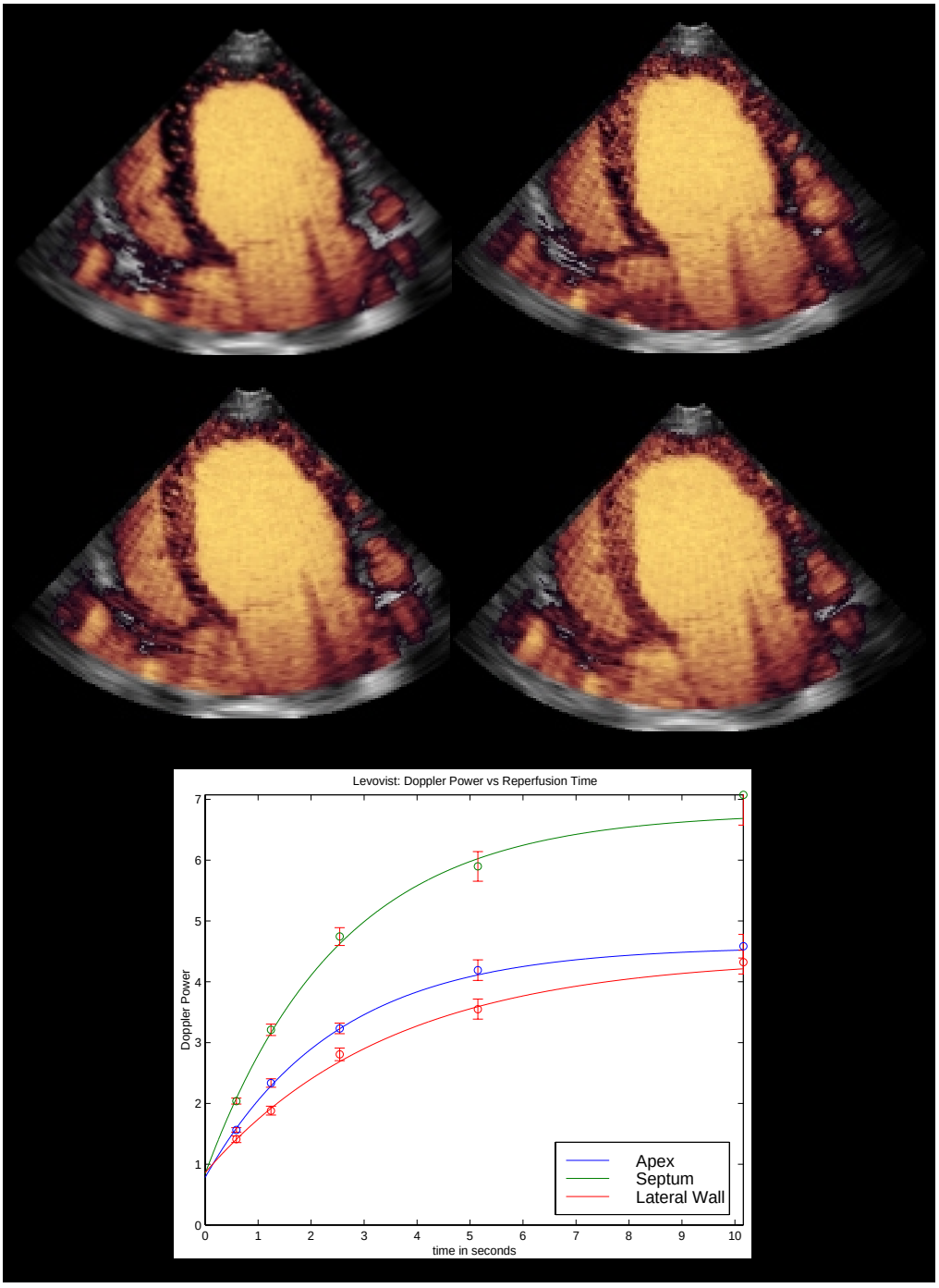
InterACTIONS

CANADIAN MEDICAL PHYSICS NEWSLETTER
Le BULLETIN CANADIEN de PHYSIQUE MÉDICALE



Myocardial Perfusion with Doppler Ultrasound

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46 (3) juillet/July 2000

Myocardial Perfusion with Doppler Ultrasound

Myocardial perfusion imaged with a microbubble contrast agent (Levovist) and harmonic Doppler imaging. These are the first real-time images of capillary perfusion in the myocardium of the beating heart. Currently, Doppler ultrasound is the only modality capable of such a measurement and these images represent technical break throughs in contrast delivery and imaging. The key is to select the microbubble size, the microbubble wall stiffness, the transducer frequency, and the acoustic intensity so that much of the acoustic energy impinging on the microbubble is transferred into the second harmonic. This increases the contrast of the microbubbles compared to the surrounding tissues when using a special imaging technique known as pulse inversion Doppler, dramatically increasing the ability to measure perfusion.

The apical views show the left ventricle surrounded by perfused myocardial muscle acquired at different times. The microbubbles in the region of interest can be disrupted by a large burst of acoustic energy from the acoustic transducer, followed by low acoustic energy monitoring of the wash-in rate of the microbubbles as a function of time. The graph shows that reperfusion takes more than 8 seconds, demonstrating that the flow velocities are at the capillary rate. From the wash-in curves quantitative information such as microvascular velocity, relative microvascular volume, and relative flow rate can be measured.

Images and graph courtesy of Dr. Peter Burns, Senior Scientist, Sunnybrook and Women's College Health Sciences Centre, and Professor, Medical Biophysics, University of Toronto.

The Canadian Medical Physics Newsletter, which is a publication of the Canadian Organization of Medical Physicists (COMP) and the Canadian College of Physicists in Medicine (CCPM) is published four times per year on 1 Jan., 1 April, 1 July, and 1 Oct. The deadline for submissions is one month before the publication date. Enquiries, story ideas, article submissions, and advertising submissions can be made to:

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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.

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Inside this issue:

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Message from the COMP Chair:

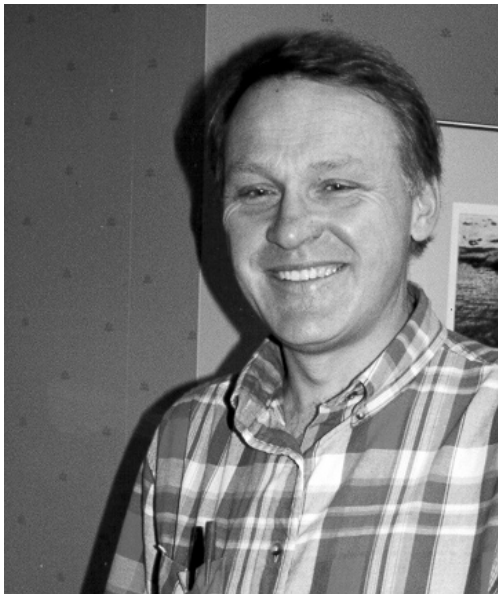
Despite these highlights and advances for COMP it has become very clear to me that we are still a small organization almost completely reliant on volunteer labour. ... We are all busy, but COMP can only survive and improve if it has broader participation from its members.

This is my final message to the members of COMP. At the Annual General Meeting on July 25th I will turn the gavel over to Gino Fallone (provided I can find it between now and then!) and join the ranks of COMP "elder statesmen". Although it has at times been more work than I bargained for, I have enjoyed my two years as the chair. In particular, it has been a privilege to share the load with the talented and hardworking members of the executive. Two of them will be leaving at the same time I step down and I want to recognize their contributions. Paul Johns has been on the executive for six years as chair-elect, chair, and past chair. In this last role I have often had the benefit of his wise counsel and experience which will be hard to replace. Peter Munro is completing his term as Councillor for the Newsletter. Not only was he responsible for major improvements in *Interactions* (he even gave it a name), he undertook several initiatives in establishing better communications between the machinery of COMP and its members. Peter's successor will be announced at the AGM, as will the new chair-elect.

As you know, the AGM will be held as part of the World Congress in Chicago. It looks like we will have a strong Canadian contingent at this meeting and the Canadian night-out is shaping up to be a big event. I would like to thank the COMP corporate members who have helped to make this party possible and Sherry Connors and Gino Fallone for handling the logistics.

I am also pleased that the COMP TG51 Committee has submitted its final report and that this has been published in this issue. After a thorough consideration of its advantages and disadvantages, the committee has recommended adoption of this protocol. Institutions will make their own decisions about this, but therapy physicists will appreciate the advice of this expert panel. I would like to thank Erv Podgorsak who chaired the group, and the other members: Marina Olivares, Carl Ross, Randall Miller, Dave Rogers, Alan Rawlinson and Darcy Mason.

As this is my last message, I would like to reflect for a minute on the highlights of the last two years. For me, the brightest of these was our scientific meeting in Sherbrooke in 1999. Those of you have organized a conference know the sense of accomplishment (and relief!) when it all comes together successfully. The creation of our website has also been great for COMP. I expect it to become the primary source of information for our members and a link to the "outside world". I have already referred to our newsletter and its metamorphosis over the last two years - I wish I could claim credit for this! Our interaction with CCPM has also been improved and clarified in this period; it has been a pleasure to work with the president of CCPM, John Schreiner, on a number of issues. Finally, the creation of the Executive Director position (although unfortunately vacant at this time) has also been a significant step for COMP.



Despite these highlights and advances for COMP it has become very clear to me that we are still a small organization almost completely reliant on volunteer labour. It would be painful to see COMP fall back on these initiatives, but that is exactly what will happen if other members do not step up to the plate and take over for those who have already made their contribution. We are all busy, but COMP can only survive and improve if it has broader participation from its members.

Okay, that's my sermon…a final thumbs up to my successor, Gino Fallone, and I'm out of here! See you in Chicago.

Mike Patterson
Hamilton Regional Cancer Centre

Message from the CCPM President:

We will be meeting in just over a month's time in Chicago. I am very happy to report that in Chicago the Canadian College of Physicists in Medicine will be sitting for the first time on the Board of the Commission on Accreditation of Medical Physics Education Programs, as our sponsorship of CAMPEP has been accepted. This is an excellent development for medical physics in Canada, and I

look forward to a long and strong interaction between the College and CAMPEP.

Many College issues that we are dealing with have been reviewed in previous president's messages. However, one new priority for the Board will be planning for the next year when recertification will commence. I would like to give you a brief preview of one issue we may look at. It is becoming apparent that the CCPM has to become more public and clear in announcing its membership to the outside world. Recent questions from other organizations have made this obvious, and the requirement to keep our public membership/fellowship lists current will increase with recertification. I will be recommending to the Board that we begin to better publicize our membership list, perhaps on the Web. I will also recommend to the Board that we be more clear in putting the onus of keeping one's credentials current, and fees paid up, on the individual members and not on the College. We do not have the resources to chase after members who have not submitted their documents for recertification, or their fees for the year, and whose memberships may lapse. We have by-laws to deal with this, but I think we have to stress more actively to members and fellows the importance of keeping their dossiers up to date. So, as a related quick exercise for this week, and to QA our database, I ask that you email to me your date of election to membership and fellowship.

Finally, in this issue of Interactions I have submitted two documents from the Human Resources Planning Working Group of the Canadian Cancer Strategy. I have been representing the College and COMP on this Working Group since the beginning of the year, and thought it would be useful to fill you in on the committee's activities. In this issue you will find my brief to the HRPWG on medical physics staffing in radiation therapy departments in cancer clinics across Canada, and a second document from Dr. Andrew Padmos, the HRPWG Chair, reviewing the activities of the group. Please, take a good look at these documents and send me any comments that you feel should be presented to the Canadian Cancer Strategy regarding human resources in medical physics.

