Review Article

Pharmacy education in Nigeria: The journey so far

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ABSTRACT

The last four decades have witnessed developmental changes in pharmacy education in Nigeria. The paradigm change in the role of the pharmacist from a product-oriented to patient-oriented focus requires that the overall education of pharmacists be reorganized to meet the increasing changing roles. Curricular of schools of pharmacy in Nigeria are continually reviewed with the aim of attaining the dynamic competency required to reflect the paradigm shift in service focus and the development of the necessary clinical skills that will enable pharmacists to identify and meet the increasingly complex medication needs of patients. This review focuses on the historical development of pharmacy education from one school of pharmacy in the 1920s to about twenty schools 40 years later. The study looked at the continuous efforts made to produce the pharmacist with the requisite competency for the ever-changing roles in meeting the dynamic and varied needs of patients.

INTRODUCTION

Rapid changes are witnessed today in pharmacy education all over the globe due to the ever-changing and-evolving medicine-related needs of the society. Changes in pharmacy education and training are necessary for the professional to remain relevant to the society requiring pharmaceutical services. It is the mandate of the educational institutions to continue to provide the requisite education based on new knowledge. The training institutions can identify gaps in the training and quality of pharmacists to meet the continually changing and evolving medicine-related needs of the society. Information sharing on pharmacy education can help improve the training that would lead to improved competencies of the pharmaceutical workforce across the globe. Several studies have been reported on the development of pharmacy education and pharmacy practice in some parts of the world, including Canada, Middle East, France, Australia, United Kingdom (UK), and China.[1-6] Each of these countries have their peculiarities but the studies showed that the paradigm shift in the training of pharmacists to meet the divergent patients' medicines needs is a common denominator across the globe. The focus in pharmacy education is toward competencies in medicines-related needs of the community than on the product. Thus, the professional role of the pharmacists in hospitals and community pharmacies is changing from a focus on preparation, dispensing, and sale of medications to one in which pharmacists are involved in medication management and review consultation.[7]

Nigeria is the most populous country in Africa with abundant human resources. An understanding of pharmacy education in Nigeria would be of importance to other countries of the world that may require or use pharmaceutical workforce from Nigeria. Moreover, Nigeria is one of the countries that supply pharmacist workforce to North America, UK, and Canada, among others.[8-10] The profession and practice of pharmacy did not start in Nigeria as a well-defined health care area of specialization as it is today. Rather, pharmaceutical training was borne from the necessity to provide assistance to expatriate medical officers. A number of developments have taken place since 1960 in the education, legislations,

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and practice of pharmacy in various areas, including industry, hospital, and community.[11-14] However, due to increasing knowledge and understanding of the drug-related needs of the populace, corresponding efforts are being made to match the paradigm shift in the curriculum development and pharmacy education that would yield the desired competencies. The purpose of this article was to review and discuss the advances in pharmacy education in Nigeria.

LITERATURE SEARCH

Articles and reports on pharmacy education in Nigeria were searched in Pubmed, international pharmaceutical abstract, Google, and Google scholar. Websites of schools of pharmacy, Pharmacists Council of Nigeria, National Universities Commission (NUC), and other relevant institutions were visited to obtain information on the history, programs, teaching and learning methods, entry requirements, and development of pharmacy education in Nigeria.

HISTORY OF PHARMACEUTICAL SCIENCES EDUCATION IN NIGERIA

Pharmaceutical sciences education in Nigeria is historically rooted in the British educational system. Pharmacy education in Nigeria commenced in the early 1920s with the training of the Chemists and Druggists at the schools of pharmacy located at Yaba in 1927 (Western Nigeria) and Zaria in 1930 (Northern Nigeria). The Chemists and Druggists Diploma, patterned after the British education system, was the first minimum requirement for registration as Chemist and Druggist.[13,15] The entry requirement for the Diploma program was the postsecondary certificate obtained from the Nigerian College of Arts, Science and Technology (NCAST), Ibadan. The program also accepted candidates from secondary school with credits in the relevant science subjects in the General Certificate of Education 'Ordinary' Level (GCE 'O' Level) Level for a 5-year course instead of a 3-year course.

In 1957, the school of Pharmacy, Yaba, Lagos was moved to Ibadan as a Department in the former NCAST, Ibadan. University of Ife, Ile-Ife (now Obafemi Awolowo University), established in 1962, eventually took over the pharmacy program and continued to award the Chemists and Druggists Diploma as well as the Diploma in Pharmacy until June 1965. The degree-awarding pharmacy program of the university was concurrently started in September 1963 to replace the diploma program.[16] Thus, in 1966, Obafemi Awolowo University graduated the first indigenously trained pharmacists with Bachelor of Pharmacy (BPharm.; classified) degree. It was 7 years later that Ahmadu Bello University, Zaria, produced the first batch of Bachelor of Science (BSc.; classified) degree in Pharmacy (BSc.Pharm.), and became the second degree-awarding university in Nigeria. What is known today as the Faculty of Pharmaceutical Sciences in Ahmadu Bello University was the former school of Pharmacy, Zaria. The School of Pharmacy, Zaria, like its counterpart in the west, was integrated into Ahmadu Bello University in 1968 as a 3-year BSc. degree in Pharmacy. The pharmacy program of the university as a degree-awarding program was initially domiciled in the Department of Pharmacy and Pharmacology, Faculty of Science. In both universities, the conventional classification of first degree as first class, second class upper, second class lower, third class, or pass was applied to the pharmacy degree and the program duration was 3 years after advanced ('A') level. During this period, admission to university to study pharmacy was only by holders of Higher School Certificate (HSC), 'A' level General Certificate of Education, or the Interim Joint Matriculation Board (IJMB) examinations.[17] A 1-2 year postsecondary study in a school of preliminary or basic studies was usually necessary to prepare the candidates for these examinations.

