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Estimates Of Health Care Professional Shortages In Sub-Saharan Africa By 2015

Critical shortages of health workers are projected in 2015 throughout sub-Saharan Africa, and the projected cost to eliminate them approaches \$20 billion.

by **Richard M. Scheffler, Chris Brown Mahoney, Brent D. Fulton, Mario R. Dal Poz, and Alexander S. Preker**

ABSTRACT: This paper uses a forecasting model to estimate the need for, supply of, and shortage of doctors, nurses, and midwives in thirty-nine African countries for 2015, the target date of the United Nations Millennium Development Goals. We forecast that thirty-one countries will experience needs-based shortages of doctors, nurses, and midwives, totaling approximately 800,000 health professionals. We estimate the additional annual wage bill required to eliminate the shortage at about \$2.6 billion (2007 \$US)—more than 2.5 times current wage-bill projections for 2015. We illustrate how changes in workforce mix can reduce this cost, and we discuss policy implications of our results. [*Health Affairs* 28, no. 5 (2009): w849–w862 (published online 6 August 2009; 10.1377/hlthaff.28.5.w849)]

THE UNITED NATIONS ADOPTED ITS Millennium Development Goals to meet the needs of the world's poorest nations. Three of the eight goals concern health directly: reducing child mortality; improving maternal health; and combating HIV/AIDS, malaria, and other diseases. These goals are critical, given that each year three million babies are stillborn, 500,000 women die from complications related to pregnancy and childbirth, and 2.9 million people die from HIV/AIDS.¹ Successful delivery of essential health care services depends on a sufficient supply of health workers.

The World Health Organization (WHO) estimated that Africa has a needs-based shortage of 818,000 health care professionals—defined as including only

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doctors, nurses, and midwives—based on a country needing 2.28 health care professionals per 1,000 population.² The WHO found that countries below this threshold were, on average, unable to achieve an 80 percent coverage rate for deliveries by a skilled birth attendant. In addition to health worker shortages, nearly all African countries face skill-mix imbalances, uneven geographic distribution, negative work environments, and a weak knowledge base.³ The lack of health workers is a major bottleneck in implementing evidence-based interventions, thus providing a significant challenge to meeting the Millennium Development Goals.⁴

The development of the health-sector workforce in low-income countries has suffered from years of neglect.⁵ Many African nations struggle with corruption, political instability, and ineffective institutions, which drain them of resources to train and maintain adequate numbers of health care professionals. Moreover, these professionals sometimes migrate to high-income countries that pay higher wages.⁶

The lack of health workers has become the binding constraint in implementing many priority health programs in Africa.⁷ Achieving the health Millennium Development Goals will require major health workforce investments, which are strategic because they affect the overall performance of health care systems.⁸

A number of studies have examined the skill mix of health workers as a possible solution to overall shortages. The results have shown that shifting to less-trained workers can be cost-effective in some circumstances.⁹ Substitution of health workers in Africa with less training than nurses resulted in cost savings in one study but did not in another.¹⁰ Establishing appropriate roles for each category of health worker and the optimal worker mix will continue to present a major challenge to health care professionals, managers, and policymakers.¹¹

One important study presented an alternative approach to addressing the supply of health care professionals by providing a framework to examine the supply from a labor-market perspective.¹² Such alternative approaches will be needed to effectively address the health worker crisis in Africa.

Funders and policymakers need forecasts to plan ahead and make efficient decisions about the number, training level, and distribution of health workers required to meet the Millennium Development Goals.¹³ This paper provides empirically based forecasts for doctors, nurses, and midwives in Africa in 2015. It extends Richard Scheffler and colleagues' recent doctor need and supply forecasts to nurses and midwives—two other types of health workers that are critical to successful implementation of the goals.¹⁴ Specifically, the study addresses three important, interrelated questions using the most current and accurate data available: (1) What is the projected health workforce shortage (or surplus) of doctors, nurses, and midwives in Africa by country in 2015? (2) What will be the annual wage bill required to pay for these health care professionals? (3) How do different skill mixes of doctors, nurses, and midwives change the annual wage bill? We conclude by discussing the policy implications of our findings from these three questions.

