



# Capacity of South African nursing education institutions to meet healthcare demands: A looming disaster?

Susan J. Armstrong<sup>a,\*</sup>, Nelouise-Marie Geyer<sup>b</sup>, Catherine A. Bell<sup>c</sup>

<sup>a</sup> Department of Nursing Education, University of Witwatersrand, 7 York Road, Parktown, Johannesburg, South Africa

<sup>b</sup> Nursing Education Association, Sessional Lecturer Department of Nursing Education, WITS, PO Box 35763, Menlo Park, Pretoria 0102, South Africa

<sup>c</sup> PO Box 489, Strathavon, Johannesburg, South Africa

## 1. Introduction

South Africa has seen significant legislative and policy changes during the last two decades to address the quadruple burden of disease in the country (Breier, Wildschut & Mgqolozane, 2009; Gray & Vawda, 2016), which increases the demand for more nurse/midwife practitioners, and, in particular, specialised practitioners. This demand includes the need to develop practitioners with new competencies to manage care of a complex burden of disease (Armstrong & Rispel, 2015; Buchan & Aiken, 2008; Frenk et al., 2010; South African Department of Health [Department of Health], 2013; World Health Organization [WHO], 2013a). These changes have occurred simultaneously with transformation in the higher education system in South Africa that ensure cohesion and equity in the sector (Blaauw, Ditlopo & Rispel, 2015; Department of Health, 2013). This has, in turn, required a restructuring of nursing education in order to align nurse training to higher education (Armstrong & Rispel, 2015; Blaauw et al., 2015; Department of Health, 2013). Change is always difficult, but the delays in moving nursing education forward are threatening the efforts of the health service to provide universally accessible, affordable, safe, quality healthcare (WHO, 2013b). While this article refers to the challenges experienced in South Africa, a failure to resolve training issues in South Africa will have a ripple effect on the rest of Africa as many post-graduate students from neighbouring countries study in South Africa to obtain specialist qualifications or higher degrees.

The aim of this article is to demonstrate the possible impact and consequences of change to policies and legislation on the provision of nurses through failure of authorities to respond to the need for change, by providing an historic overview of the production of nurses, and background to the changes in nursing education that need to be effected in response to the new governmental policies and legislation put in place to manage the disease burden in the country.

Failure on the part of South Africa to provide for advanced nursing education programmes will have serious implications for the quality and safety of healthcare in the country and the rest of Africa. Although not all nurses wish to take up advanced nursing education programmes,

there is evidence that educational qualifications impact the quality and safety of healthcare (Aiken, Clarke, Cheung, Sloane & Silber, 2003; Aiken, Clarke, Sloane, Lake & Cheney, 2008; Swart, Pretorius, & Klopper, 2015). Thus a substantial pool of undergraduate nurses in professional nursing programmes must be produced to allow for sufficient numbers of practitioners to take up post graduate specialist programmes.

## 2. Historic background

Historically, there are a range of factors influencing human resources for health that have not left the countries in Africa untouched. Globally, lack of planning, shortages, maldistribution and migration, suboptimal use, relevance and appropriateness of the preparation of nurses and midwives, and staff establishments to improve health service delivery have been reported on and identified for urgent attention (Coovadia, Jewkes, Barron, Sanders & McIntyre, 2009; Pick, 1995; Lehman, 2008; Lehmann & Sanders, 2002; Makan, 1998; Padarath, Ntuli, & Berthiaume, 2004; Van Rensburg & Van Rensburg, 1999; Sanders & Lloyd, 2005; Oulton, 2006; WHO, 2006; Van Niekerk & Sanders, 1997; Wadee & Khan, 2007). A case in point was the increased use of existing antenatal services in South Africa as a result of the provision of free maternal healthcare services from 1994 (Breier et al., 2009; Gilson & Schneider, 2006; Lehman, 2008), which exacerbated nursing shortages at the time. This was followed, two years later, by the introduction of free primary healthcare for all. No additional human or financial resources were made available for these additional patient loads. In addition, the growing burden of HIV and AIDS intensified nursing shortages at the time, leading to the nurse initiation and management of antiretroviral therapy (NIM-ART) programme being implemented only in 2003 (Padarath et al., 2004).

Further impacting on the shortage during this period was the voluntary severance package made available by the Department of Public Services and Administration (DPSA) in 1996 (Breier et al., 2009; Coovadia et al., 2009; Franks, 2014; Padarath et al., 2004). The resultant loss of institutional memory had a detrimental effect on the

\* Corresponding author at: 7 York Road, Parktown, Johannesburg, South Africa.

E-mail addresses: [sue.armstrong@wits.ac.za](mailto:sue.armstrong@wits.ac.za) (S.J. Armstrong), [n.geyer@edunurse.co.za](mailto:n.geyer@edunurse.co.za) (N.-M. Geyer), [incaline@iafrica.com](mailto:incaline@iafrica.com) (C.A. Bell).

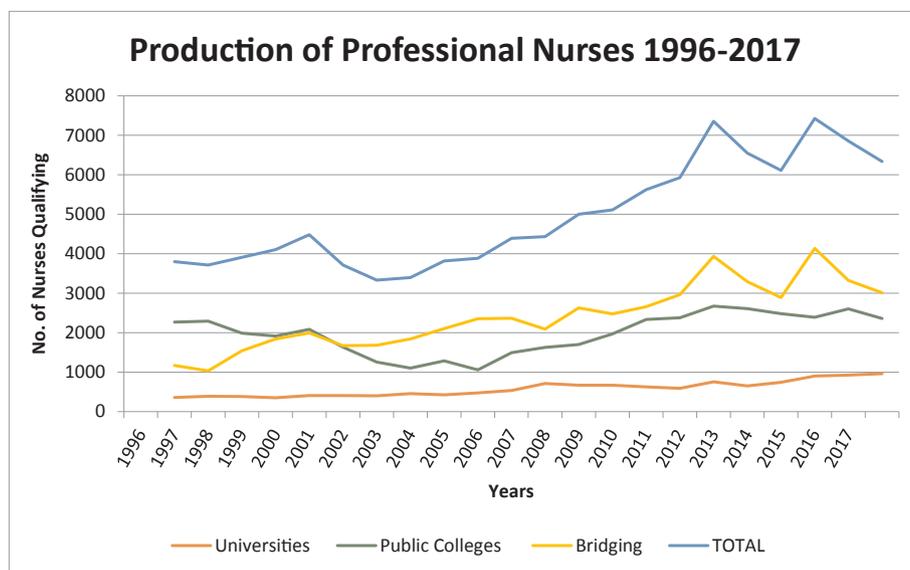


Fig. 1. Production of professional nurses 1997–2017 (SANC, 2006b, 2016b, 2018b).

quality and safety of healthcare services, as well as the education of nurses (Padarath et al., 2004). During this same period, the production of nurses decreased, following the rationalisation of nursing schools, which was accompanied by cuts in funding available for nurse training, resulting in a drop in the production of professional nurses between 1997 and 2001 by almost 20% (Breier et al., 2009; Franks, 2014; South African Nursing Council (SANC), 2006a, 2016a, 2018a). In Fig. 1 the decrease in the registration of professional nurses is reflected while the production at universities remained stable until 2002 (SANC, 2006b, 2016b, 2018b).

The current nursing education structure responsible for producing nursing human resources in South Africa consists of four types of nursing education institutions, namely universities, public colleges, private colleges and nursing schools. All curricula for nursing programmes, the nursing education institutions and their clinical facilities must be accredited by the South African Nursing Council (SANC). This arrangement provides students who complete their programmes with an academic qualification (degree, diploma or certificate) and a professional qualification registered with the SANC. South Africa has three categories of nurses, namely registered professional nurses, enrolled nurses and enrolled nursing auxiliaries.

The introduction of the Bridging programme in 1989 created a path for enrolled nurses to become professional nurses. There has been a 254% increase in professional nurses produced through the Bridging programme since 1996, when 1169 were trained, to 2015, when 4136 were trained (Fig. 2) (SANC, 2006b, 2016c). The contribution of the private sector has been significant in this regard, producing 61% of all Bridging programme candidates qualifying in 2015 (Fig. 2) (SANC, 2016c). While this source of professional nurses made a significant contribution to the overall number of professional nurses available, concern exists that the average age is 35 years on entry into the workforce, they are not qualified as midwives, and they lack the scientific background of the comprehensively trained nurse and are therefore, arguably, not as productive or flexible as nurses trained on the four-year comprehensive programme.

