



USAID
FROM THE AMERICAN PEOPLE



SPS 
Strengthening
Pharmaceutical
Systems



Exploring the Establishment of a Pharmacy Course at the University of Namibia

For better health worldwide

**Technical Report:
Exploring the Establishment of a Pharmacy Course at the
University of Namibia
March 12–27, 2009**

Tina Brock
Tana Wuliji
Evans Sagwa
David Mabirizi

Printed: July, 2009



Strengthening Pharmaceutical Systems
Center for Pharmaceutical Management
Management Sciences for Health
4301 N. Fairfax Drive, Suite 400
Arlington, VA 22203 USA
Phone: 703.524.6575
Fax: 703.524.7898
E-mail: sps@msh.org

This report is made possible by the generous support of the American people through the U.S. Agency for International Development (USAID), under the terms of cooperative agreement number GHN-A-00-07-00002-00. The contents are the responsibility of Management Sciences for Health and do not necessarily reflect the views of USAID or the United States Government.

About SPS

The Strengthening Pharmaceutical Systems (SPS) Program strives to build capacity within developing countries to effectively manage all aspects of pharmaceutical systems and services. SPS focuses on improving governance in the pharmaceutical sector, strengthening pharmaceutical management systems and financing mechanisms, containing antimicrobial resistance, and enhancing access to and appropriate use of medicines.

Recommended Citation

This report may be reproduced if credit is given to SPS. Please use the following citation.

Brock, T, Wuliji, T, Sagwa, E, Mbirizi, D. 2009. *Technical Report: Exploring the Establishment of a Pharmacy Course at the University of Namibia, March 12–27, 2009*. Submitted to the U.S. Agency for International Development by the Strengthening Pharmaceutical Systems (SPS) Program. Arlington, VA: Management Sciences for Health.

Strengthening Pharmaceutical Systems
Center for Pharmaceutical Management
Management Sciences for Health
4301 North Fairfax Drive, Suite 400
Arlington, VA 22203 USA
Telephone: 703.524.6575
Fax: 703.524.7898
E-mail: sps@msh.org
Web: www.msh.org/sps

CONTENTS

Acronyms.....	v
Acknowledgments.....	vii
Executive Summary.....	ix
Findings.....	ix
Recommendations.....	x
Background.....	1
Purpose of Consultancy.....	3
Scope of Work.....	5
Activities.....	5
Collaborators and Partners.....	5
Adjustments to Planned Activities and/or Additional Activities.....	7
Overview of Human Resources Issues Related to Pharmaceutical Training.....	9
Private Sector Labour Market.....	10
Public Sector Labour Market.....	11
Pharmacist Workforce Distribution.....	13
Pharmacist Workforce Needs Versus Projected Supply and Attrition.....	15
Human Resource Planning.....	18
Overview of Educational Issues Associated with Pharmaceutical Training.....	21
Primary and Secondary Education.....	21
Pharmacist’s Assistants, Certificate Course (currently available).....	21
Pharmaceutical Technicians, Diploma Course (currently not available).....	22
Pharmacists, Degree Course (currently not available).....	23
Post-Graduate Pharmacy Training, Degree Courses (currently not available).....	24
Key Themes.....	25
Key Themes Arising from Stakeholder Interviews.....	25
Key Themes Arising from Review of Documents.....	26
Next Steps.....	29
Immediate Follow-up Activities.....	29
Annex 1. SWOT Analysis for Establishing a Pharmacy Degree Course at the University of Namibia.....	33
Annex 2. Pharmacy Degree Courses Available Regionally.....	37
Courses Available in SADC.....	37
Courses Available in Other African Countries.....	38
Annex 3. Potential Resource Persons.....	39
Annex 4. West African Health Organisation (WAHO) Proposed Harmonised Curricular Aims and Objectives for Schools of Pharmacy.....	41

List of Tables

Table 1. Private Sector Pharmacies and Pharmacist Workforce (March 2009) 11
Table 2. Public Sector Pharmacy Workforce (March 2009)..... 12
Table 3. Current Pathways for Becoming a Pharmacist in Namibia 23

List of Figures

Figure 1. Total Number of Public Sector Pharmaceutical Human Resource Posts (2009) 13
Figure 2. Distribution (%) of Pharmacist Posts and Population by Region..... 14
Figure 3. Distribution (%) of Pharmacist Assistant Posts and Population by Region..... 15
Figure 4. Projected Pharmacist Workforce Levels and Posts, 2009–2020 17
Figure 5. Dimensions of Pharmacy Workforce Planning and Service Delivery
Development..... 19

ACRONYMS

AIDS	Acquired immunodeficiency syndrome
ART	Antiretroviral treatment (medicines used in the management of HIV disease)
CPM	Center for Pharmaceutical Management [MSH]
FIP	International Pharmaceutical Federation
HCW	Health care worker(s)
HIGCSE	Higher International Certificate of Secondary Education
HIV	Human immunodeficiency virus
HR	Human resources
IGCSE	International Certificate of Secondary Education
INRUD	International Network for the Rational Use of Drugs
MoE	Ministry of Education
MoHSS	Ministry of Health and Social Services
MSH	Management Sciences for Health
NAD	Namibian dollar
NHTC	National Health Training Centre (of Namibia)
NIP	Namibia Institute of Pathology, Ltd.
NQA	Namibia Qualifications Authority
NQF	National Qualifications Framework (for Namibia)
NTA	Namibia Training Authority
PA	Pharmacy assistant
PCN	Pharmacy Council of Namibia
PSN	Pharmaceutical Society of Namibia
RPM Plus	Rational Pharmaceutical Management Plus Program [MSH]
SADC	South African Development Community region; includes Angola, Botswana, Lesotho, Malawi, Mozambique, Swaziland, Tanzania, Zambia, Zimbabwe, Namibia, South Africa, Mauritius, Democratic Republic of the Congo, Madagascar, Seychelles
SPS	Strengthening Pharmaceutical Systems [MSH]
TA	Technical assistance

TB	Tuberculosis
TIPC	Therapeutics Information and Pharmacovigilance Centre [Namibia]
UNAM	University of Namibia
UNESCO	United Nations Educational, Scientific and Cultural Organization
USAID	U.S. Agency for International Development
UWC	University of Western Cape [South Africa]
WHO	World Health Organization

ACKNOWLEDGMENTS

We would like to thank the outstanding staff of the SPS/Namibia office for their support and assistance during this scoping exercise as well as the stakeholders who gave generously of their time.

EXECUTIVE SUMMARY

Management Sciences for Health conducted a field assessment during March 12–27, 2009 to evaluate the process for and make recommendations toward establishing a pharmacist degree course at the University of Namibia (UNAM).

Namibia faces a shortage of pharmaceutical personnel. The increased burden that HIV/AIDS has placed on the health system has made this shortage even more severe. More pharmacists and pharmacist's assistants are required to support the ongoing decentralization of antiretroviral treatment (ART) services and making ART available to patients in rural settings.

The majority of the pharmacist workforce in Namibia at present is foreign and on short- or medium-term contracts. The proposed course would help to strengthen pharmaceutical systems in the country by increasing the number of trained pharmacists available in the labour market. Strategies to reduce attrition rates and increase workforce supply should also be considered as part of the strategy to expand the pharmaceutical workforce.

Findings

There is an overall positive attitude regarding establishing a national pharmacy degree program and there are economies to be realized in synchronizing the development process with those of the medical degree course to be started in 2010.

Unlike the medical profession, however, pharmacy has not been well publicized and promoted as a career option for Namibians. In addition, the career ladder for pharmacists in Namibia is fairly flat. This suggests that an assertive marketing campaign will be necessary to increase the number and quality of Namibian youth interested in studying pharmacy. Such efforts are currently on-going but should be increased and further tailored to focus on geographic areas and populations of greatest needs.

In following the plans set forth by the medical school steering committee, the viability of a local pharmacist degree program is tied inextricably to the development and functionality of the new medical school. The pharmacy school would be effectively dependent on the medical school for its infrastructure and institutional resources, and could not operate independently or in the absence of the medical school. Progress is conditional on the success of the medical school implementation process. This has two-way implications for student recruitment, curricular development, shared classroom teaching, and multidisciplinary clinical training. Because of this dependency, all viable training options should be explored.

The perception of the pharmacist workforce shortage was found to be more acute than the actual workforce statistics demonstrate. Dependency on foreign pharmaceutical staff both at facility and national levels in the public sector is a valid threat to pharmacist workforce sustainability. Expansion of the pharmacist workforce is necessary to meet demands in the private and public sector, however, this expansion is modest. Assuming that donor-funded posts will continue to exist or be absorbed into the public sector and private pharmacy grows consistently, the workforce required in 2020 is approximately 260, a 50% increase on current workforce levels. This target could be achieved by scaling up pharmacist training (either

locally or by increasing scholarships to study abroad) and improving retention rates in the public sector.

Recommendations

In order to build a sustainable and comprehensive strategy to expand the pharmacist workforce in Namibia, six main human resource policy actions should be considered:

1. Increase workforce supply by increasing the enrolment of students into a pharmacist degree program (e.g., by instituting a local degree program or increasing scholarships for study abroad).
2. Improve workforce retention through financial and non-financial incentives.
3. Increase the number of public sector posts and support the growth of private pharmacies commensurate with the workload and service expectations.
4. Define a competency framework for pharmaceutical services.
5. Establish infrastructure to improve efficiency of services and performance (e.g., computerized dispensing, equipment and other systems required to enhance efficiency in the pharmacy, develop a strategic pharmaceutical human resources plan and information system for both private and public sectors).
6. Establish an operational platform for public-private partnership in the delivery of pharmaceutical care in Namibia.

The outcomes could be achieved through concerted and collaborative work of the MoHSS, UNAM, Pharmacy Council, and Pharmaceutical Society with technical and administrative support from donor agencies.

If the creation of a pharmacist degree course at the University of Namibia is the optimal next step to achieving the human resource policy actions listed above, then the following activities should be undertaken:

- Recruitment of a high-level and visible Namibian champion for this effort.
- Scheduling of a well-publicized town hall-type meeting to gain input from all stakeholders and interested parties.
- Review the composition of the existing medical school steering committee to ensure that it includes the appropriate professional, educational and political stakeholders to steer the creation of a school of pharmacy (and adjust as necessary).
- Consultation with staff from other new pharmacist degree courses in Africa, experts in the fields of curricular design and quality assurance, and professional bodies (e.g., FIP) working within this realm.
- Creation of a Gantt chart to support project management and include relevant university and government deadlines.

- Recruitment and support of qualified academic staff to support curriculum development and approval process.

The process for which the School of Engineering received course approval was highly recommended by some UNAM officials as a model for pharmacy to follow.

BACKGROUND

Beginning soon after its independence in 1990, the Namibian Government and other stakeholders in the health and education sectors have been working towards the establishment of a national medical school in order to better meet the health needs of the country. This work has taken the form of workshops (1995), advisory committees (2001), strategic reports (2003), and published accounts (2004, 2006) to address the feasibility, viability and sustainability of such a program.

Citing an additional need for other cadres of health professionals, an interest in including degree-level programs in pharmacy, dentistry, physiotherapy and other allied health services training has been expressed. Several influential Namibians in the fields of medicine, education and government have supported these efforts.

Most recently (2008), the Office of the Vice Chancellor at the University of Namibia (UNAM) has coordinated an effort to institute a Namibian medical degree course. Through this work, a steering committee was formed in September 2008 and a strategic plan was adopted in March 2009, providing for a phased enrolment beginning in February 2010 of medicine, dentistry, pharmacy, physiotherapy and postgraduate students. This is supported by planned construction of a UNAM medical campus in close proximity to clinical training sites at Windhoek Central and Katatura Hospitals.

In addition to these efforts, in 2008 MSH/SPS Namibia signed a Memorandum of Understanding (MoU) with UNAM to provide technical assistance in strengthening the pharmaceutical training programs offered by the institution. The overall aim for this agreement was to help improve the pharmaceutical human resource capacity situation in Namibia.

As outlined in its COP08 annual work plan, MSH/SPS will be working closely with UNAM Office of the Vice Chancellor to:

1. Support the existing pharmacotherapy (prescribing) course in order to strengthen capacity for pharmaceutical care provision by nursing professionals.
2. Develop pharmaceutical research capacity at UNAM through the International Network for the Rational Use of Drugs (INRUD) and linkages with other research institutions in Namibia.
3. Introduce HIV/AIDS pharmaceutical management training in the curriculum of pharmaceutical and other mid-level healthcare workers (HCWs).
4. Develop the curriculum for the new Pharmacy course at UNAM.
5. Provide lecturers, technical assistance (TA), resources and other support required for the setting up of the new pharmacy course at UNAM.

Tasks 1–3 have been addressed previously (see Dr. Paul Waako, Trip Report, 2008) or are ongoing. Tasks 4–5, related to the setting up of the new pharmacy course, are planned to be implemented in two phases, the timelines for which may overlap, namely:

Phase I: Strategic, organizational and management systems set-up

Phase II: Technical and operational (staffing and other resourcing, pharmaceutical course development, implementation and research)

This report describes the activities in Phase I of this effort.

PURPOSE OF CONSULTANCY

Dr Tina Brock, Director of Capacity Building and Performance Improvement for the MSH Center for Pharmaceutical Management (CPM) and Ms Tana Wuliji, Project Manager, Human Resources and Education, International Pharmaceutical Federation (FIP) travelled to Windhoek, Namibia to interview stakeholders and collect information about pharmacy education and practice in Namibia. The purpose for this activity was to provide technical support to UNAM, MoHSS and MSH/SPS Namibia, and to offer guidance on how to approach developing a new pharmacy course at the University of Namibia, and specifically to:

- Provide technical assistance and support towards the establishment and strengthening of pharmaceutical training programs at UNAM.
- Provide input for the hiring of qualified technical staff to conduct pharmaceutical courses and curriculum design and development to include modules on key topics addressing rational use of medicines in HIV/AIDS, TB, Malaria, and include relevant topics in pharmaceutical management.

SCOPE OF WORK

The scope of work for this effort included the following:

1. Provide technical assistance (TA) for developing vision, mission, and strategic objectives of the pharmacy program.
2. Provide TA to determine and project expected student enrolment, teaching and research workload and match with staffing needs and availability.
3. Provide TA to guide curriculum design and development to include modules on key topics addressing rational use of medicines in HIV/AIDS, TB, Malaria, and include relevant topics in pharmaceutical management for the pharmacy course.
4. Provide TA for setting up networks and establishing linkages with other courses and departments in UNAM, universities, training and research institutions, professional bodies, divisions of the Ministry of Health and Social Services, Ministry of Education, other ministries, employer organizations and regulatory bodies.
5. Provide TA for designing an organogram for the pharmacy department at UNAM, including committees, their Terms of Reference (ToRs); job descriptions and specifications of the required technical and administrative personnel; and building capacity for INRUD Namibia.
6. Provide TA for identifying and exploring opportunities for potential synergies with other health courses being established at UNAM, including medicine, dentistry, nursing and others.

Activities

The scope of work required interviews with multiple and diverse stakeholders, review of government reports and published accounts, and comparisons with experiences of developing new pharmacy degree programs in other African countries.

Collaborators and Partners

The following stakeholders were interviewed as part of this consultancy:

Stakeholder	Organization
Mr Alfred Adrian van Kent	Director, National Research, Science, Technology & Innovation Ministry of Education
Ms Ilupleni Hilya Shikongo	Science & Technology Officer, Industrial Linkages Development & Beneficiation Ministry of Education
Ms Natascha Cheikhyoussef	Science & Technology Officer Research & Technology Development & Planning Ministry of Education

Stakeholder	Organization
Ms Elizabeth Sam	Head, National Health Training Centre Directorate of Policy, Planning and Human Resource Development Ministry of Health and Social Services
Ms Sofia Black	Head of Continuous Education, National Health Training Centre Directorate of Policy, Planning and Human Resource Development Ministry of Health and Social Services
Ms Jennie Lates	Deputy Director, Division: Pharmacy Services Directorate of Tertiary Healthcare & Clinical Support Services Ministry of Health & Social Services
Ms Bridget Kadungure	Pharmacy Assistant Tutor [MSH supported] National Health Training Centre
Mr Chakanyuka Mano	Pharmacy Assistant Tutor [MSH supported] National Health Training Centre
Ms Nicolette Maumbe	Pharmacy Assistant Tutor [Global Fund supported] National Health Training Centre
Ms Celine Usiku	Director; Directorate of Policy, Planning & Human Resource Development Ministry of Health & Social Services
Ms Maatuu Zauana	Deputy Director; Directorate of Policy, Planning & Human Resource Development Ministry of Health & Social Services
Ms Mary Tembo	Curriculum Consultant [I-TECH supported] Faculty of Medical and Health Sciences University of Namibia
Prof Jacob Mafunda	Coordinator, National School of Medicine Project Office of the Vice Chancellor University of Namibia
Mrs Tangeni K Angula	Chief Executive Officer Namibia Institute of Pathology, Ltd.
Dr Lischen Hoases-Gorases	Dean, Faculty of Medical and Health Sciences University of Namibia
Mr Johannes Gaeseb	Chief Pharmacist, Pharmacy Control and Inspection Ministry of Health and Social Services
Mr Lewis Durango	NHTC Consultant [MSH supported]
Dr Peter Gichangi	Senior HIV/AIDS Care & Treatment Advisor US Agency for International Development
Mr Todd Koppenhaver	Strategic Information Officer US Agency for International Development
Miss Namene Nashidengo	Pharmacist, Windhoek Central Hospital Ministry of Health and Social Services
Mr Victor Sumbi Muthiani	Pharmacist, National Medicines Policy Coordination Division: Pharmaceutical Services Ministry of Health and Social Services
Mr Robert Tuala Tuala	Regional Pharmacist, Otjozondjupa region
Ms Karin Brockman	Secretary, Pharmaceutical Society of Namibia
Dr M van der Vyver	Deputy Dean Faculty of Medical and Health Sciences University of Namibia

Stakeholder	Organization
Ms Nafunda Sumpi	Head of Department Faculty of Medical and Health Sciences University of Namibia
Dr Erika Maass	Director, Teaching & Learning Improvement Unit University of Namibia
Prof EMR Kiremire	Dean, Faculty of Science University of Namibia
Ms Annele Akwenkye	Deputy Director, Regional & Strategic Planning National Planning Commission Office of the President
Ms Dega Ali	Country Director International Training and Education Centre on HIV
Ms Sara Wood	Deputy Director of Curricula and Communications International Training and Education Centre on HIV
Ms Dinah Tjipura	President, Pharmacy Council and Director, Directorate of Tertiary Healthcare & Clinical Support Services Ministry of Health & Social Services
Ms Magda Robalo	WHO Representative, Namibia World Health Organization

Adjustments to Planned Activities and/or Additional Activities

Concomitant to this consultation, the Steering Committee for the National Medicine Project met to review the reports from the subcommittees concerning the master plan and land allocation, human resource recruitment, revised curriculum, the roadmap and resource mobilization. Although the original reports (“Roadmap for the School of Medicine: 2009–2013” and “Curriculum for the Degrees of Bachelor of Medicine and Bachelor of Surgery”) include plans for a 2011–2012 start for the pharmacy degree program, the committee discussion (as reported, minutes not available) ultimately supported enrolling twenty pharmacy students in February 2010. The aggressive timeline for this initiative shifts the focus of this assessment from “how” to “how quickly.”