Study Data And Methods

■ **Data.** Data on the number of doctors, nurses, and midwives by country are from the WHO *Global Atlas of the Health Workforce* database (as of 1 March 2007).¹⁵ Doctor and nurse wage data are from the *Occupational Wages around the World* (OWW) database, published by the National Bureau of Economic Research. Because of the lack of specific data on midwives' wages, we assumed that a midwife's wage was equal to that of a nurse.¹⁶ Projected population numbers were obtained from the United Nations Population Division.¹⁷

■ **Estimating workforce need, supply, and shortage.** For thirty-nine African countries, we estimated each country's shortage (or surplus) of doctors, nurses, and midwives in 2015 as follows: (1) estimated the workforce need by worker type, (2) estimated the workforce supply by worker type, and (3) estimated the workforce shortage by worker type, which is the difference between the first two estimates.

Following the WHO, we assumed that each country needs 2.28 doctors, nurses, and midwives per 1,000 population.¹⁸ The WHO threshold is bolstered by other studies that found either a similar threshold or a positive relationship between health worker density and health outcomes or vaccination coverage.¹⁹ We then assumed that the 2.28 health care professionals per 1,000 population comprise 0.55 doctors, based on Scheffler and colleagues, leaving the remainder at 1.73 nurses and midwives.²⁰ We did not determine the nurse-midwife mix within the 1.73 number because these data are not normally disaggregated or available.

We then estimated each country's supply of doctors, nurses, and midwives in 2015 using a combination of previous estimates and data.²¹ For doctors, we used Scheffler and colleagues' supply estimates because, to our knowledge, theirs is the only study that forecasts doctor supply by country in 2015, and its forecasting methodology used the most comprehensive data available, including up to twenty-two years (1980–2001) of a country's doctor-supply data.²² To obtain the nurse and midwife supply estimate, we calculated the nurse-plus-midwife-to-doctor ratio for each country using the WHO *Global Atlas* data, and we then multiplied this ratio by the number of doctors from Scheffler and colleagues' study.²³

To calculate the workforce shortage (or surplus) for each country by worker type in 2015, we subtracted each country's supply from its need by worker type. To state the shortages in a single dimension, we also calculated each country's health care professional shortage (or surplus) in doctor-equivalent units by assuming that a nurse or midwife was equal to 0.8 doctors. Because there are few reliable estimates of what this relative productivity factor is in low-income countries, we chose 0.8 based on estimates in the United States, while recognizing that the factor may be higher in low-income countries because a greater share of doctors' tasks in these countries involves primary health care.²⁴ Moreover, we performed sensitivity analyses by allowing this factor to vary between 0.7 and 0.9. By measuring the workforce in doctor-equivalent units, we could examine changes in

the workforce mix by substituting nurses and midwives for doctors, based on nurses' and midwives' productivity relative to that of doctors.

■ **Calculating the wage bill to fill health workforce shortages.** The wage bill for health workforce need is the amount required to pay for a workforce of 2.28 health care professionals (0.55 doctors and 1.73 nurses and midwives) per 1,000 population, and the wage bill for health workforce supply is the amount required to pay for the estimated workforce supply. The wage bill for the health workforce shortage is the difference between the need and supply wage bills. We calculated the annual wage bill for health workforce need by summing the wage bill of doctors and that of nurses and midwives. For doctors, we multiplied the number of needed doctors by doctors' wages for each country. We did the same calculation for nurses and midwives and used each country's nurse wages (because midwife wages were not reliably reported). We used this same process to calculate the annual wage bill for health workforce supply.

We then recalculated the need wage bill under various workforce-mix scenarios, all of which increased the number of nurses and midwives relative to doctors, holding the number of doctor-equivalent units constant. We assumed that the supply wage bill would not change, because that is the wage bill that the country is estimated to be willing and able to pay. The difference between these two wage bills resulted in a new wage bill required to eliminate the workforce shortage.

For these forecasts and calculations, we caution the reader that given the quality of the available data and the assumptions that are required, these estimates are to be considered as rough orders of magnitude. But waiting for ideal data is not an option, given the dire health problems in Africa.