While the production of nursing auxiliaries was relatively constant until 2016, at an average of 5566 per year, private nursing schools produced approximately 80% of them. Of these, 58.7% were from private nursing schools in Gauteng and 18.5% from private nursing schools in KwaZulu-Natal, together producing more than 80% (SANC, 2006c) of nursing auxiliaries. Anecdotal evidence suggests that large numbers of these private nursing school trained nursing auxiliaries fail to find work on completion of training; this was reported in a survey

conducted by the SANC (SANC, 2016e).

Traditionally, human resource capacity is measured in terms of supply versus demand. This is most commonly calculated as simple ratios such as provider (in this context, nurses) to population ratios. This method is easily calculated and can be used to compare countries and regions, but it assumes that all ‘nurses’ are nurses and are nursing, that those who are employed are productive, that the health needs of the population are uniform throughout the region or country, and that needs are the same as demands (Murphy et al., 2012; Uys & Klopper, 2013). While capacity is usually measured on a national level, according to nurse to population ratios, with the inherent problems alluded to above, healthcare institutions commonly use historic staffing levels to plan and measure their staff establishments (Littlejohn, Campbell, Collins-McNeil, & Khanyile, 2012). This often meant that pre-1994 norms, based on time and motion studies in selected hospitals, were used in the post-apartheid healthcare system. When rationalisation and equity were introduced, staffing numbers were not necessarily appropriately adjusted. In the interim, the quadruple burden of disease including the HIV/AIDS epidemic, has resulted in significant changes in patient profiles requiring healthcare services.

Other factors impacting on the supply and demand for nurses include the inequities in the provision of nurses between rural and urban areas, and between the private and the public sector, and regional differences in disease patterns, the acuity level and needs of in-patients, and the age distribution of nurses and their health status and productivity (Buchan & Aiken, 2008). While these are all acknowledged as being significant factors relating to capacity, as previously described in human resources for health (Rispel, 2016), only the nurse:population ratios are used as an indicator of capacity in this article.

### 3. Education status of nursing

Policy changes in South Africa during the last decade include the re-engineered district healthcare system, which, while welcome, is nurse driven and therefore places additional demands on the number of nurse/midwife practitioners who are required, and also the need to develop new competencies to fulfil these demands, as seen in the *Human Resources for Health (HRH) Strategy* (Department of Health, 2011). Also influencing the demands are the National Health Insurance [NHI] (Department of Health, 2018), *HIV testing and counselling (HCT) campaign* (Department of Health, 2015), *task shifting* to nurses and midwives for NIM-ART (Georgeu et al., 2012), and more recently, the HIV Prevention, Care and Treatment targets as outlined in the 90-90-90

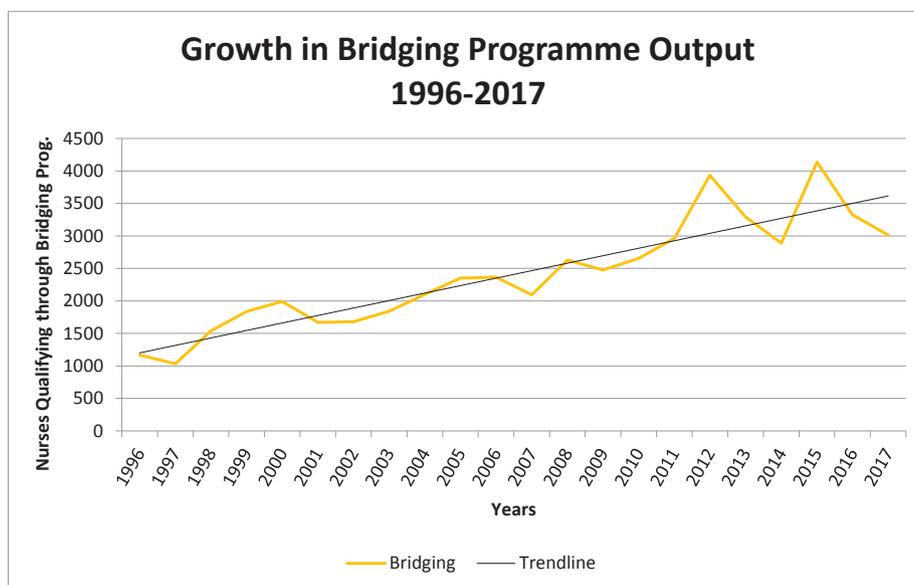


Fig. 2. Growth in Bridging programme output 1996–2017 (SANC, 2006b, 2016b, 2018b).

strategy (Joint United Nations Programme on AIDS [UNAIDS], 2015), together with the Sustainable Development Goals [SDGs] (United Nations, 2015). All of these increase the demand for professional nurses and midwives and, in particular, specialised practitioners for Africa's growing population.

While educational standards and programmes are controlled nationally by the South African Nursing Council [SANC], public nursing colleges and some nursing schools are funded and administered by Provincial Departments of Health. There is always a concern that when resources are scarce, service delivery, which is the provinces' main priority, will be resourced at the expense of nursing education (Van Niekerk & Saunders, 1997). In the private sector a symbiotic relationship also exists between the services and the nursing education institutions as student numbers are largely determined by available finances and staffing needs in the hospitals.

As far back as 1997, the White Paper on Higher Education expressed the view that nursing education should be relocated to the Department of Education in its totality (Department of Higher Education and Training [DHET], 1997). However, concern was expressed at the time that such relocation would impact negatively on the capacity of health service delivery, which may be one of the reasons for the delay in political decision making to transition the public nursing colleges to Higher Education (Padarath et al., 2004). All nursing education programmes fall within the higher education levels on the National Qualifications Framework (NQF) i.e. level 5 and higher, and this, by definition, falls under the jurisdiction of the Ministry of Higher Education and Training. Nursing programmes are, therefore, a national competence, according to the South African Constitution of the Republic of South Africa, 1996 (South Africa, 1996) (Table 1). Provision is made in section 238 of the Constitution for an executive organ of state to

delegate any function to any other executive organ of state, provided that the delegation is consistent with legislation related to the function (South Africa, 1996). Higher Education can thus delegate functions to the Department of Health at a national level, but accreditation of programmes remains the responsibility of Higher Education, through the Council of Higher Education (CHE) (South Africa, 1997a,b). In addition, nursing programmes will be accredited by both CHE and SANC in future (SANC, 2013c). By implication, all nursing education institutions (NEIs) must be accredited as higher education institutions (HEIs) to offer higher education programmes.

University nursing departments and some of the private colleges are already accredited or are in the process of being accredited as private HEIs. The future of public nursing colleges, which currently educate 73% of professional nurses in the country, is uncertain as, in order to provide higher education, they must be under the authority of a national department (DHET, 1997) and must, according to the Higher Education Act (No. 101 of 1997), also be a juristic person (South Africa, 1997a,b). This challenge has been partially addressed in the Higher Education Amendment Act (No. 9 of 2016) (South Africa, 2016), which makes provision for a public higher education college [S 5(1)(b)] which, when declared a higher education institution, will be a juristic person [S 5(4)] that must perform certain functions under the supervision of another public higher education institution [S 5A(a)]. This section can make provision for each of the provincial colleges. Another option provided by the Amendment Act is the establishment of a national institute of higher education as a juristic person with a specific scope of application [S 49K] that could make provision for an institute, including all colleges nationally, as an academic institute. It is not clear, though, how these clauses would be implemented.

Currently nurses are trained according to SANC regulations R425 or

**Table 1**  
Nursing and midwifery qualifications framework.

Professional registration	Qualification	Section in Act	NQF level	Credits
Auxiliary nurse	Higher Certificate	31(1)(d)	5	120
General (staff) nurse	Diploma	31(1)(c)	6	360
Midwife	Advanced Diploma	31(1)(b)	7	480
Professional nurse and midwife	Bachelor's Degree	31(1)(a)	8	120
Nurse or Midwife Specialist	Post Graduate Diploma	31(2)	8	120
Advanced specialist	Master's Degree (Professional)		9	180
	Master's Degree (Research)		9	180
	Doctoral Degree (Professional)		10	360

R683, R2176 and R2175 respectively (Breier et al., 2009; SANC, 1985, 1989, 1993b,c). These were the categories prescribed in the Nursing Act, 1978, which has been repealed, and continued to be produced under the transitional clause (S 61) of the current Nursing Act, 2005.

