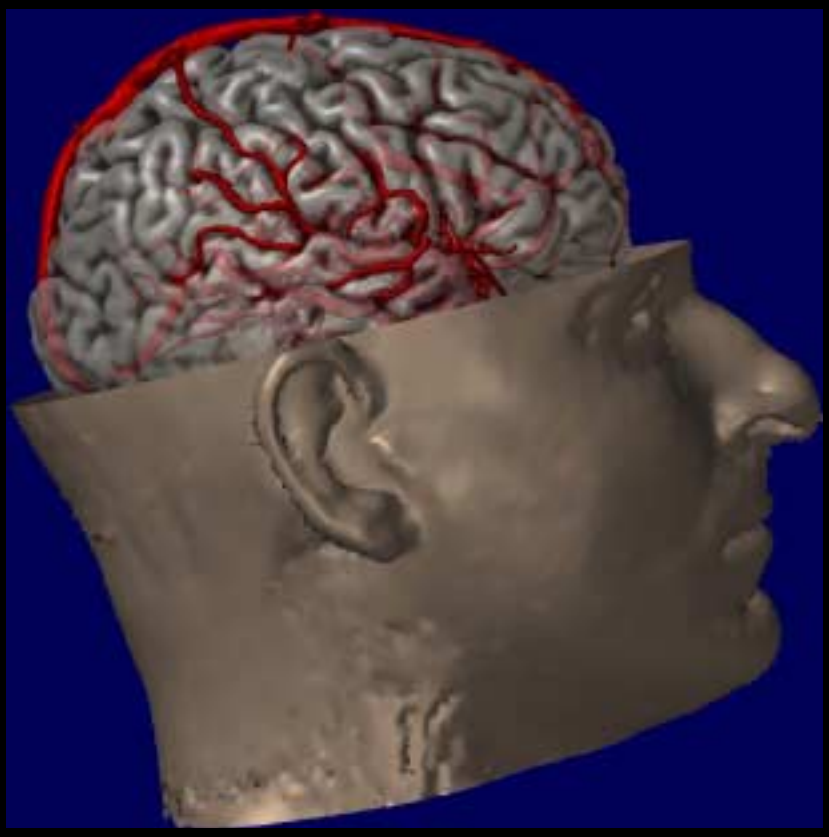
InterACTIONS

CANADIAN MEDICAL PHYSICS NEWSLETTER
Le BULLETIN CANADIEN de PHYSIQUE MÉDICALE



Combined MRI and MR Angiography for Neurosurgery Planning

COMP OCPM

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About our Cover

Preoperative magnetic resonance images (MRI) can be used to visualize, plan, and simulate neurosurgical procedures in advance of surgery and provide guidance in the operating room. Intra-operative guidance is achieved by registering pre-operative MRI data to the patient's head using a special probe that is tracked in 3D. Once registered, the position of the probe is tracked in real-time and displayed on the pre-operative MRI images.

This image is a computer rendering of the skin surface, cerebral cortex (semi-transparent) and cerebral vasculature (in red). The rendering is based on a whole head 1 mm isotropic 3D anatomical MRI and a phase-contrast 3D MR angiogram. Phase-contrast MR angiography images blood by detecting its movement in the presence of a magnetic field gradient and does not use a contrast agent.

Courtesy Drs. Bruce Pike and Richard Hoge of the McConnell Brain Imaging Centre, Montreal Neurological Institute.

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 can be made to:

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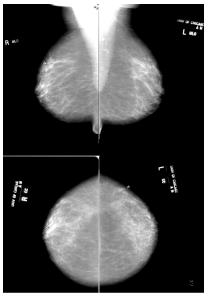

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Message from the COMP Chair:

We are having some difficulty in finding COMP representatives to various inter-organizational committees. This may involve, for example, a COMP representative to CRISM.

You may or may not have received the printed version of this Newsletter article before the Kelowna meeting. Most of the COMP's activities, especially at this time of the year, are centered around the Annual Meeting. As you are probably aware, this year's COMP and CCPM's annual meeting have been approved for the CAMPEP continuing education credits. I believe this represents a good step towards the "modernization" of COMP. Of course, this is also the first COMP meeting where articles have been submitted through the web. We apologize for any inconvenience this new process may have had on the membership, but that's progress. Comments on how this process can be improved for subsequent years are, of course, welcome. We would have two years to correct any deficiencies for the next COMP independent meeting which will be held in Edmonton, 2003. Next year's meeting will, of course be held with the AAPM in Montreal. Our thanks go to the Communication and Local Arrangements Committees for implementing the web services.

The Program Committee organized the scientific schedule to accept as many oral papers as possible, and the Committee thanks those authors who graciously decided to change their papers to a poster presentation. I think that everyone would agree with the concept that the number of days for the COMP Annual meeting should not be extended to accommodate all of the oral presentations submitted. Although the use of parallel session may be an option, this option may be pre-mature at this time because of the relatively small size of the COMP meetings.

We are having some difficulty in finding COMP representatives to various inter-organizational committees. This may involve, for example, a COMP representative to CRISM. These committees are quite important because they may influence government policies and in so doing, hopefully increase the profile of medical physicists. Therefore, if you are looking for a good challenge and want to make a change, please be positively receptive to any requests for joining, or offer your services. This is more productive than the simple act of complaining.

As always, I welcome any comments or recommendation for our operations. I hope to see most of you at this year's meeting in Kelowna. It promises to be an exciting and interesting meeting.

B. Gino Fallone, Chair of COMP
June 2001.

Message from the CCPM President:

This summer message is in anticipation of our annual Canadian medical physics meeting. I am looking forward to this year's meeting because in Kelowna we will again experience the best three days for medical physics science one can find anywhere in the world.

There are also a number of organizational issues to be addressed during College board and annual general meetings. The business of the College is to provide certification processes through which clinically qualified medical physicists are identified for the Canadian public. While it might seem that this work is well established and should continue happily without much change or development, in fact, the work is under constant review and development. Part of this results from transitions when new officers of the College take over. Also, we are continually being asked to make our materials more accessible to the medical physics community in Canada and to the general population. To accommodate this various Board members made a major effort to post our registration and exam documents on the CCPM and Canadian Medical Physics websites. I wish to congratulate the members of the Board and the Joint Communications Committee of COMP and the CCPM, for their hard work in getting these documents out as quickly as possible. Admittedly, there were some growing pains in this process. A major effort of the Board in Kelowna will be to discuss how to avoid future problems as we continue to roll out new documentation. We will be reviewing how application documents can most easily be submitted, and how times and schedules should be implemented to ensure a fast and equitable notification of potential candidates regarding their status within the College.

As always we continue to review our examination procedures at both the membership and fellowship levels. Again this reflects that, contrary to popular belief, the College examinations are not stagnant but do evolve as problems are identified, and as new areas of imaging and therapy are developed. This is illustrated in this issue of InterACTIONS by Ervin Podgorsak's article asking some timely and important questions about our membership exam. The College has always taken pride in the fact that success at our exams is a clear indication of a good, fundamental background in medical physics. However, it is not always clear what a lack of success has been measuring. As Ervin nicely points out, it could be that failure to succeed on the membership exam is an indication of a lack of preparedness by a candidate; on the other hand, it may be the result of insufficient time for thought and reflection by a candidate during the actual sitting of the exam. The College Board will be reviewing this also in Kelowna.

