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Depriving the Deprived: A Narrative Review of Brain Drain of Health Professionals from Low- and Middle-Income (LMICs) to High Income Countries through an Equity Lens

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Abstract: With an estimated population of 7.8 billion, health professionals (HPs) are grossly inadequate globally and far below the WHO's benchmark of one physician, four nurses per 1000 population. Despite hosting 11% of the world's population and 24% of the global burden of diseases, Sub-Saharan Africa (SSA) has the most significant health professional HPs shortages. The prolonged haemorrhage of HPs from SSA and other low and middle-income countries (LMICs) to Organization for Economic Co-operation and Development (OECD) member states continues to complicate health equity in LMICs. This has raised concerns about social justice and breach of ethics. A narrative review approach was used to appraise the brain drain situation in Egypt, Nigeria, and South Africa, countries most affected by the phenomenon. The review showed that between 2016 and 2019, Egypt lost over 10,000 physicians. Nigeria also experienced a significant brain drain, with over 16,000 doctors and 75,000 nurses emigrating in the past five years (2020 – 2025). South Africa faced a physician density drop from 0.8 to 0.31 per 1,000 people in a year. A global shared responsibility is required to mitigate the worsening brain-drain of physicians and nurses from African LMICs to High Income Countries such as the OECD. Collaborative framework between OECD member states and LMICs that allows for a fairer and mutually beneficial HPs emigration regime is proposed in this review. A role for the World Health Organization, and other international public health institutions, is further suggested to propose and promote sustainable innovative strategies to ensure justice, fairness, and equity in reversing the exodus of HPs from LMICs. Although strengthening health systems in African countries is vital, sustainable progress depends highly on collaborative partnerships with OECD countries to co-invest in expanding capacity building, educational infrastructure, and the adoption of technology-enabled learning in the LMICs.

Keywords: Brain drain, Health professionals, Health professionals in LMICs, Health professionals Deficit

INTRODUCTION

Health Professionals (HPs) comprise all categories of medical doctors, nursing professionals, midwifery professionals, dentists, pharmacists, paramedical professionals, traditional and complementary medical professionals, environmental and occupational health, and hygiene professionals [1]. Health professionals play an integral role in promoting health among individuals and populations. They are critical for effective and functional health systems

and accelerating the attainment of Universal Health Coverage (UHC) [2]. In 2020, it was estimated that globally there were 12.7 million medical doctors, 29.1 million nurses, 3.7 million pharmacists, 2.5 million dentists, and 2.2 million midwives [3]. With an estimated global population of 7.8 billion in 2020 [4], the population of HPs is grossly inadequate when compared to WHO's recommendation of one physician, four nurses, and midwives per 1000 population [5].

In addition to this global shortage of HPs, the available HPs are inequitably distributed, with low- and middle-income countries (LMICs) being disproportionately affected. Sub-Saharan African countries face the most significant HPs shortage challenges. Although the region has 11 percent of the world's population and 24 percent of the global burden of disease, it has less than 3 percent of the world's HPs [6]. For example, of the 63 countries with less than two nurses and midwives per 1000 population, 40 (64%) are in Africa, and the rest are in the Caribbean and the Pacific. Of these 40 countries, more than half have less than one nurse or a midwife per 1000 population. Similarly, of the 81 countries with less than one physician per 1000 population, 50 countries (62%) are in Africa, and 43 (86%) of them have between 1 and 4 physicians per 10,000 populations. This disproportionate shortage of HPs in sub-Saharan African countries is primarily a result of the recruitment of HPs from these countries to the Organization for Economic Cooperation and Development (OECD) countries, a practice often described as brain drain. According to the OECD, Egypt, Nigeria, South Africa, Algeria, and Sudan are the countries in Africa with the highest brain drain [6].

On the other hand, the United Kingdom, the United States, France, and Canada are the major beneficiaries of HPs brain drain from Africa. The persistent emigration of skilled medical professionals from low- and middle-income countries, particularly in Africa, poses a critical challenge to the sustainability and effectiveness of national health systems [7]. In countries like Nigeria, Egypt, and South Africa, the migration of doctors and nurses to high-income countries has intensified in recent years due to poor working conditions, low remuneration, limited career progression, and weak health infrastructure. This "brain drain" has led to acute shortages of qualified personnel, particularly in rural and underserved areas, further straining the already fragile health systems of these countries. As the worldwide population is aging, this issue is set to intensify and require proactive adaptive solutions.

The need to urgently examine the physician and nurse brain drain from Africa has never been greater for several reasons. These include population growth acceleration in many countries, a rise in the absolute global burden of diseases, with LMICs being disproportionately affected, and an ageing population, especially in OECD countries. These factors are intensifying competition for scarce HPs globally, at the same time when LMICs like Egypt, Nigeria, and South Africa are facing unprecedented workforce depletion. Although existing literature has described the push and pull factors for HPs emigration/ brain drain [8,9], fewer reports interrogate the ethical responsibilities of beneficiary countries [10,11], or those that propose concrete, mutually beneficial models of OECD - LMIC collaboration that expand training capacity and ensure equitable workforce mobility [12,13]. This narrative review addresses this critical gap by reframing brain drain as a shared global challenge that requires cooperative investment rather than unilateral and worsening loss for LMICs.

