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NCRP Report 158, Uncertainties in the Measurement and Dosimetry of External Radiation, National Council on Radiation Protection and Measurements, 2007, 546 pp. (hard cover), $145, $116 PDF download; $246.50 hard cover & PDF, Suite 800, 7910 Woodmont Avenue, Bethesda, MD 20814; http://www.ncrppublications.org/.

NCRP Report 158, *Uncertainties in the Measurement and Dosimetry of External Radiation,* is the first of a planned series of three documents (i.e., External Radiation, Internal Radiation, and Principles of Dose Reconstruction) from the National Council on Radiation Protection and Measurements. Individually, and particularly collectively, these documents represent important guidance to radiation dose assessment practices. The primary essence of Report 158 concerns uncertainty, broadly and specifically, such as types, distributions (e.g., probability density functions), expression and propagation. Uncertainty is an integral component of any and all technology used to measure radiation exposure in the context of its calibration, use and interpretation, and to determine an associated organ dose. An important distinction in the scope of Report 158 is the assumption that measurements were taken upon a person or the person was present where the measurements were taken as opposed to the scope of the third report being prepared which concerns uncertainties due to assumptions regarding the radiation exposure scenario and interpolations, and the uncertainty in extrapolations in space and time from limited or no measurements.

The Scientific Committee's substantial knowledge of measurement methods and uncertainty is presented in chapter 3 for each of the primary measurement systems available currently or historically in terms of their respective applications, history, radiation response characteristics, and potential sources of uncertainty. This information will undoubtedly be of significant interest to health physicists in the context of selecting measurement systems with a potential for less uncertainty for particular applications based on characteristics of the radiation field. Information is presented for measurement systems for beta, photon and neutron radiation.

Chapter 4 concerns sources of uncertainty in the models used for conversion of measured quantities to organ doses. Many topics are considered including relationships among fundamental dose measurement quantities, relationships between measurements using calibration standards and anthropomorphic phantoms, variations involving energy and geometry, and variations among body size, shape, and organs. Dosimetric models used to develop dose conversion coefficients include many parameters that vary with energy, homogeneity of the radiation field, irradiation geometry and anthropomorphic details of the phantom.

Chapter 5 describes methods and examples of propagating uncertainty as well as examining the sensitivity of the model results to various parameters. This is a particularly relevant chapter to assessing the overall error and is well illustrated by the use of several examples. Chapter 6 may be most interesting to readers in that it presents examples of uncertainty analyses that illustrate the concepts presented in the earlier chapters. Five relevant examples are presented: 1) atomic veteran, 2) radiological technologist, 3) member of the public exposed from Techa River environmental pathways, 4) worker exposed to neutron radiation from the multi-site leukemia study, and 5) worker exposed to photon radiation from the U.S. Department of Energy (DOE) Worker Compensation Program.

In summary, NCRP Report 158 is very well organized and indexed. It describes the information required to understand various sources of uncertainty, the magnitude and range of likely uncertainties, and methods for combining these uncertainties. It represents a "must have" reference document to health physicists involved in radiation measurements or dose reconstruction. Summaries are provided at the end of each chapter. Information in the document seems particularly easy to find. Care in the preparation of this document is evident throughout and this undoubtedly required significant effort by the committee.

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Advances in Medical Physics, edited by A. B. Wolbarst, K. L. Mossman, and W. R. Hendee, 2008, 352 pp. (hard cover), $94.00, Medical Physics Publishing, 4513 Vernon Blvd., Madison, WI 53705-4964; http://www.medicalphysics.org; ISBN: 978-1-930524-38-5 H.

ADVANCES in Medical Physics first appeared in 2006 with the intent to assist medical physicists, physicians and "and in particular the subfields of medical physics *other than*." This is the second of the series that addresses therapy and diagnostic medical physics. The third publication divides into advances in medical physics: diagnostic imaging published in the even-numbered years and odd-numbered years, and advances in medical physics: radiation therapy in the odd-numbered years.