Federal universities were established and situated to cater for the various regions of the country, and so were the schools of pharmacy. Obafemi Awolowo University was to the Western as Ahmadu Bello University, Zaria was to the Northern region. In the Eastern region, the pharmacy program at the University of Nigeria, Nsukka was established in 1967 but effectively took off in 1970.[18] University of Benin also established a degree program in pharmacy in 1970 to cater mid-Western Nigeria.[19] These regional schools laid the foundation for pharmacy education in Nigeria; and from this point, the schools of pharmacy ran degree programs as the minimum standard required for registration as a pharmacist with the regulatory body.

In the 1980s pharmacy programs were established at the Universities of Ibadan, and Lagos. During the same period, a Faculty Pharmaceutical Sciences was established at the Federal University of Technology, Makurdi, but was later moved to University of Jos when the Federal University of Technology was changed to Federal University of Agriculture.

More schools of pharmacy began to spring up from then till date. The ownership of Universities offering pharmacy has moved from what used to be solely Federal to include State, Mission, and private.

The watershed of pharmacy education in Nigeria

The year 1958 is regarded as the watershed of pharmacy education in Nigeria. In this year, the Pharmacists Board (then known as Pharmacy Board) revised the syllabus of the Northern Dispensers' Course and ordered that the 2-years practical training certificate programme be changed first to a 9-month, full-time course and later upgraded to lead to the Chemists and Druggists Diploma.[13] The School of Pharmacy, Zaria, was integrated into the Institute of Health, Kaduna and later into the Ahmadu Bello University, Zaria in 1966. The School of Pharmacy, Yaba was transferred to the Nigerian College of Science, Ibadan in 1958 (a precursor of the University of Ife or Obafemi Awolowo University), and its graduates were prepared for the Diploma in Pharmacy, Nigeria [Dip. Pharm. (Nig)] vis a 3-year curriculum based on the BPharm. UK Course.[11] A Curriculum Conference was held at Ibadan in 1958 to harmonize the Nigerian and UK syllabi and holders of the diploma from Nigerian schools of pharmacy were also allowed a 3-year study in a British School of Pharmacy to BPharm. (UK) degree.

PHARMACY PROGRAMS OFFERED IN NIGERIA

Table 1 shows the accredited schools of pharmacy in Nigeria and their years of establishment.[15,16,19-25] At the inception of training of pharmacists in Nigeria, two broad approaches were used; one emphasized the training of the pharmacist as a professional and the other as the professional pharmacist and scientist at the same time. These approaches defined the nomenclature of the faculties and the core courses they offer. The school of pharmacy is either known as Faculty of Pharmacy or Faculty of Pharmaceutical Sciences, depending on how the founding fathers defined pharmacy, as a profession or an applied science.

Table 1: Accredited pharmacy educational institutions in Nigeria and year program established

Institution	Nomenclature	Year established	Program	Duration (year)
Federal institutions				
Precursor institutions				
Yaba College	School of Pharmacy	1927	Diploma	3*
School of Pharmacy, Zaria	School of Pharmacy	1930	Diploma	3*
Universities				
Ahmadu Bello University	Fac. Of Pharm. Sciences	1968	B.Sc. Pharm. (1970-1982)	3*
			B. Pharm.(1983-1987)	3*
			B. Pharm. (Declassified, 1987-date)	4*/5
Obafemi Awolowo University	Faculty of Pharmacy	1962	B.Sc. Pharmacy	3*
			B. Pharm	3*
			B. Pharm (Declassified, 1987-date)	4*/5
University of Nigeria, Nsukka	Faculty of Pharm. Sciences	1970	B. Pharm	3*
			B. Pharm. (Declassified 1993-date)	4*/5
University of Benin	Faculty of Pharmacy	1970	B. Pharm	3*
			B. Pharm. (Declassified 1993-date)	4*/5
			PharmD (2007-date)	5*/6
University of Ibadan	Faculty of Pharmacy	1980	B. Pharm	3*
			B. Pharm (Declassified 1992-date)	4*/5
University of Lagos	Faculty of Pharmacy	1980	B. Pharm (Declassified in 1993)	4*/5
University of Jos	Faculty of Pharm. Sciences	1982	B. Pharm. Declassified	4*/5
University of Maiduguri	Faculty of Pharmacy	2001	B. Pharm Declassified	4*/5
Nnamdi Azikiwe University, Awka	Faculty of Pharm. Sciences	2007	B. Pharm to date	5
University of Uyo	Faculty of Pharmacy		B. Pharm	5
Niger-Delta University	Faculty of Pharmacy	2002	B. Pharm	5
State institution				
Olabisi Onabanjo University, Ago-Iwoye	Faculty of Pharmacy		B. Pharm	5
Private/missionary institution				
Madonna University, Elele	Faculty of Pharmacy	2003	B. Pharm	