Using physicians and nurses as proxy for HPs in Egypt, Nigeria and South Africa, the top three African countries affected by the brain drain situation to make the case, this review will appraise the impact of the brain drain phenomenon in these countries and offer recommendations on how OECD member states benefiting from the situation can collaborate with the affected countries to promote morally and ethically acceptable HPs' emigration from LMICs to their countries. Findings and recommendations from this review will serve as an "alarm bell" for concerned policy makers, the WHO, and other related bilateral and multilateral institutions to collaborate and address this issue.

METHODOLOGY

This narrative review consolidates existing knowledge on health workforce emigration in Africa, using published literature, policy documents, technical reports, and grey literature [14]. Using this approach allows for a more flexible appraisal of evidence and policies relevant to health workforce emigration [15].

The review investigates the three African countries most impacted by physician and nurse emigration, using data from the WHO Global Health Observatory, OECD Migration reports, and recent research. It highlights countries with the highest emigration rates and workforce shortages, primarily relying on secondary sources such as electronic databases, institutional repositories, and grey literature. Search terms included "brain drain," "health workforce migration," "physicians' emigration," "nurses' migration," "Africa," "OECD," "health workforce shortage," "ethical recruitment," "LMICs," and "bilateral agreements." Articles and reports published between 2010 and 2025 in English were used, focusing on African health professionals' migration patterns, effects, and ethical issues.

The literature was thematically categorized to capture the magnitude of physician and nurse brain drain in the top three African countries [16]. Analysis focused on the push and pull factors behind health worker emigration, its impact on health systems and population health in source countries.

Recommendations were developed by drawing on the expertise of the authors in global health policy, workforce governance, and ethics, combining evidence from the literature with policy trends and practical insights, and benchmarking against international standards such as the WHO Code of Practice on International Recruitment, ILO guidelines on decent work for health professionals, the Global Compact for Migration, and the OECD's Guidelines for Multinational Enterprises.

HEALTH SYSTEMS OF THE THREE STUDY COUNTRIES

Egypt: Egypt operates a healthcare system that is primarily comprised of two main components: the state-run public sector services and an increasingly robust the private sector [17]. The public sector, which is governed by the Ministry of Health and Population, and is primarily designed to ensure universal health coverage, focusing on prevention and essential health care service for low-income citizens at a minimal cost [18,19]. On the other hand, the private healthcare sector has expanded significantly, and now offers a broader range of services with high-tech and specialized medical interventions. Many Egyptians frequently prioritize the private healthcare facilities due to shorter waiting times and

perceived higher quality of service, albeit at a higher cost [20]. Consequently, the country navigates a stratified health care environment in which the public sector aims to be inclusive, serving as a safety-net for the vulnerable, while the private sector caters to those with the capacity to procure enhanced medical services.

Egypt's health services are delivered through a multi-tiered system of primary, secondary, and tertiary care. Primary care comprises basic health units and family health centres, which are often under-resourced. The secondary level of care comprises general hospitals at the district level, while the tertiary level comprises specialized and teaching hospitals at urban centres [21]. Egypt's health expenditure has been at about 4.6% since 2021, and of this, only 1.7% is from the government [22]. Health insurance coverage is about 60% predominantly among the formal sectors, students, pensioners, and their dependents [23].

Nigeria: Operates a decentralized healthcare system, with responsibilities shared among federal, state, and local governments. The federal government is responsible for policy, regulation, tertiary hospitals, and national programs. The state government is responsible for general hospitals (secondary level of care), while the local government is responsible for primary healthcare facilities. Like Egypt, primary level serves as the first point of contact and includes health posts, dispensaries, and primary healthcare centres, while secondary level is responsible for referrals, and the tertiary level is responsible for medical centres and teaching hospitals [24]. Both public and private sectors deliver services in Nigeria, whereby public healthcare facilities are meant to provide subsidized and free services. The private sector is growing rapidly and provides nearly 60% of healthcare services but is costly and mostly urban-based [24]. Like Egypt, Nigeria spends about 3.6% of its GDP on health as of 2016. Although recent data in 2022 shows that the country's spending has increased to 4.2% of its GDP [25], it is still below the 15% Abuja Declaration commitment. The total budget allocation for health was N669 billion naira, equivalent to $90.92 per capita [26]. The low spending on health by the government contributes to high out-of-pocket expenditure of about 70% [27]. Health insurance coverage in Nigeria is abysmally low, at about 7 – 10% mainly in the formal sector [28].

