SPECIAL ARTICLE

The Metrics of the Physician Brain Drain

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ABSTRACT

BACKGROUND

There has been substantial immigration of physicians to developed countries, much of it coming from lower-income countries. Although the recipient nations and the immigrating physicians benefit from this migration, less developed countries lose important health capabilities as a result of the loss of physicians.

METHODS

Data on the countries of origin, based on countries of medical education, of international medical graduates practicing in the United States, the United Kingdom, Canada, and Australia were obtained from sources in the respective countries and analyzed separately and in aggregate. With the use of World Health Organization data, I computed an emigration factor for the countries of origin of the immigrant physicians to provide a relative measure of the number of physicians lost by emigration.

RESULTS

International medical graduates constitute between 23 and 28 percent of physicians in the United States, the United Kingdom, Canada, and Australia, and lower-income countries supply between 40 and 75 percent of these international medical graduates. India, the Philippines, and Pakistan are the leading sources of international medical graduates. The United Kingdom, Canada, and Australia draw a substantial number of physicians from South Africa, and the United States draws very heavily from the Philippines. Nine of the 20 countries with the highest emigration factors are in sub-Saharan Africa or the Caribbean.

CONCLUSIONS

Reliance on international medical graduates in the United States, the United Kingdom, Canada, and Australia is reducing the supply of physicians in many lower-income countries.

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THE UNITED STATES, THE UNITED KINGdom, Canada, and Australia have been the beneficiaries of large-scale immigration of physicians over the past half century.[1-3] Medical-training positions in these developed nations, as well as opportunities for medical employment, have proved a strong draw for physicians from many nations. This medical migration, often called the "brain drain," has attracted frequent commentary[4,5] and has been the subject of deliberations by the Institute of Medicine and the Council on Graduate Medical Education (COGME) in the United States, both of which have expressed concern about heavy reliance on doctors from abroad.[6,7] Although some observers point to the remittances that immigrant physicians send home and to clinical and educational links that they establish as evidence of a "brain gain,"[8,9] there is growing global concern about the large variation among the world's nations in the availability of physicians and the negative impact of the scarcity of physicians on health equity, health disparities, and the fight against human immunodeficiency virus (HIV) infection and the acquired immunodeficiency syndrome (AIDS).[10-12]

Despite the large number of international medical graduates working in the United States, the United Kingdom, Canada, and Australia, comparative data on the numbers or national origins of these physicians have not been available. This study examines the status of physician immigration in these four countries and quantifies this migration with respect to the source nations, using data from the four countries and the World Health Organization (WHO).

METHODS

I defined the United States, the United Kingdom, Canada, and Australia as recipient countries with respect to international medical graduates; all countries, including these four, were defined as source countries. International medical graduates were defined as graduates of medical schools in countries other than those in which they are practicing. Data about the countries of origin of international medical graduates in recipient countries (including active physicians and trainees) were obtained from sources in the respective countries for the most recent year available. Physicians for whom data on the country of medical education were missing were assigned to countries according to the distribution of countries among physicians for whom the data were available.

Data on the numbers of international medical graduates in practice and in training in the United States were drawn from the 2004 Physician Masterfile, the database on all physicians in practice or in training in the United States maintained by the American Medical Association.[13] International medical graduates were identified by country of medical education, except for U.S.-born citizens who had gone abroad to attend medical school and had returned to the United States to practice; the latter were designated separately as "U.S. international medical graduates." Missing data on birth country were provided by the Educational Commission for Foreign Medical Graduates. U.S. international medical graduates were treated as a separate group in all calculations and were not assigned to the country in which they attended medical school.

The National Health Service (NHS) of the United Kingdom maintains databases on all of its physicians, entitled the Department of Health Medical and Dental Workforce Census and the Department of Health General and Personal Medical Services Census. Data are available on the country of medical education of international medical graduates working for the NHS in England, but not for those working for the NHS in Scotland, Wales, and Northern Ireland — jurisdictions with 16.3 percent of the United Kingdom population. To estimate the total number of international medical graduates

Table 1. Characteristics of International Medical Graduates (IMGs) in Physician Workforces of the United States, the United Kingdom, Canada, and Australia.

Country	No. of Physicians per 100,000 Population	Total No. of IMGs	% of IMGs in Workforce	% of IMGs from Lower-Income Countries	% of IMGs from the Three Other Developed Countries
United States	293	208,733	25.0	60.2	6.5
United Kingdom	231	39,266	28.3	75.2	2.5
Canada	220	15,701	23.1	43.4	22.3
Australia	271	14,346	26.5	40.0	33.5

Table 2. International Medical Graduates (IMGs) in the Physician Workforces of the United States, the United Kingdom, Canada, and Australia.