In addition, some of the initial activities (e.g., determine and project expected student enrolment, teaching and research workload and match with staffing needs and availability; designing an organogram for the pharmacy department at UNAM) have already been completed as part of the National Medicine Project Steering Committee. The resulting work will focus on identifying and exploring opportunities for potential synergies with other health courses being established at UNAM as well as recommended strategies for ensuring stakeholder support.

OVERVIEW OF HUMAN RESOURCES ISSUES RELATED TO PHARMACEUTICAL TRAINING

The demand for pharmaceutical services, particularly with the advent of the HIV/AIDS epidemic has increased markedly and points to the need for comprehensive and sustainable scale-up of the pharmacist and pharmacist assistant workforce in Namibia. Scale-up should be supported through seven main human resource policy actions:

1. Increase workforce supply by increasing the enrolment of students into a pharmacist degree program (e.g., by instituting a local degree program or increasing scholarships for study abroad).
2. Improve workforce retention through financial and non-financial incentives.
3. Increase the number of public sector posts and support the growth of private pharmacies commensurate with the workload and service expectations.
4. Define a competency framework for pharmaceutical services.
5. Establish infrastructure to improve efficiency of services and performance (e.g., computerized dispensing, equipment and other systems required to enhance efficiency in the pharmacy).
6. Develop a strategic pharmaceutical human resources plan and information system for both private and public sectors.
7. Establish an operational platform for public-private partnership in the delivery of pharmaceutical care in Namibia.

The need to build local workforce capacity is highlighted by significant dependency on foreign pharmacists, a scenario which has the potential to limit the provision and the extension of pharmaceutical services should there be a downturn in foreign workforce.

Prior to independence in 1990, pharmacists were predominately white with few black Namibian pharmacists. Immediately after independence, there was a rapid efflux of pharmacists from the public sector to the private sector and to South Africa. Public sector hospitals in the early years of independence were essentially devoid of pharmacists and two key policy measures were taken to rectify this crisis: (1) pharmacist posts in district hospitals were disestablished, and (2) the cadre of pharmacist assistant (PA) was created to fill these gaps by providing basic dispensary services.

Pharmacists transitioned to adopt primarily supervisory and administrative roles in the districts to oversee pharmaceutical services (Regional Pharmacists). Pharmacists, who were mostly foreign, were situated in the major secondary (district) and tertiary hospitals and public sector administration (MoHSS). This scenario still applies to date with no growth over the last 20 years in public sector posts and continued reliance on the recruitment of foreign pharmacist workforce.

Since 2006, donors have played an important role in creating and funding short-term pharmacist and pharmacist assistant posts in the districts to build capacity for HIV/AIDS and

other pharmaceutical services. Further recognition of the need to expand the pharmacist workforce was evident by the recent decision of the MoHSS to increase the pharmacist public sector establishment to extend coverage of pharmacists into every district hospital, effectively a near doubling of public sector posts.

Pharmacist assistants continue to provide the mainstay of basic pharmaceutical services in the public sector outside the major urban centres. With support from MSH/SPS funded by United States Agency for International Development (USAID), the output of PAs from the two year certificate program at National Health Training Centre (NHTC) has increased significantly from 8 to 27 per year with the support of donors over the last two years. A projected 50 graduates per year is envisioned in the near future.

Key stakeholders described a high level of demand for PAs in both the public and private sectors to prepare and dispense medicines. High levels of attrition were attributed to the lack of opportunities for career progression and flat salary scale. There is a senior pharmacy assistant post which PAs are eligible for after 3 years of work, but these posts are few in number and only provide a salary increase of \$3000 NAD (approximately \$350 USD). Several stakeholders mentioned that “the best PAs leave for the private sector or reclassify for other posts, such as human resource manager.”

Stakeholders also raised the intention to introduce a mid-level cadre of pharmacy technicians whose level of competence and responsibility would fall between that of a PA and pharmacist. This would provide a progression pathway for PAs that could progress to become pharmacy technicians with supplementary training. In scaling up both the pharmacist and PA cadres and potentially introducing the pharmacy technician cadre, there is a need to map specific competencies and define the roles of each to assist workforce planning and clearly delineate responsibilities.

Based on 2009 data from the MoHSS and PSN, there are a total of 180 pharmacists currently employed in Namibia across both public and private sectors. Forty percent of the pharmacist workforce is employed in the public sector by the Ministry of Health and Social Services and donors (CDC, MSH, SCMS) and the remaining 60 percent are employed in the private sector by community pharmacies, wholesalers and manufacturers.

There are 109 PAs employed in the public sector. The total number is likely to be much greater; however, there is an absence of data on the number of PAs employed in the private sector.

Over the last 12 years, there has been an improvement in the workforce levels and distribution between private and public sectors (Long Term Human Resource Plan, 1997–2027, MoHSS). In 1997, there were a total of 149 pharmacists, 88 percent of which were in the private sector. There has also been a near four-fold increase in the number of PAs employed in the public sector since 1997 (38 PAs).

Private Sector Labour Market

Community pharmacies are the predominant employer of pharmacists in this sector with few private hospital pharmacies, wholesalers and one manufacturer. Registration data from the Pharmaceutical Society for March 2009 indicates a total of 78 pharmacies and 109

pharmacists working in this sector (Table 1). No data was available on pharmacist assistants or pharmacist interns. Private pharmacies and pharmacists are concentrated in the urban centres of Namibia. Private pharmacies are predominately owned by white Namibians and South Africans (personal communication, PSN).

Table 1. Private Sector Pharmacies and Pharmacist Workforce (March 2009)

Districts	Pharmacies	Pharmacists
Caprivi	1	1
Erongo	10	12
Hardap	4	5
Karas	3	6
Kavango	3	3
Khomas	35	55
Kunene	2	2
Ohangwena	1	1
Omaheke	1	1
Omusati	1	2
Oshana	12	14
Oshikoto	2	2
Otjozondjupa	3	5
Total	78	109

Source: Pharmaceutical Society of Namibia (March 2009)

The number of pharmacists in the private sector differs considerably to the 170 described in the Annual Report 2007/2008 of the Division of Human Resource Development, MoHSS. Such data discrepancy highlights the need for a systematic approach to pharmacy workforce data collection and reporting.

Public Sector Labour Market

From 2006, donors in collaboration with the MoHSS began to recruit pharmacists and PAs for deployment in the public sector to support donor supported programs and fill critical gaps. This has led to greater success in filling posts despite offering equivalent salaries to the MoHSS. However, of the 46 pharmacist posts existent in the MoHSS establishment as of March 2009, 13 remained vacant (Table 2).

Efficiencies in the recruitment process by outsourcing recruitment to an external agency and bypassing the bureaucratic government recruitment process (which can take up to a year in the MoHSS) is a major contributing factor to this success. The approval to use external recruitment agencies to employ public sector personnel has been recently revoked, however, and donors have struggled with the impact of this decision. Challenges remain around human resource management of donor-funded posts with reports of inadequate attention to the needs

of the workforce recruited by donors compared to those within the official public system which could potentially increase attrition rates.

At this stage it is unclear whether donors will continue to fund these positions in the mid- to-long term although previous reports indicate an agreement of the MoHSS to absorb these posts into the public sector establishment (Nwokike, Mafirizi, Saleeb, 2007, and Tjipura et al, 2007).

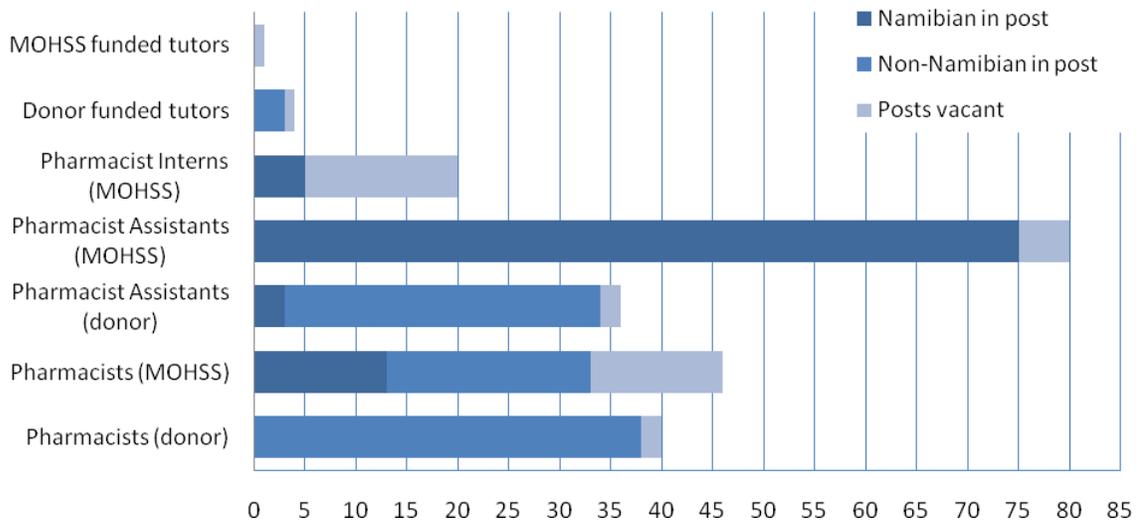
Table 2. Public Sector Pharmacy Workforce (March 2009)

Sector	Pharmacists		Pharmacist Interns		Pharmacist Assistants	
	Posts	Filled	Posts	Filled	Posts	Filled
Public sector (MoHSS funded)	46	33	20	5	80	75
Public sector (Donor funded)	40	38	0	0	36	34
Total	86	71	20	5	116	109

Sources: MOHSS Pharmacy Staff Excel spreadsheet (March 2009), and Potentia Pharmacy Staff List (December 2008)

Such rapid and successful human resource deployment by donors has also been made possible in part through the recruitment of foreign workforce which mostly originates from the SADC region (Figure 1). All donor funded pharmacists positions are filled by foreign pharmacists and most PA positions are filled by PAs of foreign origin (likely to be pharmacy technicians or technologists). Forty percent (40%) of filled MoHSS pharmacist positions and all PA positions are held by Namibians.

This represents an improvement on 2006 where only 10% of public sector pharmacist posts were held by Namibians (Frelík G, Mameja J. Strategies for the Rapid Start-up of HIV/AIDS Program in Namibia: Outsourcing the Recruitment and Management of Human Resources for Health, The Capacity Project and USAID, July 2006).



Sources: MoHSS Pharmacy Staff Excel spreadsheet (March 2009), and Potentia Pharmacy Staff List (December 2008)

Figure 1. Total Number of Public Sector Pharmaceutical Human Resource Posts (2009)

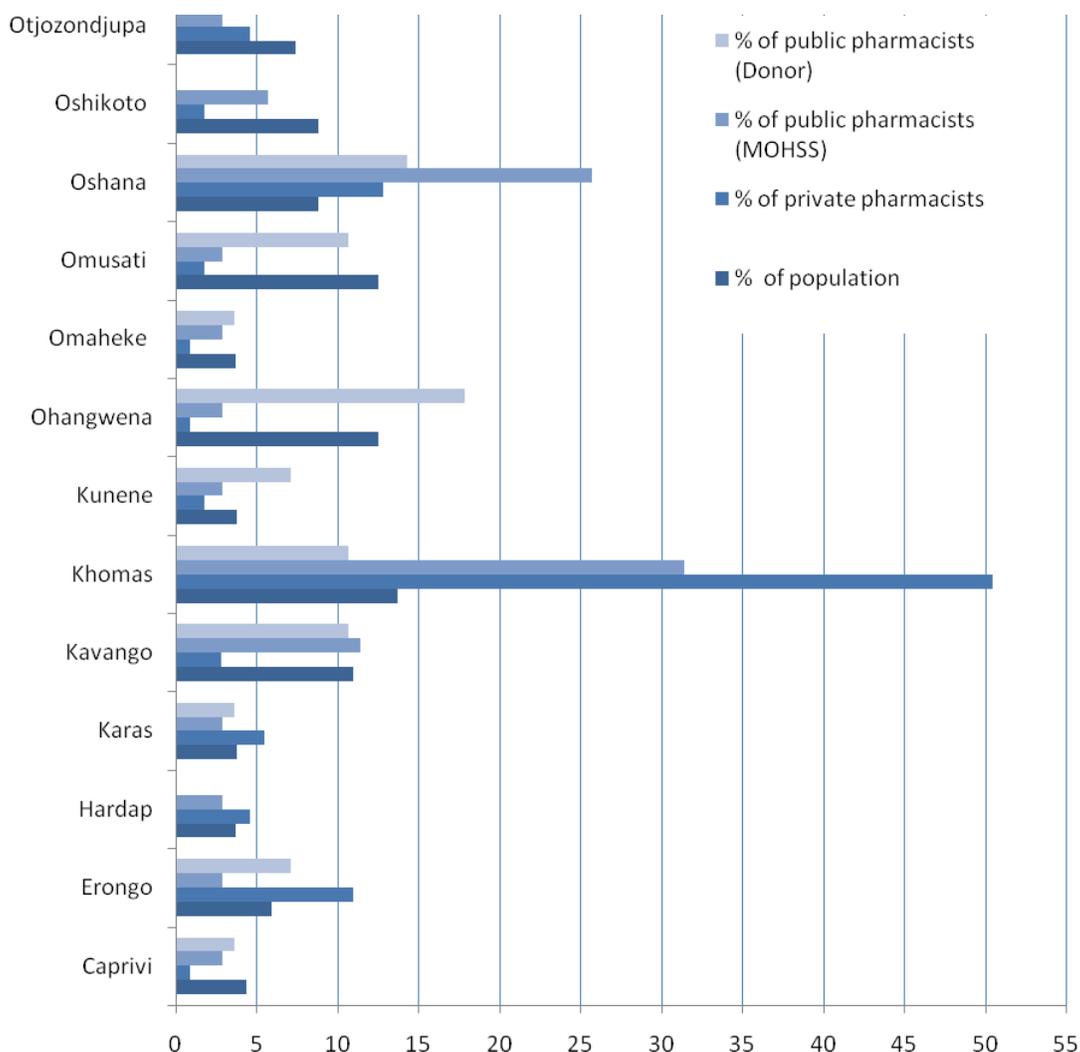
Whilst fiscal space to accommodate 15 additional pharmacist interns in the public sector exists, the capacity to do so in practice is limited due to a lack of accredited public sector preceptors and appropriate internship sites with adequate supervision and support. Donors support four tutor positions for the PA training program at NHTC and the MoHSS will contribute one post in the next financial year, which will facilitate the sustainability of the program at the conclusion of the funding period.

Pharmacist Workforce Distribution

Pharmacists are concentrated in the urban centres in both the private and public sectors. Figure 2 describes the distribution of public and private sector posts across each of the 13 regions of Namibia and compares it with the proportion of the population which resides in each region. It gives a crude visualization and means of assessing the geographical distribution of the workforce with respect to likely demand (based on population).

Donor funded posts are more equitably distributed between the regions due to the purposive deployment into regions where there was a lack of pharmacists. Public sector pharmacist posts are concentrated in the Khomas (includes Windhoek and Katatura) and Oshana regions where major secondary and tertiary hospitals are located.

