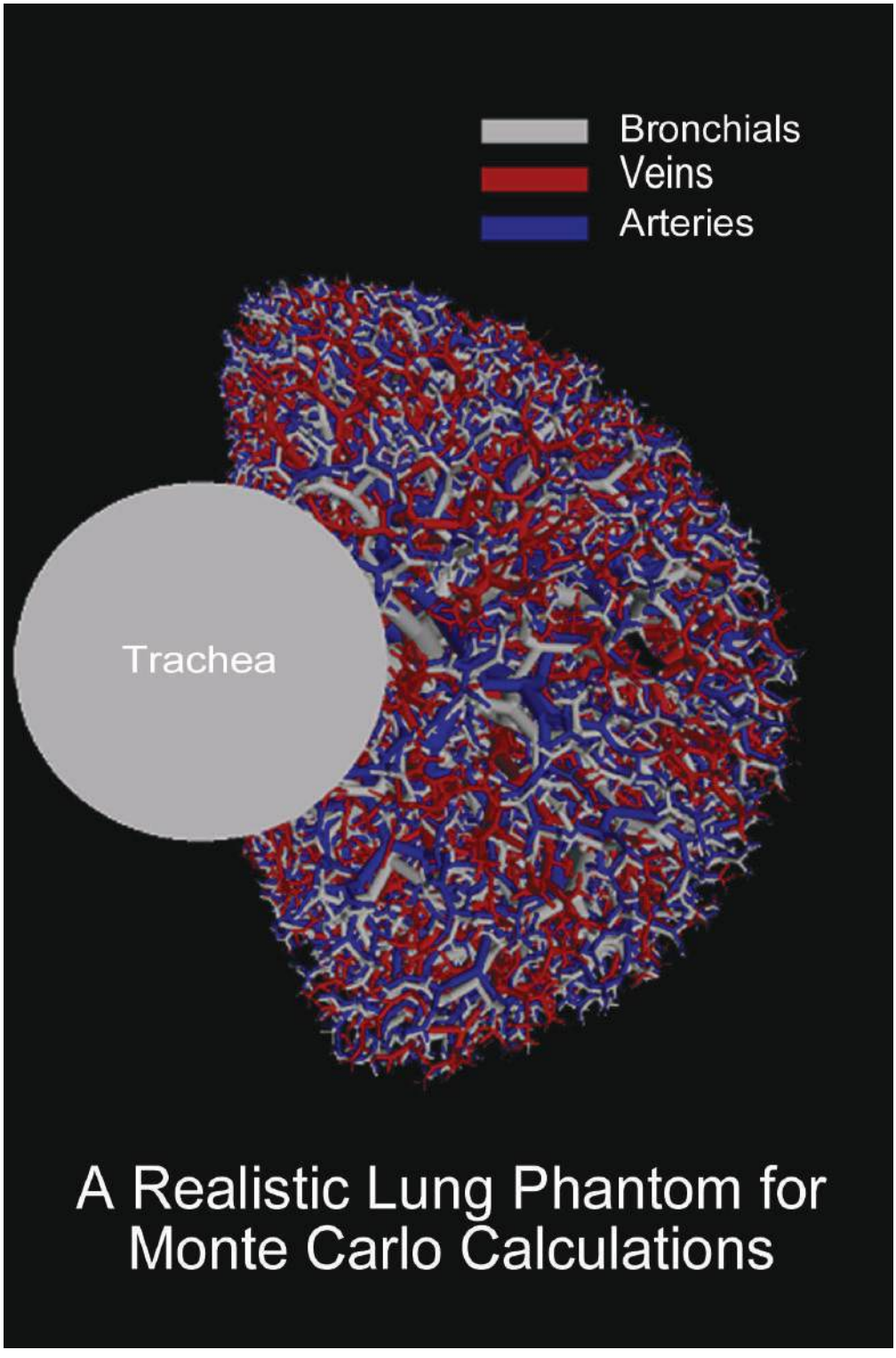
InterACTIONS

CANADIAN MEDICAL PHYSICS NEWSLETTER
Le BULLETIN CANADIEN de PHYSIQUE MÉDICALE



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LE COLLÈGE CANADIEN DES PHYSICIENS EN MÉDECINE

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InterACTIONS

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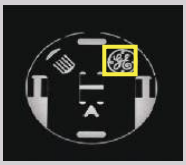

Cover Image

At the Saskatoon Cancer Centre, in association with the University of Saskatchewan, we are investigating the accuracy of superposition-convolution algorithms for radiotherapy treatments of lung based tumours. To that end, we have constructed a three dimensional Monte Carlo model of the right lung. This model, in part, consists of three bifurcating networks: the bronchial, arterial and venous trees. The morphometry of the bronchial tree is derived from a model created by Kitaoka e*t al. (A three-dimensional model of the human airway tree*, J Appl Physiol, 87(6), 1999, pp2207-2217). Their code, written in C++, generates a dichotomous, asymmetric branching network of hollow cylinders from the trachea down to the terminal bronchioles. The model consists of more than 54,000 branches broken up into 5 lobes and 18 segments as is the case in the living lung.

Our work included an expansion of this model to generate the arterial and venous pathways for the right lung. The arterial tree was made to shadow the bronchial tree as is the case in the human lung. The venous tree then filled the empty spaces left by the first two trees. The tree geometries were coded into a modified version of the DOSXYZnrc Monte Carlo code. In the Monte Carlo code, each branch is represented as a hollow, thick walled cylinder. At a bifurcation point in the network, a parent branch is joined to its two daughters by a hollow sphere. Future work includes a CT reconstruction of this model that will be fed into the superposition-convolution algorithm of the treatment planning system. The figure shows a cranial view of the lung model. The grey, blue and red branches represent the bronchial, arterial and venous branching networks respectively. The dimension of the lung model is approximately 12 cm x 18 cm x 24 cm in size. The trachea appears disproportionately large as it is the closest object in the image.

Image provided by Kerry Babcock and Narinder Sidhu, Dept of Physics, University of Saskatchewan

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Please submit stories in Publisher 98, Word 6.0, Word 97, or ASCII text format. Hardcopy submissions will be scanned to generate an electronic document for inclusion in the Newsletter. Images in Tiff format at 300 dpi resolution are preferred.

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Message from the CCPM President:

Currently CAMPEP accredited residency training is not required for CCPM certification, but some legislative developments in the US may lead the CCPM to require CAMPEP accredited residency training in the future. CAMPEP is a US organization that accredits residency, graduate and continuing education programs in North America.

Currently CAMPEP accredited residency training is not required for CCPM certification, but some legislative developments in the US may lead the CCPM to require CAMPEP accredited residency training in the future.

The CCPM and COMP jointly sponsors CAMPEP and has two members that sit on the CAMPEP board. Although neither the ABR nor the ABMP require graduation from a CAMPEP accredited training program for board certification, this is set to change in 2012 when the ABR is planning to add CAMPEP accredited training as a requirement for board certification.

Up to now the assumption has been that this requirement will be delayed past 2012 because of the lack of CAMPEP accredited training positions compared to the number of vacant medical physics positions, and the lack of any legal requirement for medical physics certification in most states.

Although the number of vacant physics positions is unlikely to change very quickly, the legal requirement may change this year in the US at the federal level.

There is a bill called CARE (Consistency, Accuracy, Responsibility, and Excellence in Medical Imaging and Radiation Therapy) which is likely to get passed and will require that individuals involved in medical imaging and radiation therapy meet federal standards that still have to be set.

There is a bill (US) called CARE (Consistency, Accuracy, Responsibility, and Excellence in Medical Imaging and Radiation Therapy) which is likely to get passed and will require that individuals involved in medical imaging and radiation therapy meet federal standards that still have to be set.

The AAPM believes that this will quickly (within years) lead to state licensure for medical physicists, but that licensure will lead to more stringent requirements for board certification such as graduation or training in an accredited medical physics program similar to the requirements for other medical professions (see the May/June 2007 AAPM Newsletter).

If the above scenario does come to pass in the US there will be several reasons for the CCPM to follow suit regarding graduation from a CAMPEP accredited training program as a requirement for CCPM certification.

First, this is an opportunity to improve our professional standards, something that we continuously strive for anyway.

Second, if we want to continue to have cross border recognition of each other's certifications we need to have similar standards.

Dr. Dick Drost,
CCPM President

The AAPM believes that this will quickly (within years) lead to state licensure for medical physicists, but that licensure will lead to more stringent requirements for board certification ...

Third, better consistency in medical physics training across Canada should make certification less intimidating and improve the pass rate for first time applicants.
The downside is the current lack of sufficient CAMPEP accredited training positions and the work required to add more CAMPEP accredited training programs.

The more interesting question is whether licensure in the US will increase the probability of licensure in Canada.

Message from the COMP Chair:

I have just returned from South Africa where I attended the 46th Annual Scientific Meeting and Winter School held by the South African Association of Physicists in Medicine and Biology (SAAPMB). The Winter School was on Radiological Protection and Diagnostic Reference Levels and the invited speakers included Cupido Daniels and Joel Gray.

In spite of the small number of certified Medical Physicists (40 for a population of 50 million) and a history of funding shortages in the 90's, there are clear signs of progress. A number of new pieces of equipment have or are being installed (one physicist I spoke to has commissioned 4 linacs in the past year,) and there are currently about 30 residents (called "interns" in South Africa) in training. In spite of the high patient/physicist ratio, South African Medical Physicists often assist in the commissioning of equipment in the rest of Africa and some centres are carrying out IMRT on a routine basis.

Trying to ensure optimal quality in therapy and diagnosis was a theme at both the conference and the business meetings and one of the biggest issues facing the SAAPMB was how to ensure that QA was carried out appropriately. Guidelines for the workload of therapy physicists were discussed with numbers of 600 to 1000 new patients per physicist being suggested. The SAAPMB has decided to adopt our QA standards and are contemplating accreditation of any group carrying out diagnostic QA to ensure that standards are being maintained. As a native South African I am proud that South Africa was one of the first countries in the world to legally require that Medical Physicists be certified in order to practice independently.

In South Africa the roles of the SAAPMB (the scientific and professional association) and the certifying body (the Health Professions Council of South Africa) are quite distinct and clear. Unfortunately the strategic planning survey showed that our members are confused as to the roles of COMP and the CCPM. It seems that many members do not understand, or maybe have not really thought about the distinction between a certifying body (CCPM) and a scientific/professional association (COMP). External organizations and groups, both scientific and government, are equally confused about the responsibilities of the two organizations with some of this possibly arising as a result of the history of the two organizations.

Because the CCPM existed before COMP, the CCPM assumed responsibilities such as radiation protection standards, education and the promotion of medical physics in Canada. These functions are often handled by the scientific organization rather than the certifying body. After COMP was established, the overlap in functions continued because medical physicists in Canada form a relatively small community. As a result the two organizations share many resources: one executive director; one communications structure, for example this newsletter; almost one membership structure, members of CCPM are a required subset of COMP; joint committees; and an overlapping financial structure.

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An important outcome of the COMP strategic planning workshop was the need to clarify the respective roles of our two organizations so that COMP could improve both its organizational structure and the services that it offered to its members. COMP's members are looking to us to support and promote the scientific, professional and educational interests of all medical physics professionals and trainees in Canada. This includes the exchange of scientific and technical knowledge and information, the development of professional standards and the promotion of the importance of CCPM certification for eligible clinical medical physicists.

Dr. Stephen Pistorius
COMP President

We have already made some changes to our committee structure so that the reporting lines are clearer. This process will continue as more committees are added to COMP to address areas such as training where we have not historically put as much emphasis as we should. Our financial reporting also needs to clearly show where our member's dues are being spent if we are to be more accountable and to show that our limited resources are being spent appropriately.

Some changes may also be required to our bylaws in order to provide you with an organization which is better able to adapt to the ongoing needs of its membership. Please note that I am not advocating a divorce, but rather a dialogue amongst the membership which will lead to role clarification between the two organizations and a structure which ensures that COMP and the CCPM are able to make independent decisions that are in the best interest of their members.

I close my letter with a request. The JACMP is a clinical journal, with the goal of providing an open access format for clinical articles in medical physics. Since the goal is the free dissemination of clinical information to benefit the patient, they hope to provide articles without cost to anyone with web access, worldwide. The JACMP publishes clinical articles only, occupies a unique publishing

(Continued on page 79)

Message from the Executive Director of COMP/CCPM:

Ms. Nancy Barrett,
COMP/CCPM Executive Director

Greetings to all – hope your summer is starting off well. Here is an update on some of the activities that the COMP office has been involved in on your behalf:

COMP/CARO Conference in Toronto – October 10th to October 13th, 2007
The joint scientific committee has designed the program to include two full days of pre-conference events, a diverse and dynamic group of speakers, workshops, paper presentations and symposia related to the theme, ***Image Guided and Adaptive Radiation Therapy***. To enhance inter-professional learning opportunities, daily joint sessions between Medical Physics and Radiation Oncology have been planned, as well as break out sessions for topics unique to each group. If you haven't already done so, go to www.caro-comp2007.com and register today!

Future Conferences
Plans have already begun for the 2008 COMP meeting which will be taking place in beautiful and historic Quebec City. The dates have been set for June 25-28 so mark you calendars! We are still looking for a host city for 2009. Perhaps you and your colleagues would like to showcase your team and your city? A Request for Proposal can be found in this newsletter and provides further details.

We have also been approached to submit a bid to host the IOMP conference in 2015. As you can appreciate, hosting an international conference can be a very rewarding experience but is also a great deal of work. Collaboration between interested organizations and prospective host city tourism bureaus is essential. If you think you might be interested in working on a committee for this international conference, please let either Stephen Pistorius or myself know.

We have also been approached to submit a bid to host the IOMP conference in 2015...If you think you might be interested in working on a committee for this international conference, please let either Stephen Pistorius or myself know.

COMP Communications Strategy

"Community" is one of COMP's key strategic pillars. To support this pillar, a communication plan was developed in conjunction with the Communications committee and looks at both internal communications (with our members) and communications with other outside groups, policy-makers and media.

To support this process, we are currently revamping the COMP website. A Request for Proposal was circulated to prospective proponents who have specific experience providing services to scientific/medical associations and understand our requirements. Proposals were due in mid-June.

COMP Administration

By now, many of you may have had an opportunity to connect with Gisele Kite, our Administrator. Gisele has been busy processing membership applications and renewals, taking care of job postings and other broadcast emails, coordinating advertising and handling inquiries. Gisele is also working closely with Maryse Mondat, the COMP Treasurer, and is dealing with the day-to-day financial management of COMP. Gisele is bilingual (English and French) and can be reached at admin@medphys.ca.

Corporate Member Support
Our corporate members continue to support us very generously through advertisements and by exhibiting and sponsoring our annual conference. This is an important source of non-dues revenue that supports our activities and we are grateful for this contribution.

Both Gisele and I thank you for your support and look forward to continuing to work with the COMP Executive and CCPM Board to address your priorities. As always I welcome your feedback and suggestions. Please feel free to contact me at any time.

HE Johns Travel Award Report

Submitted by: Rob Hunter
Juravinski Cancer Centre, Hamilton, Ontario

Although recent recipients of the HE Johns Travel Award have visited such exotic locations as Melbourne, Australia and Ghent, Belgium, I chose instead to visit the BC Cancer Agency – Vancouver Island Centre in Victoria BC. This revealed two truths: (i) you do not always have to travel someplace far and foreign to learn and (ii) Victoria is far and quite foreign to someone from Hamilton. Although flying to Victoria from Toronto is about a five-hour direct flight, that doesn't take into account airline scheduling. A few stops and long layovers make Victoria *feel* much farther away. Secondly, leaving the snow and cold of Hamilton in February to see trees blossoming and daffodils blooming in Victoria makes it seem quite exotic.

Victoria is a great city. Due to time and daylight constraints I was only able to explore the harbour and downtown areas. I'm sure that with a car and access to some of the more distant Victoria landmarks, the tourism portion of the trip would have been even better. Besides the early arrival of spring, one of the surest signs that I was no longer in southern Ontario was a sighting of a bicycle deliveryman, towing a sizable trailer filled with bins of organic food for home delivery - just what I might picture as a stereotypical West coast sight. The Vancouver Island Centre (VIC) sits about 5 km from downtown in a bright new building. The design is friendly and welcoming, as were all the staff that I encountered there.

My initial rationale for visiting Victoria was to learn about their experience with High Dose Rate Brachytherapy (HDR) for partial breast treatments. Partial breast irradiations at the Juravinski Cancer Centre are performed with external beams only. Also, at the time of my application our HDR program was just getting off the ground and it seemed like a good time to visit a centre with more brachytherapy experience. Unfortunately, due to a variety of circumstances, including patient accrual into the HDR partial breast study (which I believe has actually stopped now), the trip was delayed for longer than expected. In the meantime, our HDR program has grown quite busy, treating about 200 patients and 600 fractions per year for esophagus, lung and gynecological malignancies. Although our program is well established at this point, it is never a bad idea to observe another group's techniques for tackling various clinical problems. Furthermore, although a conference is a great way to learn new and interesting techniques and inspire one's research enthusiasm, visiting another site provides more hands-on information that one might be able to implement in daily practice. Therefore, although I was unable to actually observe a breast HDR treatment, my trip was very informative with regards to HDR and radiation therapy as a whole.

It is a difficult task writing about the work being performed at another centre. Clearly someone from the VIC could probably do a better job summarizing their various projects than I could. However, with that in mind, here are some of the projects at the VIC that caught my attention.

HDR for partial breast treatments
Although trials investigating partial breast irradiations are ongoing, using HDR seems like an excellent technique for treating only the breast seroma. The VIC has developed an excellent protocol for this treatment that involves accurate localization of the catheters for treatment, an insertion that can be performed under conscious sedation and treatment that can be completed within a week (nine fractions in five days). In another West coast theme, the template mapped on the patient skin is drawn with henna ink, like a temporary tattoo. From a dosimetry standpoint, HDR allows for a smaller margin (CTV = PTV) and allows for better normal tissue sparing. The only organ at risk is the skin, while for external beam treatments doses to the heart and lungs of these patients are critical.

Ultrasound localization of breast seroma
If covering the seroma is the new goal of breast irradiation, it would be advantageous to know how well the seroma location correlates with location of the primary tumour. This study uses ultrasound to investigate the seroma position in the breast.

Deep inspiration breath hold
In order to reduce the heart dose for left sided breast treatments, a respiratory gating technique for treating each breast field while the patient holds her breath is being developed. Portal imaging compared to treatment DRRs allow for analysis of the errors and variations in this method.

Portal image-based dose measurements for IMRT
The technique developed at the VIC for IMRT QA allows for rapid, three-dimensional reconstruction of IMRT dose. Although this was recently published (Med. Phys. **33**(9) 3369-82), seeing it in practice provides a nice companion to reading the paper.

Visiting another Cancer Centre allows the observation of techniques and treatments that are different from one's own approach. It can also provide confidence in your program's methods and measurements. It is nice to walk away and say, "Great we do all those measurements too…" Finally, it can help establish connections with other medical physicists that can lead to new developments and collaborations.

Lastly I would like to thank CCPM for providing me with this opportunity. The HE Johns Travel Award is a worthwhile program that helps new members of our profession further their career development. I would be remiss if I did not also thank all the people at VIC for taking time out of their busy schedules to inform me about their various projects, especially Dr. Will Ansbacher who I'm sure got little of his own work done while I was visiting.

2007 Recipient of the COMP Gold Medal

Submitted by: Peter O'Brien
Toronto-Sunnybrook Regional Cancer Centre, Toronto, Ontario

John C.F. MacDonald, Ph.D.,

John MacDonald was amongst the very first Medical Physicists in Canada, starting his career at with the Ontario Cancer Foundation Radiotherapy Department at Toronto General Hospital (TGH) in 1951.

In 1941, John graduated from University of British Columbia (UBC) with a degree in Mathematics and Physics. He then spent 5 years as an army artillery officer in Canada and Europe during World War II after which he completed an M.Sc. at UBC in 1948 and a Ph.D. in molecular physics from University of Toronto in 1951.

He started his Medical Physics career with an overseas fellowship in England, Denmark and Sweden and then spent 6 years at TGH. Even while at TGH, he was involved with the dosimetry of one of the two first cobalt-60 machines in the world located in London, Ontario. In 1957, he became the Chief Physicist in London, Ontario where he remained until his retirement in 1985.

John's research was very interesting and varied. His publications include infrared absorption, the use of colloidal gold for prostate treatments, a treatment time calculator for cobalt-60 teletherapy, rotational therapy, basic radiation dosimetry using different methods of measurement, spectral sensitivity of dental films, dipole oscillator strength distributions, and the determination of stopping and straggling mean excitation energies.

Furthermore, he had a significant involvement in organizational issues, especially as related to the Ontario scene but also well beyond. Twice John served as the Chair of the Division of Medical and Biological Physics of the Canadian Association of Physicists in Medicine. He was also one of the founding members and Registrar of the Canadian College of Physicists in Medicine.

John has served the Canadian Medical Physics community very well and he is definitely a worthy recipient of the COMP Gold Medal award.

Congratulations to Dr John C.F. MacDonald!

The Gold Medal is the highest award given by COMP. It is given annually to currently active or retired individuals to recognize an outstanding career as a medical physicist who has worked mainly in Canada.

The 2007 COMP Gold Medal is a member (or retired ex-member) of the Canadian Organization of Medical Physicists (COMP) who has made a significant contribution to the field of medical physics in Canada.
A significant contribution are defined as one or more of the following:

1. *A body of work which has added to the knowledge base of medical physics in such a way as to fundamentally alter the practice of medical physics.*
2. *Leadership positions in medical physics organizations which have led to improvements in the status and public image of medical physicists in Canada.*
3. *Significant influence on the professional development of the careers of medical physicists in Canada through educational activities or mentorship.*

CNSC Feedback Forum: Action levels for Radiation Therapy Clinics

Submitted by: Jeff Sandeman
CNSC, Ottawa, Ontario

The concept of "Action Levels" was incorporated into the Radiation Protection Regulations (RPR) at their inception in 2000. Since that time, the staff of the Class II Nuclear Facilities Licensing Division has frequently been asked to provide clarification to licensees regarding the implementation and regulatory implications of action levels. In this article, we try to address some of these issues in the context of a typical Radiotherapy clinic working environment.