Registration as a professional nurse can be obtained through a four-year degree at university, or a four-year diploma at a public nursing college. The enrolled nursing programme, a two-year programme offered at a college or nursing school, enables entry into a two-year bridging programme that leads to registration with the SANC as a professional nurse with a qualification in general nursing. The enrolled nursing auxiliary programme was a one-year programme offered at all nursing education institutions, except universities. Intakes for programmes leading to registration as an enrolled nurse or an enrolled nursing auxiliary were phased out by 30 June 2015. Students enrolled in these programmes prior to this date had the opportunity, until May 2018, to complete the programme, whereafter no additional names would be included in the rolls for enrolled nurses or enrolled nursing auxiliaries. No new schools or legacy programmes would be approved by SANC for implementation of these courses (SANC, 2016d). Termination of new intakes into those programmes resulted in many of the smaller private nursing schools retrenching staff or even closing down.

All the programmes currently offered by all NEIs, including post basic and specialist programmes where practitioners from other neighbouring African countries participate (SANC, 1993a), are referred to as legacy programmes. Intakes for these programmes must be phased out by 31 December 2019, as declared by the Minister of Higher Education and Training (DHET, 2016). Academic programmes that are not compliant with the Higher Education Qualifications Sub-framework (HEQSF) may not be offered after this date (DHET, 2016). Students in training at the end of 2019 will have time to complete their programmes during a specified teach-out period. Students who terminate from the four-year programme and qualify for enrolment as a nurse or nursing auxiliary will be enrolled accordingly (SANC, 2007). Those who do not meet the requirements will be terminated from the programme, since the registers for the enrolled programmes are closed for new entrants. However, they may be allowed admission to the Bridging programme through recognition of prior learning, provided it is prior to December 2019 (SANC, 2016). All these programmes will be replaced in 2020 by programmes developed according to the new regulations promulgated in 2013 in terms of the Nursing Act, 2005, to produce the three categories prescribed in the Nursing Act, 2005, namely auxiliary nurse, general nurse and professional nurse (SANC, 2013a,b,d). The qualifications framework for nursing has been aligned with the HEQSF as summarised in Table 1.

While placing all nursing education in the higher education sector provides an opportunity to enhance the quality of education of all categories of nurse, and allows for the new category of nurse, the three-year diploma general nurse to contribute meaningfully to the provision of care and universal access, these developments necessitate radical change not only in the institutions able to provide nurse education and training, but to the curricula needed to educate these new categories of nurses. These changes coincide with increasing demand for nursing human resources. Transformation in the sector impacts on the capacity of nursing education institutions to produce the required number of graduates to meet nurse: patient ratios that would enable safe, quality healthcare to communities in South Africa and neighbouring countries.

#### 4. Determining training and capacity needs

Bearing in mind that population-based ratios have their limitations, efforts have been made in the public sector to establish activity-based norms, using the Workload Indicators of Staffing Needs (WISN) model (WHO, 2015b). The three large private sector hospital groups have been using similar methods for many years, but there has been no success in coordinating these projects, making it impossible to use the data for determining norms on a national level. The authors, therefore, used

population-based norms for the purpose of making projections.

One of the factors crippling nurse workforce planning is that the only source of national data is from the SANC register, which does not indicate whether a person is providing a nursing service or not. The numbers on the register include those who have retired, those who have temporarily given up work and those who have left the country but choose to remain on the register. Determining the ideal ratio is an impossible task as there are so many variables. Looking to the WHO for assistance in this regard, the recent publication on health workforce requirements for universal health coverage and the sustainable development goals (2016) is useful. The “SDG index threshold”, which is thought to be the number needed to provide minimum care, is 4.45 nurses per 1000 population (WHO, 2016). While this includes doctors, nurses and midwives, it is a useful indicator given that the majority of health workers in South Africa are nurses and midwives, and that there is no recommended ratio for midwives and nurses only. This presents a challenge not only for the safety of patient care but also to nursing education institutions, which need guidance from ratios to determine the size of the intake of nursing students and the types of courses to which they should be admitted (Aiken et al., 2010; Cimioti, Aiken, Sloane, Wu, 2012).

The WHO (2015a) and World Bank (2014, 2015a) published comparative statistics, which indicated that certain high income countries with “good quality” healthcare had a nurse: population ratio of 8.6 nurses and above per 1000 population. These countries include the United Kingdom, Australia, New Zealand, Cuba and the United States of America. South Africa currently has 5.1 nurses per 1000 population and an infant mortality rate (IMR) of 32.8 per 1000 live births (StatsSA, 2017). In order to try to understand what “good quality” healthcare means, the IMR is a useful proxy indicator (World Bank, 2015b). In Table 2, it can be seen that the nurse: population ratio is a better indicator of health (based on the IMR) than expenditure on health, and those with ratios of 8 or more per 1000 population, generally have lower IMRs. This is particularly evident when looking at the favourable IMR and relatively low health expenditure of Cuba.

It is acknowledged that while the inequities between the private and public sectors are not the focus of this article, it is important to point out that the private sector (doctors 24.6%, hospitals 1.6%, clinics 1.2%, traditional healer 0.7%, pharmacy 0.4% and other 0.4%) deliver healthcare services to approximately 28.8% of households in South Africa, with 71.2% of households seeking public sector services (63.7% public clinics, 7.0% public hospitals and 0.5% other) (StatsSA, 2018). Although 71% use public health services, only 47.5% of nurses on the SANC register work in the public sector (StatsSA, 2016a,b). When taking this into account, the ratio of nurses to population using public sector health services is 3.41 nurses per 1000 population, whereas in the private sector it is 9.63 nurses per 1000 population.

**Table 2**  
Comparison of Nurse: Population Ratios, Health Expenditure and Infant Mortality Rates in selected HIC and BRICS countries.

Country	Ratio Nurse: 1000 population (World Bank, 2015b; WHO, 2015a)	IMR (deaths per 1000 live births) (World Bank, 2015a)	Health expenditure per capita (current \$US) (World Bank, 2014)
Australia	10.6	3	6031
United Kingdom	8.8	4	3935
Cuba	9.1	4	817
USA	9.9	6	9403
Russia	8.5	8	893
China	1.7	9	420
Brazil	7.6	15	947
RSA	5.1	34	570
India	1.7	38	75

World Bank (2014); World Bank (2015a); World Bank (2015b); WHO (2015a).

### 5. Predictions for future nursing capacity

In the absence of more accurate data, in order to produce the original statistics in this article, the authors used the sources available to them including the SANC Time and Annual Series Statistics, which provide statistics on the growth in registers, nursing education institution output and an age analysis on persons on the register, starting from 1996 to the present, providing more than 20 years of data.

In order to predict future requirements for nurses in South Africa, it is necessary to make several assumptions, even if some of them seem unlikely. The authors have assumed that the population growth rate per annum will be 1.62%, which is the average growth rate in South Africa for 2016–2017 according to [Statistics South Africa \(2018\)](#), that all nurses retire at 65, and that everyone who trains as a nurse enters the nursing workforce at 30 years, works for 35 years and then retires. Due to the absence of data, it has been assumed that nurses remain productive and healthy for the duration of their 35-year careers. As explained earlier, this article assumes that 4.45 nurses per 1000 population ([WHO, 2016](#)) is the absolute minimum level that can be tolerated, and that the benchmark should be 8.6 nurses per 1000 population ([WHO, 2015a](#); [World Bank 2014, 2015a](#)). Population was determined on a basic straight line projection from the population statistics, using the current average increase. The SANC age analysis over the last 10 years provides an average age for qualifiers/new entrants across all programmes of 30 years, and the generally accepted retirement age in South Africa is 65, hence this was used. The 20 years of data from SANC provided a current output per year and an average increase per year per category of nurse. The current output and average increase in output were used to determine the projected outputs.

As seen above, profound changes are occurring in the nursing education system. If this were not the case, and if the growth were to continue as it has in the last two decades, the country would reach the desired WHO benchmark by the year 2037, and already exceeds the SDG minimum threshold (Fig. 3). When looking at the proportion of nurses in the three categories (Fig. 3) this also shows a healthy growth of registered nurses. However, as will be seen, this prediction cannot be realised due to the in progress changes to the nursing education system.

As new intakes of enrolled nurses and nursing auxiliaries was

stopped in 2015, there will be no further production of these categories. If nothing is done to replace these categories, the nurse capacity will drop below the SDG minimum level as early as 2023 (Fig. 4).