*Admission by direct entry into the program after 'A' level examination certificate

For example, the pharmacy program at Obafemi Awolowo University is run in the Faculty of Pharmacy and the core courses were Pharmaceutical Chemistry, Pharmacognosy, Pharmacology, and Pharmaceutics and awarded BPharm., whereas the counterpart at Ahmadu Bello University is Faculty of Pharmaceutical Sciences and the core courses were Pharmaceutical and Medicinal Chemistry, Pharmacognosy and Drug Development, Pharmacology and Therapeutics, and Pharmaceutics and Pharmaceutical Microbiology and awarded BSc. in Pharmacy. The schools of pharmacy devoted different time to the teaching of components of the course based on their philosophies. The summary of percentage contribution of various subjects taught in schools of pharmacy to pharmacy degree program in Nigeria is shown in Table 2.[26] Anatomy was offered only at the University of Benin while Pathology and Computers in Pharmacy were offered only in the Faculty of Pharmaceutical Sciences, Ahmadu Bello University, Zaria. Obafemi Awolowo University and University of Nigeria taught only Biochemistry and Physiology outside the core pharmacy courses, as shown in the table. Subsequent schools of pharmacy fall into one of the above approaches in nomenclature in a regional fashion. West and mid-Western regions predominantly use Faculty of Pharmacy while the North and the Eastern regions predominantly use Faculty of Pharmaceutical Sciences. The ease of recruitment of staff from an existing school of pharmacy within a region or contiguous one to start a new school of pharmacy had influence on the philosophy of the new school. Although the differences in the nomenclature of the faculties remain till today, there is a unified minimum benchmark for all the faculties offering pharmacy education in the country.[27] Since the late 1980s, schools of pharmacy have a common focus in developing a clinically oriented pharmacist. In early 1980s, the Pharmacists Council of Nigeria directed that the faculties offering pharmacy education should emphasize clinical pharmacy practice in the bid to train a patient-oriented professional. The development of a new curriculum led to the upward review of the duration of the course from a 3-year to a 4-year course by Direct Entry (DE) mode of entry to university undergraduate program. BPharm. degree became the accepted nomenclature and the degree awarded with the new curriculum became a "declassified" BPharm. degree. The minimum pass mark was also raised from 40% to 50% and a cumulative performance equivalent to a second class lower became the minimum requirement for graduation.[27,28]

Table 2: Percentage contribution of various subjects (theory) to the whole B. Pharm. Degree programs of Nigerian schools (1985)

Subjects	Schools ((theory) hr % contribution)			
	Zaria	Benin	Ife	Nsukka
Pharmaceutics	305 (18.9)	195 (14.4)	154 (11.3)	150 (13.4)
Pharm. Micro-biology	105 (6.5)	150 (11.1)	140 (10.3)	120 (10.7)
Pharm. Chem	285 (17.7)	180 (13.3)	252 (18.6)	200 (17.9)
Pharmacology	210 (13.4)	240 (17.8)	154 (11.3)	110 (9.8)
Pharmacognosy	230 (14.3)	90 (6.7)	224 (16.5)	100 (8.9)
Clin/Hosp. Pharm	240 (14.9)	150 (11.1)	112 (8.3)	70 (6.3)
Pharm. Management	60 (3.7)	45 (3.3)	56 (4.1)	80 (7.1)
Pharm. Law/Ethics	30 (1.8)	30 (2.2)	28 (2.1)	30 (2.7)
Physiology	60 (3.7)	120 (8.9)	70 (5.2)	60 (5.4)
Biochemistry	60 (1.8)	60 (4.4)	56 (4.1)	80 (7.1)
Maths/Biostatistics	75 (4.6)	-	112 (8.3)	120 (10.7)
Anatomy/Histology	-	45 (3.3)	-	-
Pathology	30 (1.8)	-	-	-
Computers and Pharmacy	60 (3.7)	-	-	-

Source: Wambebe, C.O., Training of Pharmacists to meet the nation's needs in *The Nigerian Journal of Pharmacy*, Vol. 16, No. 5, 11/12/85[2]

The call for admission into this new BPharm. program to study pharmacy appeared in the Joint Admission and Matriculation Board (JAMB) brochure of 1984[29] that would lead to the award of BPharm. degree after the completion of the course with a duration of 4 years (DE) or 5 years (UME). It was convenient for Obafemi Awolowo University that had been running BPharm. degree program classified since the 1960s to declassify the degree with the 1987 set without attaining the 4-years duration specified in the JAMB brochure. In this way, OAU technically became the first university to graduate the BPharm. declassified but Ahmadu Bello University was the first university to graduate the BPharm. declassified degree,[30] 4 years after the JAMB advertisement. This was because the admission to the schools of pharmacy at this time was by DE. The BPharm. degree, declassified, has remained the minimum national pharmacy program for registration as pharmacist with the national regulatory body till date.