What are action levels?

Section 6 of the Radiation Protection Regulations defines an "Action Level" as:

"A specific dose of radiation or other parameter that, if reached, may indicate a loss of control of part of a licensee's radiation protection program and triggers a requirement for a specific action to be taken."

Are action levels mandatory?

NO. Action levels are a tool which may or may not be used by the licensee. However, if action levels are being used, then they must be specified in the application for the licence as required under section 3(f) of the General Nuclear Safety and Control Regulations (GNSCR).

Are personal dose monitoring results the only quantity used for defining action levels?

NO. Personal dose monitoring results are most commonly used because they are an obvious indicator of the effectiveness of a radiation protection program in keeping doses "As Low As Reasonably Achievable" (ALARA); but they are not the only possible measure of a program's effectiveness. Action levels can potentially be assigned to any measurable quantity having radiation safety implications, such as contamination monitoring results.

Are we violating the regulations if an action level is exceeded?

NO. Exceeding an action level does not necessarily constitute a violation of any regulatory requirement (unless the corresponding dose limit in sections 13 or 14 of the RPR has also been exceeded). It is simply an indicator that something *may* be less than optimal, and that further investigation is required to identify cause and to take corrective action if necessary.

What are we required to do if an action level is exceeded?

Section 6 of the RPR identifies three specific actions that must be taken, namely:

(a) conduct an investigation to establish the cause for reaching the action level;
(b) identify and take action to restore the effectiveness of the radiation protection program implemented in accordance with section 4; and
(c) notify the CNSC within the period specified in the licence.

If the root cause can't be identified, isn't this a violation of the regulations? How do we then identify an action which will "restore the effectiveness of the radiation protection program"? If we can't identify an action to take, isn't this also a violation of the regulations?

It is entirely possible that the licensee's investigation will find that the instance appears to be an anomaly. Take the case where the personal dose for one staff member exceeds an action level for a wearing period. If no systemic increase is observed in the doses incurred by other staff performing similar duties, and there are no apparent causes for the dose, such as changes to job duties, new operating procedures and/or technologies, increased workloads, or failure to follow established work practices, then it may be impossible to identify a root cause. In such cases, the act of reviewing work procedures and activities with the individual as part of the investigation, coupled, if possible, with increased monitoring (e.g., use of a electronic dosimeter as well as a TLD over the next wearing period), might suffice as the "…*action to restore the effectiveness of the radiation protection program.*"

Provided that the licensee can clearly demonstrate they have exercised due diligence in their investigation, are continuing to monitor the situation appropriately, and have reported this to the CNSC within the time period specified in the licence (which is usually 21 days for Class II licences), the requirements of the RPR will have been satisfied.

How do we determine appropriate action levels?

Action levels are intended to be an indicator of a possible breakdown in the effectiveness of the radiation protection program. As such, they should represent values which are clearly above the normal range of deviation expected for the parameter being measured. Conversely, they should not be so far in excess of normal operating levels that significant, systemic increases can occur without being flagged.

Radiotherapy licensees have proposed to set whole body staff dose action levels as low as 0.5 mSv/y, and as high 10 mSv/y. By comparison, the annual staff radiation doses reported by radiation therapy clinics in Canada indicate that out of approximately 4000 doses reported every year, about 2% are $\geq$ 0.5 mSv while less than 0.1% are > 5 mSv.

Given the normal statistical variation in the annual doses reported, setting an action level for radiotherapy staff at 0.5 mSv/y is likely to result in multiple instances of the action level being exceeded every year, having little or no real significance in terms of the efficacy of the radiation safety program. This potentially places an unwarranted burden upon both the licensee and the regulator with respect to investigating and reviewing doses which are already well below the general public dose limit of 1 mSv/y. Another problematic outcome of setting very low action levels is that the licensee may become complacent about periodic excursions above the action level, and may consequently fail to note systemic in-

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creases within one or more of the working groups being monitored.

On the other hand, setting an annual dose action level of 10 mSv/y at a radiotherapy clinic is likely to catch only the rarest and most unusual of incidents. Thus, significant systemic increases in dose could potentially occur long before the action level is breached. In addition, such doses are frequently due to unusual events which are identified, investigated and reported immediately pursuant to section 29 of the GNSCR, irrespective of any action level.

In either case, the action level would not serve the purpose for which it was intended.

The National Dose Registry (NDR) contains the dose records of people who are monitored for occupational exposures to ionizing radiation. The annual report of the NDR for occupational exposures in Canada is available online at: http://www.hc-sc.gc.ca/ewh-semt/pubs/occup-travail/radiation/regist/reports_radiation-rapports_radioexpositions_e.html. For new clinics, this could be used as a starting point for determining appropriate dose action levels. Existing clinics should also consider their individual dose history when establishing and reviewing action levels.

Can we have several different action levels?

YES. In fact, one of the most common mistakes in setting action levels is trying to set a single action level covering all of the activities undertaken at a particular institution. For example, a whole body dose action level suitable for staff working exclusively with teletherapy equipment is not necessarily appropriate for staff performing manual brachytherapy implants. An action level for extremity dose is probably not warranted for teletherapy, but may be appropriate to manual brachytherapy or some types of servicing activities. Consequently, different types and values of action levels may be needed for different licensed activities or groups of staff.

What is the difference between the action levels in the RPR the and the action levels in the radiation therapy quality assurance standard?

The CAPCA standard, *"Standards for Quality Control at Canadian Radiation Treatment Centres - Medical Linear Accelerators"* (www.medphys.ca/Committees/CAPCA/Linac050722.pdf) defines two quantities called the "action level" and the "tolerance level" respectively, for QA purposes. In that document, the term "action level" is used to define a level of performance which is clearly unacceptable and which definitely requires remedial action, while "tolerance level" defines an upper bound on what is considered to be optimum performance. Anything in-between is acceptable in the short term but is probably suboptimal and a range of responses from immediate corrective action to long term monitoring are possible.

The action levels defined in the RPR are specifically related to monitoring the efficacy of the radiation protection program and not equipment QA. **Conceptually they more comparable to the tolerance levels in the QA standard** than they are to the QA action levels. The annual dose limits specified under sections 13 and 14 of the RPR are more analogous to the term "action level" as it is used in the QA standard. The use of an identical term to describe these two very different quantities may be the cause some of the apparent confusion surrounding action levels.

Where can I get more in depth guidance regarding setting and using action levels?

CNSC Regulatory Guide G-228 *"Developing and Using Action Levels"* provides detailed guidance on this subject.
(www.nuclearsafety.gc.ca/pubs_catalogue/uploads/G228_e.pdf)

2008 Francophone Conference in Medical Physics

L'Association Marocaine de Physique Médicale (AMPM) with the support of the Société Française de Physique Médicale (SFPM) and the Société Belge des Physiciens d'Hôpital (SBPH), is organizing the first Francophone Conference in Medical Physics in 2008.

COMP will certainly be promoting this conference on our website and advertising it to our members. The organizing committee is looking for a Canadian medical physicist to serve on the Scientific Committee.

If this is something that you are interested in or if you would like more information, please contact nancy@medphys.ca or 613-599-1948.

Message from the COMP Chair: ...continued

(Continued from page 74)
space and does not try to compete with any traditional medical physics journal.

Canadians are authors in 20-25% of the submitted articles and the COMP Executive has agreed to co-sponsor this Journal. We are looking for volunteers with board certification, some 5-10 years of clinical experience and a publication track record to assist as Associate Editors. Please let me know if you are interested.

I wish you all a great summer. See you in Toronto in October.

Citation Award 2006

Submitted by: Michael Patterson
Juravinski Cancer Centre and McMaster University, Hamilton, Ontario

It is once again time for my annual recognition of the medical physics paper published ten years ago (1996) that has been cited most often in the following ten years. Readers interested in the origins of this quixotic pursuit are referred to my article in *Interactions* (Vol. 50, pp. 29-32) and the announcements for 2004 (Vol. 51, p. 103) and 2005 (Vol. 52, p. 92). I am still hopeful (but less than I used to be) that COMP will initiate a formal award based on similar criteria, but in the meantime, this will have to do. The rules (invented by the author) are simple and similar to those established for the Sylvia Fedoruk Award: the work must have been performed mainly at a Canadian institution, only papers in peer-reviewed journals are considered, review or "popular" articles are not eligible, and the paper must be "medical physics" – for example, articles dealing with clinical application of a mature imaging technology are not included, even if medical physicists are co-authors. The winner is determined by data in the Science Citation Index. I believe that my search strategies are thorough, but no claim of infallibility is made by the author.

This year I have a pleasure usually reserved for third-world dictators – giving an award to myself! From publication in 1996 until the end of 2006, the following paper was cited 125 times:

> A. Kienle, L. Lilge, M. S. Patterson, R. Hibst, R. Steiner and B. C. Wilson, Spatially resolved absolute diffuse reflectance measurements for noninvasive determination of the optical scattering and absorption coefficients of biological tissue, Applied Optics 35 (13): 2304-2314 (1996).

Abstract: The absorption and transport scattering coefficients of biological tissues determine the radial dependence of the diffuse reflectance that is due to a point source. A system is described for making remote measurements of spatially resolved absolute diffuse reflectance and hence noninvasive, noncontact estimates of the tissue optical properties. The system incorporated a laser source and a CCD camera. Deflection of the incident beam into the camera allowed characterization of the source for absolute reflectance measurements. It is shown that an often used solution of the diffusion equation cannot be applied for these measurements. Instead, a neural network, trained on the results of Monte Carlo simulations, was used to estimate the absorption and scattering coefficients from the reflectance data. Tests on tissue-simulating phantoms with transport scattering coefficients between 0.5 and 2.0 mm(-1) and absorption coefficients between 0.002 and 0.1 mm(-1) showed the rms errors of this technique to be 2.6% for the transport scattering coefficient and 14% for the absorption coefficients. The optical properties of bovine muscle, adipose, and liver tissue, as well as chicken muscle (breast), were also measured ex vivo at 633 and 751 nm. For muscle tissue it was found that the Monte Carlo simulation did not agree with experimental measurements of reflectance at distances less than 2 mm from the incident beam.

For the record, here are the winners from previous years:

Year of publication	Winner	Citations in 10 years	Current total
1994	R. M. Henkelman, G. J. Stanisz, J. K. Kim and M. J. Bronskill, Anisotropy of NMR properties of tissues, Magnetic Resonance in Medicine 32: 592-601.	129	166
1995	D. W. O. Rogers, B. A. Faddegon, G. X. Ding, C.-M. Ma and J. Wei, BEAM: A Monte Carlo code to simulate radiotherapy treatment units, Medical Physics 22: 503-524.	310	365

CCPM Recertification Fee

Submitted by: Wayne Beckham
CCPM Registrar

Hello from Victoria.

I was asked to put this column together because the CCPM Board are considering the introduction of a fee to cover the cost associated with Membership Recertification.

Until this year recertification has been managed by the Registrar using resources of their local department and considerable donation of time and energy. In order to ensure that the Registrar's duties are not too onerous it was felt important that components of the work could be contracted out (I certainly want to be able to coerce a successor when my term draws to a close!). Many of the tasks are clerical e.g. soliciting applications, following up on missing information and assembling multiple copies of application packages for distribution to the recertification review committee members. This year we are testing this process for recertification.

In order to ensure that the Registrar's duties are not too onerous it was felt important that components of the work could be contracted out .

Please be clear that assessment of recertification applications from members will be carried out by the Registrar and 2 other members of the Recertification Review Committee that is convened once per year for the purpose. Nothing will change in this respect.

In addition, it is proposed that clerical tasks associated with the considerable job of receiving and assembling examination applications will be done commencing with applications for the 2008 examinations.
We have assessed the cost of doing these clerical tasks via the COMP office and have determined that it will be around $4,000 per year for both recertification and examination applications. On average we recertify 45 members per year and to keep things simple the Board's proposal to the AGM in October will be to levy a $120.00 recertification fee to cover all of these costs and allow a bit extra for future increases.

We could have divided the costs between the recertification fee & the examination fees, but the latter has a smaller number of people involved and so would add significantly to exam fees, which were only recently hiked up.

Some of you may wonder why CCPM is assessing members this fee when you pay your membership fees to COMP. The reason is that in recent times it has become clear that CCPM needs to keep all direct certification (and recertification) activities and associated financial processes at arms-length from COMP. To ensure this, CCPM operates a dedicated budget that balances examination fee income against examination expenses (e.g. examiner's travel & accommodation costs, certificates, courier costs etc.). The same principle should apply to recertification.

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CCPM does make requests of the COMP/CCPM Joint Finance Committee from time to time for funding for specific activities that are not directly related to our certification process. In addition we get standing funding from the same source for Board members to attend the November Board meeting each year. For the other Board meeting held in conjunction with the COMP Annual Meeting the Joint Finance Committee commits to one night's accommodation cost for each attending Board member. In order to pilot the recertification process being run through the COMP office we were allotted $2,000 by the Joint Finance Committee on a one off basis, on the understanding that CCPM would introduce a recertification fee to its members commencing in 2008.

In order to pilot the recertification process being run through the COMP office we were allotted $2,000 by the Joint Finance Committee on a one off basis, on the understanding that CCPM would introduce a recertification fee to its members commencing in 2008.

Please feedback if you have any comments on the above, either directly to me or any other CCPM Board member.

Regards.
Wayne Beckham,
CCPM Registrar

Survey of Medical Physics Salaries Scales and Benefits across Canada

Submitted by: Sherry Connors
Cross Cancer Institute, Edmonton, AB

Prior to salary negotiations for this year, the Edmonton group contacted a number of Canadian centers to obtain current salary scales for discussion at the professional session at WesCan 2007. We were greatly aided by the Saskatchewan group, who had tabulated scales in the Western Provinces. Note this information was solicited from individual physicists, not human resource departments, and reflects the most current scales (some provinces have not settled for the current year.) If there are errors, we apologize.

Only the scales for physicists and senior physicist positions were included. Comparison of residency positions was not done because of the wide variation in hiring practices and requirements for promotion.

The survey results presented here do not include salaries for section chiefs or managers/directors.

The survey asked a number of questions regarding salary scales used by employers along with benefits, such as vacation time, professional allowances, travel expense allotments, and the certification/examinations requirements. With the exception of Ontario, the employers operate at a provincial level (i.e., pay-scales remain the same for medical physicists within that province). For Ontario, physicists are either members of a collective bargaining unit (ON), or deal directly with the host hospital/cancer centre (PHM being the largest hospital). The figure below illustrates the salary scales for each of the provinces along with the number of tiers (see caption below).

With regards to vacation time and other benefits, there were varied responses.

In British Columbia, employees start with 4 weeks/year vacation time and increase at a rate of 1 day per year, starting after the 4th year of employment, to a maximum of 35 days. Travel stipend of $3,500 and professional allowance of $1,200/year is provided. In order to move to the second tier, certification of some type is required.

In Saskatchewan, employees start with 4 weeks vacation time, increasing to 5 weeks/year after 6 years of employment, and 6 weeks/year after 17 years. Travel and professional allowance of $5,000/year is provided.

In Alberta, employees start with 4 weeks/year vacation time, and obtain 6 weeks after 15 years of employment. Professional allowance and travel stipend is $5,775/year. To achieve tier 1 and 2, physicists must pass MCCPM, FCCPM, respectively.

In Manitoba, employees start with 4 weeks/year of vacation time, increasing to 5 weeks after 5 years of employment, and 6 weeks after 10 years. Professional allowance and travel allowance of $5,000/year

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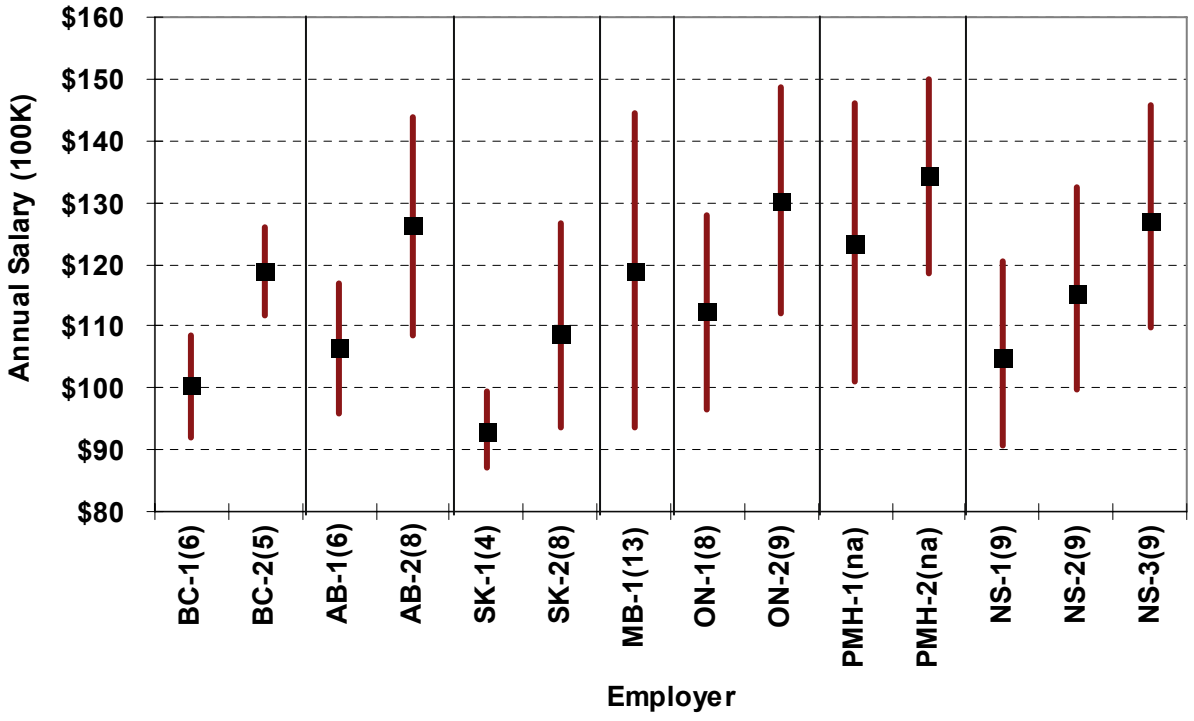

Minimum to maximum salary scales for different provinces. The average is shown as a box. Each graph label shows the province and the tier of the pay-scale. The bracket in the x-axes labels provide the number of scales in that tier. For example, BC has two tiers, one with 6 scales, and the other with 5 (na= not available).

International Standardization of Radiation Devices Used in Health Care:

Canadian Participation in the International Electrotechnical Commission

Submitted by: Pavel Dvorak Ph.D., Lee Gerig Ph.D., FCCPM
Ottawa, Ontario

THE IEC

In 1904 delegates to the International Electrical Congress, held in St. Louis, USA, recognized that "steps should be taken to secure the co-operation of the technical societies of the world, by the appointment of a representative commission to consider the question of the standardization of the nomenclature and ratings of electrical apparatus and machinery." As a result the International Electrotechnical Commission (IEC) was founded in June 1906, in London, England. The IEC is now the leading global organization that prepares and publishes international standards for all electrical, electronic and related technologies. These standards, some of which are developed jointly with the International Organization for Standardization (ISO), often serve as a basis for national standards and as references when drafting international tenders and contracts. In principle, using IEC standards for certification at the national level ensures that a certified product has been manufactured to a specific standard and removes the local need for type testing. Adherence to standards also facilitates international trade by removing technical trade barriers.

The IEC is made up of members called National Committees (NC), and each NC represents its nation's electrotechnical interests, including those of manufacturers, vendors, consumers, all levels of governmental agencies, professional societies, trade associations and standards developers from national standards bodies. National Committees are constituted in different ways. Some NCs are public sector only, some are a combination of public and private sector, and some are private sector only. About 90% of those who prepare IEC standards work in industry. The IEC, with its headquarters and administrative offices in Geneva, currently includes 65 voting members (one of which is Canada) and 69 affiliate countries.

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IEC STRUCTURE

The development of IEC standards and specifications is carried out by Technical Committees (TC) and in many cases Sub Committees (SC) to the TC. Currently there are over 90 active TCs as well as close to 20 Joint IEC-ISO Subcommittees. The role of the TCs or their SCs is to produce Safety Standards (standards that describe safety and essential performance), Technical Reports, Performance Standards and Performance Guidelines. The work of an individual SC or TC is often divided among multiple Working Groups (WG). The complete list of technical committees and subcommittees can be found at:
http://www.iec.ch/cgi-bin/procgi.pl/www/iecwww.p?wwwlang=e&wwwprog=dirlst.p&committee=ALL.
Technical Committee 62 (*Electrical equipment in medical practice*) prepares most of the safety and performance standards for equipment used in health care, although Technical Committee 87 (*Measuring equipment for electrical and electromagnetic quantities*) addresses the standards for ultrasound devices used in health care. Technical Committee 62 consists of 4 subcommittees:

SC 62A - Common aspects of electrical equipment used in medical practice,
SC 62B - Diagnostic imaging equipment,
SC 62C - Equipment for radiotherapy, nuclear medicine and radiation dosimetry
SC 62D - Electromedical equipment.

Canadian participation in IEC is coordinated by the Standards Council of Canada (SCC). There is a Canadian National Committee (CNC) for each IEC Technical Committee and Subcommittee in which Canada participates as a voting member. CNCs consist of professionals who volunteer their time and are subsidised by their employers or, partly, by the SCC. The SCC also provides administrative support for these committees. The Chairmen of CNCs are, among others, responsible for collating comments on document drafts and submitting them to the IEC Secretariat. They also vote on individual documents on behalf of the SCC.

