# MEDICAL PHYSICS FOR WORLD BENEFIT (MPWB): A GLOBAL, COLLABORATIVE AND PARTNERING ORGANIZATION

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## INTRODUCTION

It is well recognized that disparities in social and economic status exist locally, nationally, and globally. In a well-resourced country, such as Canada, these disparities are addressed, at least to a large extent, through various government or non-government support systems. Globally, especially in lower income contexts, social, economic and healthcare disparities are much more complex to address, primarily due to limited resources and limited societal and government infrastructure.

With the slow, gradual and incremental improvement of health care conditions in low-to-middle income countries (LMICs), their populations are aging, resulting in a growing incidence of non-communicable diseases. In 2011, the United Nations (UN) issued a resolution explicitly stating that the rising burden of non-communicable disease "constitutes one of the major challenges for development in the twenty-first century, which undermines social and economic development throughout the world and threatens the achievement of internationally agreed development goals" [1]. One of the major diseases affected by this trend is cancer. Indeed, cancer kills more people in LMICs than HIV/AIDS, malaria and tuberculosis combined [2]. In September 2015, the new UN Development Goals [3] called for a reduction by one third, by 2030, in premature mortality from non-communicable diseases, including cancer and heart disease [4]. In 2015, The Lancet Oncology published a report by the Global Task Force on Radiotherapy for Cancer Control (GTFRCC), which was led by Drs Mary Gospodarowicz and David Jaffray of Toronto's Princess Margaret Cancer Centre under the auspices of the Union for International Cancer Control (UICC) and included Jacob Van Dyk as one of the multiple co-authors [5]. This report projected what it would take to provide uniform access to radiation therapy for cancer patients globally by the year 2035. One of the major conclusions was that not only would there be a healthcare advantage but there would also be an economic advantage to LMICs if an upfront and on-going investment is made to provide radiotherapy services in those countries. Table 1 summarizes the resources required for providing equal access in LMICs by 2035.

The results of the GTFRCC report indicate that another 22,100 radiation oncology medical physicists will need to be trained for LMICs by the year 2035. Considering that in the high-income context, radiation oncology medical physicists represent approximately 75% of the medical physics workforce, with the remaining 25% representing diagnostic imaging, nuclear medicine and other medical physics related activities, a total of about 30,000 medical physicist will need to be trained for LMICs. The GTFRCC made a number of "calls for action" with the third one being: ***"Action 3: human resources for radiotherapy.*** *We call for new approaches to train radiotherapy professionals globally, with the creation of new core curriculums, innovative learning methods, and international credentialing to expand the radiotherapy workforce. Training should become part of the mandate of each national radiotherapy centre to self-propagate the required skills, enabling national expansion of cancer therapies and providing the ability to replace staff as they leave or are recruited out of country. Target: 7,500 radiation oncologists, 20,000 radiation technologists, and 6,000 medical physicists to be trained in low-income and middle-income countries by 2025."*

**Table 1.** Projected radiation treatment fractions and related resources needed in 2035. Adapted from [5].

| | High-income countries | Upper-Middle-Income Countries | Lower-Middle-Income Countries | Low-Income Countries | Total in Low-to-Middle-Income Countries |
|---|---|---|---|---|---|
| Treatment fractions | 76,424,000 | 77,014,000 | 40,974,000 | 13,268,000 | 131,256,000 |
| Radiotherapy departments | 4,600 | 3,700 | 2,000 | 600 | 6,300 |
| Megavoltage machines | 9,200 | 7,400 | 3,900 | 1,300 | 12,600 |
| CT scanners | 4,600 | 3,700 | 2,000 | 600 | 6,300 |
| Radiation oncologists to be trained | 15,500 | 16,800 | 9,900 | 3,300 | 30,000 |
| Medical physicists to be trained | 17,200 | 12,500 | 7,200 | 2,400 | 22,100 |
| Radiation technologists to be trained | 51,900 | 45,300 | 24,900 | 8,100 | 78,300 |

