

MEDICAL PHYSICS DEVELOPMENT IN AFRICA – STATUS, EDUCATION, CHALLENGES, FUTURE

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I. INTRODUCTION AND 10 YEARS OF FAMPO

Formation of FAMPO

At the 48th Annual South African Association of Physicists in Medicine and Biology (SAAPMB) meeting in Durban (South Africa) in 2008, the idea of establishing an African regional body of medical physics was mooted by the then IOMP Vice-President, Prof. Fridtjof Nuesslin. A letter of intent was prepared to the IOMP executive committee, after which a draft constitution was developed. The draft constitution was unveiled in March 2009. The first Executive Committee of FAMPO was elected at the African Radiation Oncology Group (AFROG) conference in Harare (Zimbabwe) in December 2009, with Ahmed ibn Seddik (Morocco) elected as President and Rebecca Nakatude (Uganda) as Vice-President. Other elected members were Khaled El-Shahat (Egypt) and Taofeeq Ige as Treasurer and Secretary-General respectively. In March 2010, the IOMP council approved FAMPO's application as the newest and youngest regional organization of the International Organization for Medical Physics (IOMP). As part of FAMPO 10th Anniversary celebrations, the IOMP Journal Medical Physics International made its issue of Dec 2019 focused on medical physics development in Africa [MPI, 2019].

Aims and Functions

FAMPO was established to improve and solve the challenges faced by Medical Physicists in Africa and with aims and functions as follows: (i) To promote improved quality service to patients and the community in the region (ii) To promote the co-operation and communication between medical physics organization in the region, and where such organizations do not exist between individual medical physicists (iii) To promote the profession and practice of medical physics and related activities in the

region (iv) To promote the advancement in status and standard of practice of medical physics profession (v) To promote and improve the training of medical physicists (vi) To promote research and development in the field of medical physics (vii) To promote appropriate use of technology to the benefit of rural populations (viii) To organize and / or sponsor international conferences, regional and other meetings or courses (ix) To collaborate or affiliate with other scientific organizations.

Current Status and Some Achievements

The current (2020) Executive Committee members are: Taofeeq Ige – Nigeria (President), Chris Trauernicht – South Africa (Vice-President), Ahmed ibn Seddik - Morocco (Past President), Odette Samba – Cameroon (Treasurer) and Francis Hasford – Ghana (Secretary General). The three committee chairs are: Nadia Toutaoui-Khelassi – Algeria (Education and Training); Graeme Lazarus – South Africa (Professional Development) and Ehab Attalla – Egypt (Scientific). There is a 24-member FAMPO Council which was inaugurated on 10th October 2018, thus, devolving the governance of the body to the “grass-root/member-state” level and fulfilling a major constitutional requirement. The AJMP (African Journal of Medical Physics) was launched in November 2018 with Prof. O.B. Awojoyogbe (Nigeria) as the Editor-in-Chief and the second edition was recently released. The FAMPO website (www.fampo-africa.org) has been a success story and major information dissemination attraction. The FAMPO newsletter debuted in January 2019 and the fourth edition is set to be released soon.

Globally, Africa is one of the continents with very low number of MPs per million population (MP/mill), and it is the aim of the Executive Committee of the Federation to increase the numbers as well as the capacities of trained personnel in the near future.

Figure 1 presents an approximate global picture of medical physics workforce as per the Regional Organizations (RO) of IOMP (N.B. some medical physicists work in private and other institutions, and are not members of the RO, hence the total global number is usually higher).

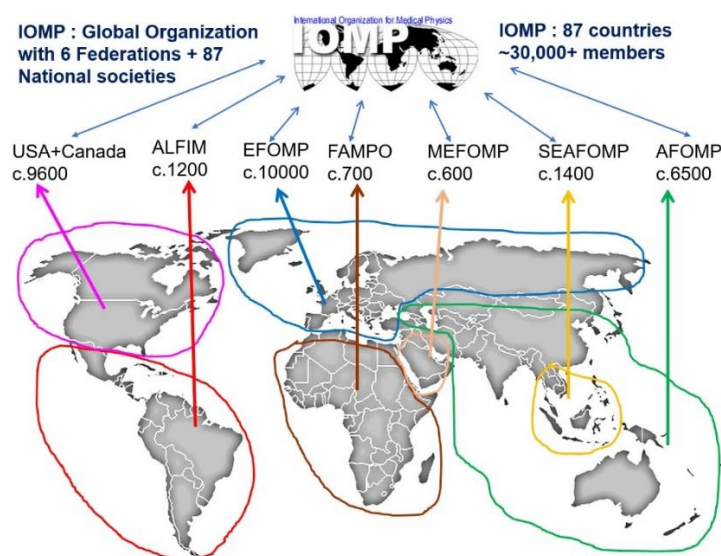


Fig. 1: Global MPs workforce presented in geographical regions [Information based on data from IOMP and its Regional Organisations, also Tabakov (2016), and Tsapaki, Tabakov and Rehani (2018)]