The subjects covered in the text are: digital radiography, image display systems, computed tomography (CT) positron emission tomography (PET) reconstruction algorithms, CT quality control, CT doses, magnetic resonance imaging (MRI) update, the principles of quantitative MRI, molecular imaging, finite training of radiologists, computer-aided detection/computer diagnosis, health risks from low doses of ionizing radiation, image-guided radiation therapy, stereotactic radiosurgery, treatment plan optimization, therapy vault shielding design, regulations in medicine, statistical

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modeling of clinical studies, and a description of the grant process in the National Institute of Biomedical Imaging and Bioengineering (NIBIB) at the National Institutes of Health (NIH). The 2008 edition strongly emphasizes imaging medical physics with ten chapters followed by radiation therapy with four chapters. Nuclear medical physics and health physics each have one chapter, along with statistical modeling and NIBIB. Thus, eighteen chapters discuss material in 335 pages. As stated in the preface of the book, roughly 20 pages per topic is a reasonable summary of the subjects covered in the publication.

The review of digital radiography, mammography, and fluoroscopy by J. Anthony Seibert is well written, concise, and covers the subject area well, including references for a description of quality assurance and acceptance testing as well as providing references for delving into the subject in greater depth. This approach is not only valuable for medical physicists outside of the subject area, but also a good starting point for medical physicists pursuing board certification. On the other hand, the chapter on MRI update describes hardware developments and software and advanced application developments, but does not offer guidelines for quality control or quality improvement.

The chapter on stereotactic radiosurgery covers the wide topic in good depth for the allotted number of pages, but is light on quality assurance/plan verification. The measurement techniques for small beam dosimetry, as well as the review of dose delivery systems are covered well with a good reference selection. Perhaps one of the most practical chapters in this textbook is the introduction to therapy vault shielding design in accordance with the National Council on Radiation Protection and Measurements (NCRP) Report No. 151 (NCRP 2005). The material is presented clearly with minimal chance of misinterpretation and is well referenced.

The most complex topic is addressed by Donald E. Herbert in Some Perspective and Insights in Modern Statistical Modeling, with a chapter covering over 40 pages of the text. This chapter is in depth, complex, and extremely well delivered. The topics range from the introduction to models, the selection of the most appropriate model, the delineation of the three principal models used for analyzing sets that are commonly confront medical physicists, which are the general linear model, the nonlinear regression model and the generalized linear model. Herbert goes on to discuss the properties of parameter estimates in the aforementioned models as well as model averaging. This is then followed by an in-depth discussion of inference models, including the name and height of the Pearson, the Bayes model, the information theory model, and models for the future. As always, Herbert follows Confucius' proverb of "Know what you know and know what you don't know."

In summary, the textbook is an excellent coverage for a review of topics in diagnostic medical physics and radiation therapy medical physics. It is, of course, limited by the finite resources allotted to 18 topics. The authors are all entirely drawn from within the United States. Future editions would benefit from contributions from other countries and cultures. Increased depth and breadth improvement appears to be realized with the future policy dividing the publications into biannual reports alternating diagnostic medical physics and therapy medical physics. I am positive that the addition of future volumes will amount to an excellent library of medical physics reviews.

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REFERENCE

National Council on Radiation Protection and Measurements. Structural shielding design and evaluation for megavoltage x- and gamma-ray radiotherapy facilities. Bethesda MD: NCRP; Report No. 151; 2005.

Radioactive Aerosols, by Constantin Papastefanou, 2008, 186 pp. (hard cover), $145, GBP 83, EUR 121, Elsevier, New York; http://www.elsevier.com; ISBN: 978-0-08-044075-0, ISSN: 1569-4860.

THIS book covers the topic of radioactive aerosols with sufficient breadth to justify its ambitious title; topics include sources, health effects, fate and transport, measurement methods, and use as indicators for atmospheric processes. The book begins with a brief introduction to atmospheric aerosol physics. Sources of radioactive aerosols are discussed ranging from naturally occurring radioactive aerosols, including cosmic ray formation mechanisms and radon and thoron decay products and their attachment to existing aerosol, to anthropogenic production of radioactive aerosols from nuclear device testing, nuclear reactors, and particle accelerators. The fate and transport of radioactive aerosols are also addressed by chapters on atmospheric transport and deposition with information on resuspension of deposited particles. Tables and formulae are given to enable calculation of aerosol deposition and resuspension.

Of particular interest is the chapter on human exposure and dose. The subtleties of the relationship of the ambient aerosol distribution to the activity distribution of radon decay products and the subsequent effect on inhalation dose are well presented.

The book contains numerous tables and graphs summarizing information found in the literature as well as a comprehensive list of citations. It is useful for those desiring an introduction to the various topics covered as well as those familiar with the subject as a good compilation of basic references for a literature search.

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