South Africa: South Africa's health system is well-structured and comparatively well-funded, but remains highly unequal, like Egypt's and Nigeria's, with a stark divide between public and private care. Similarly, the public sector is meant to provide free or subsidized care, with coverage of about 84% and the private sector covers about 16% of the population but accounts for almost 50% of total health spending [29]. Also, health services are decentralized and managed at the national, provincial, and district levels. The National Department of Health (NDoH) sets policy, while provincial and district governments are responsible for service delivery. Like Egypt and Nigeria, service delivery is in three tiers – primary, secondary, and tertiary. Primary level of care is provided at clinics and community health centres (CHCs) and is largely nurse-driven, and the secondary care level is at the district and provincial level with general specialists while tertiary care is at central and academic hospitals offering advanced services and training [30]. Unlike Egypt and Nigeria, South Africa has made good progress in improving healthcare spending and serves as one of the best in Africa at 8.5% of GDP and has one of the least out-of-pocket expenditures at about 7% [31].

Comparatively, South Africa has the highest health investment and infrastructure, but with a sharp public-private divide, while Egypt is expanding coverage via its Universal Health Insurance (UHI) but still faces high out-of-pocket costs. Unfortunately, Nigeria lags in most metrics, with low insurance coverage, funding gaps, and high health inequity as illustrated in Table 1.

Table 1: Comparative Analysis of Key Health System Indicators for Egypt, Nigeria, and South Africa (2021 – 2024)

Indicator	Egypt	Nigeria	South Africa
Health Spending (% of GDP 2024)	6 - 7%	4.0%	15.0%
Health Budget 2024 (in billion USD)	~10.3	~0.95	~17.0
Health as % of total budget (2024)	~13.0	~4.6%	~12.0
Life Expectancy (years)	~71	~55	~65.5
Out-of-Pocket Spending (% of Total Health Spending)	~60%	~72%	~7%
Physicians per 1,000 People	~0.8	~0.2	~0.9
Health Insurance Coverage (% of Population)	~60% (via HIO)	~10% (NHIA)	~16% (Medical Aid)
Public vs Private Sector Split	Public underfunded, private growing	Public underfunded, private expanding	Private well-funded, public overcrowded
Universal Health Insurance Plan	HI (Phased rollout by 2032)	NHIA (Low uptake)	NHI (In development)

Resources: World Bank Health Indicators (2023) – https://data.worldbank.org, WHO Global Health Observatory – https://www.who.int/data/gho, National Health Strategies (Egypt UHI Authority, Nigeria NHIA, South Africa NHI White Paper)

Abbreviations: HIO – Health Insurance Organization, UHI - Universal Health Insurance, NHIA – National Health Insurance Authority, NHI – National Health Insurance

THE SIGNIFICANCE OF THE PROBLEM

Egypt: Since 2016, Egypt has experienced a steady decline in the number of physicians and nurses. The number of physicians per 1000 population reduced from 0.82 in 2016 to 0.75 in 2024, and the number of nurses has also reduced from 1.93 in 2016 to 1.72 in 2024 [32, 33]. Additionally, over 10,000 physicians have emigrated from Egypt between 2016 – 2019. About 10,000 students graduate annually from medical faculties in the country, of which 65% leave to work abroad [34], leaving only about 3,500 students retained from the pool. Similarly, the number of doctors resigning from public service is huge, reaching a record high of 4,261 at the rate of about 12 doctors per day in 2022 [35]. With this trend, there will be a negative net gain in the number of physicians in Egypt. Coupled with aging, retirement, and death of existing doctors, the deficit will continue to surge. The country's health index score in 2023 was 67.2, ranking 106th among 167 countries assessed globally [36], indicating a weak health

system, of which the availability of adequate and qualified healthcare professionals is a strong pillar. Importantly, over 60% of Egypt's licensed physicians reportedly work abroad; and only 38% of registered doctors remain in the domestic health system [37]. Sadly, the remaining doctors and nurses handle increased caseloads with inadequate tools and low pay, frequent incidence of verbal and physical abuse, broken equipment and lower morale.

Overburdened staff, equipment shortages, and clinic closures force less experienced staff to fill critical roles, leading to delayed diagnoses, longer hospital stays, and potential medical errors [38]. The lack of adequate healthcare professionals in Egypt has also exacerbated the longstanding pervasive health inequity in the country, which has one of the widest population wealth gaps in the world [39]. Public hospitals are grossly understaffed, leading to congestion and long waiting times, and therefore, are mainly patronized by the poor majority. The decline in the number of healthcare providers, especially with the spread of many diseases, will increase the demand for healthcare services. This will lead to several negative outcomes, including a rise in the cost of healthcare services, which will be a burden to Egyptian families who already complain about the high cost of living, leading to a rise in inflation [40]. Additionally, the brain drain phenomenon will further degrade the quality of healthcare services. The increased cost and declining quality of healthcare will lead to poor health conditions for workers, which will directly impact on productivity due to increased sick leave or deteriorating health conditions among workers. All of this will negatively impact production and economic growth. In a study in Egypt, it was found that for every 1% increase in brain drain, there is a 5.7% decrease in GDP [41].