I hope to see many of you in Chicago.

L. John Schreiner,
john.schreiner@krcc.on.ca

Many College issues that we are dealing with have been reviewed in previous president's messages. However, one new priority for the Board will be planning for the next year when recertification will commence.

WesCan 2000

By Pat Cadman

The 22nd annual Western Canadian Medical Physics Conference, WesCan 2000 (W2K), was held in Saskatoon from March 30 until April 1, 2000. WesCan is attended by physicists, radiation therapists, technicians, computer scientists, grad students and vendors. This year, 81 participants registered for WesCan, a new record! Traditionally WesCan begins on Thursday evening with registration and an icebreaker reception, followed by a stimulating topic for discussion. Scientific sessions proceed all day Friday and Saturday morning. At the Regina Wescan in 1998, a Thursday workshop was added to the main conference and this event seems to have become a permanent part of the WesCan program.

In Saskatoon, the conference opened on Thursday afternoon with a workshop on Stereotactic Radiosurgery/Radiotherapy. **Dr. Luis Souhami**, a practiced radiation oncologist from the McGill University Health Centre, provided his clinical perspective on stereotactic radiosurgery. **Dr. Brenda Clark**, chief medical physicist at the Vancouver Cancer Centre, discussed planning parameters for conformal stereotactic radiosurgery. Both the clinical and technical presentations were well received by the audience. It was interesting to hear about the migration from multiple arc techniques using standard circular fields for the treatment of small irregular lesions to the use of conformal fields and multileaf collimators.

The conference delegates registered Thursday evening and there was a chance to socialize with old and new acquaintances. An interesting feature of the WesCan Thursday evening is that, after a few refreshments, a topic of debate or issue of concern is presented to the delegates. This year, **Ramzi Jammal** from the A.E.C.B. (or is that now the C.N.S.C.?), agreed to subject himself to the rueful questioning of the audience (tomatoes and all other vegetables were checked at the door). Ramzi, an ex-Saskatoonian, presented the upcoming regulatory changes for Class II Nuclear Facilities. We thank Ramzi for his courage in the face of danger and his willingness to share his insights into the regulatory process.

The scientific sessions began Friday morning. Eleven presentations were given during the day with each speaker restricted to 20 minutes including time for questions from the audience. A prize of $200.00 was awarded to **Parminder Basran**, a Ph.D student from the Tom Baker Cancer Centre, for his student competition winning paper: "Reliability of Active Breathing Control in Reproducing Diaphragmatic Position". Two RTTs split the $200.00 Technologist/ Technician competition prize**: Lori Underwood** from the Cross Cancer Institute for her paper: "Climbing the IMRT learning curve on Helax-TMS", and **Karen Davis**, hometown winner, for her paper: "Single Session Simulation and Verify for Tangential Breast Irradiation". Congratulations to all our winners.

Doug shared stories and pictures from the years that Harold Johns was with the Saskatchewan Cancer Commission (1945-1956). The story of the development of the Co-60 unit and the people involved is fascinating and it was good to have the human story as told by one of Johns' graduate students and colleagues.

Our invited speaker, **Jerry Battista**, from the London Regional Cancer Centre, delivered a very lively and stimulating discourse on "Radiotherapy in the New Century". Jerry outlined what he views as the megatrends that will play a key role in the diagnosis and treatment of cancer. He was able to mix a very broad and expert perspective with a good measure of wit and humor. Jerry also teased us by rekindling the debate on the origins of Co-60 therapy in Canada (was it Saskatoon, London, or Russia?) and had the crowd (including Douglas Cormack, renowned Co-60 historian) thoroughly amused.

The Friday scientific session was followed by a tour of the Saskatoon Cancer Centre and the awards banquet at the University of Saskatchewan Faculty Club. During the tour, two special presentations were provided. **Sylvia Fedoruk** displayed artifacts from the Harold Johns Archives located in the SCC library. Sylvia has assembled a wealth of historical documents and artifacts including the notes and writings that became "The Physics of Radiology" (there were even Chinese and Russian versions) as well graduate thesis from each of Johns' students. Perhaps the best treasures were the anecdotes that Sylvia was able to share with us. **Douglas Cormack** positioned himself below the 1951 Co-60 unit, yes, the original unit commission by Harold Johns and company a half century ago. Doug shared stories and pictures from the years that Harold Johns was with the Saskatchewan Cancer Commission (1945-1956). The story of the development of the Co-60 unit and the people involved is fascinating and it was good to have the human story as told by one of Johns' graduate students and colleagues.

The scientific sessions began again Saturday morning and ended at noon. This year, representation from diagnostic medical imaging was particularly strong

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WesCan 2000 ... *(Continued from page 102)*
with presenters from the University of Saskatchewan speaking on MRI, fMRI, and x-ray imaging topics. All abstracts may be found on the WesCan web site at www.cancercentre.com/wescan (go to Paper Status, find the presenter and title, and click on File Name). It was remarked that the quality and variety of the presentations was excellent. I think we were especially lucky to have such a good group of students presenting (and graduating!! – for all those potential employers out there).

It should be mentioned that this was the second year that the WesCan web site has been in operation. The site is being brokered by the Cancer Centre for the Southern Interior (Kelowna) and Frank Hilliard is the webmaster. This facility has proven invaluable for the organization and operation of the conference, especially since the majority of the presentations were in electronic form.

There was excellent representation by commercial vendors. We would gratefully like to thank the following sponsors for their support: Varian, Sofamor Danek, BrainLab, Siemens, Scanditronix-Wellhofer, Elekta, ADAC Laboratories, MDS Nordion, Donaldson Marphil, Mentor Corporation, IMPAC Medical, Standard Imaging, Marconi Medical, and Best Industries.

Next year, the WesCan conference will be hosted by the Surrey clinic and we wish them all the best. Those of you reading this article from Eastern Canada should consider the trip out west next spring. This has been my 7th consecutive WesCan, and I have always enjoyed the informality and the opportunity to get to know and talk with staff members from the various clinics and departments; I think WesCan is unique in the scope of the people it attracts. Looking back at the WesCan archives, I can imagine those faithful delegates plowing through March prairie snowstorms, 10 people per station wagon and the parties that would ensue in the hosting physicist's basement "rec" room. They don't make 10-seater station wagons anymore and the rec room has now been replaced by the home theatre, but the spirit of sharing ideas and common problems that began at those early meetings lives on at WesCan today.

Crop Circles at Fraser Valley Cancer Centre?

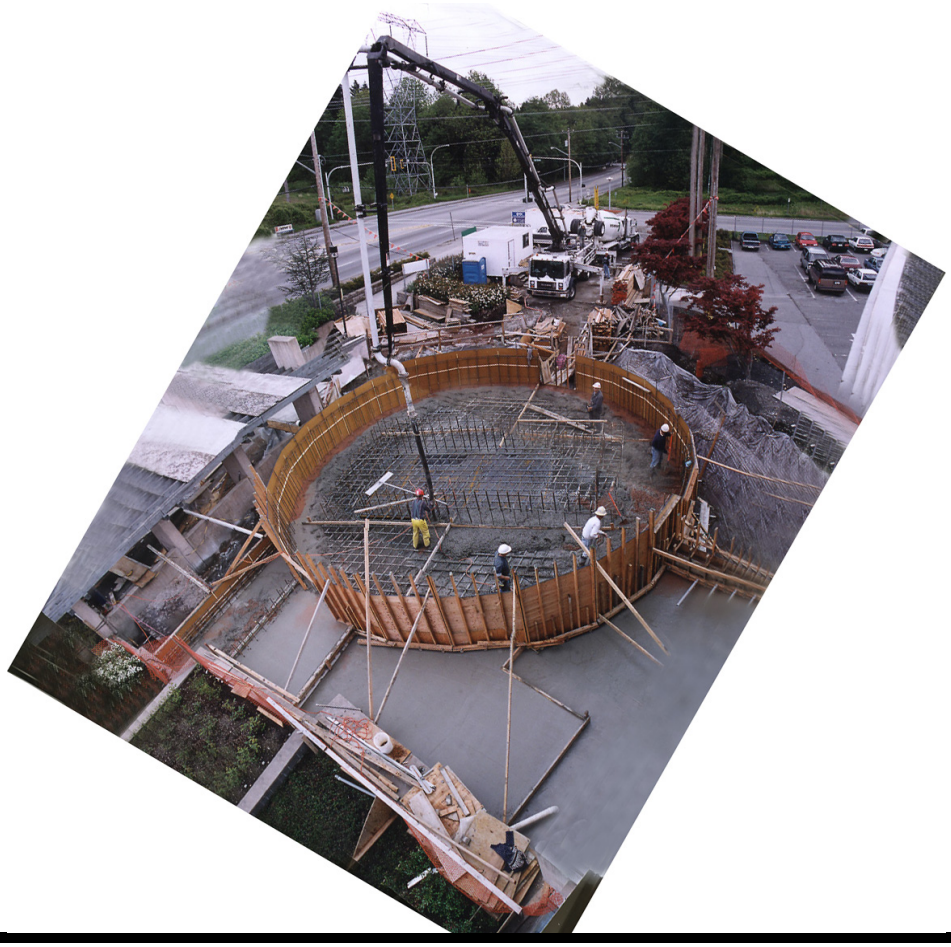
By Sherali Hussein

Construction of a new vault at Fraser Valley Cancer Centre (FVCC) started in February, 2000. The new vault will house a dual energy Varian Clinac 21EX with IMRT capability, and will produce 6 MV and 18 MV photon beams, as well as electron beams at several energies between 3 and 20 MeV. The new accelerator will treat an additional 450 patients a year when fully operational.

Because the new vault is an addition to the existing building, a novel circular room design has been adopted to (a) avoid the primary beam facing the main three-floor building, (b) match the existing building structure, and (c) maximize the functionality of the available space around the control area.

The shielding design has allowed for an increased head leakage for IMRT treatments. Based on an IMRT workload of 25 %, and assuming that each IMRT field may be treated with an average of fifteen segments, the head leakage has been increased by a factor of 4.5 in shielding calculations. Provision has also been made for the future installation of a secondary neutron shielding door to reduce the number of neutrons entering the maze. This would substantially reduce the dose at the outer surface of the main door by eliminating a large fraction of the capture gamma component.

Delivery of the accelerator has been scheduled towards the end of August, following which acceptance testing and commissioning should generate enough excitement for the physicists to last us through to the New Year. We are in the process of hiring a seventh physicist, well in time to share the joy!



Report of the COMP TG-51 Committee

By Ervin Podgorsak
Chair of the TG51 Committee

During the past few years, both the *American Association of Physicists in Medicine* (AAPM Task Group-51, ref. 1) and the *International Atomic Energy Agency* (IAEA) have been developing new dosimetry protocols for calibration of megavoltage photon and electron beams, based on chamber dose calibration factors in water. The imminent introduction of these new protocols into clinical service has prompted the Chair of the *Canadian Organization of Medical Physicists* (COMP), Dr. Michael Patterson, to appoint, in December 1998, a megavoltage dosimetry committee. The committee is referred to as the *"COMP TG-51 Committee"* and consists of 7 COMP members (*Darcy Mason*, Kelowna; *Randall Miller*, Halifax; *Marina Olivares* - Secretary, Montreal; *Ervin B. Podgorsak* - Chair, Montreal; *J. Alan Rawlinson*, Toronto; *David W. O. Rogers*, Ottawa; and *Carl Ross*, Ottawa). The committee was charged with developing, by December 1999, a recommendation to the COMP executive on the feasibility of introducing the AAPM TG-51 protocol into Canadian institutions.