The status of the public nursing colleges, which were the producers of the majority of nurses, is most uncertain at present, due to the fact that they need to be moved under the jurisdiction of a national department and also be established and accredited as higher education institutions, which is a long process and fraught with problems due to the many shortfalls in their being able to be established as HEIs. It is necessary, therefore, to reflect on what would happen if the public nursing colleges were not able to produce nurses. Clearly, as seen in Fig. 5, this would be disastrous as the only educational institutions left producing professional nurses would be the universities, and hence the nurses: population ratio would rapidly decline as only 1/3 of the retiring professional nurses would be produced, and only 1/6 of all retiring nurses would be replaced/produced. Even if the population remained static, the nurse population would continue to decline, and when normal population growth is considered the situation is bleak, with a nurse: population ratio falling below 4.5 (SDG minimum) by 2023 and a minimum ratio of 1.36 being reached around 2057.

The Higher Education Act (No. 101 of 1997) allows for the establishment of private higher education institutions. Several of the large private nursing education providers have already applied for, and some have received, accreditation as higher education institutions, which means that they will be able to start offering the “new” nursing programmes as soon as their curricula are approved. While they would be entitled to offer the degree programme, few, if any, are opting to do this, due to the strain this would place on resources. For this reason, the authors have assumed these providers will only offer the three-year diploma programme for general nurses and the one-year nursing auxiliary programme. Another assumption made is that they will commence with training on these new programmes in 2020 and will accept the same number of students for general nurse and nurse auxiliary training as they did in the past for the bridging and enrolled nurse programmes, and the enrolled nurse auxiliary programmes respectively. If this happens, and they are able to maintain the same growth rate as the private NEIs have done for the last two decades, it will make a considerable difference to the ability to meet the SDG minimum

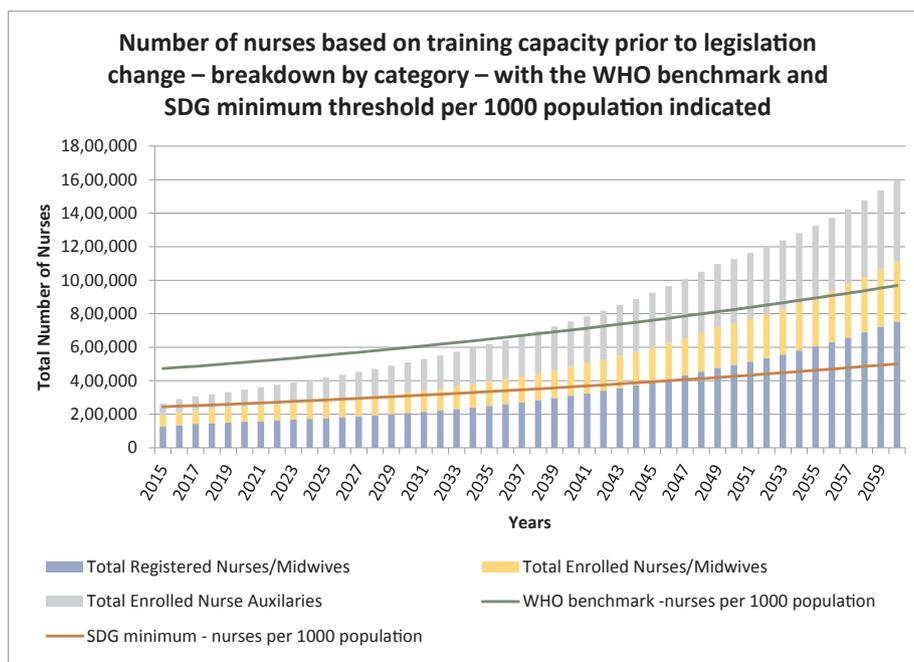


Fig. 3. Number of nurses based on training capacity prior to legislation change – breakdown of categories – with the WHO benchmark and SDG minimum threshold per 1000 population indicated.

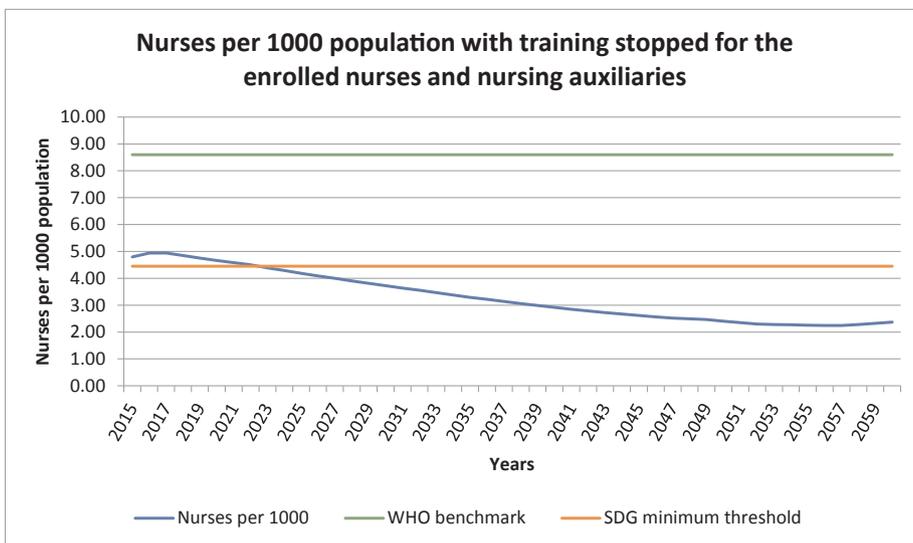


Fig. 4. Nurses per 1000 population with training stopped for the enrolled nurses and nursing auxiliaries.

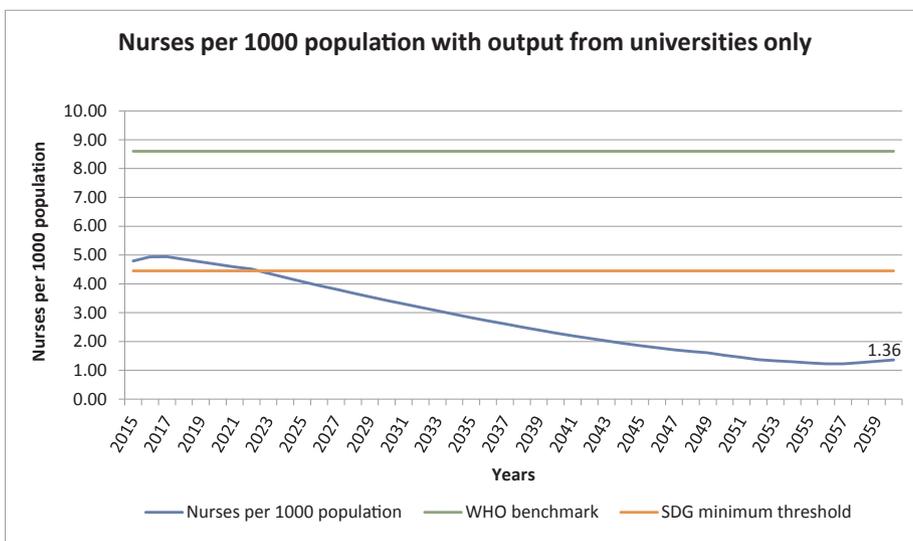


Fig. 5. Nurses per 1000 population with output from universities only.

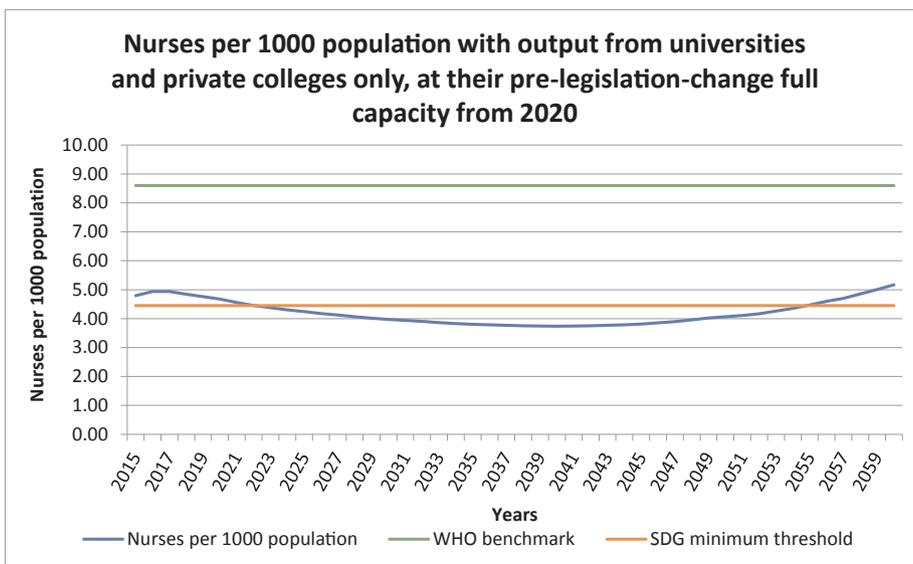


Fig. 6. Nurses per 1000 population with output from universities and private colleges only at their pre-legislation-change full capacity from 2020.