I would encourage you all to contact members of the Board of the College to present your views on these issues. I have in the past often solicited opinions of the membership in these messages to InterACTONS. Unfortunately, I can count on two fingers the number of comments that have come back to me after these requests. I wish to make it very clear that the Board of the College and I take comments from membership very seriously. Recently, for example, there have been criticisms made to Board members regarding the experience criteria and time lines required by medical physicists before they can apply for membership. These comments have been taken to heart, and will also be discussed at length next month.

The Canadian College of Physicists in Medicine is not a stagnant entity. We are attempting to move forward and to continue to serve our members and the Canadian public. To do this work we are constantly reviewing and reassessing how we work. In my next message, I hope to report on how our deliberations went in Kelowna.

Sincerely,
L. John Schreiner, Ph.D., FCCPM,
Kingston, Ontario

contrary to popular belief, the College examinations are not stagnant but do evolve as problems are identified, and as new areas of imaging and therapy are developed.

CRISM Submission to Senate of Canada Committee Study on Health Care

By Paul C. Johns
COMP Representative to CRISM

The Canadian Radiation and Imaging Societies in Medicine (CRISM) is an umbrella organization whose members are professional societies involved in medical imaging and/or the application of ionizing radiation in medicine. Currently five societies are members: the CANM, CAR, CAMRT, CSDMS, and COMP. More information can be found on the COMP web site under "links".

There is currently a large study into the Canadian health care system being conducted by a standing committee of the Senate of Canada, namely the committee on Social Affairs, Science, and Technology. The committee is chaired by Senator Michael Kirby, who previously had chaired an in-depth study of the banking system. CRISM submitted a written brief, and was accepted to give a presentation to the committee on 16 May 2001, which I delivered. It was well received.

The 10-page brief, dated May 7, is being posted on the COMP web site. The official transcript of the proceedings, held May 16, can be found by going to:

www.parl.gc.ca

and following the links to Senate committee business, select Social Affairs, Science & Technology committee, then proceedings, then select the entry for Issue 13, May 16, 2001.

(The specific url is: http://www.parl.gc.ca/37/1/parlbus/commbus/senate/Com-e/soci-e/13cv-e.asp Language=E&Parl=37&Ses=1&comm_id=47).

There were 5.5 hours of hearings that day. CRISM appeared in the last hour. The copy of the transcript that I printed out is 72 pages long, and the last hour starts on p. 56, with my presentation starting on p. 62. The messages were: shortage of personnel, lack of equipment, and low research funding. On the latter point, we recommended that the CIHR set up a new Institute whose mandate would be to foster research and development on technology applied to health care, including imaging, monitoring, therapeutic, and image-guided treatment technologies, and to aid in the education of scientists in this area. The existing 13 Institutes of the CIHR are organized along disease or public health lines, and none are a natural home for cross-cutting technological development.

There are a few glitches on the transcript but on the whole I think that the message is there. The really bad glitches were fixed in a review cycle. I will comment that it's quite humbling to read the official and independent record of what one has said and compare it to memory.

The presentations of the session, afternoon and evening, were arranged in three panels. The first panel comprised physician groups (CMA, Canadian Medical Forum,...), the second panel comprised nursing groups (CNA, Nurse Practitioners, ...), and the third panel comprised laboratory technologists, chiropractors, and CRISM. There is certainly some significance to the ordering of the panels. At the same time, the panels all reinforced each other, with common messages about vacant positions, not educating enough people in the next generation, and lack of equipment. The message about the research environment being important was mostly one from CRISM.

In preparing the brief, it became apparent to me that COMP needs to do a personpower survey which includes forecast for future positions, retirement estimates, recruitment from outside Canada and loss of physicists to outside Canada, and the numbers of graduate students and clinical physics residents currently in the system. This should include not only cancer therapy physics, where we are the most visible to government and the public, but also diagnostic physics and other areas. These data would be very useful in arguing for more resources for educating and retaining medical physicists in Canada. Some of the other professions have analysed their own personnel statistics and have a much better understanding of their situation than we do.

Computer-aided Diagnosis for Screening Mammography

By Robert Nishikawa
University of Chicago

The field of medical imaging has made remarkable progress since the first radiograph was recorded in 1895. Techniques using radiation spanning much of the electromagnetic spectrum have evolved fueled recently by the use of computer technology. However, techniques for the interpretation of these images have remained essentially unchanged: a human observer looks at the radiograph, extracts as much pertinent information as he or she needs, and then renders an opinion. Recently, researchers have been applying computer analysis techniques to help radiologists interpret radiographs. Computer-aided diagnosis (CAD) is a diagnosis made by a radiologist who incorporates the results of a computer analysis of the image when making a diagnosis {1}.

CAD techniques are now being developed for many different areas of medicine: mammography, chest radiography, thoracic and gastro-intestinal CT, ultrasonography, MRI, dental radiography and many more. Of these, mammography serves as an excellent test case for several reasons. First, mammography has a narrow focus -- to detect and diagnosis breast cancer. Compare this to a plain chest x ray, where there are probably more than one hundred different diseases or conditions that can be detected. Second, breast cancer is a prevalent form of cancer and a major health problem. Third, mammography is common procedure, since it is recommended that women receive regular asymptomatic screening. Fourth, breast cancer is a relatively slow growing cancer in which the earlier the cancer is detected the better the patient prognosis. Fifth, while being effective at reducing mortality, between 5-30% of breast cancers are missed by mammography and between 60-90% of all breast biopsies recommended based on the mammogram are benign. Furthermore, it has been shown that double reading of the same case by two radiologists can increase the cancer detection rate by up to 15%. Using CAD as a second reader is proposed as a cost-effective method of implementing double reading. Given its appropriateness for CAD, I will illustrate how CAD can improve image interpretation using examples from mammography.

There are two major types of CAD schemes for mammography. The first are detection schemes, which are applicable to screening mammography, and the second are classification schemes, which are applicable for diagnostic mammography. In screening mammography, the goal is to identify lesions that may be malignant. In diagnostic mammography, the goal it to classify lesions as benign or malignant and thereby make appropriate biopsy recommendations. There are also schemes for estimating breast cancer risk based on parenchymal pattern or breast density, but these will not be discussed in this article.

How CAD Schemes Work

Detection and classification schemes essentially reduce to a problem of differentiating two populations: actually positive and actually negative lesions. For detection schemes, the two populations are actual lesions and false signals; and in classification schemes, the two populations are malignant lesions and benign lesions. To do this differentiation, a number of features characterizing the lesions or signals are extracted from the image. These features are then merged using techniques such as artificial neural networks or linear discriminant analysis to calculate the likelihood that the signal is a true lesion or that a lesion is malignant. To obtain features, a number of steps must occur first. These are outlined in the flowchart in Figure 1.

