

REVIEWS

Determinants of the physician assistant/associate concept in global health systems

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ABSTRACT

Introduction: A global shortage of doctors has led to strategies to improve access to care. The physician assistant/associate (PA) was established in North America and Africa in the 1960s in response to medical shortages. PA activity was cataloged to understand what determines their utilization in a country's health system.

Methods: A mixed-method study design began with searching the available literature regarding the development of PAs worldwide. Key words included "physician assistants", "non-physicians", "physician associates", and "advanced practice providers". Additional data was through an online search of reports; personal communications with researchers, policymakers, government officials, and practitioners in each country; visits by the authors to a number of the countries; and a review of official documents. In each country interviews included educators, policymakers and government officials who had direct involvement with the introduction of the PA concept, and clinically active PAs. Domain analyses were based on stratification of differences among countries: global region, income, physician to population ratio, attitudes of medical professionals, and practice/regulatory authority. Countries were segmented into two categories: well resourced and less well resourced.

Results: The history and status of the PA concept into the health systems of 15 states were reviewed. The determinants for the successful incorporation of PAs include prevailing medical needs, a shortage of physicians or an aging physician workforce; support and sponsorship by physician organizations and government agencies; the ability to mobilize and establish a legal and regulatory framework to accommodate PAs; and evidence that their introduction is acceptable to patients, physicians, and other health professionals.

Discussion: The introduction of PAs into health systems occurs because their education is less expensive and time intensive than physicians. In addition, graduates are more likely to occupy roles where there is scarcity of doctors such as in rural and underserved areas. In most instances, a physician-dependent role permits their introduction into health systems in a non-threatening manner to doctors and their practices. The utilization of PAs, particularly in primary healthcare roles, increases access to services, is cost-beneficial, and shows a physician-equivalent quality of care.

Conclusion: The PA has been a remarkable health workforce policy development that has spread among countries' health systems and is likely to continue.

Key Words: Physician assistants, Physician associate, Clinical assistants, Associate physicians, Workforce, Health professionals

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1. INTRODUCTION

The contemporary physician assistant/associate (PA) movement began in North America and Africa in the mid-1960s. As of 2018, the adoption of PAs has spread globally across a variety of health systems.^[1-3] Fifteen nations have formally introduced the PA concept including Australia, Canada, Bulgaria, Germany, Ghana, India, Ireland, Israel, the Netherlands, Saudi Arabia, Scotland, South Africa, The United Kingdom (UK), and the US.^[4] While these countries differ in their health system structures, workforce needs, and degrees of integration, they have, as a common denominator, a formerly trained PA in their society.^[5] By definition, a PA is a healthcare professional who is not a physician but is trained and licensed to practice medicine in defined domains with varying degrees of professional autonomy.

Typically the PA concept emerges within a country due to an insufficient and/or aging supply of doctors.^[6,7] Where PAs have been introduced, the results are deemed successful in some countries, and less so in others. To this end, the question arises: *What determinants contribute to the success or failure of PA utilization in a country's health system?*

PA's in the health workforce

In the USA, UK, Liberia, Ghana, The Netherlands, and South Africa, the PA has been incorporated into the nation's medical workforce and their presence is growing. PA programs, in general, are structured to train a capable clinician in a shorter time than that of a doctor, with less investment and more rapid deployment. The fundamental model of PA education is a two-three-year period of intense training that prepares competent and effective practitioners to assume a wide range of medical tasks working with doctors in either primary or specialty care. As programs develop, they take into account the political context, the requirements, and the financial resources of the country. With lessons learned from around the globe, each nation has modified the PA concept to fit the needs of its citizenry.^[8]

Employing PAs is an attractive option for many countries to address medical workforce shortages. Their clinical versatility makes them particularly valuable in supplementing doctors in a wide range of roles, as well as replacing doctors in areas of doctor shortage.^[9] In some systems, there may be a reluctance to create a new category of practitioner – a concern raised by Ontario nurses in 2014 (<http://www.hprac.org/en/projects/physicianassistants.asp>). However, PAs do not substitute for nurses. Instead, the PA concept tends to encourage all people with varied backgrounds, healthcare experience, and other skills, into a health system they may not otherwise have been attracted to enter, and at the same time incorporate them with a doctor/nurse/PA

team approach to healthcare needs.^[10] As in Canada's case where only 4 of the 13 providence/territories permit civilian PAs, the barriers to the successful incorporation of PAs into the full framework of a country often depends on whether physicians want them.^[11]