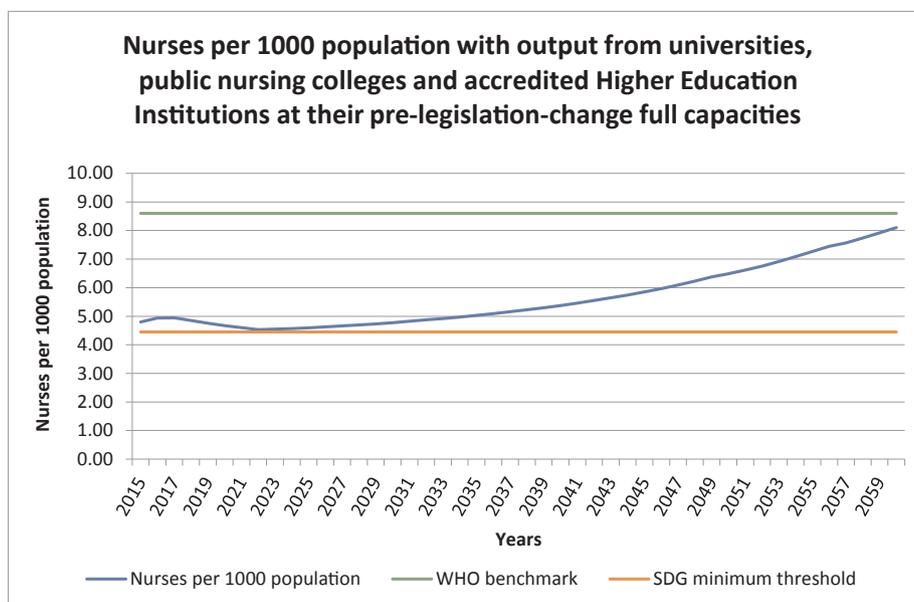


Fig. 7. Nurses per 1000 population with output from universities, public nursing colleges and accredited Higher Education Institutions at their pre-legislation-change full capacities.

threshold (Fig. 8). However, this is unlikely to happen, as the 5% growth rate of the private NEIs is largely attributable to the small and medium sized profit making private nursing schools, of which most have not, as yet, obtained accreditation as private HEIs. It should be borne in mind that, although a considerable improvement on the data is shown in Fig. 6, the capacity will be less than it is currently and will fall well below the SDG threshold for a complete generation (25 years) and will never reach the WHO benchmark for “good quality” healthcare (WHO, 2015a).

The training capacity of the public nursing colleges, i.e. the maximum number of students that the institution is able to successfully educate, is crucial to resolving the supply problems, but they would have to meet the educational requirements of the CHE to be accredited as HEIs in order to do so. Even if this were possible, the colleges have an additional constraint, which is that a limited number of their nurse educators have Masters’ degrees, which is a requirement for teaching a Bachelors’ programme. For this reason, it would seem sensible for the majority of these colleges to concentrate on the training of the three-year diploma programme for general nurses, which, after all, will be the group that is the mainstay of the District Health Care service. Fig. 7 assumes that public colleges will be accredited in time to start offering the diploma programme for general nurses and the certificate programme for nursing auxiliaries in 2020.

This is a far more encouraging picture and shows how important it is for public colleges to continue to contribute to training. If, however, one looks at Fig. 8, one sees that although the nurse: population ratio looks favourable, the balance between categories does not. The number of degreed nurses is inadequate, and far more nursing auxiliaries would be trained than needed. This means that some of the capacity to train nursing auxiliaries should be given to the general nurse training, and the capacity for degree level training needs to increase considerably as this will be the only source of professional nurses in future.

It has not been possible, thus far, for public colleges to meet the requirements to be HEIs. The Chief Nursing Officer reported at the 2018 Annual Nursing Education Conference, that public colleges had submitted their curricula for accreditation at the end of August 2018, however, the outcome remains uncertain and it may be more realistic to assume that public colleges will start training again in 2022.

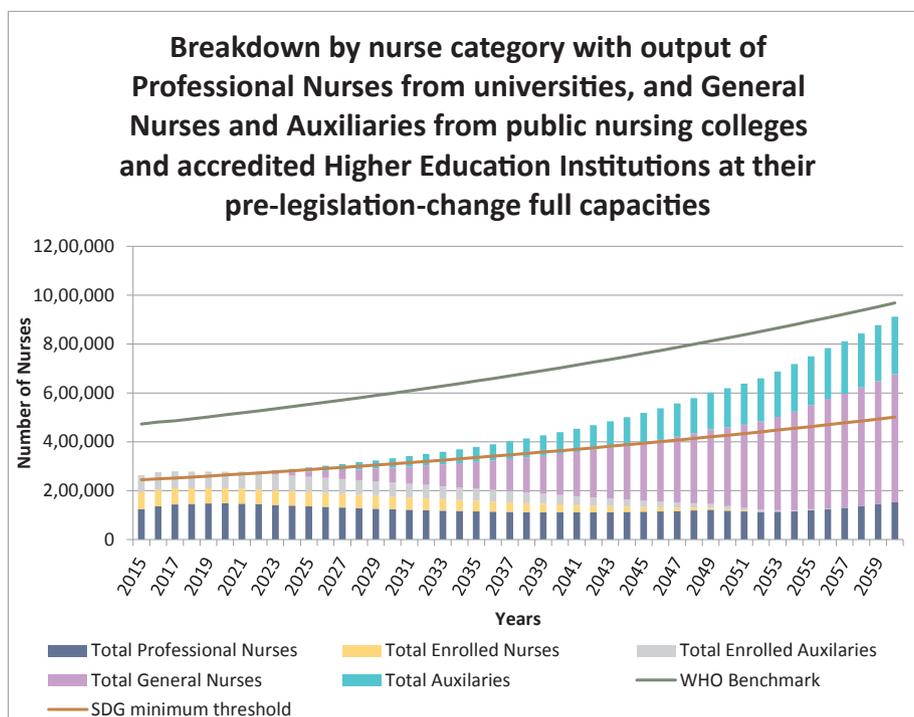
## 6. Discussion

The data presented shows the necessity for retaining the capacity of public nursing colleges and accredited private nursing education institutions to provide all three categories of nurse. The country cannot afford a drop in the numbers, and concerted efforts need to be made to increase the number of professional nurses trained and to train diploma nurses, or general nurses, as these two groups will be the mainstay of the nurse-led district health care team. More work needs to be done to determine the balance that is required among these categories to meet the healthcare needs of the country. Much has been done to develop new curricula, but a failure to establish the public nursing colleges as higher education institutions and approve proposed curricula to enable them to produce quality nurses, of at least diploma and certificate level, will compromise nurse: patient ratios and safe patient care.

The legislation already exists to enable the changes required, but implementation, including the amendments to the higher amendment legislation, cannot occur without moving public nursing colleges from provincial governments to the jurisdiction of the national government. This requires regulations and policies to be developed to move funds for staff and to establish public nursing colleges as institutions of higher education. This, by implication means upgrading of facilities and staff. A reduction in the time to effect all the bureaucratic requirements to achieve these goals is required to ensure the nurse: population ratio remains within accepted norms and falls below the SDG minimum for as short a time as possible.

The alternative route, which requires less change, would be to enable public nursing colleges to enter into agency agreements with existing universities. This would put a heavy load on universities, which would clearly need more resources to do this, but should be seriously considered if South Africa is to avert the pending disaster caused by the slow movement of public nursing colleges towards becoming higher education institutions.

Clearly, some preliminary decisions need to be taken with regard to the numbers to be trained at the various levels as, in the absence of this information, costing and resource planning is not possible. A rule of thumb in the past, which was based more on “eminence” based ideas than “evidence based” ideas, was that there should be roughly the same number of professional nurses as there are sub-category nurses (enrolled nurses and nursing auxiliaries). The advent of the District Health



**Fig. 8.** Breakdown by nurse category with output of Professional Nurses from universities, and General Nurses and Auxiliaries from public nursing colleges and accredited Higher Education Institutions at their pre-legislation-change full capacities.