A new core syllabus for a 5-years Pharmacy course (UME) was eventually outlined by the NUC in 1989, just before the Gray Longe Commission Review of Higher Education in Nigeria.[31] The NUC introduced the semester system in 1990 to replace the academic system based on terms. Two semesters of at least 15 weeks replaced the three terms of 12-15 weeks in an academic session. Other changes included the mode of entry to universities. Before this time, admission to some programs, such as pharmacy,

medicine, and law in some universities like Ahmadu Bello University programs was based on DE and an academic year consisted three terms, each lasting for 12-15 weeks. The directive of 1990, however, unified the mode of entry to all programs in Nigerian universities, making it possible to enroll into any program through DE or UME. Credit units system in the allocation of lectures and grade computation were introduced. One credit unit means 1 hour of lecture per week or 3 hours of practical per week. The semester consists of 17-18 weeks of lectures, practical, and clinical ward rounds and a minimum of ten (10) or eight (8) semesters are required for graduation by candidates who enter the university from secondary or by DE mode of entry, respectively. The new curriculum includes clinical pharmacy, anatomy course, and organized clinical ward rounds that were absent in the old program that paid little attention to patient care. According to Adenika,[13] the revised syllabus, although it reformed the pharmacy core curriculum, it was not the outcome of a fundamental curriculum study and review.

Improvement on the curriculum was reflected in the 2007 NUC benchmark and the minimum academic standards for pharmaceutical sciences and emphasizing pharmaceutical care. Indication of the acceptance of a Doctor of Pharmacy (PharmD) degree as the future minimum qualification for registration as pharmacist in Nigeria was its inclusion in that benchmark.[28] PharmD program, first introduced in the United States of America (USA), is all about pharmaceutical care. The PharmD curriculum provides students with course work and clinical preparation that is basic to understanding the diagnosis and treatment of diseases, and the therapeutic use, appropriateness, selection, monitoring, and cost-effectiveness of drugs. Students participate in a variety of learning opportunities that are necessary for educating and counseling patients, and for understanding and appreciating the social, emotional, and psychological implications of diseases. The PharmD professional program fulfill the educational aspect of the requirements for licensure as a pharmacist. This full-time, 4-year program prepares students to practice in community or hospital settings, in technological or administrative positions in the pharmaceutical industry, and for some teaching positions in schools or colleges of pharmacy.[32] The duration of study prescribed in the curriculum for the PharmD is 6 years through UME. At the moment, it is only University of Benin that is offering PharmD in the country. University of Benin has begun to offer Doctor of Pharmacy degree program alongside the BPharm. degree for close to a decade now. A number of schools of pharmacy in the country are at various stages of implementing the PharmD program. University of Jos, for example, has obtained the approval of the university senate to commence the program. The final endorsement lies with the regulatory body, PCN. The benchmark for pharmacy education in Nigeria is issued by the PCN and a school of pharmacy is accredited based on meeting the basic benchmark.[27,28,33] Table 2 shows the educational institutions awaiting accreditation from the PCN.

REGULATION OF PHARMACY EDUCATION IN NIGERIA

To appreciate pharmacy education in Nigeria, it is important to understand that pharmacy education is regulated by both the Ministries of Education and Health. It is the responsibility of the NUC,[34] (an agency in the Federal Ministry of Education, FME) to accredit programs in all Nigerian Universities. Established in 1962, The NUC was an advisory agency in the Cabinet Office until 1974 when it became a statutory body and it is a parastatal under the FME charged with the responsibility of: (i) Granting approval for all academic programs run in Nigerian universities; (ii) Granting approval for the establishment of all higher educational institutions offering degree programs in Nigerian universities; (iii) Ensure quality assurance of all academic programs offered in Nigerian universities; and (iv) Channel for all external support to the Nigerian universities.

The pharmacist Council of Nigeria, on the other hand, is a statutory body established under the Pharmacists' Council of Nigeria Act[35] and is responsible for:

- Determining the standard of knowledge and skill to be attained by persons seeking to become registered members of the Pharmacy Profession (in this Act referred to as the profession) and reviewing those standards, from time to time as circumstances may require
- Securing in accordance with the provisions of this Acts, the establishment and maintenance of register of person entailed to practice as members of the profession and the publication, from time to time of lists of those persons
- Reviewing and preparing from time to time, a statement as to the code of conduct which the council considers desirable for the practice of the pharmacy profession
- Regulating and controlling the practice of the profession in all its aspects and ramifications.

Table 4 shows the benchmark for pharmacy education in Nigeria drawn by The Pharmacists Council of Nigeria, from which the faculties draw out their training programs.[27,28] Both NUC and PCN independently carry out routine accreditation of the institutions to assure quality. The school of pharmacy would usually work toward achieving the minimum requirements. The PCN ensures that such curriculum approved by the University Senate meets the minimum benchmark requirements.

ENTRY CRITERIA FOR PHARMACY PROGRAM

The basic requirement for baccalaureate program in any Nigerian universities is a minimum credit pass in five subjects at not more than two sittings at the GCE 'O' Level administered by the West African Examinations Council (WAEC) or the National Examination Council (NECO), including Mathematics and English language. Admission to universities in Nigeria is done centrally by the JAMB. Two modes of admission to Nigerian universities exist-Unified Tertiary Matriculation Examination (UTME), formerly called Universities Matriculation Examination (UME) or by DE. The UTME subjects for a prospective pharmacy student are Physics, Chemistry, Biology, and English language and JAMB determines the cut-off score. DE admission to pharmacy is offered to those who obtained sufficient points in Physics, Chemistry, and Biology at GCE 'A' level or its equivalent, in which case they would be admitted to the second year (200 level) instead of 100 level. A new dimension to the DE mode of entry that was not allowed previously is the acceptance of candidates with a bachelor degree in a science-based program from a recognized university. Student enrolment into a program in Nigerian universities is regulated by the NUC and the relevant professional regulatory body based on the carrying capacity of the institutions.[23,24] This carrying capacity varies from 50-100 depending on the facilities and personnel available in an institution. For example, a ratio of 1:10 of academic staff to student is recommended by the NUC.[28] A 1:19 academic staff to student has, however, been reported.[36] With only 13 accredited universities for pharmacy programs across the country, competition for entry into pharmacy programs is intense. Thus, many individuals who may meet minimum published admission requirements do not always gain admission to a pharmacy program.