The objective of this undertaking was to understand why the PA movement succeeded in some countries and offers reasons why it did not in others. This cataloging work comes at a time when medical professionals are in short supply and the demand far exceeds any accumulative medical school capacity.^[12,13] PAs are seen as one strategy to help bridge some gaps in physician services.^[14,15]

The introduction of the PA concept into a health system depends on factors that appear to be necessary for the successful establishment of the profession in the workforce. Among these the apparent need for such professionals is often due to a shortage or aging of the physician workforce, the support (or at least lack of opposition) of the countries' medical professional organizations, government funding support for the establishment of training programs, and creation of legislative and regulatory mechanisms.^[4] Drawing data from the published literature, on-site observations, and a wide range of communications with host nationals, a summary of status and developmental characteristics of the PA profession across nations was undertaken. The goal is to analyze the factors that serve to promote or impede the development of the PA concept in global health systems.^[16]

2. METHODS

A mixed-method study was undertaken. First, the available literature regarding the development of PAs globally was searched and analyzed. Key words included "physician assistants", "nonphysicians", "physician associates", and "advanced practice providers". Next, personal communications was made with researchers, policymakers, government officials, and practitioners in each country; visits by the authors to a number of the countries; a review of official reports; and searches of peer-reviewed publications. From this knowledge base, topics and determinants of success or non-success were postulated and requirements that appeared to contribute to the development (or demise) of the introduction of the PA concept were identified. Data of interest centered on the characteristics of the country, the state of PA deployment, rate accelerants or limiters of adoption, and potential reasons for this growth or stagnant rate. Interviews involved policymakers and government officials who had involvement with the introduction of the PA concept. During visits, educational leaders, government organizations, medical organization officials, and practicing PA clinicians were met. Domain analyses were based on differences among coun-

tries: global regions; income; physician to population ratio; attitudes of medical professionals, and practice/regulatory authority. Countries were segmented into two categories: well resourced and less well resourced. Well-resourced countries and lesser-resourced countries were used to organize the data. Those listed in the Organization of Economic Co-operation and Development (OECD) comprised the first category.

3. RESULTS

As of 2018, there are 15 countries where the experience of introducing the PA concept into their healthcare systems has occurred. The list of PA utilizing nations differs considerably in terms of the structure of their healthcare arrangements, their workforce needs, and the degree of PA integration. For example, in India, PAs are primarily used in the surgical setting whereas in The Netherlands they are broadly used across medical specialties and surgical settings; in each case, their numbers are proportionally small compared to doctors.

A summary of the status of the PA profession among various states is presented.

3.1 The PA concept in well-resourced countries (see Table 1)

3.1.1 Australia

Australia is a nation of six states and ten territories. PAs were introduced in 2005 in a demonstration project drawing on the recruitment of American-trained PAs in Queensland and South Australia.^[17,18] The demonstration projects revealed positive results in terms of acceptance and utilization in both general medicine and surgery.^[18,19] Following the pilot projects the University of Queensland inaugurated a PA program.^[20] That program graduated two classes (2012 and 2013) and then closed due to opposition by the medical community. In 2014 James Cook University (Northern Queensland) started a PA program with a class of 4 students. As of 2018 20 students have graduated.