United States

Source Country	No. of IMGs from Source Country (% of Workforce)
India	40,838 (4.9)
United States (U.S. IMGs)*	25,380 (3.0)
Philippines	17,873 (2.1)
Pakistan	9,667 (1.2)
Canada	8,990 (1.1)
China	6,687 (0.8)
Former USSR	5,060 (0.6)
Egypt	4,593 (0.5)
Mexico	4,578 (0.5)
South Korea	4,401 (0.5)
Iran	4,002 (0.5)
United Kingdom	3,439 (0.4)
Dominican Republic	3,232 (0.4)
Syria	3,219 (0.4)
Germany	3,071 (0.4)
Lebanon	2,556 (0.3)
Nigeria	2,392 (0.3)
Argentina	2,374 (0.3)
Poland	2,365 (0.3)
Colombia	2,362 (0.3)

United Kingdom

Source Country	No. of IMGs from Source Country (% of Workforce)
India	15,093 (10.9)
Ireland	2,845 (2.1)
Pakistan	2,693 (1.9)
South Africa	1,980 (1.4)
Egypt	1,592 (1.1)
Nigeria	1,529 (1.1)
Germany	1,523 (1.1)
Sri Lanka	1,422 (1.0)
Iraq	1,248 (0.9)
Australia	872 (0.6)
Spain	657 (0.5)
Greece	596 (0.4)
Myanmar	487 (0.4)
Jamaica	472 (0.3)
Italy	464 (0.3)
Bangladesh	464 (0.3)
The Netherlands	419 (0.3)
Sudan	395 (0.3)
Libya	394 (0.3)
New Zealand	305 (0.2)

Canada

Source Country	No. of IMGs from Source Country (% of Workforce)
United Kingdom	2,735 (4.0)
South Africa	1,754 (2.6)
India	1,449 (2.1)
Ireland	1,164 (1.7)
Saudi Arabia	658 (1.0)
Egypt	558 (0.8)
United States	519 (0.8)
Poland	441 (0.6)
France	432 (0.6)
Pakistan	320 (0.5)
Philippines	261 (0.4)
Australia	247 (0.4)
Hong Kong	224 (0.3)
Vietnam	223 (0.3)
Taiwan	189 (0.3)
Romania	187 (0.3)
Jamaica	179 (0.3)
Sri Lanka	163 (0.2)
Lebanon	161 (0.2)
Kuwait	154 (0.2)

Australia

Source Country	No. of IMGs from Source Country (% of Workforce)
United Kingdom	4,664 (8.6)
India	2,143 (4.0)
New Zealand	1,742 (3.2)
South Africa	1,253 (2.3)
Sri Lanka	627 (1.2)
Egypt	545 (1.0)
Singapore	438 (0.8)
Ireland	424 (0.8)
Hong Kong	312 (0.6)
Poland	189 (0.3)
Philippines	157 (0.3)
Malaysia	152 (0.3)
Pakistan	133 (0.2)
China	112 (0.2)
Vietnam	108 (0.2)
Germany	101 (0.2)
Myanmar	93 (0.2)
Hungary	85 (0.2)
Serbia and Montenegro	78 (0.1)
Slovakia	76 (0.1)

* U.S. IMGs are U.S. citizens who have gone abroad for medical education and returned to the United States to practice.

working for the NHS in the United Kingdom, the number of international medical graduates working for the NHS in England in 2002 was adjusted upward proportionally. A substantial number of physicians who work in the United Kingdom are not employed by the NHS or included in its databases; these include physicians performing locum tenens work, those who are in purely private practice, and those who work in the armed forces, the prison system, and the civil service (clinical officers). Although no formal census of this group exists, several informants estimated that they accounted for 10 percent of the physicians working in the United Kingdom, and therefore an additional upward adjustment of this magnitude was made to the NHS figures (Sibbald B: personal communication).

