EDUCATIONAL RESOURCES

The AAPM's Resources for Medical Physics Education Wherever You Are

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Abstract— **Educational and instructional materials are a critical resource in the academic and professional preparation of Medical Physicists. The access to this material is one of many barriers that Medical Physicists in low and middle income countries encounter in their academic and professional pursuit. The American Association of Physicists in Medicine (AAPM) has a vast repository of information and didactic material, created through many years of dedicated voluntary efforts by its members. Most of this material is collected in the Virtual Library. A cornerstone of the AAPM's mission is to advance the education and professional practice of Medical Physics. Consequently, the AAPM has made these resources available to the profession. This article describes the various educational and scientific resources available, and the ways that AAPM members and others can have access to these resources in order to advance the practice of Medical Physics worldwide.**

Keywords— **Online, virtual library, Web-based, Learning, Education**

I. Introduction

The education and training requirements for clinical Medical Physicists have been the subject of several documents in North America [1] [2] and internationally [3] [4][5][6] in recent years. These documents are very detailed in terms of the content and offer valuable tools for the organization of programs. They contain abundant references to textbooks and other educational resources and are often used as guidelines to many academic and training programs worldwide. Some of these programs are at different stages of implementation but all are pursuing advances in the education and training of Medical Physicists. One common need is that of teaching materials and trained faculty.

Beyond new graduates and trainees, established Medical Physicists, require constant learning in order to maintain proficiency in the continuous advances in Medical practice and the introduction of modern equipment and techniques.

Educational and instructional materials in Medical Physics are a critical resource in the process of teaching and training competent professionals. While it is known that teaching and training cannot be accomplished by lectures and reading material alone, lectures and reading materials are essential components of this learning process.

Medical Physicists have been involved in the teaching and education of other Medical Physicists, and of other professionals, from the very early years of the profession. With the increased use of electronic media, the pace of creation of new material has accelerated significantly in the last two decades. Over the years, members have produced a vast and sophisticated array of didactic material, lectures and reports on the scientific and practical aspects of Medical Physics, and they continue doing so.

The AAPM has recognized the value of these resources and created a vast repository of information and didactic material on its website as part of its mission to advance the education and professional practice of Medical Physics.

Members of the AAPM get free access to use the vast majority of these educational resources in their electronic version. Physical copies are available at affordable cost. Publications and materials that are considered to be important for wider audiences are often made available at no cost.

It is well known that access and affordability vary widely across nations and regions. What is affordable in North America may be beyond the reach of the majority of students and professionals in low and middle income countries (LMIC).

Medical Physicists in LMIC's encounter significant challenges in their quest to achieve the necessary skills in the profession. One of these barriers is the ready availability of educational and instructional materials and the cost of printed books and manuals. The other is the limited access

to experienced professionals until a critical mass of expertise and skills develops locally.

Recognizing that membership in the AAPM may not always be an option for all Medical Physicists in LMIC's, the AAPM makes special accommodations for students and professionals in developing countries to benefit from these resources.

We review the AAPM resources, and ways to access them, in the following section.

Fig. 1 The AAPM's webpage link to Resources

II. Materials and Methods

The AAPM's webpage (www.aapm.org) links directly from its front page to several educational resource areas (Fig 1). While many of these materials are easily, and often freely, obtainable from the AAPM, the readers must abide by the "Copyright and Permissions" policy of the AAPM as spelled out at the end of this article.

The main areas are:

1. Two main journals are published by the AAPM:

   "Medical Physics" [7] is the scientific journal of the AAPM and is an official science journal of the Canadian Organization of Medical Physics (COMP), the Canadian College of Physicists in Medicine (CCPM), and of the IOMP. It publishes research concerned with the application of physics and mathematics to the solution of problems in medicine and human biology. It is available in print and online through individual and library subscriptions. All AAPM members have free access to the online version. A considerable number of articles are "Open Access" and available to the general public. [8]. Among these are items in categories such as "Author's Choice", "Editor's Picks", Editorials, Books and Publications, Medical Physics Letter, Review Articles, Vision 20/20, Point/Counterpoint discussions, Focus Series, Award Winning Papers, Ph.D. Abstracts and the 50th Anniversary Papers.