The chairmen of individual CNCs are as follows:

CNC/IEC/TC62, CNC/IEC/SC62A, CNC/IEC/SC62D: Alfred Dolan, Professor, Institute of Biomaterials and Biomedical Engineering, University of Toronto, a.dolan@utoronto.ca

CNC/IEC/SC62B: Christian Lavoie, Chief, Medical X-ray and Mammography Division, Consumers and Clinical Radiation Protection Bureau (CCRPB), Health Canada, christian_lavoie@hc-sc.gc.ca

CNC/IEC/SC62C: Pavel Dvorak, Head (retired), X-Ray Section, CCRPB, pdvorak@magma.ca

Each of these subcommittees has several working and maintenance groups, dealing with individual types of devices. In particular, SC 62C has three working groups:

WG1 – *Equipment for Radiotherapy*
WG2 – *Equipment for Nuclear Medicine*
WG3 – *Equipment for Dosimetry*

The list of all international working groups, including the names of members, within TC62 can be found at:
http://www.iec.ch/cgi-bin/procgi.pl/www/iecwww.p?wwwlang=e&wwwprog=dirdet.p&progdb=db1&committee=TC&css_color=purple&number=62

IEC Publications

The IEC produces seven types of publication:

International Standard (IS)
Technical Specification (TS)
Technical Report (TR)

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Guide
Industry Technical Agreement (ITA)
Publicly Available Specification (PAS)
Technology Trend Assessment (TTA)

Of these, the first three are most likely to apply to the equipment used by health care professionals.

An **International Standard** (IS) is a normative document, developed according to consensus procedures. An IS is approved by the IEC National Committee members of the responsible committee as a committee draft for vote and then as a final draft International Standard which is published by the IEC Central Office. In standards terminology "normative" means prescriptive. For electrical equipment used in health care, an IS typically specifies the mandatory requirements on equipment design, performance and safety that must be met by manufacturers. The word "consensus" is important since it represents a common viewpoint of those parties concerned with its provisions, namely producers, users, consumers and general interest groups.

The word "consensus" is important since it represents a common viewpoint of those parties concerned with its provisions, namely producers, users, consumers and general interest groups.

A Technical Specification (TS) is similar to an IS in that it is normative in nature, developed according to consensus procedures and is approved by two/thirds of the Participating Members of an IEC technical committee or subcommittee. A TS is published when required support for an IS cannot be obtained, or when the subject is still under technical development, or when there is a future - but no immediate - possibility of an IS.

A Technical Report (TR) is more descriptive than normative and is intended as an informative document (e.g. collection of data). A TR is approved by simple majority of Participating Members of an IEC technical committee or subcommittee. A TR usually specifies type tests, often destructive, that can be performed on the manufacturer's premises but may be impractical in the clinical setting.
More detailed descriptions and definitions are at http://www.iec.ch/ourwork/iecpub-e.htm#ts.

Documentation Numbering and Structure - the 60000 Series

All standards beginning with "IEC" are international standards based on ISO/IEC Directives part 1 and 2 – http://www.iec.ch/tiss/directives.htm. There are many other standards which are either regional or national. Such standards may be produced by a regional or national Standards Writing Organization (SWO), or can be adopted (verbatim or with modifications) from international or other national standards. For example, the Canadian Standards Association (CSA) provides standards prepared by its own committees, but also those produced by organizations such as IEC, the Institute of Electrical and Electronic Engineers (IEEE), or in cooperation with the US Underwriter Laboratories (UL) or the Mexican Association of Standardization and Certification (ANCE). Standards published by national standards organizations use their own naming conventions. For example a European Standard begins with "EN", an Austrian standard begins with "ON", and a Canadian Standard begins with "CAN".

All IEC standards from TC 62 are related to medical equipment and all are numbered such that they begin with 60 and are hence immediately identifiable as standards relating to medical equipment. In principle, standards can be roughly divided into safety and performance standards. For medical equipment (i.e. TC 62) the system of safety standards are all based on IEC 60601-1 "General Standard for Medical Equipment" and are not independent of its structure. This system is peculiar to TC62 and does not exist in any other TC of the IEC. Strictly speaking, such a system of standards is not in line with the ISO/IEC Directives but is accepted by the Standardization Management Board (SMB) of IEC. This philosophy is described in IEC TR 60513 "Fundamental aspects of safety standards for medical electrical equipment".

The 60601 document series consists of the General, Collateral and Particular Standards which apply to all medical electrical equipment. A particular standard is a standard (requirement) that amends the general requirement for particular types of equipment.

60601-1 Medical electrical equipment - Part 1: General requirements for basic safety and essential performance is the General Standard for Medical Electrical (ME) Equipment and Systems and addresses such things as:

Conditions for application
Risk management process
Essential performance
Expected service life
General requirements for testing
Protection against electrical hazards
Identification, marking and documentation
Protection against unwanted and excessive radiation hazards, etc.

It gives requirements applicable to all ME Equipment and Systems, as well as references to Particular and Collateral Standards for more specific requirements.

There are many other standards which are either regional or national. Such standards may be produced by a regional or national Standards Writing Organization (SWO), or can be adopted (verbatim or with modifications) from international or other national standards. For example, the Canadian Standards Association (CSA) provides standards prepared by its own committees, but also those produced by organizations such as IEC ...

Below this general standard are the collateral standards which, although still general, are more specific. The Collateral Standards in the 60601 series are:

60601-1-2 Electromagnetic compatibility
60601-1-3 X-ray radiation protection
60601-1-4 Programmable electrical medical systems
60601-1-6 Usability
60601-1-8 Alarm systems
60601-1-9 Environment (under development)
60601-1-10 Closed-loop controllers (under development)

In addition to the general and collateral standards are the Particular Standards. Within the 60601 series some of these are:

60601-2-1 Particular requirements for the safety of electron accelerators in the range 1 MeV to

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50 MeV
60601-2-2 Particular requirements for the safety of high frequency surgical equipment
60601-2-3 Particular requirements for the safety of short-wave therapy equipment
60601-2-4 Particular requirements for the safety of cardiac defibrillators
60601-2-5 Particular requirements for the safety of ultrasonic physiotherapy equipment
60601-2-6 Particular requirements for the safety of microwave therapy equipment
60601-2-7 Particular requirements for the safety of high-voltage generators of diagnostic X-ray
generators

One can search for the IEC documents on http://www.iec.ch/searchpub/cur_fut.htm

As an example, entering the Header IEC, Number 60601, Part 2, one gets the complete list of Particular Requirements. Clicking on a selected item brings the Preview that contains the full name of the document, its applicability, date of issue, and the list of contents. This information is provided to general public.

Any document within the 60601 series applies to the safety and essential performance of medical electrical equipment designed for use for therapy or diagnosis in human medical practice. Other documents which describe performance standards for medical equipment will begin with 60, but are not part of the 60601 series. Examples would be performance standards for Treatment Planning Systems, Record and Verify Systems, and for Radiotherapy Co-ordinate Systems. Often the performance standards are accompanied by a technical report and they would be numbered consecutively, with the technical report indicated by a TR before the number. For example IEC 60976 "Medical electrical equipment - Medical electron accelerators - Functional performance characteristics" is the performance specification (standard) for linacs while IEC TR60977 - Medical electrical equipment - Medical electron accelerators in the range of 1 MeV to 50 MeV - Guidelines for functional performance characteristics" is a technical report with recommendations, but is not a standard.

In addition, all medical devices are regulated under the Food and Drugs Act (see http://laws.justice.gc.ca/en/f-27/240900.html), which in some aspects parallels the RED (Radiation Emitting Devices) Act and can be used to deal with medical devices not specifically covered by the RED Act and Regulations.

IEC Influence on Medical Equipment Used in Canada

There are three routes by which IEC documents affect the electrical equipment used in medical practice in Canada.

(1) Most medical electrical equipment is imported from other countries which generally follow the requirements specified by the IEC.

(2) The Canadian Standards Association (CSA), following its policy to "harmonize Canadian standards with North American and international requirements wherever it makes sense to do so," adopts many of the IEC standards and republishes them as Canadian standards, with a Canadian foreword and possibly some minor modifications. Most of these standards are published in the C22.2 series, which includes a broad spectrum of devices, from defibrillators to electron accelerators. The list is at:
http://www.csa-intl.org/onlinestore/GetCatalogDrillDown.asp?Parent=3428.
The Standards Council of Canada (SCC) must accept a standard in order for it become a national standard of Canada, and their requirements may be adopted as mandatory in provincial regulations.

(3) The Canadian Department of Health (Health Canada) regulates, under the Radiation Emitting Devices (RED) Act, all equipment emitting radiation such as dental X-ray equipment, medical radiographic/fluoroscopic equipment, CT, MRI, medical ultrasound equipment, medical lasers, etc. While the regulations reflect the Canadian radiation protection philosophy, the technical requirements specified in them are generally harmonized with international standards. Within Health Canada, the Consumer and Clinical Radiation Protection Bureau (CCRPB) is responsible for the enforcement of the RED Act and the Regulations. The full text of this Act and corresponding Regulations can be found at
http://laws.justice.gc.ca/en/showtdm/cs/R-1 or at
http://www.canlii.org/ca/sta/r-1/.
The RED Act contains no provision for the registration or certification of devices sold in Canada. CCRPB investigates reported or suspected problems, but ultimately it is the manufacturer or vendor who must take the corrective action. The manufacturer or vendor must also inform CCRPB of any regulatory noncompliance he becomes aware of. For devices not specifically addressed by RED regulations, Health Canada would use an applicable Canadian or International Standard, typically produced by CSA or IEC (but may also consult any other authoritative source if no applicable standard is available) to determine if the device meets the general safety requirements under the RED Act. Safety Codes (http://www.hc-sc.gc.ca/ewh-semt/pubs/radiation/safety-codes-securite_e.html), produced by the CCRPB and addressing the requirements for the design, installation and operation of radiation emitting devices, also reflect some IEC standards. Some provinces use these codes as a basis of their regulatory requirements.

In addition, all medical devices are regulated under the Food and Drugs Act (see http://laws.justice.gc.ca/en/f-27/240900.html), which in some aspects parallels the RED Act and can be used to deal with medical devices not specifically covered by the RED Act and Regulations. Under the Medical Devices Regulations of the Food and Drugs Act, manufacturers or importers must obtain a licence to sell their products in Canada. Medical devices are categorized using a risk based classification. For example, dental and radiographic X-ray equipment are Class 2 while mammography and therapy equipment are Class 3. To make things even more complicated, particle accelerators are included under the Nuclear Safety and Control Act, but these same electron accelerators used in cancer treatment are not specifically excluded from the RED Act and the Food And Drugs

To make things even more complicated, particle accelerators are included under the Nuclear Safety and Control Act, but these same electron accelerators used in cancer treatment are not specifically excluded from the RED Act and the Food And Drugs Act, regardless of the energy and mode of operation and therefore are governed by two different Acts.

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Act, regardless of the energy and mode of operation and therefore are governed by two different Acts.

Below are some specific examples of how the TC62 SC62A WG1 presently affects or will affect the equipment we use in radiation therapy. These include:

Examples of existing clauses

IEC 61217 is an International Standard that defines the coordinate system for all teletherapy equipment, radiotherapy simulators, information from diagnostic equipment when used for radiotherapy, record and verify equipment and for data used in the treatment planning process.

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IEC 60976 describes the functional performance characteristics for electron accelerators, specifies the tests that manufacturers must perform and data that it must provide to the customer. Its companion document IEC 60977 recommends the minimum acceptable performance for each of the criteria. This covers a huge range of characteristics including:

- Dosimetry systems (linearity, stability, dependence on gantry angle etc.)
- Geometry and motions speeds of Beam Limiting Devices (BLDs)
- Field size indicators
- Beam symmetry and flatness
- Beam stability with time
- EPID performance
- Light field brightness and accuracy
- Table movement accuracy, table sag, table load limits

IEC 60976 describes the functional performance characteristics for electron accelerators, specifies the tests that manufacturers must perform and data that it must provide to the customer. Its companion document IEC 60977 recommends the minimum acceptable performance for each of the crite-

Examples of IEC Documents/clauses under development:

Proposed new safety clauses for Stereotactic Radio Surgery
- Positioning accuracy
- Strain caused by moving parts
- Collision avoidance

Proposed new safety clauses for IMRT
- Incorrect field shape
- Incorrect Mu for part of the field
- Beam stability for small mu
- Neutron dose
- Whole body dose

Proposed new safety clauses for EPIDs
- Correct image orientation
- Correct scale factor for image
- Correct field of view
- Collision avoidance
- Artefacts

Proposed New Safety Clauses for IGRT
- Registration of images
- Accuracy of patient support movement
- Movement of MLC in response to imaging
- Movement of gantry in response to imaging

Summary

The IEC is an active international organization which is continually developing standards for new and emerging technologies (medical devices) or updating existing standards consistent with new applications or requirements for older technologies. The work of the IEC has a direct effect on the equipment that medical physicists use and are responsible for. The standards set by the IEC are the standards that manufacturers must meet or exceed. The tests and performance criteria developed by the IEC form the core of the acceptance tests we perform on new equipment and to a large degree define the quality assurance standards we apply to our equipment for daily, weekly, and annual QA. In addition, the standards set by the IEC address the protection of staff and patients from many hazards not normally tested by the end user (e.g. leakage currents, conductor insulation, and structural integrity). The work of the IEC affects our work and our patients. The Canadian medical physics community should maintain an awareness of the IEC activities, and when required ensure that their views are heard.

Advanced MR Image Reconstruction Using Non-Fourier Methods*

Authors:
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*This work is based partially on a presentation given at the 2006 Scientific Meeting of the International Society for Magnetic Resonance in Medicine and the 2006 Annual Meeting of the Canadian Organization of Medical Physicists.

Introduction

Magnetic resonance (MR) imaging is a non-invasive tomographic imaging modality that produces images of the internal physical characteristics of an object by using externally measured nuclear magnetic resonance (NMR) signals. In essence, MR imaging differs from NMR by employing two key concepts: (a) Using magnetic field gradients, the raw MR data are spatially encoded, acquired and stored into a matrix known as k-space. (b) The measured k-space data are reconstructed by using the appropriate image reconstruction algorithm to form MR images. In conventional MR imaging applications that completely and uniformly sample k-space using a Cartesian grid, images can be directly reconstructed by taking the inverse Fourier transform (iFT).[1]

Conventional 3D MR imaging, unfortunately, is a time-consuming procedure if k-space is completely and uniformly sampled. The total scan time T_0 for acquisition of a 3D k-space is $N_{\text{ave}}N_{\text{y}}N_{\text{z}}TR$, where N_{ave} and TR are the number of signal averages and pulse sequence repetition time, respectively. By convention, frequency encoding is used to spatially encode data in the kx-direction and phase encoding encodes the $k_{\text{y}}-k_{\text{z}}$ plane. $N_{\text{y}}N_{\text{z}}$ is the total number of phase-encoding permutations required for complete and uniform Cartesian sampling of $k_{\text{y}}-k_{\text{z}}$. For many rapid and/or real-time 3D MR imaging applications T_0 is usually too long. Reducing the total acquisition time is the focus of intense research activity within the MR community.[2-6]

Recent developments in MR fast imaging techniques have focused on strategies to rapidly acquire data in order to reduce the total scan time T_0. Specifically, we have investigated real-time imaging for interactive continuously moving table large field-of-view contrast-enhanced MR angiography (iCMT LFOV CE MRA).[6] Many of these 3D MR imaging applications would benefit from techniques that acquire, reconstruct and display images rapidly, or in real time. Fully understanding the interaction and possible synergies between different acquisition and reconstruction techniques is a major thrust of our activities.

One important method to reduce T_0 is by reducing the number of phase encodings ($N_{\text{y}}N_{\text{z}}$), so that only a portion of k-space is acquired. This methodology results in the formation of incomplete, or partially sampled, 3D k-space data. Image reconstruction from incomplete k-space data is naturally more involved than simply applying the iFT. The simplest approach first zeroes the missing data (i.e., zero filling [7]) before applying the iFT. This approach generally produces images of unacceptably poor quality and/or resolution and image artifacts. More sophisticated image reconstruction methods have been proposed and used, which include homodyne,[8] maximum entropy,[9] autoregressive moving average (ARMA),[10] generalized series (GS) [11] and projection onto convex sets (POCS) [12] reconstructions.

Here, we compare image reconstruction by the phase-constrained transient error (PC-TERA) reconstruction approach [13] to the previously examined 3D POCS approach.[14] Both methods reconstruct the sparsely sampled k-space data matrix commonly acquired in iCMT LFOV CE MRA [6]. In both methods the central zone of the phase-encoding $k_{\text{y}}-k_{\text{z}}$ plane is completely sampled whereas its periphery is sparsely sampled (Figure 1). The relative size of central zone α is defined as $\alpha = \dfrac{N_{c,y}N_{c,z}}{N_yN_z}$, where $N_{c,y}N_{c,z}$ is the number of phase encodings in the fully sampled central region. The peripheral region is only partially sampled and the sparse sampling ratio is $\beta = \dfrac{N_{\text{acquired}}}{N_yN_z - N_{c,y}N_{c,z}}$, where N_{acquired} is the number of phase encodings in the peripheral region. Relative scan time τ is defined as $\tau = \dfrac{T_{\text{acq}}}{T_0}$.

Two essential components required to achieve rapid or real-time 3D MR imaging are the concurrent development of (a) rapid data acquisition strategies and (b) fast, minimum-latency image reconstruction algorithms. We investigated the individual performance of POCS and PC-TERA to reconstruct images from sparsely sampled k-space by examining (a) both the qualitative and quantitative aspects of the reconstructed images, (b) the computational speed, and (c) the ease of implementation for each reconstruction algorithm.

Methods and Materials

POCS Algorithm

We will employ a 2D MR imaging example to illustrate the basic concepts in the POCS and TERA approaches. Given a 2D image consisting of pixels, a unique image could be obtained by Fourier transform if the $N \times N$ corresponding $N \times N$ k-space data is fully sampled. If the k-space data is not fully sampled, however, then the solution in image space is not unique, *i.e.*, a number of possible image solutions exist.

A Hilbert space, ***H***, is defined as a set that contains all possible solutions for a given problem. Each constraint imposed on the reconstruction problem is a set of solutions, ***W***, in the Hilbert space that

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contains all solutions that fulfill the constraint. The set $\boldsymbol{W}$ is convex, if and only if, for any two solutions x_1, $x_2 \in \boldsymbol{W}$, a linear combination $x = \lambda x_1 + (1-\lambda)x_2$ with $0 < \lambda < 1$ also belongs to $\boldsymbol{W}$. By the Gerchberg-Saxton algorithm, [15] if there are m convex sets in $\boldsymbol{H}$, $\boldsymbol{W_i}$ $(i = 1 \cdots m)$, relating to *m* constraints, and if $\boldsymbol{W}_0$ is defined as the intersection of these convex sets, $\boldsymbol{W}_0 = \bigcap_{i=1}^{m} \boldsymbol{W_i}$, then after a finite number of iterations, any initial solution $\boldsymbol{U_0}$ will converge to a final solution, $\boldsymbol{U_n}$, located inside $\boldsymbol{W}_0$ which satisfies all constraints simultaneously.

In the specific application of using the 3D POCS algorithm to the reconstruction of iCMT LFOV CE-MRA images from sparsely sampled 3D k-space, we introduce two constraints. First, a phase constraint, whereby the phase of the image is forced to match the phase map derived from the central full sampled k-space zone. Second, a data consistency constraint, whereby the k-space data points in the peripheral zone are forced to match the originally measured data points. It can be shown that both constraints result in convex sets.[11] Therefore, the final image Un that simultaneously satisfies the two constraints can be found.

PC-TERA algorithm

The conventional TERA algorithm [10] belongs to the class of parametric modeling methods that models the infinite-length k-space data based on a finite-length set of measured data. This modeling is accomplished by implicitly extrapolating the finite data. TERA treats the measured data as a subset of the transient response of an infinite impulse response filter excited by the Kronecker delta excitation.[10] For reconstruction of our sparsely sampled MR data, we proposed a PC-TERA algorithm that exploits the significant amount of important phase information contained in the acquired data. The rationale behind this algorithm is similar to POCS in that the quality of the reconstructed image depends much on estimating the true image phase map. Because the k-space data is under-sampled, we face what seems like an unsolvable problem. However, based on the underlying assumption that the true phase map contains mainly low spatial frequency components, an estimated phase map that is a good representation of the true phase map can be obtained from the central k-space zone. To provide for this initial constraint, the Fourier transform (FT) of the phase map was used as the TERA excitation sequence, instead of the Kronecker delta function.

*Fully sampled and sparsely sampled **k**-space data acquisitions*

Complete raw k-space datasets were acquired using a clinical 3.0 T scanner (Signa; General Electric Healthcare, Waukesha, WI). A standard, vendor-supplied, quality assurance (QA) phantom was used as this object contains a representative mix of low and high frequency structures. Simulated sparsely sampled k-spaces were generated from the fully sampled data using commercial software (MATLAB, version 6.5.0, R13; Mathworks, Natick, MA). Simulations were performed on a general-purpose workstation (PowerMac: dual 2.5GHz, PowerPC G5, 3.5 Gb RAM running Mac OS X 10.3.4; Apple Computer, Cupertino, CA).

In iCMT LFOV CE MRA, we are primarily interested in investigating acquisitions where τ = 0.2 as this achieves good spatial coverage and resolution in acceptable acquisition times. [6] Four different combinations of α and β values, (α, β) = {(0.4%, 19.7%), (4.8%, 16.0%), (15.9%, 4.9%), (20.0%, 0.0%)}, were chosen such that $\alpha+\beta(1-\alpha)$ = 0.2 and evaluated. In order to assess the sensitivity and robustness of the reconstruction techniques, 100 sparsely sampled k-space datasets were randomly generated and reconstructed for each combination of α and β. Images were reconstructed from the

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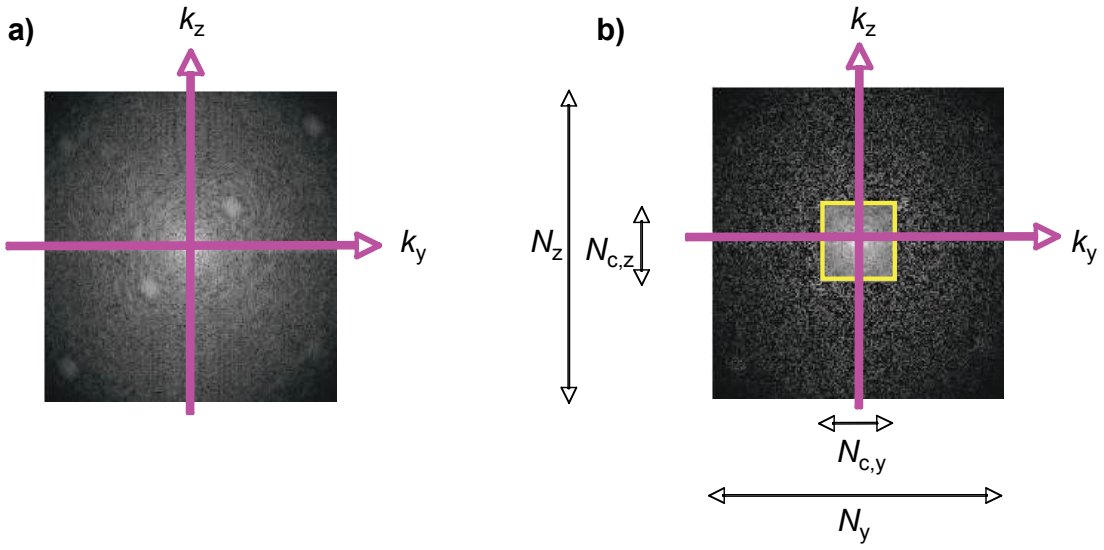

Figure 1: Schematic diagram illustrating coverage of 3D **k**-space data in the 2D phase-encoding $k_y - k_z$ plane. Shown are representations of (a) complete and (b) sparsely sampled 3D **k**-space matrix. The central area ($N_{c,y} \times N_{c,z}$) inside the square region represents the completely sampled central zone of **k**-space used to generate the low-frequency phase map of the image when using POCS or PC-TERA algorithms. For clarity, the third axis, k_x, is omitted.