The committee met during the COMP annual meeting in Sherbrooke (June 1999) and corresponded through e-mail during the first year of its mandate. It was obvious to the committee that three options are available to Canadians with regard to the AAPM TG-51 protocol: (i) watchful waiting through keeping the existing protocols in effect, while watching the TG-51 developments and its introduction in the U.S.; (ii) endorsing both the AAPM TG-51 protocol as well as the new IAEA protocol and leaving the decision on relative merits of the two protocols to individual Canadian institutions; and (iii) clearly endorsing the AAPM TG-51 protocol as the most practical option for Canadians to take.

After a careful evaluation of the AAPM TG-51 protocol and a detailed discussion of the "pros and cons" of the introduction of the protocol into Canadian institutions, the *"COMP TG-51 committee"* recommends that the COMP executive endorses and recommends the use of the AAPM TG-51 dosimetry protocol for external beam reference dosimetry in Canadian institutions.

The new protocol relies on a cobalt-60 in-water dose calibration factor for institutional ionization chambers, and the *Ionizing Radiation Standards Group* of the *National Research Council* (NRC) in Ottawa is capable and willing to provide this dose calibration factor to institutions requesting it. The cost of the in-water cobalt-60 calibration factor will be similar to that of the cobalt-60 air-kerma calibration factor.

The *COMP TG-51 committee* recommends that a reasonable amount of time (on the order of 2 years) be allowed to existing institutions for the transition from the currently used AAPM TG-21 or IAEA TRS-277 protocols to the new AAPM TG-51 protocol. The gradual phase-in time will not only allow the institutions an orderly and reliable transition in dosimetry services, it will also enable the NRC to make an efficient transition in calibration services without an immediate excessive and uncontrollable workload demand. New institutions just starting with their beam calibrations, on the other hand, are encouraged to start with the AAPM TG-51 protocol immediately.

The AAPM TG-51 protocol is based on cobalt-60 in-water dose calibration factors and requires that output calibrations of megavoltage radiotherapy machines be carried out in water phantoms of at least 30x30x30 cm^3. Ionization chambers thus must be waterproof or must be equipped with waterproofing sleeves.

In TG-51 the calibration of megavoltage photon beams is carried out at a depth of 10 cm in water. For specification of photon beam quality the protocol relies on percentage depth doses measured at a depth of 10 cm in water with a field of 10x10 cm^2 and an SSD of 100 cm. The percentage depth doses for beams above 10 MV must be determined with a 1 mm thick lead foil placed into the beam at either 30 cm or 50 cm from the water phantom surface. The calibration depth for electron beams, on the other hand, is at a reference depth in water defined as:

$$d_{ref} = 0.6\, R_{50} - 0.1 \text{ (cm)}.$$

At d_{ref} the water to air stopping-power ratio is a function of R_{50} only, and this function fully accounts for the realistic nature of the incident electron beam (2).

Although the overall calibration procedure in TG-51 is simpler to implement than the TG-21 procedure because of the simpler TG-51 formalism, the TG-51 protocol insists on the use of a water phantom and this implies more work than using plastic phantoms which are allowed in the TG-21 protocol. However, TG-51 requires an in-water calibration of a therapy machine only once per year; the regular routine machine output checks still may be carried out in plastic phantoms, provided that a transfer factor relating the chamber response between water and plastic phantom is determined for the particular beam.

For a given irradiation with a 6 to 18 MV photon beam, the doses at a given point in water are essentially equal for the TG-21 and TG-51 protocols (3). For 6 MeV electron beams on the other hand, the doses at a given point in water are about 1% higher for TG-51 compared to TG-21 protocol, the discrepancy increasing with electron energy to about 3% at 20 MeV (3). Thus, for a given dose prescription, adopting the new protocol is likely to result in the patient receiving an identical dose for megavoltage photon beams and a 1 to 3% lower dose for electron beams.

Canada has made a considerable contribution to the AAPM TG-51 protocol

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through NRC's theoretical and experimental work on the k_Q parameter as well as through the membership of D. W.O. Rogers on the AAPM TG-51 committee. In addition to the Canadian content, the following points can be made in favour of using the new AAPM TG-51 protocol over the currently used kerma-in-air-based protocols:

1. Recent work (4) suggests that the dose uncertainty resulting from the dose-in-water based calibration protocols is somewhat smaller than that of currently used kerma-in-air protocols.
2. The dose-in-water calibrations are certain to become prevalent in the future.
3. American institutions are rapidly adopting the AAPM TG-51 protocol, and since most Canadian institutions contribute to American treatment protocols, it would be expedient (although it is not mandatory) to follow the same protocol for megavoltage machine calibrations.
4. The AAPM TG-51 protocol corrects many mistakes and inconsistencies present in the AAPM TG-21 protocol. It also improves the accuracy of the protocol by including a correction for the central aluminum electrode of the chamber and by the use of realistic electron stopping-power ratios rather than those calculated for monoenergetic electron beams.

This report was endorsed by 6 of the 7 *COMP TG-51 Committee* members and submitted to Dr. Michael Patterson, Chair of the COMP, on June 14, 2000.

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4. J.P. Seuntjens, C.K. Ross, K.R. Shortt, D.W.O. Rogers, *Absorbed-dose beam quality conversion factors for cylindrical chambers in high energy photon beams*, Med. Phys. (to be published).

After a careful evaluation of the AAPM TG-51 protocol and a detailed discussion of the "pros and cons" of the introduction of the protocol into Canadian institutions, the *"COMP TG-51 committee"* recommends that the COMP executive endorse and recommend the use of the AAPM TG-51 dosimetry protocol for external beam reference dosimetry in Canadian institutions.

Why To Use TG-51

By D.W.O. Rogers
IRS/INMS/NRC

The TG-51 protocol for clinical reference dosimetry of high-energy photon and electron beams was published last year[1]. It is recommended for use by the AAPM and the RPC in Houston has started using it as the basis of its clinical dosimetry comparisons. In addition, all clinical members of a COMP committee have voted in favor of a recommendation that TG-51 be adopted for use in Canada.

Despite all this approval and support, the protocol is very much a prescriptive document and the rationale for using it is not as clear as it could be. In this article I would like to present a brief rationale for why TG-51 should be used instead of TG-21.

The arguments for changing to TG-51 from TG-21 are summarized in the text box.

In the following I will concentrate on the issue of the improved accuracy and indirectly address the other issues along the way. I will also discuss why TG-51 has adopted $\%dd(10)_x$ as a beam quality specifier. For a more general introduction to the advantages of using absorbed-dose calibration factors, see ref [2].

Where does the improved accuracy come from for photon beams?

1) TG-51 gets the absorbed dose in a ^{60}Co beam correct since it uses a calibration factor directly. When using air-kerma and absorbed-dose calibration factors traceable to Canadian primary standards, the doses determined with TG-51 are 0.1 to 0.8% higher than those determined using TG-21 (the exact value depends on the chamber used; data are from Shortt et al[3], and Seuntjens et al [4]). If one corrects all the known mistakes in TG-21 and uses the same data sets as in TG-51, these discrepancies range from -0.47% to +0.33%, so at least part of the problem is due to errors in TG-21, but the rest of the problem must be due to other, as yet not understood problems with TG-21 or the data used (any errors in the standards would show up as a constant offset). If one is using calibration factors traceable to NIST, all of the above figures are increased by 1.1% because of the known differences between the NIST and NRC primary standards for air-kerma and absorbed dose to water[3]. Given that the uncertainties on the primary standards for absorbed dose to water and air kerma are roughly equal, then by changing to TG-51 there is a clear increase in accuracy in the dose assigned in a ^{60}Co beam since the uncertainty in TG-21 to convert from air kerma to absorbed dose is removed. Furthermore there is a noticeable change in the assigned dose, which is a 1.1% larger change for calibration factors traceable to NIST.

2) For photon beams, TG-21 used stopping powers from ICRU Report 35 whereas the electron beam portion of the protocol used the more accurate and definitive values from ICRU Report 37[5]. TG-51 consistently uses Report 37 stopping powers which reduces the assigned dose in accelerator photon beams by up to 1.3% compared to TG-21.

3) TG-21 ignores the fact that many ion chambers have aluminum electrodes. Ma and Nahum[6] have done a complete set of calculations showing that such electrodes increase ion chamber response by up to 0.8%. Since this also affects air-kerma calibration factors, it is not a major effect in photon beams, but it does increase the dose assigned in high-energy photon beams by up to 0.3% and TG-51 takes this into account.

Fortunately, for accelerator photon beams these 3 effects tend to cancel and so the dose assigned in accelerator photon beams using TG-51 is about the same as that assigned with TG-21 when using NRC traceable calibration factors or about 1% higher using NIST traceable factors. Ding et al[7] and Huq[8] have experimentally confirmed this.

Where does the improved accuracy come from for electron beams?

1) TG-21 was unclear about how to determine R_{50}, the depth at which the dose fell to 50% of its maximum. TG-51 has clarified and simplified this by requiring a measurement of I_{50}, the depth at which the ionization drops to 50% and then uses a simple equation to get R_{50}.

2) TG-21 used stopping-power ratios calculated for mono-energetic electron beams but Ding et al[10] showed that these could lead to errors of up to 1.8%. TG-51 has overcome this shortcoming by changing to a new reference depth for electron beams at $d_{ref} = 0.6\ R_{50} - 0.1$ cm. This is at dose maximum for low-energy beams but deeper for high-energy beams. By making this change in the reference depth, the TG-51 protocol is able to use the stopping-power ratios calculated for the realistic electron beams and at the same time have a much simplified data set[11]. This reduces the dose assigned by up to 0.6% for low-energy electron beams and increases it by up to 1.2% for high-energy beams.

3) TG-51 takes into account the aluminum central electrode in many Farmer chambers and in electron beams this leads to a 0.7% increase in the assigned dose.

4) By avoiding the conversion from air to water based quantities in ^{60}Co beams, TG-51 makes the same gains in accuracy for electron beams as outlined above for

(Continued on page 107)

Advantages of TG51 Versus TG21

*TG-51 is much simpler conceptually since it avoids the irrelevant quantity air-kerma.

*TG-51 is much less work to use (once converted!)

*TG-51 is easier to teach and has none of the many known errors in TG-21.

*TG-51 has improved accuracy.

*The TG-51 formalism allows direct measurement of the major factors in the protocol (k_Q, k_{ecal}, k'_{R50}).

photon beams.

So the overall gain in accuracy in electron beams using TG-51 is increases of between 0 and 3% compared to TG-21, the larger changes being for measurements with chambers having aluminum electrodes at high energies. Ding et al have confirmed these expectations[7].

TG-51 recommends cross-calibrating plane-parallel chambers in high-energy electron beams but allows the use of ^{60}Co calibrations of plane-parallel chambers. This latter option is to meet US legal requirements and the cross-calibration technique is to be strongly encouraged in Canada since the data required to use the ^{60}Co calibration factors are somewhat suspect[7](despite being my own calculations, and at the risk of reducing our calibration income!).

Why switch to using %dd(10)$_x$ from TPR$_{20,10}$?

Perhaps the most controversial aspect of TG-51 concerns the issue of beam quality specification in photon beams. Why change?

Consider what happens if NRC measures a k_Q factor for an NE2561 ion chamber in a beam with TPR$_{20,10}$=0.791 and then asks the British standards lab (NPL) to do the same thing. The factors measured differ by 1.2% with a measurement uncertainty of about 0.4%. If we now specify the beam qualities in the two labs using %dd(10)$_x$ we get agreement at the 0.1% level. This is because TPR $_{20,10}$ does not specify the quality of the beams as well as %dd(10)$_x$. If we now ask, How well does this NRC measured k_Q agree with the value predicted by TG-51? the answer is, within 0.5% using %dd(10)$_x$ but it would disagree by 1.6% if TG-51's physics were implemented using TPR$_{20,10}$. The data are from Seuntjens et al[4] who also show that what occurs in this specific example (admittedly extreme) is generally true for different ion chambers and different laboratories. So the need for %dd(10)$_x$ is well established experimentally and was predicted by calculations in 1993[12].