Results

We estimated that thirty-one of the thirty-nine African countries analyzed will experience a shortage of doctors, nurses, and midwives in 2015 (Exhibit 1). The estimated shortage is overwhelming. We estimated the total need for doctors, nurses, and midwives to be approximately 1.163 million, whereas supply is estimated to be only 371,000—just 32 percent of need. Our estimated shortage of 792,000 health care professionals includes 240,000 doctors and 551,000 nurses and midwives.²⁵

When these figures are broken out by country (Exhibits 2 and 3), the doctor shortage ranges from 0.23 per 1,000 population in Comoros to 0.54 per 1,000 population in Mozambique. The nurse and midwife shortage ranges from 0.03 per 1,000 population in Sierra Leone to 1.62 per 1,000 population in Madagascar. Two countries had surpluses of nurses and midwives.

Exhibit 4 provides the annual estimated wage bill required to pay for needed and supplied health care professionals by country (columns 1 and 2). The difference between these two wage bills is the shortage wage bill, which is also presented for doctors versus nurses and midwives (columns 3–5). The annual wage

EXHIBIT 1**Summary Of Health Care Professional Need, Supply, And Shortage Estimates (In Thousands) For Thirty-One Countries In Sub-Saharan Africa, 2015**

	Doctors	Nurses and midwives	Total	Doctor equivalents
Need	280	883	1,163	986
Supply	39	332	371	305
Shortage	240	551	792	681

SOURCES: Authors' analysis; R.M. Scheffler et al., "Forecasting the Global Shortage of Physicians: An Economic- and Needs-Based Approach," *Bulletin of the World Health Organization* 86, no. 7 (2008): 516–523; World Health Organization, *Global Atlas of the Health Workforce* (1 March 2007); and United Nations Population Division.

NOTES: The number of doctor equivalents is equal to the number of doctors plus 0.8 times the number of nurses and midwives. Numbers might not add to total because of rounding.

bill to pay for the need in the thirty-one countries with projected shortages is approximately \$3.6 billion (in 2007 U.S. dollars), and the annual wage bill for the supply is approximately \$1 billion. The \$2.6 billion difference is the annual wage bill required to eliminate the health care professional shortage for these countries, including \$1.1 billion for doctors and \$1.5 billion for nurses and midwives.²⁶ Doctors represent 42 percent of the wages needed to eliminate the shortage but only 30 percent of the health care professional shortage.

Next, we examined how altering the workforce mix would affect the annual wage bill required to eliminate the workforce shortage. Exhibit 5 shows the percentage savings from the \$2.6 billion required to eliminate the health care professional shortage by increasing the nurse-plus-midwife-to-doctor ratio by different percentages and assuming that a nurse or midwife was equal to either 0.7, 0.8, or 0.9 doctors. For a given increase in the nurse-plus-midwife-to-doctor ratio, the savings increased as a nurse's or midwife's assumed productivity became relatively more equal to a doctor's. Increasing the ratio by 50 percent resulted in savings of 2.1 percent when a nurse or midwife equaled 0.7 doctors, and the savings increased to 4.7 percent when a nurse or midwife equaled 0.9 doctors. When a nurse or midwife equaled 0.58 or fewer doctors, no savings resulted from increasing the nurse-plus-midwife-to-doctor ratio.²⁷

Discussion

We estimate the shortage of doctors, nurses, and midwives for thirty-one African countries in 2015 to be approximately 792,000 health care professionals, and the estimated annual wage bill necessary to eliminate the shortage is approximately \$2.6 billion (in 2007 U.S. dollars). This wage bill could be decreased by increasing the ratio of nurses and midwives to doctors because doctor wages are higher than nurse and midwife wages. Our study provides a framework to analyze different workforce-mix scenarios, based on health care professionals' relative wages and productivity. Our results show that most countries with shortages can eliminate those shortages for less money by changing their health workforce mix.