Nigeria has a population of over 160 million and there are 129 universities in Nigeria comprising 40 federal, 38 State, and 51 private universities accredited by the NUC. Out of these, 13 are currently accredited by the Pharmacists Council of Nigeria to run pharmacy program leading to the award of BPharm. degree.[16-25]

Table 3: Pharmacy educational institutions processing accreditation with the pharmacists council of Nigeria

Institution	Nomenclature
Federal institutions	
Uthman Danfodio University	Faculty of Pharm. Sci
University of Ilorin	Faculty of Pharm. Sci
University of Port Harcourt	Faculty of Pharm. Sci
State institutions	
Gombe State University	Faculty of Pharm. Sci
Delta State University,	Faculty of Pharmacy
Kaduna State University	Faculty of Pharm. Sci
Private Institution	
Igbinedion University, Okada	Faculty of Pharmacy

Table 4: Pharmacist council of Nigeria benchmark for pharmacy schools in Nigeria summary of courses and credit units in each year of study

Subject	Lectures (units)	Practical (units)	Total units
First year courses (100 level)			
Physics	8		
Chemistry	8		
Biology	8		
Mathematics	6		
General studies courses	5		
Introduction to pharmacy	1		
Total	36		
Second year courses (200 level)			
Pharmacognosy	3	1	4
Pharmaceutics/ pharmaceutical technology	4	3	7
Pharmaceutical microbiology	2	1	3
Pharmaceutical chemistry	4	1	5
Anatomy/histology	3	1	4
Physiology	4	1	5
Biochemistry	3	1	4
Entrepreneurship studies	1	1	2
Information communication technology	1	1	2
Total	25	11	36
Third year courses (300 level)			
Pharmacognosy	3	1	4
Pharmaceutics	1	2	3
Pharmaceutical microbiology	2	1	3
Pharmaceutical chemistry	4	1	5
Administrative pharmacy	2	-	2
Pharmacology	4	2	6

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Clinical pharmacy	2	-	2
Pharmaceutical technology	2	1	3
Entrepreneurship studies	1	1	2
Pathophysiology	2	-	2
SIWES	-	2	2
Total	23	11	34
Fourth year courses (400 level)			
Clinical pharmacy	5	-	5
Pharmaceutical Analysis	1	1	2
Pharmacognosy	1	1	2
Pharmaceutics	1	1	2
Pharmaceutics Microbiology	3	1	4
Pharmaceutical Chemistry	2	1	3
Administrative Pharmacy (Jurisprudence/Management)	6	-	6
Pharmacology	3	1	4
Pharmaceutical Technology	2	1	3
Information and Communication Technology in Pharmacy	1	1	2
Biotechnology	1	1	2
Veterinary Pharmacy	2	-	2
SIWES	-	2	2
Total	28	11	39
Fifth year courses (500 level)			
Clinical Pharmacy	5	3	8
Pharmaceutical Analysis	1	1	2
Pharmacognosy	1	1	
Pharmaceutics Microbiology	1	1	2
Pharmaceutical Chemistry	1	-	1
Pharmacology	3	-	3
Pharmaceutical Technology	2	1	3
Toxicology	2	-	2
Project	-	4	4
Total	16	11	27

One each of the accredited institutions is owned by a State and a private religious organization while the remaining are owned by the Federal Government [Table 3], and are spread throughout the country's six geo-political regions. Table 4 shows universities that their pharmacy programs are yet to receive accreditation by the PCN.

TEACHING AND LEARNING METHODOLOGIES IN SCHOOLS OF PHARMACY IN NIGERIA

The benchmark for pharmacy education encourages the use of lectures, tutorials, case studies, and practical as methods of imparting knowledge to the pharmacy students.[27,28] The most commonly used method is didactic method. The delivery mode has shifted from the chalk and board to use of projectors in lecture presentation. E-learning methods are employed in some school.[37,38] For example, the university of Jos supplementary lectures are on the university website and students can access the notes under the Modular Object-Oriented Dynamic Learning Environment (Moodle) e-learning program.[37] Computer laboratories are now common place in many faculties offering pharmacy education in Nigeria. University of Benin developed a computer-teaching laboratory christened "e-learning center" for both staff and students to improve teaching and learning.[38] Universities recognize the important role of internet and telecommunication technology (ICT). In a study conducted at the University of Benin, for example, the actual use of ICT is limited but many schools of pharmacy are embracing it in their teaching and learning. Ward rounds of at least 3 hours weekly is a practical component of the clinical pharmacy curriculum. The students participate in clinical ward rounds sometimes with physicians or their supervisor and note patients' medication profile. Each student is assigned a patient to observe and interact with on medication-related issues. Case presentations are made by the students and are discussed. At the moment, documented experiences of the students and their teachers during the ward rounds and bed side pharmacy practice is nonexistent. Studies show the willingness of pharmacists to participate in pharmaceutical care, with more positive attitude being displayed by those younger in practice.[39,40] Studies on the perception and attitude of pharmacists on pharmaceutical care have been reported and may be useful in assessing the program.[39-46] These studies showed that pharmacists had positive perception of their participation in ward rounds, some of whom were already involved in the exercise on a low scale. Peer reviews of patients' cases were frequently conducted in some hospitals, but were usually dominated by the physicians. The researchers showed that the clinical role of the pharmacists was not clearly defined in respect to ward round and that the impact in patient care activities during ward round at the time of these studies was not significant. Lack of support by the hospital administration and resistance from the physicians were identified as some of the external hindrances to effective participation in ward rounds. A comprehensive analysis of the impact of pharmaceutical care by pharmacists is yet to be made and known.