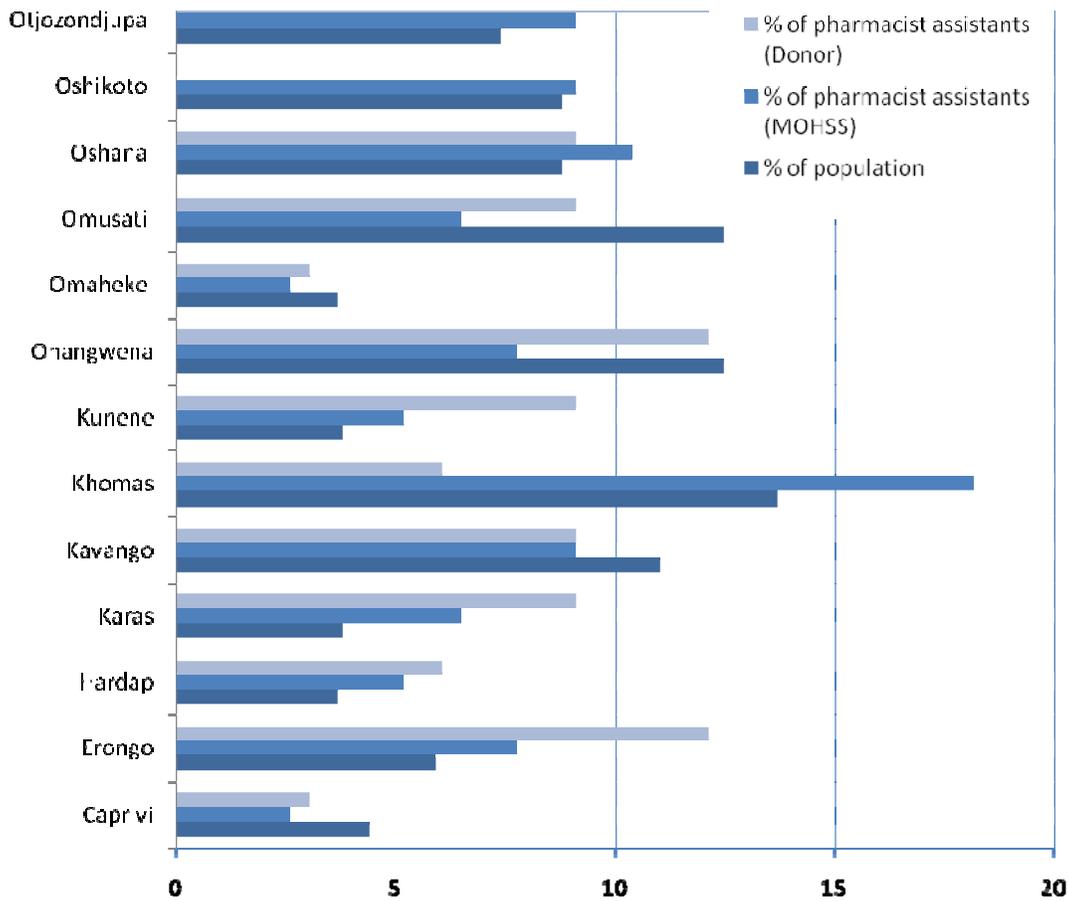
Fifty percent of private pharmacists are located in Khomas and the remaining are located in the urban and tourist centres of Erongo and Oshana with very few in the other regions. Despite the lack of private pharmacies in most regions and districts, illegal drug outlets have not been found to operate in Namibia. The public sector constitutes an important source of medicines for rural communities.



Sources: MoHSS Pharmacy Staff Excel spreadsheet (March 2009), Potentia Pharmacy Staff List (December 2008) and Pharmaceutical Society of Namibia (March 2009), Census 2001.

Figure 2. Distribution (%) of Pharmacist Posts and Population by Region

A more equitable distribution is observed with PAs (Figure 3) who are situated in all district hospitals. No major differences are observed between those recruited by donors and the MoHSS. Data on PAs in the private sector was unavailable.



Sources: MOHSS Pharmacy Staff Excel spreadsheet (March 2009), Potentia Pharmacy Staff List (December 2008), and Pharmaceutical Society of Namibia (March 2009), Census 2001.

Figure 3. Distribution (%) of Pharmacist Assistant Posts and Population by Region

Pharmacist Workforce Needs Versus Projected Supply and Attrition

The total number of pharmacist posts in the public sector stands at 86 with a likely increase in the next financial year to 116 following the re-introduction of district hospital pharmacist positions. Donors currently fund 40 posts in the public sector and it is unclear if these posts will continue to be funded in the mid to long-term.

There are 109 pharmacists currently employed in the private sector, a sector that is likely to grow with increasing pharmacist workforce levels. Stakeholders felt that there were significant business opportunities for community pharmacy development in Namibia, particularly in peri-urban areas.

A model was developed to estimate pharmacist workforce needs for the period 2009 and 2020 in both private and public sectors (Figure 4). Three scenarios were explored in this exercise and the current attrition rate of 20% was assumed (Box 1).

Box 1. Scenario Descriptions

Scenario A: Status quo, 20% attrition rate with 5 pharmacists trained per year.

Scenario B: Introduction of localized pharmacist training in 2010 with an output of 20 pharmacists per year graduating from 2014.

Scenario C: Status quo until 2013 (20% attrition and 5 pharmacists trained per year). Increase in 2014 to 10 pharmacists trained per year (through expansion of scholarships for foreign training). Reduction of attrition rate from 20% to 10% through implementation of financial and non-financial retention schemes.

The following assumptions made in these scenarios:

- Growth in private sector posts is consistent with economic growth in Namibia projected to be 2.2% for 2009–2012 (Republic of Namibia, Budget at a Glance MTEF 2009/10–2011/12, <http://www.mof.gov.na/Budget%20Documents/2008-09/BudgetGlance.pdf>).
- 30 additional posts in the public sector are introduced in 2010.
- Workforce supply is solely resulting from the output of trained Namibian pharmacists (rather than recruitment of foreign pharmacists).
- Donors continue to fund 40 posts in the public sector.
- Attrition remains stable at 20% per year.
- Student attrition is negligible.

The dashed lines in Figure 4 represent the number of available posts in the pharmaceutical labour market over time. The solid lines represent the projected workforce levels in each scenario.

Should funding of additional posts in the public sector by donors end in 2012, by 2013, all posts in the public sector (including 30 additional posts introduced by the MoHSS in 2010) should be filled, if the current situation of 20% attrition and 5 pharmacist graduates per year prevails (scenario A). Should donors continue to fund the 40 additional posts or if these posts were to be further absorbed into the MoHSS personnel emolument, significant shortages of pharmacists would persist in scenario A.

This shortage would be addressed by 2016 in scenario B (20% attrition), should a new school of pharmacy enrol students in 2010 with its first 20 graduates in 2014. However, unless additional posts are created in the public or private sector, there is likely to be an oversupply of pharmacists.

Scenario C estimates the potential impact of a dual strategy of increasing workforce supply from 5 to 10 graduates a year and reducing attrition rates from 20% to 10% in 2014 by implementing improved retention schemes. It assumes that student attrition is negligible. As

in the case of scenario B, shortages would be met by 2016 and the rate of pharmacist workforce growth is less likely to lead to oversupply yet sustainably addresses workforce needs.

These are crude projections based on available evidence. There are no data regarding student attrition rates and the workforce attrition rates of Namibian pharmacists compared to that of foreign pharmacists. There are also concerns that an increase in return migration of Zimbabwean pharmacists may lead to a rapid rise in attrition. Should this be the case, the attrition rate in the next 3 years may rise significantly but should stabilize thereafter. This will undoubtedly affect the projections described in Figure 4. In the extreme case that all of the foreign pharmacist workforce were to leave Namibia's public sector, resulting in a loss of around 60 pharmacists, there would need to be significant investment into both expanding the workforce supply of Namibian pharmacists and reducing workforce attrition rates by implementation of retention measures.

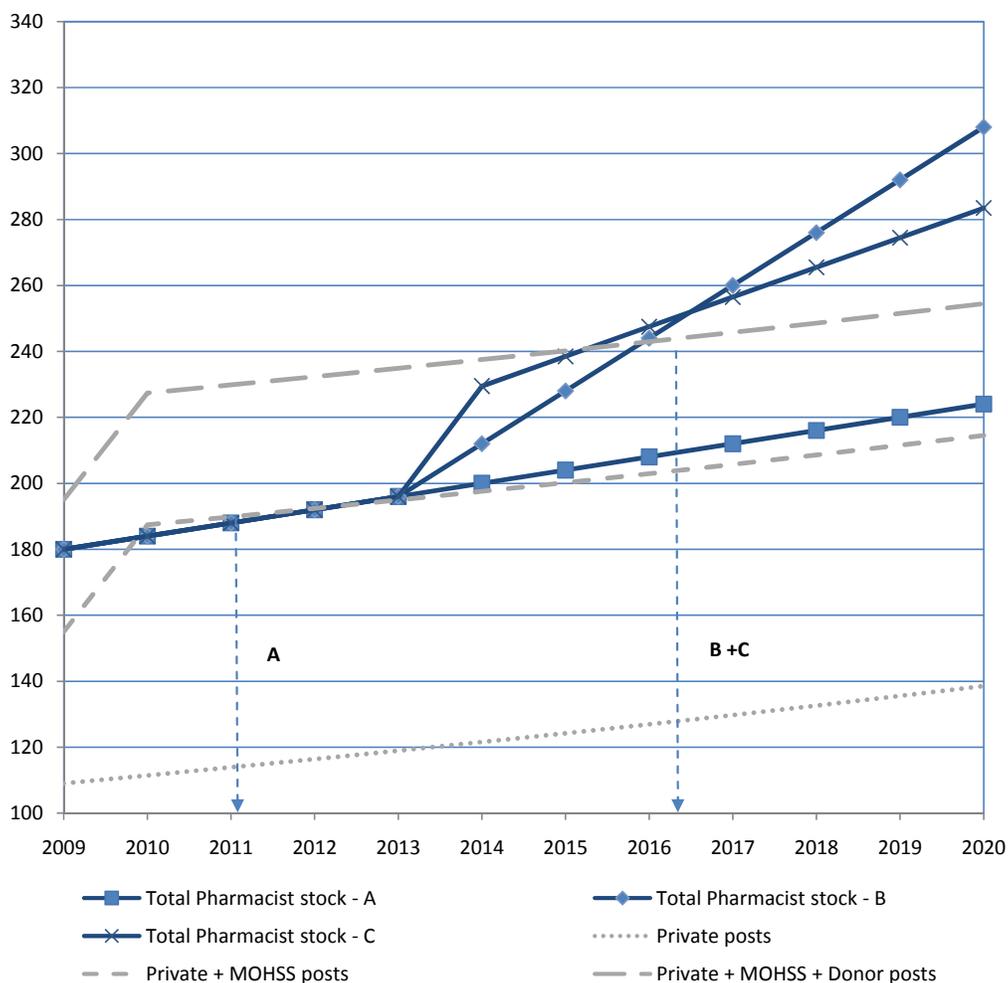


Figure 4. Projected Pharmacist Workforce Levels and Posts, 2009–2020

There is a need to cost each scenario and investigate policy options in depth in order to identify a policy approach that is most suited to needs. This analysis indicates the need for a comprehensive approach to pharmacist workforce scale up that considers both improving retention as well as increasing workforce supply.

Human Resource Planning

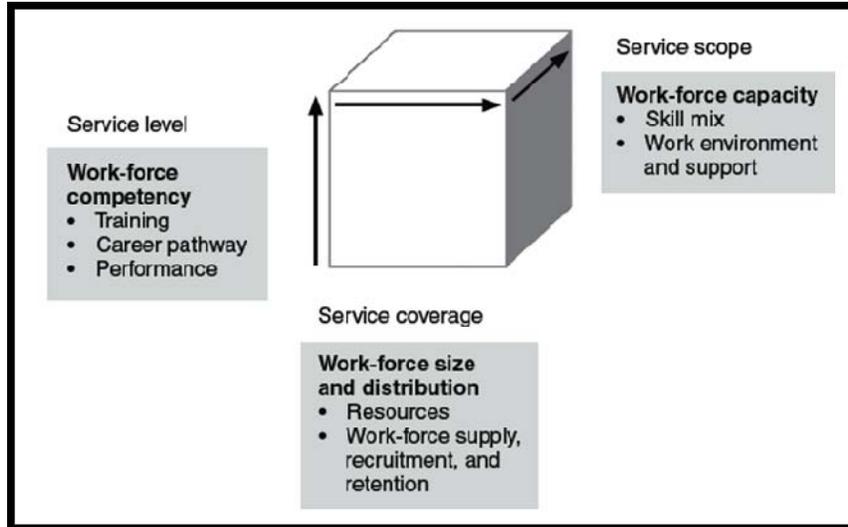
Human resource strategic planning and information systems require strengthening and consolidation, particularly with respect to pharmaceutical workforce development. Various inconsistencies were observed in key policy documents such as the Human Resource Development Strategy 2008–2012, Long Term Human Resource Plan 1997–2027 and the University of Namibia Roadmap for the School of Medicine 2009–2013.

The Human Resource Development Strategy 2008–2012 proposes the budget for pre-service training and projects the need to increase pharmacist training to 20 per year for 2008–2010 with a reduction to 15 from 2011, despite the University of Namibia Roadmap for the School of Medicine (March 2009) describing plans for enrolling 20 students per year from 2011. The Long Term Human Resource Plan 1997–2027 envisaged a total pharmacist workforce of 266 by 2027 with 75 of these positions in the public sector and projected an intake requirement of 8 to 9 pharmacists per year between 2012 and 2027. However, at the time of the Long-Term Strategy's development, HIV/AIDS has emerged as a growing and significant cause of morbidity and mortality in Namibia, amplifying the health workforce needs.

Pharmacist assistant training was limited to 10 per year between 2008–2012 in the Human Resource Development Strategy despite concurrent active efforts on the part of the MoHSS and donors to increase the number of graduates from 10 to 50 per year over this same period. This differs again from the Long Term Human Resource Plan which projected an annual intake requirement of 11–14 PAs between 2012 and 2027.

Such inconsistencies raise the need for a comprehensive pharmaceutical workforce information system which encompasses both the private and public sectors. Workforce data could be collated at a national level and stratified by sector (public, private, and private not for profit), active workforce, district, gender, age group and country of origin to better inform workforce planning and minimize inconsistencies.

Three dimensions of pharmaceutical workforce planning, including workforce competency, size and distribution, and capacity development, should be considered and integrated pharmaceutical service delivery (Wuliji, T., *Current Status of Human Resources and Training in Hospital Pharmacy: Literature Review*. AJHSP. 66:56-60. http://www.ajhp.org/cgi/reprint/66/5_Supplement_3/s56)



Source: Wuliji, T., 2009. Reproduced with permission.

Figure 5. Dimensions of Pharmacy Workforce Planning and Service Delivery Development

OVERVIEW OF EDUCATIONAL ISSUES ASSOCIATED WITH PHARMACEUTICAL TRAINING

Primary and Secondary Education

Currently 95 percent of Namibian children attend at least primary school which is essentially free for ages 6–16 (excepting fees for books and uniforms). Unfortunately, only about 50 percent of Namibian students continue past grade 10, and even those who do are often lacking in the science, math and English language skills which are prerequisite to a university course of study for the health professions.

The challenges to the Namibian secondary school system have been discussed widely in a variety of arenas. In 1998, the President initiated Vision 2030, a unified approach designed to guide the achievement of good education, good and accessible health care, a clean and productive environment, an efficient and profitable economy that supports full and rewarding employment, low levels of crime, a just and tolerant society, and good transparent governance. As part of these efforts, the Namibian government has prioritized—

- Improvements to science, math and technology training
- Encouraging the development of entrepreneurial skills
- Increased access to vocational training

There are some private high schools in Namibia (e.g., St Paul’s, Oshigambo) that offer a university preparatory curriculum, which would enable direct access to a foreign pharmacy course, but currently, most Namibians interested in studying pharmacy must complete a 2-year pre-medical course at the University of Namibia before transferring into a foreign 4-5 year pharmacy degree course (most often located in South Africa or Kenya). This 2-year “catch up” course includes foundations of biology, chemistry, physics, computer literacy, and English, as well as a contemporary issues topics required by all UNAM students. Although the shortfalls in Namibian secondary education will be an initial challenge to a new pharmacy degree course, it is possible that the availability of local training in medicine, dentistry, pharmacy, and other allied health professions will not only encourage Namibian youth to seek more higher level training in the prerequisite math, science, and technology areas, but also exert demand-side pressure for improvements at this level.

Pharmacist’s Assistants, Certificate Course (currently available)

The training of pharmacist’s assistants (PA) in the Namibia is long-standing, evolving from an informal, hospital-based program initiated in 1991, to a more formalized certificate course based at the National Health Training Centre (NHTC) in 1994. Currently, the NHTC course is the only approved PA certificate program in Namibia; however, informal training opportunities (primarily based on the South Africa’s model of apprenticeship training of PAs at private community pharmacies) are still allowed.

Management Sciences for Health/Strengthening Pharmaceutical Systems Program (MSH/SPS), Namibia recently collaborated with the Ministry of Health and Social Services to expand the capacity of the NHTC to train PAs. This included using funding from the U.S.

President's Emergency Plan for AIDS Relief to refurbish lecture rooms, develop a simulation laboratory and provide tutors.

In addition, NHTC, with support from MSH/SPS is currently collaborating to update the PA training curriculum in order to have the course registered on the National Qualifications Framework (NQF), accredited by the Namibia Qualifications Authority (NQA) and supported by the Namibia Training Authority (NTA).

As a result of this support, NHTC increased PA training from a previous annual average of 8 students per year to a current average of 27 students per year with a target of training 50 students per year as from 2010. This increased number and quality of pharmacist's assistants graduating from the centre will improve the capacity to deliver critically needed medicines to the people of Namibia.

Despite the many advances, there are still some challenges associated with this training program. Most critically, the program tutors are all externally funded (i.e., MSH/SPS, Global Fund) with inadequate MoHSS support. During the time of this consultation, one publicly-funded tutor position was approved, with recruitment to begin in April 2009.

All stakeholders agreed that the current level of training for the pharmacist's assistant was not good enough preparation (particularly in math, science and problem-solving) for direct transfer into a pharmacist degree course; however, some stakeholders felt that after gaining work experience, a small percentage of PAs would be prepared for further training in the field.

Pharmaceutical Technicians, Diploma Course (currently not available)

Although the Namibian pharmacy regulations currently include a designation for pharmaceutical technician, this cadre has not yet been realized. Currently, pharmacy technicians who have been trained in other countries are registered to practice as PAs in Namibia.