EXHIBIT 2**Health Care Professional Supply Estimates (Professionals Per 1,000 Population) For Thirty-Nine Countries In Sub-Saharan Africa, 2015**

Country	Doctors	Nurses and midwives	Total	Doctor equivalents	2015 population (1000s)
Sub-Saharan Africa ^a	0.08	0.65	0.73	0.60	509,940
Mozambique	0.01	0.14	0.15	0.13	23,513
Gambia	0.01	0.15	0.16	0.13	1,889
Madagascar	0.10	0.11	0.21	0.19	23,813
Central African Republic	0.04	0.21	0.25	0.21	4,647
Burundi	0.04	0.29	0.33	0.27	10,617
Rwanda	0.04	0.30	0.33	0.27	11,262
Cameroon	0.04	0.36	0.40	0.33	19,040
Equatorial Guinea	0.14	0.24	0.38	0.33	627
Lesotho	0.03	0.40	0.43	0.35	1,744
Niger	0.04	0.40	0.44	0.36	19,283
Mali	0.05	0.39	0.44	0.36	18,093
Ethiopia	0.05	0.41	0.46	0.38	97,155
Uganda	0.05	0.47	0.52	0.43	41,918
Togo	0.06	0.48	0.53	0.44	7,847
Zambia	0.03	0.54	0.58	0.47	13,841
Cape Verde	0.17	0.49	0.66	0.56	628
Burkina Faso	0.07	0.63	0.69	0.57	17,678
Guinea	0.13	0.58	0.71	0.60	11,890
Zimbabwe	0.12	0.68	0.80	0.66	13,804
Cote d'Ivoire	0.14	0.68	0.81	0.68	21,553
Senegal	0.13	0.69	0.82	0.68	14,538
Benin	0.04	0.81	0.86	0.69	11,217
Ghana	0.13	0.78	0.91	0.75	26,562
Mauritania	0.15	0.91	1.06	0.88	3,988
Malawi	0.04	1.15	1.19	0.96	15,998
Kenya	0.14	1.30	1.44	1.18	44,194
Guinea-Bissau	0.24	1.35	1.58	1.31	2,133
Sierra Leone	0.11	1.71	1.82	1.47	6,897
Comoros	0.32	1.62	1.93	1.61	1,019
Gabon	0.12	2.01	2.13	1.73	1,605
Angola	0.12	2.11	2.23	1.81	20,947
Nigeria	0.45	2.70	3.15	2.61 ^b	160,900
Congo	0.57	2.78	3.35	2.80 ^b	5,441
Botswana	0.58	4.51	5.09	4.19 ^b	1,690
South Africa	0.75	4.85	5.60	4.63 ^b	47,902
Algeria ^c	2.57	5.06	7.63	6.62 ^b	38,085
Mauritius	1.94	6.87	8.81	7.442 ^b	1,344
Namibia	1.17	13.36	14.53	11.86 ^b	2,248
Swaziland	0.54	21.62	22.16	17.83 ^b	992

SOURCES: Authors' analysis; R.M. Scheffler et al., "Forecasting the Global Shortage of Physicians: An Economic- and Needs-Based Approach," *Bulletin of the World Health Organization* 86, no. 7 (2008): 516–523; and World Health Organization, *Global Atlas of the Health Workforce* (1 March 2007).

NOTES: Numbers might not add to total because of rounding. Presented in ascending order of doctor equivalents.

^a Thirty-one shortage countries.

^b These eight countries did not have doctor-equivalent shortages because their doctor-equivalent supply was above 1.93 doctor equivalents per 1,000 population (0.55 doctors plus 0.8 times 1.73 nurses and midwives). The number of doctor equivalents is equal to the number of doctors plus 0.8 times the number of nurses and midwives.

^c Algeria is not located in sub-Saharan Africa, but is located in Africa.