Some claim that %dd(10)$_x$ is hard to measure because of electron contamination effects. For beams with energies of 10 MV and above, one needs to insert a 1 mm lead sheet (being given away for free at the World Congress in Chicago) in the beam instead of measuring the depth-dose curve in the open beam. Then one uses a simple formula to deduce the value of %dd(10)$_x$ in the open beam taking into account the electron contamination generated by the lead and the hardening of the beam by the lead. If we assume that these Monte Carlo calculations are wrong by 50% (and we know they are more accurate than that!), then for a beam with %dd(10)$_x$ = 80%, the error in the assigned dose would be 0.17%. If we altogether ignore the electron contamination correction with the lead foil, the error in the assigned dose is 0.35%. So for an uncertainty concerning electron contamination effects of no more than a few tenths of a percent, we remove an uncertainty (when using measured values of k_Q) of up to 1.1% due to beam quality specification issues.

The Measured Values

One distinct advantage of the TG-51 protocol over the TG-21 protocol is that the major factors (k_Q , k_{ecal} and k'_{R50}) can be measured directly using primary standards for absorbed dose to water whereas many factors in TG-21 are impossible to measure directly (eg, N_{gas}, P_{wall}, (L/rho) etc). Seuntjens et al[4] have measured the most important of these, viz k_Q , and report that for measurements with 20 ion chambers of 6 types at 3 energies, the rms deviation between TG-51 values and measured values is 0.4%, which is comparable to the measurement uncertainty. This gives confidence in the use of these factors. One could, of course, also measure the overall accuracy of TG-21 and Seuntjens et al report that the rms deviation vs TG-21 is 1.7%. They also report that an optimal air-kerma based protocol has an rms deviation from their data of 0.7% (this means that the *extra* rms deviation introduced by using and air-kerma based protocol is larger than the *entire* rms deviation using TG-51).

Conclusions

The TG-51 protocol is not only easier to use than TG-21, it is more accurate and has been experimentally verified for photon beams. The hope is that once it is fully implemented in Canada there will be an improvement in radiotherapy, if only because TG-51 will save overworked medical physicists some time, while at the same time improving accuracy in the doses they assign and minimizing the chances of mistakes.

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Initial Experience with Beam Weight Optimization using Helax-TMS

By Ernst Lederer, C.M.D. and Peter Dunscombe, Ph.D.

The Northeastern Ontario Regional Cancer Centre has been using the Helax-TMS treatment planning system routinely since 1997. With the recent upgrade to Version 5.0, NEORCC was selected as a pilot site for the optional beam optimization software package. In this brief note we review our initial experience in using this software to optimize beam weights for breast and prostate plans.

The optimization algorithm is based on a gradient technique applied to a cost function incorporating dose-volume constraints selected by the user. This software option does include the ability to optimize the modulation of beams to be used for IMRT. Our assessment so far is limited to the optimization of beam weights for open and wedged fields. The user selects the machine, energy, gantry angle and field size and shape and then inputs the dose constraints. These constraints reflect, in a limited way, the desired form of the cumulative dose volume histogram for the target and critical organs of interest. For the target(s) the constraints are used to infer the mean dose and the dose uniformity desired. Additionally the maximum allowed dose can be specified although we did not use this feature. In the case of the critical organs, two points, essentially on an idealized cumulative dose volume histogram, are used to assign relative weights to each organ identified for use in the optimization procedure.

Beam weight optimization of tangential breast fields

Each of the tangential fields comprised an open beam and a (virtually) wedged beam. Thus there were four weights to optimize. Single mid breast (non-CT) transverse contours, including the estimated lung position, were used. These contours were idealised (arc shaped) and three sizes representing small, medium and large breasts were used to explore the behaviour of the algorithm. Optimization was performed on a target volume only and this was drawn within the breast to exclude both the lung and the build up region. Our experience with this part of the study can be summarized thus:

- Optimization required about 2min on an Alpha Station 250.
- Very loose constraints (e.g min 50%; max 150%) resulted in a distribution which satisfied the constraints but was not optimal.
- Very tight dose constraints (e.g. min 98.5%; max 101.5%) resulted in a failure to optimize and equally weighted beams were returned.
- "reasonable" dose constraints in the vicinity of min 95% and max 102% always led to the same optimized beam weights.

We have compared the computer optimized beam weights with those identified by experienced dosimetrists using the conventional approach on four clinical contours. On the basis of the dose statistics within the planning target volume (i.e. minimum, maximum and standard deviation) there was no significant difference between computer optimization and dosimetrist optimization for this simple geometrical situation.

Beam weight optimization of four field prostate treatments

For this part of the study seven clinical CT series were used, thus providing three- dimensional anatomical and density data. The planning target volume was the prostate plus a margin. The organs at risk were the rectum, bladder and entire contour. The target was treated with two orthogonal pairs of parallel opposed beams at 23 MV. Our observations were as follows:

- Optimization typically required 20 min when constraints were placed on four volumes in a 3-D data set.
- With or without critical organ constraints, the optimization routine always returned a reasonably uniform dose distribution for the target (s= 1%) provided reasonable constraints were inputted (for example 100% of the target volume to receive at least 95% of the prescribed dose and no more than 3% of the volume to receive more than 105%).
- The optimised weights returned for the four beams certainly depended on the critical organ dose constraints. However due to the way in which these input dose constraints were used to determine the relative importance of each critical structure some experience was required to obtain clinically acceptable weights.

Helax-TMS could reproduce the beam weights and dose distribution generated by an experienced dosimetrist and acceptable to a radiation oncologist provided the critical organ dose constraints were appropriately chosen. Relative beam weights close to 100(laterals); 80(anterior) and 60(posterior), which are typical of NEORCC's prostate plans, are returned if the critical organ dose constraints require that no more than 40% of the bladder and rectum receive more than 85% of the prescribed target dose and no more than 20% of the scanned volume (in our scanning protocol) , except targets and organs at risk, receives more than 20% of the target dose. These dose constraints were found by trial and error although they could probably have been found by a retrospective analysis of previously approved plans.

Our initial experience with the Helax-TMS optimization software confirms that it does what it claims to do at least as far as beam weight optimization is concerned. With realistic dose constraints for the target volume, a dose distribution is returned which meets or exceeds (slightly) the dose uniformity achievable by an experienced dosimetrist. This bodes well for applications in IMRT where a primary objective is, usually, to design 2-D modulated beams, with possibly complex geomet-

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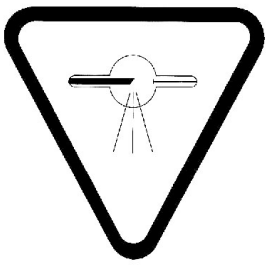
Beam Weight Optimization *(Continued from page 108)*

rical relationships, which yield dose uniformity in a specified three-dimensional target region. Our adventure using dose constraints on critical organs have shown the fairly complicated, and not initially intuitive, relationships between these constraints, the relative importance attached to the various critical organs identified and the resulting optimized beam weights. The value of this feature of the optimization algorithm, given the restriction on the dose constraint input parameters, is not likely to be in the generation of routine plans such as a coplanar four field prostate. An experienced dosimetrist can do just as well.

The true value of such an advanced software tool will be in IMRT where operator design of heavily modulated fields is impractical. To fully realise the potential of dose optimization for both IMRT and traditional radiotherapy, using the Helax-TMS approach, it will be necessary for radiation oncologists, dosimetrists and physicists to be able to distil their requirements for a three dimensional dose distribution down to a few pairs of numbers reflecting the desired dose volume characteristics of the target and, with more difficulty, the relevant critical organs. This is the challenge for the future.



Clinical First at the Cross Cancer Institute

By Colin Field

On April 4, 2000, a team of Medical Physicists, Radiation Oncologists, Dosimetrists, Therapists, and Graduate Students at the Cross Cancer Institute (Edmonton, Alberta) began treatment of their first patient accrued to an in-house protocol designed to study the feasibility of using inverse-planned IMRT for treating Nasopharynx cancer while sparing parotid gland function.

According to Helax, this represents the first clinical use of the Helax-TMS inverse-planning dose optimization software.

The inverse-planning was performed using the FDA approved inverse planning option of Helax-TMS (MDS Nordion, Kanata, Ontario) and delivered on a Varian 2300CD linear accelerator (Varian Oncology Systems, Palo Alto, CA) using the 'step and shoot' technique with a 52 leaf MLC. According to Helax, this represents the first clinical use of the Helax-TMS inverse-planning dose optimization software.

The primary disease and bilateral neck nodes were treated to a median dose of 50 Gy in 25 fractions while sparing one parotid gland. The primary disease received a boost of 16 Gy in 8 fractions, again sparing one parotid gland. Dose-volume constraints were specified for the spinal cord, brain stem, and a parotid gland. An acceptable dose distribution was obtained using 7 treatment fields with each field comprised of 13 to 15 multi-leaf collimated (MLC) segments – a total of 103 MLC segments. These multileaf modulation (MLM) fields were exported from Helax-TMS and, using software developed in-house, converted to the Varian format required for dynamic MLC delivery.

Each treatment field was verified by treating a flat polystyrene phantom and comparing the Beam's-eye view dose distributions measured with film to the corresponding calculated distributions. The composite treatment was delivered to an anthropomorphic phantom (Rando, Alderson Scientific) containing 27 thermoluminescent dosimeters (TLDs). The total time to setup the patient, take localization films, and deliver the treatment was 30 minutes.

EPI2K a PISing Good Time

By Peter Munro

The 6th International Workshop on Portal Imaging (EP12K) was held on 5-7th June 2000, immediately before the 1st International Workshop on IMRT, which was held on 8-9th June 2000. Both workshops were held in the Hotel "Le Plaza" in Brussels, Belgium. The Workshop on Portal Imaging is held every two years and its location alternates between Europe and North America. There were 216 attendees, of which 111 registered for both workshops. [One advantage of a combined meeting was that, unlike most meetings, the last sessions of EPI2K were better attended than the first, due to the influx of attendees for the IMRT workshop.] EPI2K featured an extensive program with 6 refresher courses, 6 invited talks, 56 proffered presentations, and one demonstration, covering topics ranging from clinical implementation of portal imaging to new imaging technologies. For the complete scientific program see http://pc93.roc.wayne.edu/epi2k. Spread out over three days, and with each proffered talk allotted 12 minutes, the pace seemed quite a bit less intense than the average COMP meeting. In addition to the scientific sessions, there was a small commercial exhibit area consisting of about 10 companies.

One of the highlights of the conference was a DICOM demo held on Tuesday afternoon. Marcel Van Herk and his colleagues from the Netherlands Cancer Institute (NKI), set up a DICOM server based on the free software from UC Davis Medical Centre. The demo was set-up very effectively with one computer projector showing the DICOM server and the other showing each vendor's console software. Thus, the audience could see an image being transmitted from the console software and they could also see the response at the server. When the first vendor transmitted their image and it appeared in a display window running on the server, the audience broke into spontaneous applause. This DICOM demo acted as a real impetus for the EPID vendors to implement DICOM support. There were some vendors who had to do some last minute heroics in order to participate successfully in the demo. So apart from Siemens, which was notably absent from the demo, all of the EPID vendors demonstrated their DICOM (or DICOM RT) support.