From Fig.1 is obvious that Africa has about 0.6 MP/mill, while in the three Federations in Asia (AFOMP, SEAFOMP, MEFOMP) this number is about 1.5 MP/mill in average; in Latin America

(ALFIM) this number is about 2.0 MP/mill; in Europe (EFOMP) this number is about 13 MP/mill, and in USA+Canada this number is about 26 MP/mill. We have to underline that inside the Regions there are further significant variations between MP/mill for specific countries. These figures show that the development of medical physics in Africa (FAMPO) will need significant backing in order to have sufficient number of medical physicists to support the healthcare delivery in the region.

Professional, Education and Training, and Scientific Activities

The Professional Development Committee (PDC) has the sole mandate to promote the professional development, status and recognition of medical physicists in Africa. The PDC has a constituted membership and is liaising with the Education and Training Committee (ETC) to establish professional certification scheme for medical physicists. Through this, professional medical physicists in the region will gain desired recognition in status and standard.

The ETC works to promote activities related to education and training of FAMPO medical physicists for the purpose of improving the quality of medical services for patients in Africa. The Committee has sub-committees working to promote regional education and training programmes, establish database of medical physics training sites, develop accreditation methodology, and develop regional continuous development (CPD) scheme.

The Scientific Committee (SC) is mandated to undertake projects and programmes aimed at promoting collaboration in scientific research and exchange of scientific information and materials between FAMPO medical physicists and other relevant bodies. This is achieved through communications, publications, workshops, symposia and conferences. The SC has a constituted membership and on course to roll out its programmes.

II. POPULATION AND GDP OF AFRICAN COUNTRIES

Africa is the world's second-largest and second-most populous continent. At about 30.3 million km² including adjacent islands, it covers 6% of Earth's total surface area and 20% of its land area. With 1.3 billion people as of 2018, it accounts for about 16% of the world's human population. The continent is surrounded by the Mediterranean Sea to the north, the Isthmus of Suez and the Red Sea to the northeast, the Indian Ocean to the southeast and the Atlantic Ocean to the west. The continent includes Madagascar and various archipelagos. It contains 54 fully recognised sovereign states (countries), four territories and two *de facto* independent states with limited or no recognition. The majority of the continent and its countries are in the Northern Hemisphere, with a substantial portion and number of countries in the Southern Hemisphere.

Africa hosts a large diversity of ethnicities, cultures and languages. Ten countries within the region have national medical physics societies, all of which have membership to the Federation of African Medical Physics Organizations (FAMPO). The countries with national member organizations (NMOs) are Algeria, Egypt, Ghana, Morocco, Niger, Nigeria, South Africa, Tunisia and Uganda. Figure 2 indicates countries with FAMPO NMOs and Table 1 presents the data on GDP per capita and numbers of medical physicists per million population for countries. Medical physicists in the remaining countries also serve as members of FAMPO in individual capacities. Such members, as well as NMOs, have delegates serving on the FAMPO Council to bring the governance to the grassroots.