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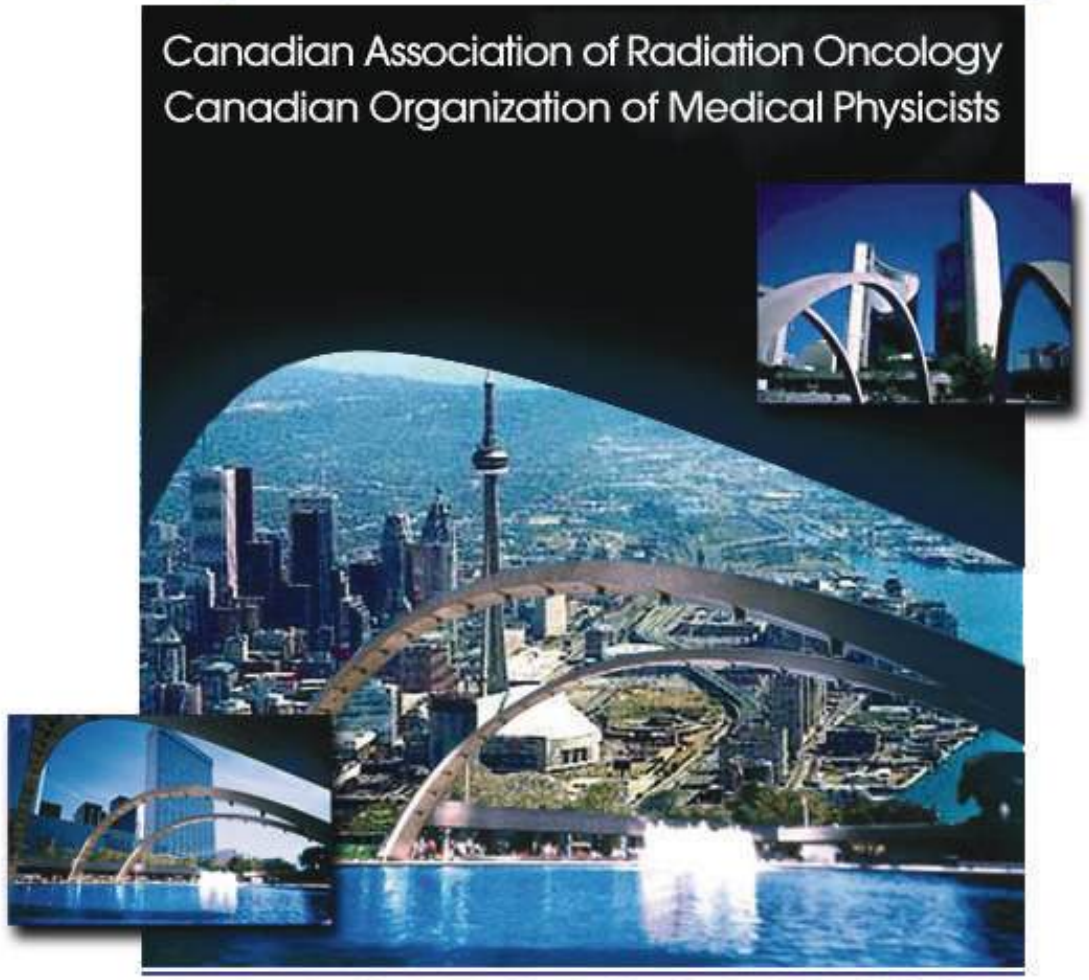
Image Guided and Adaptive Radiation Therapy



Come to Toronto in 2007 for an integrated Canadian Organization of Medical Physicists / Canadian Association of Radiation Oncology meeting!

The theme is "Image Guided and Adaptive Radiation Therapy" with guest lecturers Dr. David Jaffray, Head, Department of Physics, Princess Margaret Hospital, as the CARO Lecturer and Dr. Glenn Bauman, Chair of Oncology, University of Western Ontario, and Director of Research, London Regional Cancer Program, as the Gordon Richards Lecturer. The Canadian College of Physicists in Medicine will organize a symposium of expert speakers on the theme of the meeting and COMP will present a lifetime achievement award at its Gold Medal session. COMP will also sponsor a presentation by a lecturer from the Canadian Association of Physicists.

To enhance interprofessional learning opportunities, we have planned daily joint sessions between Medical Physics and Radiation Oncology, as well as break out sessions for topics unique to each group.

For CARO, plan to attend the CARO Lecture, the Gordon Richards Lecture, participate in the workshops, the theme symposia, the People's Choice and the Resident/Graduate student session for each discipline. The CARO Pre-conference Symposia will be led by Dr. Cynthia Menard (PMH) and will relate to MRI .

For COMP, plan to attend the Gold Medal Session, the YIS Symposium, the CCPM symposium and the CAP Public Lecture, presented by Radiation Oncologist and Associate Professor, Dr. J-P Pignol from the Toronto-Sunnybrook Regional Cancer Centre.

Toronto is always an exciting city to visit with many attractions, shopping, and fine dining.

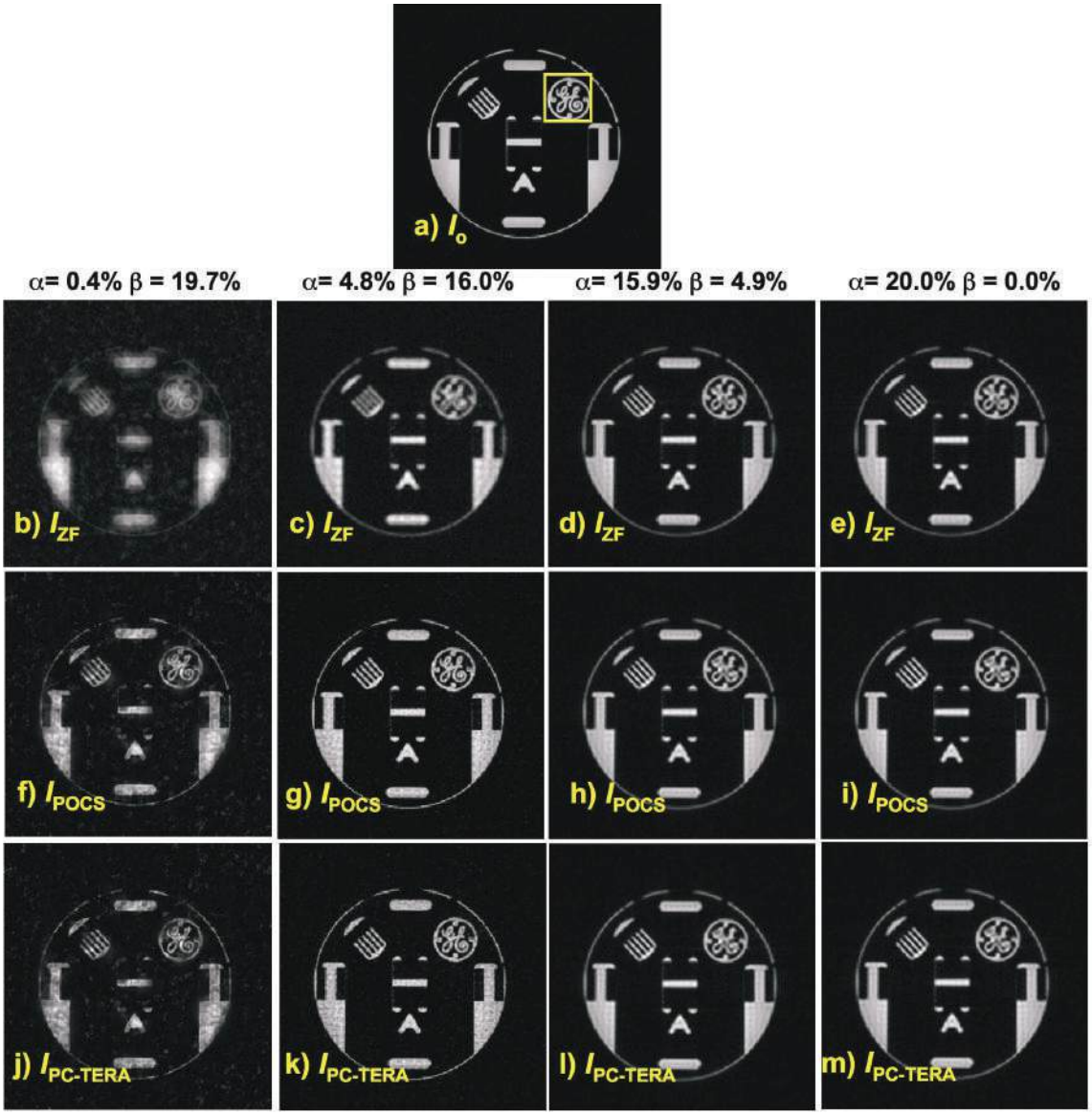


Figure 2: (a) I_0 Image reconstruction from fully sampled **k**-space; (b-e): ZF image reconstruction from a number of α and β pairs when τ = 0.2; (f-i): POCS reconstructed images; (j-m): PC-TERA reconstructed images. Images are reconstructed from a number of different (α, β)-sampling scenarios. Yellow region in (a) was used for local performance error calculation (see text for description and Figure 3 for results). Images are displayed with the same window and level settings.

(Continued from page 88)

completely sampled k-space data (resulting in the true image I_0) and from the randomly generated sparsely sampled k-spaces using ZF (I_{ZF}), POCS (I_{POCS}) and PC-TERA ($I_{PC\text{-}TERA}$). The stopping criterion for the POCS method was $\left|(I_{POCSn} - I_{POCSn-1})/I_{POCSn}\right| \le 0.01$, where $I_{POCS\,n-1}$ and $I_{POCS\,n}$ were the [n – 1]th- and nth-iteration of the POCS reconstruction, respectively.[14] For PC-TERA, autoregressive (AR) and moving average (MA) orders, *p* and *q*, were selected as *N*/3 and *N*, respectively.[10]

The quality of the resulting images was first assessed by visual inspection and then quantified by the calculation of local performance errors, $LPE = \sqrt{\sum(\zeta_i - o_i)^2} \Big/ \sqrt{\sum o_i^2}$, where ζ_i and o_i denote pixel intensities in a defined region of a reconstructed ZF, POCS or PC-TERA image. The defined region was selected to include high-frequency structures in the images (see Figure 2a). Normalized (to the time required for ZF reconstruction) computational times were also measured.

Results

Both POCS (Figure 2f-2i) and PC-TERA (Figure 2j-2m) images demonstrated improved visualization of high-frequency structures compared to the ZF reconstructed data (Figure 2b-2e). ZF image quality improved as α approached 20% (and thus β approached 0%) for τ = 0.2. By visual inspection, the best POCS and PC-TERA images were observed when α was 4.8%. Other than the presence of image blurring, no systematic image artifacts were found in the reconstructed ZF, POCS and PC-TERA images except when β = 20% (i.e., α = 0%, such that no central region was acquired).

Figure 3 plots the LPE measurements in a region containing high-frequency structures. As β increased from 0% to 20% and less of the central zone was acquired, the LPE for ZF images increased monotonically. In contrast, the LPE for both the POCS and PC-TERA reconstructed images decreased towards a broad minimum before increasing as β approached 20%. At the minimum, the PC-TERA LPE was less than the POCS LPE. At α =

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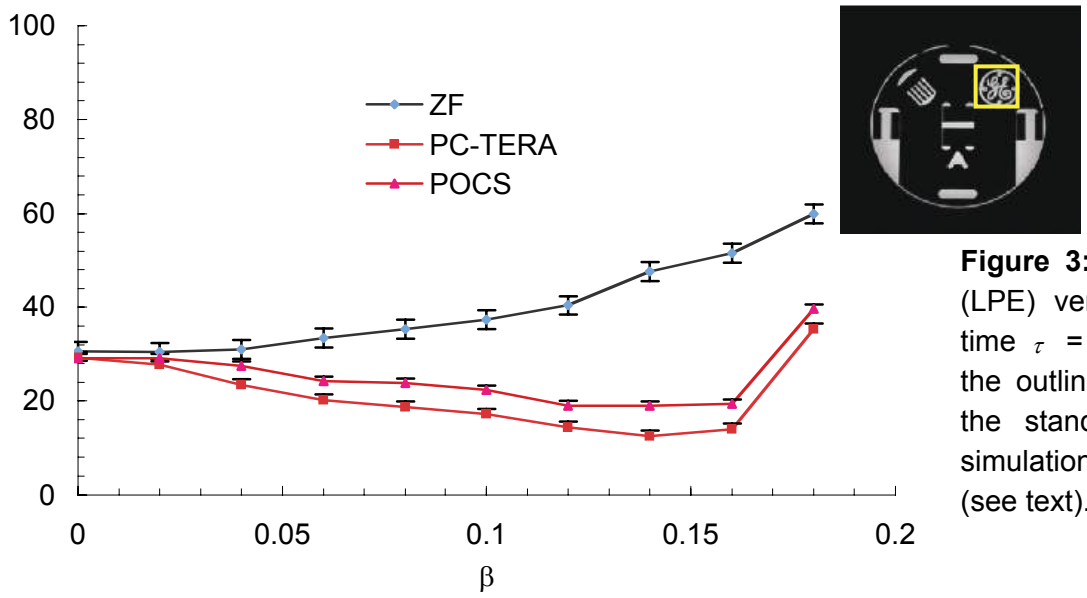

Figure 3: Local performance error (LPE) versus β for relative scan time τ = 0.2. LPE is defined over the outlined region. Error bars are the standard deviation over 100 simulations. Lower LPE is better (see text).

(Continued from page 92)

4.8% and β = 16.0%, LPE_{ZF} was 51.6%, LPE_{POCS} was 19.4% and $LPE_{PC\text{-}TERA}$ was 14.0%.

Computation times required for image reconstruction varied greatly between the algorithms (Figure 4). POCS image reconstruction times were always higher than when using ZF, increasing approximately linearly between β = 0% and ~15% before reaching a plateau. Computation times were nearly constant for PC-TERA but were much larger compared to POCS and to ZF. For α = 4.8% and β = 16.0%, the computation times for POCS and PC-TERA were 109 and 309 times longer relative to ZF, respectively.

Conclusions

Both the POCS and PC-TERA algorithms reconstruct high quality images (Figure 2), and, compared to ZF, can greatly improve the depiction of high-frequency containing structures, such as small blood vessels. POCS and PC-TERA demonstrate similar LPE measures (Figure 3), with PC-TERA producing somewhat lower errors. Our findings indicate similar qualitative and quantitative reconstruction quality for the POCS and PC-TERA algorithms, with both being much superior to simple ZF. The ability of the POCS algorithm to reconstruct images depends on the availability of true phase maps, which is usually approximated by the low-frequency phase map derived from the fully sampled central zone of k-space. Our findings suggest that inclusion of some information about the peripheral zone of k-space (at the expense of reducing the central zone) improves image quality. Likewise, PC-TERA extrapolates

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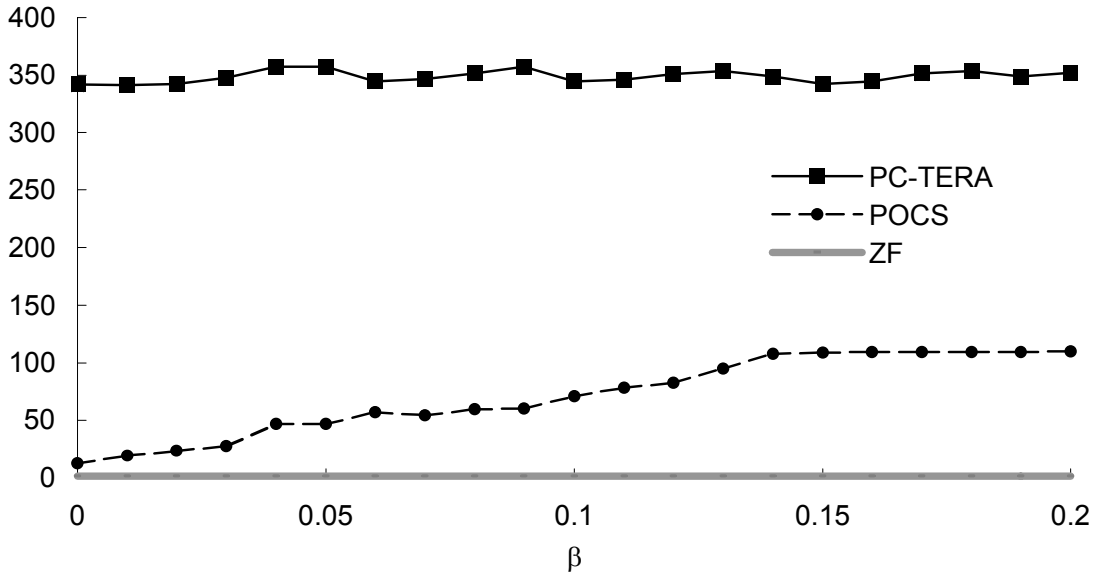

Figure 4: Normalized computation times for PC-TERA and POCS algorithms versus β for relative scan time τ = 0.2. The normalization is relative to the computational time of ZF algorithm, which replaces missing data samples with zeroes and then uses a Fourier transform based reconstruction approach. Error bars (standard deviation) are smaller than the symbols.

(Continued from page 93)
missing high-frequency data from the fully sampled central region, but also benefits from some peripheral zone data. In these experiments the total acquisition time was fixed. In this case and as $\beta \to \tau$, the fully sampled central zone decreases leading to a poor estimate of the true phase map (in the case of POCS) and less accurate extrapolations (in the case of PC-TERA). While these experiments examine a specific test phantom, other work (not shown) suggests that the principle findings are generalizable across a variety of anatomical sites.

Our results also confirm that for a given relative scan time, τ, it is possible to find an optimal specific sparse sampling strategy (i.e., α optimal, β optimal) for both POCS and PC-TERA. Near optimal conditions, the corresponding POCS and PC-TERA images (Figure 2) demonstrated better high-resolution image quality compared to other, less optimal, sampling strategies. We propose that this illustrates one potential advantage for POCS and PC-TERA, making it desirable to acquire some high-frequency data ($\beta > 0$), as opposed to spending time only collecting an enlarged central region ($\alpha < \tau$). Interestingly, and upon reflection perhaps not surprisingly, POCS and PC-TERA images share approximately the same optimal sampling (α optimal, β optimal) strategy (Figure 3). These results provide a preliminary affirmative answer to the important question — Should data collection strategies reflect image reconstruction algorithms?

As expected for the iterative POCS method, as $\beta \to \tau$, the computation time increased to a plateau compared to the constant time required for ZF. At the (α,β) values yielding the lowest LPE, the POCS algorithm took ~100 times longer than the ZF algorithm. Conversely, PC-TERA is a non-iterative approach and had a constant computational time across all (α,β) values, though it took considerably longer (>300 times) than ZF approaches. Both of these times represent a challenge if acquisition and image display are to occur in real time. Such is the case in our application, iCMT LFOV CE MRA where the leading edge of a bolus of MR contrast agent is imaged as it passes through the legs.[6]

Due to their intrinsic complexities compared to conventional Fourier transform and ZF reconstruction, POCS and PC-TERA algorithms are not typically implemented on commercial clinical MR scanners. Both are interesting approaches: POCS is an iterative algorithm that requires identification of stopping criteria and PC-TERA is a non-iterative algorithm that requires careful *a priori* selection of modeling parameters. Nevertheless, rapid progress on understanding these algorithms, particularly the advantages of using peripheral zone **k**-space data as additional constraints, coupled with advances in computer hardware and computational algorithms, may allow these complex algorithms to be put onto clinical MR scanners in order to facilitate real time 3D imaging.

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Request for Proposal:
COMP Annual Scientific Meeting
Local Arrangements Committee

The Canadian Organization of Medical Physicists (COMP) is seeking proposals from groups interested in serving as the Local Arrangements Committee (LAC) for the COMP Annual Scientific Meeting (ASM) for 2009.

BACKGROUND

COMP is the main professional body for medical physicists practicing in Canada.
The membership meets formally once a year, usually in mid-June. Proffered papers on various topics of current research and clinical interest are presented. This is an opportunity for the members to network and keep abreast of colleague's activities. It is also a venue to formally discuss issues of concern to the membership. COMP attempts to ensure that the ASM's are geographically dispersed as much as possible. We also attempt to hold stand-alone meetings at least every second year. The following locations have been confirmed for future ASM's:

2007 – Toronto (joint with CARO)
2008 – Quebec City
2010 – Ottawa
2011- Vancouver (joint with AAPM)

SCOPE OF REQUIRED SERVICES

The LAC is required to do the following:

- Work with the Executive Director to select appropriate meeting space for the ASM and accommodations for the delegates
- Work with the Conference Committee to develop the theme for the ASM and program schedule
- Coordinate all aspects of the public lecture
- Develop a detailed budget for the ASM and manage all related financial transactions
- Plan and execute all social/networking activities
- Coordinate onsite registration
- Coordinate audio visual requirements
- Coordinate the printing of the ASM proceedings
- Following the ASM, present a final report to the Conference Committee which reconciles all financial transactions, outlines what worked well and makes suggestions for improvements. This report will serve as a resource to future LAC's.