Some stakeholders indicated that establishing a pharmaceutical technician diploma course would be an appropriate first step to developing a pharmacist degree course. During this visit, interest in developing/maintaining such a course was expressed directly by UNAM, NHTC and indirectly by the Polytechnic. Other countries (notably Malawi and Zambia) have used the pharmaceutical technician category as a potential recruitment pool for pharmacy degree training, particularly in the initial cohorts.

Other stakeholders, however, felt that the need for pharmacists was a higher priority and that the efforts toward establishing the degree course should be the initial focus in light of limited resources available. When applying the principles of the NQF, it is logical that competencies required across the continuum of pharmaceutical cadres (i.e., PA, senior PA, pharmaceutical technician, pharmacist) should be scoped prior to initiating any new educational programs.

Pharmacists, Degree Course (currently not available)

There are currently four available pathways for becoming a pharmacist in Namibia. These are described in Table 3.

Table 3. Current Pathways for Becoming a Pharmacist in Namibia

	Pathway 1	Pathway 2	Pathway 3	Pathway 4
Citizenship	Namibian	Namibian	Non-Namibian	Non-Namibian
Secondary education	IGCSE	HIGCSE	N/A	N/A
Pharmacy training	2 years pre-medicine at UNAM 4 years pharmacy abroad (SA, Kenya)	4 years pharmacy abroad	4 years pharmacy abroad	4 years pharmacy abroad
Internship	1 year Namibia	1 year Namibia	1 year Namibia or abroad	Abroad
Registration	Pharmacy Council	Pharmacy Council	Pharmacy Council	Pharmacy Council
Career options	Public or private sector	Public or private sector	Public sector typically until Namibian registration, then opt for private sector	Public sector via MoHSS-donor program (short-term contract)

Although the SADC region has established quotas to ensure that countries without pharmacy degree courses have access to such training programs, reliance on these externally-mediated pathways has led to an underdevelopment of pharmacy as a career pathway in Namibia and instability of the public sector workforce.

Parallel with this, surveys suggest that Namibian youth do not seem to prefer pharmacy as being a desirable or viable career option. Although loan and grant support is available from the MoE and MoHSS, these do not cover the additional costs of studying abroad and in recent years, the number of qualified Namibian students seeking pharmacy degree qualifications has been fewer than the number of slots available, suggesting that the barriers are more complex than mere access.

Review of previous reports and stakeholder interviews suggest that perceived barriers to pursuing pharmacy studies include:

- Lack of awareness of pharmacy as a career option
- Lack of awareness of the number and variety of jobs available within the field of pharmacy
- Lack of adequate preparation in math and sciences at secondary school level

- Preparatory two years of university study (pre-med course) required for most Namibians intending to study pharmacy abroad
- Excessive costs (despite loan and grant support) associated with studying abroad
- No mechanism in place for study loan forgiveness based on employment in public sector or similar public sector retention strategies

Post-Graduate Pharmacy Training, Degree Courses (currently not available)

In many countries, career-enhancing training for pharmacists is available. These include practical experiences (e.g., residencies, fellowships), as well as university courses (e.g., in areas such as clinical pharmacy, public health, business, social and administrative sciences, and advanced pharmacological sciences). Post-graduate pharmacy degree programs include training at the master's and doctoral levels. Often pharmacists with advanced training are employed as university lecturers, Ministry advisors, chief pharmacists, and other high level positions. Currently, Namibia has no direct pathway for advanced pharmacy training for pharmacists and, hence, there are very few Namibian pharmacists who have advanced degrees within the country. This might serve as an early limitation in recruiting Namibian pharmacists to serve as academic staff for the new school.

Although the model is uncommon, the University of Namibia might consider the option of initiating a part-time, post-graduate clinical pharmacy training as an early step (perhaps even prior to initiating an undergraduate degree course) in this process. As compared to an undergraduate pharmacy degree course, a post-graduate program would likely require fewer full-time staff to manage, would not rely on access to (expensive) “wet” laboratories or already overfilled UNAM undergraduate courses, and could be linked to work-based projects that support INRUD and TIPC priorities. Graduates of this training could ultimately serve as instructors for training other health professions (e.g., medicine, nursing) about advances in medicines as well as pharmacy student/intern supervisors.

KEY THEMES

Key Themes Arising from Stakeholder Interviews

- ✓ Need for a Namibian workforce
 - There was recognition of all stakeholders of the need for pharmacists from both the perspective of workforce sustainability and acceptability by service users and other health professionals.
 - *“It is risky to rely so heavily on foreign health care workers; it would be much better to train our own pharmacists to our own standards.”*
 - *“Having a Namibian pharmacist at each district hospital would make a difference; if pharmacy assistants were supervised by pharmacists they could do good work at the right level.”*
 - ✓ Quality assurance of pharmacy education
 - Several key stakeholders commented on the need to ensure a quality pharmacy program to establish a positive academic reputation and to prepare pharmacists for seamless professional registration. This suggests a need to integrate quality assurance systems into the planning and operational stages of program development.
 - *“In general, Namibian pharmacists would be supportive of a new school as the need for more practitioners is desperate; however, some would be sceptical regarding the standard of the new program.”*
 - ✓ Sustainability
 - Several key stakeholders raised the issue of the long-term sustainability and viability of the pharmacy program and emphasized the need to ensure proper planning and processes were in place.
 - *“Once the [pharmacy] program is approved, it should be viewed like any other program; the government is committed to this.”*
 - ✓ Lack of understanding of pharmacy as a profession or career path
 - Most of the stakeholders felt that there was a lack of awareness of the pharmacy profession and its roles which without intervention might limit interest among potential candidates for the training.
 - *“My friends see pharmacists as pill counters. They ask me, ‘you go to school for four years for this?’”*
 - ✓ Career pathway from certificate level pharmacist assistant to pharmacist
 - In line with the Namibian philosophy of providing a pathway for access to every level of qualification, various stakeholders felt that there should be a pathway which would enable a pharmacist assistant to become a pharmacist.
 - *“Could a diploma-level [pharmacy technician] be the first step of the degree program?”*
-

- ✓ Poor retention of public sector staff
 - Attrition of pharmacist assistants and pharmacists in the public sector was perceived to be high due to the lack of career progression pathways, inadequate financial incentives and challenges in human resource management.
 - *“We need to examine the incentives to stay in the public sector.”*
- ✓ Inadequate science, mathematics, computer skills and English language content in secondary school curriculums
 - Students in possession of HIGCSE appear to have adequate competencies in these areas; however, those without must be provided access to programs which can develop these competencies if they are to be successful in professional training. With the exception of private schools, most secondary schools in Namibia do not offer HIGCSE.
 - *“It’s a weakness of the Namibian secondary system that there is no ‘A’ levels, this means that Namibian students can arrive at University without the necessary background in science and math. The UNAM pre-med course has helped with this.”*
- ✓ Clear roles for pharmacist assistants, pharmaceutical technicians and pharmacists
 - The roles and competencies of each cadre should be clearly defined and linked to job descriptions. Several stakeholders commented on the potential of labor market confusion should this be lacking.
 - *“One possible model is pharmacists – manage, technicians – check, assistants – dispense.”*
- ✓ Value of having a multidisciplinary environment for training of health professionals
 - With the establishment of a multidisciplinary health professions training institution (benefit to service delivery)
 - *“Training together will help decrease the conflicts that can occur [between health professions in practice].”*

Key Themes Arising from Review of Documents

- ✓ Current crisis regarding availability of classroom and lab space at UNAM until new medical campus is constructed
 - Currently, math classes in at UNAM are overenrolled and can include up to 800 students with only one junior-level instructor. Additional stress on this system (even at the inclusion of only 20 pharmacy students) could significantly challenge the academic infrastructure.
- ✓ Current crisis regarding availability of academic staff to teach preparatory and professional coursework
 - An important part of any contemporary accredited pharmacy training program is the practical component to the curriculum. This might include short-term, supervised placements at community pharmacies, hospitals and other pharmaceutical sites. Activities such as medicines selection, formulary management, warehousing, medicines use studies and patient care are best learned actively, in a practice-based environment. The availability of staff to support

mentoring for these activities can be limited, however, and without the appropriate preparation, mentors often confuse the expectations of a pharmacy intern (a recent graduate) with those of a pharmacy student, leading to a poor training experience. In many countries, the time to capacitate the practical training component of the curriculum has been the rate-limiting step to the overall curriculum development process.

The recently approved Roadmap for the School of Medicine: 2009–2013 suggests a mechanism by which clinical staff in hospitals will be involved in teaching students in posts entitled “honorary members of the School of Medicine.” A similar mechanism might be appropriate for pharmacy.

- ✓ Lack of clarity regarding where the new pharmacy unit will fall within the UNAM structure
 - Although there is potential for overlap in teaching and research with both current (nursing) and future (medicine) programs, further communications are needed before adapting the plans described within the Roadmap for the School of Medicine: 2009–2013.
- ✓ Lack of depth in biological sciences in revised (year 0) pre-medical curriculum could adversely affect professional pharmacy curriculum
 - The Roadmap for the School of Medicine: 2009-2013 suggests that the current 2-year pre-medical course will be abbreviated to a 1-year pre-medical course at the expense of much of the biological science and basic math content. Having this preparatory course co-available for pharmacy students would be an asset, but the lack of biological sciences could prove a barrier to the professional curriculum.
- ✓ Timeline constraints at University (9–12 months for curriculum approval, 18 months for approval of academic post) and Government (up to 36 months for budgetary additions in MoE) levels
 - Submission documents from the UNAM Learning and Teaching Improvement Unit and the timelines utilized by the School of Medicine Steering Committee and the School of Engineering Steering Committee suggest that the UNAM review process is thorough but lengthy. Abbreviation to these timelines could result in a loss of quality, although the examples of medicine and engineering may provide a template that could save time overall.
- ✓ Lack of clarity about the financing infrastructure for the medical course
 - Although stakeholders mentioned the support of several foreign Universities and donors, specific information to support the sustainability of this model were not provided. With the success of the pharmacy course so closely linked to that of the medical course, additional information should be sought.

NEXT STEPS

Immediate Follow-up Activities

Due to time constraints, the following individuals/offices were not able to be consulted; however, based on feedback received from other stakeholders, we recommend that this should be pursued prior to the planning of the stakeholder workshop:

Stakeholder	Organization
Dr Norbert Forster	Deputy Permanent Secretary Ministry of Health and Social Services
Dr Ishmael Katjitae	Windhoek Central Hospital Head, Internal Medicine
Dr FPL Kavishe	Founding Dean, School of Engineering University of Namibia
Dr Francis S Nyathi	NQA Liaison Director, The Language Centre University of Namibia
Mr Joppie Jansen	Bursar University of Namibia
Ms Ellen Namhila	Librarian University of Namibia
Ms Freda Simaata	Ocean Pharmacy First black pharmacist in Namibia
Mr Johan Badenhorst	Victoria Pharmacy Tutor for UNAM nursing pharmacotherapy course
Mr Edem Adubra	Officer in charge/ Programme Specialist in Education UNESCO Southern Africa Cluster Office
Mr Hans Justus Amukugo	Manager Health Professions Council
	Head, Education Committee Pharmacy Council of Namibia
	Directorate for Human Resources Management Ministry of Health and Social Services
	Polytechnic of Namibia
	Ministry of Finance
	Public Service Commission Office of the Prime Minister
	National Council for Education Ministry of Education

In addition, the Namibian government currently has agreements with several universities (e.g., South Africa, Kenya) to support training of Namibian nationals. As the creation of a new pharmacy course could impact these agreements, the appropriate persons should be consulted as soon as possible.

Recommendations

The following activities are recommended as formative steps in creating a sustainable pharmacy workforce in Namibia, adequate in number and skill:

1. Continue to develop the potential pharmacist pool by increasing interest in pharmacy as a career choice by Namibian youth. Some sample activities include:
 - Develop targeted communications for existing college career fairs
 - Develop targeted communications for grade 8 Namibian youth; in particular, for those based in underserved districts
 - Partner with Pharmaceutical Society of Namibia to identify influential pharmacists to serve as community role models using existing social networks (e.g., churches, sports teams, etc.)
 - Create a summer mentoring program for students to bring high performing secondary school students to UNAM for a 1–2 week “pharmacy camp” over the summer
2. Form a working group to develop a systematic approach to pharmacy workforce data collection and reporting to minimize inconsistencies, help project workforce needs and make a compelling case for the introduction of new pharmacy posts.
3. Identify a highly respected and visible Namibian “champion” for the pharmacy profession.
4. Hold a workshop/forum in which all stakeholders can contribute and provide comments. (This step was indicated as critical by almost all stakeholders.)
5. Form a Steering Committee to serve as an advisory body for this effort. If the composition of the Medical Steering Committee is appropriate for this task, it may be adapted for this task. The group should build on the previous efforts and consider all the options associated with creation of the pharmacy course and the time frame.
6. Draft a competency framework to describe the scope of work expected from certificate-level (PA), diploma-level (pharmaceutical technician) and degree-level (pharmacists) practitioners.
7. Develop a strategic pharmaceutical human resources plan for both private and public sectors which addresses issues of workforce supply, needs, retention, remuneration, recruitment of foreign workforce and career progression.

If the introduction of a pharmacist degree course at UNAM is the decision of the Steering Committee, then:

8. Hire a senior-level pharmacist coordinator to work with the Steering Committee to drive the course development and curriculum approval process.

9. Hire a junior-level pharmacist academician and provide support for this person to gain educational training as a lecturer.
10. Work with UNAM, NQA, the Pharmacy Council and other UNAM health professions' training programs to develop the curriculum using unit standard paradigm and appropriate University format.
11. Work with UNAM to make budget projections which are communicated to the Ministry of Education and National Planning Commission.
12. Initiate process with UNAM for hiring permanent academic and administrative staff for pharmacy course.
13. Work within the university and donor partners to provide for the physical needs of the program (e.g., classroom space, laboratory space, dormitories, etc).
14. Identify and cultivate community-based practitioners who can serve as lecturers and site-based mentors in the course.
15. Work with Ministry of Health and Social Services to ensure continued development of pharmacist posts in the public sector.
16. Explore mechanisms for study loan forgiveness based on service in the public sector.
17. Explore the potential for developing the capacity for Namibian health outcomes research (among physicians, nurses, pharmacists and other allied health professions) through establishing a Namibian chapter of the International Network for the Rational Use of Drugs (INRUD) associated with UNAM.

**ANNEX 1. SWOT ANALYSIS FOR ESTABLISHING A PHARMACY DEGREE COURSE
AT THE UNIVERSITY OF NAMIBIA**

Theme	INTERNAL		EXTERNAL	
	Strengths	Weaknesses	Opportunities	Threats
Resources	Building on existing Medical School development activities	No infrastructure specific to pharmacy (e.g., laboratories)	MSH/USAID support for development of pharmacy program	Uncertainty of long-term donor funding once current commitment ends
	Existence of health professions training at UNAM	No established clinical teaching sites	Long term commitment for operational funding by state	Three year budget cycle in the Ministry of Education
	Institutional support systems at UNAM (e.g., Learning Unit, teacher capacity development, recent approval of Engineering course)			High student loan and no scheme for loan forgiveness
	Availability of state resources for Medical School establishment			
	New medical school campus			
	Potential for shared multidisciplinary teaching to optimize limited teaching resources			

Exploring the Establishment of a Pharmacy Course at the University of Namibia

Theme	INTERNAL		EXTERNAL	
	Strengths	Weaknesses	Opportunities	Threats
Strategic planning	Positive attitudes from stakeholders to establish pharmacy education	Low stakeholder engagement	Development of a needs-based pharmacy workforce	Unclear total pharmacy human resource needs in both private and public sectors
	High political commitment for a medical school	Politics and power dynamics	Unite and strengthen the pharmacy profession	Politics and power dynamics
	Proposed intake is based on human resources for health strategic plan 2008–2012	Time required for institutional and supportive processes	Develop a pharmacy career ladder pathway	Lack of career progression pathway for all pharmacy cadres
		Gaps in details regarding leadership of pharmacy course	Build a national vision for pharmacy profession and education	Absence of a vision for pharmacy
			Coordinate pharmacy profession advocacy activities	
Visibility	Vice-chancellor is championing the Medical School. Interest from lay press in establishment of Medical School	X	Strong pharmacist leaders	Lack of awareness of pharmacy as a career
	The need for pharmacist education is broadly recognized by stakeholders		Advocate for the profession	

Annex 1. SWOT Analysis for Establishing a Pharmacy Degree Course at the University of Namibia

Theme	INTERNAL		EXTERNAL	
	Strengths	Weaknesses	Opportunities	Threats
Partnerships	Shared multidisciplinary learning	X	Improve inter-professional relationships	X
			Engage external support and partners to form institutional linkages for education and research and development	
			Train pharmacists for other countries	
Capacity development	UNAM program for teacher professional development	Lack of pharmacist academics	Teaching support by pharmacy stakeholders	Lack of qualified lecturer pool
			Build local technical expertise	Inadequate math, science, computer and English education in secondary schools
			Build research and development	Internship bottleneck - limited by number of available posts in public sector and accredited preceptors and training sites
Regulation	X	X	To establish and consolidate a quality assurance system for education	Lack of an operational education regulatory system

Theme	INTERNAL		EXTERNAL	
	Strengths	Weaknesses	Opportunities	Threats
Service delivery	X	X	Improve pharmaceutical service delivery and health outcomes	Limited human resource posts
			Increase the number of private community pharmacies in underserved areas	High public sector attrition
			Possibility of mandatory community service	Poor retention, human resource management and inadequate human resource retention policies in the public sector
			Flexible public sector work contracts	Inadequate infrastructure for pharmaceutical service delivery
			Limited human resource posts	Dependency on foreign pharmacist workforce