For those of you interested in DICOM servers, the server created by the NKI group is worth considering. It runs under Window NT, has step-by-step installation and maintenance instructions; and pages for configuration, server status, known DICOM hosts, etc. This software is freely available at "ftp://ftp-rt.nki.nl/outbox/MarcelVanHerk/dicomserver/dicom.html" should anyone be interested in trying it out.

The general tone of this workshop was quite encouraging. The clinical use of EPIDs, especially in The Netherlands, has increased considerably in the past two years. The key seems to be the delegation of image acquisition **and review** to the therapists. Presentations from several therapists discussed training techniques where novice therapists are presented with large numbers of image pairs to register. Only after successful completion of these training exercises can the individuals review portal images. In addition, there was much more information about the extra workload created by the addition of portal imaging to routine clinical procedures. The general number was an additional 2-3 minutes for each image that was acquired and about 40 extra minutes per patient for scanning simulator films, measuring set-up errors and other administrative tasks. One of the most interesting talks was an invited talk from Emile van Lin, a radiation oncologist from Nijmegen, The Netherlands, who described how portal imaging protocols were introduced into their clinic. Their implementation scheme is divided into three phases. In the first phase, technical details such as the optimal imaging technique (e.g., number of monitor units) and the relevant anatomy for that anatomic site are identified by imaging 3-5 patients. In the second phase, 15-25 patients are imaged and the magnitudes of the random and systematic deviations are identified. Then various quantities such as: thresholds for correction, number of fractions that should be imaged, the expected number of corrections, etc. are estimated. Both phase one and two are performed by a small group - in their case two therapists and one oncologist. Finally the protocol is introduced widely, by notifying all staff and by educating a larger fraction of the therapy staff (~30%) with the details of the protocol.

While I was **very** impressed with these sessions, the one thing that I thought was missing from the discussions was how to start portal imaging in centres where no portal imaging is done currently. In addition, a common feature that I noted in all centres that currently use EPIDs extensively is that they have developed extra components (e.g., image archives, easy to use image registration software, etc.) to solve problems that the EPID vendors have not addressed. So it seems to me that portal imaging is still waiting for better EPIDs and more clinically usable software before it can become more widely used. These are coming (e.g. flat panel images, new generations of software), but they will probably not be widely available for several years.

There were several other topic focuses. One was the verification of intensity modulated radiation beams. Two general approaches were presented: leaf tracking, where the position of the MLC leaves are identified in a rapid sequence of frames; and integrated dose measurement, where the fluence reaching the EPID is integrated over the entire beam delivery and compared with the dose prescription. Leaf tracking seemed especially popular, with three presentations on the dynamic perform-

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EPI2K *(Continued from page 110)*

ance of the liquid ion chamber EPID and how to speed up its readout rate (or account for its relatively slow readout) and one presentation using a TV camera system for this task. Another topic was the use of Monte Carlo to predict portal images. One very impressive presentation discussed the use of Peregrine 3D Monte Carlo dose calculation system to simulate portal images. With a calculation resolution of 1 mm^2, the images generated by Monte Carlo were almost identical to those acquired by the imager!

For me, the most interesting session was the "New Technologies" session held at the very end of the workshop. One of the devices discussed was the Gas Electron Multiplier (GEM) system [see Interactions April 46 (2) 67 (2000)] and its imaging performance. The key feature of this imaging device is its potential to have a single device that can image at both kilovoltage and megavoltage energies. However, the most exciting trend is towards non megavoltage imaging approaches. There were talks about using TV cameras to set-up patients, using kilovoltage sources and flat panel imagers to perform cone-beam CT, and integrating kilovoltage sources into linear accelerators. In future, it looks like patient verification will not just be done using the megavoltage beam, but by a repertoire of alternative imaging equipment, as well.

The workshop was tremendously well organised. All lunches were provided, the vendors were very close to the presentations, there were no parallel sessions, and there were several very well attended and enjoyable social activities. In many ways this workshop reminded me of a COMP annual meeting.

With the wide availability of Belgium chocolate and Belgium beer - two of the more important food groups - it was rather difficult not to enjoy the meeting. And the huge quantities of Belgium beer consumed gave a new meaning to the acronym PIS (and I don't mean portal imaging system!).

Fig. 1 Brussels is famous for a different kind of Portal Imaging System - the Manneken Pis.

Hopefully as Canadians we will prove to be as able hosts, because the next International Workshop on Portal Imaging will be hosted in Vancouver in 2002.

Briefing Note for the Human Resources Planning Working Group of the Canadian Cancer Strategy

By L. John Schreiner

Staffing has been a major concern in the medical physics community for some time. The Canadian Organization of Medical Physicists and the Canadian College of Physicists in Medicine have described the role of medical physics in radiation therapy [1], and have suggested staffing formulas for the various professionals in medical physics departments [2,3]. More recently, some provincial cancer agencies have attempted to review staffing standards. For example in February 1999, Cancer Care Ontario presented a report dealing with the core staff for radiation therapy [4] to Ontario's Ministry of Health. A report addressing training and staffing changes for Ontario's medical physicists was prepared at the same time with the Michener Institute [5]. Similar reports have been prepared both officially and unofficially in other provinces [6,7]. These documents all present a consistent view of the medical physics staffing situation and concerns across Canada. This view will be reviewed below.

It should be noted that this submission is restricted to staffing issues for radiation therapy physicists in Canada since it is my understanding that this is the scope for the current Working Group. It should be recognized that imaging medical physicists have similar concerns. In some provinces imaging physicists may also be in the jurisdiction of cancer agencies and staffing problems in these groups may also affect cancer care.

The primary issues identified in the studies of medical physics staffing are similar to those for other professions in oncology. They include recognition of the requirements to:

a) Establish staffing standards

Although recommendations have been made (see Table 1 and ref.[2]), there is considerable variation in current staffing levels across Canada (see Tables 1 and 2). This presents problems, particularly in provinces where workloads are at high extremes. Furthermore, no province has yet achieved 'recommended' levels proposed in past analyses. Finally, the staffing levels established today, or recently in the past, have to be flexible to account for the considerable change in standards of practice in radiation oncology as treatments become more aggressive and complex.

Staff Category	Treated Courses/Year/ FTE Staff - Proposed Ontario Standard	Typical Actual Levels
Physicists	300	~340 to >400
Physics assistants	600	>900 most centres have none
Electronics engineers	500	>750
Mechanical engineers	1000	~1100
Dosimetrists[§]	(450)	?

Table 1: Comparison of actual staffing levels in Canada to the levels proposed in Cancer Care Ontario's *Report Task Force On Human Resources For Radiation Services.* [§]The standard for dosimetrists was included in an initial draft of the report but was rolled into the radiation therapy staffing levels in the final document. [It should be noted that these standards have not been adopted by all provinces. However, they fall in line with past recommendations by physics groups in Canada.

b) Develop strategies to improve staff retention

Salaries, opportunities for professional development, ability to participate in research and sustainable work levels are all recognized as issues which promote (or hinder) staff retention. These are being addressed in select locations across Canada, but there are no national standards. Inequities across the country (and internationally) are currently causing considerable concern, especially in Québec, Saskatchewan, Manitoba and New-Brunswick, as well as in the smaller centres in the other provinces. In the past, Canada trained a significant number of medical physicists that were attracted to the US, where they have always been, and are still, highly regarded.

c) Improve recruitment of new staff,

The issues of importance for staff retention are also central in recruitment. In fact, they are more important as people will not move unless they perceive that their situation is improving. The smaller centres in Canada are extremely concerned that they will not be able to compete in the new competitive market. Cancer centres which are part of individual hospital centres rather than cancer agencies are particularly vulnerable in this regard as administrations may not recognize concerns of medical physics departments.

d) Training of future staff through residency programs.

It is clear that the physicist shortages have resulted partially because of the lack of committed and sustained support of clinical training of medical physicists. It takes 4-8 years of post graduate education to train a medical

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Province	Physicists		Physics Assistants		Residents		Comments
	Actual	Vacancies	Actual	Vacancies	Actual	Vacancies	
Nfld	2	1	(1)	-	-	-	
NS	7	(2)	2	-	-	(1)	
PEI	1	-	-	-	-	-	Physicist supervises operation of whole RT department.
NB	6	-	-	-	-	-	> 400 new treated courses / physicist neglecting administrative duties
QC	38	4	-	-	2	-	Lowest staffing levels and wages in Canada. 1 or 2 additional physicists per year required over next 10 years to reach and maintain 400 new treated courses per year. On average 2 physicists leave QC per year.
ON	64	10 + (8)	30	-	12	7 (starting April 2000)	3 new centres requiring at least 12 physicists will open in next 2-3 years. 36 physicists left Ontario between 1994 and 1999 (inclusive) while 5 were recruited in this period.
MB	6	4	-	-	2	1	
SK	7	0	-	-	-	-	
AB	14	(6)	2	-	2	-	Report of physics staffing prepared by medical physicists in 1999 [6]
BC	31	6	7	-	-	-	
Total Canada	**176**	**41**	**42**	**?**	**18**	**9**	

Table 2: Comparison of actual staffing levels in Canada for the three professions which impact directly on medical physicists' activities in the support of clinical radiation oncology. Data are from provincial studies and from a straw poll of Medical Physics clinical heads in early February 2000. Numbers in parentheses are NOT funded currently.

Briefing Note HRPWG *(Continued from page 112)*

physicist, two years as a resident or junior physicist. This training is only supported in a minority of provinces. Lack of supported training programs is a particular problem in the smaller provinces which have a greater difficulty recruiting qualified personnel. As recognized above, retention of trained physicists in provinces that do have clinical training programs has been a problem, and a large fraction of trained individuals have left.

The requirements a) to d) are important for the consideration of this working group. Ontario has moved to address these issues to some degree in the last year, and other provinces are looking to see the implications of this change. There is considerable concern that recruitment in Ontario (and perhaps BC and Alberta which may follow Ontario's lead) will deplete physics staff in the rest of the country.

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Report of the Human Resources Planning Working Group of the Canadian Strategy for Cancer Control

By Andrew Padmos, BA, MD, FRCPC
Chair, Human Resource Planning Working Group
Commissioner, Cancer Care Nova Scotia
(Contributed by L. John Schreiner)

The members of the HRPWG acknowledge with thanks the contributions of the late Dr. Bill MacDiarmid, patient representative to this committee, on behalf of the Canadian Cancer Society.

Introduction

Canada is rife with acute and chronic shortages of key personnel in the cancer workforce needed to address cancer prevention, treatment and support programs. Shortages of cancer human resources have been experienced in most geographic areas of Canada and in most cancer disciplines on more than one occasion in the past twenty years.

These workforce shortages result in delayed treatment for some cancer patients or divergence from the acceptable standard of care for others. Shortages of key personnel result in disruption of referral patterns and interference with collaborative, interdisciplinary programs of clinical care, education and research.

Canada is currently dependent on external resources for treatment of some cancer patients with radiation therapy as well as for supply of many personnel in the cancer workforce. Existing cancer programs are operating with reduced staffing while facing increasing caseloads resulting in distress and demoralization.

Since cancer system requirements can be predicted using population-based models, information, data and advice on policy and practice for cancer workforce development and maintenance have not been lacking. Rather, there has been a failure or inability to implement recommendations on the part of funding authorities and cancer employer agencies. Failure to implement recommendations has been in part due to a lack of intersectoral cooperation leading to deep cynicism on the part of stakeholders who question the commitment of authorities and agencies to respond adequately to staffing problems and reduce the likelihood of future shortages of key personnel.

Members of the Human Resources Planning Working Group have identified the clear need for a human resources strategy and process rather than a project or analysis at a single point in time.