INFORMATION REQUIRED

Proposals shall be in a word file of no more than three pages and forwarded by e-mail to nancy@medphys.ca.
Proposals should include the following:

- Information about the organization and capabilities of the prospective LAC
- Information about the medical physics community in the proposing city
- Information about prospective venues for the meeting
- A preliminary budget
- Information on similar events hosted

COMP reserves the right to:

- accept a proposal without negotiation
- negotiate changes to the successful proposal
- cancel or reissue this RFP at any time

The COMP contact for the purposes of response to this request for proposal is:

Nancy Barrett
Executive Director
nancy@medphys.ca

Results of a Canadian IMRT Practice Survey for 2006

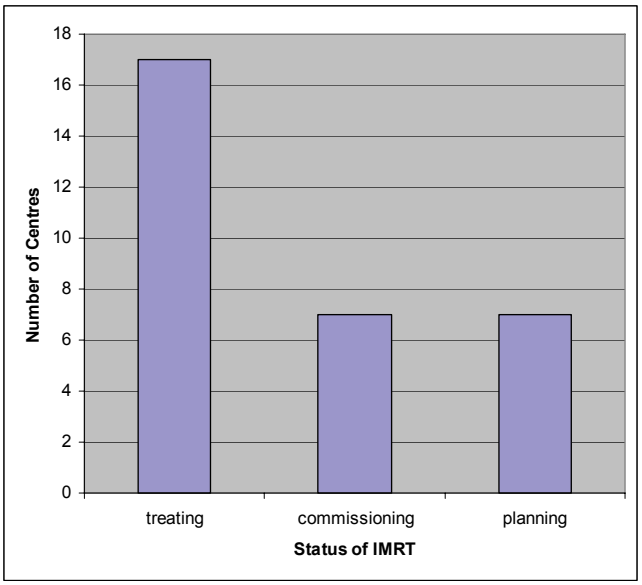
Submitted by: Boyd McCurdy
Cancercare Manitoba
Winnipeg, MB

In January of 2007, an informal survey was distributed to cancer treatment facilities across Canada. This was similar to a Canadian IMRT survey performed in January of 2006. The survey again asked questions pertaining to the use, implementation, and quality assurance of intensity modulated radiation therapy (IMRT). The survey was modified (and hopefully improved somewhat) from the 2006 version. Similar to last year, the response rate was excellent (31 out of 36 Canadian centres responded). I would like to thank all those who participated in this survey. No Medical Physicists are short of work these days, and this survey involved some additional effort on your part. So again, thank you! Feedback from last years survey was very positive, and I hope that most of the COMP members will also find this year's updated results useful.

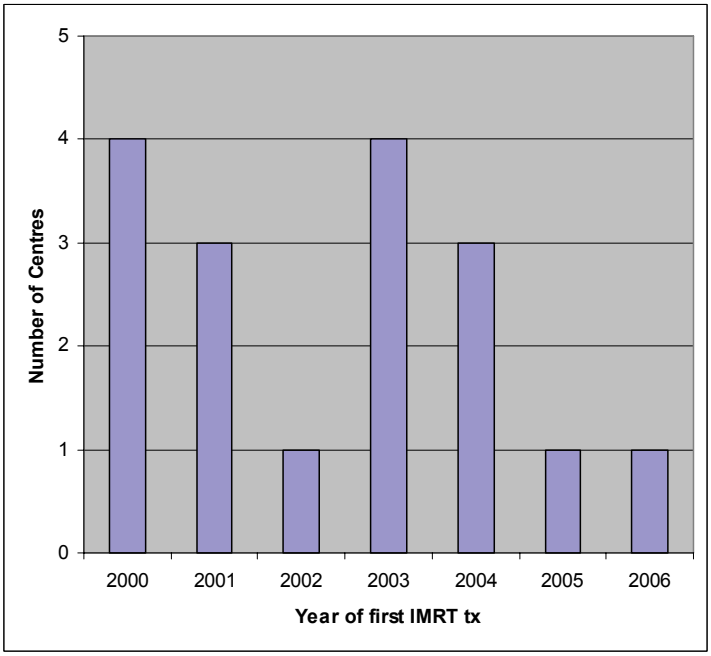
NOTES: **(1)** Helical, dynamically delivered IMRT treatments (ie. those delivered by Tomotherapy units) are now included in questions one and two. **(2)** Several vendor names appear in the responses to some of the survey questions. Their appearance in the reported survey results do not indicate an endorsement by this author, the newsletter, or COMP/CCPM in any way. **(3)** Questions two through six only include responses from those centres clinically delivering IMRT.

Question 1 - Current status of IMRT in your clinic

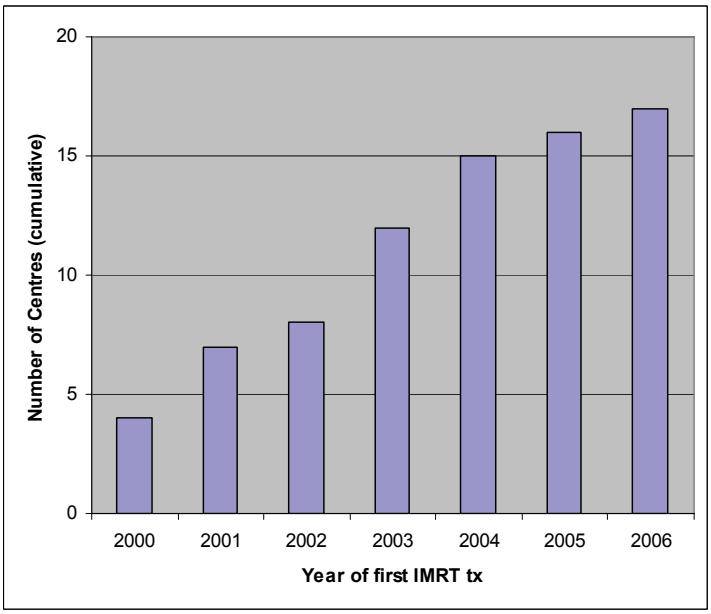
Question 1(a) - Is your centre treating patients, commissioning, or planning on commissioning IMRT?



Questions 1(b) - If you began IMRT treatments after January 2006, what was the approximate date of your first IMRT treatment on a clinical patient? [Note: Data presented below also includes all centers responding last year who began prior to January 2006]



And the same data in cumulative form:



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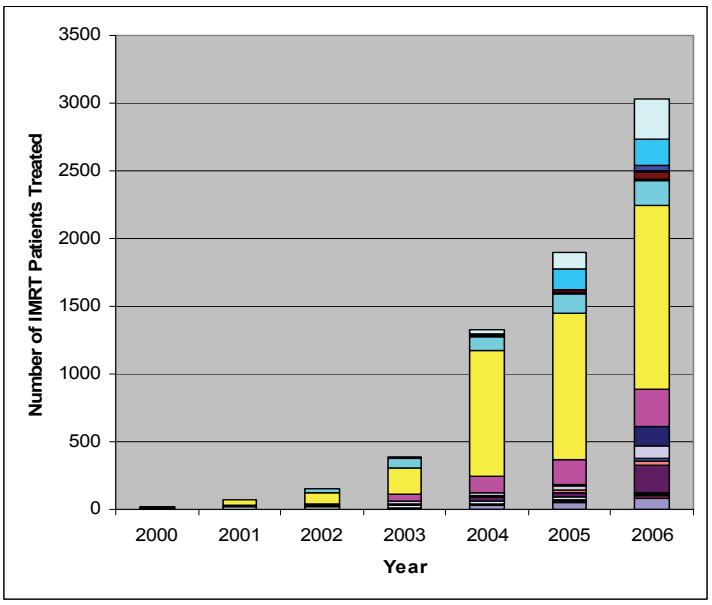
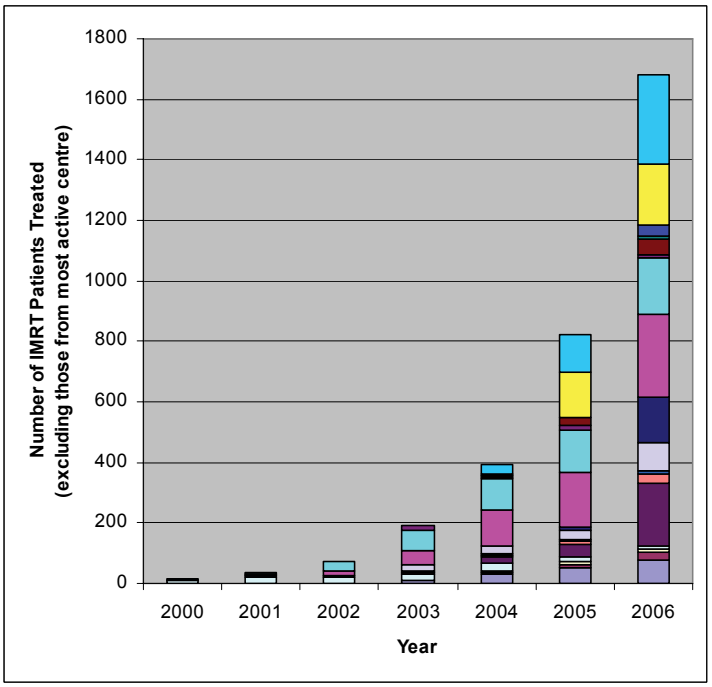
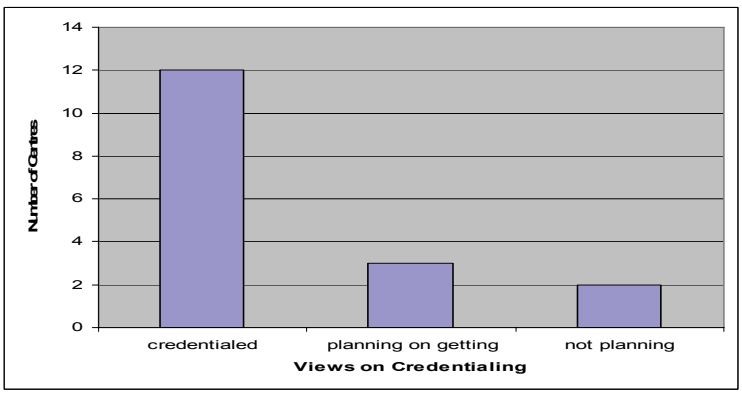
Question 1(c) - How many IMRT patients did your clinic treat in 2006?



And the same data excluding one centre treating a very large number of IMRT patients:



Question 1(d) - Are you credentialed by the RPC (or in progress, or planning on getting credentialed)?



Summary of results from Question 1 – Current status of IMRT:

By the end of 2006, seventeen out of thirty-one responding centres (55% of responding centres or 47% of all possible centres) had clinically implemented an IMRT program. An additional seven centres are in the commissioning phase, while another seven centres are planning to begin commissioning work on IMRT. This compares to approximately 87% of clinics in the USA offering IMRT as of 2004 [AAPM "Profile of Radiation Oncology Departments – Calendar Year 2004", www.aapm.org/pubs]. It should be noted that most of the USA clinics responding in the 2004 AAPM survey were relatively small by Canadian standards (80% in the 1-3 linac range), and therefore this may not be an entirely fair comparison. However, the impression is that Canadian cancer centres have adopted IMRT technology somewhat more cautiously than their USA counterparts.

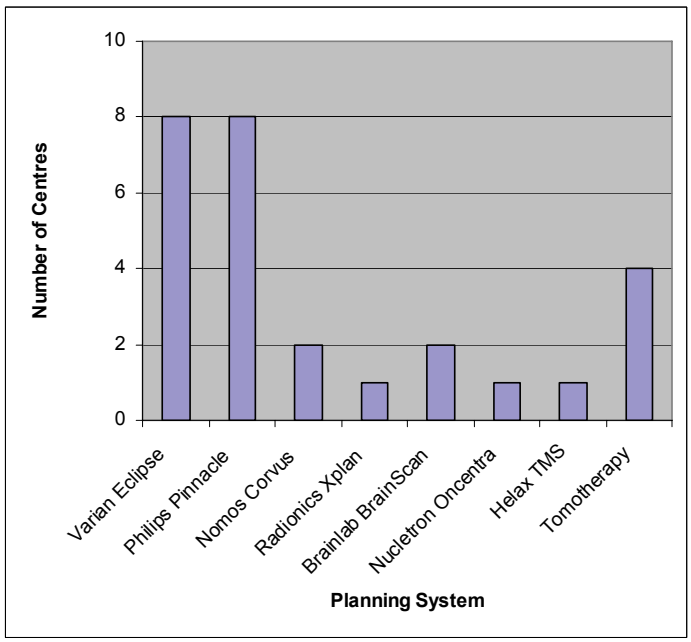
The cumulative distribution of the first year of clinical implementation of IMRT reveals that Canadian implementation has slowed between 2004 and 2006 (only 1 centre per year bringing IMRT to the clinic) compared to earlier years. However, many centres that responded to the survey as being in the 'commissioning' phase will likely be successful this year or early next year. Implementation of IMRT could reach levels as high as 70% of the number of cancer centres within a year.

The total number of patients treated with IMRT in Canada in 2006 exceeded 3000. Even excluding the largest centre, over 1600 patients received IMRT treatment. High growth is still observed and expected to continue over the next several years as more centres begin to offer IMRT, and those centres that already offer IMRT become more comfortable with the technique. Also, as published clinical evidence of patient benefit mounts for IMRT for multiple treatment sites, clinicians will demand more access to IMRT for their patients.

The majority of centres (12) offering IMRT are credentialed by the Radiological Physics Center (RPC), while 3 others are planning on obtaining RPC credentialing.

Question 2 - Software/hardware involved

Question 2(a) - What Treatment Planning Software manufacturer (s) and version(s) do you use for IMRT planning?



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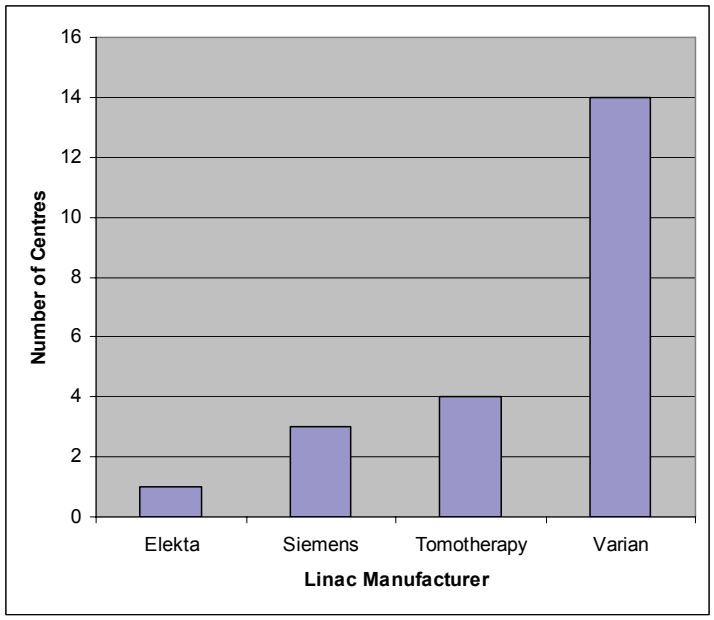
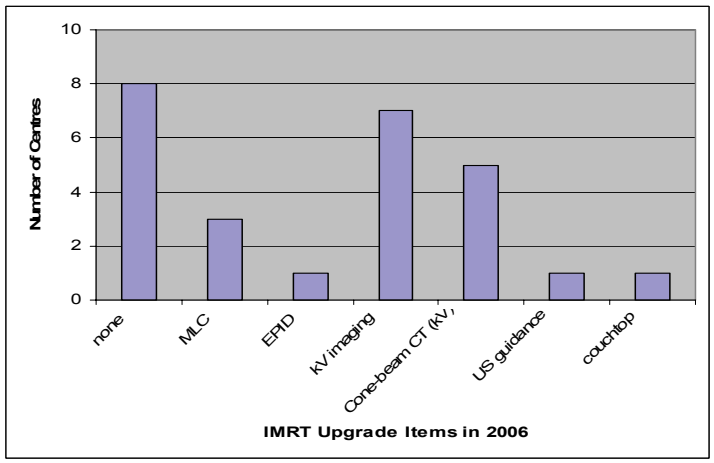
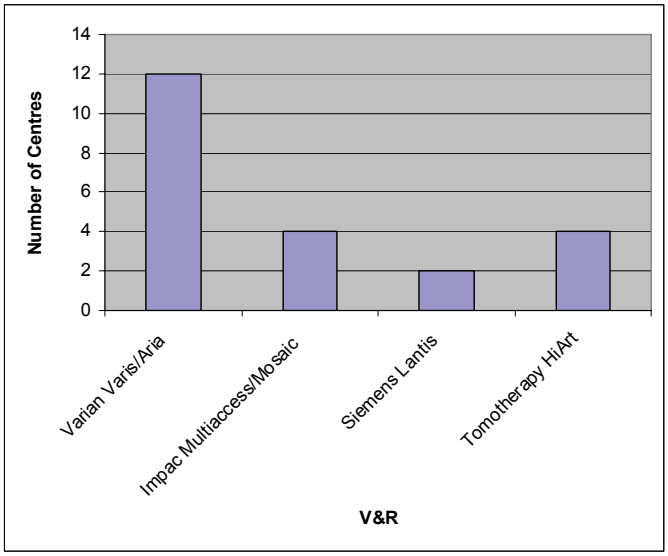
Question 2(b) - What linear accelerator manufacturer(s) and version (s) do you treat IMRT patients on?



Question 2(c) - In 2006, what linear accelerator upgrades/options have you purchased *specifically* for IMRT delivery (ie. higher resolution MLC, kV imaging option, etc.), if any?



Question 2(d) - What Verify & Record software package and version do you use for clinical IMRT delivery?

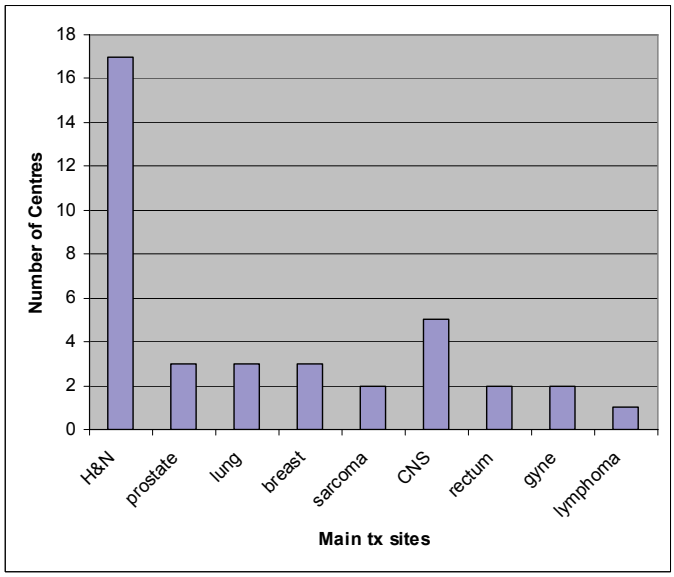


Summary of results from Question 2 – Software/hardware involved:

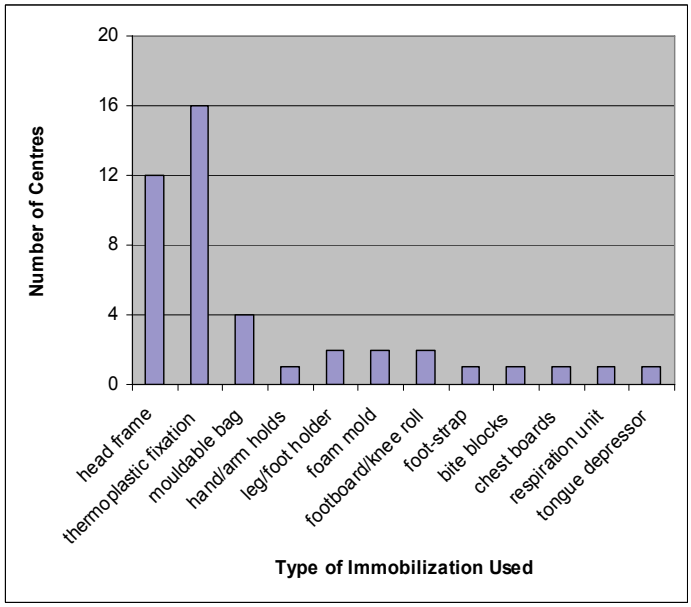
A variety of treatment planning software is being used to plan IMRT treatments, with some centres actively using multiple software packages. IMRT delivery occurs primarily with Varian linacs, although Tomotherapy, Siemens, and Elekta are also utilized. Equipment upgrades specifically for IMRT in 2006 were dominated by kV imaging and cone-beam CT. Several centres also upgraded MLC's. Verify and Record software used was primarily supplied by Varian (Varis/Aria), although Impac, Lantis, and HiArt were also used.

Question 3 - Current IMRT application

Question 3(a) - What are the main patient treatment sites to which IMRT is applied at your centre (ie. head & neck, prostate, lung, breast, sarcoma, central nervous system)?



Question 3(b) - What methods of immobilization do you use for IMRT patients? -- this may vary between treatment sites (head & neck, prostate, lung, breast, sarcoma, central nervous system).