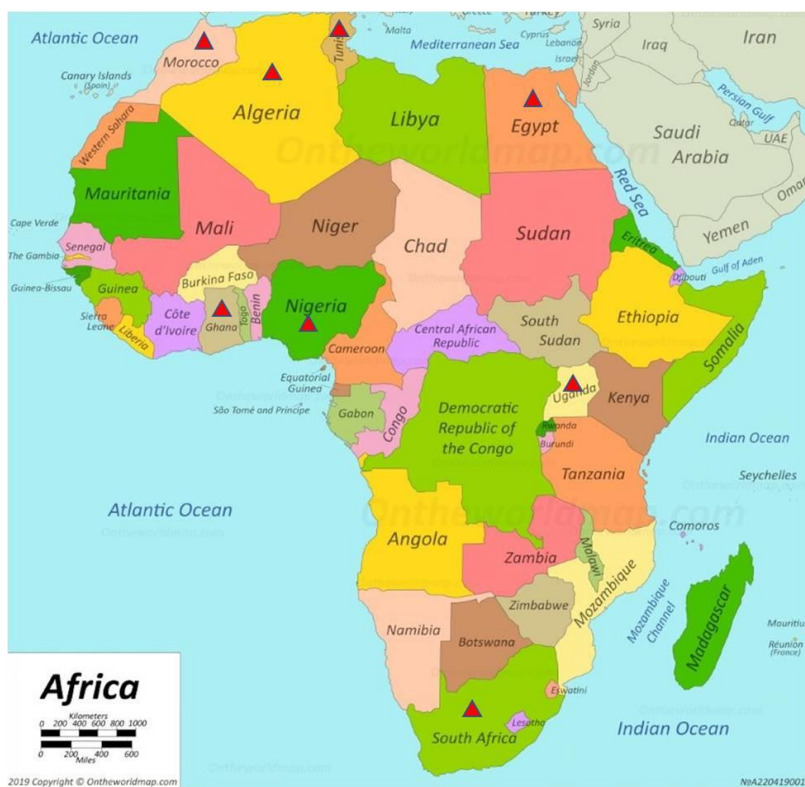


Fig 2: African countries with medical physics societies (indicated in red dots)

Table 1: Information about African countries with medical physics societies [Wikipedia, 2020]

Country	GDP per capita	No. of MPs	Population (per million)	MPs per million population
Algeria	4,229	129	43.0	3.0
Egypt	3,047	374	99.6	3.7
Ghana	2,262	58	31.1	1.9
Morocco	3,441	61	35.7	1.7
Niger	510	4	22.4	0.2
Nigeria	2,244	100	200.9	0.5
South Africa	6,331	136	58.8	2.3
Sudan	808	28	41.6	0.7
Tunisia	3,587	37	11.5	3.1
Uganda	769	5	42.8	0.1

III. MEDICAL DEVICES FOR RADIOTHERAPY (RT), DIAGNOSTIC RADIOLOGY (DR) AND NUCLEAR MEDICINE (NM)

Increasing incidence of cancers, cardiovascular diseases, orthopaedic disorders and other degenerative conditions among the general population is presenting a pool of patients who would need medical imaging and radiotherapy procedures for adequate healthcare. A rapidly growing population like Africa records a pool of patient population suffering from age-related disorders. The aim of meeting health challenges posed by cancers and other conditions in Africa has driven countries within the region to invest heavily in medical equipment and radiotherapy equipment. Table 2 presents an approximate distribution of major equipment available in radiation medicine as at December 2019.

Table 2: Radiation medicine equipment approximate distribution in Africa

Country	Radiotherapy		Diagnostic Radiology			Nuclear Medicine		
	Teletherapy (Linac, Co-60)	Brachytherapy (LDR, HDR)	CT	FL / IR	Mammo	SPE CT	SPECT/CT	PET/CT
Algeria	37	12	>570	170	280	24	11	1
Angola	3	1	-	-	-	-	-	-
Benin	0	0	5	-	6	0	0	0
Botswana	1	2	-	-	-	-	-	-
Burkina Faso	0	0	10	-	-	1	0	0
Cameroon	1	0	-	-	-	1	0	0
Congo Republic	1	0	>10	0	>5	0	0	0
Cote D'Ivoire	2	0	-	-	-	0	1	0
Egypt	110	23	725	622	185	72	15	52
Ethiopia	1	1	91	27	28	1	0	0
Gabon	2	0	12	5	13	0	1	0
Ghana	4	3	48	35	42	1	0	0
Kenya	11	5	-	-	-	1	1	0
Libya	6	1	-	-	-	2	3	1
Madagascar	2	0	-	-	-	-	-	-
Mali	1	0	-	-	-	0	0	0
Mauritania	2	1	1	-	1	0	1	0
Mauritius	3	1	-	-	-	-	-	-
Morocco	42	10	360	-	-	12	11	11
Mozambique	1	0	-	-	-	-	-	-
Namibia	2	1	-	-	-	-	-	-
Niger	0	0	10	3	10	0	2	0
Nigeria	10	6	150	8	50	2	1	0
Rwanda	2	0	-	-	-	-	-	-
Senegal	3	0	-	-	-	1	0	0
South Africa	97	24	-	-	-	-	-	-
Sudan	8	2	-	-	-	-	5	0
Tanzania	5	2	21	400	<21	-	-	-
Tunisia	23	4	191	66	-	11	4	4
Uganda	1	1	26	1	12	0	1	0
Zambia	3	2	2	-	-	-	-	-
Zimbabwe	7	3	-	-	-	1	0	0

*CT – Computed Tomography; FL – Fluoroscopy; IR – Interventional Radiology; SPECT – Single Photon Computed Tomography; PET – Positron Emission Tomography; N/A – No Data Available

IV. MEDICAL PHYSICISTS (MP) IN AFRICA

Medical physicists within Africa are mainly found in the radiotherapy, diagnostic radiology and nuclear medicine sectors (Table 3). Other sectors where services of medical physicists are deployed are in radiation safety, academia, research and industry. South Africa and Ghana are the two countries within the region with proper legislation for regulation of the medical physics profession [Vetter, Stoeva, 2015]. A summary of the distribution of medical physicists is presented in Figure 3.