ANNEX 2. PHARMACY DEGREE COURSES AVAILABLE REGIONALLY

Courses Available in SADC

SADC country	Language of Higher Education	Pharmacy degree course?
Angola	Portuguese	No
Botswana	English	No
Lesotho	English	No
Malawi	English	Yes (1) 1. University of Malawi/College of Health Sciences/Department of Pharmacy; since 2006 (~ 8 students/year); 8FTE + service teaching from other departments
Mozambique	Portuguese	Yes (0+1?) Informal information suggests that Portugal has been supporting a development effort
Swaziland	English	No
Tanzania	English/Swahili	Yes (1+2) 1. Muhimbili University College of Health Sciences/School of Pharmacy; since 1974 (~60 students/year); 48 FTE 2. St Luke Training School at Kilimanjaro Christian Medical Center (pending); 3. St John's University in Dodoma (pending);
Zambia	English	Yes (1) – University of Zambia/Department of Pharmacy; since 2001 (~35 students/year); 3 FTE +/- service teaching from other departments and Ministry of Health
Zimbabwe	English	Yes (1) – University of Zimbabwe/Department of Pharmacy
Namibia	English	No
South Africa	English	Yes (8) 1. University of the Northwest- Potchefstroom campus/School of Pharmacy 2. Rhodes University/ School of Pharmaceutical Sciences 3. Nelson Mandela Metropolitan University/ Department of Pharmacy 4. University of the Western Cape /School of Pharmacy 5. University of the Witwatersrand /Department of Pharmacy 6. University of KwaZulu Natal - Westville campus 7. University of Limpopo – MEDUNSA campus

SADC country	Language of Higher Education	Pharmacy degree course?
		(in collaboration with Tshwane University of Technology) 8. University of Limpopo –Turfloop campus
Mauritius	English/Creole	No
Democratic Republic of the Congo	French	Yes (1) 1. University of Kinshasa Faculty of Pharmacy
Madagascar	French/Malagasy	Yes (1) 1. Ecole de Medicine et de Pharmacie
Seychelles	French/English	No

Courses Available in Other African Countries

Other African Countries	Language of Higher Education	Pharmacy degree course?
Kenya	English	Yes (1) 1. University of Nairobi, School of Pharmacy <i>Note: 2 new pharmacy degree programmes are starting in 2009 though are not yet accredited</i>
Uganda	English	Yes (3) 1. Makerere University – Department of Pharmacy, Faculty of Medicine 2. Mbarara University of Science and Technology (new) 3. Kampala International University-Western campus (new)
Ghana	English	Yes (2) 1. Kwame Nkrumah University of Science and Technology - Faculty of Pharmacy and Pharmaceutical Sciences, College of Health Sciences 2. University of Ghana, School of Pharmacy, College of Health Sciences (new)

ANNEX 3. POTENTIAL RESOURCE PERSONS

The following persons have been identified as potential expert resources for this initiative:

Expert	Function	Contact
Ian Bates	Ian is the Director of the WHO UNESCO FIP Global Pharmacy Education Taskforce and the Head of Education Development, School of Pharmacy, University of London.	ian.bates@pharmacy.ac.uk
Mike Berry	Mike is the Head of the Department of Pharmacy at the University of Malawi, established in 2006.	mberry@medcol.mw
Mahama Duwiejua	Mahama is the Dean of Faculty of Pharmacy at the Kwame Nkrumah University of Science and Technology in Ghana. He has been involved with curricular review at the School of Pharmacy in Liberia and in developing the proposed WAHO harmonized pharmacy curriculum.	mahama_duwiejua@yahoo.com
Billy Futter	Billy is a South African curriculum expert who recently retired from Rhodes University School of Pharmacy. He developed the stakeholder analysis tool that has been used by other African schools of pharmacy.	B.Futter@ru.ac.za
Lungwani Muungo	Lungwani is the Head of the Department of Pharmacy at the University of Zambia, established in 2001.	tmuungo@yahoo.com
Atieno Ojoo	Atieno is a Kenyan pharmacist who has designed curricula for pharmaceutical personnel regarding HIV and malaria management. She currently works for UNICEF.	atisojoo@yahoo.co.uk
Mike Rouse	Mike is a Zimbabwean pharmacist who currently serves as the Assistant Executive Director, International and Professional Affairs of the Accreditation Council for Pharmacy Education. He is the Project Lead for Quality Assurance FIP-WHO-UNESCO Pharmacy Education Taskforce and as developed the Quality Assurance Framework that is currently being tested throughout Africa.	mrouse@acpe-accredit.org

**ANNEX 4. WEST AFRICAN HEALTH ORGANISATION (WAHO)
PROPOSED HARMONISED CURRICULAR AIMS AND OBJECTIVES
FOR SCHOOLS OF PHARMACY**

**PROPOSED HARMONISED CURRICULUM FOR THE TRAINING OF
PHARMACISTS IN ANGLOPHONE WEST AFRICA**

1.0 PHILOSOPHY AND OBJECTIVES OF PHARMACY EDUCATION

The ultimate goal of the programme is to produce Pharmacy Practitioners with knowledge, skills and attitude to provide comprehensive Pharmaceutical Services.

1.1 PHILOSOPHY: The Philosophy of Pharmacy Education is to produce well educated and trained professionals.

1.2 AIMS AND OBJECTIVES

AIM:

To produce Pharmacists with a broad and balanced knowledge in all areas of Pharmacy and who should be competent enough to:

- i. Manage all aspects of Pharmacy Operations within a pharmaceutical outfit (pharmacy stores/premises, including inventory, personnel and security with emphasis on patient/client/customer relations.
- ii. Work to assure the safe, appropriate and cost-effective use of medicines.
- iii. Work in collaboration with other health care professionals to provide the most appropriate drug treatment for patients and to promote health.
- iv. Work in collaboration with the other professionals in the production and distribution of high quality drugs and other medicinal products and devices.

OBJECTIVES:

At the end of the training the graduate should be able to:

- Demonstrate knowledge of Biomedical and Pharmaceutical Sciences as applicable to Pharmacy practice.
- Demonstrate the ability to apply pharmaceutical knowledge in health care delivery.
- Identify and analyze the symptomatology of various disease states with the purpose of monitoring drug therapy.
- Document, analyze and maintain patient drug profiles in order to evaluate outcomes of drug therapy.
- Demonstrate an understanding of the ethics and laws of Pharmacy practice.

- Demonstrate an understanding of the principles of resource management.
- Communicate effectively with patients and other stakeholders in health care.
- Demonstrate knowledge in drug development, manufacturing processes and drug quality assurance.
- Demonstrate knowledge of herbal medicinal products (phytomedicines).

1.3 NOMENCLATURE

The name of the Degree to be awarded under the programme shall be Doctor of Pharmacy (Pharm.D.) or equivalent.

2.0 ADMISSION REQUIREMENTS

The candidate is expected to have successfully passed in Chemistry, Physics, Biology, Mathematics and English Language at the Credit level in the Senior Secondary School Certificate Examination (SSCE) or its equivalent.

Candidates with A' Level credits in three science subjects which are Chemistry, Physics/Mathematics and Zoology/Botany/Biology, or First degree in appropriate subjects may be admitted to the second year of the programme.

2.2 DURATION OF THE COURSE

Not less than five (5) years

2.3 PROGRAMME

The principal objective of the programme is to provide a plan for the education, development and training of qualified students for careers in pharmacy practice. It is, therefore, expected that the programme would provide the student with the following areas:

- (a) General Education
- (b) Basic and Biomedical Sciences
- (c) Pharmaceutical Sciences
- (d) Clinical Pharmacy and Professional Studies

(i) General Education

These will include a variety of courses in the humanities, social and behavioural sciences (including Communication skills).

- a. Human Psychology
- b. Sociology
- c. Communication skills
- d. Ethics
- e. Languages (French)
- f. Information and Communication Technology

(ii) Basic and Biomedical Sciences

The Basic sciences include: Physics, Chemistry, Biology and Mathematics.

The biomedical courses are:

- i. Anatomy
- ii. Biochemistry
- iii. Physiology
- iv. Pathology and Clinical Chemistry
- v. Microbiology and Parasitology
- vi. Immunology
- vii. Biostatistics and Research Methodology
- viii. Molecular Biology/Genetics
- ix. Public Health (including Health care delivery system)

(iii) Pharmaceutical Sciences

- a. Pharmaceutics
- b. Pharmaceutical Technology
- c. Pharmaceutical Microbiology
- d. Pharmacology and Toxicology
- e. Pharmaceutical/Medicinal Chemistry
- f. Pharmacognosy and Herbal Medicine
- g. Basic Pharmacokinetics

(iv) Clinical Pharmacy

- a. Biopharmaceutics
- b. Clinical pharmacokinetics
- c. Pharmacoepidemiology
- d. Pharmacotherapeutics

- e. Clinical Pharmacy Clerkship
- f. Pharmacovigilance
- g. Drug Information Services
- h. Essentials of Nutrition

(v) **Professional Studies**

The varieties of courses are classified under the following headings.

- a. Pharmacy Management (including Resource Management, Drug Supply management)
- b. Pharmacy Practice
- c. Pharmacy Ethics Jurisprudence
- d. Pharmacoeconomics
- e. Clinical Externships

FIRST YEAR COURSES (100 LEVEL)

Subject	Hours (units)
Physics	120
Chemistry	120
Biology	120
Mathematics	90
General Studies Courses	90
	540 (36)

*1 Credit unit = 15hours of Lectures or 45hours of Practical Sessions

SECOND YEAR COURSES (200 LEVEL)

Course	Lectures	Practical	Tutorial	Total
	Hours	Hours	Hours	Hours
Anatomy/Histology	75	90		165
Physiology	75	90		165
Biochemistry	75	90		165
Microbiology & Parasitology	30	45		75
Pharmacognosy	30	45		75
Pharmaceutics/Pharm. Tech.	60	90		150
Pharmaceutical Chemistry	60	90		150
Information and Communication Technology	15	45		60
Total hours (credit units)*	420 (28)	585 (13)		1005 (41)

*1 Credit unit = 15hours of Lectures or 45hours of Practical Sessions

THIRD YEAR COURSES (300 LEVEL)

Course	Lectures	Practical	Tutorial	Total
	Hours	Hours	Hours	Hours
Pharmacognosy	30	45		75
Pharmaceutics	45	45		90
Pharmaceutical Microbiology	45	45		90
Pharmaceutical Chemistry	75	90		165
Languages (French)	15	-		15
Pharmacology	60	90		150
Pharmaceutical Technology I	45	45		90
Basic Pharmacokinetics	30	-		30
Health psychology and Sociology	15	-		15
Pathology	30	45		75
Immunology	15	-		15
Clinical Chemistry	15	-		15
Molecular Biology/Genetics	15	45		60
Total	435 (29)	450(10)		885 (39)

*1 Credit unit = 15hours of Lectures or 45hours of Practical Sessions

FOURTH YEAR COURSES (400 LEVEL)

Course	Lectures	Practical	Tutorials	Total
	Hours	Hours	Hours	Hours
Public Health	45	45		90
Pathophysiology	15	-		15
Pharmacognosy (Phytochemistry)	30	45		75
Pharmaceutics	30	45		75
Pharmaceutical Chemistry	45	90		135
Pharmacology	60	45		105
Pharmaceutical Technology II	30	45		75
Pharmacy Ethics & Jurisprudence	30	-		30
Biostatistics & Research Methodology	30	-		30
Introduction to Clinical Pharmacy	30	-		30
Essentials of Nutrition	30	-		30
Pharmacotherapeutics I	30	-		30
Pharmaceutical Microbiology	30	-		30
Veterinary Pharmacy & Agrochemicals				
Pharmaceutical biotechnology	45	-		45
Pharmaceutical care	30	-		30
Languages (French)	30	-		30
	15	-		15
Total	555(37)	315(7)		870(44)

*1 Credit unit = 15hours of Lectures or 45hours of Practical Sessions

FIFTH YEAR COURSES (500 LEVEL)

Course	Lectures	Practical	Tutorials	Total
	Hours	Hours	Hours	Hours
Biopharmaceutics	30	-		30
Herbal & other alternative Medicines	30	-		30
Pharmacy Management I	30	-		30
Communication skills	15	-		15
Clinical Pharmacokinetics	30	-		30
Medicinal Chemistry	30	-		30
Pharmaceutical Analysis II	30	45		75
Pharmacology	30	45		75
Clinical Pharmacy Clerkship I	-	135		135
Clinical & Environmental Toxicology	30	-		30
Pharmaceutical Technology III	30	45		75
Languages (French)	15	-		15
Industrial Training (Externship)	-	675		675
Total	300(20)	945 (21)		1245(41)

*1 Credit unit = 15hours of Lectures or 45hours of Practical Sessions

SIXTH YEAR COURSES (600 LEVEL)

Course	Lectures	Practical	Tutorials	Total
	Hours	Hours	Hours	Hours
Drug Information and Pharmacovigilance	30	-		30
Pharmacy Practise	30	-		30
Pharmacy Management II	30	-		30
Pharmacotherapeutics II	30	-		30
Clinical Pharmacy Clerkship II	-	270		270
Clinical Pharmacy Clerkship III	-	270		270
Pharmacogenetics and genomics	30	-		30
Radio-Pharmaceuticals	30	-		30
Advanced Drug Production Technology	30	-		30
Pharmacoepidemiology and Pharmacoeconomics	30	-		30
Projects	-	270		270
Total	240(17)	810(18)		1050(35)

*1 Credit unit = 15hours of Lectures or 45hours of Practical Sessions

COURSE EVALUATION

Each course shall be evaluated by combination of in-course assessment and end of course assessment.

In-course assessment shall consist of term papers, laboratory reports and/or tests (written, oral or practical).

End-of-course assessment shall consist of:

- i) Written examinations
- ii) Practical examinations
- iii) Oral examinations

The total performance score shall be made up of 30-40% in-course assessment and 60-70% end of course assessment. The minimum pass mark for any course taken in the professional years (200Level to 600Level) shall be fifty percent (50%).

Evaluation of projects shall be guided by the rules of each institution.

RESOURCE REQUIREMENTS FOR TEACHING AND LEARNING IN THE PROGRAMME

Academic Staff

Based on students' enrolment, the minimum academic staff to student ratio should be 1:10. Full time academic staff should have a second degree or advance professional qualification.

Academic and Physical Spaces

There shall be provided adequate spaces for lecture theatres, seminar rooms, reading rooms, staff offices and research spaces.

Library and Information Resources

There should be a Faculty Library, which has appropriate reference books, journals and periodicals in all areas of pharmacy. Access to Internet facilities is highly desirable.

Laboratories and Equipment

There should be adequately equipped laboratories with items of equipment for effective learning as expected in this curriculum.

Teaching Methodology

Problem solving case-studies should be included in order to inculcate into the learners the attitude of self-study which will promote life-long learning that is required in responding to the changing environment and challenges of the future.

Accreditation

An accreditation system should be in place to assure the quality of learning and the products of the programme.

DETAILED COURSE CONTENTS

FIRST YEAR COURSES (100 LEVEL)

A. PHYSICS

- i. **Mechanics and Properties of Matter**
Dimensional analysis. Elements of Statistics. Vector algebra. Kinematics and dynamics of a mass point; law of mechanics and gravitation, Kepler's laws. Motion of rigid bodies, moment of inertia, angular momentum. Conservation laws. Simple harmonic motion. Elastic properties of solids, moduli of elasticity. Fluid mechanics and hydrodynamics.
- ii. **Thermal Physics Sound and Optics**
Zeroth Law of thermodynamics, temperature, Calorimetry. Change of State, critical points. Heat transfer, conduction, convection, radiation, first and second laws of thermodynamics, thermal energy. Gas laws. Kinetic theory of gases. Black body radiation.

Production of sound by vibrating solids, speed of sound in solids, liquid and gases; vibrating air columns, intensity, pitch and quality, response of the ear to sound waves, interference of sound waves, Doppler effect.
Reflection at plane surfaces, image formation refraction, dispersion, transmission and absorption of light waves, spherical mirrors, thin lenses, combination of lenses, lens aberrations, optical instruments, resolving power of microscope.
- iii. **Electromagnetism & Modern Physics**
Electrostatics, Coulomb's law, Gauss' law, simple applications, electric field, electrostatics potential. Energy in electric field, capacitance, Insulators, conductors, dielectrics; polarization. Electric current. Ohm's law, circuit analysis. Thermo electricity. Magnetic effect of currents. Ampere's law applications. Permanent magnetism, earth's magnetic field. Faraday's law of induction. Alternating current AC circuits. Measuring devices. Motion of charge particles in electricity through gases, e/m for electrons. X-rays, nuclear energy.
- iv. **Basic Practical Physics**

B. CHEMISTRY

- i. An introduction to atomic structure and electronic configuration of the element
Electronic theory of valency. The periodic classification of the elements. General study of hydrogen, nitrogen, oxygen phosphorus, sulphur, chlorine, bromine, iodine, sodium, calcium, aluminum, iron, manganese, copper and zinc with emphasis on similarities and differences based on position of the elements in the Periodic Table, radioactivity and its applications.