Canadian figures for international medical graduates were drawn from the 2002 Southam Medical Database (a comprehensive source of data on physicians in practice, maintained by the Canadian Institute for Health Information) and the 2002 Canadian Post-MD Education Registry (the central repository of information on physicians in training, maintained by the Association of Faculties of Medicine of Canada). These merged data provide a complete profile of the international medical graduates in Canada.[14,15]

Data on the country of medical education of international medical graduates in Australia in 1999 were supplied by the Labour Force and Rural Health Unit of the Australian Institute of Health and Welfare (AIHW). In addition, there are approximately 4000 international medical graduates termed Overseas Trained Doctors or Temporary Resident Doctors who are working in Australia under temporary visas but are not in the AIHW database.[16] Accordingly, 4000 international medical graduates were added to those taken from the AIHW database and assigned to countries of origin in proportion to the countries of origin of those in the database.

The economic status of countries was obtained from the World Bank's country classification system.[17] Those nations rated as having low-income or lower-middle-income economies are referred to as lower-income countries. Data on national physician workforces are taken from the WHO Global Atlas of the Health Workforce, the only existing global compendium of workforce information. The numbers are those from the most recent years reported to the WHO by 198 participating nations.[18]

An "emigration factor," reflecting the level of emigration of physicians from each source nation to the recipient countries, was constructed according to the formula $[A \div (A+B)] \times 100$, where A is the number of physicians from a source country practicing in the recipient countries and B is the total number of physicians practicing in the source country. Emigration factors were computed for 120 nations with domestic physician workforces of more than 1000. They were also calculated for global regions, with A being the number of physicians from countries in the region who have emigrated to work in one of the four recipient countries (either in their own or in another region), and B being the total number of physicians practicing in countries in the region.

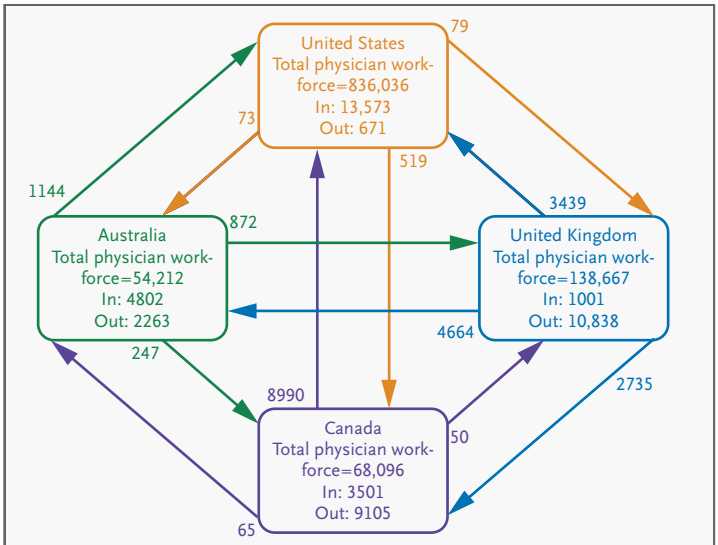

Figure 1. Cycling of Physicians among the Four Recipient Countries.

The rectangles list, in order, the number of physicians currently practicing in the country; the number practicing in the country but educated in one of the other three countries; and the number educated in the country but now practicing in one of the other three countries. The numbers of physicians who have moved from one to another of the four countries are shown on the arrows. The numbers are those from the most recent years for which data were available.

RESULTS

International medical graduates constitute between 23 and 28 percent of the physician workforces of the recipient countries, with lower-income countries contributing between 40.0 percent (in Australia) and 75.2 percent (in the United Kingdom) of the international medical graduates in recipient countries (Table 1). The principal source countries for each of the recipient countries are displayed in rank order in Table 2. The second largest group of international medical graduates in the United States (25,380 physicians, or 3.0 percent of the U.S. phy-

Table 3. Emigration Factors for Countries in Eight Regions of the World.

Region and Source Country	Location of Physician's Practice		Emigration Factor*
	Recipient Country†	Source Country	
	no. of physicians		
East Asia and the Pacific			
New Zealand	2,483	8,491	22.6
Philippines	18,303	91,408	16.7
Singapore	750	5,747	11.5
Thailand	1,562	18,140	7.9
South Korea	4,455	84,611	5.0
Australia	2,263	54,212	4.0
Europe and Central Asia			
Ireland	6,423	9,166	41.2
Malta	204	1,144	15.1
United Kingdom	10,838	138,667	7.2
Romania	2,562	42,339	5.7
Hungary	1,367	31,768	4.1
Greece	1,987	47,944	4.0
Caribbean			
Jamaica	1,589	2,253	41.4
Haiti	1,067	1,949	35.4
Dominican Republic	3,262	15,670	17.2
Cuba	2,069	66,567	3.0
Trinidad and Tobago	23	1,004	2.2
North America			
Canada	9,105	68,096	11.8
Mexico	4,741	172,266	2.7
United States	673	836,036	0.1

sician workforce) consists of U.S. international medical graduates, that is, U.S. citizens who have gone abroad for medical education and returned to the United States to practice.