Table 3: Distribution of MPs in the sub-disciplines (FAMPO collated data as at January 2020)

N.B. Historically some of these do not have MSc, but the new University courses on the subject are quickly filling this gap. Also some of the countries in the list are not yet members of FAMPO.

Country	No. of MPs				Total
	Radiotherapy	Diagnostic Radiology	Nuclear Medicine	Other fields	
Algeria	112	4	13	0	129
Angola	4	0	0	0	4
Benin	0	1	2	0	3
Botswana	4	0	0	0	4
Burkina Faso	0	0	2	0	2
Cameroon	2	0	0	0	2
Congo DR	1	0	0	0	1
Cote d'Ivoire	1	0	1	0	2
Egypt	232	86	56	0	374
Eritrea	0	2	0	0	2
Ethiopia	2	1	1	0	4
Gabon	3	0	1	0	4
Ghana	32	8	6	12	58
Kenya	3	2	2	0	7
Libya	22	0	5	0	27
Madagascar	2	0	0	0	2
Malawi	2	0	0	0	2
Mauritania	3	0	3	0	6
Mauritius	4	1	0	0	5
Morocco	57	0	4	0	61
Namibia	0	0	2	4	6
Niger	0	0	2	0	2
Nigeria	40	10	4	46	100
Senegal	0	0	3	0	3
Sierra Leone	0	1	0	0	1
South Africa	86	17	13	20	136
Sudan	28	0	0	0	28
Tanzania	2	1	1	0	4
Tunisia	37	0	0	0	37
Uganda	6	3	0	1	10
Zambia	4	0	2	0	6
Zimbabwe	8	0	1	0	9
Total					1,041

Figure 3 below summarizes the distribution of the clinical activities in which MPs in the region are engaged. It is obvious that about 2/3 of medical physicists work in the field of Radiotherapy (this is a typical figure worldwide).

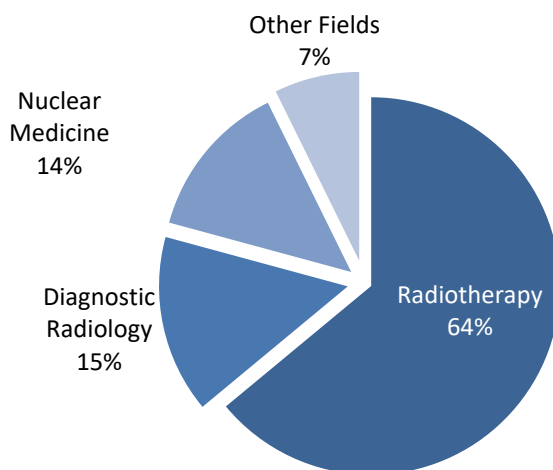


Fig. 3: Distribution of activities of MPs in Africa

Professional development

Background information (i.e. year of establishment, name of first president and membership) of the ten FAMPO NMOs have been presented in Table 4.

Table 4: Data on FAMPO national member organizations (NMOs)

NMO	Year Established	Name of 1 st President	Membership	
			% Men	% Women
Ghana	2011	Prof. John H. Amuasi	85	15
Algeria	1994	Prof. Habib Zaidi	50	50?
Niger	2017	Moussa Also	75	25
Egypt	1998	Dr. Ahmed Reda Shafeai	60	40
Nigeria	1986	Prof. Tagirin A. Fregene	75	25
Morocco	1996	Ahmed ibn Seddik	60	40
South Africa	1968	PLM le Roux	60	40
Sudan	1999	Mustafa Elhassan Mohammed	75	25
Uganda	2019	Dr. Kavuma Awusi	57	43
Tunisia	2011	Prof. M Maalej	43	57

V. EDUCATIONAL COURSES DEVELOPMENT

Close collaboration has existed between FAMPO and the International Atomic Energy Agency (IAEA) over so many years in efforts to raise the level of medical physicist in the region. Through these collaborations, FAMPO has endorsed some IAEA publications developed to support the training of medical physicists. The documents include Technical Course Series 37, 47 and 50, which provide guidelines on the clinical training of medical physicists specialising in Radiation Oncology, Diagnostic Radiology and Nuclear Medicine, respectively.

Generally, there has been a lack of recognition of medical physics as a profession in most of the African countries. In addressing this challenge, the African Regional Cooperative Agreement (AFRA) and the International Atomic Energy Agency (IAEA), in collaboration with FAMPO, has through series

of Task Force Meetings, produced the AFRA Syllabus on Medical Physics Academic and Clinical Training for the Africa region. The syllabus spells out the roles and responsibilities, and education and training requirements for clinically qualified medical physicists (CQMP) in an attempt to promote the profession internationally. The publication has received endorsement by the Federation of African Medical Physics Organizations (FAMPO).