Table 1. The PA concept in well-resourced countries

Country	Number of PAs [as of 2018]	Physicians/1,000 Population Ratio [#]	Legal Structure	Acceptance
Australia	11	3.4	One of 6 states and 10 federal territories has legislation [Queensland]	Opposition by medicine and nursing
Canada	500	2.3	Three of 10 provinces and three territories [Alberta, Manitoba, New Brunswick]	Opposition by Nursing
Ireland	25	2.6	Evolving	Too new to know
Israel	35	3.5	Recognized by Ministry of Health	Positive
New Zealand	< 10	2.8	Not recognized by Health New Zealand	Too new to know
The Netherlands	1,200	3.3	Full recognition and practice authority	Positive
United Kingdom	450	2.8	Recognized by NHS; no prescribing authority	Mixed
United States	120,000	2.6	Practice authority and prescribing in all 50 states and four territories	Positive

Note. [#] World Health Organization's Global Health Workforce Statistics, OECD, supplemented by country data, as of 2013 @<https://www.cma.ca/En/Pages/basic-physician-facts.aspx>

The Australian report concluded that the PA role had facilitated medical teaching by allowing doctors to balance their teaching responsibilities with clinical responsibilities.^[18] Most doctors, nurses, and other health providers reported positive contributions to the team and excellent care. Similar positive comments were made by patients generally in the form that almost all would be willing to be seen by the PA again or were satisfied with the care they received.^[18]

The concern expressed by Australian doctors and nurses regarding the role and its potential effect is that PAs might impact negatively on medical training, either by reducing junior doctor opportunities to learn on the job or by increasing competition by providing a cohort of newly trained

PAs who would be competing for supervision.^[21] During the PA demonstration projects, these concerns diminished once doctors worked with PAs and came to understand their role.^[17,18] As of 2018, only the State of Queensland has legislation/regulation for PAs in Australia in spite of positive analyses and physician advocacy.^[22] Queensland Health, the funding health authority for the state, employs four PAs working in the public health system. Private doctors are free to hire PAs, but without access to Medicare reimbursement (Australia's national healthcare scheme) and prescribing privileges, it is difficult for PAs to find employment in spite of the benefits already assessed.^[23]

Numerous medical leaders have advocated for the expansion

of PAs. Such advocacy has been blunted; since 2010 Australia has almost doubled its output of new doctors, gradually filling the gaps in supply and demand. With this trend the resistance of organized prevails.^[24]

3.1.2 Canada

Canada is a confederation of 10 provinces and three territories - each with responsibility for regulation and administration of all health professions in their jurisdiction. Three have formal policies on PA practice.^[11] PAs have been utilized in the Canadian Forces since 1985 and train in civilian hospitals but are not permitted to work as civilian PAs in most of the provinces.^[25] The number of PAs in various clinical settings providing patient care for the general population is growing slowly.^[26]

Regulations to practice as a PA are tied to specific criteria, and the regulating province then provides title protection and medical privileges, which include prescriptive rights and certain controlled acts. Manitoba, the first province to regulate PAs, required a formal application approved by the College of Physicians and Surgeons of Manitoba Practice Description with a Contract of Supervision.^[27] The Government of Ontario uses the Delegated Acts provision of the Ontario Medical Act but does not provide title protection. Ontario requires physician approval in writing or verbally for each act performed by their PAs. In spite of 26 diverse health professions regulated in Ontario, PAs remain unregulated.^[28]

As of 2018 there are approximately 500 PAs in Canada with approximately a fourth in the Canadian Forces. The first year of a PA graduation was in 2005 and there are five PA programs (three in Ontario, which includes the Canadian Forces PA program).^[25] The projection of clinically active PAs is 800 by 2020.

3.1.3 Ireland

The Royal College of Surgeons in Ireland carried out a two-year pilot project in 2015 by recruiting four PAs from North America. The first program started in 2016 with a class of seven and a second class in 2017 with 14 (personal communication, Pauline Joyce, February 2018). The drivers for exploring the PA role in the Irish hospital setting included the clinical teams' over-dependence on non-training doctors compared to international norms; major recruitment challenges with continuity of care, particularly at change-over times in January and July; and improving European working Time Directive compliance.^[29]

3.1.4 Israel

Interest in PAs has been developing slowly and, as of 2017, a modified type of PA to work in emergency medical settings was developed (personal communication O. Berkowitz