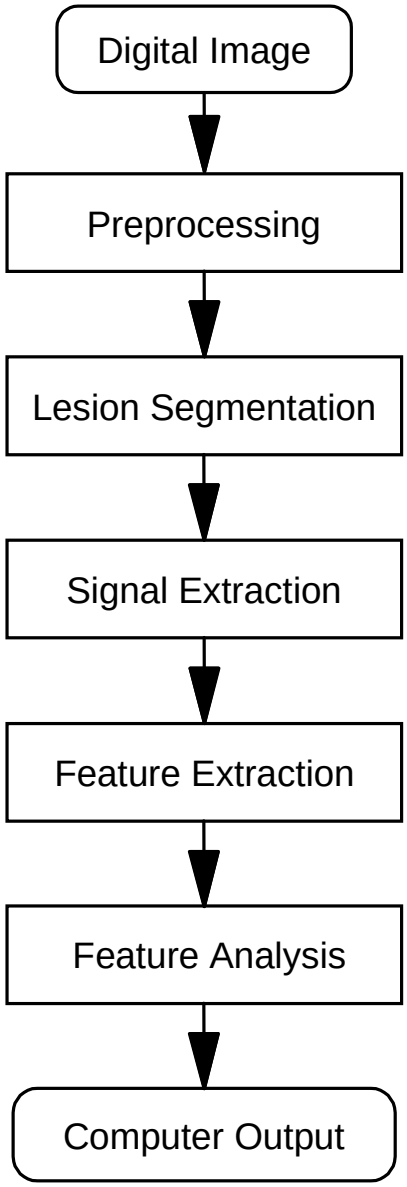

Figure 1. A generic flowchart for a computer-aided diagnosis (CAD) scheme

There are many ways to accomplish these steps. Much of the research in CAD is to discover or invent techniques that produce accurate detection or classification results. An overview of a number of approaches is given in a review by Giger *et al.* {2}. The computer output for detection schemes is usually given by annotating a low-resolution copy of the mammograms. The output for classification scheme is usually given by a percent likelihood of malignancy. An example is shown in Fig. 2.

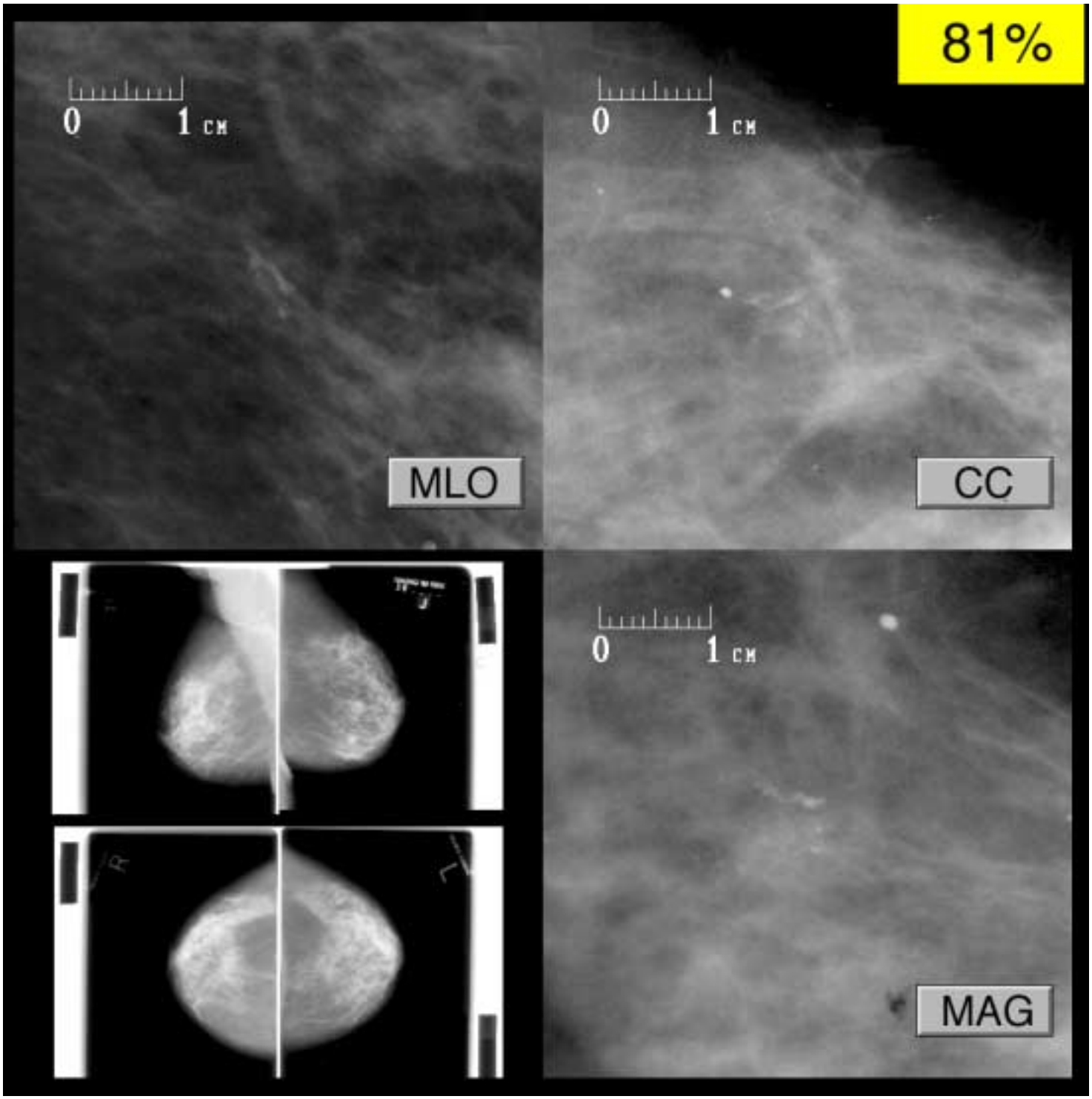

Figure 2. A mock up of a possible softcopy CAD display system for digital mammography. The radiologist can examine the images before consulting the computer output. The computer output, the likelihood that the patient has breast cancer, is given as a percentage in the upper right hand corner (Courtesy of Yulei Jiang, University of Chicago).

Current State-of-the-Art

CAD for screening mammography has now become a clinical reality. There are at least six companies worldwide developing commercial systems for mammography and one company has FDA approval to sell their product in the United States. These commercial systems have impressive accuracy. For detecting clustered calcifications, sensitivities as high as 98% have been reported when tested on a set of 1000 cancer cases; for mass detection, sensitivities are around 86% {3}. The false-positive rates are at or below 0.5 per image. As a benchmark, radiologists, who are experts in breast imaging, have sensitivities of 85% with false-positive rates of below 0.05 per image. Thus automated detection schemes have sensitivities in the range of the best radiologists, but have 10 times the false-positive rate. The poorer specificity of the automated schemes is one of the major reasons why the computer can act only as an aid and not as a primary reader. One may ask whether one day a computer will be able to be as accurate as a radiologist. Figure 3 shows performance of one commercial system in terms of number of false positives per image as a function of software development time. If companies continue to invest resources at their current rates, then one estimate is that in about three years computers will have equaled radiologists' performance. It is unlikely, however, that a company having reach a high level of performance would continue their same rapid development, since they are making computerized aids not primary readers. They would be more likely to reallocate their resources to developing new products.