EXHIBIT 3**Health Care Professional Shortage Estimates (Professionals Per 1,000 Population)
For Thirty-One Countries In Sub-Saharan Africa, 2015**

Country	Doctors	Nurses and midwives	Total	Doctor equivalents	2015 population (1000s)
Sub-Saharan Africa ^a	0.47	1.08	1.55	1.34	509,940
Mozambique	0.54	1.59	2.13	1.81	23,513
Gambia	0.54	1.58	2.12	1.80	1,889
Madagascar	0.45	1.62	2.07	1.75	23,813
Central African Republic	0.51	1.52	2.03	1.72	4,647
Burundi	0.51	1.45	1.95	1.66	10,617
Rwanda	0.51	1.44	1.95	1.66	11,262
Cameroon	0.51	1.37	1.88	1.60	19,040
Equatorial Guinea	0.41	1.49	1.90	1.60	627
Lesotho	0.52	1.33	1.85	1.58	1,744
Niger	0.51	1.34	1.84	1.58	19,283
Mali	0.50	1.34	1.84	1.57	18,093
Ethiopia	0.50	1.32	1.82	1.56	97,155
Uganda	0.49	1.26	1.76	1.51	41,918
Togo	0.49	1.26	1.75	1.50	7,847
Zambia	0.52	1.19	1.70	1.47	13,841
Cape Verde	0.38	1.24	1.62	1.37	628
Burkina Faso	0.48	1.10	1.58	1.36	17,678
Guinea	0.42	1.15	1.57	1.34	11,890
Zimbabwe	0.43	1.05	1.48	1.27	13,804
Cote d'Ivoire	0.41	1.06	1.47	1.26	21,553
Senegal	0.42	1.04	1.46	1.25	14,538
Benin	0.50	0.92	1.42	1.24	11,217
Ghana	0.42	0.95	1.37	1.18	26,562
Mauritania	0.40	0.82	1.22	1.06	3,988
Malawi	0.51	0.58	1.09	0.98	15,998
Kenya	0.41	0.43	0.84	0.76	44,194
Guinea-Bissau	0.31	0.38	0.70	0.62	2,133
Sierra Leone	0.44	0.03	0.46	0.46	6,897
Comoros	0.23	0.12	0.35	0.32	1,019
Gabon	0.43	-0.28	0.15	0.21	1,605
Angola	0.42	-0.38	0.05	0.12	20,947

SOURCES: Authors' analysis; R.M. Scheffler et al., "Forecasting the Global Shortage of Physicians: An Economic- and Needs-Based Approach," *Bulletin of the World Health Organization* 86, no. 7 (2008): 516–523; World Health Organization, *Global Atlas of the Health Workforce* (1 March 2007); and United Nations Population Division.

NOTES: Presented in descending order of doctor equivalents. A positive number of workers per 1,000 population represents a shortage, and a negative number represents a surplus. Only Gabon and Angola had nurse and midwife surpluses, but these surpluses did not offset their respective doctor shortages when measured in doctor-equivalent units. The number of doctor equivalents is equal to the number of doctors plus 0.8 times the number of nurses and midwives. Nigeria, Republic of Congo, Botswana, South Africa, Algeria, Mauritius, Namibia, and Swaziland were not estimated to have shortages when measured in doctor-equivalent units; therefore, these countries were excluded from this exhibit. Numbers might not add to total because of rounding. A sample calculation using Mozambique follows. We assumed the need to be 0.55 doctors and 1.73 nurses and midwives per 1,000 population. We estimated that Mozambique's supply of doctors in 2015 would be 0.01 per 1,000 population, resulting in a shortage of 0.54 doctors per 1,000 population. Similarly, we estimated that its supply of nurses and midwives would be 0.14 per 1,000 population, resulting in a shortage of 1.59 nurses and midwives per 1,000 population. This results in a total shortage of 2.13 health care professionals per 1,000 population, or a doctor-equivalent shortage of 1.81 health workers per 1,000 population. The 1.81 doctor-equivalent shortage per 1,000 population is equal to the 0.54 doctor shortage plus 0.8 times the 1.59 nurse-and-midwife shortage, because one nurse or midwife was assumed to equal 0.8 doctors.

^a Thirty-one shortage countries.