The reliance of the United States, the United Kingdom, Canada, and Australia on physicians from other nations does not preclude them from drawing on each other. Physicians from the United Kingdom constitute the largest group of international medical graduates in Canada and Australia, and physicians from Canada are the fifth largest group of international medical graduates in the United States. The patterns of emigration and immigration of physicians among these countries constitute a form of workforce "cycling," which is summarized in Figure 1. The net beneficiaries of this cycling are the United States and Australia, with net gains of 12,902 and 2539 physicians, respectively, whereas the net donors are the United Kingdom and Canada, with net losses of 9837 and 5604 physicians, respectively. Canada actually enjoys a net positive position with regard to the United Kingdom and Australia but has lost 8990 physicians to the United States while gaining 519.

The collective physician draw of the four recipient nations on the other nations can be seen in Table 3. India has sent the most physicians to recipient countries (59,523), followed by the Philippines (18,303) and Pakistan (12,813). Since the size of the population and the number of physicians vary greatly from nation to nation, it is hard to interpret the importance of these numbers in isolation. Proportionality is provided by computing an emigration factor that represents an approximate percentage of medical school graduates from a source country who are now working in one of the four recipient countries. Table 3 displays the countries with at least 1000 physicians and with the highest emigra-

Table 3. (Continued.)

Region and Source Country	Location of Physician's Practice		Emigration Factor*
	Recipient Country†	Source Country	
	no. of physicians		
Central and South America			
Peru	1,631	29,799	5.2
Bolivia	305	6,220	4.7
Guatemala	472	9,965	4.5
Panama	229	4,942	4.4
Costa Rica	304	6,788	4.3
Colombia	2,464	58,761	4.0
Middle East and North Africa			
Lebanon	2,749	11,505	19.3
Iraq	2,327	12,955	15.2
Syria	3,577	23,742	13.1
Libya	624	6,371	8.9
Israel	1,959	24,140	7.5
Jordan	732	10,623	6.4
Indian Subcontinent			
Sri Lanka	3,027	7,963	27.5
Pakistan	12,813	96,900	11.7
India	59,523	503,900	10.6
Myanmar	1,545	14,356	9.7
Bangladesh	1,718	32,498	5.0
Nepal	54	1,259	4.1
Sub-Saharan Africa			
Ghana	791	1,842	30.0
South Africa	6,993	30,740	18.5
Ethiopia	359	1,971	15.4
Uganda	195	1,175	14.2
Nigeria	4,053	30,885	11.6
Sudan	622	4,973	11.1

* The emigration factor was computed as $[A \div (A+B)] \times 100$, where A is the number of physicians from a source country practicing in the recipient countries and B is the total number of physicians practicing in the source country.
† The recipient countries are the United States, the United Kingdom, Canada, and Australia.

tion factors in eight regions of the world. Six of the 20 countries with the highest emigration factors are in sub-Saharan Africa, and 3 are in the Caribbean. Canada, Ireland, and New Zealand are also in the top 20 countries. The United States is a major recipient of physicians and loses very few.

The emigration factor is also a useful tool for looking at the regional impact of emigration. Calculating the emigration factors according to global regions gives a measure of the loss of physicians from various regions of the world as a proportion of the physicians remaining to do the work of health care (Table 4). The emigration factors for sub-Saharan Africa, the Indian subcontinent, and the Caribbean are the highest, whereas those for Central and South America, Europe and Central Asia, East Asia and the Pacific, and North America are minimal.

DISCUSSION

India and the Indian subcontinent provide the largest absolute number of physicians to the recipient nations, but the relative draw on nations, as measured by the emigration factor, is actually greater

Table 4. Emigration Factors for Eight Regions of the World.