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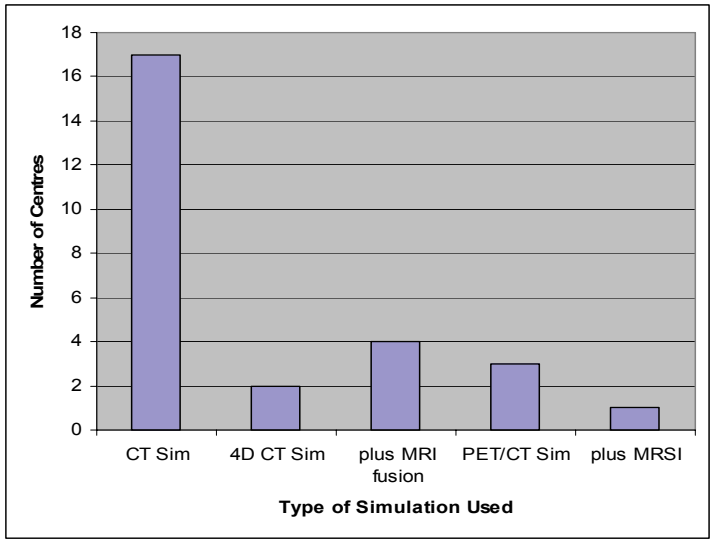
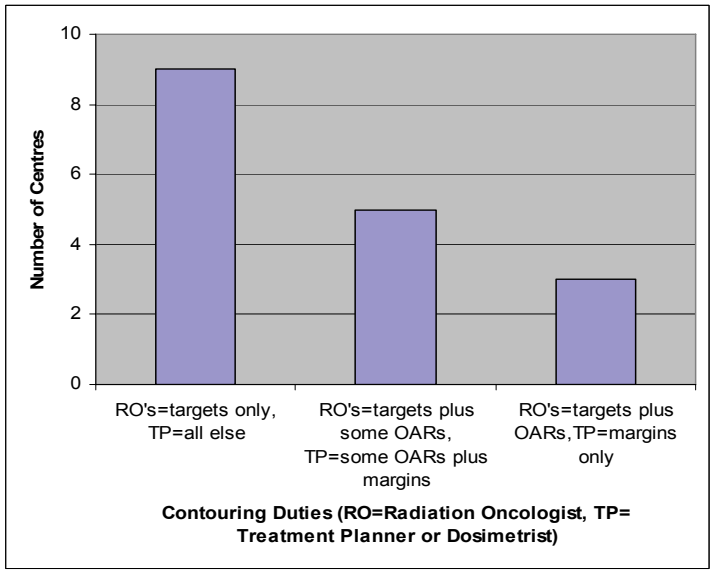
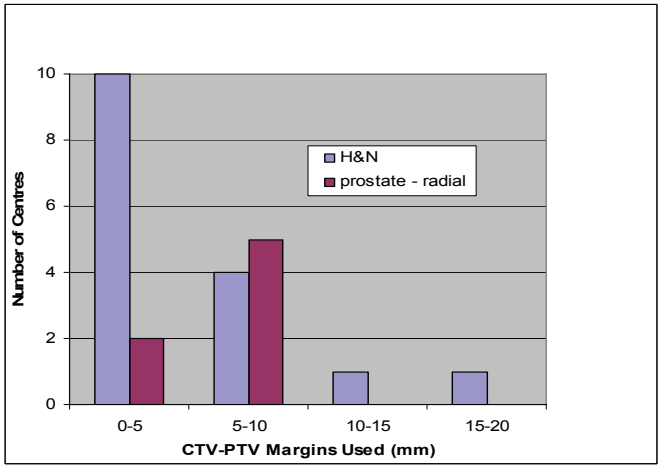
Question 3(c) - What simulation methods do you use for IMRT patients?



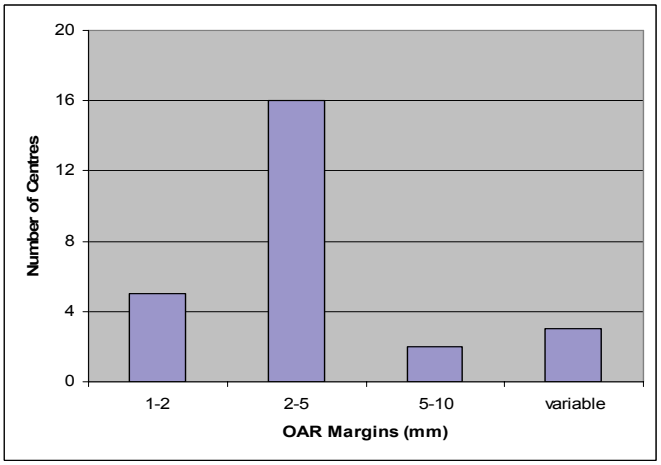
Question 3(d) - How is structure contouring organized (ie. what do Radiation Oncologists contour, what do the treatment planners or dosimetrists contour)?



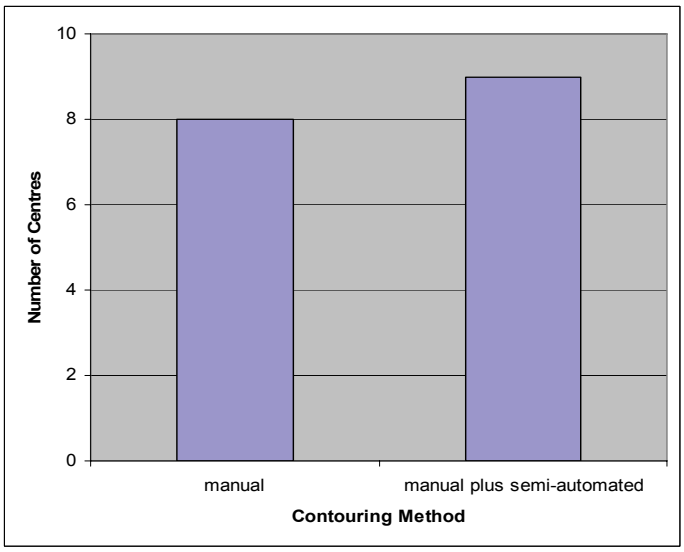
Question 3(e) -What clinical-to-planning target volume margins (ie. CTV-PTV margins) are typically applied? -- this may vary between treatment sites (head & neck, prostate, lung, breast, sarcoma, central nervous system).



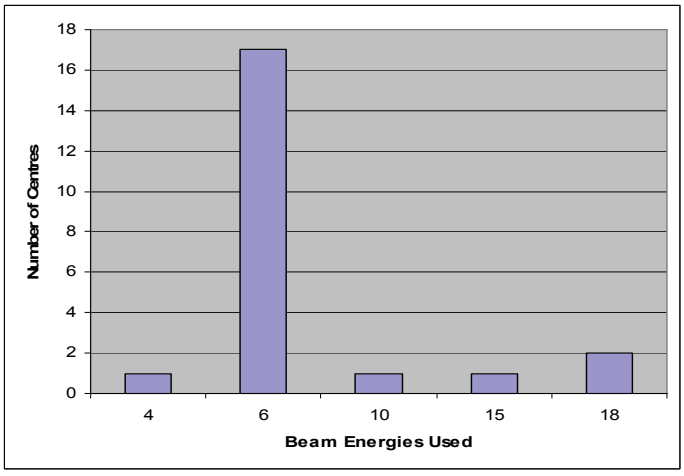
Question 3(f) - What margins are applied to the organs-at-risk? -- this may vary between OARs of different treatment sites (head & neck, prostate, lung, breast, sarcoma, central nervous system).



Question 3(g) - What contouring methods are used in your clinic for critical structures or organs-at-risk (ie. manual, semi-automated, fully automated)?



Question 3(h) - What beam energies do you use for IMRT delivery (low energy for all treatment sites, or is beam energy used dependent on depth of target)?



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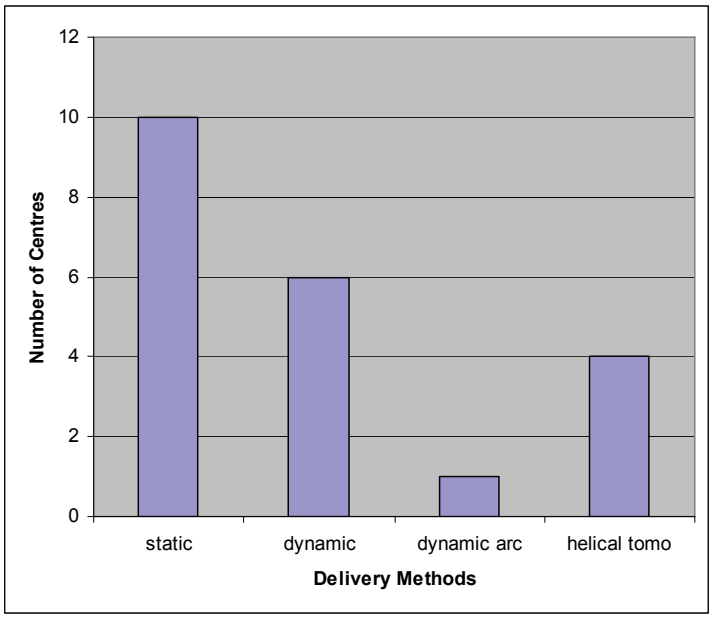
Question (i) - What method(s) of IMRT delivery are actively implemented at your clinic (ie. static, dynamic, arc, sequential or helical tomo)?



Summary of results from Question 3 – Current IMRT application:
Head and neck is the main treatment site where IMRT is applied, and the responses on patient immobilization reflect this. However, it is interesting to observe that there is a wide number of treatment sites where IMRT is being applied by at least one or two centres. CT simulation is of course the standard simulation technique used, although more exotic methods, such as PET/CT simulation, are also being used at some centres. Regarding the division of labour for contouring structures, most centres (9) have the Radiation Oncologist contour the target structure only, with the Treatment Planner (or Dosimetrist) handling all other contouring.

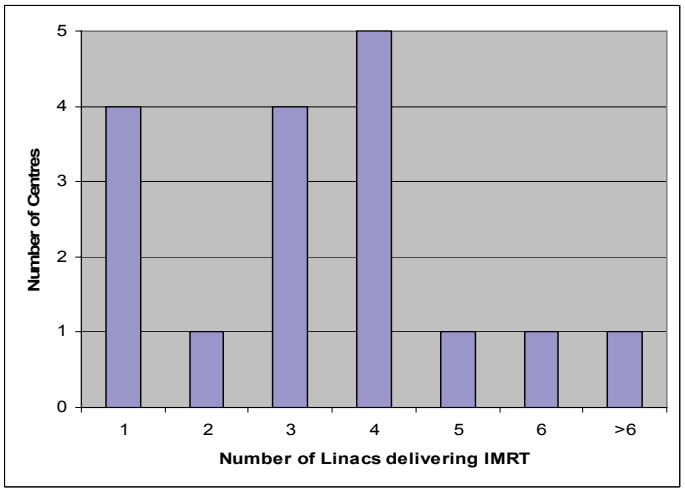
A few centres (3) are at the opposite end of the spectrum, having the Radiation Oncologist perform all contouring, with the exception of margin additions. The remaining centres (5) have the Radiation Oncologist contour the target plus some critical structures while Treatment Planners/Dosimetrists contour additional critical structures. Enough centres responded to the PTV margin addition to allow answers in the head and neck, and prostate treatment sites.

Most head and neck margins reported are in the <5 mm range, while most prostate margins reported are in the 5-10 mm range. Margin addition around organs-at-risk (to form planning organ-at-risk volumes) is common and typically involves a 2-5 mm margin. Contouring methods were nearly evenly divided between pure manual (8) and manual plus semi-automated tools (9).

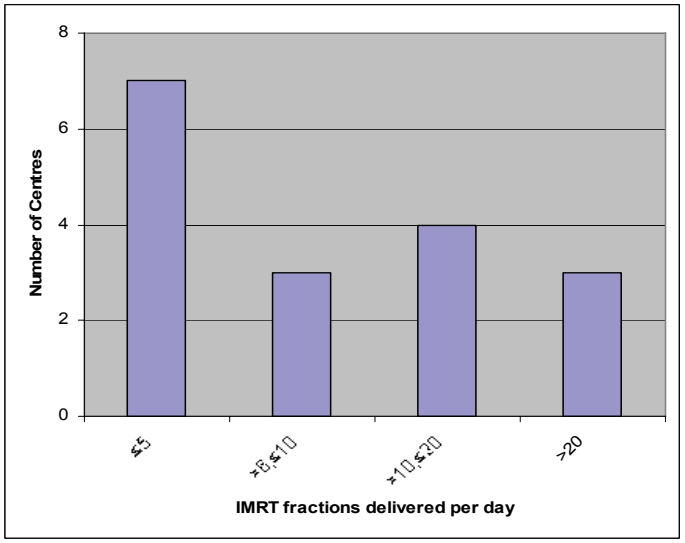
All centres delivering IMRT use 6 MV photons, with the occasional use of alternate energies (4-18 MV). The majority of centres are using a static MLC delivery technique (10), with many also using dynamic MLC delivery (6) and helical tomotherapy (5).

Question 4 - Current IMRT workload

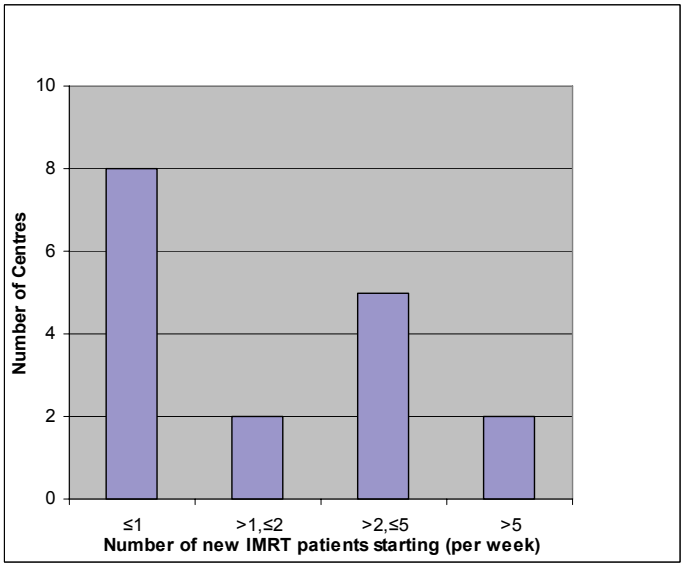
Question 4(a) - How many treatment units are currently delivering IMRT at your centre?



Question 4(b) - What is the average number of IMRT fractions being delivered (per day)?



Question 4(c) - What is the average number of new IMRT patients beginning treatment course (per week)?



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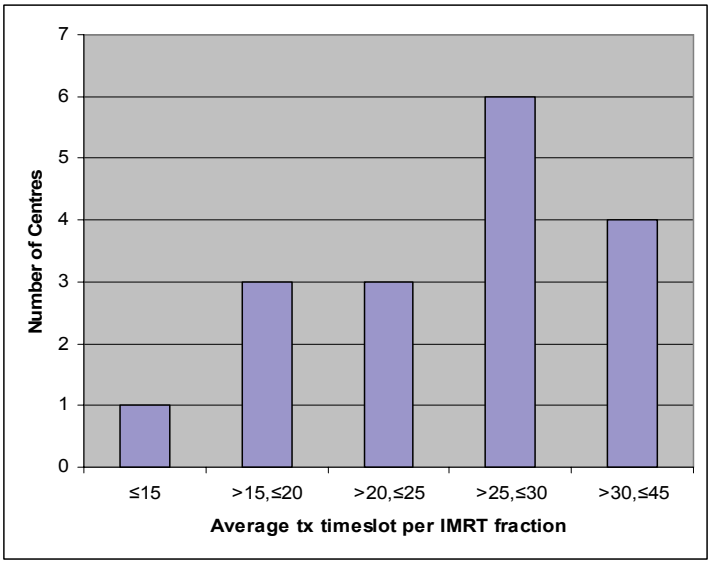
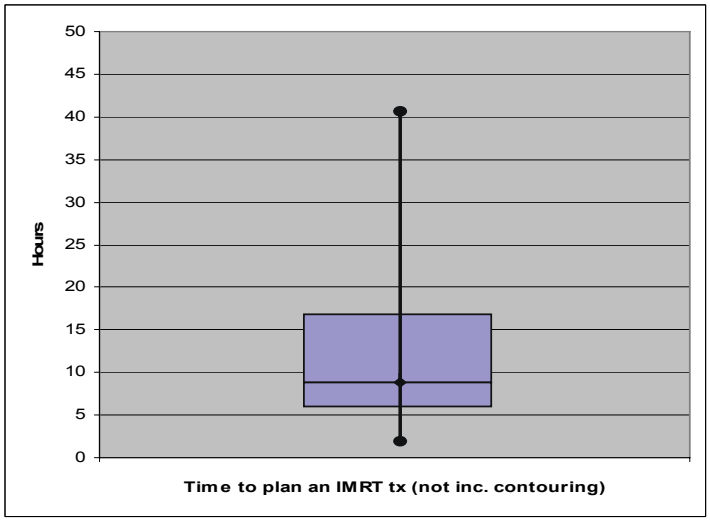
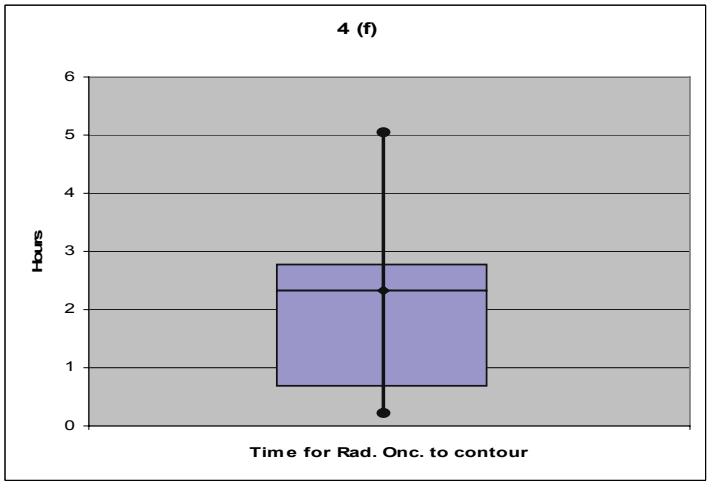
Question 4(d) - What is the average treatment timeslot scheduled for 1 IMRT fraction?



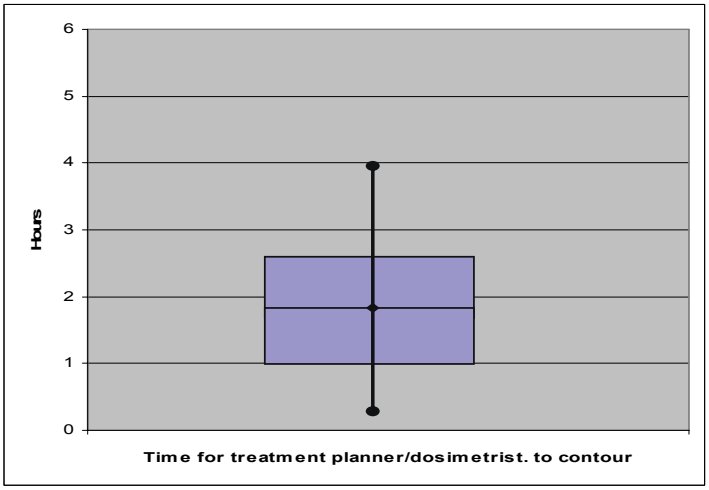
Question 4(e) - What is the average (and range) of time to plan a treatment, not including contouring time? -- this may vary between treatment sites (head & neck, prostate, lung, breast, sarcoma, central nervous system).



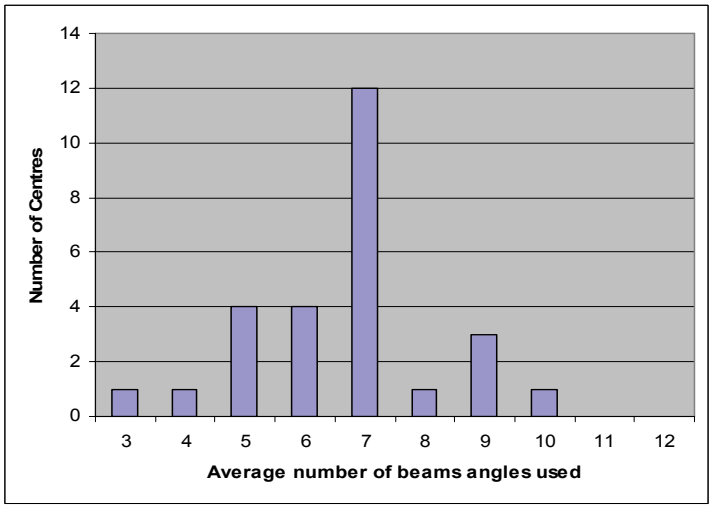
Question 4(f) - What is the average and range of time for the Radiation Oncologist to perform contouring per patient?



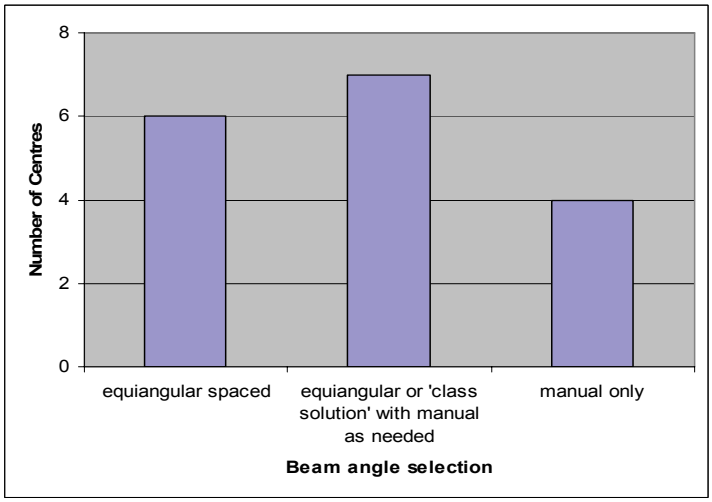
Question 4(g) - What is the average and range of time for the Treatment Planner or Dosimetrist to perform contouring per patient?



Question 4(h) - What is the average number of beams used per IMRT fraction (not including split fields)? -- this may vary between treatment sites (head & neck, prostate, lung, breast, sarcoma, central nervous system).



Question 4(i) - For IMRT beam arrangements, do you use manually optimized or standard equi-angular spaced selections, or something else?