The schematic diagram (Fig. 4) shows the recommended education requirements for recognition as a CQMP in Africa. Alternatively, the academic programme would prepare a student for an academic career in medical physics research or industry.

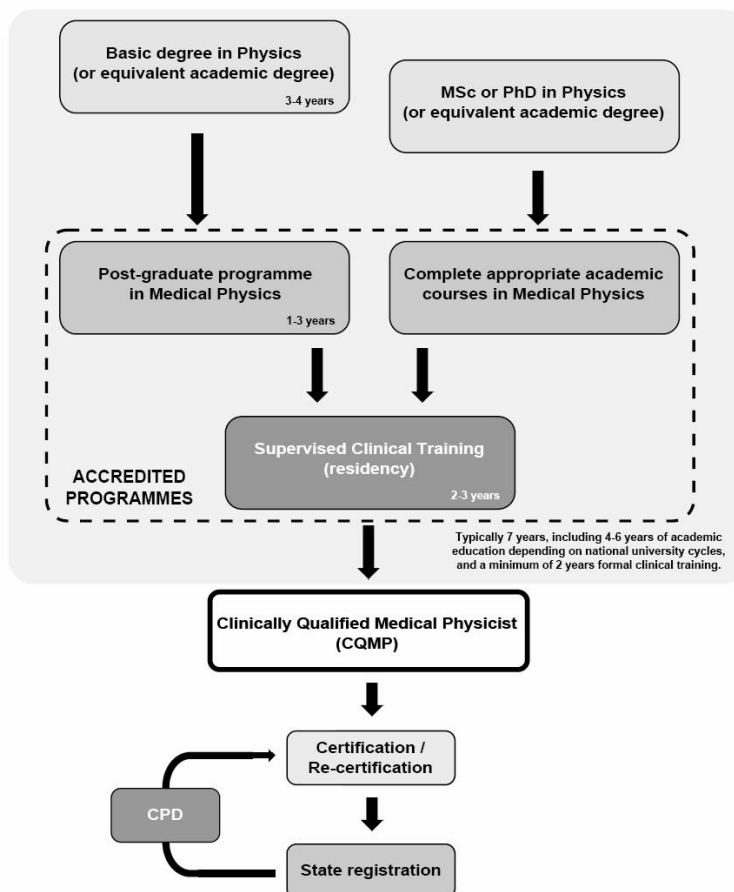


Fig. 4: Structure for education and training of clinically qualified medical physicists [IAEA HHS 25 (2013)]

With the publication of this syllabus and its adoption by a number of the African countries, the education and training of MPs has been largely harmonized within the African region. Countries which currently offer academic and clinical training programmes in medical physics in the region are Algeria, Egypt, Ghana, Morocco, Nigeria, South Africa, Tunisia and Zimbabwe. Table 5 and Table 6 present brief lists about these education and training programmes, as per the available data at the time of this publication.

Table 5: Universities offering academic degrees in medical physics

Country	University	Academic Programme	Curriculum used	Year established	Graduates per year
Algeria	Université des Sciences et de la Technologie Houari Boumediene (USTHB) Algiers	MSc; PhD		2004	10

	Université Saad Dahlab Blida	MSc		2007	15
	Université des Sciences et de la Technologie d'Oran	MSc; PhD		2007	20
	Université de Constantine	MSc		2009	10
	Université Farhat Abbas Sétif	MSc; PhD		2013	10
	Université Abou Bakr Belkaid Tlemcen	MSc		2013	10
Egypt	Cairo University	MSc, PhD			
	Ain Shams University	MSc, PhD			
	Helwan University	MSc, PhD			
	Mansoura University	MSc, PhD			
	Suez Canal University	MSc, PhD			
	Assiut University	MSc, PhD			
	Fayoum University	MSc, PhD			
	Minia University	MSc, PhD			
Ghana	University of Ghana	MPhil; PhD	AFRA syllabus; TCS 37, TCS 47, TCS 50, TCS 56	2004	8
Morocco	Mohammed V University	MSc; PhD	TCS 37, TCS 47, TCS 50, TCS 56	2007	
Nigeria	Benue State University, Makurdi.	MSc; PhD			
	Federal University, Lafia.	MSc; PhD			
	Federal University of Technology, Minna.	MSc; PhD			
	Nasarawa State University, Keffi.	MSc; PhD			
	Nnamdi Azikiwe University, Awka.	MSc; PhD			
	Obafemi Awolowo University, Ile-Ife.	MSc; PhD			
	University of Benin, Benin-City	MSc; PhD			
	University of Calabar, Calabar.	MSc; PhD			
	University of Lagos, Lagos.	MSc; PhD			
University of Nigeria, Nsukka.	MSc; PhD				
South Africa	University of Witwatersrand	BSc (Hons); MSc; PhD			
	University of Free State	BSc (Hons); MSc; PhD			
	University of Cape Town	BSc (Hons); MSc; PhD			
	Stellenbosch University	BSc (Hons); MSc; PhD			
	University of Pretoria	BSc (Hons); MSc; PhD			
Tunisia	Salah Azaiez Institute, Tunis.	MSc; PhD			
	Habib Bourguiba Hospital				
Zimbab	National University of Science	MSc	AFRA	2016	10