The overall summary is that there is a tremendous need to educate and train a very significant number of medical physicists in LMICs. In view of this, what are the issues and limitations of successful education and training of medical physicists in LMICs? Firstly, there are very few education and training programs, especially in low-income countries (LICs). When you consider that 28 countries in Africa have no radiation therapy at all [6], and, thus, there are no medical physicists working in these countries nor do they provide medical physics education and training programs. The combination of the lack of medical physicists and the lack of equipment to train medical physicists are significant impediments for education and training. The infrastructure for developing education and training programs requires significant time and resources for development. While education and training "abroad" might be a partial solution, this is hampered with limitations as well. It is well recognized that the incidence of different cancers can vary dramatically from one country to another, especially comparing HICs to LMICs. Furthermore, low income contexts tend to have much later staged diseases at the time of diagnosis compared to HICs. The entire healthcare and education systems have very different infrastructures in HICs compared to LMICs, meaning that getting trained in one system provides significant disconnects in the other system. Finally, for individuals from low income contexts, getting educated and trained in an HIC context develops a general concern about the "brain drain" where the individuals either get offers to stay or they seek to stay in a better endowed environment [7;8].

While these disparities are well recognized, there is no single, nor simple, solution to resolving them. The general conclusions from various reports are that the issues need to be addressed through multiple approaches by multiple organizations [9-11]. For example, Abdel-Wahab et al. [9] of the International Atomic Energy Agency (IAEA) indicate that "A possible way forward for the global community to work together is through global projects in radiotherapy with commitment of governments and engagement of multiple capable partners." Datta et al [10] conclude that "Based on the assessment of gap in radiation therapy in LMICs, it is evident that there is no one blueprint nor any magic bullets to resolve the crisis in radiation therapy accessibility in LMICs. Urgent, coordinated, and multi-pronged approaches at individual country levels are desirable that could be supplemented with assistance from international organizations and health policy makers." From Ngwa and Ngoma [11], "Altogether, the plan boils down to more resources and collaborations, along with political will, at the highest levels. This execution plan is also relevant in advancing global radiation oncology towards improved healthcare outcomes, millions of saved lives and the elimination of global cancer disparities." More reports could be quoted; however, the general theme is that partnerships and collaborations are a way forward. From a medical physics perspective, this implies the collaboration of medical physicists in better endowed contexts with those in less resourced environments. Once a country has developed a national strategy for addressing the cancer needs and developing a plan for action [12],

one of the early considerations will be addressing the acquisition of professional staff, including medical physicists, since it can take multiple years to recruit these professionals, especially if they need to be fully trained. Partnerships and collaborations can be directly involved in: (1) graduate education programs; (2) practical and on-the-job training or residency programs; (3) joint on-the-job mentoring support either locally or remotely through information and communication technology (ICT); (4) Development of user friendly, on-line education and training materials; (5) short-term continuing education programs; (6) partnering and guidance support for specific activities such as development and/or review of shielding design, implementation of new techniques or technologies, review of commissioning new technologies or procedures; (7) remote mentoring support regarding any questions on techniques and procedures; (8) remote lectures for courses and seminars; and (9) any other activities that are deemed worthy of partnering activities.

## MPWB VISION AND MISSION

There are multiple organizations in support of enriching radiation therapy capabilities in LMICs. We have listed 34 such organizations in a paper on quality and safety considerations in radiation therapy in lower income environments published in 2017 [13]. Since then, we have added more organizations to this list. However, many of these organizations have multiple other priorities and the support of education, training and other activities in LMICs often represents less than 1% of their budgets. It is out of recognition of the limited human resource availability and limited training opportunities in LMICs that the concept of Medical Physics for World Benefit (MPWB, www.mpwb.org) developed. MPWB is a young, non-profit, volunteer organization that was formally registered as a charitable association in Canada in November 2016 and in the United States in December 2016. It has a vision of a world with access to effective and safe applications of physics and technology in medicine. This includes all areas of medical physics although MPWB recognizes that radiation therapy has the largest need. MPWB's mission is to support activities which will yield effective and safe use of physics and technologies in medicine through advising, training, demonstrating and/or participating in medical physics-related activities, especially in LMICs. Thus, its emphasis is on providing intellectual support through educating, training, mentoring and collaborating. As shown in Figure 1, the theme is "partnering" with a goal of having individuals and/or educational or healthcare institutions in both LMICs and HICs work together to meet well-defined needs. To help ensure sustainability, the intent is to provide support in those LMIC circumstances where basic infrastructure and staff already exist.


**Figure 1.** Schematic diagram emphasizing the partnering relationship between MPWB and the individuals or institutions being supported by MPWB.