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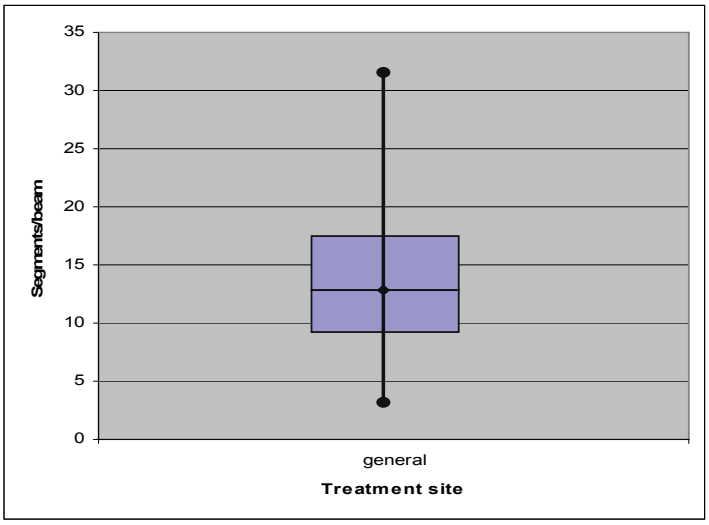
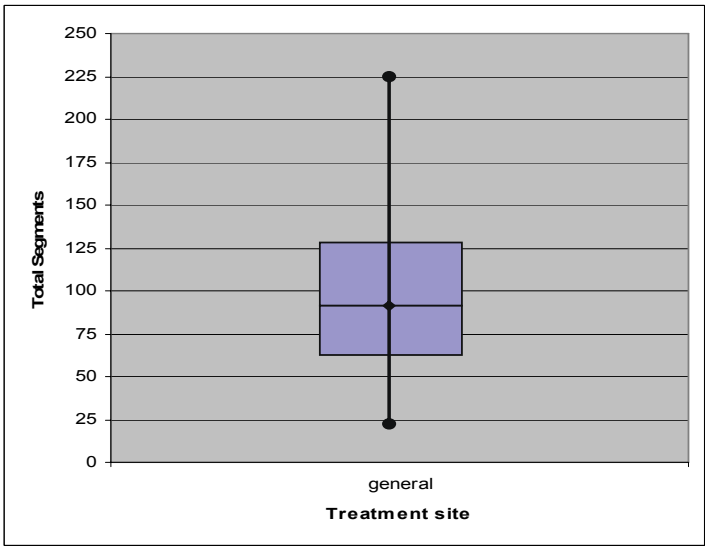
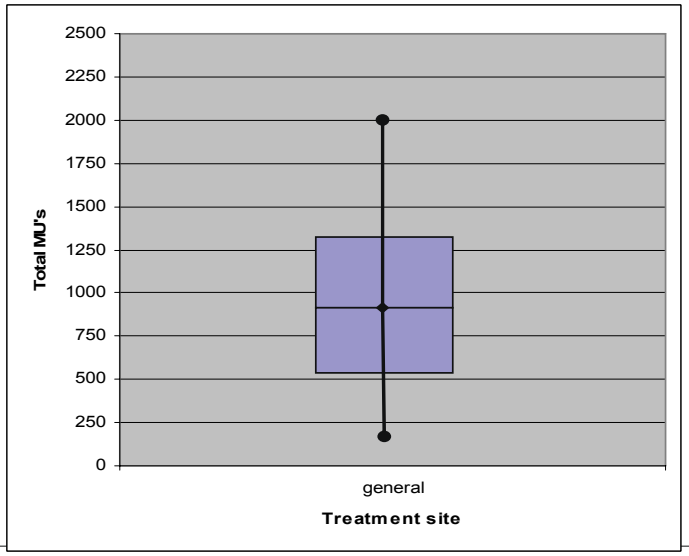
Question 4(j) - What is the average and range of segments per beam (if static MLC delivery used)? -- this may vary between treatment sites (head & neck, prostate, lung, breast, sarcoma, central nervous system).





Question 4(k) - What is the average and range of monitor units per fraction? -- this may vary between treatment sites (head & neck, prostate, lung, breast, sarcoma, central nervous system).



Summary of results from Question 4 – Current IMRT Workload:

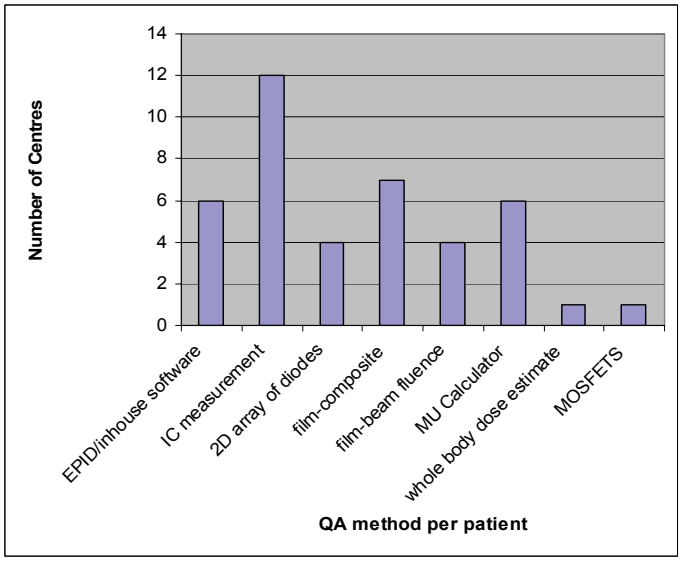
Most centres (14) are delivering IMRT on 4 or fewer linacs. Although many centres (7) are delivering 5 or fewer IMRT fractions per day, several centres are delivering between 6-10 (3), 11-20 (4), or even more than 20 per day (3). Most centres (8) are starting less than one IMRT patient per week on average. The average scheduled time slot for an IMRT fraction was typically 25-30 minutes (6), with a few centres (4) able to deliver in less than 20 minutes.

The responses to Questions 4 (f), (g), (h), (j), and (k) are presented graphically as box plots, where the average value is the centre line of the blue box, the average minimum estimate is the bottom of the box, the average maximum is the top of the box, and the overall minimum and maximum responses are indicated by the extension of simple lines from the box centre. Thus, the average time reported for IMRT planning is 9.0 hours, with a very large range of 1-40 hours. This will be very dependent on treatment site and complexity, but most respondents are describing plans for head and neck patients. Radiation Oncologist contouring time is reported as 2.3 hours on average, ranging from 0.25 to 5.0 hours. Treatment Planner/Dosimetrist contouring time is reported as 1.8 hours on average, ranging from 0.3 to 4.0 hours.

The most common number of beam angles used for IMRT delivery is 7 (reported by 12 centres). Beam angle selection for IMRT is accomplished primarily through the use of equiangular beam spacing (6), or equiangular beam spacing with manual adjustment as needed (7). For static MLC delivery, the average number of segments per beam is reported as 13, ranging from 3 to 32, while the average number of segments (all beams) is reported as 93, ranging from 20 to 224. The average total monitor units reported was 890, ranging from 150 to 2000. Note that some responses separated head and neck from other treatment sites, such as prostate, where typically less modulation is required. However, since the majority of centres are treating head and neck disease site only, these average values will be more typical of that treatment site.

Question 5 - Quality Assurance (QA)

Question 5(a) - What is your QA method per patient (brief description is appreciated), including hardware or software that may be used?



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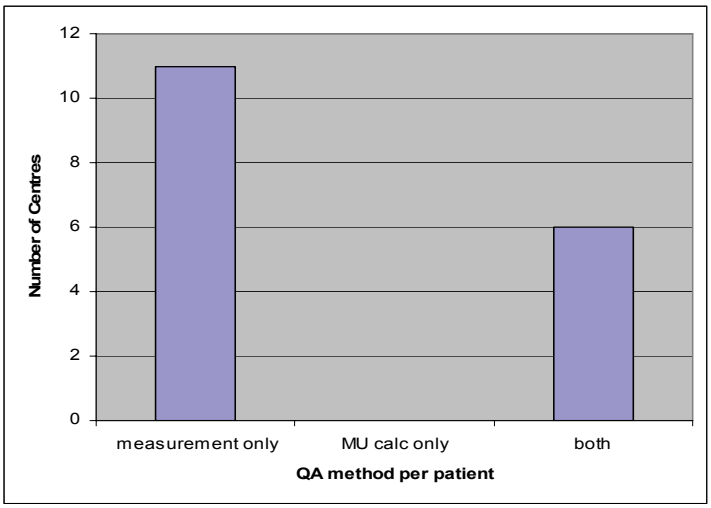
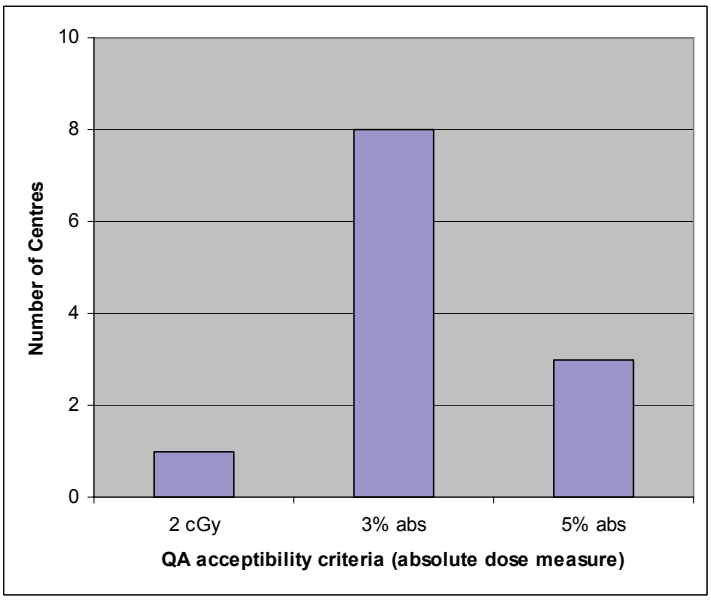
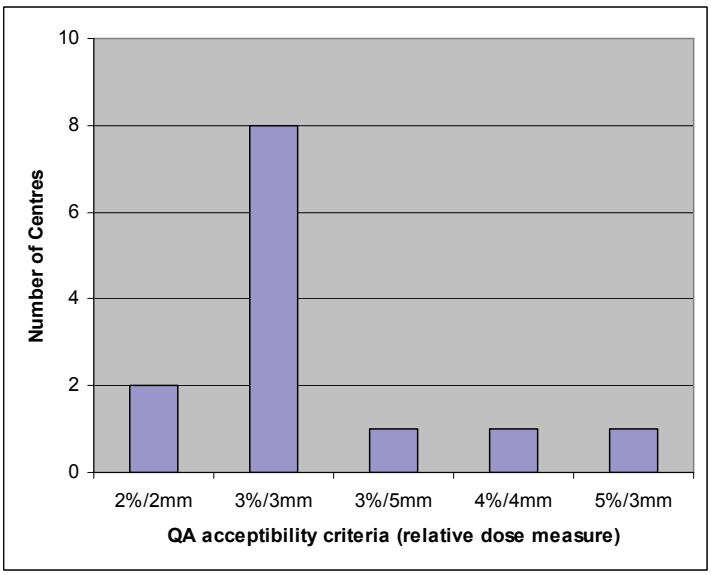
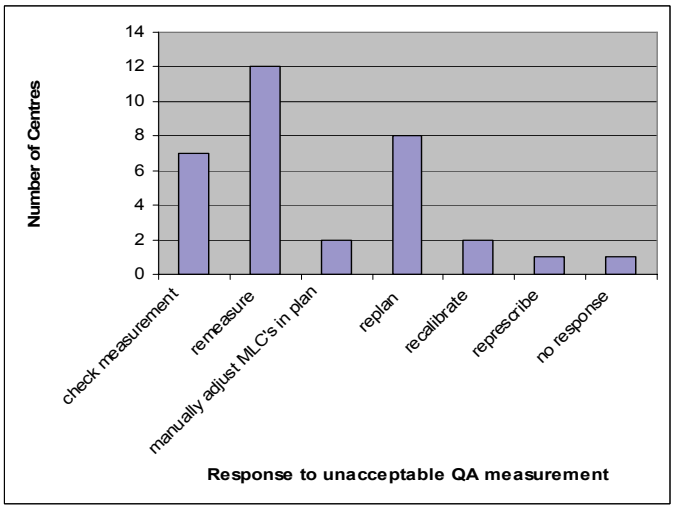


Question 5(b) - What is your QA acceptability criteria (ie. percent difference and distance-to-agreement for gamma index, absolute dose, relative dose, etc.)?

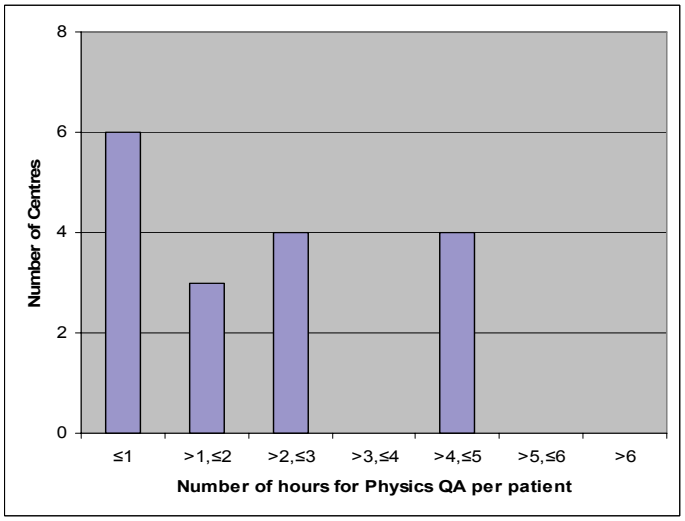




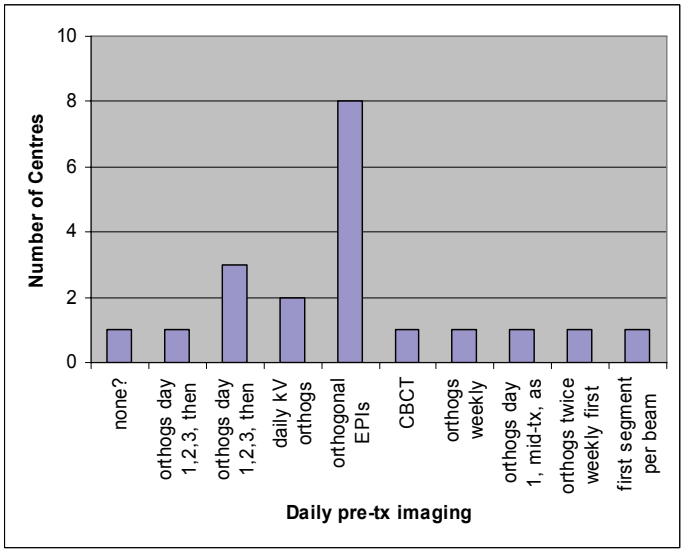
Question 5(c) - What approach is taken if the QA acceptability criteria, in 5b above, is exceeded?



Question 5(d) - What is your average time for physics QA per patient?



Question 5(e) - What daily pre-treatment imaging is performed (orthogonal portal images, KV or MV cone-beam imaging, none, or other)?



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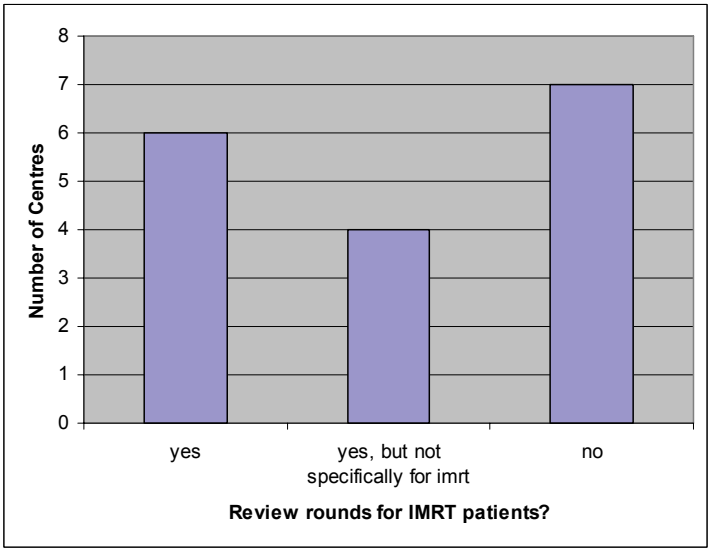
Question 5(f) - Do you have a 'Patient Review' rounds or similar, where IMRT patient plans are reviewed by a group of local experts?



Summary of results from Question 5 – Quality Assurance:
It is apparent that a wide variety of approaches are taken to perform patient-specific quality assurance (QA) for IMRT. Most centres (12) employ a single-point ion chamber measurement of absolute dose as part of a broader QA method. Many centres also measure individual beam fluences (14), accomplished by a variety of methods (such as 2D diode arrays, film, or electronic portal imaging). Some (6) use MU calculation software. These results may be divided into centres that use measurement only (11) compared to centres that use a combination of measurement and MU calculation software (6). For centres making an absolute dose measurement, the most common (8) acceptability criteria is 3% of dose. For centres making relative dose measurements (utilizing such comparison methods as g-factor or c-factor), the most common (8) acceptability criteria is 3%/3 mm. When faced with a situation of a QA measurement which fails the acceptability criteria, many centres will go through the processes of checking the measurement (7), remeasuring (12), and even replanning (8). Some variability exists for the average amount of physics time required for per-patient QA. Although most centres report less than 2 hours (9), others report 2-3 hours (4) and 4-5 hours (4). Daily pre-treatment imaging is also quite variable, although most centres (15) report the use of orthogonal EPIs in some manner. Daily kilovoltage orthogonal imaging is employed by two centres, while one centre reported daily cone-beam CT imaging. Several centres (6) perform IMRT specific review rounds, while many centres (4) perform review rounds not specific to IMRT, but may include IMRT patients. Many centres (7) indicated they do not perform review rounds.

Final Comments:
It is evident that while the adoption of IMRT by Canadian centres has slowed over the last two years, this has not effected the significant year-to-year growth in the number of IMRT patients treated. Of the centres not offering IMRT as of January 2007, it is expected that nearly 20% will begin clinically delivering IMRT within the next year. IMRT is becoming a standard option for radiation treatment within Canada. With the maturation of commissioning, planning, and QA methods, it is poised to be embraced by all Canadian cancer centres within a few years.

2015 International Federation for Medical and Biological Engineering's World Congress

Background

- COMP has been approached by the City of Vancouver to consider participating in a bid to host the 2015 IFMBE World Congress, a triennial event that attracts over 3000 attendees
- This congress has not been to Canada since 1976 when it was in Ottawa.
- The IFMBE requires that applications to host the World Congress must be submitted jointly by the national IFMBE and IOMP affiliates (in this case CMBES and COMP) indicating their mutual commitment in the planning, preparation and financial management of the World Congress.
- Bids are due in 2009

Why bid?

- International recognition for COMP
- Providing Canadian medical physicists with an opportunity to attend an international event at a lower cost
- Networking opportunities
- Information exchange and cooperation
- Potential financial rewards (other organizations have used profits for special projects, scholarships, exchanges etc)

Why Not Bid?

- Time required to prepare bid and lobby decision-makers
- May not be successful
- Potential financial risks of hosting an international congress

The next step is determining if there is sufficient interest and the resources within the COMP membership for a bid team and/or organizing committee.

Please contact me at nancy@medphys.ca or 613-599-1948 if you would be interested in getting involved or if you would like more information.

Belgian Recipes for Chocolates and Image Guidance

Submitted by: Vitali Moiseeko
BC Cancer Agency
Surrey, BC

In the spirit of modern times I kept a blog running when I attended the ESTRO Course "Image-Guided Radiation Therapy in Clinical Practice", December 3-7, 2006, Brussels, Belgium. This blog was not intended to describe lectures, industrial exhibitions and tours as they were. It was rather intended to reflect a general feel for the place, course and, most importantly, people. Any resemblance to actual events or people is unintentional and coincidental.

Dec 2. Brussels met me with wet weather. It felt like Vancouver only the buildings looked older. I checked in the hotel "Citadines" at Sainte-Catherine. My window overlooked a skating rink where romantic couples skated to some chansons with a lot of "bonjour", "amour" and "toujours" in them. Nobody had hockey skates on which looked a bit odd. I took a quick walk around the hotel and made my way to the famous La Grand-Place. The square looked indeed grand; the city hall was spectacular. Christmas décor was in full display with a tree in front of the city hall. Projectors were shooting images of reindeer and some strangely shaped characters on the walls of the hall in synchrony with cosmic music which reverberated through rain. I was positively inspired, this will be a wonderful trip, a great course. Only great things can be done in surroundings like these.

Dec 3. As I boarded a bus going to the conference site, I noticed about twenty participants on the bus who already registered yesterday and had their badges and bags. A bunch of Dutch attendees were talking in their unique multiple vowel language, looking positively authoritative. A few French ladies quietly discussed what sounded like quality of breakfast croissants at their hotels. I loved mine! A lone American dude had ginormous headphones on and was doing that headbanging thing from "Wayne's World" – it is good to know that I am not the only fan of "Bohemian Rhapsody" by "Queen" at this conference.

After a very efficiently organized registration I got my badge and respectably heavy bag with course material. I like it when the conference bag is presentable, it makes me feel that the registration fee was spent well. A quick look over the vendors' booths and off we go – the first lecture.

After a brief opening statement by Dirk Verellen of VUB, Brussels, the podium was given to Vincent Khoo (Royal Marsden) who gave a talk "IGRT: a physician's perspective". The lecture mostly consisted of quoting Jerry Battista: if we cannot see it - we cannot hit it, if we cannot hit it – we cannot cure it. I am still hanging on to my inspired feeling. After a quick coffee break my inspiration was back on track thanks to Dirk Verellen and Rianne de Jong (NKI, Amsterdam) who gave wonderfully insightful talks "physicist's perspective" and "RTT perspective" of IGRT.

Over the lunch break of what I hoped was some sort of seafood I met a delightful attendee from the UK, Emily James, who was very interested in studies done in Vancouver. After three attempts I managed to write her name with correct spelling and promised to keep her posted. The second half of the day was a hands-on tour to Ghent, which according to organizers was in the Flemish part of the country, and in fact all the way across the country. We boarded the bus. The lone American dude already had his headphones on and was doing the headbanging – "Bohemian Rhapsody" again? After a 40 minute trip we arrived at the other side of the country to be introduced to ultrasound and kV image guidance.