   The Journal of Applied Clinical Medical Physics (JACMP) [9] is an applied journal, which publishes papers that can help clinical medical physicists perform their responsibilities more effectively and efficiently for the increased benefit of the patient. JACMP was established in 2000 and is an open access electronic journal published bi-monthly by the AAPM, and therefore available freely to anyone interested. Articles are grouped in sections such as: Radiation Oncology Physics, Medical Imaging, Radiation Measurements, Radiation Protection and Regulations, Education, Management and Profession, Technical Notes and Non-ionizing Radiation topics. Periodically there are articles in a series named "Parallel/Opposed" that presents arguments and a discussion on the topic at hand.

2. AAPM Reports: The AAPM periodically publishes official reports [10]. These are typically extensive and detailed documents on scientific, professional or educational topics which have undergone extensive review by members of the various committees and councils of the AAPM. The frequency and subjects of these reports depend on the work of many AAPM member volunteers and therefore is not regular. In the last five years - 2010 to 2014 - a total of 33 reports were published. The electronic versions of these reports are freely available on the AAPM's website.

3. AAPM Monographs and Summer School proceedings are reviews of medical physics topics and are primarily the output of many of the AAPM Summer Schools, and more recently the spring clinical meetings and specialty meetings. They can be purchased from Medical Physics Publishing (MPP) [11], a non-profit outfit dedicated to the publication and distribution of educational and scientific books in medical physics and related fields, founded in 1985 by Dr. John Cameron.

4. Selected Presentations from the AAPM Annual Meetings, recent AAPM Summer Schools and other meetings, are recorded in CD or DVD format. As of the end of 2014, a total of 34 collections of presentations were available for purchase from Association Archives [12].

5. The Women's Professional Subcommittee (WPSC) publishes a Newsletter for the members of the AAPM. It includes selected news items and notices coinciding with the vision of the WPSC, including opportunities for leadership and mentorship within the organization, providing avenues for connecting women medical physicists around the world, addressing programming in areas of professional development that may not be addressed in other forums, and drawing attention to the important work that many women medical physicist do. Access to the Newsletter, which is published twice a year, requires a member's login.

6. The Newsletter of the AAPM is a source of information about activities and items of interest to the members. It contains timely information and serves as a forum for lively debate. It is published bi-monthly as an interactive PDF and is distributed to over 8,000 members and affiliates. A login is required to access its contents [13].

7. E-News is released to AAPM members every three weeks via email and carries timely summaries of issues related to educational and professional topics [14].

8. NCRP Publications became freely available online to AAPM members starting in April 2015. This includes all digitally-available NCRP Publications, going back to 1971.

9. Medical Physics Practice Guidelines (MPPGs) [15] are clear and concise statements of the minimum acceptable level of routine medical physics practice to support a clinical service. These MPPG's can be referenced by clinical physicists, accreditation bodies, regulators, and hospital administrators.

10. The AAPM Virtual Library [16] is the central repository of resources. Hundreds of members use it for their continuing education, research, and information needs. The Virtual Library includes streaming video and/or audio of speakers as well as slides of the presentations from AAPM meetings and conferences. This includes the Annual Meetings, Summer Schools and Spring Clinical Meetings as well as specialty meetings such as the 2015 Incident Learning Workshop, the 2014 Radiation Oncology Program Accreditation Meeting, the 2013 CT Dose Summit and more. Presentations from the annual Conference of Radiation Control Program Directors (CRCPD) [17] meetings are also included. Transcription of the audio is also included for some presentations. All content in the AAPM virtual library is free to members.