Nigeria: Over the last 10 years, Nigeria has steadily maintained 0.2 – 0.3 physicians and 0.86 – 1.76 nurses and midwives per 1000 population [6] as illustrated in Table 2 and Figure 1. According to the Nigerian Minister of Health, from 2018 – 2023, Nigeria has lost over 16,000 physicians due to emigration to OECD member states, leaving the country with as low as 55,000 physicians to serve a population of over 200 million populations [42]. This implies that on average, Nigeria loses about 2,700 doctors annually. On the other hand, Nigeria graduates between 3000 – 3,500 doctors [43] across 48 medical schools in the country [44]. Therefore, the annual net gain in the number of physicians will be below 500, keeping in mind retirement and deaths. Without necessary interventions, the number of physicians per 1000 population will continue to fall to about 0.1 per 1000 population due to the high exodus of physicians in addition to the exponential growth of the country's population.

Similarly, according to the Nigeria Nursing Council, over 15,000 nurses have left Nigeria in 2023 and over 42,000 in the last three years, mostly to the United Kingdom [45]. The continuous loss of doctors and nurses from Nigeria has crippled the public health sector, eroded trust, widened inequalities, and significantly reduced life expectancy and health outcomes. The country's health index score in 2023 was 50, ranking 157th among 167 countries assessed globally [36]. Not different from Egypt, Nigeria's health system is in a critical situation with persistent suboptimal health indices. For example, Nigeria still accounts for about 10% of maternal mortality globally [46] a situation that is greatly impacted by poor access to HPs that provide skilled care to pregnant women during childbirth, especially in rural areas. To complicate issues, Nigeria is also among the countries with the highest income inequality, whereby the wealthiest individual in Nigeria can earn 8,000 times more in one day than what the poorest 10% of Nigerians typically spend on their basic consumption in an entire year [47]. The pervasive wealth inequity complicates health equity among Nigerians, leaving the indigent with no access to quality care by HPs.

Other negative impacts of HPs' brain drain in Nigeria included overburdened HPs, resulting in reduced compassionate care due to high caseloads. Additionally, suboptimal clinical mentorship for young doctors due to inadequately skilled and experienced HPs serves as a serious threat to the health system. There is a rising erosion of trust in the health system, resulting in indiscriminate self-medication, proliferation of quack HPs, and a rising rate of health tourism among the wealthy individuals. It is estimated that medical tourism in Nigeria attracts about US$1 billion annual expenditure [48], which, if spent in the country, would have contributed to strengthening the fragile health system. The brain drain of physicians and nurses has enormously contributed to the failure of Nigeria in achieving health-related Sustainable Development Goals (SDG) targets [49]. According to the 2019 Sustainable Development Report, Nigeria was ranked 159th out of 162 countries assessed internationally and ranked 16th among the 16 nations of West Africa in terms of achieving the 2030 Sustainable Development Goals. This implies a high rate of poverty and a low level of living among citizens [50]. Unlike in other countries such as India, the Nigerian government is not paid by individuals who leave for other nations, which may bring about the underdevelopment of the health sector and other major industries and fiscal losses in the economy. Sadly, over the last 5 years, Nigeria has lost about 16,000 to 75,000 nurses to brain drain, translating to about US$ 1.7 billion investment loss over the years [51].

South Africa: The number of physicians per 1000 population grew marginally from 0.78 in 2017 to 0.8 in 2022 - 2023 [6] as illustrated in Table 2 and Figure 1. However, in 2024, the ratio dropped to 0.31 physicians per 1000 population according to the South African Minister of Health [52]. The country graduates about 3000 doctors annually on average, including foreign-trained doctors [53]. In terms of nurses, South Africa recorded a significant decline from 3.9 nurses and midwives per 1000 population in 2004 to 1.3 in 2023 [6]. According to the South African Nursing Council, there were 271,047 practicing nurses in the country at the end of 2022. This is almost a 190% increase when compared to the year 1998. The population of South Africa has, however, increased by more than 25% in the same period from about 45 to 60 million [54]. The population has also become sicker due to the devastating impact of HIV on the population, with the country having the highest burden of HIV in the world. South Africa's health index score in 2023 was 59.9, ranking 129th among 167 countries assessed globally [36].

Like Egypt and Nigeria, income and wealth inequity in South Africa are among the highest in the world. In its report, the World Bank found that the top one percent of South Africans control 70.9% of the country’s wealth while 60% of the country’s population collectively control only 7% of the country’s assets [55]. In line with this economic imbalance, South Africa has a two-tiered and highly unequal healthcare system. The public sector, which serves 70% of the population, is grossly underfunded by the government. The private sector serves about 27% of the population. It is primarily funded through individual contributions to medical aid schemes or health insurance, mainly by the rich and individuals working in the formal sector [56]. According to the South African Health Review, around 30% of South African-trained doctors are practicing abroad, especially in the UK, USA, Canada, Australia, and New Zealand [57]. The shortages have exacerbated preexisting healthcare access disparities between rural and urban populations. For example, rural areas often have as few as 13 doctors per 100,000 populations, compared to over 50 per 100,000 in urban areas.