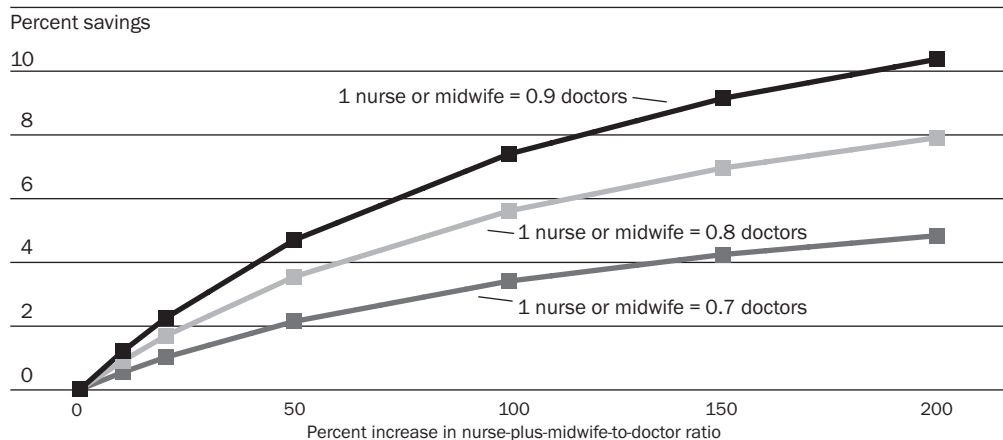
EXHIBIT 4**Annual Wage Bill Estimates (In Millions Of 2007 U.S. Dollars) For Health Care Professional Need, Supply, And Shortage For Thirty-One Countries In Sub-Saharan Africa, 2015**

Country	Need	Supply	Shortage		
			All worker types	Doctors	Nurses and midwives
Sub-Saharan Africa ^a	3,607	1,002	2,605	1,097	1,508
Mozambique	143	8	135	53	82
Gambia	16	1	15	6	10
Madagascar	52	5	46	15	32
Central African Republic	144	16	128	32	96
Burundi	51	7	45	19	26
Rwanda	110	16	95	29	65
Cameroon	630	102	528	205	323
Equatorial Guinea	10	2	8	2	6
Lesotho	20	3	16	6	10
Niger	246	44	201	73	129
Mali	131	22	109	49	60
Ethiopia	333	62	271	101	170
Uganda	25	5	20	8	12
Togo	63	13	50	20	30
Zambia	61	10	51	35	16
Cape Verde	7	2	5	1	4
Burkina Faso	198	57	141	55	86
Guinea	110	33	77	29	48
Zimbabwe	139	46	92	37	55
Cote d'Ivoire	180	62	118	43	75
Senegal	117	39	77	32	45
Benin	99	32	66	33	33
Ghana	171	59	111	63	49
Mauritania	34	15	19	9	11
Malawi	56	25	31	19	12
Kenya	281	158	122	79	44
Guinea-Bissau	12	7	4	3	2
Sierra Leone	14	10	4	4	0
Comoros	9	7	1	1	0
Gabon	26	23	3	6	-3
Angola	121	107	13	31	-18

SOURCES: Authors' analysis; R.M. Scheffler et al., "Forecasting the Global Shortage of Physicians: An Economic- and Needs-Based Approach," *Bulletin of the World Health Organization* 86, no. 7 (2008): 516–523; World Health Organization, *Global Atlas of the Health Workforce* (1 March 2007); United Nations Population Division; and *Occupational Wages around the World* (OWW) database.

NOTES: Positive dollar amounts represent millions of dollars required to pay the wage bill, and negative dollar amounts represent surpluses. Gabon and Angola had estimated surpluses of nurses and midwives; therefore, they had a surplus nurse-and-midwife wage bill. However, each of these countries' respective surpluses were more than offset by its doctor-shortage wage bill, resulting in a net shortage wage bill. Nigeria, Botswana, South Africa, Algeria, Mauritius, Namibia, Republic of Congo, and Swaziland were not estimated to have shortages when measured in doctor-equivalent units; therefore, these countries were excluded from this exhibit. An explanation of the first row of the exhibit follows. The total estimated annual wage bill for the needed and supplied doctors, nurses, and midwives is \$3,607 million and \$1,002 million, respectively, resulting in a shortage of \$2,605 million. This shortage is composed of \$1,097 million for doctors and \$1,508 million for nurses and midwives. Numbers might not add to total because of rounding.

^a Thirty-one shortage countries.