11. For an additional fee, AAPM members can also obtain Medical Physics Continuing Education Credits (MPCEC) from the Commission on Accreditation of Medical Physics Education Programs (CAMPEP) [18] by answering question sets on these presentations. CAMPEP credits are recognized as category 1 credits by the American Board of Radiology (ABR) [19] and satisfy the maintenance of certification (MOC) requirements of the ABR. The AAPM Online Learning Services Subcommittee routinely formulates and posts question/answer sets for selected Virtual Library presentations and other source material in the Online Learning Center.

12. The AAPM Online Learning Center is the web page home for the Virtual Library and the MPCEC mentioned above. There are also links to the Self Assessment Modules (SAMs), another type of educational credit specified by the ABR.

13. Access to the resources is one of the many benefits of membership in the AAPM. The categories of membership – Full, Emeritus, Corresponding, International Associate, Resident, Junior, Student – depend on the education, experience, place of residence and the degree of involvement desired. The requirements and benefits are described in detail on the AAPM's website [20].

    Members of all categories, including International affiliate member of the AAPM have access to the same resources as full members, with all of this information available at no additional cost. Moreover, much of the content of the Summer Schools, annual meeting, the Spring Clinical meeting as well as specialty meetings are posted online.

    Physicists from any country can apply for Full Member status but many not living in North America might find Corresponding Membership more appropriate.

    For physicists in Developing Countries [21], the Partners in Physics Program (PIP) offers the opportunity to have the application fee and dues waived. Information about the PIP program is available through the International Affairs Committee of the AAPM.

    The membership application process is described in the website [21] and in a flow chart [22] to guide the applicant to the best suited membership category. It entails a few simple steps from the applicant:

    - Answer a few questions about your Education, Location, etc.
    - Download the appropriate Membership Application (MS Word format).
    - Fill out the application, then email to membership@aapm.org along with any documentation to be considered (CV, List of Publications, Certifications)
    - The AAPM will send an invoice via email for the application fee, if it is required.

    Educational Resources, such as Proceedings of the AAPM Summer Schools, Continuing Education Programs from the Annual Meetings and AAPM Task Group Reports are also available to medical physicists in Developing Countries that are interested in the AAPM, regardless of other criteria. The main requirement is to register as a Developing Country Educational Associate (DCEA) and obtaining a DCEA USERNAME and PASSWORD [24].

III. Results and discussion

The AAPM provides educational materials in electronic format to medical physics worldwide including selected articles in Medical Physics, all articles in JACMP, all AAPM Reports, and all Medical Physics Practice Guidelines.

Additional material is available for a fee, including all articles in Medical Physics, AAPM Monographs and Summer School proceedings, CD or DVD recordings from the Annual Meetings and Summer Schools.

All of the material above is available for no extra charge to all members (including International Affiliates) as well as additional material available only through AAPM membership. That additional material includes NCRP publications and the AAPM Virtual Library.

Non-members have access to many resources provided by the AAPM as described above.

The AAPM is looking into the viability of providing fee-based access to the Virtual Library and Medical Physics Continuing Education Credits for non-members as well. Until such a decision is made, however, full access is available to physicists outside the U.S. at a greatly reduced rate (for Corresponding Members or International Affiliates) or at the standard rate for Associate Members.

IV. conclusions

We presented the educational resources made available by the AAPM to the Medical Physics community worldwide.

We hope that this article will be of help to further the international educational mission of the AAPM and to the further development of medical physics in Developing Countries by complementing their educational, training and continuing education programs.

Most of these resources are freely accessible to all interested parties. Although some of the material is restricted to AAPM members, Medical Physicists in Developing countries, and others who qualify as such, have special access to much of it in electronic form..

ACKNOWLEDGMENTS

We thank the many hundreds of AAPM members that contribute to the preparation of Task Group reports, presentations and other didactic material to the Virtual Library over the years, as well as the AAPM's technical staff that manages this content and the supporting web application.

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