Table 2: Ten-Year Comparative Trend Analysis of Physician and Nurses/Midwives per 1000 Population Between Three Most Affected Sub-Saharan African Nations and Average of OECD Countries.

Year	Physician				Nurse			
	Egypt	Nigeria	South Africa	OECD Countries (Average)	Egypt	Nigeria	South Africa	OECD Countries (Average)
2014	0.79	0.3	0.75	3.4	1.43	1.76	1.23	8.6
2015	0.82	0.3	0.78	3.4	1.94	1.76	1.27	8.8
2016	0.82	0.3	0.77	3.5	1.93	1.76	1.33	9
2017	0.8	0.2	0.78	3.7	1.93	0.93	1.31	9.1
2018	0.77	0.3	0.79	3.7	1.93	0.93	1.31	9.2
2019	0.75	0.2	0.79	3.7	1.93	0.93	1.1	9.4
2020	0.75	0.2	0.79	3.7	1.93	0.93	1.03	9.4
2021	0.75	0.2	0.8	3.7	1.93	0.93	1.03	9.6
2022	0.75	0.2	0.8	3.7	1.93	0.86	1.03	9.6
2023	0.75	0.2	0.8	3.7	1.93	0.86	1.03	9.6
2024	0.75	0.2	0.3	3.7	1.72	0.86	1.03	9.6
Average	0.77	0.24	0.74	3.63	1.87	1.14	1.15	9.26

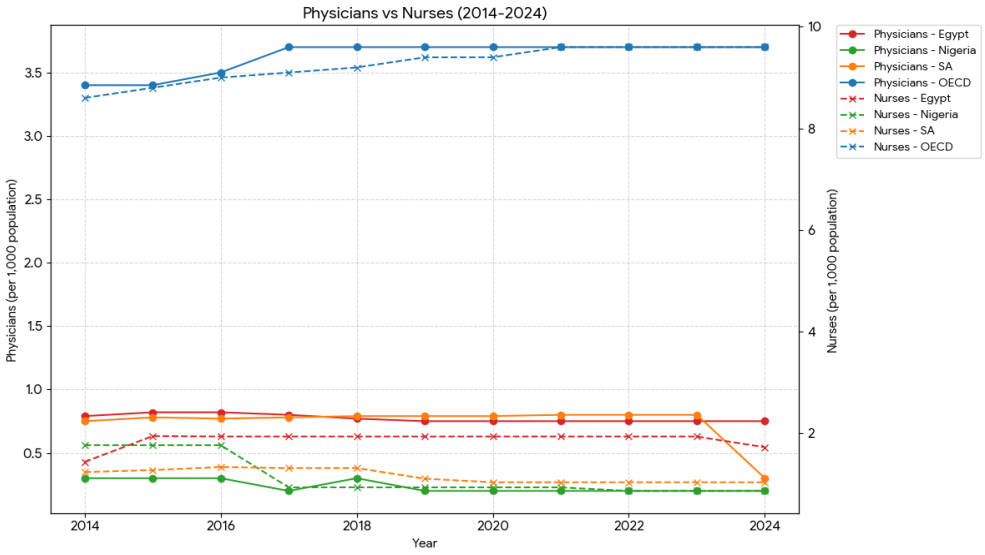

Figure 1: Ten-Year Comparative Trend Analysis of Physician and Nurses/Midwives per 1000 Population Between Three Most Affected Sub-Saharan African Nations and Average of OECD Countries

Additionally, the few health professionals available in the country are overburdened. For example, about 70 percent of South African nurses admitted to moonlighting (supplementing their income sometimes illegally) to make ends meet. Nurses also admitted that they had to shoulder extra work because of the shortage of skilled professionals [58]. This practice may proliferate extortion from citizens before care provision, especially the rural population, who are predominantly poor.

The brain drain of South African medical professionals has led to substantial decline in the domestic health care delivery capacity, loss of training investment on immigration health professionals, loss of morale and dedication on the part of the remaining staff, increased shortage of skills, increased pressure and workloads on the remaining professionals and reduced efficiency in the functioning of the health sector [59]. Brain drain of physicians and nurses in South Africa has enormous economic consequences, for instance, each South African-trained doctor emigrating to OECD represents a loss of approximately US $58,700 in government-subsidized training expenses—resulting in over $1.41 billion lost to date [60].

DYNAMICS AND CRITICAL ANALYSIS

Brain drain among HPs is not a new phenomenon and has been a topic of discussion for the past 3 decades. Sadly, the problem has continued to surge, depriving LMICs of adequate and skilled HPs. The persistence of the problem is because the strategies being implemented by the affected countries are not working, and/or there is no substantial support and commitment from the beneficiary countries toward addressing the problem. Several studies [61 – 66] have discussed the push and pull factors facilitating this phenomenon, with no emphasis on the roles the beneficiary countries may play in minimizing the problem or creating a fair mechanism for emigration of HPs to OECD member countries that is not at the expense of LMICs. The beneficiary countries are contemporarily strong advocates for protecting the oppressed and underserved populations and promoting social justice and health equity. However, it is unclear why such noble principles have not been extended to the issue of emigration of HPs from LMICs to their countries, which can be perceived as unethical [67]. There is increasing demand for HPs among both the deprived LMICs and the OECD member states (the recipients/the beneficiaries), which is, however, driven by fundamentally different needs. LMICs' demand for HPs is to address primordial health needs related to emerging and reemerging infectious diseases, unhealthy lifestyles, poverty, and hunger. On the other hand, the demand for HPs by OECD member countries is to address needs related to affluence-related health conditions and diseases [61].