## MEMBERSHIP ORGANIZATION

MPWB is a membership-driven organization with the formal membership application process having opened in June 2017. There are now over 230 registered Canadian, American, and International members, and a mailing list of over 800 individuals who have expressed an interest in MPWB activities. The Board consists of six members plus an executive director; presently, three of the members are from Canada and three from the US, and the executive director is Nancy Barret, who is also the executive director for COMP. With a Board transition beginning in 2019, there will be four Canadian (Jacob Van Dyk, John Schreiner, Parminder Basran and David Wilkins) and 2 US members (Yakov Pipman and Robert Jeraj). The Board meets electronically biweekly and addresses requests for assistance from LMICs that have come largely, although not exclusively, from Africa. In addition to projects specifically targeted towards addressing needs in LMICs, broader activities related to training and implementation are also addressed by the Board. For example, a generous grant from Dr. Jack Cunningham to MPWB is being allocated largely towards training activities related to treatment planning. In this context, the MPWB Board members are open to and welcome similar initiatives.

## MPWB ACTIVITIES

The following summarizes some of the activities in which MPWB has been involved. There is not enough space in this article to give all the details; hence, they are summarized in bullet form.

- MPWB has file folders on 16 LMICs, which involve a variety of activities and communications
- Support for recruitment
  - Ethiopia, Botswana, Tanzania
- Collaborating with AAPM/IOMP Equipment Donation Program
  - Dosimetry systems
    - Training of recipients of dosimetry systems
      - Continued communication/ mentoring
- Open syllabus
  - Providing on-line links to the syllabus of IAEA Clinical Training programs
    - Collaborating with the IAEA Advanced Medical Physics Learning Environment (AMPLE) project
- Collaborating on CERN/STFC/ICEC initiative to develop low cost, robust radiation therapy technologies (CERN= European Organization for Nuclear Research, STFC= Science and Technology Facilities Council (UK), ICEC=International Cancer Experts Corps)
- Requested to help with development of a medical physics Master's degree programs in Zimbabwe, Kenya, and Ethiopia
- Provided support for shielding design and radiation therapy departmental layout in LMICs
- Fundraising to perform the above

## WHY WORK AS AN INDEPENDENT ORGANIZATION?

The question has been asked a number of times as to why MPWB does not function under the auspices of one of the major medical physics organizations such as the International Organization of Medical Physics (IOMP) or the American Association of Physicists in Medicine (AAPM). The answer is that these bigger organizations have multiple priorities that go well beyond providing grass-roots support to individuals, to clinics or to educational institutions in LMICs. They have a broader mandate and more complex administrative structures such that charitable status, allowing tax-deductible donations, is often not available or appropriate. However, MPWB strives to work in close partnership with such organizations. Hence, MPWB has developed a memorandum of understanding (MOU) with the AAPM, which helps clarify the communication and working relationship. For instance, if working on closely-related projects, MPWB and the AAPM agree to minimize the duplication of efforts and maximize potential benefits. A similar MOU is under review with COMP. MPWB is also in discussion about becoming an Affiliated International Organization of the IOMP.

MPWB is in frequent communication with the International Atomic Energy Agency (IAEA) about projects in LMIC environments. Indeed, at the recent IAEA International Conference on Advances in Radiation Oncology (ICARO2) in Vienna in 2017, the President of MPWB attended representing MPWB as a non-government organization. Similarly, MPWB was profiled in two sessions at the World Congress of Medical Physics and Biomedical Engineering in Prague in June 2018. MPWB is also working closely with the International Cancer Expert Corps (ICEC, www.ICEC-cancer.org) on various projects including meetings on developing robust, low cost radiation treatment technologies for challenging environments [14;15]. Two of the MPWB Board members (Yakov Pipman and Jacob Van Dyk) are on the Advisory Board for ICEC. Furthermore, right from the outset, the President of MPWB has been in close communication with the Board Members of Physicien Médical Sans Frontières (PMSF, www.pmsf.asso.fr) who have a similar, although not identical, mandate as MPWB; however, they are not well recognized in the English-speaking world. PMSF has been very supportive of MPWB developing a sister organization. MPWB continues to maintain close contact with PMSF to ensure collaborative efforts where appropriate and to avoid overlapping projects. In the 2017 Canadian Organization of Medical Physicists (COMP) Strategic Plan, under Strategic Priority 4, "Engage in strategically aligned international initiatives", the following is included: "COMP is providing support for the newly launched Medical Physics for World Benefit."