- ii. Fundamental chemical principles; the gas laws, kinetic theory of gases. Properties of dilute solutions. Thermo chemistry, chemical equilibrium; law of mass action, reaction ratio and chemical energetics. Electrolytes and ionic equilibria. Theory of acids, bases and indicators. Phase equilibrium study of multicomponent systems and indicators. Phase equilibrium study of multicomponent systems and applications in partition and absorption chromatography.
- iii. Introduction to organic chemistry IUPAC nomenclature, elemental analysis and molecular formula, structural isomerism. Isolation and purification methods. The concept of functional groups, resonance and aromaticity. A brief study of saturated and unsaturated hydrocarbons, cyclic hydrocarbons, alcohols, alkylhalides; ethers, aldehydes, ketones, carboxylic acids, amines and aromatic compounds. Comparisons of phenols, alkylhalides and aromatic amines with their aliphatic analogues. Common synthetic polymers and their uses. Introduction to carbohydrates, proteins, oils and fats and optical isomerism.
- iv. **Basic Practical Chemistry**

C. BIOLOGY

- i. Morphology and life cycles of plants and animals, a general study of plant and animal group from algae/fungi to chordates. Structural and functional study of plants and animals (cells, tissues, organs and systems).
- ii. Elements of biological chemistry - Inorganic and micro molecules relevant to life – enzymes and cellular metabolism. Taxonomic, physiologic and development studies of plants and animals.
- iii. Reproduction, genetics-hereditary substances, mechanism of nuclear division and new cell formation; evolution, natural selection and evolution as a continuous process; study of the environment from the ecological view point.
- iv. **General Practical Biology**

D. MATHEMATICS

- i. Algebra of real numbers (Quadratic equations, indices, surds, logarithms, Binomial theorem for positive integral index, solution of inequalities, polynomials and their factorization. Rational function and partial fractions). Trigonometry (definitions and elementary properties of trigonometric function, radian measure, periodicity of circular functions, addition formulae and other basic identities).
- ii. Definitions, use of the Δ - process, formulae for sum, product and quotient, the chain rule, differentiation of simple algebraic trigonometric exponential and definite and indefinite integrals of simple algebraic, trigonometric, exponential

and logarithmic functions and fundamental theory of integral calculus, simple application to areas and volumes, methods of integration.

E. GENERAL STUDIES COURSES

1. Communication in English I (2 Units)
2. Logic, philosophy and human existence (2 Units)
3. Peoples and culture (2 Units)
4. Use of Library, study skills and Information Communication Technology (ICT) (2 Units)
5. History and philosophy of science (2 Units)
6. Peace studies and conflict resolution (2 Units)
7. Introduction to Entrepreneurial skills (2 Units)

SECOND YEAR COURSES (200 LEVEL)

A. ANATOMY/HISTOLOGY

Basic Anatomy

Basic organization of the human body: A study of human biological structure at various levels of complexity: from subcellular to gross and microscopic structure of individual organ systems. Structure - function correlations are emphasized: Integumentary system, Circulatory system, Lymphoid system, Alimentary system, Musculoskeletal system, Respiratory system, Urinary system, Genital system, Endocrine system, Organs of special sense.

Neuroanatomy

Basic structural organization of the nervous system: The neuron (Soma and neurites); Centralization and Telencephalization; Neural Circuitry (Receptors, Effectors and the synapse); Spinal cord and brain vesicles; Fate of the Neural Crest. Spinal Cord: General Topography; Grey matter; Ascending and Descending pathways. Brain: General Topography; Brainstem; Cerebellum; Diencephalon; Cerebrum. Meninges and Ventricular system: Pia, Arachnoid & Dura Matera; Secretion and Circulation of Cerebrospinal fluid; Blood-Brain Barrier. Peripheral Nervous System: Basic plan; Afferent and Efferent cerebrospinal peripheral nerve endings; Ganglia. Autonomic Nervous system: Basic plan; Sympathetic system; Parasympathetic system; Autonomic effector endings.

General Embryology, Teratology and Genetic Anatomy

General embryology - Male gamete, female gamete, fertilization (gametogenesis), development of early embryo and developmental malformations

Systemic embryology - musculoskeletal system, respiratory system, cardiovascular system, nervous system, urogenital system, and developmental malformations

Genetic anatomy - genetic apparatus, and genetically related malformations

Influence of drugs on development.

Histology

- (a) The Tissues
- (b) The lymphatic system
- (c) The alimentary system
- (d) The exocrine glands
- (e) The urinary glands
- (f) The reproductive system
- (g) Organs of special senses

Histology Practicals

B. PHYSIOLOGY

Introductory and Blood Physiology

Body fluids, Cell Physiology, Transport System, Excitable cells, Contractile tissues. Homoestasis, Control Systems; Blood; Introductory Autonomic Nervous system.

Cardiovascular and Respiratory Physiology

Cardiovascular physiology: Cardiac muscle, E.C.G., Hemodynamics, systemic Circulation, Events in Cardiac cycle, Heart rate and its control, Blood Pressure, Cardiac output.

Respiratory Physiology: Introduction to Mechanics of respiration, Lung volumes, Gas tensions, Oxygen Transport, Oxygen dissociation curve, Carbon dioxide transport, Carbon dioxide dissociation curve, Nervous regulation of respiration, Chemoreceptors, Hypoxia, hyperpnoea, Apnoea, Periodic respiration, Dyspnea, Cyanosis.

Renal, Gastrointestinal and Endocrine Physiology

Renal Physiology: Introductory Renal anatomy, Glomerular Filtration and clearance, Tubular reabsorption, T_m , Countercurrent Mechanism, E.C.F. Regulation; Dilute and concentrated urine output, Micturition, Renal hormones, Renin-Angiotension system.

Gastrointestinal Physiology: Introduction: Mastication, deglutation; Salivation, Stomach and its emptying, Small intestine, Large intestine, Salivary, Gastric and Pancreatic juices, Reflexes, Digestion, Absorption and Assimilation, Bile.

Endocrinology & Reproduction: Introduction and general features, Thyroid; Parathyroid and calcium Metabolism, Pituitary gland, Adenohypophysis, Neurohypophysis, Adrenal Cortex and Medulla. Pancreas, Thymus, Pineal Gland, Male and Female Reproductive systems.

Neurophysiology and Special Senses

Neurophysiology: Organisation of the CNS and CNS control systems, Spinal reflexes, Excitation, Inhibition. Localization of functions in the cortex, Motor system, Pyramidal and Extrapyramidal Sensory systems, Reticular formation, Cerebellum, Control of posture, Neurobiology rhythms, Sleep and unconscious states, Memory, Learning.

Autonomic Nervous System: Parasympathetic and sympathetic neuroeffectors, Cholinergic mechanisms, Adrenergic mechanisms, Autonomic reflexes, Adrenal medulla, autonomic drugs.

Special Senses: Eyeball, retina, sight, accommodation, Photochemical mechanism, receptor potential, light reflexes, adaptation, Ear, Sound waves, Hearing, Taste, Smell.

Practicals

C. BIOCHEMISTRY

Importance of biochemistry to the health Sciences - levels of medical care and biochemistry. Membranes and cell structure techniques used in biochemistry and medicine. Protein structure and function-primary, secondary and tertiary structure of proteins in blood, digestion, absorption and transport across membranes; Protein calorie malnutrition.

Metabolism - introduction of the study of intermediary metabolism. Carbohydrate chemistry, digestion, absorption and metabolism. Lipid chemistry, digestion, and metabolism including phospholipids and prostaglandins; lipidoses. Metabolism of amino acids; amino acid degradation and biosynthesis. Essential and non essential amino acids. Ketogenic and glucogenic amino acids.

Introductory Molecular Biology - Nucleic acids - DNA, RNA and elementary treatment of their structure. Biochemistry of heredity. Discovery and properties of the genetic materials, DNA replication and cell division. Cloning and recombinant DNA Technology, Mutagens and mutation. Mechanism of protein synthesis. Biochemistry of hormones and hormonal action to include actions of cyclic-AMP, cyclic-GMP, adrenaline, glucagon and insulin. Detoxification mechanisms including cytochrome P₄₅₀ and other isoforms. Haem degradation and other important biochemical transformation of medical importance.

Biochemistry Practicals

D MICROBIOLOGY AND PARASITOLOGY

Historical development of microbiology and the effects on health. General structure of the bacterial cell; the bacterial spore, its structure and resistance to inactivating agents. Systematic classification of bacteria and characteristics of major groups – Taxonomy. Protoplasts, spheroplasts and L-Forms. Nutritional requirements and growth of bacteria. Bacterial culture media and evolution of pure culture technique. Enumeration of microorganisms. Fungi and moulds; their importance in pharmacy, and medicine. The Rickettsia, Chlamydia, Viruses (including HIV/AIDS) and viral replication. Introductory parasitology. Protozoal parasites of Public Health importance.

Practical - Laboratory exposure for handling, identification and growing of microorganisms. Experiments to bring out other salient parts of the course.

E. PHARMACOGNOSY

Classification of Vegetable Drugs: Alphabetical, Morphological, Pharmacological, Chemical, Pharmacological, Plant description – morphology and anatomy. The cell differentiation and organic cell contents – carbohydrates, proteins, fixed oils, gums and mucilages with emphasis on those used in pharmacy and pharmaceuticals. Biological and geographical

sources and uses of plant drugs – crude drugs with particular reference to Nigerian sources. Factors involved in production of plant drugs: climate, cultivated and wild, collection, adulteration, plant pests.

Practicals

F. PHARMACEUTICS & PHARMACEUTICAL TECHNOLOGY

Fundamental Operations in weighing: Errors in using dispensing balances; minimum weighable amounts and weighing techniques; conical and beaker shaped measures for dispensing liquids; errors in measurements and measuring technique. Household measures and weighing of small amounts of materials.

Ethics of Dispensing and Presentation of Products: General dispensing procedure; the prescription; Information given on the labels of dispensed medicines. Presentation of information on labels; Additional labels.

Pharmaceutical Calculations: Percentage, proportional calculations and alligation; Calculations involving very small quantities.

Types of Pharmaceutical Preparations: Solutions, mixtures, linctuses, syrups, elixirs, oral liquids, emulsions, applications, lotions, gargles, mouth washes, nasal and ear drops. Divided and bulk powders, granules, cachets, capsules and tablets, etc.

Pharmaceutical solutions and Solubility: factors affecting solubility and rate of solution; Solutions of liquids in liquids; The distribution of solutes between immiscible liquids and applications of the distribution law in pharmacy; Colligative properties of solutions.

Phase equilibria: The phase rule; Systems of one and two components and applications in pharmacy, e.g., eutectic mixture and sublimation (freeze) drying.

Dispensing Practicals

G. PHARMACEUTICAL CHEMISTRY

Atomic and Molecular Structure: In this course, a short review of electronic structure of atoms and molecules including introduction of quantum theory, application of Shrodinger equations to simple systems (e.g. the Hydrogen atom) to show the origin of the: n, l, m, s. nomenclature will be carried out. The relationship between the electronic structure of elements and the formation of covalent, ionic and coordinative (dative) bonds leading to complexation and chelation and the nature and pharmaceutical important application of co-ordination compounds, metal complexes and chelating agents will be discussed.

Pharmaceutical Inorganic Chemistry: This course will involve a comparative study of the physico-chemical properties, preparation and uses of the elements of the periodic table and their compounds of pharmaceutical importance. The chemical basis for the pharmaceutical uses will also be emphasised.

Physical Chemistry: Review of principles of thermodynamics, chemical and ionic equilibria, and chemical kinetics relevant to pharmacy, effect of these on the feasibility, of drug synthesis, mixing, solubility, biological redox systems.

Practicals

H. INFORMATION and COMMUNICATION TECHNOLOGY

- a) Overview of information and communication technology and their applications in contemporary society
- b) Computer types (mainframe, mini computers, micro computers), computer parts and terminology (hardware, software)
- c) Computer Hardware:
 - i) Input Devices: keyboard, mouse, joystick, microphone and scanner;
 - ii) Output devices: video display unit (VDU), printers, speakers;
 - iii) Important internal components including CPU or Processor, RAM or Memory, and Storage Devices – Disk Drives
- d) Components affecting the performance of a computer: Processor, memory & hard disk
- e) Computer software:

System Software

Operating Systems: examples & characteristics, functions, drives (floppy, removable disks such as flash disks, CD drives), directories/folders, file management.

Driver Software.
- f) Application Software
 - Word Processors
 - Graphics
 - Spreadsheets
 - Educational Software
 - Database management system.

Business Solution Software e.g. Accounting packages, Airline Reservation System, Hospital Management System, Point of Sale System, Banking and financial management System.
- g) Networking and Internet

Practicals

THIRD YEAR COURSES (300 LEVEL)

A. PHARMACOGNOSY

Plant collection, preparation and storage of herbarium specimens

Standardization/evaluation of crude drugs with particular emphasis on chemical constituents, adulteration and substitution, microbial contamination, toxic residues, moisture content, ash values, extractive values, crude fibre, and other numerical values of crude drugs.

Formulation and production of phytomedicines of some Nigerian medicinal plants

Physio-chemical characteristics and assessment of quality of the phytomedicines.

History and present state of herbal medicines. The practitioner, the plant – collection, drying and storage, pests and pesticides.

Herbarium, herbarium specimen and voucher numbers.

Research findings and documentation of medicinal plants.

Selected examples of Nigerian medicinal plants will be discussed under the following headings: local names, geographical sources, microscopy, medicinal uses, chemical constituents and toxicity profile. Examples will be taken from the following areas: antimalarials, antisicklings, antihypertensives, antidiabetics, antimicrobials. Also to be discussed are toxic special plants – hallucinogens, allergens and molluscicides.

Phytochemical principles involved in formulation of phytomedicines will be discussed. Substantial emphasis will be laid on physiochemical and pharmacological assessment of quality, efficacy and safety.

Practicals

B. PHARMACEUTICS

Adsorption: The mechanism of adsorption: The Langmuir and B.E.T. isotherms, chemisorption; and factors affecting the amount absorbed; application of adsorption in pharmacy.

Surface and Interfacial Phenomena: Surface tension: contact angle and the wetting of solids, spreading of one liquid over another, mechanism of capillary rise and effect of temperature, method of determining surface tension.

Surface active agents and their classification: pharmaceutical applications and medicinal importance of surface active agents.

Bulk Properties of Surfactant Solutions: micelle formation and methods for the determination of the critical micelle concentration (C.M.C.); factors affecting micelles; stability of micelles. Solubilization: factors affecting solubilization, and pharmaceutical applications of solubilization.

Colloidal systems: classification of colloids; properties of colloidal solutions; preparation of lyophobic solutions; stability of lyophobic colloids.

Rheology: Newtonian fluids; flow characteristics of Newtonian fluids and effect of temperature; determination of viscosity - principles of capillary tube; Redwood and falling sphere viscometers; rotational viscometers; the flow properties of disperse systems and viscosity coefficients of colloidal dispersions; viscosity imparting agents in pharmacy; non-Newtonian fluids; plastic, pseudoplastic and dilatant flows; thixotropic systems; rheological properties of suspensions; emulsions, ointments and creams. Mechanism of fluid flow; significance of Reynolds number; distribution of velocities across a tube and boundary layers.

Practicals

C. PHARMACEUTICAL MICROBIOLOGY

- i. Production and storage of water
- ii. Quality determination
- iii. Parenteral products
- iv. Pyrogens and pyrogen testing
- v. Evaluation of microbial contents of pharmaceutical preparations and products.

Practicals

D. PHARMACEUTICAL CHEMISTRY

(a) Pharmaceutical Organic Chemistry

Types of organic reaction mechanisms taken in relation to types of organic functional groups, effects on their stability, use in pharmacy, other physicochemical properties, solubility, absorption, distribution and excretion when found in drug molecules. Functional groups to be treated include Aldehydes and ketones, alcohols and phenols, carboxylic acids and their derivatives (amides, Esters, acid anhydrides, Acyl halides) and sulphonic acid, also to be treated are amines and imines, also to be treated are amines and imines, nitriles, nitro and nitroso groups and azo-compounds.

General review of the concept of aromaticity in benzene and how this affects substitution in such structures.

General review of organic reactions leading to interconversion and modification of functional groups through nucleophilic and electrophilic substitution, elimination addition and rearrangement reactions. Utility of these reactions for isolation, characterisation, elucidation of structure and synthesis of medicinal products.

Stereochemistry: Review of total concept of stereoisomerism as distinct from isomerisms of other types-optical and geometrical isomerism chiral and achiral molecules, stereoisomerism and molecular conformation in relation of drug action through drug-receptor interaction. Biological examples, Determination of configuration- spectroscopic methods, Resolution of racemic mixtures and importance in Pharmacy using named medicinal examples. Optical rotatory dispersion and its uses. Importance of stereochemistry in terpenes.

Organic Synthesis on medicinal compounds involving several stages, e.g preparation of benzocaine (Ethyl-p-aminobenzoate); Preparation of Aspirin; Preparation of sulphanilamide;

(b) Pharmaceutical Analysis I

Official standards for pharmaceutical chemicals and formulated products which are designed primarily to set limit of tolerance for the product at the time it reaches the patient. Such quality criteria which are specified in official monographs for pharmaceutical chemicals include: A description of the drug or product, Solubility, Test for identity, Physical constants, Quantitative assay of pure chemical entity in the case of pharmaceutical chemicals, or of the principal active constituents in the case of formulated product, Limit tests of exclude excessive contamination, and Storage conditions. In addition to the above, the students should be aware of the source of impurities in pharmaceutical. The methods mentioned above should include: Acid-base titrations, non aqueous acid base titrations, oxidation-reduction titrations, complexometric titrations, gravimetry and limit tests.

Practicals

E. LANGUAGES

French for Beginners

F. PHARMACOLOGY

General Principles of Pharmacology

Definition of pharmacology, scope and sub-divisions of pharmacology, methods and measurements in pharmacology: drugs development and evaluation; biological assays; clinical trials; measurement and evaluation of toxicity, Pharmacokinetics: routes of drug administration, kinetics of drug absorption, distribution, blood-brain-barrier, placental barrier, biotransformation and elimination, Pharmacodynamics: mechanisms of drug action, drug receptors, signal transduction and second messengers, selectivity of drug action, factors affecting drug action in man, dose-response relationships, agonists, antagonists and their interactions with receptors. Drug toxicity and adverse drug reactions.