EXHIBIT 5**Summary Of Estimated Wage Bill Shortage Savings By Increasing The Nurse-Plus-Midwife-To-Doctor Ratio For Different Nurse-And-Midwife-To-Doctor Productivity Equivalencies**

SOURCES: Authors' analysis; R.M. Scheffler et al., "Forecasting the Global Shortage of Physicians: An Economic- and Needs-Based Approach," *Bulletin of the World Health Organization* 86, no. 7 (2008): 516–523; World Health Organization, *Global Atlas of the Health Workforce* (1 March 2007); United Nations Population Division; and *Occupational Wages around the World* (OWW) database.

NOTES: This exhibit shows the percentage savings from \$2.6 billion (see vertical axis) to eliminate the health care professional shortage in the thirty-one sub-Saharan African countries by increasing the nurse-plus-midwife-to-doctor ratio by different percentages (see horizontal axis). This is done for three scenarios by assuming that a nurse or midwife was equal to either 0.7, 0.8, or 0.9 doctors.

Our shortage estimate of 792,000 professionals is similar to the WHO's 818,000 shortage estimate; however, the supply and shortage estimates by country sometimes differed because we used different methods, and our estimates were based on forecasts in 2015, while the WHO's estimates were as of 2006.²⁸ Even with these differences, for the vast majority of countries that both studies analyzed, the studies were consistent in finding either a surplus or a shortage.

Funds required to eliminate the health care professional shortage, even under optimistic scenarios for economic growth as well as governments' commitments to the health sector, will be difficult for countries to generate. Funds in addition to the wage bill would be needed to hire health care support staff; train the new professionals and support staff; and pay for expenses such as supplies, pharmaceuticals, equipment, and facilities. Based on health care expenditures reported by the WHO and wage data from the OWW database, the health care wage bill for doctors, nurses, and midwives represented 14 percent of health care expenditures in these thirty-one countries in 2003. Based on that percentage, the \$2.6 billion wage bill shortfall is equivalent to an annual shortfall of \$19 billion in total health care spending.²⁹ Global aid will help, but the approximate \$16.7 billion in global aid for health each year is not enough to solve sub-Saharan Africa's shortage, let alone that of the entire world.³⁰ Additionally, the estimated cost to train 1.5 million health workers is \$26.4 billion, and this estimate was based on approximately the

“Most countries with shortages can eliminate those shortages for less money by changing their health workforce mix.”

.....

same shortage of doctors, nurses, and midwives we estimated plus an additional 682,000 health support staff.³¹

■ **Study limitations.** Our estimates are to be viewed as rough orders of magnitude because, like other studies examining health workers in Africa, the greatest limitation of our study results from poor data quality. The WHO provided the health care professional supply estimates for our study (and for those of Scheffler and colleagues’ earlier study).³² The WHO obtains the number of health care professionals from four major sources: government administrative systems, national population censuses, employment surveys, and health facility assessments. Most of the data from sub-Saharan Africa are based on government payroll and administrative registration sources, which may vary in quality across countries for a number of reasons. For example, the administrative data may count doctors who only work part time for the public sector as working full time, and they may also count doctors on the public sector’s payroll who actually do not work in the public sector (also known as ghost workers). The estimates also tend to undercount health care professionals who work in the private sector only. Countries do not use the same definitions to define health care professional occupations; the definitions vary based on education and training requirements.³³

These data limitations could be reduced if more resources were allocated to improve the administrative systems or to fund employment surveys. Standardizing the definitions of health care professional occupations across countries (for example, using the most recent International Standard Classification of Occupations [ISCO-08]) would improve shortage estimates within occupations. These same recommendations also apply to improving the quality of the wage data.

■ **Policy implications.** Given the estimated shortage of health workers and the lack of available funds to alleviate it, several policy options can be recommended. We focus on three that involve productivity and training: (1) workforce skill-mix changes, (2) worker incentives, and (3) training capacity.

Productivity increases are important to reduce shortages. To illustrate, a productivity increase of 3 percent per year from 2008 through 2015 would lower the number of needed health care professionals by about 19 percent, which would reduce the shortage from 792,000 to 575,000. The workforce skill mix and worker incentives both affect productivity.