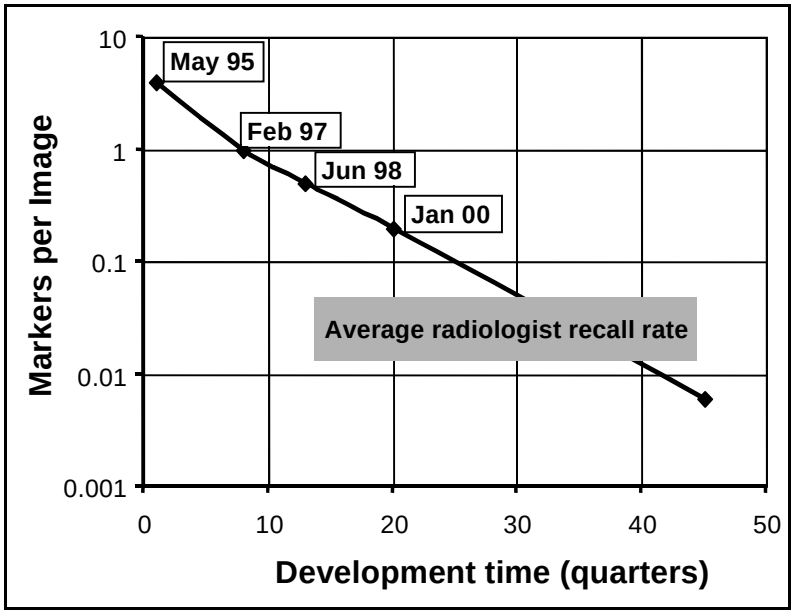

Figure 3 This graph Illustrates the progress in automated detection schemes for mammography. The number of markers per image is a measure of the false positive rate at a fixed sensitivity. (Courtesy Jimmy Roehrig, R2 Technology, Inc.)

One impediment to the rapid development of CAD schemes is the difficulty in comparing different schemes {4, 5}. The measured performance of a CAD scheme depends on the scheme's actual unbiased performance, the cases used to test the scheme, and the method used to determine whether the computer's output was correct (i.e., the scoring method used). The last two factors can overwhelm the first, making it extremely difficult to compare two schemes that were tested using difference cases or scored with different criteria or both.

Potential Benefits of CAD

There are three potential benefits from employing CAD. These are improved accuracy, reduced intra- and inter-observer variability, and shorter reading times.

Evidence for improved accuracy are circumstantial, at this time, as there has not been a proper clinical study published. For CAD to be effective two conditions must be met. First the computer must identify or correctly classify a lesion that a radiologist would miss or misclassify. Second, the radiologist must, upon reviewing the computer output, take appropriate action – agreeing with the computer, when the computer is right, while dismissing computer false positives and false negatives. A number of studies have shown that detection schemes can find cancers missed on mammography – between 50-75% of overlooked cancers were identified by a computer detection scheme {6-8}. Figure 4 shows an example of a screening mammogram read as negative where the computer detected the cancer. There have been a number of observer studies – laboratory experiments that simulate clinical reading conditions – that have shown computers can help improve radiologists' ability to find cancers {9, 10} and to be better able to classify lesions {11-13}. In the most dramatic study, Jiang *et al.* showed that when using a computer aid, radiologists could increase their sensitivity by 19% while simultaneously increasing their specificity by 30% for the task of classifying clustered microcalcifications {13}. These studies provide strong evidence that CAD will be effective clinically, but this remains to be shown.

As it is with any decision that is made entirely subjectively, there is variability in radiologists' interpretation of a mammogram. Since computers produce objective measures, a radiologist can reduce their internal variability and reduce disagreements with their colleagues if they use CAD. Jiang *et al.* showed that the amount of disagreement in recommending biopsy was reduced by approximately 50% when radiologists used the computer classifier as an aid.

Shorter reading times will probably not be realized until softcopy reading of mammograms becomes widespread. If the radiologist is reading from film then a separate medium, for example a piece of paper or a CRT monitor, is needed to convey the computer output to the radiologist. This requires the radiologist to look away from the films to view the computer output and then to go back to the films, locate the corresponding computer detection and then make a decision. This is not only time consuming, but some radiologists find it bothersome to look away from the films. With softcopy reading, the computer-detected locations can be superimposed on the primary image. Radiologists may be able to read quicker with CAD for several reasons. Since most cases are normal in screening, the computer can increase radiologists' confidence that no cancer is present, if the com-

puter shows no detections. Otherwise, the radiologist has to search carefully the whole image until he or she is satisfied that no cancer is present. With diagnostic mammography, cases that are borderline take time to decide what to recommend to the patient. Radiologists could quickly check the computer's likelihood of malignancy and quickly make a decision. The biggest time saving could be in searching for clustered microcalcifications. Because microcalcifications are only a few hundred microns in size, radiologists usually search the images with a magnifying glass (electronic magnifying glass can be used with softcopy reading). Current, commercial CAD schemes have sensitivity of 98% for clustered calcifications, which is probably higher than even the most expert radiologist. As radiologists gain more experience and confidence in the computer's ability to detect calcifications, they may learn to depend upon the computer and not the magnifying glass. The implications for softcopy digital mammography are even greater. Digital mammograms can be 4k x 5k in size, whereas the display monitor is only 2k by 2.5k. If it is not necessary to display the full image at full resolution, then the time to read the case will be shorten substantially. It is assumed that to classify microcalcifications, the radiologist would need to look at the image at full spatial resolution.

In addition to helping radiologist find overlooked cancers, by using CAD radiologists could be more vigilant and avoid missing cancers in the first place. Since there are typically only 5 cancers in every 1000 mammograms, remaining alert while reading can be difficult. When reading with a computer aid, some radiologists play a game trying to guess where the computer might detect a lesion or they try not to be "beaten" by the computer. In such a situation, the radiologist is more likely to view each case carefully and thereby be less likely to overlook a cancer.