March 2018). The ratio of physicians per capita in Israel has been declining since the 1990s due to an aging European-trained cadre; PAs were seen as a natural remedy.^[30] The first program for Israeli PAs began in 2016 with 35 students, mostly experienced paramedics who also held a bachelor's degree.^[31] The program is run by the Ministry of Health Training and Development Department and is focused on emergency medicine (approximately nine months) with a mix of didactic and clinical training at their respective site of employment. The Ministry of Health has authorized foreign-trained PAs to enter the country. The early objective is to grow the emergency medicine PA force and then expand training to offer separate courses in anesthesiology and pathology.^[32]

3.1.5 The Netherlands

PAs were introduced in The Netherlands in 2002 and, as of 2018 about 1,200 are employed in a variety of healthcare settings (personal communication G. van der Brink February 2018). The training model in The Netherlands differs in that PA students are employed part-time within a certain medical specialty from the day of enrollment.^[33] Students are admitted with an undergraduate degree in either nursing or paramedical sciences with patient care experience of at least two years. On-campus PAs are offered a broad medical curriculum but because it is blended with classroom and clinic, the student concurrently starts acquiring specialty knowledge and skills such as neurology or urology depending on their employment destination. Students are supervised by medical doctors and undertake clinical rotations in the major medical disciplines along with their own specialty traineeship.

The Dutch PA movement is linked to government funding. The cost for the first decade of this five-university development was estimated to be €1B (\$1.4B). The expansion of PA training and the increase of subsidies is because the Ministry of Health has more interest in the success of the PA profession rather than the building of more medical schools.

The PA profession in The Netherlands has witnessed an important landmark in terms of legalization. The 2012 law for PAs provisionally enabled them to practice independently of medical supervision, similar to some US state laws for NPs. This law was codified in 2018. Within a clearly defined and negotiated scope of practice, physician supervision is not obligatory, even though a collaborative partnership with an MD is encouraged. The Dutch PA is registered as a profession as are pharmacists, medical doctors, physical therapists, health psychologists, dentists, midwives, and nurses. Acceptance of PAs by physician collaborators shows promise for the profession in The Netherlands.^[34] Research is proving that it is advantageous for Dutch physicians to hire PAs to

improve and extend the care of the populations they serve. With greater visibility of the success of PAs in practice, more positions are made available for the graduates of the five PA programs.^[35]

3.1.6 New Zealand

New Zealand (NZ) is an island nation in the South Pacific with a population of about 4.5 million people with 27.4 doctors per 100,000. One of the challenges of New Zealand medicine is retention, as many doctors migrate to Australia and other countries. This has led to medical practitioner shortages, particularly in rural settings. In addition to shortages, general practices have had to contend with high turnover of practitioners, leading to inconsistent healthcare for the 25% of New Zealanders who live rurally. New Zealand provides universal healthcare through taxation. A commitment to healthcare for all citizens combined with difficulties in finding medical practitioners has made NZ a fertile ground for PAs. Interest in using PAs in New Zealand started in 2000 when US visitors to New Zealand and Australia discussed PAs and physicians from NZ visited the United States to observe their utilization. Positive interest has come from the medical community, as well as positive reporting in the media.^[36] The biggest question facing the PA profession has been how to translate a successful pilot project into a regulated profession that will have a lasting, effect on the healthcare system.^[37] Although the New Zealand government appears supportive of the PA profession, and three American PAs work there, as of 2018 Health Workforce New Zealand has not approved PAs as a regulated profession.

3.1.7 United Kingdom

Traditional doctor-driven models of workforce planning are no longer sustainable in the United Kingdom healthcare economy and newer models are needed.^[38] The physician associate emerged as an integrated, front-line, “generalist” clinician.^[39] Over 1,500 student PAs were in training across 30 UK programs, with continued expansion underway to support national policy and increased workforce demand. Annual graduate numbers are projected to exceed 800 by 2020, bringing the total number of qualified UK PAs to over 1,200. Following the 2015 inauguration of the Faculty of Physician Associates at the Royal College of Physicians, UK PA development has been on a fast trajectory.