Autonomic/Neuro-Pharmacology

Review of the anatomy and physiology of the autonomic and somatic nervous systems; General principles of neurohumoral transmission; Cholinergic transmission; synthesis, storage and release of ACh; Muscarinic and nicotinic actions of ACh; Muscarinic receptor agonists and antagonists; Cholinesterases and anticholinesterases; Drugs used in myasthenia gravis; Drugs affecting autonomic ganglia; Neuromuscular blocking agents; Adrenergic Transmission; Synthesis, storage and release and inactivation of noradrenaline; Neuronal and extraneuronal uptake mechanisms; Sympathomimetic amines, adrenergic neuron blocking drugs, drugs affecting the storage, release and disposition of neurotransmitters; Adrenoceptor blocking agents (alpha and beta blockers); Methods of studying

neurotransmitters; Nitric oxide (NO) and Non-Adrenergic Non-Cholinergic (NANC) trans-mission.

Systemic Pharmacology

Ocular Pharmacology: Miotics and mydriatics, drugs used in glaucoma, ophthalmological diagnostic agents; Respiratory Pharmacology: Asthma and antiasthmatic drugs, expectorants, mucolytics and antitussives; Gastrointestinal pharmacology: Laxatives and purgatives, antidiarrhoeal drugs, oral rehydration therapy, antipeptic ulcer drugs, spasmolytics, emetics and anti-emetics; Renal Pharmacology: Diuretics – osmotic diuretics, carbonic, anhydrase inhibitors, thiazides, loop diuretics, K⁺ sparing, diuretics. Urine pH-altering agents.

Practicals

G. PHARMACEUTICAL TECHNOLOGY I

Filtration: factors affecting filtration; mechanism of filtration; filter media and aids; filtration equipments (continuous rotary vacuum filter, the filter press and the edge filters).

Centrifugation: principles of centrifugation; laboratory and large scale centrifuges.

Dispersed systems: -

Suspensions: factors affecting the preparation of a physically stable suspension; flocculated and deflocculated systems; caking and resuspension; sedimentation behaviour of flocculated and deflocculated suspensions; pharmaceutical applications of suspensions; colouring agents used in the formulation of suspensions.

Emulsions and emulsification: types of emulsion and testing of emulsion types; theories of emulsions (Bancroft's Harbens oriented wedge and the complex film theories); emulsifying agents and their classification; methods available for the preparation of emulsions; preservation and stability of emulsions; concept of hydrophile-lipophile - balance (HLB); formation of emulsions by HLB methods; methods for determining HLB numbers; semi-solid emulsions

Creams - types and preparations.

Ointments - types of ointment bases and methods of preparation.

Pastes - their bases and method of preparation.

Jellies and Poultices - Kaolin Poultice B.P.C.

Gels: The structure and properties of gels; application of gels in pharmacy.

Suppositories and Pessaries: methods of their preparation, shapes and sizes properties of an ideal suppository base; types of suppository bases; general methods of preparation of suppositories and their packaging.

Practicals

H. BASIC PHARMACOKINETICS

- (a) Definition of terminology and symbols used in pharmacokinetics.
- (b) Fate of a drug after administration;
- (c) Physical significance of drug concentration in the blood;
- (d) Biological factors in drug absorption;
- (e) Physicochemical factors affecting drug absorption;
- (f) Dosage form consideration in gastrointestinal absorption;
- (g) Drug-drug and drug-food interactions, bioavailability and bioequivalence with emphasis on product registration with regulatory bodies.
- (h) Problems associated with pre-formulation of drugs and the design of dosage forms from an industrial perspective.
- (i) Compartment models: Single and Multiple Compartment models.
- (j) Drug clearance
- (k) Hepatic elimination of drugs
- (l) Intravenous infusions
- (m) Multiple dosage regimens
- (n) Prolonged action dosage form administration
- (o) Non-linear pharmacokinetics
- (p) Relationship between pharmacokinetic parameters and pharmacologic response.
- (q) Calculation of various pharmacokinetic parameters

I. HEALTH PSYCHOLOGY AND SOCIOLOGY

General principles of psychology, medical sociology, role of psychology in healthcare delivery, management of aggression and stress, psychological factors in anxiety, depression and psychosomatic illness, etc. At the end of the course, the student will be able to apply psychological approach in providing an effective pharmaceutical care for the management and prevention of drug abuse and dependence, and other illnesses.

J. PATHOLOGY

- 1. The normal cell and the adapted cell
- 2. Cell injury and cell death
- 3. Inflammation and repair
- 4. Neoplasia and its clinical aspects
- 5. Diseases of immunity
- 6. Systemic diseases:
 - (a) Diabetes mellitus
 - (b) Iron storage disorders
 - (c) Gout and urate deposits in the kidneys
- 7. Fluid and haemodynamic derangements
- 8. Infectious disease
- 9. Deficiency diseases:
 - (a) protein-calorie malnutrition

- (b) vitamins and minerals deficiency
- 10. Blood vessels and the heart
- 11. lymph nodes and spleen
- 12. All systems, skin, liver, gastrointestinal tract, pancreas, breast and biliary tract.

Practicals

K. IMMUNOLOGY

Principles of Immunology
Antigen/Antibodies reactions and applications
Antibody production
Antigen/Antibody reaction – allergy, etc.
Immunological products
Immunization procedures
Bacterial and viral vaccines
Diagnostic reagents
Immuno sera, etc.

L. CLINICAL CHEMISTRY *

M. MOLECULAR BIOLOGY/GENETICS

- i. **Basic techniques in biotechnology** – cutting and joining of DNA molecules, cloning techniques, construction of DNA structure, screening methods, DNA analysis, mutagenesis, PCR
- ii. **Medical importance of recombinant proteins** e.g., insulins, growth hormones, interferon.
- iii. **Engineering antibodies for therapy** – production of monoclonal antibodies, recombinant antibodies and antibody fragment.
- iv. **Biotechnology in vaccines development** – DNA vaccines, vaccine production by recombinant DNA for prevention of viral and bacterial infections

FOURTH YEAR COURSES (400 LEVEL)

A. PUBLIC HEALTH *

B. PATHOPHYSIOLOGY

This course is designed to provide the pathological and physiological foundation necessary for understanding the basis of pharmacotherapeutics. The pathophysiological changes occurring in disease processes will be discussed. The content of this course will focus on alterations in body function and system or organ failure.

After completing the course, the student will be able to describe the various pathophysiological mechanisms of disease processes which are vital for the drug use decision-making process. The student will acquire the scientific knowledge essential for the application of pharmaceutical care.

C. PHARMACOGNOSY (Phytochemistry)

(a) General Phytochemical Methods in drug Analysis:

(i) Plant collection, drying and processing. Extraction methods including maceration, percolation, Soxhlet and count-current methods and others.

(ii) Separation and Isolation of constituents. Chromatographic techniques (Analytical and preparative, paper, conventional column, HPLC, DCCC, G.C., gel filtration, electrochromatological flash column, modern pressure liquid chromatography, and affinity chromatography. Adsorbents in chromatography, Applications.

(b) Secondary Plant Metabolites

The under-mentioned will be discussed under the following headings: sources, chemical constituents, Identification tests, medicinal uses and toxicities:

Glycosides

(a) Saponins – at least, sources to be discussed are one for the Steroidal and one for the Triterpenoidal type. Natural steroids for the production of pharmaceuticals.

(b) Tannins and Galls.

(a) Anthraquinones – The purgative drugs – local and foreign sources.

(b) Cardiac glycosides. Foreign and local sources.

Alkaloids - Tropane alkaloids (including cocaine), quinoline, Isoquinoline, indole, Steroidal alkaloidal glycosides. The Indian hemp an anticancer agents from plants and semi-synthetic products

Others – Coumarins and flavonoids.

Practicals

- (a) Extraction methods: Maceration processes, percolation and demonstration of Soxhlet extraction. Chemical tests for glycosides, alkaloids, tannins, general and specific tests for identification.
- (b) Chromatography methods in plant material analysis – Thin layer and paper analytical and preparative, Column, GC, PTLC (Demonstration only) to be applied for analysis of glycosides phenolics alkaloids.

D. PHARMACEUTICS

Dosage Form Evaluation and Drug Stability

Pharmaceutical Evaluation of Dosage Forms:

Standard for tablets and capsules: Shape, weight, content of medicaments, diameter, crushing strength (hardness) and friability of tablets and capsules. Formulation factors affecting the dissolution rates of solid dosage form.

Liquids: Labelling and packaging, description, content, appearance (colour, clarity, etc), pH, weight per ml, refractive index, etc.

Semi-solids: Labelling and packaging, description, content, appearance, weight per ml.

Tablets and Capsules: Labelling and packaging, description, content, appearance, disintegration and dissolution tests.

In-vitro dissolution tests for solid dosage forms: Natural convention - Non-sink methods such as solvometer, hanging pellet, and static disc methods, forced convention - non-sink methods such as wruble, beaker, oscillating tube rotating disc, sounder & ellenbogen methods, and forced convention - sink methods (adsorption, partition, dialysis and column methods, continuous flow through system, computerised automated systems.

Drug Stability: Incompatibilities in liquid dosage forms; chemical degradation of pharmaceutical products (hydrolysis, oxidation, isomerization, polymerization, decarboxylation and adsorption of carbon dioxide); physical factors influencing chemical degradation (temperature, moisture, light and radiation): factors influencing and methods of reducing chemical degradation; physical degradation of pharmaceutical products e.g. loss of volatile constituents, loss of water, absorption of water, crystal growth, polymorphic changes and colour changes. Microbiological degradations.

Accelerated stability testing.

Packaging Materials - general principles

Metals (e.g. tin, iron and aluminium) and plastics - solvent properties, toxicity, permeability and light transmission characteristics

Glass - mechanical strength and resistance to thermal shock.

Strip and blister packaging

Flake and spicule formation; Paper and board; Closure testing: folded, bung and push-on seals, reasons for test failures; Package-testing.

Practicals

E. PHARMACEUTICAL CHEMISTRY

Instrumental Methods of Analysis of pharmaceuticals:

Absorption spectrophotometry;
Infra-red spectroscopy;
Fluorimetry;
Atomic Absorption spectroscopy;
N.M.R. Spectrometry;
Gas-liquid chromatography;
HPLC;
Other methods; e.g. Polarography, Potentiometry; and Polarimetry; Mass Spectrometry.

Drug design

Physico-chemical approaches to drug design. Historical, Free-Welton and Hansch approaches. The concept of isosterism. Bioisosterism as a tool in drug design. SAR in drug design. Anti-metabolite and pro-drug approach to design of new drugs.

(ii) Medicinal chemistry of some selected compounds: A study of the following classes of drugs in respect of their nomenclature, physical and chemical properties, structure-activity, relationship, synthesis (where necessary), assay, metabolism, where applicable and uses. General and Local anaesthetics; Sedative-hypnotics – benzodiazepines; Antipsychotics-phenothiazines; Anticonvulsants- phenytoin, carbamazepine; Analgesics; Antidepressants-mepramine.

(iii) Chemistry of drug metabolism

Practicals

F. PHARMACOLOGY

Chemotherapy

The pharmacology of the following drugs: Sulphonamides, beta-lactam antibiotics (penicillins, cephalosporins, carbapenems, and monobactams), tetracyclines, chloramphenicol, aminoglycosides. Miscellaneous antibiotics - macrolides, polymyxins, lincosamides, fluroquinolones, metronidazole, bacitracin.

Chemotherapy of tuberculosis and leprosy; Antifungal agents; Chemotherapy of protozoan parasitic infections: antimalarials, antiamebics, drugs used in trichomoniasis, gardiasis, trypanosomiasis, leishmaniasis; Anthelmintics; Antiviral agents; HIV/AIDS treatment; Antineoplastic agents.

Cardiovascular Pharmacology

Physiology of the cardiovascular system
Cardiac glycosides
Anti-dysrhythmics
Vasodilators; antianginal drugs
Antihypertensive drugs including diuretics
Vasoactive peptides and their analogues
Drug treatment of shock
Cholesterol and hypocholesterolemic drugs
Anticoagulants and fibrinolytics
Oxytocin and the ergot alkaloids

Endocrine Pharmacology

Introduction to endocrine pharmacology
Hypothalamo-pituitary axis
Hormones of the hypothalamus and pituitary gland
Thyroid and antithyroid drugs
Adrenocortical hormones
Oestrogen and progestogens; oral contraceptives and ovulatory drugs
Androgens, anabolic steroids; mineralocorticoids
Insulin and orally effective hypoglycemic drugs
Parathyroid hormone, calcitonin and vitamin D

Practicals

G. PHARMACEUTICAL TECHNOLOGY II

Size Classification: Particle shape and size; sieving and sifting; determination of particle size.

Comminution: General principles. Size distribution during comminution and importance of fine particles in pharmacy. Communiting machines.

Mixing: Definition and objective of the mixing process, mixing process and types of mixtures. The scale of scrutiny. The mixing of solids; some properties of random mixture. The degree of mixing and de-mixing of powders. Assessment of degree of mixing.

Drying of Solids: The rate of drying and the distribution of moisture in solids. The three stages of moisture distribution in a drying particulate bed. Factors involved in the selection of drying methods and choice of drying equipment; freeze drying.

Flow properties of Powders: Methods for the determination of angle of repose; factors affecting the angle of repose; flow of powders through tubes and holes; cohesive pharmaceutical powders; experimental methods used for measuring the "cohesiveness" of powder beds; factors affecting the tensile strength of powders, factors affecting the flow properties of powders e.g., effect of particle shape and size; moisture; glidants and temperature.

Granulation and Tablet Technology: Reasons for and methods of granulation; essential granule properties. Tablet manufacture; types of compressed tablets; formulation of tablets; excipients; the compression of granules, compression weight and pressure; principles of the operation of single punch and multiple (rotary) punch tablet machines; problems encountered during tablet manufacture and ways to remedy them.

Solid dosage coating: Types of coating materials and methods - pan, sugar, film and enteric coatings; requirements for core tablets and coating of granules; fluidized - bed and compression coating.

Capsules: Hard gelatin capsules materials for capsules; method of capsule production; capsule filling; equipment and operations; formulation and finishing of capsules; soft gelatin capsules; nature of the soft gelatin shells and of the capsule content.

Practicals

H. PHARMACY ETHICS & JURISPRUDENCE

Ethics of pharmacy profession in relevant country; history of pharmacy in relevant country; laws related to National Agency for Food and Drug Administration and Control, National Drug Law Enforcement Agency, Pharmacists Council of country, WHO/FAO Codex Alimentarium Commission, United Nations Narcotic Commission, Environmental Protection Agency, etc; Food, Drug and Cosmetics laws including regulation, inspection, registration, advertising, manufacture, sale/distribution; Poison, Dangerous Drugs and Pharmacy Acts; Essential Drugs List (EDL), Fake and Counterfeit Drug laws; Consumer Protection Council law; All other relevant laws related to the practice of pharmacy including those of the Pharmacists Disciplinary Committee and Assessors rules, Pharmacists registration rule, Dispensing of Drugs, Patent and Proprietary Medicines, etc. Legislation on animal health products National Health Insurance Scheme (NHIS) and other health policies, and National Drug Policy.

I. BIostatISTICS AND RESEARCH METHODOLOGY

The objective of this course is to ensure that the student is able to use and evaluate biostatistical and research methodologies in the practice of pharmacy. This will involve a review of basic statistics from measures of central tendency to paired sample hypothesis: parametric and non-parametric analysis, multi-sample hypotheses and multiple comparisons, two factor analysis of variance, data transformations, multi-way factorial analysis of variance; linear regression and comparing linear regression equations; simple linear correlation and multiple regressions; binomial distribution, testing for randomness; and analysing data using statistical computer packages. Students will gain knowledge of various health-education problems and the statistics used to monitor and measure health.

At the end of the course, the student will be able to evaluate the appropriateness of the research methodology designed to answer a research question or to test a hypothesis, select an appropriate statistical test, analysing data using a statistical computer package, explain and evaluate the results, and apply the results to decisions about research and practice.

J. INTRODUCTION TO CLINICAL PHARMACY

Introduction to clinical pharmacy
Principles of clinical pharmacy
Clinical pharmacy in the tropics
Use of medical terms and abbreviations
Patent medication profile

K. ESSENTIALS OF NUTRITION

Nutrition and food health
Total Parenteral nutrition in emergency cases, e.g., shock, coma, and Gastro-Intestinal obstruction
Essential and non essential amino acids formulation of total parental nutrition

L. PHARMACOTHERAPEUTICS I

This course will also emphasise the application of the knowledge of the pathophysiology, clinical manifestations, epidemiology, diagnosis, biopharmaceutics and pharmaceutical care to develop skills in planning the rational therapeutic and non-drug therapy of selected diseases. Case studies and WHO/other standard indicators/prescribing guidelines are employed as approaches to developing the ideas of rational drug therapy, monitoring drug therapy and drug interactions.

Areas to be covered will include cardiovascular systems, nephrology, psychiatry/neurology, hematology/ oncology, infectious diseases (including HIV/AIDS and STDs), common eye and ear disorders, paediatric and geriatric drug therapeutics, drug therapy in pregnancy and clinical toxicology.

Other areas to be covered will include, fluid and electrolyte balance, pulmonary systems, gastroenterology, rheumatology, endocrinology, medical emergencies and critical care therapeutics including treatment of poisoning and adverse drug reactions.

M. PHARMACEUTICAL MICROBIOLOGY

Microbial Chemotherapy and Bacterial Genetics

Brief historical perspective of chemotherapy. Fundamental principles of rational chemotherapy – selective toxicity principle. Classification of antimicrobial agents with special reference to mechanism of action and

chemical structures. Drugs inhibiting cell-wall synthesis - beta-lactam antibiotics. Inhibitors of protein synthesis - aminoglycosides, macrolides, tetracyclines. Drugs which interfere with cell membrane integrity. Inhibitors of RNA and DNA Synthesis – rifamycins and quinolones. Miscellaneous antimicrobials e.g., sulphonamides, trimethoprim, fusidic acid, clindamycin, lincomycin, chloramphenicol. Antifungal Agents. Antiviral Agents. Interferon and Interferon Inducers. Chemotherapy of some parasitic infections. Development of resistance to antibiotic by microorganisms: plasmid mediated and biochemical basis. Control of emergence of resistance. Introduction to Bacterial Genetics and Genetic engineering.