we	and Technology, Bulawayo		syllabus, TCS 37, TCS 47, TCS 50, TCS 56		
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Table 6: Centres offering clinical training

Country	Centre	Curriculum used	Year established	Graduates per year
Egypt	National Cancer Institute, Cairo University, Cairo.			
Ghana	Korle-Bu Teaching Hospital, Accra.	TCS 50; AFRA syllabus	2006	5
Morocco	INO, Rabat.		2007	
Nigeria	National Hospital, Abuja.	TCS 50; AFRA syllabus		
	University College Hospital, Ibadan.	TCS 50; AFRA syllabus		
South Africa	Charlotte Maxeke Johannesburg Academic Hospital (CMJAH), Johannesburg.			
Tunisia	Salah Azaiez Institute, Tunis.			
	Habib Bourguiba Hospital			
Zimbabwe	Mpilo Central Hospital, Bulawayo.	TCS 50; AFRA syllabus	2016	10

The majority of the faculty and students in the above University Programmes in Africa have very good command of either English or French language. This allows use in the educational process of contemporary teaching resources, including the IAEA Handbooks (Radiotherapy, Diagnostic Radiology and Nuclear Medicine), other IAEA and WHO materials and websites, as well as online resources as Emerald training materials, AAPM Virtual Library (both specially made free after 2000), Sprawls resources and EMITEL Encyclopaedia. All attendees at ICTP College on Medical Physics and Radiotherapy School receive free all lecture slides and teaching materials, which they can use in the educational process. The Journal Medical Physics International (issue December 2019, vol.7, No.3) presents in more detail the medical physics education and training development in 8 African countries (S. Africa, Zimbabwe, Nigeria, Ghana, Morocco, Algeria, Tunisia, Egypt).

VI. TRAINING COURSES AND WORKSHOPS

The International Centre for Theoretical Physics (ICTP) also runs the 3-year Advance Masters Programme in Medical Physics, a programme which many African Medical Physicists have benefitted from. The programme has components of didactic lectures, research work and internship, and it is built in line with the AFRA syllabus developed by the IAEA. So far about 40 MPs from Africa have graduated from the programme.

In addition to these education and training programmes, MPs from the region have participated in a number of short-term training courses / workshops contributing to capacity building of MPs within the Africa region. Below are some activities held in the last 2 years:

- Regional (AFRA) Training Course on CT QA and Dosimetry for French-speaking Countries, 30 June – 04 July 2019, Algiers, Algeria.
- Regional (AFRA) Training Course on Computed Tomography Quality Assurance and

- Dosimetry Lusaka, Zambia, 11 – 15 February 2019.
- Regional (AFRA) Training Course on Quality Control Practices in Nuclear Medicine Dar es Salaam, United Republic of Tanzania; 01 – 05 April 2019.
 - IAEA National Project, Work-plan Meeting, Vienna Austria, 25 – 26 February 2019.
 - National Training Course on Radiation Dosimetry of Patients and Workers in Diagnostic and Interventional Radiology, Ethiopia, 04 – 08 February 2019
 - Joint IAEA/ICTP Advanced School on QA requirements in Digital Diagnostic Radiology, Italy, 11 – 15 November 2019.
 - National Training Course on Quality Assurance in CT, Mammography and Diagnostic Reference Levels, Accra, Ghana; 04 – 08 November 2019
 - Regional (AFRA) Training Course on Train-the-Trainer for Clinical Training of Medical Physicists, Abuja, Nigeria: 18 – 20 December, 2018.
 - Training on Enhancing Capacity Building of Medical Physicists to Improve Safety and Effectiveness of Medical Imaging (AFRA), 19 - 23 November 2018, Zimbabwe.
 - Joint ICTP-IAEA School on Quality Assurance and Dose Management in Hybrid Imaging (SPECT/CT and PET/CT), 17 – 28 September 2018, Italy.
 - 14th Radiology Days of Francophone Africa; 25 – 28 April 2018, Douala, Cameroon.
 - Regional (AFRA) Training Course on QA for Non-imaging Equipment and Radiation Monitoring Instrumentation in Nuclear Medicine, 22-26 January 2018, Cape Town, South Africa.
 - National Training Course on Train-the-Trainer for Clinical Training of Medical Physicists, Accra, Ghana: 09 – 11 December, 2019.
 - The Egyptian Association of Medical Physics (EAMP) Summer Science Club 3 Nasser Institute, August 2018, Cairo, Egypt.