The historical development of the PA profession in the UK began in 2002 with rising demands on the healthcare workforce. The UK first investigated the use of PAs in clinical practice in 2003. American-trained PAs were sent to the West Midlands to work in a rural care office with a high-demand doctor.^[40]

PA programs in the UK are two-year postgraduate diplomas,

which require an honors degree in biology or medical sciences prior to matriculation. After program completion the prospective PA is eligible to sit for a national exam and an institutional assessment. The scope of practice negotiated by the supervising doctor and PA develops over time.^[41] However, while PAs are able to take medical histories, perform examinations, diagnose illnesses or medical conditions, and request/analyze test results, they are not permitted to independently prescribe medications or order imaging involving ionizing radiation.^[42,43]

The NHS predicts that the PA profession will positively influence clinical workforce challenges across the UK healthcare economy. PA programs in the UK offer a generalist, or broad clinical curriculum, which follows the *UK Department of Health Competence and Curriculum Framework for the Physician Assistant*. The Faculty of Physician Associates at the Royal College of Physicians supports the UK PA profession. The certification and re-certification process is largely modeled after the United States system, with questions derived from the US testing bank, and re-certification set for every six years, including the completion of annual “continuous professional development” hours. Recognizing the potential for PAs to support GPs in their work, the UK government has outlined plans for 1,000 primary care-based physician associates by 2020.^[44] To achieve this annual national recruitment of PAs into primary care will need to increase from 15%-30%. Health Education England (HEE) and national partners are considering innovative investment and workforce strategies to support recruitment, professional development, and retention of PAs. Such strategies are aligned to identified workforce need across both the primary and secondary care interface (including the Clinical Pharmacist programme and development of Advanced Clinical Practice roles for nursing and Allied Health Professionals). Initiatives include the Primary Care PA Internship and the Physician Associate Ambassador programs which are being piloted across the West Midlands, East Midlands, and East of England.

3.1.8 United States

The US is credited as one of the creators of the contemporary PA concept and, within its entrepreneurial health system, has the largest presence, mostly in the private sector. As of 2018 there are roughly 120,000 PAs licensed for clinical practice and 229 accredited educational programs (with 30 more in development). The American PA is employed in hospitals, clinics, medical specialty practices, and the military. PAs work proportionally more with rural and underserved locations than do physicians, as well as with vulnerable populations.^[45] Since 2000, the PA profession has attained legal recognition and prescribing authority in all 50 US states and four territories. Their services are eligible for reimbursement

under the federal insurance schemes of Medicare and Medicaid, as well as private health insurance plans. During early development, PA educational programs received federal support if they met key health workforce priority areas such as deployment in primary care, medically underserved areas, and rural settings. Extensive research has shown that they

are well accepted by physicians, patients, and other health professionals. A factor in the success of the US PA is the economic benefit that accrues to physician and hospital employers of PAs.^[46] About one-quarter of US PAs work in primary care, with the rest in specialties.

Table 2. The PA concept in less-resourced countries

Country	Number of PAs [as of 2018]	Physicians/1,000 Population Ratio [#]	Legal Structure	Acceptance
Bulgaria	Unknown	4.0	No	Unknown
Ghana	2,500	1.0*	Partial	Good
India	375	1.73*	Partial	Emerged in private education sector; practice and educational standards absent
Liberia	1,000	1.1*	Unstructured	Accepted in practice
Saudi Arabia	200	2.7*	Education and practice confined to the Military	On hold as of 2018
Taiwan	None	2.6	Non-existent	Negative

Note. * Estimate; # World Health Organization's Global Health Workforce Statistics, OECD, supplemented by country data, as of 2013. @<https://www.cia.gov/library/publications/the-world-factbook/fields/2226.html>

3.2 The PA concept in lesser-developed countries (see Table 2)

3.2.1 Bulgaria

The PA profession was established in Bulgaria in 2014 in response to a growing shortage of doctors and other medical staff and was modeled on the United States experience. Feldschers provided a similar role historical in Bulgaria from 1878 to 1999 but were discontinued because of a surplus of physicians.^[47] However, healthcare in Bulgaria has changed since joining the European Union. With this EU inclusion, some physicians departed for better opportunities elsewhere. With a loss of doctors, an aging population, and a depopulation trend in general, PAs were seen as a strategy to offset Bulgaria's growing medical staff shortage.^[48]

3.2.2 Ghana

The PA movement in Ghana began in the 1960s to meet the needs of rural and remote populations and due, in large part, because of a doctor shortage. Three training programs are in operation.^[49] As of 2015 reports are that the 2,500 PAs are well accepted in Ghana and work well with the 3,500 physicians and dentists. About three-quarters of Ghana PAs are in medical roles with the remainder in surgical roles.