Preservation and Fermentation Biotechnology

General principles of spoilage and preservation against biodegradation. Raw Materials quality. Water and its purity. In-process Microbiological Controls; Quality Assurance of finished products; limiting number of viable organisms. Principles of preservation of multiphase systems, Factory and Hospital hygiene. Code of Good Pharmaceutical Manufacturing Practice (GMP). Fundamentals of Industrial Fermentation. Use of Micro Organisms in Biotechnology. Search for Cultures. Approaches in Strain Development Genetic/Enzymatic engineering techniques. Selective Isolation of Mutants. Maintenance and Preservation. Media development and processing. Fermentation and product recovery. Primary and Secondary Metabolites.

Infectious Diseases and Pathogenesis

Current drug therapies for AIDS and its associated opportunistic infections; the psychological aspects of HIV pharmaceutical services will be discussed with emphasis on the role of the pharmacist as HIV/AIDS counselor/educator; Infections, mechanisms of infections, host-parasite relationship, transmission of infections. Pathogenesis, human pathogenic bacteria, identification and infection patterns of Gram negative and Gram positive organisms, urinary tract, GIT and respiratory tract infections.

N. VETERINARY PHARMACY AND AGROCHEMICALS

Introduction to Veterinary Pharmacy
Formulation and Storage of Veterinary Drugs
Administration of Veterinary Drugs
Growth promoters
Agrochemicals

Common animals diseases

This course will afford the student a knowledge of the common diseases of ruminants (sheep, goats and cattle), horses, pigs, fish, small animals (cats and dogs) and poultry; contagious bovine pleuropneumonia, foot and mouth disease, sleeping sickness, African swine fever, rinderpest, rabies, fowl cholera, Salmonellosis and coccidiosis.

Therapy of common animal diseases

Veterinary dosage forms and routes of drug administration in veterinary practice; common veterinary drugs – antibacterial, antiviral, antifungal, antiprotozoan and anthelmintics;; vaccines and other biologicals; anti-inflammatory agents and corticosteroids; vitamins; haematinics; dietary supplements; digestants and other feed additives; insecticides and ascaricides and rodenticides; disinfectants (antiseptics topical and urinary).

O. PHARMACEUTICAL BIOTECHNOLOGY

- i. **Basic techniques in biotechnology** – cutting and joining of DNA molecules, cloning techniques, construction of DNA structure, screening methods, DNA aalysis, mutagenesis, PCR
- ii. **Medical importance of recombinant proteins** e.g., insulins, growth hormones, interferon.
- iii. **Engineering antibodies for therapy** – production of monoclomal antibodies, recombinant antibodies and antibody fragment.
- iv. **Biotechnology in vaccines development** – DNA vaccines, vaccine production by recombinant DNA for prevention of viral and bacterial infections

P. PHARMACEUTICAL CARE

- I Principles of pharmaceutical care including health promotion, health defeating behaviors, proper nutrition, age-related changes affecting medication selection and effects;
- II Direction, evaluation and reporting of adverse drug reactions;
- III And the pathophysiologic, pharmaceutical, pharmacologic, and therapeutic considerations in managing pain, fever, nausea, vomiting, constipation, and diarrhea.

Q. LANGUAGES

Advanced Course in French

FIFTH YEAR COURSES (500 LEVEL)

***A BIOPHARMACEUTICS**

B. HERBAL AND OTHER ALTERNATIVE MEDICINES

This course will introduce various categories of alternative/complimentary medical practices and explores the reasons for the rising trend towards alternative medicine including cultural, socioeconomic, immigration, and perceptions of conventional medicine. Mind-body interventions, Manual manipulations, Asian and Chinese healing methods, Aromatherapy, Hypnosis, Acupuncture, Diet, Homoeopathy, Traditional birth attendance, Nutrition and lifestyles, Psychiatry, Bone setting, Hydrotherapy, will be discussed. Global situation in the use of traditional medicine will also be discussed.

The regulatory aspects of alternative medicines will be discussed. The course will use case studies to enhance understanding of the relationship between the various alternative medical practices and orthodox medicine.

C. PHARMACY MANAGEMENT I

Starting & Managing a Pharmacy Enterprise: Pharmacy financing and administration (sources and limitations of funds, choosing between new pharmacy and buying existing one, purchasing part-time interest in existing pharmacy) and healthcare financing (government and donor finance, revolving funds, etc); Managing drug supply (drug procurement, quality assurance, storage, distribution, and inventory control/management).

Finance and Record Keeping: Financing business venture; costing and pricing products/services; financial analysis and control (record-keeping systems, financial statements and their analysis, and budgeting and cash flow.

Research & Development: Consultancy and research services; product design, development and presentation; launching of new products/services.

Pharmacoeconomics

Definitions, overview of basic economics. Structure and politics of Nigerian health system; healthcare costs. Pharmacoeconomic techniques i.e. cost minimization, cost effectiveness, cost utility, cost benefits; pharmacoeconomic methods i.e. objectives, study design, comparison of alternatives and cost assessment. Pharmaceutical outcomes. Health maintenance organizations, National health insurance scheme.

D. COMMUNICATION SKILLS

This course will introduce the principles of communication and interpersonal communications, effective questioning, emphatic listening, reflective responding, assertiveness, conflict management and other socio-behavioural aspects of patient care. Skill development in patient education and counselling, interprofessional communications patient interview and medication history taking.

E. CLINICAL PHARMACOKINETICS

This course focuses on the utilization and application of pharmacokinetic principles in developing a pharmaceutical care plan for a given patient. After completing the course, the student will be able to clinically dose and monitor drug therapy for those particular drugs with narrow therapeutic indices, utilizing their knowledge regarding the influence of age, disease and drug interactions on drug disposition.

F. MEDICINAL CHEMISTRY

Study of the chemistry of medicinal compounds: The chemistry, nomenclature, physico-chemical properties, stereochemistry synthesis (where necessary), structure-activity relationship, metabolism and uses of the following groups of drugs:

- (i) Antihypertensives, diuretics, steroids including steroidal hormones, chemotherapeutic agents such as sulphonamides, anti-malarials, antibiotics, anthelmintics, trypanocides, schistosomicides, amoebicides, anticancer and antiviral agents.
- (ii) Photochemistry: general principles, characteristics of photochemical reactions and applications both in the synthesis and spoilage of drugs.

G. PHARMACEUTICAL ANALYSIS II

Drug quality assurance system; Monographs and specifications for drugs and drug products. Applications of chemical and physicochemical analytical methods in purity determinations identification of pharmaceuticals, radio-pharmaceuticals and medicinal products; Basic tests methodology for essential drugs. Equivalence and bioequivalence of drug products, biopharmaceutical methods in purity determination. Analysis of drugs in biological samples.

H. PHARMACOLOGY

Central Nervous System Pharmacology

Review of the functional organization of the CNS; Local anesthetics, theories of general anaesthesia, general anaesthetic agents, preanaesthetic medication; Hypnotics and sedatives; Centrally acting muscle relaxants; Alcohol and alcohol abuse; CNS stimulants; Drugs used in Parkinson's disease; Drugs used in other neurodegenerative diseases; Antipsychotics; Antidepressants and mood stabilizing drugs; Opioid analgesics, and antagonists; Non-steroidal anti-inflammatory analgesics; Antiepileptic drugs.

Biochemical Pharmacology

Principles of biochemical pharmacology

Pharmacological methods of screening various drugs e.g., analgesics

Screening of sedatives, hypnotics, neuroleptics, diuretics, muscle relaxants, and local and general anaesthetics

General principles of drug evaluation – clinical trials, potency and toxicity

Statistical calculations of LD₅₀, ED₅₀, and data comparison (Student t-Test)

Drug antagonism and determination of pA values – Schild plot

Transport of drugs across biological membranes; function of subcellular structures

Neurohumoral transmission

Drug-receptor interactions and theories of drug action, mechanisms of drug action

Biochemical mechanisms of drug resistance

Structure-activity relationships e.g., sympathomimetics, cholinomimetics, narcotic analgesics, barbiturates, etc.

I. CLINICAL PHARMACY CLERKSHIP I

This practical course is designed to provide the opportunity for the student to have direct patient contact and associated pharmacy experiences. The course is constructed to enable the student to assimilate and apply his/her previously acquired pharmaceutical knowledge in a patient care environment. In addition, the student will progressively develop clinical pharmacy communication skills emphasizing empathy, education and ethics through interactions with a variety of patients on specific-drug related problems and medical diseases, improve professional communication and interpersonal relationship with other health care providers through ongoing interactions related to patient care issues and develop students to become pharmacists with good-problem solving skills and professional judgment.

Clerkship in hospitals should be conducted in such a way that the student is trained to achieve the following outcomes:

- patients receive the maximum benefit from drug therapy.
- effective drug management of sub-acute care of patients in hospitals including post-myocardial infarction, trauma, post-surgical, asthma exacerbation, oncology, and end-of-life care.
- appropriate selection of drugs and monitoring of drug therapy.
- cost-containment initiatives in patient care.

- pharmaceutical care provision in multiple-practice environments.
- educational services on drug-related issues to other health care practitioners, pharmacy students and residents, patients and the community.
- drug information services to clinicians, patients and the community.
- play key roles in the development of disease specific drug-treatment guidelines.

Areas where students will be posted to will include psychiatry and community pharmacy practice. Activities will cover history taking, medication records review, patient education and counseling, drug therapy monitoring, interventions and counter prescribing, health promotion, disease prevention and responding to symptoms.

The students will be rotated through different sites including teaching and specialist hospitals, community pharmacies, and primary health care centres.

In consultation with hospital authorities, students will participate in each rotation under the instruction of a preceptor (registered pharmacist resident in the site) who will be assisted by Faculty clinical instructor. In hospitals, students will also participate in consultants ward rounds and be involved in drug decision-making process in the care of in-patients, in consultation with the medical consultants.

Each student will make an oral case presentation and submit a written report at the end of each rotation.

J. CLINICAL AND ENVIRONMENTAL TOXICOLOGY

Definition of toxicology and toxicant;
Management of acute drugs poisoning;
Plant, bacterial and animal poisoning;
Solvent poisoning;
Pesticides, herbicides;
Radiation toxicology;
Air-borne poisoning;
Food additives and food poisoning;
Poisoning caused by animal bites;
Heavy metals and chelating agents;
Toxicity of drug-drug interactions
Management of poisoning

K. PHARMACEUTICAL TECHNOLOGY III

- a. Formulation and production of medicines
- b. Present state of Pharmaceutical industry in Nigeria, systematic development of Pharmaceutical industry, essential elements for setting up a viable Pharmaceutical industry including primary and auxiliary industries.

- c. Materials of construction, plant design, infrastructural facilities, building specifications
- d. Production management
- e. Potential and unexplored raw materials in Nigeria for Pharmaceutical industry: pilot plant, scale up technologies for tablets, capsules, semi-solids, etc.
- f. Formulation of herbal medicines into dosage forms, standardization, stability studies, microbiological evaluation and standardization of doses.

L. LANGUAGES

Advanced French Course II

M. STUDENTS INDUSTRIAL WORK EXPERIENCE (SIWES)

This is a supervised work-experience program of approximately three months' duration, commencing with the long vacation (following the end of the 300 level second semester examinations) and ending on November 30, or an appropriate date stipulated by the Industrial Training Coordinator. During the programme, students are attached to pharmaceutical establishments including drug manufacturing concerns, hospital pharmacies and community pharmacies. The objective is to expose students to pharmacy practice in an actual work - related environment. Each student keeps a record of his/her training and experience during the programme in a log book and is visited for supervisory purposes by an academic staff member from the Faculty. In addition, an experienced pharmacist located in the pharmaceutical establishment to which the student is attached provides day-to-day supervision.

SIXTH YEAR COURSES (600 LEVEL)

***A DRUG INFORMATION AND PHARMACOVIGILANCE**

B PHARMACY PRACTICE

This course will cover the concept of pharmaceutical practice; responding to symptoms; referral and intervention, counter prescribing; how various healthcare professionals interact to provide care in hospitals, long-term care facilities, ambulatory and managed-care institutions; the role of government as payer and provider of healthcare, the effect of managed-care systems on quality and access to healthcare, and the mechanisms by which health policies are formulated; investigate cultural aspects of attitudes, beliefs and behaviours related to medical and non-medical uses of drugs, decisions about non-prescription drugs and subscription to unorthodox healing systems.

C. PHARMACY MANAGEMENT II

Definition, Purpose and Scope: Definition, nature and functions of entrepreneurship (including pharmacy business); types of entrepreneurship.

Managerial Skills: Definitions of management and administration; Management process; Importance of management in pharmacy business (customers/patients/public relationship, retail competition, selling and promotion in hospital and community pharmacies); Industrial pharmaceutical organisation (medical and sales representative); Marketing (concept, functions, marketing mix and communication, product growth, salesmanship); Advertising and sales promotion; Personnel management (leadership, recruitment, remuneration, negotiation, staff training, evaluation, motivation and management).

Entrepreneurial Development: Generating and developing business ideas; conducting market surveys; preparing a business plan; selecting a business location, including roads, water and electricity supplies, and appropriate technology for the business.

Policy and Legal Framework: Legal procedure; information service; intellectual property rights and patenting of inventions; risk and insurance; legal aspects of employment; taxation; ethics and good business practice.

D. PHARMACOTHERAPEUTICS II

This course emphasises the application of the knowledge of the pathophysiology, clinical manifestations, epidemiology, diagnosis, biopharmaceutics and pharmaceutical care to develop skills in planning the rational therapeutic and non-drug therapy of selected diseases. Case studies and WHO/other standard indicators/prescribing guidelines are employed as approaches to developing the ideas of rational drug therapy, monitoring drug therapy and interactions.

Areas to be covered will include fluid and electrolyte balance, pulmonary systems, gastroenterology, rheumatology, endocrinology, medical emergencies and critical care therapeutics including treatment of poisoning and adverse drug reactions.

E. CLINICAL PHARMACY CLERKSHIP II

Same as in Clinical Clerkship I expect in areas **where students will be posted which will** include general practice medicine, obstetrics and gynaecology, and surgery as well as first aid and cardiopulmonary resuscitation.

F. CLINICAL PHARMACY CLERKSHIP III

Same as in Clinical Clerkship I expect in areas **where students will be posted which will** include general practice medicine, obstetrics and gynaecology, and surgery as well as first aid and cardiopulmonary resuscitation.

G. PHARMACOGENETICS & GENOMICS

- i. Genomics
- ii. Drug metabolism and disposition
- iii. Implication and application in drug delivery systems

H. RADIO-PHARMACEUTICALS

- i. **Introduction to Radiochemistry:** Types of radioactivity and radio-active decay particles and their measurements.
- ii. Pharmaceutical application of radio isotopes.
- iii. A brief review of fundamental concepts in organic chemistry such as bonding and reactivity of organic compounds, hybridisation, resonance theory, inductive, mesomeric hyperconjugative and electrometric effects.

I. ADVANCED DRUG PRODUCTION TECHNOLOGY

Correlation of in-vitro and in-vivo tests

Examples of correlation of in-vitro and in-vivo data of some drugs, e.g. aspirin, digoxin, grieseofluvin and oxytetracycline tablets and capsules. Problems involved in obtaining perfect correlation. Regulatory affairs and clinical trials will also be discussed.

Drug Delivery Systems and Biotechnology

Drug release mechanisms; ocular, transdermal and trans-nasal delivery systems; other novel drug delivery systems; site-specific/targeted delivery; bioartificial organs; production of therapeutic proteins/biochemicals; gene therapy, protein/peptide delivery, liposomes, polymeric substances; design of therapeutic and diagnostic agents.

Aerosol Science and Technology

Formulation of aerosols; basic aerosol technology; formulation techniques of different aerosol systems; factors affecting spray characteristics of aerosols; filling techniques and testing methods of aerosol packs.

cGMP

- I General introduction with glossary of terms: general inspection, quality assurance and quality control procedures and sampling.
- II Personnel and training, building and environmental hygiene, planning formula and manufacturing instructions. Handling of starting materials, packaging materials, intermediate products, finished products, standard and batch packaging and labeling instruction, control of packaging materials and packin g operations, supervision of production, storage, transport and distribution.
- III Manufacture and control of sterile medicinal products including premises processing environment, aseptic area and equipment. Cross contamination etc.

J. PHARMACOEPIDEMIOLOGY AND PHARMACOECONOMICS

This course will cover an overview of epidemiological methods (types of epidemiological studies, sampling techniques, sample size and power); epidemiology of communicable and non-communicable diseases. It will also cover Literature search, data gathering modalities, questionnaire design, approaches to data analysis, operational research and experimental design and report writing. Other areas include Principles and concept of Primary Health Care (PHC); Drug use and management in PHC (commonly used drugs, drug selection and distribution/essential drug list concept and drug information/education in primary health care; and Traditional Medicines in PHC. with emphasis on health technology and available resources, community participation, etc; Drug use in infertility and family planning management; Nutrition (good nutrition, nutritional status of the community and drug

management/prevention of malnutrition; The provision of preventative, curative, promotive and rehabilitative services and public education/enlightenment in primary health care will be discussed with special emphasis on the role of pharmaceutical care in promoting public health

K. PROJECTS

It is expected that each student at the level of final year (fourth professional year) should carry out independently a project encompassing a written research dissertation as well as a specific amount of laboratory or field work in some fields. The period spent on such projects will have to be carefully guided.