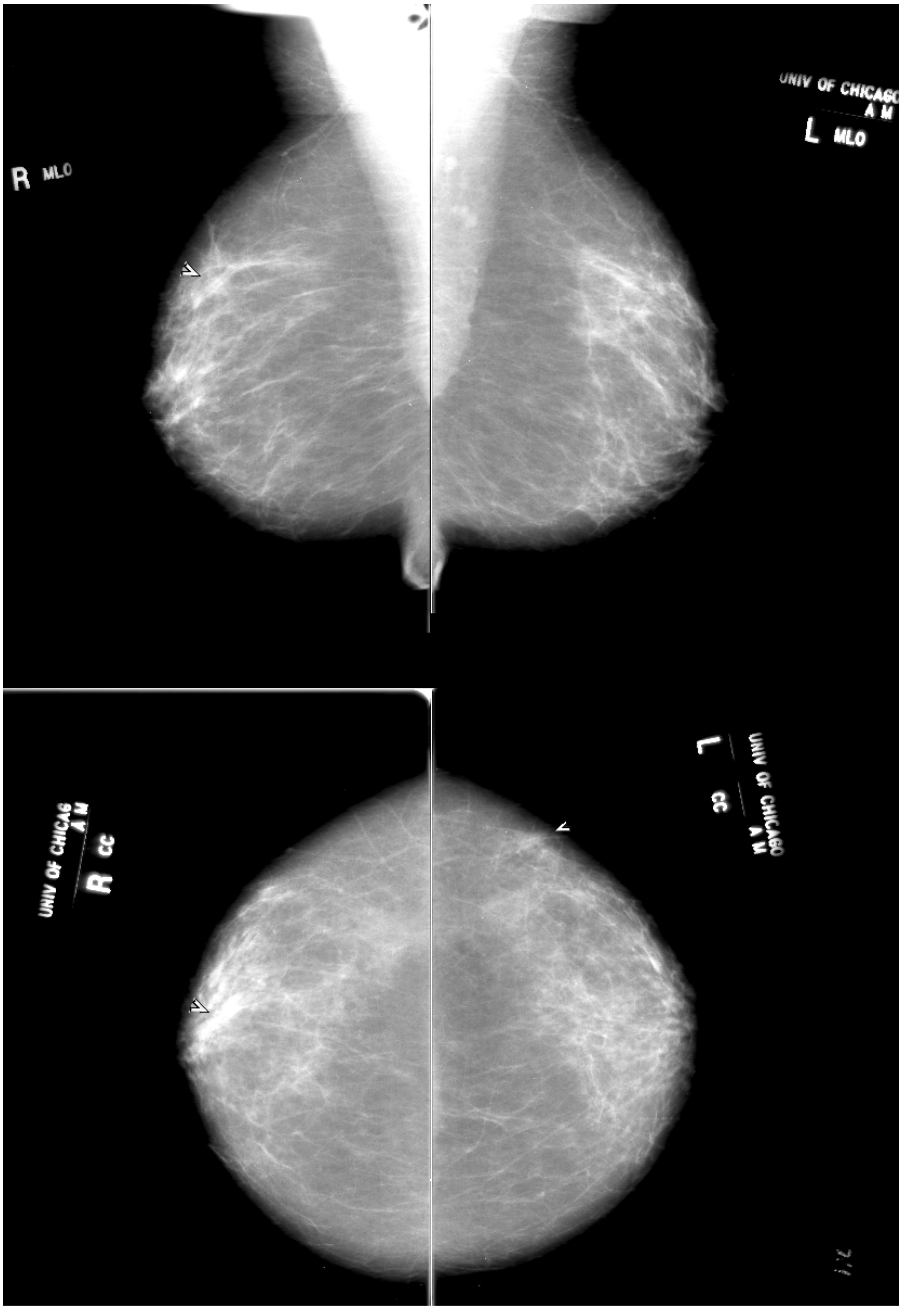

Figure 4. An example of a cancer overlooked clinically and detected by computer. The computer identified the cancer in the left craniocaudal view (lower right image), missed it in the left mediolateral view (upper right image), and identified a false positive in each of the corresponding views of the right breast.

Outstanding Issues

There are a number of issues that need to be resolved before CAD is widely accepted as a beneficial clinical tool. These include proof that CAD can improve radiologists' performance, medicolegal uncertainties, patient throughput, and cost.

A large-scale clinical trial needs to be performed to prove that radiologist have higher performance when using CAD. With one company having clearance to sell systems in the United States and another expecting clearance soon, there will soon be enough systems being used clinically to conduct a trial. One of the worries is that because the computer's false positive rate is higher than that of the radiologists', CAD may cause more women to receive unnecessary work-up or even an unnecessary biopsy. The data to date, although not from tightly controlled studies, indicates that with CAD, the call back rate does not increase {8}.

One interesting phenomenon could arise in the future. In tests so far, CAD has been effective because it detects lesions that a radiologist will miss. In effect, the computer "thinks" differently than the radiologist. Over time, the radiologist will become familiar with the computer's capabilities: what types of lesions it can detect and what types of false positives it identifies. There is a danger that as this happens, the radiologist will begin to "think" like the computer. If this should occur, the computer

will have reduced benefit to the radiologist. Alternatively, the radiologist may learn the types of lesions the computer misses and pay extra attention to those types of lesion for which they will be effectively reading solo.

There is concern by some that, by employing CAD, a radiologist is putting him or herself at risk for being sued. The thinking is that if the computer identifies a lesion that the radiologist discerns not to be cancer and that lesion later is found to be malignant, then the radiologist would be considered negligent. First, there will be lesions that the computer identifies that will later be found to be cancer. We have found in observer studies that radiologists do not always agree with the computer when the computer identifies a very subtle cancer. Overlooking a cancer can be grounds for a successful lawsuit. However, if a radiologist identifies a lesion and considers it not to be cancer, then the chances of a successful litigation is much less likely. This concern of liability when using CAD must be balanced against the liability when not using CAD. That is, CAD, in theory, would greatly reduce your chances of overlooking a cancer, particularly an obvious cancer. Given the evidence to date, it is more likely that using CAD will prevent a suit, rather than be the cause for one.

Much of the cost of commercial film-based CAD systems is in the hardware (digitizer, computer, and display medium). When applied to digital mammograms, the cost of implementing CAD should be greatly reduced. Furthermore, in the United States, Medicare, Medicaid, and growing number of HMO's are reimbursing for computer analysis. Medicare will reimburse for a screening mammogram "processed to produce digital image analyzed for potential abnormalities" an extra $15, which represents approximately a 20% increase in the technical fee rate.

Concluding Remarks

CAD is now a clinical reality for screening mammography, although its efficacy remains to be proven. The synergy between CAD and digital mammography is such that wide clinical acceptance of either depends on the success of the other. That is because for relatively small incremental cost a digital mammography system can have CAD capabilities, while the ease of incorporating CAD into a digital mammography system makes the implementation of CAD much easier.

Mammography is a good test case for CAD. There is now a commercial CAD system for lung nodule detection on plain chest radiographs available in the United States. The CAD scheme that will most likely be next in clinical implementation will be for lung cancer screening from CT scans. The application of computer analysis to aid physicians in interpreting medical images will likely accelerate in the near future and beyond.

Disclosure

Robert Nishikawa is a shareholder in R2 Technology, Inc (Los Altos, CA). It is the University of Chicago Conflict of Interest Policy that investigators disclose publicly actual or potential significant financial interests that would reasonably appear to be directly and significantly affected by the research activities.

References

1. Doi K, Giger ML, MacMahon H, *et al.*: Computer-aided diagnosis (CAD): Development of automated schemes for quantitative analysis of radiographic images. *Sem Ultras CT MRI* **13**: 140-152, 1992.
2. Giger M, and MacMahon H: Image processing and computer-aided diagnosis. *Radiol Clin North Am* **34**: 565-96, 1996.
3. Roehrig J, and Castellino RA: The promise of computer aided detection in digital mammography. *Eur J Radiol* **31**: 35-9., 1999.
4. Nishikawa RM, Giger ML, Doi K, *et al.*: Effect of case selection on the performance of computer-aided detection schemes. *Med Phys* **21**: 265-269, 1994.
5. Kallergi M: Evaluating the performance of detection algorithms in digital mammography. *Med Phys* **26**: 267-75, 1999.
6. Schmidt RA, Nishikawa RM, Schreibman K, *et al.*: Computer detection of lesions missed by mammography. In: *Digital Mammography*. Gale AG, *et al.*, Eds. (Elsevier Publishing, Amsterdam, 1994), pp. 289-294.
7. te Brake GM, Karssemeijer N, and Hendriks JHCL: Automated detection of breast carcinomas not detected in a screening program. *Radiology* **207**: 465-471, 1998.
8. Warren Burhenne LJ, Wood SA, D'Orsi CJ, *et al.*: Potential contribution of computer-aided detection to the sensitivity of screening mammography [published erratum appears in Radiology 2000 Jul;216(1):306]. *Radiology* **215**: 554-62, 2000.
9. Chan HP, Doi K, Vyborny CJ, *et al.*: Improvement in radiologists' detection of clustered microcalcifications on mammograms. The potential of computer-aided diagnosis. *Invest Radiol* **25**: 1102-10., 1990.
10. Kegelmeyer WP, Pruneda JM, Bourland PD, *et al.*: Computer-aided mammographic screening for spiculated lesions. *Radiology* **191**: 331-337, 1994.
11. Getty DJ, Pickett RM, D'Orsi CJ, and Swets JA: Enhanced interpretation of diagnostic images. *Invest Radiol* **23**: 240-252, 1988.
12. Chan HP, Sahiner B, Helvie MA, *et al.*: Improvement of radiologists' characterization of mammographic masses by using computer-aided diagnosis: an ROC study. *Radiology* **212**: 817-27, 1999.
13. Jiang Y, Nishikawa RM, Schmidt RA, *et al.*: Improving breast cancer diagnosis with computer-aided diagnosis. *Acad Radiol* **6**: 22-33, 1999.