"Push" factors are those factors that occur within the country of origin (LMICs), encouraging professionals to emigrate. On the other hand, 'Pull' factors are the deliberate or unintended actions that attract HPs to immigrate to the recipient countries (mostly OECD member states). The push factors - within-country factors that encourage emigration of HPs in LMICs to OECD member countries, may differ from country to country. They include low remuneration, poor working conditions, and low job satisfaction, political and ethnic problems, as well as civil strife and poor security [61 – 66]. On the other hand, pull factors are more similar and may include better remuneration, good working conditions, job satisfaction, and political stability. One may wonder why the OECD member countries couldn't be self-sufficient without recruiting foreign HPs. One explanation is that in most of these OECD member countries, the policies of investment in education of HPs are insufficient to meet the demands of their growing healthcare market [68, 69]. This has led to suboptimal planning and investment in health workers' education in the OECD member countries, with the consequence of having too few health workers to meet their surging demand [70]. Additionally, in the developed world, there are several competing professions that can be pursued with less stress, less spending, and fewer years of education that can

match the remuneration of medical professionals or even outweigh them. A study in the UK, for example, revealed that over 75% of young people between 16 and 26 years of age interviewed would put off health careers because of low pay, poor work-life balance, stress of the job, and long working hours [71].

Low remuneration is one of the major push factors for brain drain from LMICs. Among the three countries reviewed here, South Africa has the best compensation package where physicians and nurses in the public sector earn 69,460–140,065ZAR (3,961–7,988USD) [72] and 17,828 – 46,217ZAR (1,017 – 2,636USD) [73] per month, respectively. Physicians in the public sector earn 139,000 – 710,000 NGN (93 – 473 USD) and registered nurses earn 30,000 – 474,000NGN (20 – 315USD) per month in Nigeria [74]. In Egypt, physicians and nurses earn 2000 – 5,571EGP (222 - 619USD) [75] and 1,200 – 2,500 (135 – 280USD) respectively [76]. However, the low remuneration among HPs in LMICs is more pronounced when compared to compensation packages of HPs obtainable in OECD member states. When compared with other professions within an LMIC, HPs are among the highest compensated professionals in most cases. For example, in Nigeria and South Africa, physicians' monthly compensation is about 25 times and 18 times higher than the countries' minimum wage, respectively. The higher wages for HPs may serve as motivation for thousands of young people to pursue careers in the medical profession. Sadly, the admission rate into medical professions in the LMICs is abysmally low. For example, according to the Joint Admissions and Matriculation Board (JAMB), the agency responsible for the regulation of admissions into tertiary institutions in Nigeria, out of over 1.2 million candidates who applied for medicine-related programs in Nigerian public and private universities in three years (2019 – 2021), only 105,226 (8.8%) were admitted [77]. Similarly, in South Africa, the annual graduation of medical students in the eight accredited medical schools is 1,600 (200 per medical school) despite thousands of qualified applicants who were turned down [78].

Improving remuneration of HPs in LMICs may be perceived as the easiest way to minimize brain drain; however, the complexity of this approach is enormous, keeping in mind the GDPs and economic viability of the LMICs as well as the countries' public and private compensation structures across other professions [79]. Therefore, it is imperative to devise innovations that will exponentially increase the number of HPs without compromise in the quality of education in the LMICs so that the haemorrhage to beneficiary countries will not deprive LMICs of qualified HPs.

ADDRESSING THE PROBLEM

Policy Interventions and Compensation Strategies

Several studies have proposed solutions toward resolving the push factors that may likely minimize the exodus of HPs to wealthy nations [61 – 66]. This includes improvements in compensation packages for HPs and providing enabling environments for HPs to exercise their duties by adequately funding and resourcing health systems, among others. On the other hand, studies such as [80] proposed some policies that, if beneficiary countries adopt, may likely influence emigration dynamics or provide moral justifications for them to continue recruiting HPs from the LMICs. Some of these proposals include ensuring self-sufficiency [81], temporary work visas to HPs and equipping them with skills so that when they returned to their home countries, they can apply the acquired skills [82], compensation

for loss (reverse-aid) by paying an LMIC the cost of graduating a health professional or some agreed-upon amount [83]. In line with these strategies, the Nigerian government is exploring the possibility of mandating beneficiary countries to fill the vacuum created by the drain of doctors to their countries by training an equal number of doctors they receive from Nigeria.