Skill mix. Changes in skill mix and redistribution of tasks among health workers holds some promise for alleviating shortages.³⁴ Substitution of health workers with less training than nurses in Africa is cost-effective because of relatively faster training and higher retention within their country and in rural communities.³⁵ A large increase in the number of mid-level and community health workers, who can

provide support for doctors, nurses, and midwives, could be a partial solution.³⁶ A policy recommendation report cites task redistribution studies in Malawi, Mozambique, and Uganda but notes that there has been resistance from professional groups because of concerns about quality and safety.³⁷ Another study emphasizes the importance of appropriate supervision and systems support.³⁸ Further research is required to provide country-specific recommendations.

Incentives. Incentives for workers are necessary to improve motivation and morale. Senior managers and policymakers must help by establishing occupational health services, improving poor work environments, and developing new career systems. Programs are needed to prevent and treat workplace risks (such as protecting workers from HIV/AIDS and providing HIV testing).³⁹ Poor work environments must be improved by strengthening management of existing resources; assuring adequate supplies, facilities, and technology; and creating monetary and nonfinancial incentives to retain and motivate health workers.⁴⁰

One monetary incentive scheme, pay-for-performance (P4P), is being tested in the United States; some studies show a modest effect on quality of care.⁴¹ The studies cannot determine whether to attribute the improvements to the incentives themselves or to the education that accompanies P4P programs that were studied; the two interventions occur simultaneously.⁴² The response of health workers in low-income countries to monetary incentives is still largely unknown, but the World Bank is studying incentives in Rwanda, Ghana, and Malawi.⁴³ In-country funds are limited for productivity-improving investments; the donor and international community must play a key role in this effort.

Training capacity. Countries with estimated health care professional shortages must increase their training capacity, reduce the training dropout rate, improve the quality and consistency of secondary education to increase the number of eligible students, and provide continuous learning opportunities.⁴⁴ Training capacity and quality can be improved by establishing and strengthening partnerships between training and education institutions from low- and high-income countries, to which the World Health Organization is committed.⁴⁵

The additional health workers will need to be either trained in-country or hired from other countries. Training health workers within these countries would take some time: three years for a nurse and up to ten years for a doctor, plus an additional five to ten years to add training capacity.⁴⁶ The relatively low wages paid in these countries means that it will not be very feasible for them to hire health workers from middle- or high-income countries.

THE RAPID SCALING UP OF PRODUCTION AND deployment of a well-trained health workforce requires a sizable investment.⁴⁷ The international community, which has made commitments to supporting developing countries to achieve the Millennium Development Goals, must increase funding to support this critical area. The 2008 Group of Eight summit committed support to in-

creasing the number of health care professionals; this follows the framework of the 2008 Kampala Declaration and Agenda for Global Action.⁴⁸

No one seems to disagree—there is clearly a need to scale up the health workforce in sub-Saharan Africa.⁴⁹ However, macroeconomic and fiscal realities present major challenges. Therefore, the global community will need to support the development of the health workforce to meet the health Millennium Development Goals. It is important that the global community's efforts be well coordinated, that workforce planning decisions be based on high-quality data, that workforce skill-mix changes be considered, that productivity improvements be implemented, and that training capacity and quality be increased. This will improve the health and, ultimately, the quality of life of the world's poorest citizens.

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NOTES

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 26. Between 2001 and 2006, these countries experienced an average increase in gross national income (GNI) per capita of 7 percent per year. If one assumes that the rate of growth is the same between 2007 and 2015 and that the income elasticity of health care spending is approximately 0.8 in low-income countries, then this would result in the annual wage bill to eliminate the shortage increasing to \$4.0 billion, assuming that the real wage increase did not result in a productivity increase. Given the current global financial crisis, economic growth between now and 2015 is difficult to predict; therefore, we chose to not increase wages

- in real terms between 2007 and 2015.
27. Exhibit A-2 in the technical appendix (as in Note 16) shows the savings by country, assuming that the nurse-plus-midwife-to-doctor ratio increased by 50 percent and that one nurse or midwife equaled 0.8 doctors. The overall savings were 3.5 percent, but the savings varied by country, the highest being 16.1 percent.
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