WESCAN 2001

By Brenda Clark
Vancouver Cancer Centre
and Sherali Hussein
Fraser Valley Cancer Centre

The 23rd Annual Western Canadian Medical Physics Conference held on 15 - 17 March was hosted by the Fraser Valley Cancer Centre, one of the 4 BC Cancer Agency centres. The events on 15 and 16 March were held at the Inn on the Quay, New Westminster. On Saturday, the meeting moved to the Fraser Vallley Cancer Centre in Surrey. This annual event is traditionally attended by physicists, therapists, electronics staff, machinists and students in medical physics and radiation therapy from all of Western Canada including (for historic reasons) Thunder Bay. This year's event attracted approximately eighty participants. The aim of the meeting is to promote informal, grassroots type discussions on current issues on all aspects of radiation therapy ranging from radiation safety issues & accelerator technology to the state-of-the-art topics in medical physics.

The meeting opened on Thursday evening with a keynote presentation given by Dr. Katharina Sixel, Medical Physicist at Toronto - Sunnybrook Regional Cancer Centre, entitled: "Multimodality Image-Based Treatment Planning". This lively and stimulating presentation discussed a very topical issue, the potential offered by augmenting the more traditional CT image planning data sets with MRI, PET, FMRI and MRSI. The presentation was followed by a Wine and Cheese reception.

On Friday, a total of 23 scientific papers were presented, on topics ranging from basic dosimetry to brachytherapy to diagnostic radiology PACS implementation. The abstracts can be viewed at http://cancercentre.com/wescan/program.cfm. Twelve of the papers were entered in two competitions, evaluated by an 8 member anonymous, honest-to-goodness "no-conflict-of interest" panel of multi-disciplinary judges from across the Western Canada who declared all winners to be from British Columbia!

The Medical Physics student competition comprised 6 participants, the declared winners being: Andrew Jirasek, first place, for his presentation entitled *FT-Raman studies of polyacrylamide dosimetry gels: effects of crosslinker fraction* and Karl Otto, second place, with *Investigation of a Linear Systems Model for evaluating radiation dose delivery*. Both Andrew and Karl are currently pursuing a PhD at UBC/BCCA.

The 6 papers entered for the Technologists Competition covered such topics as CT simulation, electronic portal imaging and job satisfaction amongst Canadian radiation therapists. There were 2 first place winners, Vince Lapointe, Physics Assistant from VCC for his presentation on *Utilization of a Database Application to Track Planning Activities* and Sarah Kristensen, RT, FVCC who presented on *Development of a CT-Simulation Breast Technique: moving from 2D to 3D treatment planning.*

A banquet dinner finished the day with live music from Ted Gergeley and his Jazz Trio.

The Saturday events at the Fraser Valley Cancer Centre included sessions on Radiation Protection issues and IMRT, and a hands-on workshop on immobilization devices. Concurrent sessions were held for electronics staff (15, from all five provinces) and machinists (9 representing Ontario, Manitoba, Alberta and British Columbia).

After the Saturday morning session on Radiation Protection, where radioactive activation of components and pending CNSC regulations were discussed, the electronics technologists held their own breakout session. Most of the discussion focused on professional issues, prompted in part by the potential requirement by CNSC that accelerator service personnel be licensed. In general, there was agreement that service techs need to have better access to training and other resources to properly fulfill or expand their role in the clinics. The possibility of forming an association similar to those of the physicists and therapists was discussed. Other topics considered were the increased integration of networked computers to the linac systems and various vendor related issues regarding parts and documentation. As this was the first session in some time that focused on service issues, it was agreed that the meeting was useful and those in attendance would work on coming up with topics for discussion at future Wescan meetings.

The machinists met at VCC on Thursday with presentations on Expanded PVC [InteCel] and expanded Polyethylene [Kelron] radiotranslucent board, router template machining, vacuum formed immobilization devices, a four-field breast set-up jig (Lawrence Degagne, NW Ontario), CAD drafting – programming – CNC machining (Gary Morrison, Edmonton AB), a Varian block tray that can accommodate a compensator on the underside and a unique Aquaplast clamping frame for total head immobilization. On Friday, the group moved to FVCC and discussed manufacturing of various Linac parts and an exposé of some cost fluctuations of supplier replacement parts (Tom Bryceland, FVCC) and custom in-house vacuum bags for patient immobilization at a substantial savings compared to the commercial equivalents (Mark Robinson, CCSI).

Both groups greatly appreciated the opportunity to share ideas and compare notes on techniques and procedures.

Peter McGhee's group in Thunder Bay, the eastern most centre participating in Wescan, have volunteered to host next years meeting.

The conference ended with a group photo and a buffet lunch. Congratulations to the organizing committee led by Cheryl Duzenli at FVCC for a very successful conference and thanks also to the generous corporate sponsors: Kodak, who sponsored the technologist and student competitions, ADAC Laboratories, Donaldson-Marphil, Elekta, MDS Nordion, Siemens Canada Ltd and Varian Medical Systems.

Report on Target Insight Symposium

Toronto, Ontario May 4 to 6, 2001

By Kathy Mah
Toronto-Sunnybrook Regional Cancer Centre

From May 4 to 6, 2001, the University of Toronto's Department of Radiation Oncology held its biennial symposium entitled "Target Insight: Innovative Strategies to Improve Target Definition in Radiation Oncology". The focus of the conference was timely as many of us recognize that while we have the tools to 'paint' radiation dose with great precision, our ability to accurately identify the target, both physically and molecularly, is limited. The symposium was held at the Sutton Place Hotel in downtown Toronto. Conference banquet and meals were enjoyed on the 33rd floor of the hotel offering an outstanding view of the Toronto skyline. There were over 185 registrants with participants coming from as far as Sweden. The conference was well-received. As part of the organizing committee for this conference, I was very pleased with the feedback we received from the participants.