3.2.3 India

The inauguration of a PA movement in India is not well anchored but the Indian Association of PAs was started in 1998.^[50] The first PA program started in a private hospital – The Madras Medical Mission - in 1992. As of 2017 there were an estimated 375 PAs formally trained and in clinical

practice. PA development in India originated with surgeons who had had exposure to PAs the US or UK and were familiar with PA utilization.^[51] The majority of PAs work in surgery, with a plurality in cardiology, and the rest in internal medicine specialties. All are employed in private hospitals. Efforts to standardize their education are underway (personal communication Gomathi Sundar, March 2018).

3.2.4 Liberia

The majority of healthcare in Liberia is delivered by approximately 1,000 PAs.^[52] Prior to the Ebola outbreak in 2014, there were four million people, 150 doctors, and a substantial PA cadre. During the epidemic many doctors fled the country. About 170 healthcare workers, including at least 17 PAs, died during this period. However, as of 2017, the PA program is again operational. The US Public Health Service staffed some of the Ebola clinics with American PAs, which permitted more collaborative work.^[53]

Liberia has had a PA program since 1965, located at the Tubman National Institute of Medical Arts John F. Kennedy Memorial Hospital in Monrovia. The Baptist Missionary Physician Assistant program was started in 2015 (personal communication S Trexler June 2015). Cuttington University has a third program in Suakoko. The Mother Patern College of Health started a Bachelor Degree program for PAs in 2016.

3.2.5 Saudi Arabia

The Saudi Arabian Ministry of Defense established an “associate physician” (aka PA) program in 2010 to train soldiers

for medical field units. In collaboration with The George Washington University Medical Faculty Associates, the Ministry of Defense established PA education at the Prince Sultan Military College of Health Sciences in Dhahran.^[54] Clinical rotations during the second year were at the military hospitals and affiliated institutions.

After five years of operation, following the 2015 graduation, the program closed. At present the National Education Council does not accredit the master's degree granted at graduation and, therefore, is not recognized by the Saudi commission of health specialties that grants licenses to practice in the healthcare sector. It is reported that academicians believed that graduate education be taught by doctorate-degreed (PhD & MD) faculty. Recommendations include the curriculum be modified and redesigned at a Bachelor's level. The next step is to submit the bachelor-level PA curriculum to the National Commission of Academic Accreditation Association (NCAAA) and obtain approval from the Saudi commission of health specialties. After the approval, they will plan to take new cohorts for the PA program (personal communication N. Ahmed March 2018).

3.2.6 South Africa

South Africa made the decision in 2005 to develop the clinical assistant (ClinA) modeled after PAs. The reasons for this were to improve the staffing of rural district hospitals and to provide health workers appropriately trained in common diseases of South Africa to alleviate the burden of doctors.^[55,56] A common national curriculum was developed, with implementation in three faculties for a three-year bachelor degree.^[57] The first graduates entered the profession in 2011 and, as of 2017, there were 920 graduates, primarily in hospital settings in all nine provinces of South Africa (personal communication M. Bahadur December 2017). ClinAs make an important contribution to rural healthcare, and are seeking ways in which the profession can be enhanced to ensure sustainability through the advocacy of the Professional Association of Clinical Associates of South Africa (PACASA). An Honours degree in Emergency Medicine began in 2017 at the University of Witwatersrand along with three additional ClinA programs in various stages of development to increase the output of graduates (personal communication S. Smalley Dec 2017).