Region	Location of Physician's Practice		Emigration Factor*
	Recipient Countries†	Source Countries	
	no. of physicians		
Sub-Saharan Africa	13,272	82,100	13.9
Indian Subcontinent	78,680	656,876	10.7
Caribbean	8,010	87,443	8.4
Middle East and North Africa	27,010	489,464	5.2
Central and South America	12,103	707,416	1.7
Europe and Central Asia	44,988	2,741,717	1.6
East Asia and Pacific	39,910	2,808,400	1.4
North America	14,519	1,076,398	1.3

* The emigration factor for a region is computed as $[A \div (A+B)] \times 100$, where A is the number of physicians from countries in the region who have emigrated to work in one of the four recipient countries (either in their own or in another region), and B is the total number of physicians practicing in countries of the region.
† The recipient countries are the United States, the United Kingdom, Canada, and Australia.

for sub-Saharan Africa and is very pronounced for Caribbean countries. The United Kingdom, Canada, and Australia draw substantially from South Africa, and the United States draws very heavily from the Philippines. Former colonial ties and the English language are strongly associated with many of the avenues of heavy migration.

The emigration factor is a more specific measure of the impact of emigration on a country than is the absolute number of emigrants. As computed, however, it understates the full magnitude of emigration, since it includes neither physicians who have left their country of medical education for a destination other than the four recipient nations nor physicians who have emigrated to recipient nations but have not succeeded in obtaining certification to practice. Many small nations with large emigration factors were not included in this study, since countries with fewer than 1000 physicians were excluded from analysis. For the United Kingdom and Australia, where the existing databases are incomplete, all calculations are based on estimates.

Although there are undoubtedly benefits that accrue to source countries whose physicians move to high-income English-speaking nations, there can be little question that the emigration of these physicians is also a loss to the health systems of the source countries.[19,20] The effect of the emigration of physicians, many of whom come from poor countries, varies from nation to nation, but there are always costs to the source country in terms of financial resources (investment in education) and human capital (gifted, ambitious people). Moreover, many medical schools in source nations are influenced by the "Western aspirations" of their students, so that their training programs are not well aligned with local patterns of disease and levels of technology.[21,22] The result is that graduates can be dissatisfied with opportunities in their own countries, inappropriately trained for local problems, and inclined to seek placement abroad. The inadequacy and instability of the physician workforce in many lower-income countries are major impediments to disease-reduction initiatives sponsored by the Global Fund, the WHO, the World Bank, the U.S. government, and many others.[23-25]

Reliance on physicians trained elsewhere is not a universal characteristic of wealthy nations. Aside from the 4 recipient countries, there are only 3 among the remaining 26 nations in the Organization for Economic Cooperation and Development in which international medical graduates constitute more than 10 percent of the medical workforce: New Zealand (34.5 percent), Switzerland (17.8 percent), and Norway (12.7 percent).[26] Whereas New Zealand's international medical graduates are similar in country of origin to Australia's, 60 percent of Switzerland's international medical graduates come from Germany, as do 33 percent of Norway's. Virtually none of the international medical graduates in Switzerland and Norway come from outside Europe. International medical graduates constitute 3 percent of the physician workforce in France and 1 percent in Japan.[27]

Although the United States, the United Kingdom, Canada, and Australia have never formally adopted policies of meeting medical service needs with international medical graduates, the heavy reliance by these countries on physicians trained elsewhere suggests that they would have substantial physician shortages without international medical graduates. Moreover, pressures are mounting in all four recipient countries to increase the supply of physicians in practice. The government of the United Kingdom is committed to achieving a rapid increase of 9500 physicians by a combination of new medical schools and increased recruitment abroad.[28-30] Canada is adding residency positions to accommodate more international medical graduates and is streamlining immigration and training requirements to facilitate the direct entry of international medical graduates into practice.[31,32]

Australia plans to increase the numbers of Overseas Trained Doctors and Temporary Resident Doctors in practice, in addition to increasing the number of medical school positions.[16,33] In the United States, a number of professional organizations and academic leaders as well as the COGME have called for measures to augment the numbers of physicians in practice.[34,35] These developments suggest that the demand for international medical graduates in the United States, the United Kingdom, Canada, and Australia is likely to grow in the near future, thus exacerbating current trends.

This report on physician migration documents a substantial transfer of physicians among nations, especially from lower-income countries to the United States, the United Kingdom, Canada, and Australia. Although these patterns of migration have provided benefits in the form of services to the recipient countries and benefits in the form of remittances to the source countries, the brain drain has also weakened the physician workforces of many poor nations and limits the ability of those nations to respond to HIV infection, AIDS, and other pressing needs. Increased investments by recipient nations in domestic medical education would probably decrease the amount of medical migration from poor countries and increase the medical-education opportunities for citizens of recipient countries. It would also help lower-income nations to retain physicians and focus training on national needs rather than on the international physician market.

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