Care model, requires the number of general nurses to be more than that of professional nurses, as they will be the core of nursing services. They will be able to care for “uncomplicated, stable” patients, who constitute the majority of patients, and will also be able to care for “complicated, unstable” patients under the direction of a professional nurse.

In the absence of carefully calculated activity based norms for each category of nurse and each patient group, it would seem reasonable to assume that a 'suitable' mix of categories of nurse should be 25% professional nurses, 45% general nurses and 30% auxiliaries. It has already been shown in Fig. 8 that, even in the best scenario, there will be insufficient professional nurses available, and training capacity for degree training needs to be substantially increased. If the assumption is that 25% of professional nurses is needed, and if universities are the only the nursing education institutions training professional nurses, university nursing departments will, collectively, have to increase their capacity to a 10% increase per annum from the current 5% to reach even the required capacity by 2048 – 30 years from now.

While the average population growth for 2016/2017 was 1.62%, this figure has been increasing almost every year, and hence a straight line increase projection is likely to be an underestimation of South African population growth. Similarly, assuming that every nurse that is trained enters the profession stays in the profession, and no one dies or leaves before retirement, is not a true reflection, as nurses are leaving to work in other sectors and/or overseas, and some are dying, thereby reducing the possible number of nurses in the system. This overestimation of the number of nurses available in the system, coupled with the underestimation of population growth, makes the real situation worse than the one shown in the graphs.

## 7. Conclusion

It is clear from the scenarios that, unless the capacity of public colleges to train new general nurses is safeguarded and strengthened, the shortage of professional nurses will reach crisis point within the next decade. Regulations to support the establishment of public nursing colleges, in terms of the amendment to the Higher Education Act (No. 9

of 2016), need to be promulgated in order to fast track the establishment of public nursing colleges as colleges of higher education; alternatively, public nursing colleges need urgently to engage with universities to enter into agency agreements. The capacity of university nursing departments to provide for the training of professional nurses needs to increase, and the well-established private nursing colleges' contribution to training needs to be preserved. It is a matter of urgency that provincially based nursing norms be developed to guide the selection of students and the appropriate use of resources. There also needs to be investment in degree nursing training for nurses both at under and post graduate level if the country is to retain the capacity (and quality) of nurse training and so prevent the numbers falling below the requirements for quality healthcare services.

Building capacity to prevent a disaster resulting from a shortage of nurses means providing legislative and financial support to nursing education institutions, together with continuous efforts to upgrade the competencies of nurse educators to enable them to teach within higher education. There is a small window of opportunity, of less than five years, to do this and so to avert a crisis in healthcare.

## Conflict of interest

The authors do not have a conflict of interest to declare.

## Funding sources

No funding was made available for this study.

## Ethics approval

Ethical approval was not required as no human participants were involved in the study.

## Ethics statement

It is hereby certified that all listed authors have made substantial

contributions to the conception and design of the study, the acquisition, analysis and interpretation of data as well as the drafting of the manuscript. The final product was approved before submission to IJANS.

The study did not require the involvement and responses by human participants. The data used to prepare the manuscript are available in the public domain and did not require ethical approval. The authors reflected the data sourced accurately and referenced the sources of all data used to develop the statistical projections.

The manuscript has not been submitted for publication elsewhere.

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ijans.2019.01.009>.