3.2.7 Taiwan

Taiwan experimented with a PA model of healthcare provider that was popular and growing from the mid-1980s to 2005. Nurses in large medical centers were trained in medical and surgical skills and identified as PAs. However, an effort to formalize the education process met resistance from the Taiwan Medical Association and organized nursing. In the end,

legislation to legalize the PA profession was defeated. All PAs in Taiwan became nurse practitioners (NPs) and assumed roles that spanned nursing and medicine.^[58] As of 2015 the scope of practice of NPs remains underdeveloped and does not meet the need for more medical care services.^[59]

4. DISCUSSION

A number of reasons have emerged as to why PAs have succeeded in some countries and not in others. Some theories about social movements and innovative, transformative events offer suggestions. From a historical standpoint, divergence from the traditional medical profession was seen in the Officer de Santé in 19th-century France, the Practicante in 20th-century Puerto Rico, the Barefoot Doctor in China during the mid-20th century, the Assistant Medical Officer in Sri Lanka during the late 20th century, and the PAs in Taiwan during the early 21st century, to name a few.^[58,60-64] These prototype PAs were successful at a time of doctor scarcity but as the medical profession grew, they were seen as a threat to the income of more professionally organized doctors and their elimination followed. Yet, the 2,600 medical schools spread across 184 countries are insufficient to graduate enough doctors for the more than 7.5 billion people in need.^[65] A strategy to fill shortages with PAs appears to be underway. In this domain analysis, the postulate is that a key reciprocal relationship should exist in a country where PAs are to be introduced. That is, if a country had a shortage of, and/or an aging population of physicians, the introduction of the PA is more likely to be receptive to organized medicine.

4.1 Successes

The utilization of PAs, particularly in primary healthcare roles, and increases access to services, is cost-beneficial, and shows a physician-equivalent quality of care.^[66] The US, UK, Liberia, Ghana, and The Netherlands appear to have the most robust development of PAs with social and professional acceptance and anticipated growth. The economic attractiveness of PAs is particularly noticeable in entrepreneurial systems like the US. Liberia, Ghana, and the US have five decades of development and a growing ratio of PAs per capita. The Netherlands is notable for its observations of PA developments and education in various countries, successful inauguration efforts, careful documentation of its implementation, protected name, and deployment efforts. While these attributes are likely contributors to a sustained profession, the number of PAs remains small throughout most of the countries when compared to doctors.

Canada has an important history in PA development and seems to mirror the early growth of the American version with each province creating its own regulation. Ontario,

where the greatest density of PAs resides, has no healthcare regulation for PAs, which stifles, needed growth in rural and underserved areas.^[28] Funding salaries through provincial health authorities is also a rate-limiting issue since salaries are part of the financial scheme.

The UK is in a rapid growth phase as it ramps up at least 27 new PA programs, is endorsed by the Royal College of Physicians, and is infused with a new funding stream by the national health service/national health education for program development. Like The Netherlands, top-down, long-term investment may be key to launching a sustainable program for PAs in Great Britain.

4.2 Failures

One country, Taiwan, ceased any development of PAs and converted those PAs to NPs in 2005.^[58] The consensus was the nurse profession was threatened by converting surplus RNs into PAs and enough doctors would not back further PA development. New Zealand has undertaken two demonstration projects using PAs in 2014-2015 but has yet to announce whether they will proceed with their development.^[36,37] As of 2018 Bulgaria and Ireland are deploying PAs but how they will be utilized is still undetermined.

4.3 Barriers to PA development

Canada and Australia PAs are struggling with physician resistance and/or indifference in some province/states. Both countries had well-funded demonstration projects with good results, endorsements by health professionals and patients, and a set of documents supporting PA deployment. In the case of Ontario, the nurse resistance has been strong and in British Columbia, the resistance has been by privately employed physicians concerned about competition for reimbursement. In Australia, the push for PAs seems to have been blocked by a strong push from junior doctors. Saudi Arabia's AP (PA) is on hold pending curriculum and accreditation revision.