Leveraging AI and other Technologies to Improve Productivity

New technological solutions can augment HPs' productivity, which in turn can increase salary and institution budgets as well as enhance the appeal of HPs in LMIC. While this may sound like a long-term dream for the LMICs, the OECD member states, on the other hand, have the potential to deploy AI and other cutting-edge technology to complement healthcare provision. A 2023 study suggests that some routine, repetitive, and predictable HP tasks could be: firstly, augmented and secondly, automated with AI systems [84]. It allows HPs to concentrate on more complex issues, thereby increasing their productivity. Since the statistical, cultural, and behavioural characteristics of tasks that AI systems aim to address may vary by location and issue, their development should be preceded by thorough research, compilation, and analysis of endemic data, information, and knowledge needed to augment those tasks. Their deployment must consider the entire AI system's life cycle. To implement it successfully within a health system, countries and localities should cooperate and support each step in the AI life cycle. This includes leadership and oversight; development of an enabling technical infrastructure; appropriate frameworks for sharing data; plans to build workforce capability; accepted standards and clear regulatory requirements; and engagement and collaboration with those both involved in and impacted by the development of AI systems [85]. For example, despite spending $4.3 trillion annually on health care, with $3.4 trillion ($10,193 per capita) attributed to care delivery, the United States still experiences the worst health outcomes among high-income countries. Administrative costs are the second largest contributor, with $353 billion ($1,055 per capita) spent annually. Addressing clinical and administrative fragmentation using AI can reduce annual costs by up to $265 million and increase health care productivity, both of which contribute to care delivery that is necessary, effective, equitable, and fiscally responsible [86]. By focusing on the AI initiatives, the OECD nations can minimize demands in HPs, thereby improving their retention in LMICs.

Infrastructure Challenges

Based on several developmental indicators, LMICs are vulnerable compared to the developed nations, and therefore recruiting HP from them may be perceived as a violation of national and international codes of practice for ethical recruitment [81]. On the other hand, some human rights advocates argued that the rights of individual professionals supersede those of the overall population in LMICs [87]. Similarly, others argue that restrictions on professional emigration may affect the dynamics of the international labour market [82]. Therefore, the emphasis here should be on strategies that, if adapted, will be beneficial to both LMICs and beneficiary countries without apparent moral or ethical violations. Before we propose strategies that may be mutually beneficial to the LMICs and OECD member countries with regard to HPs' emigration, there is a need to understand two important contexts. High-school graduates in LMICs are highly motivated to pursue health professions

[77, 78], but unfortunately, hundreds of thousands of them are unable to secure admission into medical schools. This is not because they are not qualified, but instead due to the incapacity of the medical schools to admit and train many students and at the same time, maintain the desired quality of education. Medical schools are incapacitated mainly due to inadequate infrastructure, human resources to train HPs, and clinical placements in teaching hospitals, among others.

Additionally, when doctors or nurses graduate from schools, they undergo internships, residency, and other professional certifications, whereby the trainees are compensated as workers. Therefore, without proper planning, there will be excessive pressure on the limited infrastructure, and trainers and mentors will also be overwhelmed. Additionally, there must be adequate resources to support the compensation of interns and residents.

International Regulatory Frameworks and Innovative Partnership Models

In 2018 the International Platform on Health Workforce Mobility (IPHWM) was established which brings together WHO, OECD, ILO, national governments, health associations, and recruiters. Its mission is to operationalize WHO Global Code of Practice on International Recruitment of Health Personnel and align with UN's Global Compact on Migration [88]. Key activities of IPHWM include setting up an Expert Advisory Group, tracking migration flows, and steering normative guidance—like ethical recruitment standards and discouraging OECD recruitment from 55 countries with critical health workforce shortages [89]. Establishment of IPHWM set the stage for formation of several OECD-LMICs partnerships, for example, Ghana and Philippines signed bilateral recruitment agreement with several OECD countries in line with WHO Global Code of Practice to ensure ethical recruitment of HPs from the countries [90]. To address these challenges, and in line with OECD-LMICs partnerships trend, we are proposing a new partnership model whereby the OECD member states as critical stakeholders will invest graciously in improving the constraints that limit enrolment of optimal number of qualified students into health professional careers in LMICs. In addition to other financial, infrastructural and technological interventions, innovations such as use of AI to complement learning should be deployed and strengthened in health professional schools. For example, high-school graduates to use customized AI systems to self-study certain theoretical aspects of medical education, similar to current language learning apps but with professor-moderated feedback for approved students. Meanwhile, medical educational institutions could concentrate on practical issues and address any gaps in the theoretical knowledge of those students. This approach would enhance educational institutions' productivity by potentially shortening the study duration for admitted self-studied students. It could also serve as preventive health measures for those who do not qualify for admission.