## References

- Aiken, L. H., Clarke, S. P., Cheung, R. B., Sloane, D. M., & Silber, J. H. (2003). Educational levels of hospital nurses and surgical patient mortality. *Journal of the American Medical Association*, 290(12), 1617–1623. <https://doi.org/10.1001/jama.290.12.1617>.
- Aiken, L. H., Clarke, S., Sloane, D., Lake, E., & Cheney, T. (2008). Effects of hospital care environment on patient mortality and nurse outcomes. *Journal of Nursing Administration*, 38(5), 223–229. <https://doi.org/10.1097/01.NNA.0000312773.42352.d7>.
- Aiken, L. H., Sloane, D., Cimiotti, J. P., Clarke, S. P., Flynn, L., Seago, J. A., ... Smith, H. L. (2010). Implications of the California Nurse Staffing Mandate for Other States. *Health Services Research*, 45(4), 904–921. <https://doi.org/10.1111/j.1475-6773.2010.01114.x>.
- Armstrong, S. J., & Rispel, L. C. (2015). Social accountability and nursing education in South Africa. *Global Health Action*, 8(1, S4), 5–13. <https://doi.org/10.3402/gha.v8.27879/zgha20.2015.8.issue-s4>.
- Blaauw, D., Ditlopo, P., & Rispel, L. C. (2015). Nursing Education Reform in South Africa – lessons from a policy analysis study. *Global Health Action*, 7(1, S4), 14–25. <https://doi.org/10.3402/gha.v7.26401/zgha20.2015.8.issue-s4>.
- Breier, M., Wildschut, A., & Mqolozana, T. (2009). *Nursing in a New Era. The Profession and Education of Nurses in South Africa*. Pretoria: Human Sciences Research Council Press.
- Buchan, J., & Aiken, L. (2008). Solving nursing shortages: a common priority. *Journal of Clinical Nursing*, 17(24), 3262–3268. <https://doi.org/10.1111/j.1365-2702.2008.02636.x>.
- Cimiotti, J. P., Aiken, L. H., Sloane, D. M., & Wu, E. S. (2012). Nurse staffing, burnout, and health care-associated infection. *American Journal of Infection Control*, 40(6), 486–490. <https://doi.org/10.1016/j.ajic.2012.02.029>.
- Coovadia, H., Jewkes, R., Barron, P., Sanders, D., & McIntyre, D. (2009). The health and health system of South Africa: Historical roots of current public health challenges. *The Lancet*, 374, 817–834. [https://doi.org/10.1016/S0140-6736\(09\)60951-X](https://doi.org/10.1016/S0140-6736(09)60951-X).
- Department of Health (2013): see South African Department of Health.
- Franks, P. E. (2014). The crisis of the South African Public Service. Retrieved on 20 April 2017 from *The Journal of the Helen Suzman Foundation*, 74, 48–56. <http://hsf.org.za/resource-centre/focus/state-and-nation/9.the-crisis-of-the-south-african-public-service-p.pdf>.
- Frenk, J., Chen, L., Bhutta, Z. A., Cohen, J., Crisp, N., Evans, T., ... Zurayk, H. (2010). Health professionals for a new century: transforming education to strengthen health systems in an interdependent world. *The Lancet*, 376(9756), 1923–1958. [https://doi.org/10.1016/S0140-6736\(10\)61854-5](https://doi.org/10.1016/S0140-6736(10)61854-5).
- George, D., Colvin, C. J., Lewin, S., Fairall, L., Bachmann, M. O., Uebel, K., ... Bateman, E. D. (2012). Implementing nurse-initiated and managed antiretroviral treatment (NIMART) in South Africa: A qualitative process evaluation of the STRETCH trial. *Implementation Science*, 7, 66. <https://doi.org/10.1186/1748-5908-7-66>.
- Gilson, L., & Schneider, H. (2006). The impact of free maternal healthcare in South Africa. In M. Berer, & T. Sundari Ravindran (Eds.). *Safe Motherhood Initiatives: Critical Issues*. Oxford: Blackwell Science.
- Gray, A., & Vawda, Y. (2016). *Health Policy and Legislation*. Durban: Health Systems Trust. Retrieved 10 March 2017 from In A. Padarath, J. King, & J. Casciola (Eds.). *South African Health Review 2016* (pp. 3–16).
- Joint United Nations Programme on HIV/AIDS (UNAIDS). (2015). 90-90-90 An ambitious treatment target to help end the AIDS epidemic. New York: United States of America. Retrieved 10 March 2017 from < <http://www.unaids.org/en/resources/documents/2014/90-90-90> > .
- Lehman, U. (2008). Strengthening human resources for primary health care. Durban: Health Systems Trust. Retrieved 10 March 2017 from In P. Barron, & J. Roma-Reardon (Eds.). *South African health review 2008* (pp. 163–178).
- Lehmann, U., & Sanders, D. (2002). Human resource development. Durban: Health Systems Trust. Retrieved 10 March 2017 from In P. Ijumba (Ed.). *South African health review 2002* (pp. 119–134).
- Littlejohn, L., Campbell, J., Collins-McNeil, J., & Khanyile, T. (2012). Nursing Shortage: A Comparative Analysis. Retrieved 30 March 2017 from *International Journal of Nursing*, 1(1), 21–26. <http://www.ijnonline.com/index.php/ijn/rt/captureCite/21/0>.
- Makan, B. (1998). Distribution of health personnel. Durban: Health Systems Trust. Retrieved 10 March 2017 from In A. Ntuli (Ed.). *South African health review 1998* (pp. 63–82).
- Murphy, G. T., Birch, S., MacKenzie, A., Alder, R., Lethbridge, L., & Little, L. (2012). Eliminating the shortage of registered nurses in Canada: An exercise in applied needs-based planning. *Health Policy*, 105, 192–202.
- Oulton, J. A. (2006). The global nursing shortage: an overview of issues and actions. *Policy, Politics & Nursing Practice*, 7(3 Suppl), 34S–39S. <https://doi.org/10.1177/1527154406293968>.
- Padarath, A., Ntuli, A., & Berthiaume, L. (2004). Human resource development. Health Systems Trust: Durban. Retrieved 10 March 2017 from In P. Ijumba, C. Day, & A. Ntuli (Eds.). *South African health review 2004* (pp. 229–316).
- Pick, W. (1995). Human resources development. Durban: Health Systems Trust. Retrieved on 8 March 2017 from In D. Harrison (Ed.). *South African health review 1995*.
- Rispel, L. (2016). Analysing the progress and fault lines of health sector transformation in South Africa. Durban: Health Systems Trust. Retrieved 10 March 2017 from In A. Padarath, J. King, E. Mackie, & J. Casciola (Eds.). *South African health review 2016* (pp. 17–24).
- Sanders, D., & Lloyd, B. (2005). Human Resource: International context. Durban: Health Systems Trust. Retrieved 10 March 2017 from In P. Ijumba, & P. Barron. (Eds.). *South African health review 2005* (pp. 76–87).
- South Africa (Republic). Higher Education Act (Act 101 of 1997), as amended. Pretoria: Government Printer. (1997). Retrieved 10 July 2018 from < [http://www.chc.ac.za/media\\_and\\_publications/legislation/higher-education-act-101-1997](http://www.chc.ac.za/media_and_publications/legislation/higher-education-act-101-1997) > .
- South Africa (Republic). Higher Education Act, 1997. Notice of last enrolment date for first time entering students into Non-HEQSF aligned programmes. Government Notice 801, Government Gazette 40123. (1997). Retrieved 12 March 2017 from < [http://www.gov.za/sites/www.gov.za/files/40123\\_gon801.pdf](http://www.gov.za/sites/www.gov.za/files/40123_gon801.pdf) > .
- South Africa (Republic). The Constitution of the Republic of South Africa, Act 108 of 1996. Pretoria: Government Printer. (1996). Retrieved 4 July 2018 from < <http://www.justice.gov.za/legislation/constitution/SACConstitution-web-eng.pdf> > .
- South Africa (Republic). Higher Education Amendment Act (Act 9 of 2016). Pretoria: Government Printer. (2016). Retrieved 10 July 2018 from < <https://www.gov.za/documents/higher-education-amendment-act-9-2016-17-jan-2017-0000> > .
- South African Department of Health. Human Resources for Health South Africa. HRH Strategy for the Health Sector 2012/13-2016/17. Pretoria: Department of Health. (2011) Retrieved 12 March 2017 from < [http://www.gov.za/sites/www.gov.za/files/hrh\\_strategy.0.pdf](http://www.gov.za/sites/www.gov.za/files/hrh_strategy.0.pdf) > .
- South African Department of Health. Strategic Plan for Nursing Education, Training and Practice 2012/13 – 2016/17. Pretoria: Department of Health. (2013) Retrieved 10 March 2017 from < [http://www.sanc.co.za/archive/archive2013/linked\\_files/Strategic-Plan-for-Nurse-Education-Training-and-Practice.pdf](http://www.sanc.co.za/archive/archive2013/linked_files/Strategic-Plan-for-Nurse-Education-Training-and-Practice.pdf) > .
- South African Department of Health. National Health Insurance for South Africa. Towards universal health coverage. Version 40. (2015) Retrieved 10 March 2017 from < <https://www.health-e.org.za/wp-content/uploads/2015/12/National-Health-Insurance-for-South-Africa-White-Paper.pdf> > .
- South African Department of Health. (2018). National Health Insurance Bill, 2018. Government Gazette, 636 (41725).
- South African Department of Higher Education. (1997). Draft White Paper on Higher Education Notice 712 of 1997. Government Gazette, 382 (17944).
- South African Department of Higher Education. Higher Education Act, 1997. Notice of last enrolment date for first time entering students into non-HEQSF aligned programmes. Government Notice No. R.401236 July 2016. (2016) Retrieved on 11 July 2018 from < [https://www.greengazette.co.za/pages/national-gazette-40123-of-06-july-2016-vol-613\\_20160706-GGN-40123-00004](https://www.greengazette.co.za/pages/national-gazette-40123-of-06-july-2016-vol-613_20160706-GGN-40123-00004) > .
- South African Nursing Council (SANC) (2013d). *R174: Regulations relating to the Approval of and the Minimum Requirements for the Education and Training of a Learner leading to Registration in the Categories Professional Nurse and Midwife*. Retrieved 6 December 2018 from Pretoria: SA Nursing Council. <http://www.sanc.co.za/regulat/Reg-cpn.pdf>.
- South African Nursing Council (SANC) (2013c). *R173: Regulations relating to the Accreditation of Institutions as Nursing Education Institutions*. Retrieved 6 December 2018 from Pretoria: SA Nursing Council. <http://www.sanc.co.za/regulat/Reg-acc.pdf>.
- South African Nursing Council (SANC) (2013b). *R171: Regulations relating to the Approval of and the Minimum Requirements for the Education and Training of a Learner Leading to Registration in the Category Staff Nurse*. Retrieved 6 December 2018 from Pretoria: SA Nursing Council.
- South African Nursing Council (SANC) (2016d). *Circular 7/2016. Information regarding the phasing out of Legacy Qualifications; and implementation of Nursing Qualifications aligned to the Higher Education Qualifications Sub-Framework (HEQSF)*. Retrieved 10 March 2017 from Pretoria: South African Nursing Council. <http://www.sanc.co.za/pdf/Circular%20Info/Circular%207%20of%202016%20Phasing%20out%20of%20Legacy%20Qualifications.pdf>.
- South African Nursing Council (SANC). Output Bridging Programme 2006 – 2015. (2016). Retrieved 10 March 2017 from < [http://www.sanc.co.za/stats/stat\\_ts/Output/Output%202006-2015%20BP.pdf](http://www.sanc.co.za/stats/stat_ts/Output/Output%202006-2015%20BP.pdf) > .
- South African Nursing Council (SANC). Output Bridging Programme 2008 – 2017. (2018). Retrieved 11 July 2018 from < [http://www.sanc.co.za/stats/stat\\_ts/Output/Output%202008-2017%20BP.pdf](http://www.sanc.co.za/stats/stat_ts/Output/Output%202008-2017%20BP.pdf) > .
- South African Nursing Council (SANC). Growth in the Registers 2006 - 2015. (2016). Retrieved 10 March 2017 from < <http://www.sanc.co.za/stats/Stat2015/Growth%202006-2015.pdf> > .
- South African Nursing Council (SANC). Regulations relating to the approval of and the minimum requirements for the education and training of a Nurse (General,