First we were treated to a demo of the Z-med ultrasound system. A group of ten of us surrounded a treatment couch with a good looking, as we later learned, radiation oncologist, comfortably resting in a supine position, sporting fancy European underwear. The RTT gave us a quick demo and asked for volunteers to scan the "patient" whose belly was now glistening with generously applied jelly. Ladies and the American dude stepped forward, other men produced a hesitant laughter. The volunteering lady with a slightly wobbly hand took a quality scan of a blob which was expertly identified as a prostate which was further matched to a CT scan of an actual patient. We pushed buttons, punched keys and asked QA questions. This was hands-on, useful, and positively inspiring. The next was XVI system of Elekta. The demo with a phantom went smoothly and was flawless. The world of image guidance started to make sense. Couch moves and rotations, target visualization and patient realignment, it all was getting settled in my head, albeit in a strange mess of English, French, what I guess was Flemish and a bit of Russian and body language.

Back to the bus. The lone American dude was already in his seat with headphones on doing his headbanging thing. As a friendly neighbor from the North I should be polite and considerate. "Queen", "Bohemian Rhapsody"? - inquired I with a friendly Canadian smile as I was passing his seat. "Garth Brooks" replied the lone American dude with a voice filled with sense of superiority giving me his "my dental plan is better than yours" big toothy American smile. Oh yeah! But who won all the consequential hockey bouts as of late!? I inhaled deeply to unwrinkle my grey and red Roots sweatshirt and marched towards my seat. Garth Brooks?! I should try headbanging to Celine and if this does not work, perhaps Anne Murray.

Dec 4. The day started with Emily James giving me a note with one more request for info. I promised to reply after I get back. Her note was in tidy handwriting and signed in full, Emily James. I wondered if there was a hidden message in there. I checked for water marks, smell and taste. Nothing. Perhaps Emily figured that if I saw her name written enough times, I will finally memorize its spelling? I think she should change her name to one of those easy to spell East-European names, which effortlessly roll off your tongue, like Tsvetana Grzhybowska-Zbriuyak. Not going to happen though, I know it.

The first lecture was "Errors and margins in IGRT" by magnificent as ever Marcel Van Herk. Marcel had ten movie files running at the same time on the screen, with MLC chasing the target, margins hugging the moving CTV, gated beam turning on at a precise moment. Alternating "O-o-o-o"s and "A-a-a-a"s filled the audience. We were in touch with a genius, we listened to the word of wisdom, a long-haired magician generously shared his wisdom. I felt small and inspired.

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For a while I have been wanting to take a tissue sample from Ken Yuen. I want to check if he is a carbon-based life form. I am convinced he is extra-terrestrial. I am also convinced that Marcel Van Herk came from the same planet. Two of them probably arrived in the same spacecraft laughing all the way. I am positive that they were sent to Earth so that we will fully appreciate the feeble misery of our brainpower.

Over a lunch break I arranged for a meeting the next day with three local grad students involved with IGRT projects. I also arranged for a meeting with a radiation safety officer. To me, meeting people is the most important aspect of all conferences and workshops.

Lectures proceeded, we were getting used to the format, our presenters and take home messages started to shape up. References to Canadian studies were infrequent, but regular. Mostly PMH, of course, what else. My mental image of Laura Dawson was gradually changing from an outstanding radiation oncologist to a somewhat godly figure with CT and MRI bores interchangeably gleaming over her genius head, spinning slowly and respectfully. There appears to be Canada beyond Laura Dawson though, here is this reference to the Canadian lung study by Jacques Fondijk again. Never heard of this one. I should really pay more attention to studies coming from French Canada. There is more to Quebec medical physicists than showing us during conferences how to properly eat seafood. They do produce lovely studies and even publish them in English. Note to yourself, upon coming back home talk to Jake Van Dyk about a French Canadian lung study by Jacques Fondijk, I am sure Jake knows about it.

Rianne de Jong's lecture "Patient preparation and positioning" made a highlight of the afternoon session. Her illustration to Amsterdam approach to stereotactic body radiation therapy was thorough and convincing. I wonder if any Canadian centres participate in RTOG 0236? Hypo lung treatment with IGRT looks very worthwhile to me – note to yourself, follow up on this upon coming back.

I decided to go for a walk around this magnificent city. Right in front of my hotel I saw two Japanese attendees carefully examining a screen of some electronic gadget. Being a friendly Canadian I flashed my conference badge and asked if I can help. They were apparently looking for a good sushi place and their electronic gadget just spat out directions which started with "Go to the Central Train Station and take a short ride to Amsterdam". This sounds fishy. "Do your cellphones and other electronic gadgets work in Europe?" inquired I from a Japanese sensei. "Of course they will" replied the Japanese sensei and handed me the gadget. It comfortably laid in my hand, smooth and glimmering. It looked like a control panel of mid-size spacecraft. I was sure that somewhere in it there was a built-in vacuum. Sensei pointed at the gadget and said with a touch of pride in his voice:

"Brew tooth".

"Of course it is" thought I.

Upon getting back to the hotel I planned for a meeting with grad students. I went to a mirror and practiced facial expressions of intellectual superiority. I like meeting grad students even though some of them are depressingly smart. Younglings these days are not easy to intimidate. They know MatLab, can type blind and are convinced that they can google up anything of significance. I learned a few helpful tricks to establish the ranks which I am happy to share.

First, always let them know that you were far more advanced at their and even younger age. Do not press it, casual smart is the best. Just drop in an as-a-matter-of-factish voice something like "As I stated in my junior high essay Blobquist-Glumquist solution of the Sokolowski theorem lacks elegance of simplicity". Good form! This will be a great meeting!! Second, as often as possible mention names of famous and influential people. Make it sound as if not only you know them, but you are on friendly terms with them. Use the full name and title first time and just the first name next time. Also, make it look as if your meetings with famous people were mutually beneficial. For example, do not say "I had a meeting with professor John Schreiner who updated me on the latest developments in the field of gel dosimetry". Instead, say "I recently had a meeting with professor John Schreiner. John and I discussed what is new in the world of gel dosimetry". Third, make comments whenever you have something intelligent to say. If you don't know anything about the subject, but know who does – refer students to them. If you have no idea who is an expert in the field, send them to Joanna Cygler. Joanna knows pretty much everything and is too nice of a person to not help. To fully appreciate the last two sentences please re-read item two. Fourth, remember – students love electronic gadgets. Have a lot of them on you and make it known that they all came from your professional allowance. Students love iPods, they crave them. The only thing they want more than an iPod is an iPod bought from a professional allowance. In their mind, in their dreams a magic word "professional allowance" appears in a shape of a cheque which floats in free space and gradually warps into a bouquet of iPods on sticks, playing their favorite music in an electronic voiced chorus and chanting their name.

Dec 5. Uwe Oelfke (Heidelberg) gave us a fabulous lecture "Technology: kv-CBCT and in-room kV CT". I was particularly impressed with his 4D CBCT material. He surely showed that offline phase-correlated reconstruction of time-stamped frames leads to a reasonable "gated" imaging. CT quality was fair despite limited number of CBCT frames and presumably cone-beam scans will only get better. I wish Uwe spent more time on this – looks like a worthwhile investment.

Now off to the meeting with grad students. I attached two pagers, blackberry and palmpilot to my black and blue Roots toolbelt and marched into the room to meet students. They introduced themselves as Jean-Paul Goggard, Marie-Jean Grobbard and Pierre-Luc Glummard. What is the deal with hyphenation? I firmly shook hands and checked my pagers. Pierre-Luc glanced at them with a quizzing look on his face and asked "Do your pagers even work in Europe?". Poor lad, he had no idea who he is dealing with. I said firmly "If they need me, they will find a way". Right on queue a pager which I previously programmed for alarm went off. I pressed the button, looked at it with an expression of expert concern and said after a perfectly timed 6.28 second (2π) pause "I will answer this later". Pierre-Luc still had an unconvinced expression on his face. I looked at him thoughtfully and added:

"Brew tooth".

The rest of the meeting went smoothly. I gave three of them a lot of advice mostly consisting of suggestions to contact Joanna Cy-

(Continued on page 107)

(Continued from page 106)
gler. We said "au revoir" to each other and I went to the next room for my meeting with a radiation safety officer.

The RSO's name was Michelle-Pierre Glukkard, he met me with friendly smile and a large lapel badge reading "My today's IQ is 153". Show off! We talked a bit about upgrading bunker shielding to counterbalance increased MU from IMRT. I said that we should be really using steel for upgrading the walls more often, because if we do we could call them "the walls of steel" which has a nice ring to it. Michelle-Pierre looked at me with a touch of concern in his eyes and inquired if this was a 30 min meeting. We just started talking and he already wished we had more time! I enthusiastically confirmed that indeed this was a 30 min meeting and I intended to enjoy every moment of it. Michelle-Pierre taught me how to say in French "a contractor who finishes everything on time and according to specification". Apparently there is a word for it in French. Thirty minutes went by quickly. We shook hands and decided we will stay in touch, unfortunately Michelle-Pierre did not have his business card on him. I saw Michelle-Pierre 5 minutes later in the hall clutching a cup of coffee and talking to Marie-Jean. His badge now read "My today's IQ is 138". I wonder what happened during those 5 minutes.

Dec 6. I have now made a habit of meeting people and this far it proved very rewarding. I am sure this feeling is mutual. My morning meeting was with an IT person from the local hospital. IT people fascinate me. I enjoy receiving their auto-replies to my e-mails. I always feel anxious receiving their e-mails send to "all employees". I get emotional when I read them. "Tonight we will be upgrading server PHBKQ1003/HWT7. The whole computer network will be rebooted between 9 and 10 p.m. If everything goes smoothly you will not notice the difference." The last statement makes me feel uneasy. What if it does not go smoothly? What sort of difference should I be prepared to notice? Will my desktop change to floating heads of Bill Gates singing "Don't cry for me Argentina" in a voice of a Nickelback lead singer? And why are we doing it if no-one is going to feel the difference?

The IT guy was of a jean and sweater variety. He shook my hand, his fingers were pale, long and thin, perfectly made to hit exactly one key on these mini laptops which give me trouble. He introduced himself as Henry-Paul Garrard. Perhaps I should start hyphenating? We talked a bit about DICOM format. Henry-Paul told me about art of networking and gave some advice about managing immensely increased data flow following implementation of IGRT.

I complained to Henry-Paul that we, physicists, get paged whenever servers are down. We actually do not do anything, we simply run around the corridors yelling "The servers are down! The servers are down!", which is totally redundant. Of course we tell everybody "IT is working on it". It makes us look good though. We feel important and empowered. Our pagers keep buzzing we have a concerned look on our faces and talk to each other and therapists excitedly. "Have you noticed that servers are down?". "Oh yes I did. They are totally down". We roam around offices and look for a poor soul who was reading Johns and Cunningham with the dedication of a physics resident getting ready for a panel torture and was utterly unaware of all the commotion. And when we find him or her, we swarm. "You did not notice that servers are down?" "How could you not notice that servers are down?". "They are totally, completely, absolutely down. I have been in this business for fifteen years, I saw servers down, but this down – never. They are so down, they are digging their way to down-under. I have a friend in Melbourne, he just called me, somebody knocked on his basement floor from underneath – it was our servers. They are completely down". A bewildered soul with apologetic expression defends him/herself with Johns and Cunningham, but no avail, we won.

Henry-Paul raised his right brow and said in impeccable French something that sounded like "Eye oup yor hi tea canne elp yu wiz zis merde". Now, where is the French-English translator when you need one?! This could have been the most important take home advice.

Stine Korreman and Trine Juhler-Noettrup gave a very thorough presentation "IGRT for thorax and upper abdomen". Their illustrations to how choice of imaging modality for IGRT impacts all the steps in radiation therapy were very insightful. The part dealing with margin definition for lung patients was particularly intriguing. It was obvious that the final message would be "IGRT creates room for safe dose escalation". Stine and Trine steadily and convincingly brought us there, with every step substantiated by real life practical examples. Great job, excellent take home message.

After lunch we had another hands-on session at the local hospital where we had a demonstration of the BrainLab ExacTrac Novalis system. The presenter's name was Pierre-Jean (sure, why not) Gozzard. We introduced ourselves and when my turn came I said in my well practiced Parisienne accent "Je m'appelle Vitali". From the stunned expression on Pierre-Jean's face I figured that despite his French name and French accent he must be Flemish.

I was particularly interested in this demonstration because we have a similar system in Vancouver and I wanted to learn from Brussels' experience. I asked a lot of questions. Strangely enough Pierre-Jean became less enthusiastic about them after my twenty third one. Having taken two oblique x-rays and done automated match, Pierre-Jean said that we will now realign the phantom in six degrees of freedom, three translational, and three rotational. I immediately asked in a voice of a beauty pageant presenter, "If you were given superpowers for one day and were able to add a seventh degree of freedom, what would it be and why?" Pierre-Jean suggested that all superpower questions should be kept until the end of the presentation. I thought the question was actually very deep, but because I did not have a good come back phrase I stuck my tongue out at Pierre-Jean and he pouted and shook his fist. I contemplated scratching on the side of the gantry "COMP RULZ", but both in-room cameras were now conspicuously focused on me, so I had to refrain. The presentation went on without any hiccups, as usual. A nice gentlemen who received image-guided arc therapy on ExacTrac Novalis kindly consented to be observed by ten strangers dressed in one size fits all white coats. In a way of practical sessions, this course was surely fantastic.

This was the last day of the course, which meant the night out. St. Horiks Hallen was appropriately old and inviting. We mingled and exchanged directions to the best places to buy Belgian chocolates which quickly covered all of Brussels. Unobtrusive music helped the party spirit grow, we talked about departmental Christmas celebrations and skits. I wonder if we could put together a medical physics musical? I have in mind a few tunes we can easily corrupt. "Sound of music" would make a great source for this.

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is provided.

In Ontario (collective bargaining unit), employees start with 4 weeks/year, increasing to 5 weeks after 14 years employment, and 6 weeks after 23 years. Professional allowance of $1,800 and $2,400 is provided for tier 1 and 2 (senior). Senior physicists must pass a Peer Review 'B' examination plus the FCCPM. Physicists are required to certify within 3 years of commencing employment in order escalate through the pay-scale.

At PMH, employees start with 3 weeks vacation/year, increasing to 4 weeks after 5 years of employment, and 6 weeks after 15 years. Professional allowance and travel allowance of $3,000/year is provided. Physicists are required to certify within 3 years of commencing employment. Section chiefs, not included in the figure, are paid 172,000 per year.

In Nova Scotia, employees start with 3 weeks vacation/year, increasing to 4 weeks after 12 years of employment. Travel and professional allowance of $2,000/year is provided.

(Continued from page 107)
"Whe-e-en you kno-o-ow the fi-i-ield you shi-i-ield. You ca-a-an
shi-i-ield most a-a-ny fi-i-eld". Brilliant. "Few of my favorite things" is practically begging for it. Note to yourself, upon coming back talk to J^2B about a medical physics musical.

Half way through mingling I made up with Pierre-Jean. I explained that my questions were driven by genuine desire to learn and he said that he was actually a big fan of superman movies and superheroes in general. We shook hands as old friends, I adjusted the bow-tie of his tuxedo and he flicked a bread crumb from my grey and burgundy Roots T-shirt. I considered giving him a hug, but elected to keep it official.

After a delicious dinner and usual and well deserved toasts to the course organizers, I went back to my hotel. I walked past waffle stands and the skating rink, where oblivious-to-rain romantic couples danced to, of all the songs, "I'll be home for Christmas". I opened the door, turned on the TV and happy music of Andre Rieu filled the room. Cello wept and gave way to master's violin. This was a perfect trip, time to go home.

Acknowledgement: Erin Barnett is thanked fur chequing me grammar.

CAREER SCIENTIST/ CLINICIAN SCIENTIST

May 24, 2007

Location: **Molecular Medicine Research Centre (MMRC)**
Thunder Bay, Ontario, CANADA

The Molecular Medicine Research Centre is a newly created research initiative located in Thunder Bay, Ontario, Canada. The MMRC is a partnership of the Thunder Bay Regional Health Sciences Centre, Sunnybrook Health Sciences Centre, and Lakehead University, with active involvement of Philips Medical Systems. With more than $50 million in initial funding, MMRC will combine world-class researchers, state-of-the art facilities, training of high quality personnel, and leading-edge research programs.

In addition to the imminent plans to house a cyclotron on-site, all capital equipment will be provided based on individual researcher needs and in alignment with the research roadmap for MMRC. Corresponding funding is readily available.

Position Summary: The Career Scientist and Clinician Scientist positions offer both world-renowned researchers and high potential research talent with an outstanding opportunity to expand their molecular medicine research (cancer, cardiac and neuroscience) in an innovative, collaborative environment involving public and private interests, as well as offer a great opportunity for commercialization. Imaging will be an early focus of MMRC with projects including, but not limited to HIFU, MR Sim, X-Ray Flat Panels, SPECT/CT, and PET/CT. Cross appointments at Lakehead University and the Northern Ontario School of Medicine (NOSM) may also be available for suitably qualified candidates.

Qualifications: Minimum candidate qualifications include a PhD with at least 3 years of post-doctoral experience in molecular medicine or a related field. Requirements also include demonstrated achievement in research recognized by the international scientific community, along with proven analytical, statistical and methodological skills required to identify, conduct, supervise, and assess research activities. Outstanding oral and written communication skills are essential.

For inquiries, or to be considered for this position please submit your curriculum vitae with cover letter to:

Contact: Dr. John Rowlands
Founding Scientific Director
C/O:
Janet Northan
Director, Cancer Research, Innovation and Planning
Regional Cancer Care, Rm 2203
Thunder Bay Regional Health Sciences Centre
980 Oliver Rd.
Thunder Bay, ON, P7B 6V4
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(807)684-5800 (fax)
northaja@tbh.net

Thunder Bay Regional Health Sciences Centre
PHILIPS sense and simplicity
cancer care ontario | action cancer ontario
Sunnybrook Health Sciences Centre

Toronto Sunnybrook Regional Cancer Centre

MEDICAL PHYSICIST

POSTING DATE: May 28th, 2007
APPLICATION DEADLINE: June 29th, 2007

LOCATION: Toronto-Sunnybrook Regional Cancer Centre (TSRCC)
Sunnybrook Health Sciences Centre
Toronto, Ontario, CANADA

POSITION SUMMARY:
The Toronto Sunnybrook Regional Cancer Centre (TSRCC) has an immediate opening for a full-time ***medical physicist***. The TSRCC is a comprehensive cancer centre, one of the major programs of the Sunnybrook Health Sciences Centre and one of 12 centres in the Cancer Care Ontario network. The radiation program at the centre has 13 well equipped linear accelerator treatment rooms including one Tomotherapy facility. Planning equipment includes 2 wide-bore CT simulators, 1 PET/CT simulator, 1 conventional simulator, Pinnacle, MMS, Plato, Xplan and Corvus planning systems. There is an active brachytherapy program. The medical physics department includes 16 physicists, 12 engineering technologists, physics and computer support personnel, residents and graduate students. Qualified members of the department have academic appointments through the Department of Radiation Oncology and/or the Department of Medical Biophysics and/or other departments at the University of Toronto.

The primary focus of this position will be **clinical physics applied to radiation oncology**. The successful candidate will be assigned clinical duties which may include: quality assurance, chart checking, physics support for both external beam and brachytherapy procedures, consultation with dosimetrists and physicians, physics support for new technique and protocol development, and education of other staff as necessary. In addition all staff medical physicists are expected to participate in the research program of the department. There are active programs of investigation in image guided brachytherapy, imaging for external beam therapy and treatment delivery optimization.

QUALIFICATIONS:
The preferred candidate will have a PhD in medical physics, certification by the Canadian College of Physicists in Medicine in Radiation Oncology Physics (or ABR or ABMP) and at least 2 years progressive experience as a clinical radiation oncology physicist. Excellent written and oral communication skills are required. Preference will be given to Canadian citizens.

This is an excellent opportunity to work in a beautiful facility with state-of-the-art resources and in a team environment with a diverse group of professionals who have common patient-centered goals. Salary and benefits are among the best in Canada.

SALARY RANGE: In accordance with PIPSC scales.

APPLICATIONS: Resumes should be submitted to:
Peter O'Brien, FCCPM
Head, Medical Physics Department,
Toronto Sunnybrook Regional Cancer Centre
2075 Bayview Avenue
Toronto, Ontario M4N 3M5
CANADA
Email: peter.o'brien@sunnybrook.ca

The Alberta Cancer Board has set measurable milestones to prevent cancers, save lives, and eliminate suffering. We are committed to reducing the burden of cancer through excellence in prevention, screening, diagnosis, treatment, palliation, education and research.

Provincial Radiation Safety Officer

Managing the Alberta Cancer Board's Radiation Safety Program and supervising Site Radiation Safety Officers at the Edmonton Cross Cancer Institute and Calgary's Tom Baker Cancer Centre, you will ensure regulatory compliance, take part in the design of new and expanded radiation facilities, and oversee radiation-related programs, including external beam radiation therapy; HDR, PDR, LDR, and manual brachytherapy; diagnostic x-ray imaging; and diagnostic and therapeutic nuclear medicine. In addition,
you will oversee radiation safety activities at the Edmonton Radiopharmaceutical Centre, a PET cyclotron and associated radiopharmaceutical production facility, a number of basic research laboratories and animal imaging facilities, and an in-house vivarium.

The preferred candidate will have 5+ years' experience with RSO responsibilities in a Canadian institution, strong written/verbal communication skills, and a Ph.D. or M.Sc. in Medical or Health Physics. An academic appointment for a suitably qualified individual will be possible. Management training and experience would be beneficial. **Competition #06-ACB-54-COMP**

Please forward your resume, quoting competition number to:
Jim Lees, Human Resources,
Alberta Cancer Board,
#1220, 10405 Jasper Avenue, Edmonton, Alberta T5J 3N4
Fax: (780) 412-6326; Email: careers@cancerboard.ab.ca

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All interested candidates are invited to apply, however preference in appointment will be given to qualified Canadian citizens and residents.

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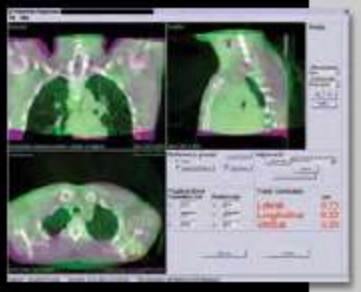

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