Another component of the teaching and learning methods in pharmacy education in Nigeria is the Student Industrial Work Experience Scheme (SIWES).

This is a scheme designed by the Federal Government of Nigeria and managed by Industrial Training Fund (ITF), whereby students of Engineering, Agriculture, Pure and Applied sciences, and other technically related fields[47] spend a continuous 6 month period in a related industry to bridge the classroom lectures with practice.[47] This program is a component of the curriculum approved by the NUC and successful participation is necessary for graduation.[48] At inception, this program was broken into 2 of 3 months and the students could use their long holidays to gain experiences at the hospital, industry, and community pharmacy setting. Many schools of pharmacy still allow students to embark on SIWES during the long vacations in the third and fourth year of study. The challenges of the SIWES program articulated by Olabiyi[49] *et al*., are applicable to those in pharmacy and may include inadequate supervision of students by both university teachers and industry-based supervisor, lack of insurance cover for both students and their teachers, and the inability of ITF and industries to provide welfare services among others. This program provides the students with the opportunity of working in any area of pharmacy practice like hospital, community, and industry and helps the students to appreciate the relationship between the classroom theory and the practice. SIWES still remain a very important tool for integrating the academia and the industry and providing information on the areas needing improvement. The advent of student ward rounds would significantly increase the bedside experiences of students but experiences in other areas of pharmacy practice, such as community, industrial, administrative etc., may still require the SIWES program. The teaching and learning methodologies in pharmacy education cannot be completely discussed without mentioning that the drivers in higher education such as technology, globalization, increasing demand for accountability, changing demographics, economy, changing employers' needs, and changing students' needs.[50,51] will continue to define the landscape of teaching and learning in higher education. More innovative methods of learning and teaching are bound to emerge in the years ahead.

CLINICAL PHARMACY EDUCATION

The future of pharmacy as a health care profession lies in its ability to contribute to the rational use of medication in health care. Pharmaceutical care is the philosophy of practice that will facilitate this future. Pharmacy education has a corresponding responsibility to promote the philosophy within the profession and to the public and to prepare students who are competent to render pharmaceutical care in practice. The mandatory creation of Department of Clinical Pharmacy as a core department from the existing Department of Pharmacology in schools of pharmacy in Nigeria became imperative as a foundational step to focusing the teaching and training of pharmacists in line with the BPharm. declassified curriculum. Today, the department is known by different nomenclatures, depending on the school. Clinical department exists in schools of pharmacy in any of the following three formats:

- Department of Clinical Pharmacy and Pharmacy Practice
- Department of Clinical Pharmacy and Pharmacy Administration
- Department of Clinical Pharmacy and Biopharmacy.

Of the 13 approved school of pharmacy, it is only University of Lagos and University of Uyo that domicile Biopharmaceutics with clinical pharmacy to emphasize the role of bioavailability and therapeutic effectiveness in patients' medication. Pharmacy Practice and Management is a separate department. Association of clinical pharmacy with either Pharmacy Practice or Pharmacy Administration is in vogue, which is the suggested nomenclature in the NUC minimum benchmark document.[28] Basic components of clinical pharmacy practice include prescribing drugs, administering drugs, documenting professional services, reviewing drug use, communication, counseling, consulting, preventing medication errors etc. Drug information, drug utilization, drug evaluation and selection, medication therapy management, formal education and training programs, disease state management, and application of electronic data processing (EDP) are the scope of clinical pharmacy. This aspect of pharmacy is where pharmacists provide patients care that optimizes the use of medication and promotes health, wellness, and disease prevention. Clinical pharmacy movement initially began inside hospitals and clinics and clinical pharmacists often collaborate with physicians and other health care professionals.

In Nigeria, clinical pharmacy education emerged in the 1980s. Investigation on the percentage contribution of clinical pharmacy to BPharm. degree program taught in Nigerian schools in 1985 showed that Ahmadu used 240 hours (14.9%); University of Benin, 150 hours (11.1%); Obafemi Awolowo University,

112 hours (8.3%); and University of Nigeria, Nsukka, 70 hours (6.3%) in the teaching of the course, as a component of the BPharm. program. Nowadays, the benchmark for pharmacy education articulated by the *NUC* and *PCN* has unified the number of hours per week to be devoted to the teaching of theory and the practical.[27,28] A minimum of 5 hours weekly in the penultimate year and 8 hours (consisting of 3 hour practical and 5 hour theory) weekly in the final year per semester have been prescribed. The practical hours are spent in the hospitals. The students participate in ward rounds and are exposed to patient medication profiles and drug-related problems. This exposure is aimed at helping the students develop the necessary skills and attitude in pharmaceutical care.