High-fidelity Simulation as an Educational Innovation

Similarly, high fidelity clinical simulation is commonplace in undergraduate nursing programs in North America and is found to be an effective learning innovation. High fidelity clinical simulation is the use of computerized manikins, virtual simulation or standardized patients in 'life like' nursing simulated scenarios [91]. The simulated technology bridges the

gap for limited clinical placements and improving students' clinical knowledge and performance in a safe 'healthcare environment'. These clinical based experiences can improve the quality of learning, help students learn teamwork, solve problems, organize care, and promote clinical decision making that translate to bedside practice [92]. Physicians in the Paediatric Emergency Medicine Fellowship Programs have used high fidelity simulation based clinical activities that include the application of advanced life support, intubation, bag-mask ventilation and cardioversion/defibrillation as part of their training [93]. The use of high-fidelity simulation is an effective educational strategy that improves clinical knowledge acquisition and skill performance for healthcare providers in light of limited clinical opportunities during educational programs [94].

Bilateral Investment and Shared Responsibility

Additionally, the beneficiary countries can also provide in-service training to trainers and mentors from LMICs to strengthen their capacity to ensure quality education. They can also provide grants to support some agreed number of placements for internships, residency, and other professional certifications. The compensation package of a specialized physician in the United States for example can cater for about 100 doctors or at least 140 early career doctors in Nigeria or 90 in Egypt [95]. With this investment from the recipient OECD member states, there will be bilateral gains in the number of HPs and in the quality of the education they receive. By helping to produce HPs in sufficient numbers that could systematically grow to meet domestic health services needs of the LMICs, OECD member countries could recruit HPs from LMICs who seek recruitment in their countries with less moral concern. We argue that these shared responsibilities approach raises less moral or ethical dilemma in the recruitment of HPs from LMICs by the OECD member countries and other developed countries. The approach will in addition promote and strengthen trust and collaborations between LMICs and OECD member states not only in healthcare but also in other aspects of economic and social development and partnership.

Critique of Disease-specific Aid versus Health Systems Strengthening

While others may argue that OECD supports LMICs in improving healthcare, for instance in the control of endemic and high mortality diseases such as tuberculosis, human immunodeficiency virus infection (HIV) and malaria by providing direct funding for the management of the diseases, unfortunately such approaches are unsustainable. For example, the US through USAID and the President Emergency Plan for AIDS Relief (PEPFAR) has invested about 120 billion USD over the last 2 decades (2023 – 2024) in LMICs in the control of HIV epidemics [96]. Though the investment has saved over 25 million lives [97], the recent US foreign policy of suspending several lifesaving aids is threatening the sustainability of these gains and risk the reversal of the successes recorded. Nigeria, the country with the worst medical brain drain push factors among the 3 study countries as illustrated here, over the 2 decades of PEPFAR investment has gained about 6.5% of the 120 billion investment (about 7.8 billion USD [98] or 11,700,000,000,000NGN) which translates to about 11 folds of Nigeria's annual healthcare budget [99]. In other words, PEPFAR has invested as much as 50% of annual Nigeria healthcare budget annually in the last 20 years. However, if these resources were invested in strengthening the healthcare system and the quality of administration of the health system by health leaders and government including

addressing HPs brain drain from Nigeria through Nigeria-US partnership using similar framework proposed in this article, Nigeria would have become “near self-sufficient” in terms of physician-patient and nurse-patient ratio, and on the other hand the US would have started to benefit from this investment through ethical recruitment of physicians and nurses from Nigeria.

SUMMARY

Taking Egypt, Nigeria, and South Africa as cases, this review has shown that brain drain of physicians and nurses (as a proxy for all healthcare workers) has critically weakened the health systems of African LMICs affected by this phenomenon. Persistent push factors in the affected LMICs, including low remuneration, poor working conditions, limited career progression, and inadequate infrastructure, interact with strong pull factors from OECD nations to drive and sustain the migration of these workers. Strengthening domestic health systems, expanding training capacity, improving working conditions, and adopting technology-driven educational innovations, such as AI-assisted learning and high-fidelity simulations, are essential to address these challenges. Furthermore, ethically sustainable OECD-LMIC partnerships that promote co-investment in workforce development can enable health professional mobility without undermining local services. Leveraging multilateral frameworks, bilateral agreements, and technological innovations can facilitate the implementation of these strategies and partnerships.

CONCLUSION

The global deficit of health professionals should be considered as a global emergency and must be managed by multilateral agencies, keeping in mind principles of justice, fairness, equity, and ethics to ensure that economically viable nations do not address their deficits at the expense of poor and vulnerable nations. Public health institutions such as the WHO should work closely with the International Labor Organization, along with other relevant institutions, to explore innovative strategies like the OECD-LMICs partnership proposed in this article to ensure justice, fairness, and equity in resolving the problem. Additionally, LMICs should always consider HPs brain drain as a priority and whenever entering into healthcare-related foreign aid agreements with donor nations, should advocate for some proportion of the aid to be committed towards implementation of some of the strategies in the framework outlined in this article.

Data Availability Statement

No new data were generated or analyzed in this study. All data supporting the findings of this narrative review are derived from previously published literature, which are cited within the article.

Ethics Statement

Ethical approval was not required for this narrative review, as it is based exclusively on previously published studies and publicly available information, with no involvement of human subjects or identifiable personal data.

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