The first day concentrated on biomarkers and molecular targeting. An international panel of clinical scientists including Robert Bristow (Princess Margaret Hospital), Steven Hahn (University of Pennsylvania School of Medicine), Michael O'Reilly (MD Anderson Cancer Centre), Brian Marples (Gray Laboratory Cancer Research Centre), Fei-Fei Liu (Princess Margaret Hospital), Rupert Schmidt-Ulrich (Medical College of Virginia Hospital), and Bradly Wouters (University Hospital Maastricht) had been invited to share their expertise in molecular sciences. Topics covered included the potential role of anti-ras inhibitors, anti-angiogenesis, gene therapy, and epidermal growth factor in cancer treatments. Both updates on the recent laboratory advances and the current status of clinical investigations were presented. In a focus session, Gillian Thomas and Ida Ackerman of the Toronto-Sunnybrook Regional Cancer Centre and Anthony Fyles and Michael Milosevic of the Princess Margaret Hospital reviewed tumour hypoxia and discussed the role of hypoxia as a target for radiation therapy. Although much of what was presented is far from clinical application, many aspects of tumour properties and molecular pathways are being discovered and the future of cancer management will likely involve both conventional and alternative approaches for localization, characterization, and treatment. For many of us physicists, the world of DNA, RAS, EGR, FTI, EGFR, TNF, ONYX-015…….. was a little bit like in the land of OZ; it was an interesting place to visit, but boy, there's no place like home!

After the first day, we felt somewhat assured that our jobs in Radiation Therapy Physics would still be around for quite a while (at least until after I retire!) In fact, there was a great deal of excitement the next day as we caught a glimpse on how advances in imaging tools will revolutionize our concept of radiation targeting. The second day concentrated on new functional imaging strategies and their potential application to Radiation Oncology. Johannes van Lier, a radiochemist and director of the Sherbrooke PET Centre reviewed the potential of PET imaging for oncology. He showed that the power of PET lies in the low concentration of material required to probe biochemical processes with great contrast and specificity. The success of 18F-fluoro-deoxyglucose-PET in improving tumour visualization and as a monitor of biochemical response to therapy has led to an intensive search for other selective PET agents from ligands to monitoring cancer-specific receptors, to tracers visualizing the efficacy of novel cancer therapies such as gene therapy. I presented our centre's work on the role of FDG-PET in radiation therapy planning. In clinical studies, we have shown that FDG-PET information integrated into planning can have a significant impact. For some sites such as lung and head and neck cancers, it can change patient management, provide better assessment of nodal involvement and location, change the planning target volume, and reduce inter-observer variation in tumour localization. Gary Freedman presented the development and use of a planning MR-simulator at Fox Chase Cancer Centre. An open bore, low field (0.23T) MR unit has been installed into the radiation therapy department at his centre. The MR data set forms the primary data for virtual simulation and initial studies have shown improved target and critical structure definition with MR-simulation compared to CT-simulation for some clinical sites such as prostate. The principles of MR spectroscopy imaging (MRSI) and the application of MRSI for radiation planning were presented by Sarah Nelson, the director of the Magnetic Resonance Science Center at UCSF. Its major advantage over other functional imaging modalities is that it can be integrated into a conventional MRI examination and therefore, provides direct correlation between tissue morphology and function. At UCSF, MRSI is used for treatment planning of prostate carcinoma and they have shown that MRSI-based target volumes for malignant gliomas may be dramatically different from that defined by conventional MR. Ting Lee from the Robarts Research Institute shared his results in functional CT and discussed the potential of imaging of angiogenesis for oncology. He presented his work in how functional CT can be used to determine maps of blood flow, blood volume, and capillary permeability. While these measures represent surrogate markers of angiogenesis, there was much discussion on how they could be interpreted and applied in clinical practice.

In the panel discussion at the end of this session, a poll of the participants showed that given the opportunity to acquire one new imaging technology, the majority of participants would like PET for their oncology programs in the immediate future. This despite it's higher costs. Perhaps most people felt this way because PET has been proven to improve cancer detection, and ultimately patient care, for many clinical sites, as well as shown enormous potential for working with various biomarkers. At much lower costs, MRSI and functional CT technologies will be available soon as an option to conventional MR and CT units, respectively.

Bringing it all together, Clifton Ling, chair of Medical Physics at Memorial Sloan-Kettering Cancer Centre, delivered the keynote address, entitled "Evidence-based IMRT: The role of biological imaging". Encouraging the adaptation of the 'biological target

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Report on the CMA's General Assembly of Accreditation Sponsors

By Michael Evans
McGill University Health Center

I recently attended the Canadian Medical Association's General Assembly of Accreditation Sponsors held in Ottawa on April 1. I was at this meeting as the CCPM's representative to the Conjoint Accreditation Service which is the body that provides accreditation to selected health related technology teaching programs across the country. As physicists we would probably be most familiar with teaching programs for technologists such as Diagnostic (Radiological, MRI, Nuclear Medicine, Ultrasound) and Radiation Therapy. In addition the service is also responsible for accreditation of technology programs dealing with the teaching of Cardiology, Cardiovascular Perfusion, Clinical Genetics, Cytotechnology, Medical Lab. Technology, Ophthalmic Technology, Orthoptics, Paramedicine, and Respiratory Therapy to name a few.

I attended three workshops with groups most closely associated with medical physics; namely Ultrasound, MRI, Nuclear Medicine, Radiation Therapy and Radiological Technology. My role in these meetings was to represent medical physicists as a profession both involved in the didactic aspects of formal teaching programs, as well as having a key role in the clinic. Representatives from physicians groups, the private sector, consumers associations and community colleges were also in attendance.

The first session was a chance for the group representatives (Ultrasound, MRI, Nuclear Medicine, Radiation Therapy and Radiological Technology) to bring each other up to date on developments within the profession during the last year. All groups mentioned the problems with recruitment and retention following graduation. There was also some discussion regarding problems with, and development of, recertification of technologists. Most of these teaching programs seem to be headed towards providing education at the B.Sc. level as opposed to community college, although implementation may take some time. Obviously many of these same issues were familiar to me as a physicist, and I tried to make this clear.

The second workshop dealt with the confidentiality of the results from an accreditation visit. At issue was how much information was to be disclosed following an accreditation visit to a teaching program. There was some discussion regarding full, partial or no disclosure, and the impact this might have on the ability of educational institutions to attract students.

The final workshop polled the members on possible means of attracting surveyors for accreditation visits. Most medical physicists may not be aware that these accreditation surveys are performed by volunteers who have both teaching and clinical expertise. Therefore professionals such as medical physicists or medical practitioners working in relevant hospital departments (for example radiation oncology or radiology to name a few) are in great demand. The problem is of course that most people are very busy, and may find it hard to give up a 4 to 5 day block of time to travel to a site visit. This does not include the time to prepare for the visit (lots to read beforehand), or the time needed to compile the results of the visit. Our group thought it was still more appropriate to proceed on a volunteer basis, simply because there were too many different professionals involved, and it would be quite difficult (as well as costly) to establish a pay scale. Instead, it was proposed to try to encourage more people to become involved in this process by promoting the positive aspects of going on a site visit. These included both personal and professional education, as well as the possibility of applying these efforts towards the surveyors own re-accreditation process. For example, I, as a site reviewer of a radiation therapy program, might receive credit towards my own recertifiction in CCPM at a later date.