VII. COMMUNICATION:

FAMPO Newsletter

The FAMPO newsletter is a bulletin issued quarterly to FAMPO membership and other interested persons and agencies to convey important information necessary to be shared. Issuance of the newsletter was initiated in 2019 and three editions were released within the year. In the year 2020, four editions are planned for release.

FAMPO Journal

The **African Journal of Medical Physics (AJMP)**, (ISSN 2643-5977) is the official scientific journal of FAMPO. It is published by the Harvard University Press and issued in both print and electronic versions. The journal has already released two editions and is in the process of issuing the 3rd edition in the Q1/2020. Below is the cover page of AJMP.

FAMPO Website

FAMPO has an active website which conveys important information relating to the Federation to its membership and the outside world. Visit the site at <https://fampo-africa.org>.

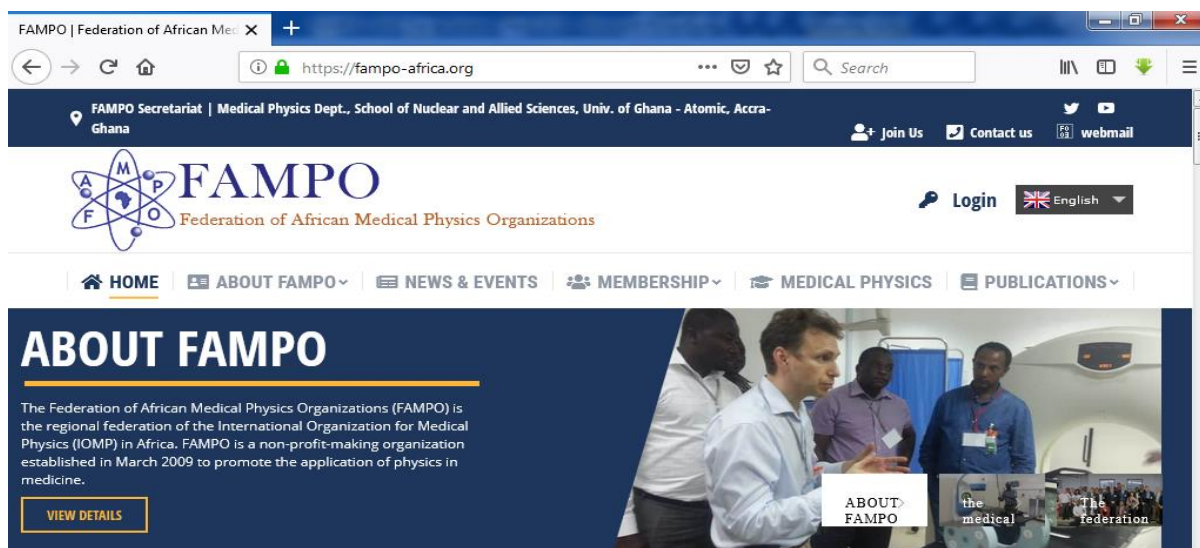


Fig. 5: Snapshot of FAMPO website



Fig. 6: FAMPO newsletter

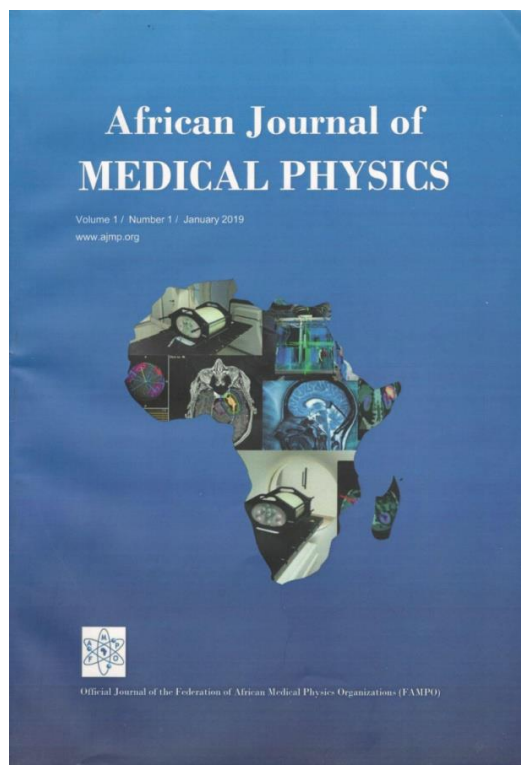


Fig. 7: Cover page of AJMP

Conferences:

Below are some recent conferences held within the region and which members of FAMPO have immensely benefited from:

- Second National Annual Scientific Conference of Medical Physicists (NAMP), 22 – 24 November, 2018, Abuja, Nigeria.
- South African Association of Physics in Medicine and Biology Congress and School: 22- 26 October 2018, Pretoria, South Africa.
- 5th African Regional Congress on Radiation Protection of IRPA, 6 - 9 September, 2018, Tunis, Tunisia.
- Uganda Society for Advancement of Radiology and Imaging (USOFARI) Annual Conference, 5th - 8th November 2018, Uganda.
- Annual National Scientific Conference of Medical Physicists (NAMP), Lagos Nigeria, 13 – 15 November, 2019.
- SAAPMB Congress and School, Cape Town, South Africa, October 2019.

FAMPO plans to organize its first ever regional conference (FAMPO-2020 Conference) in Marrakech, Morocco, from 27 – 29 November 2020.

VIII. REGIONAL PROJECTS WITH THE INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA)

Radiotherapy Medical Physics

The objective of the regional project on radiotherapy medical physics is to facilitate the implementation of regional harmonized academic and clinical training programs for clinically qualified medical physicists and promote skills upgrade for all professionals including radiation oncologists, radiotherapy technologists and oncology nurses. The project is run through one of the IAEA regional projects in Africa. IAEA member states participating in this project are Algeria, Botswana, Cameroon, Cote d'Ivoire, Egypt, Ethiopia, Ghana, Kenya, Libya, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Namibia, Nigeria, Senegal, South Africa, Sudan, Tunisia, Uganda, United Republic of Tanzania, Zambia and Zimbabwe. Several regional training courses, expert missions, scientific and technical visits, and national training courses were held under the project.

Imaging Medical Physics:

This imaging medical physics project is aimed to improve the overall safety and effectiveness of nuclear medicine and diagnostic radiology services in Africa through dose optimization and appropriate quality assurance QA programmes conducted by MPs. Algeria, Burkina Faso, Cameroon, Cote d'Ivoire, Egypt, Ethiopia, Gabon, Ghana, Kenya, Mauritania, Morocco, Niger, Nigeria, Republic of Congo, South Africa, Uganda, Zambia and Zimbabwe are the countries participating in this project. Training Courses held under the project in 2018 and 2019 include – Regional Training Course on Enhancing Capacity Building of MPs in Medical Imaging; Development of Protocols for Adult and Paediatric CT Examinations; Quality Assessment and Dose Optimization in Diagnostic Radiology; Establishment of Diagnostic Reference Levels for High Dose Emitting Equipment in Diagnostic and Interventional Radiology.

IX. CONCLUSIONS AND SUGGESTIONS FOR FUTURE

The development of medical physics in Africa has made a substantial progress from 2010 [Tabakov et al, 2011] [Ige et al, 2013], when a survey showed about 350 medical physicists in the continent. For the period 2012-2017 it has approximately doubled - 700 [Tsapaki et al, 2018], and in the period 2017-2020 it has reached 1041 (as per the current paper). This demonstrates that the activities of Medical

Physics Societies in Africa, united by FAMPO, have been very effective. Significant role for this have been played by the supporting IAEA projects, the educational programmes of the ICTP (College on Medical Physics, School of Radiotherapy and MSc programme), the support with free educational materials by various institutions and colleagues mentioned in this publication and in the MPI issue Dec 2019, focussed on Africa [J. MPI, December 2019]. A number of new University educational programmes have been opened in Africa and this underpinned the growth of specialists in the continent. Coupled with the educational programmes are clinical training programmes which are undergoing formalized FAMPO accreditation and certification schemes. Looking at the predictions for the need of medical physicist in radiotherapy by 2035 [Atun et al, 2015], and its further rough estimation for approximately tripling of this specialists globally [Tabakov, 2018], we have to aim to have at least 3000 medical physicists in Africa by 2035. This will present a number of over two medical physicists per million population. The growth of medical physicists seen Africa for the past 8 years shows that this goal is achievable. It also shows that the external support received from Organisations and colleagues has been effective and that such support really boost the development of the profession in Africa. The next steps will have to address simultaneously the overall growth of the profession and the more equal distribution of this workforce in Africa. This activity will directly support the healthcare provision in the continent.

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