Recommendation

The Human Resources Planning Working Group of the Canadian Strategy for Cancer Control recommends that:

- *Collaborating authorities create a National Cancer Workforce Strategy and office to provide accurate and regular reports to enable rational, timely and comprehensive human resource planning and resource allocation for cancer control in Canada.*

- *The National Cancer Workforce Strategy and office would be appropriately linked to processes to determine and implement workload standards and staffing ratios by professional disciplines, thereby taking into account care delivery systems, role and practice models, technical change and workforce evolution.*

Components of a National Cancer Workforce Strategy

An inventory and database would be developed and maintained to provide an accurate and up-to-date registry of cancer control personnel in Canada. Individuals would be registered by discipline, by centre or program and by geographic unit and subunit.

The inventory and database would be developed and maintained by collection of information from multiple sources including professional associations, employer organizations and agencies, licensing and certification bodies and training programs. Information collected will be validated and cross-checked for accuracy and completeness.

The end result and deliverable would be an accurate and comprehensive registry of cancer workforce membership which would support regular reports, research projects and operational planning needs for the cancer system in Canada.

The cancer workforce inventory will need to incorporate input data from training programs showing projected outputs in order to support planning and projection requirements. The net effects of immigration, emigration and relocation must be applied to the workforce inventory process.

A regular and repetitive survey of individuals registered in the inventory database would provide data on retirement projections, relocation activities and work life issues. These data would be available for analysis and research to increase the accuracy of inventory and planning functions.

Data on compensation and benefits by professional discipline and geographic location would be collected for comparative purposes to address and ameliorate competitive recruitment pressures due to differing compensation levels.

As roles evolve in each professional discipline, responsibilities will change and staffing ratios will be revised ap-

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Report of HRPWG *(Continued from page 114)*
propriately. The workforce inventory would track and predict vacancies and shortages by discipline, by geographic unit and employer organization. The National Cancer Workforce inventory will reflect changes in practice, roles and care delivery models but will not determine the direction or substance of these issues.

Deliverables from a National Cancer Workforce Strategy

The strategy would enable production of an annual report describing the cancer workforce inventory and database, reporting on staffing needs and vacancies by professional discipline, geographic area, cancer program or centre or other parameters as required.

The inventory database will serve as a rich source of information for planning and research as well as assessment of changes in workforce parameters.

Recommendations concerning workforce development and change could be regularly provided to funding authorities and sponsoring organizations.

Development of a National Cancer Workforce Strategy

Because of the number of disciplines involved and the complexity of human resources planning in health human resources a phased approach to the National Cancer Workforce Strategy may be in order. For example, it may be feasible to start with professional disciplines employed at provincial cancer centres and later expanding to include hospital-based cancer workforce members and eventually community-based caregivers.

Important linkages between the Strategy and other partners will be required including the NCCPMT (National Coordinating Committee on Postgraduate Medical Training), the CMA (Canadian Medical Association) and National Associations and Organizations representing individual professional disciplines in the cancer workforce, e.g. RCPSC (Royal College of Physicians and Surgeons), CNA (Canadian Nursing Association), etc.

Sponsorship and governance for the National Cancer Workforce Strategy and resources to develop, implement and maintain the Strategy are required. Sponsorship may be provided by any or all of the Canadian Strategy for Cancer Control, Health Canada, the Advisory Committee on Health Human Resources on behalf of Federal/ Provincial/ Territorial Departments of Health and/or the Canadian Association of Provincial Cancer Agencies (CAPCA).

In Brief

AMPM 2000

The second annual meeting of the Atlantic Medical Physicists will be held September 22-23, 2000 in Moncton, NB. Medical physics staff (physicists, dosimetrists, and support personnel) from all Atlantic Provinces are invited to attend the 2-day meeting. The annual meeting provides an excellent forum to discuss professional and scientific issues of particular interest to Atlantic Medical Physicists. See you in September!

Clément Arsenault

Manitoba Medical Physicists Salaries

The salaries of medical physicists have been on the minds of physicists in Manitoba since the large increases at PMH and CCO were given. This spring we undertook an informal salary survey and found that Manitoba medical physicists were among the lowest paid in Canada. We received a 3% raise last year and a 2% raise this year to put our salaries between $53.5k and $79.6k. In comparison the physicists in Ontario make 48% more, i.e., $79.4k to $118k. Given the strong demand for medical physicists in Ontario, management has provided an interim $20k retention bonus for the 2000/2001 fiscal year. In addition, they have promised to establish, by September 2000, new salary scales for the 2001/2002 fiscal year. The retention bonus has increased morale and we look forward salaries that are comparable to that of CCO.

Daniel W. Rickey

COMP Annual Meeting in 2001

It's time to start thinking about next year's meeting, COMP 2001 in Kelowna, BC, in particular, what to do outside the conference times. The local arrangements people will be putting information on the web site to help you decide what you and your family might do while visiting here. Kelowna is located in the Okanagan valley, in the south-central region of B.C. The Okanagan region itself is a popular tourist destination, and is a good starting point for trips to other regions of BC or western Al-

(Continued on page 117)

New Methods of Scientific Publishing

By Peter Munro

There have been several developments in the area of scientific publishing, which may eventually have a big impact on how we publish scientific research. In January 2000 PubMed Central (see http://www.pubmedcentral.nih.gov/) started making peer-reviewed publications available on-line. The brain-child of Dr. Harold Varmus when he was the Director of the NIH, PubMed Central was established as a way to make scientific research, which is generally paid for by tax-payers funding, freely available to everyone with Internet access. So far there has been relatively poor response by the publishing or scientific community, but this may soon change. On 21 May 2000 BioMed Central (see http://www.biomedcentral.com/start.asp) started to accept manuscripts for on-line publication. BioMed Central is part of the Current Science Group (see http://www.current-science-group.com), a group of independent companies that collaborate closely with each other to publish and develop information and services for the professional biomedical community. Authors publishing papers on BioMed Central will retain the copyright of their work - BioMed Central will require only the non-exclusive right to distribute the research and to be cited as the original publisher of the article. In addition, all peer-reviewed research published by BioMed Central will also be made available immediately on PubMed Central. In addition to peer-review manuscripts, BioMed Central also accepts non-peer reviewed manuscripts.

But what eventually may turn out to be a most far-reaching development, because it follows the open source software model, is "Cogprints" - a freely available software product that allows users to "publish" their manuscripts in a format that ensures interoperability with others using the same software (see http://cogprints.soton.ac.uk). While it is too early to predict whether "Cogprints" will become universally accepted, the concept of a "Napster" for scientific publications is one that probably will prove to be irresistible to the scientific community. Initially, such a system will probably link manuscripts from a single institution into a digital archive. But eventually, the opportunity to link these distributed manuscripts into a vast digital library will prove to be irresistible to some entrepreneur. So although it may take some time, significant changes in how scientific manuscripts are reviewed and distributed are likely to occur in the coming years.

Study Guide for Radiation Oncology Physics Board Exams

Author: Brian D. Breman, M.S., D.A.B.R.
Editor: Bruce R. Thomadsen, Ph.D., D.A.B.R., D.A.B.M.P., D.A.M.H.P.

By Dimitris N. Mihailidis
Richland Memorial Hospital

Medical Physics Publishing made available to me a copy of this text to be reviewed for the COMP newsletter. This guide is the only one, that I know, which became recently available and that outlines the fundamental topics required to be prepared by a candidate for any board exam in Radiation Oncology Physics. Although my personal experience is limited to the ABMP board exam, I feel comfortable to comment on the requirements of the ABR too.

The guide is structured in a methodical way starting with a condensed account of basic general physics (Chap. 1) and then nuclear and atomic physics and processes (Chap. 2). Then, it moves on to the mechanisms of x-ray production (Chap. 3) and an account of the most important properties and components of therapy radiation generators (Chap. 4). The main points of interactions of electrons and charged particles with matter (Chap. 5) and photons with matter (Chap. 6) are described in a systematic although brief way. Measurement of dose, the instruments used and their properties and a useful account of the main points of the two AAPM calibration protocols (TG-21 and TG-51) are given in Chap. 7. A number of treatment planning issues for external photon beams and algorithms (Chap. 8) and brachytherapy physics and dosimetry (Chap. 9) cover the most basic ideas on those areas. Radiation protection (Chap. 10) is the last topic of radiation therapy physics and includes information on radiation safety, structural shielding and monitoring instruments. At the very end a brief rundown of radiation biology is presented (Chap. 11).

I find this guide useful as a aide that lists the basic and general topics in radiation oncology physics during a board exam preparation and as the author says "The user should regard it as an incomplete outline of fundamentals by which you can recognize weaknesses in your understanding of the field and determine specific areas that require further study". The reader should keep in mind that there is a large number of topics required to be prepared and mastered before entering a board examination in radiation oncology physics that are not included at all in this guide. Those topics are more practical and are used in the clinical environment. Few examples are, quality assurance of radiotherapy equipment and treatment planning systems, clinical electron beams and treatment planning with electrons, radiation treatment design, special treatment procedures (total body irradiation, total skin irradiation, stereotactic radiosurgery, etc).

In Brief *(Continued from page 116)*
berta. See the web site at http://www.medphys.ca/conference/local/ to start planning! If you have any further questions, or know of good links we should add, please email me at dmason@bccancer.bc.ca.

Darcy Mason

Therapy Expansion in Ontario

Three new cancer centres are being planned or are under construction in Ontario (in Kitchener, Oshawa and Mississauga), plans are being made for two more facilities (in St. Catherines and Sault St. Marie), early discussions are being held for another (in Barrie), and expansions are planned for four existing centres (in Windsor, Sudbury, Hamilton, and ThunderBay). Of the new centres, the furthest along is the Grand River Regional Cancer Centre located in Kitchener-Waterloo [see http://www.grrcc.on.ca]. The 100,000 square-foot, $48.3 million centre is slated to open by spring 2002. So far only the CEO, Dr. Brain Dingle, has been appointed. The centre will have six bunkers of which three will be populated when the centre is opened, with the other three bunkers being populated by 2005. The Durham Regional Cancer Centre will be located beside Lakeridge Health Oshawa (the former Oshawa General Hospital). Currently, the host hospital is undergoing major construction, with construction of the cancer centre slated to be the last part of the redevelopment. The last of the three new cancer centres will be located beside the Credit Valley Hospital in Mississauga and known as the Peel Regional Cancer Centre. Currently, lands in the northeast corner of the hospital grounds are being rezoned to allow for the expansion. Both the Peel and Durham centres will have six bunkers with three populated upon initial completion of the centres. The Windsor Regional Cancer Centre is the most advanced in its expansion [see http://www.wrcc.on.ca/information/newcentreupdates/]. The shell for an entirely new building, housing three new bunkers and accelerators has been completed, accelerators are scheduled to be delivered and installed in Oct. 2000, and the expansion is projected to go clinical in Dec. 2000. Now if they could only find the staff to operate these facilities ...

Peter Munro

Update of National Survey

By William Que
Ryerson Polytechnic University

In the April 2000 issue of Interactions, I published the results of a national survey of the training of Canadian M.Sc. and Ph.D. graduates in medical physics. The survey form was sent to the 13 medical physics graduate programs listed on the COMP website. After my article appeared in Interactions, I was contacted by Dr. Luc Beaulieu, Head of the Medical Physics Research Group at CHUQ, Hotel-Dieu de Quebec. He informed me that Laval University has a graduate program in physics with medical physics as one of the subspecialties. Dr. Beaulieu was kind enough to answer the survey for Laval University. The updated results are presented in the table. I apologize for unknowingly omitting Laval University from the survey, and thank Dr. Beaulieu for pointing out the omission and answering the survey.

