meijer M, Burdick W, Alofs L, Burgers C, ten Cate O. Stages and transitions in medical education around the world: Clarifying structures and terminology *Med Teach*. 2013; 35:301-307.
64. Swanson DB, Roberts TE. Trends in national licensing examinations in medicine. *Medical education*. 2016; 50:101-14.
65. Melnick DE. From defending the walls to improving global medical education: Fifty years of collaboration between the ECFMG and the NBME. *Acad Med*. 2006; 81:S30-S35.
66. Melnick DE. International assessment of medical students: Should it matter anymore where the school is located? *Innovations in Global Medical and Health Education*. 2014; 5.
67. Norcini JJ, Boulet JR, Opalek A, Dauphinee WD. The relationship between licensing examination performance and the outcomes of care by international medical school graduates. *Academic Medicine*. 2014; 89:1157-62.
68. Van Zanten M, Norcini J, Boulet J, Simon F. Overview of accreditation of undergraduate medical education programmes worldwide. *BMC Med Educ*. 2008; 42:930-937.
69. Guttormsen S, Beyeler C, Bonvin R, Feller S, Schirlo C, Schnabel K, et al. The new licencing examination for human medicine: from concept to implementation. *Swiss medical weekly*. 2013; 143:w13897.
70. Archer J, Lynn N, Coombes L, Roberts M, Gale T, Price T, et al. The impact of large scale licensing examinations in highly developed countries: a systematic review. *BMC Medical Education*. 2016; 16:212.
71. Jolly B. National licensing exam or no national licensing exam? That is the question. *Medical education*. 2016; 50:12-4.
72. World Federation for Medical Education. Basic Medical Education WFME Global Standards Quality Improvement.
73. Educational Commission for Foreign Medical Graduates ECFMG. Requiring Medical School Accreditation for ECFMG Certification — Moving Accreditation Forward. 2010.
74. World Health Organization. Global Strategy for Human Resources for Health: Workforce 2030. Geneva, Switzerland. WHO. 2016.
75. Van Zanten M, Boulet JR, Greaves I. The importance of medical education accreditation standards. *Med Teach*. 2012; 34:136-145.
76. Tackett S, Grant J, Mmari K. Designing an evaluation framework for WFME basic standards for medical education. *Med Teach*. 2015; 0:1-6.
77. Yang EB. A study on the content validity and factor validity of accreditation standards for medical schools in Korea. *Korean J Med Educ*. 2002; 14:85-97.
78. Hunt D, Migdal M, Eaglen R, Barzansky B, Sabalis R. The Unintended Consequences of Clarity. *Acad Med*. 2012; 87:560-566.
79. Hunt D, Migdal M, Waechter DM, Barzansky B, Sabalis RF. The Variables That Lead to Severe Action Decisions by the Liaison Committee on Medical Education. *Acad Med*. 2015; XX:1.
80. Kassebaum DG, Eaglen RH, Cutler ER. The meaning and application of medical accreditation standards. *Acad Med*. 1997; 72:808-818.
81. Van Zanten M, Mckinley D, Durante Montiel I, Pijano CV. Medical education accreditation in Mexico and the Philippines: Impact on student outcomes. *Med Educ*. 2012; 46:586-592.
82. van Zanten M. The association between medical education accreditation and the examination performance of internationally educated physicians seeking certification in the United States. *Perspect Med Educ*. 2015; 4:142-145.