4.4 Adopters of PA development

Various reasons are proffered as to why PAs are adopted in some nations and not others. Clearly, a number of countries in Europe have no doctor shortage.^[67,68] Australia has less than a dozen PAs in Queensland and only 40 or so graduates who are overshadowed by a high ratio of doctors per capita and an increasing output of graduates from 19 medical schools.^[69] Yet others, such as Canada with a lean ratio of doctors per capita and a limited output of medical graduates, are moving slowly to adopt PAs (in four of 13 jurisdictions). Resistance seems to be in both medical and nursing communities in spite of open admiration for PAs serving in the Canadian Forces both abroad and at home.^[25]

One theory that may explain where PA growth is occurring is "critical mass" - the social dynamic engine that promotes novel diffusion of innovations through society.^[70] As the body of PAs grows, it becomes significant, and its ability to influence policy improves. But to do so without government fiat often requires more than a toehold. The relatively small number of PAs in Australia, Canada, India, Israel, and South Africa may explain why the movement has not been robust. In Taiwan's case, the PA movement died as a result of the lack of legislation or government sanction and few physician champions.^[58] In the UK the PA movement accelerated when the Royal College of Physicians endorsed the use of PAs and the NHS agreed to fund 30 additional programs.^[43] In Saudi Arabia, the cadre of military doctors, primarily expatriates, was costly and insufficient to meet a growing demand, but close ties with the US provided a model-type education program.

Influences that are not always apparent (or are subtly apparent) are the resistance forces of entrenched nurses. The nurse practitioner (aka advance practice nurse) movement is underway in at least a dozen countries.^[71] One argument is that PAs may not be needed if the NP movement continues to grow. The counter-argument is that the opportunity cost of PA education is allopathic in orientation, and considerably less expensive than what it takes to first produce an RN and then an NP.

The centralized government in The Netherlands permitted the development of a cadre of PAs by government fiat. In this highly socialized country of 17 million, the development of PAs was a "top-down" process led by the national government that adequately budgeted five universities for the first 10 years. The education model is 30 months long and includes simultaneous didactic content based on a nationally defined training and competency profile, clinical rotations experience, and ongoing part-time employment in a hospital. With 1,200 PAs in 2018, The Netherlands has emerged as a highly successful model of blended education. The UK may surpass the Dutch PA movement by 2025 with such a large influx of education funding and the Royal College of Physicians endorsement.

While the education of PAs is relatively similar, the title of the profession is not; most countries use PA, but "physician associate", "clinical associate", and "associate physician" are also used. PAs are educated in countries that employ them in a wide range of specialties. While countries such as India, Israel, and Ireland introduced the PA to work in a specific specialty based area of need, other countries like The Netherlands, the UK, and Canada integrated PAs into both generalist as well as specialty roles. Most countries require

PAs to work closely with physicians; however, their scope of practice is quite variable. Common among all PA roles is the ability to perform patient histories, examine patients, diagnose, and manage patients. However, serving as a first assistant in surgery, prescribing medications, and performing procedures is not universal.

4.5 Limitations

This study focused on one type of medically trained clinician - the “physician assistant/associate/clinical assistant”. Clearly it is an evolving concept and with it an evolving name. At the same time there are numerous other health professionals that may qualify and some effort has been made to identify these types of clinicians.^[72-75] Identifying all health professionals who practice more advanced medicine than a nurse but not as much as a doctor is challenging because literature is lacking and communication fragmented. While a comprehensive listing of all types of medical practitioners is beyond the nature of this analysis, this serves as notice that work in this area is slowly emerging.^[7,76]

5. CONCLUSION

Strategies for dealing with doctor shortages worldwide have focused attention on one type of health professional, the physician assistant/associate, although similar types of PA-like health professionals have not been overlooked. The growth of PAs among countries is largely because their training is less expensive and time intensive than physicians, and graduates are more likely to occupy roles where there is scarcity in doctors such as in rural and underserved areas. In addition, in most instances, a physician-dependent role permits their introduction into the health system to be non-threatening to physicians and medical practices. In the aggregate, the utilization of PAs, particularly in primary healthcare roles, increases access to services, is cost-beneficial, and has physician-equivalent quality of care. The introduction of the PA has been a remarkable health workforce policy development that has spread among many countries’ health systems and is likely to continue.

CONFLICTS OF INTEREST DISCLOSURE

The authors declare that there is no conflict of interest regarding the publication of this paper.

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