University	Number of M.Sc. Students		Years to complete M. Sc. (avg.)	Number of Ph.D. Students		Years to complete Ph.D. (avg.)	Ph.D. degrees Awarded- Last Five Years		M.Sc. degrees Awarded-Last Five Years		% Leaving Canada
	All areas	Radiation	M. Sc.	All areas	Radiation	Ph.D.	All areas	Radiation	All areas	Radiation	
McGill	17	13	2.25	4	4	3.5	8	6	26	23	16
Montreal	1	0	2	1	0	4	1	0	3	0	0
UBC	1	1	2	4	4	4	3	3	2	2	10
Toronto	21	2	2.7	18	0	4	7	1	18	0	32
Dalhousie	0	0	2	NA	NA	not offered	NA	NA	1	1	0
Western	17	1	2	32	3	4	37	5	34	0	60
Carleton	15	2	2.2	3	0	6	11	7	5	1	0
Manitoba	4	2	2	3	2	5	6	1	1	1	0
Laval	4	2	2	2	2	3.5	0	0	8	5	0
Total/year	35.65	10.43		16.56	3.86		14.6	4.6	19.6	6.6	

Letter to the Editor

By Kurt Luchka

Your April cover story (Flat Panels Arrive) showed qualitatively the remarkable improvement in image quality from the new amorphous silicon flat panel EPID. Unfortunately, the quantitative test results submitted with the images were omitted, which is a pity since therein lies an interesting Canadian success story.

The QC-3 test phantom was developed in Winnipeg by a team of Canadian researchers[1], and is now used in over 50 cancer treatment centres, including 12 centres in Canada. It gives quantitative, objective, reproducible and highly accurate measures of image quality, specifically f_{50} for spatial resolution and CNR for contrast resolution. Used with the PIPSpro software[2] (another Canadian success story), the analysis is automatic and quite independent of observer bias or error. For a list of relevant publications by authors from around the world visit the "Publications" page at http://go-pips.com.

The QC-3 test phantom was used to compare the image quality of the new PortalVision AS500 flat panel EPID[3] with our standard PortalVision Mk II EPID[3]. Published results[4] for a wide range of PortalVision EPIDs give expected values of $f_{50} = 0.258 \pm 0.008$ lp/mm at 6 MV and $f_{50} = 0.251 \pm 0.007$ lp/mm for 10-25 MV. Our test PortalVision Mk II gave results consistent with these values ($f_{50} = 0.257$ lp/mm at 6 MV and $f_{50} = 0.246$ lp/mm at 18 MV). The AS500 flat panel EPID gave $f_{50} = 0.391$ lp/mm at 6 MV and $f_{50} = 0.338$ lp/mm at 18 MV, an improvement of 16 times the standard deviation at 6 MV and 13 times the standard deviation at 18 MV. CNR increased by about 250% for the same dose, indicating that the noise level in the AS500 was less than 60% relative to the PortalVision Mk II.

There are two stories here - the greatly improved image quality from the AS500, and the use of "Made in Canada" quantitative tools to make the tests.

1. R. Rajapakshe et al. A quality control test for electronic portal imaging devices. Med. Phys. 23: 1237-1244 (1996).
2. Masthead Imaging Corporation, nanaimo, B.C.
3. Varian Medical Systems, Palo Alto, CA.
4. S. Shalev et al. Techniques for commissioning electronic portal imaging devices. Proc. XII ICCRT, Salt Lake City, 1997. pp. 272-275.

Graduate Theses 1999

By Darcy Mason

Yes, it's time once again to take a look back and appreciate the quality and variety of work coming from the nation's graduate schools. This submission covers the calendar year 1999. If you are interested in how these are collected, see the January 2000 issue of *Interactions*.

In addition to the quality and variety of theses, we are now dealing with a large *quantity* as well, which is taking up a large section in *Interactions*. So, this time we decided to print only the title and author information; the full references should be on the web site by the time you have the paper copy of the newsletter. We would appreciate any feedback on whether this new arrangement suits your needs well enough.

If you are aware if any completed theses missing from this collection, please let me know - I will make sure there are added to the web site, and published in the next newsletter

These abstracts were collected in part using the Bell and Howell web site. For more information on the abstracts or to order a copy of a dissertation, contact Bell & Howell Information and Learning Company (formerly UMI), 300 North Zeeb Road, Ann Arbor, MI 48106-1346 USA. Telephone (734) 761-7400; E-mail: info@bellhowell.infolearning.com; Web-page: www.bellhowell.infolearning.com.

Carleton University

Monte Carlo Study Of Photon Beams From Medical Linear Accelerators: Optimization, Benchmark And Spectra
Sheikh-Bagheri, Daryoush; PhD; Adviser: Rogers, David W. O.

Daltech-Dalhousie University

Event Detection And Signal Compression In Digital Electrocardiograms
Blanchett, Travis Paul; MSc; Adviser: Kember, Guy C.

McGill University

Scatter Factors and Peak Scatter Factors for Cobalt-60, 6 MV, 10 MV, and 18 MV Photon Beams
Abdel-Rahman, Wamied; Adviser: Podgorsak, E.B.

Quantitative Analysis of Metabolic Breast Images from Positron Emission Mammography (PEM)
Aznar, Marianne; Adviser: Thompson, C.J.

Magnetic Resonance Diffusion Tensor Imaging
Campbell, Jennifer; MSc; Adviser: Pike, G.E.

Local dosimetric modelling of radioactive coronary stents
Corbett, Jean-François; MSc; Adviser: Corns, R.A.

Spiral irradiation in stereotactic radiosurgery
Dubé, Frédéric; MSc; Adviser: Podgorsak, E.B.

Analysis of Metal/Film and Novel Metal/*a*-Se Portal Detectors
Falco, Tony, PhD; Adviser: Fallone, B.G.

Commissioning A Dynamic Multileaf Collimator on a Linear Accelerator
Gélinas, Dominic; MSc; Adviser: Evans, M.

Particle Size Determination for Alpha-Emitters Using CR-39
Hegyi, Gyorgy; MSc; Adviser: Richardson, R.B.

McMaster University

Beta and Electron Dose Imaging Using a Microspectrophotometer System and Radiochromic Film.
Chan, Gordon H.; PhD; Adviser: Prestwich, W.V.

Electroencephalographic Evidence for Auditory Cortical Plasticity in Humans Trained on a Frequency Discrimination Task
Eaton, Robert A.;MSc; Adviser: Roberts, L.E.

A Diffusion Theory Model of Spatially Resolved Fluorescence from Depth Dependent Fluorophore Concentrations.
Hyde, Derek E.; MSc; Adviser: Farrell, T.J.

Beta-Gradient Isochrons Using Electron Paramagnetic Resonance: Towards a New Dating Method in Archaeology
Marsh, Rebeccah E.; MSc; Adviser: Rink, W.J.

Dosimetry of 125I Brachytherapy Seed Sources
Murphy, Rebecca; MSc; Adviser:Prestwich, W.V.

Measuring Lead, Mercury, and Uranium by in Vivo X-ray Fluorescence
O'Meara, Joanne M.; PhD; Adviser: Chettle, D.R.

University of Alberta

Development Of Equivalent Uniform Dose Models For Normal Tissue Irradiation
Gagne, Isabelle Marie; MSc; Adviser: Robinson, Don

Biological Responses Of Tumour Cells To Freezing Using A Novel Cryosurgical Model System
Humphreys, Christine Elsa; MSc; Adviser: Mcgann, L. E.

Experimental Determination of Relative Outputs of Sr-90 Ophthalmic Applicators and the Anisotropy Function of the Model 6711 I-125 Seed
Menon, Geetha; MSc; Adviser: Sloboda, Ron

The Risk Of Breast Cancer From Hormone Replacement Therapy Combined With Mammographic Radiation Exposure
Schumaker, Carl David; MSc; Adviser: Filipon, Larry

University of British Columbia

Characterization Of Small High Energy Photon Beams In Homogeneous And Heterogeneous Media
Charland, Paule; PhD; Adviser: El-Khatib, Ellen

X-ray Computed Tomography for Performing Polymer Gel Dosimetry: A Feasibility Study
Hilts, Michelle; MSc; Adviser: Duzenli, C. and Audet, C.

Detection Of Soft Tissue Abnormalities In Mammographic Images For Early Diagnosis Of Breast Cancer
Sameti, Mohammad; PhD; Adviser: Ward, Rabab K.

University of Toronto

Development of a Phantom for Calibrating Thermal Therapy Devices Using MRI
Bouchard, Louis-Serge; MSc; Adviser: Bronskill, M.

Monitoring Changes in Aortic Diameter by One-Dimensional (1-D) Magnetic Resonance Imaging (MRI) of Perpendicular Diameters
Chia, Yee Hong; M.Sc., Adviser: Wood, M.

Mechanisms of Fluorescence Endoscopy of the Human Colon
DaCosta, Ralph Sebastian Lourdes; MSc; Advisor: Wilson, B.

University of Waterloo

Low Magnitude Loading Of The Spine: In-Vivo And In-Vitro Studies
Callaghan, Jack Patrick; PhD; Adviser: Mcgill, S. M.

University of Western Ontario

In-Vivo Short Echo Hydrogen Spectroscopy: Precise Quantification And Application To Mental Illness (Cerebral Metabolites)
Bartha, Robert; PhD; Adviser: Drost, Dick

Coronary Circulatory Reserve In Normotensive Hyperdynamic Sepsis (Myocardial, Oxygen Demand)
Bloos, Frank Dietrich; PhD; Adviser: Ellis, Chris

Automatic Needle Localization In Ultrasound Images
Draper, Katharine Janet; MSc; Adviser: Fenster, Aaron

Computed Rotational Angiography: Use Of C-Arm-Mounted XRII For 3D Imaging Of Intracranial Vessels During Neuro-Interventional Procedures
Fahrig, Rebecca; PhD; Adviser: Holdsworth, David W.

Design And Performance Of A Quadrature Elliptic Birdcage Resonator For Magnetic Resonance Imaging
Keller, Jeffery Stephen; MESc; Adviser: Lovetri, Joe; Rutt, Brian

Development Of A Practical Coherent Scatter Computed Tomography System
Lai, Hao; MESc; Adviser: Cunningham, I. A.; Lovetri, J.

Wall Characteristics Of Saccular Aneurysms From Polarized Light Microscopy
MacDonald, Donia Joy; MSc; Adviser: Canham, Peter

Biomechanical Analysis Of Flexor Tendon Repairs
Sanders, David William; MSc; Adviser: King, Graham J. W.

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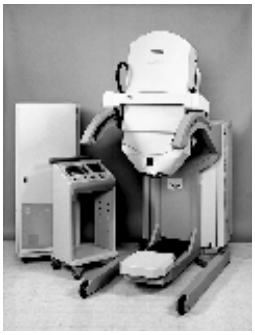

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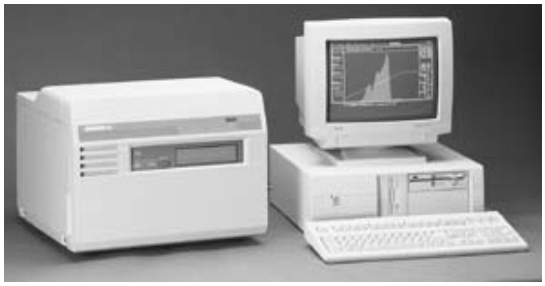

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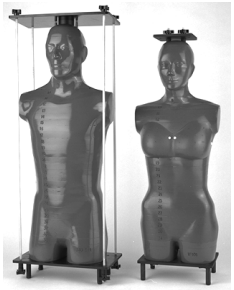

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Sean Eckford of Hilferdine Scientific will be joining Bicron RMP July 24th and 25th at their booth during the World Congress in Chicago. Canadian customers are encouraged to drop by and say hello.