For the desired benefits from pharmaceutical care to be realized, the stakeholders in the health care delivery system need to work as a team for the common good of the patient. Other members of the health care team must be appropriately educated on the expected benefits of pharmaceutical care to the system to win their cooperation. Available studies show that there is low cooperation between pharmacists and physicians on pharmaceutical care.[45,46]

The program needs infrastructural and other support from hospital administrations to succeed. Nowadays, the design and facilities in the pharmacy department of many of the hospitals have been revolutionized to facilitate better patient-related pharmaceutical services. General Hospital, Minna, Niger State was one of the first institutions to provide private consultation rooms for pharmacists to enhance their professional responsibilities to the patients. University of Jos Teaching Hospital has over the years moved from a one pharmacy stop to several units such as pediatric, psychiatric, obstetrics, and gynecology pharmacies in line with best pharmaceutical practices. Teaching and other government hospital pharmacies have been reorganized to different degrees to better serve the community.[52-55] Routine clinical seminars are held in the pharmacy of many teaching and general hospitals today where experiences are shared for continuous understanding of the practice and improvement in the delivery of pharmaceutical services to patients and physicians.

The next phase in the development of pharmacy education is the full actualization of pharmaceutical care through the *PharmD* curriculum. Studies have shown that pharmacy students are willing to participate in pharmaceutical care in order to assist the patient in their medication problems.[56] The benchmark has been set by the NUC for schools of pharmacy to adopt. Pharmaceutical Society of Nigeria (PSN) has thrown her weight behind the actualization of PharmD program and has encouraged all schools of pharmacy to switch over from BPharm to PharmD.[57] This is important because lack of understanding of the concept within the profession can thwart or delay the intended changes.[58,59] Continuous education and sensitization are good tools to achieve cooperation.[42,43] Because of their knowledge and skills in drug therapy and their accessibility to patients, pharmacists with the requisite clinical training and professional education are positioned to help patients, other health care professionals and the health care system achieve more effective and efficient drug therapy outcomes.[66,67].

POSTGRADUATE STUDIES

Schools of pharmacy have traditionally offered postgraduate education in pharmaceutical sciences, usually involving research. This serves as a means of developing and providing pharmacist manpower with requisite competencies in academia and in health care delivery system. Through the various research programs at the postgraduate levels, the schools of pharmacy are able to understand the societal medicines needs and generate information that can help in appropriate policy formulations and decision making. Through postgraduate education, research skills and attitudes are acquired by younger researchers for the preservation of quality and standards in higher education. Capacity building and capital development are the main thrust of postgraduate studies.

The main objectives of postgraduate education would usually include the following:

- Developing the spirit of enquiry in the postgraduate students through training in their research in an atmosphere of intellectual independence and individual creativity combined with a strong sense of teamwork
- Fostering, through instruction, a deeper understanding of key concepts and an increasing ability to apply fundamental ideas to new problems in the students. The student in the postgraduate school must, therefore, be made to realize quite early that intellectual growth and subsequent success are directly related to the depth of command of basic principles and ability to apply those principles. Hence, although

postgraduate studies are usually associated with a high degree of specialization, such specialization must be achieved in the context of extending mental horizons, producing new orientations, and developing a depth of understanding in the relevant discipline
- Providing training in research for those whose future careers will lie in teaching and research at university level, and for those who may have to operate in research and development situations in public or private sectors
- Providing both short- and long-term training facilities aimed at improving and upgrading the existing and potential high-level manpower needed for planning, implementing, and reviewing national development plans as well as improved productivity and performance in the private sector.

Opportunities are available for pharmacy graduates in Nigeria to pursue postgraduate studies. The universities, which are the traditional academic institutions, carry out postgraduate education. Complementary institutions that carry out postgraduate education for pharmacists in Nigeria include the West African Postgraduate College of Pharmacists and the Pharmacists Council of Nigeria in the form of mandatory continuous professional development programs.

Universities have continued to carry out postgraduate academic training for pharmacist wishing to advance their knowledge in the various core areas of pharmacy education such as pharmaceutics, pharmaceutical and medicinal chemistry, pharmacognosy, toxicology, pharmacology, therapeutics, pharmaceutical microbiology, and pharmaceutical technology. In terms of clinical pharmacy postgraduate education, the universities at Lagos, Nsukka, Ibadan, and Benin offer clinical pharmacy at postgraduate level.