- Psychiatric and Community) and Midwife leading to registration. Government Notice No. R.425, 22 February 1985. (1985) Retrieved 10 March 2017 from < <http://www.sanc.co.za/regulat/Reg-4yr.htm> > .
- South African Nursing Council (SANC). Regulations relating to the minimum requirements for a bridging course for Enrolled Nurses leading to registration as a General Nurse or a Psychiatric Nurse. Government Notice No R.683, 14 April 1989. (1989) Retrieved 10 March 2017 from < <http://www.sanc.co.za/regulat/Reg-brg.htm> / > .
- South African Nursing Council (SANC). Regulations relating to the course in Clinical Nursing Science leading to registration of an additional qualification. Government Notice No. R.212, 19 February 1993. (1993). Retrieved 10 March 2017 from: < <http://www.sanc.co.za/regulat/Reg-cln.htm> > .
- South African Nursing Council (SANC). Regulations relating to the course leading enrolment as a Nurse. Government Notice No R.2176, 19 November 1993 R. 1276, 19 November 1993. (1993). Retrieved 10 March 2017 from < <http://www.sanc.co.za/regulat/Reg-nna.htm> > .
- South African Nursing Council (SANC). Regulations relating to the course leading enrolment as a Nurse. Government Notice No R.2175, 19 November 1993. (1993). Retrieved 10 March 2017 from < <http://www.sanc.co.za/regulat/Reg-nen.htm> > .
- South African Nursing Council (SANC). Growth in the Registers 1996 - 2005. (2006). Retrieved 10 March 2017 from < [http://www.sanc.co.za/stats/stat\\_ts/Growth/growth%201996-2005.pdf](http://www.sanc.co.za/stats/stat_ts/Growth/growth%201996-2005.pdf) > .
- South African Nursing Council (SANC). Output Bridging Programme 1995 - 2005. (2006). Retrieved 10 March 2017 from < [http://www.sanc.co.za/stats/stat\\_ts/Output/Output%202006-2015%20BP.pdf](http://www.sanc.co.za/stats/stat_ts/Output/Output%202006-2015%20BP.pdf) > .
- South African Nursing Council (SANC). Output Enrolled Nursing Auxiliary Programme 1995 - 2005. (2006). Retrieved 10 March 2017 from < [http://www.sanc.co.za/stats/stat\\_ts/Output/output%201996-2005%20exp.pdf](http://www.sanc.co.za/stats/stat_ts/Output/output%201996-2005%20exp.pdf) > .
- South African Nursing Council (SANC). Circular 6: Registration with the SANC prior to successful completion of the four-year programme covered by the Regulations relating to the approval of the minimum requirements for the education and training of a nurse (General, Psychiatric and Community) and Midwife leading to registration (Government Notice No R435 of 22 February 1985). (2007). Retrieved 10 March 2017 from < <http://www.sanc.co.za/archive/archive2007/newsc706.htm> > .
- South African Nursing Council (SANC). R169: Regulations relating to the Approval of and the Minimum Requirements for the Education and Training of a Learner Leading to Registration in the Category Auxiliary Nurse. Pretoria: SA Nursing Council. (2013). Retrieved 6 December 2018 from < <http://www.sanc.co.za/regulat/Reg-can.pdf> > .
- South African Nursing Council (SANC). Output 4-year programme 1995 – 2015. (2016). Retrieved 10 March 2017 from < [http://www.sanc.co.za/stats/stat\\_ts/Output/output%201996-2005%204yp.pdf](http://www.sanc.co.za/stats/stat_ts/Output/output%201996-2005%204yp.pdf) > .
- South African Nursing Council (SANC). South African Nursing Council Media Release: Nursing Education and Training Institutions in South Africa. 15 November 2016. (2016). Retrieved 10 March 2017 from < <http://www.sanc.co.za/archive/archive2016/Media%20Release%20-%20NEIs%20in%20SA%2016Nov2016.pdf> > .
- South African Nursing Council (SANC). Growth in the Registers 2008 - 2017. (2018). Retrieved 11 July 2018 from < <http://www.sanc.co.za/stats/stat2017/Growth%202008-2017.pdf> > .
- Statistics South Africa (SSA) (2016b). *Midyear Population Estimates, 2016*. Retrieved 11 July 2018 from Pretoria: Statistics South Africa. <https://www.statssa.gov.za/publications/P0302/P03022016.pdf>.
- Statistics South Africa (SSA). Statistical Release P0318. General household survey, 2015. Pretoria: Statistics South Africa. (2016). Retrieved 11 July 2018 from < <http://www.statssa.gov.za/publications/P0318/P03182015.pdf> / > .
- Statistics South Africa (SSA). Statistical Release P0302. Midyear population estimates, 2017. Pretoria: Statistics South Africa. (2017). Retrieved 11 July 2018 from < <https://www.statssa.gov.za/publications/P0302/P03022017.pdf> > .
- Statistics South Africa (SSA). Statistical Release P0318. General household survey, 2017. Pretoria: Statistics South Africa. (2018). Retrieved 11 July 2018 from < <http://www.statssa.gov.za/publications/P0318/P03182017.pdf> > .
- Swart, R. P., Pretorius, R., & Klopper, H. (2015). Educational background of nurses and their perceptions of the quality and safety of patient care. *Curationis*, 38(1), 8. <https://doi.org/10.4102/curationis.v38i1.1126>.
- United Nations. Sustainable Development Goals. (2015). Retrieved 10 March 2017 from < <http://www.un.org/sustainabledevelopment/sustainable-development-goals/> > .
- Uys, L. R., & Klopper, H. C. (2013). What is the ideal ratio of categories of nurses for the South African public health system? *South African Journal of Science*, 109(5-6), 1–4. [http://www.scielo.org.za/scielo.php?script=sci\\_arttext&pid=S0038-23532013000300008&lng=en&nrm=iso](http://www.scielo.org.za/scielo.php?script=sci_arttext&pid=S0038-23532013000300008&lng=en&nrm=iso).
- Van Niekerk, R., & Sanders, D. (1997). Human Resource Development for health. Retrieved 10 March 2017 from In P. Barron (Ed.). *South African health review 1997* (pp. 91–98). Durban: Health Systems Trust.
- Van Rensburg, D., & Van Rensburg, N. (1999). Distribution of Human Resources. Retrieved 10 March 2017 from In A. Ntuli (Ed.). *South African Health Review 1999* (pp. 201–232). Durban: Health Systems Trust.
- Wadee, H., & Khan, F. (2007). Human Resources for Health. Retrieved 10 March 2017 from In S. Harrison, R. Bhana, & A. Ntuli (Eds.). *South African Health Review 2007* (pp. 141–150). Durban: Health Systems Trust.
- World Bank. World Bank Data base. Health expenditure per capita (current US\$). Washington DC: United States of America. (2014). Retrieved 10 March 2017 from < <http://data.worldbank.org/indicator/SH.XPD.PCAP> > .
- World Bank. World Development Indicators. Nurse and Midwives per 1000 people. Washington D.C.: United States of America. (2015). Retrieved 10 March 2017 from < <http://databank.worldbank.org/data/reports.aspx?source=2&series=SH.MED.NUMW.P3&country=2017> > .
- World Bank. World Bank Data base. Mortality rate, infant (per 1,000 live births). Washington DC: United States of America. (2015). Retrieved 10 March 2017 from < <http://data.worldbank.org/indicator/SP.DYN.IMRT.IN> > .
- World Health Organization (WHO) (2015a). *Health Workforce. Density of nursing and midwifery personnel (Total number per 1000 population)*. Retrieved 10 March 2017 from Geneva: World Health Organization. [http://gamapserver.who.int/gho/interactive\\_charts/health\\_workforce/NursingMidwiferyDensity/atlas.html](http://gamapserver.who.int/gho/interactive_charts/health_workforce/NursingMidwiferyDensity/atlas.html).
- World Health Organization (WHO) (2015b). *Workload Indicators of Staffing Needs (WISN)*. Retrieved 10 March 2017 from Geneva: World Health Organization. [http://www.who.int/hrh/resources/wisn\\_user\\_manual/en/](http://www.who.int/hrh/resources/wisn_user_manual/en/).
- World Health Organization (WHO) (2016). *Health workforce requirements for universal health coverage and the Sustainable Development Goals. Human Resources for Health Observer Series No 17*. Retrieved March 2017 from Geneva: World Health Organization. <http://apps.who.int/iris/bitstream/10665/250330/1/9789241511407-eng.pdf>.
- World Health Organization (WHO). Working together for Health. World Health Organization Report 2006. Geneva: WHO. (2006). Retrieved 10 March 2017 from < <http://www.who.int/whr/2006/en/> > .
- World Health Organization (WHO). A Universal Truth: No Health Without a Workforce. Geneva: World Health Organization. (2013). Retrieved 11 July 2018 from < <http://www.who.int/workforcealliance/knowledge/resources/hrhreport2013/en/> > .
- World Health Organization (WHO). Transforming and scaling up health professionals' education and training. World Health Organization Guidelines 2013. Geneva: World Health Organization. (2013). Retrieved 11 July 2018 from < [http://www.who.int/iris/bitstream/10665/93635/1/9789241506502\\_eng.pdf](http://www.who.int/iris/bitstream/10665/93635/1/9789241506502_eng.pdf) > .