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The Pontchartrain Hotel - New Orleans, LA
The medical physicist plays a major role in ensuring the proper application of mammography. This seminar is for those wanting to learn more about the technical aspects of mammography. It also provides an update on mammography physics and technology.

MR Imaging: A Seminar for Physicists
New Orleans, LA, USA - Sept.30-Oct. 1, 2000
Crowne Plaza Hotel – Foster City, CA
The clinical medical physicist is important in assisting facilities in expanding the use of MRI to more advanced applications. This seminar is for medical physicists wanting to learn more about the technical aspects of MR Imaging. It also serves as a review of MRI technology.

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Position for Research Physicist/Engineer in Medical Imaging

SUNNYBROOK AND WOMEN'S COLLEGE HEALTH SCIENCES CENTRE is a large, research/teaching hospital hosting multidisciplinary life science research, including the Imaging Research Group in the Department of Medical Biophysics, University of Toronto. The Digital Mammography Laboratory has immediate openings for individuals with Bachelors or Master's degree in engineering, applied physics, astronomy or applied math/computer science and a strong capability in computer software or electronics. Excellent organizational skills, english communication skills, attention to detail, flexibility and the ability to prioritize tasks and meet deadlines are essential.

A solid background in experimental physics with a good working knowledge of Fourier methods and data analysis is required. Also essential are good verbal and written communication skills. The ability to work effectively with physicians and other clinical professionals is essential. A thorough knowledge of Windows, UNIX and C/C^{++} programming is essential. Formal or informal practical experience with optics, darkroom photography, computer interfacing and machining would be considered as major assets. The position will involve occasional travel. A valid Ontario driver's license is required. Some machine shop experience would also be helpful.

The work will be project-oriented. Specific duties could include:

- design, construction and maintenance of laboratory equipment - optical, mechanical and electronic
- carrying out x-ray experiments under the supervision of a senior physicist
- developing software for medical imaging and image analysis
- inspection visits to radiological imaging facilities in Ontario to help carry out an ongoing physics quality assurance program (appropriate training would be provided)
- providing support in the preparation of reports, courses and grant applications (photography, etc.)
- providing computer support to graduate students and other users
- participation in the development and testing of digital mammography systems, data analysis and documentation of results.

If interested, please send a résumé and cover letter to:

Martin J. Yaffe, Ph.D.
Professor, Department of Medical Biophysics
Imaging/Bioengineering Research, Rm S657
Sunnybrook Health Science Centre
2075 Bayview Avenue
Toronto, Ontario
M4N 3M5

Applications from all appropriately qualified individuals are appreciated, however, we will only be able to respond to those selected for an interview. The applicant must be able to work in Canada.

Medical Physics Positions

Queen Elizabeth II
Health Sciences Centre

Applications are invited for three Medical Physics Department positions at the Nova Scotia Cancer Centre, Queen Elizabeth II Health Sciences Centre in Halifax:

- **Senior Medical Physicist** **Competition # 2150**
- **Medical Physicist** **Competition # 2152**
- **Junior Physicist (dosimetry)** **Competition # 2151**

The Nova Scotia Cancer Centre (NSCC), along with the Cape Breton Cancer Centre, provide radiation therapy treatment services to the residents of Nova Scotia. The Medical Physics Department at the NSCC presently employs five medical physicists, a Junior Physicist and a Physics Assistant who providing physics services to the NSCC. Two additional physicists are permanently located at the Cape Breton Cancer Centre. The three new positions will add to the complement in Halifax.

The Halifax Clinic has recently been re-equipped with four Varian accelerators with MLC and Portal Vision. Selectron LDR and HDR units are in use as well as a Theratron 1000 cobalt unit and a superficial x-ray machine. Simulation is carried out on a Picker AcQsim CT system and on a conventional Philips simulator. Theraplan Plus and Nucletron brachytherapy planning systems are in use. A machinist and two electronics technologists provide equipment maintenance support. Stereotactic radiosurgery and prostate implant programs are in the planning stages.

There is an active Radiation Oncology residency program and individual and cooperative research programs are encouraged. Radiation oncologists and medical physicists are members of the Dalhousie University Department of Radiation Oncology.

Applicants for the Senior Physicist position must be Fellows of the Canadian College of Physicists in Medicine (CCPM), or equivalent, and have extensive clinical experience in radiation oncology medical physics. Research, teaching, and supervisory experience is an asset.

Applicants for the Physicist position must have an M.Sc. or Ph.D. in physics, preferably in medical physics, and have completed a medical physics residency program or have two years of clinical experience.

The Junior Physicist (dosimetry) position requires an M.Sc. in physics or a B.Sc. in physics, several years of experience in the dosimetry field and, preferably, CMD certification. The preferred candidate will be a person with excellent physics, computer and inter-personal skills and with a strong dosimetry background. The position will be almost entirely within the planning and dosimetry area and will provide strong physics support for dosimetry.

Salaries depend on qualifications and experience and are under revision. Applications are invited from all qualified candidates. In accordance with Canadian Immigration requirements, priority will be given to Canadian citizens and permanent residents of Canada. Please submit a covering letter quoting the above competition number of the position being applied for, a curriculum vitae and the names of three professional references by July 30, 2000 to:

Human Resources, QEII Health Sciences Centre, 1278 Tower Road, Halifax, Nova Scotia B3H 2Y9

Applications may also be submitted electronically, see the QEII web site www.qe2-hsc.ns.ca, or by fax to (902) 473-8499.

Applicants wanting to discuss these positions prior to applying may contact Dr. John W. Andrew, Chief Physicist, at phone (902) 473-6017 or e-mail ccjwa@qe2-hsc.ns.ca.

Halifax is a vibrant metropolitan area of 350,000 between the Atlantic Ocean and beautiful countryside. Check Dalhousie, Halifax and Nova Scotia out at www.medicine.dal.ca, www.region.halifax.ns.ca, and www.explore.gov.ns.ca.

Princess Margaret Hospital
University Health Network

EXPLORE THE FUTURE IN ONTARIO, CANADA

Cancer Care Ontario's eight regional cancer centres and the Princess Margaret Hospital are currently recruiting qualified **Medical/Clinical Physicists** to join their multidisciplinary radiation program teams.

Located in Ontario, Canada's largest province with a population of over 10 million, the nine centres are equipped to support modern 3D radiation treatment planning, high energy photon and electron radiation treatment and LDR and HDR brachytherapy. Several regional cancer centres and the Princess Margaret Hospital have virtual simulation capability and perform stereotactic radiosurgery, I-125 brachytherapy, total body irradiation, and IMRT.

Cancer Care Ontario

Cancer Care Ontario's eight regional cancer centres are the foundation of one of the world's largest cancer treatment, research, and education organization. The centres are located in Ontario's major regional centres - Toronto, Hamilton, London, Windsor, Kingston, Ottawa, Sudbury and Thunder Bay. Three additional centres in Kitchener, Mississauga and Oshawa are expected to open in early 2002.

Princess Margaret Hospital (part of the University Health Network)

Princess Margaret Hospital is Canada's largest teaching hospital and research facility exclusively devoted to cancer treatment, research and education. The hospital houses 14 linear accelerators and 3 cobalt 60 units,
as well as 3D treatment planning and simulation facilities.

Ontario centres have been pioneers in the development of new radiation sources, digital portal imaging systems, tools for radiosurgery, and dose calculation algorithms for 3D treatment planning now used on computer systems worldwide. Some centres are involved with laser photodynamic therapy and radiobiology research programs.

Medical/clinical physicists are eligible for academic appointments with affiliated universities and are active participants in clinical training programs.

Successful candidates will have a MSc or PhD (preferred) in medical physics or related discipline from a recognized university, at least two years of clinical experience and membership or eligibility for membership in the Canadian College of Physicists in Medicine (CCPM). A proven record of productivity in research or clinical development activity will be a definite asset.

Cancer Care Ontario and Princess Margaret Hospital offer outstanding compensation (salary $79,403 to $105,000 annually for medical physicist; $92,195 to $118,000 annually for senior medical physicist) and benefit packages, including comprehensive health care. In addition, successful candidates will be reimbursed relocation expenses according to policy.

Please submit curriculum vitae to:

Manager, Radiation Treatment Program Recruitment
Cancer Care Ontario & Princess Margaret Hospital
620 University Avenue, 15th Floor
Toronto, Ontario, Canada M5G 2L7
Fax: (416) 971-5400
E-mail: provincial.human.resources@cancercare.on.ca

From the Editor:

As most of you are aware, this is my last issue as Editor of the Newsletter, so I think that it is an opportunity to look back on what I have accomplished in the past three years. The most obvious changes have been in the name and the layout of the newsletter. Looking back, it is quite a shock to see how visually unappealing my early publications really were. However, the layout of Interactions has evolved over the period of my tenure and I expect that it will continue to evolve in the future. Indeed, I have set some plans in motion that may ultimately turn Interactions into a very professional looking publication. One of the things that I am most proud of is improving the archival nature of Interactions. By obtaining an ISSN (International Standard Serial Number) for Interactions, two copies of all issues are now sent for legal deposit and are preserved in the National Library of Canada's permanent collection. Moreover, Interactions is now listed in Canadiana, the national bibliography, which can be searched (for best results search using the ISSN) on-line at http://amicus.nlc-bnc.ca/resanet/reslogine.htm. So, in some ways, Interactions has become an official publication. One of the side benefits of obtaining the ISSN was that the National Library requested all back issues of the newsletter. That request started me on a search for back issues that I am happy to say has just been completed, with some help from John Andrew and Karen Breitman. I find it amazing that I was able to find 19 years worth of back issues of the newsletter, especially given its very informal nature in those early days. As an Editor, being able to see the development of the newsletter over the years has been very useful. And having all of the back issues allows me to make one boast with certainty - that I am the most prolific Editor in the 19 year history of the newsletter - both in terms of numbers of issues and number of pages published. I hope that future Editors will set out to better my standard!

And talking about future Editors, Pat Cadman from Saskatoon has agreed to take over the Editor role. His contact information can be found at the bottom of the front inside cover. I hope that you will all support Pat in his efforts to create future issues of Interactions!

I hope that my most enduring legacy will be a continued change in how content is recruited. In the past, most content was recruited through the use of a general plea for contributions to all members. While this approach works, and is still an essential method of content generation, I have added two other approaches: targeted requests to individuals with interesting work or stories to share; and, creating content myself based on my interest in various events occurring in the world of medical physics. While this latter technique is too labour intensive to maintain and probably too much to ask of future Editors, I have discussed the possibility of setting up a editorial board to help the Editor come up with themes for upcoming issues and to help recruit articles. So in future, you will have to "run for cover" from more than just one individual.

I could go on about my accomplishments (e.g., new name for the newsletter, new features such as In Brief and About Our Cover, improved COMP database, COMP e-mail burster, recruitment of a team for COMP communications, web site rejuvenation, on-line distribution of Interactions, on-line membership directory, …) but I think that it is more important to let you know what I intend on doing in the future. I see the COMP/CCPM web site as becoming a major vehicle for communication within COMP and I want to help the web team move towards this goal (as well as issuing an IPO, cashing in my stock options, and retiring to the Cayman Islands). In addition, I will continue to dream up, and lobby for, new member services. For the longest time, COMP's main activity has been the promotion of an annual meeting to encourage interaction between Canadian medical physicists. While this will always be a very important service, with the large number of meetings competing for one's attention, I believe that other member services will have to become a bigger part of the benefits of COMP membership. More than ever, I see that Interactions between medical physicists, especially between therapy and imaging physicists, will reap big benefits both for ourselves and for patient care. And I see COMP as an important vehicle to promote these Interactions!

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