Problems of postgraduate education in Nigeria have been identified to include inability of students to graduate at stipulated time due to lack of functional equipment, finance, and quality of supervision.[60-62]

The West African Postgraduate College of Pharmacists plays a significant role in the postgraduate training of pharmacists in the Anglophone West African countries. The West African Postgraduate College of Pharmacists is an arm of the West African Health Community (WAHC) that was established in 1990 in response to the growing and diverse patients' medicines needs that the pharmacists have to respond to. The West African Pharmaceutical Federation (WAPF) was formed in 1976 for the region but the Francophone countries later withdrew from the federation.[63] The college had the following faculties in which candidates can specialize: Production and quality control, clinical pharmacy, community pharmacy. The curriculum of the college is continuously been reviewed in line with best practices and recently the faculty of community pharmacy was replaced with the faculty of public health. Residency programs have been introduced using industry, community pharmacies, and hospitals as the training sites. Students are attached to an institution for a period of 6 months, after which they write a report on their experiences. The National Council on establishment (NCE) in Nigeria recently recognized the Fellowship Certificate issued by the West African Postgraduate College of Pharmacists (WAPCP) as a prerequisite for appointment to the consultancy grade for pharmacist in the civil service.[64]

Other postgraduate professional program that is designed to update the knowledge of the practicing pharmacists is the mandatory continuous professional development (MCPD) of the PCN. In early 2000, the Pharmacists Council of Nigeria commenced the conduct of MCPD in designated centers across the country. The program was designed in modules, each for a year. It was made a prerequisite to annual renewal of license to practice. The program was mounted at various centers across the country. Universities and research institutions were used as the training sites. Due to the nonlegal backing in tying the annual registration to practice to the participation in the update lectures, it suffered some legal setbacks.

INTERNATIONAL COMPETENCY OF NIGERIAN PHARMACISTS AND OPPORTUNITIES FOR PRACTICE

Nigeria is one of the countries (Egypt, India, Korea, Nigeria, etc.,) that are the traditional suppliers of pharmacist's workforce to the USA.[8-10] Pharmacists in Nigeria practice in a wide array of fields, which include community, hospital and administration, academia, industry, and military. The educational programs of Nigerian schools are generally designed for international competence and the curricula for pharmacy education captured this.[28] Consequently, pharmaceutical science education in Nigeria has always prepared the professional for competency

outside the shore of Nigeria and the graduate of pharmacy could work anywhere in the world.[28] It has been reported in literature that Canadian and Nigerian pharmacy graduates ranked the highest in the Foreign Pharmacy Graduate Equivalency Examination (FPGEE) in the USA.[9] In that study of applicants performance in 2000 and 2001 equivalency examination, Nigerian and Canadian pharmacists had over 95% pass rate, whereas the pass rate for Egypt, India, Philippine, and Korea were respectively 79%, 66%, 57%, and 40%. The examinations are set with the objective of ascertaining the competencies of the migrants wishing to contribute to the pharmacists' workforce in the USA. It can therefore be a reliable measure of educational outcomes or institutional effectiveness; it can also be adjudged a reliable and valid criterion to assess the quality or success of international pharmacy programs.[9] Due to the interdisciplinary nature of the academic workforce in pharmacy schools, consisting of chemists, microbiologists, biochemists, pharmacologists, physicians, and pharmacists among others, it is hard to distinguish scholarly works attributable to pharmacists. It is an undeniable fact that the skills, knowledge, and attitude acquired from the schools of pharmacy are due to contribution from all the trainers. And although accurate data are scanty, many Nigeria academia training pharmacists have distinguished themselves internationally in their chosen disciplines and have articles in high-profile international journals. In the Scimago ranking of countries, Nigeria was listed on 51st out of 237 countries, where South Africa and Egypt took 35th and 42nd, respectively, in the 1996–2012 ranking.[65] During the period, under the subject area of pharmacology, toxicology, and pharmaceutics in the Pharmaceutical Sciences Subject Category citable documents, Nigeria was ranked 35th while Canada, Egypt, and South Africa were ranked 11th, 20th, and 37th position, respectively, out of 170 countries. USA, Germany, China, and India were in the ranking order of 1st to 4th, respectively. Pharmacy graduates from Nigerian pharmaceutical education are in UK and USA where they excel in their chosen career.

FUTURE DIRECTIONS OF THE PROFESSION OF PHARMACY-CURRENT CHANGES AND CHALLENGES

The prospects of the pharmacy profession are intrinsically linked with the education and training of pharmacists to respond to the medicine-related needs of the society. A continuous deliberate understanding of the drug needs of the patient and proffering solutions to them would make the pharmacist relevant. It has been realized that the only way to be relevant to the patient and properly contribute in the health care delivery is to move toward the PharmD program; and Nigeria must do this passionately. The challenge would be the mode of operation of this program and making every stakeholder realize the benefits of the patient-oriented pharmacy practice. Nigeria can learn from North America on how this can come about. If it is realized among health professionals that patient is the reason for the professional duties, it would be easier to work together in a complementary fashion. Because of their knowledge and skills in drug therapy and their accessibility to patients, pharmacists with the requisite clinical training and professional education are positioned to help patients and other health care professionals, and thus the health care system could achieve more effective and efficient drug therapy outcomes.[66,67] Drug therapy has become one of the cornerstones of modern health care delivery.

One may reflect that USA is an industrialized country with highly developed research and development programs and with facilities that offer unlimited opportunities to scientists. New molecules are continually investigated, developed, and commercialized. The government and agencies still offer funding opportunities to scientists to research and improve on the health care delivery of the people. The health professionals in the USA have come to mutually understand the importance and benefits of synergistic and collaborative efforts among professionals in service delivery to the patient.[68,69] And finally, private sector is the major employer of labor compared to the developing countries like Nigeria where the major employers of labor are the federal and states governments and their agencies. The future pharmacy practice would involve more professional collaborations for better patient satisfaction. Good understanding of public health, entrepreneurship, and administration would be an invaluable asset to the clinical pharmacist.

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