## SUMMARY

In summary, MPWB is a young, not-for-profit, volunteer organization with the mandate of partnering to provide education, mentoring and training support to LMIC contexts. MPWB seeks the support of individuals who have a passion for reducing global health disparities, especially as related to medical physics. More information can be found on the MPWB website (www.mpwb.org).

Portions of this article were excerpted from reference [16].

# REFERENCES


1 United Nations General Assembly: Political Declaration of the High-level Meeting of the General Assembly on the Prevention and Control of Non-communicable Diseases. http://www.un.org/ga/search/view_doc.asp?symbol=A/66/L.1 . United Nations.

2 Moten A, Schafer D, Farmer P, Kim J, Ferrari M: Redefining global health priorities: Improving cancer care in developing settings. J Glob Health 2014;4:010304.

3 United Nations: United Nations Sustainable Development Goals. https://www.un.org/sustainabledevelopment/. United Nations.

4 United Nations General Assembly: Transforming our world: the 2030 Agenda for Sustainable Development. http://www.un.org/ga/search/view_doc.asp?symbol=A/70/L.1&Lang=E. United Nations.

5 Atun R, Jaffray DA, Barton MB, Bray F, Baumann M, Vikram B, Hanna TP, Knaul FM, Lievens Y, Lui TY, Milosevic M, O'Sullivan B, Rodin DL, Rosenblatt E, Van Dyk J, Yap ML, Zubizarreta E, Gospodarowicz M: Expanding global access to radiotherapy. Lancet Oncol 2015;16:1153-1186.

6 Zubizarreta EH, Fidarova E, Healy B, Rosenblatt E: Need for radiotherapy in low and middle income countries - the silent crisis continues. Clin Oncol (R Coll Radiol) 2015;27:107-114.

7 Duvivier RJ, Burch VC, Boulet JR: A comparison of physician emigration from Africa to the United States of America between 2005 and 2015. Hum Resour Health 2017;15:41.

8 Abdel-Wahab M, Bourque JM, Pynda Y, Izewska J, Van Der Merwe D, Zubizarreta E, Rosenblatt E: Status of radiotherapy resources in Africa: an International Atomic Energy Agency analysis. Lancet Oncol 2013;14:e168-e175.

9 Abdel-Wahab M, Fidarova E, Polo A: Global Access to Radiotherapy in Low- and Middle-income Countries. Clin Oncol (R Coll Radiol ) 2017;29:99-104.

10 Datta NR, Samiei M, Bodis S: Radiation therapy infrastructure and human resources in low- and middle-income countries: present status and projections for 2020. Int J Radiat Oncol Biol Phys 2014;89:448-457.

11 Ngwa W, Ngoma T: Emerging Models for Global Health in Radiation Oncology. Bristol, UK, IOP Publishing, 2016.

12 Planning National Radiotherapy Services: A Practical Tool. IAEA Human Health Series No. 14. Vienna, Austria, International Atomic Energy Agency (IAEA), 2010.

13 Van Dyk J, Meghzifene A: Radiation Oncology Quality and Safety Considerations in Low-Resource Settings: A Medical Physics Perspective. Semin Radiat Oncol 2017;27:124-135.

14 Hills S: Combatting Cancer in Challenging Environments (https://home.cern/about/updates/2017/11/combatting-cancer-challenging-environments). European Organization for Nuclear Research (CERN).

15 Dosanjh M, Coleman N, Pistenmaa D, Jamieson C: CERN, STFC, ICEC Workshop II: Innovative, Robust, and Affordable Medical Linear Accelerator for Challenging Environments (https://www.iceccancer.org/cern-stfc-icec-workshop-ii-an-innovative-robust-and-affordable-medical-linear-accelerator-for-challenging-environments). International Cancer Experts Corps (ICEC).

16 Van Dyk J, Pipman Y, White G, Wilkins D, Basran P, Jeraj R: Medical Physics for World Benefit (MPWB): A Not-for-Profit, Volunteer Organization in Support of Medical Physics in Lower Income Environments. Medical Physics International 2018;6:152-155. (http://mpijournal.org/pdf/2018-01/MPI-2018-01-p152.pdf)