At this point I would make a pitch for all CCPM physicists, involved in both the clinic and teaching, that have any interest in becoming involved in the accreditation process, to make themselves known to myself, Andrew Rainbow, or the CCA of the CMA. It is an interesting and educational process, and by making ourselves available for these site visits we are able to promote our profession, and ensure that we have some effect on the development of these teaching programs which we are most closely associated with.

Physics Quality Control in Radiotherapy: An Overview of Canadian Practice

By Peter Dunscombe

For the Radiotherapy Quality Assurance Committee of the Clinical Trials Group, NCIC

The Radiotherapy Quality Assurance Committee of the Clinical Trials Group of the National Cancer Institute of Canada feels it is important to document adequate dosimetric standards in centres participating in NCIC trials. Two approaches are available to obtaining such confirmation. On site inspections together with remote monitoring of machine output such as performed by the Radiological Physics Centre (RPC) is one approach. A far simpler approach, with minimal resource implications, is to invite participating centres to do their own self evaluation. Particularly if centres are already primary RTOG sites, and hence are monitored by the RPC, the self evaluation approach will provide the NCIC Clinical Trials Group with adequate assurance that appropriate dosimetric standards are being met.

In September 2000, simple two page questionnaires were distributed to the heads of physics in 32 Canadian radiotherapy facilities. By February 2001, and with a little coaxing, all 32 centres had responded. The following summarizes the information gleaned.

The first question addressed participation in the RPC surveillance program. 27 centres were active participants while 5 were not registered with the RPC. These 5 included several of the newer centres. 19 of the 27 participating centres had received an RPC site visit within the last 12 years and 24 had participated in the mail out dosimetry service of the RPC in 2000. None of the participating centres reported beams whose calibration fell outside the RPC criterion of agreement of 5%.

The second question dealt with ion chamber calibration. 31 of the 32 responding centres used the NRCC calibration service while one did not. 24 out of 32 reported chamber calibration in the last two years (1999/2000) although, the chamber of one respondent had not been calibrated since 1996. 25% of centres had converted to TG51 at the time of the survey.

The final question concerned quality control protocols. Not surprisingly most (but not all) Ontario centres follow the HARP documents with centres in the other provinces following the AAPM's TG40. No significant deviations from the chosen protocol were reported.

In conclusion, there is no evidence to suggest any calibration problems with Canadian radiotherapy beams. Centres are slowly migrating to TG51 which has been formally adopted by the Canadian medical physics community. It is noted, however, that 25% of centres do not have an ion chamber calibrated within the last two years. Finally, greater uniformity in quality control can be expected when the protocols, currently being developed under the auspices of the CNSC, are accepted and adopted nationally.

May 2001

Manufacturer's Error in Shipment of I-125 Seeds

By David Wilkins
Ottawa Regional Cancer Centre

Peter O'Brien's recent piece on the importance of independent calibration of brachytherapy sources ("Caution on the Use of Licenced Radioactive Materials", Interactions 47(2) p.63, April 2001) prompts me to share with other physicists a recent experience at the Ottawa Regional Cancer Centre. A shipment of Iodine-125 seeds was received on a Friday, for permanent implantation in the prostates of two patients the following Monday. The routine independent check of the strength of a random sample of 10% of the sources revealed that the mean source strength exceeded that stated on the manufacturer's source certificate by 48%.

The manufacturer was immediately informed, and they were able to ship seeds of the correct strength in time for the implant procedure on Monday. In addition, they shipped a calibrated seed, which confirmed excellent agreement between our dosimetry and theirs. An investigation by the manufacturer revealed that an error was made at the time of placing the seeds in the vial for shipment. Two employees were dismissed for not following approved procedures.

This incident reinforces the message in Peter O'Brien's short article, namely that mistakes are made by the manufacturers of brachytherapy sources, and it is the responsibility of medical physicists to independently verify the strength of sources before they are used clinically.

Medical Physics and the Digital Classroom: Faculty and Student's Perspectives

Faculty Perspective

By: Peter Dunscombe, Konrad Leszczynski, Peter McGhee and Patrick Rapley

Both the Northeastern Ontario (Sudbury) and Northwestern Ontario (Thunder Bay) Regional Cancer Centres are associated with local, primarily undergraduate universities - Laurentian and Lakehead respectively. Both cancer centres promote and support an academic dimension to their activities and this, of course, encompasses the departments of medical physics. One of the obvious challenges faced by small departments with academic expectations is the release of resources from pressing clinical needs to carry out research and to deliver graduate courses (in our case, to Masters level students).

For some years, physicists at the Sudbury centre have been providing graduate courses at Laurentian. As a natural extension of efforts that have previously been undertaken, for the academic year 2000/2001 we attempted to combine both faculty and students at the two centres to optimize resource utilization and to enhance the course offerings. For one course, Radiotherapy Physics, both students were in Sudbury but about 25% of the course was delivered by a Thunder Bay physicist using the three conferencing modalities of telephone, conventional video and the internet. For the second course, Physics of Medical Imaging, one of the three students was in Thunder Bay and, again, about 20% of the course was delivered by a Thunder Bay physicist. The "e-classrooms" in Sudbury and Thunder Bay were connected via a "free" internet based video conferencing link for this second course. Student-teacher real time interactions were supplemented by e-mail for the setting and submission of assignments. Some electronic teaching materials available on the web were also utilized to supplement the textbooks and lecture notes.

The opinions of the faculty involved in this exercise may be summarized thus:

- Distance teaching by any of these three conferencing modalities is feasible although, as could be expected, the quality of the student-teacher interaction and ease of information exchange is enhanced significantly as the video and audio quality is improved.
- Not only can meaningful resource efficiencies be realized by such an approach, particularly for smaller centres, but also students can have access to a much broader base of faculty knowledge and expertise.
- In this our first attempt to utilize web-based videoconferencing for graduate teaching, we were only able to use a private dial-up internet connection, which limited the quality of, particularly, the video link. We are hoping that with the upcoming improvements in the information infrastructure at both cancer centres, that next time we will be able to use a high speed internet connection. With such an improvement, web conferencing will likely be the cheapest and the technically superior approach of those tried to sharing faculty and students.

So far the arrangements between the faculty members by which we have given these courses are informal. However, there are plans afoot to have one set of, probably, three graduate courses in Medical Physics appearing in the calendars of both Lakehead and Laurentian. Students would have the option of taking the courses and undertaking the required project work in the centre of their choice.

(*with thanks to Scott Cosby for setting-up the internet link).*

…

Student's Perspective

By: Mike Coughlin, Renee Korol and Isaac Tavares

As graduate students in medical physics, we have found that many concepts in our field require the use of diagrams and sophisticated notation to be properly taught. During this past semester, attempts were made to present some of our lectures over digital media in real-time. Several techniques were attempted, each of which was about 90% successful. A slow video refresh rate and a small loss of resolution were observed.

In most cases, this level of success was sufficient to understanding the material. However, there were cases where learning was inhibited by the loss of detail. It is very difficult to teach monitor unit calculations, for example, without having the ability to transmit equations with all the subscripts clearly marked. The success of the digital classroom improved when materials were prepared in advance and sent to us in a readable format. Once the details were clear, conceptual discussions using web conferencing and other electronic media became more productive. Face-to-face discussion with physicists at our facility was also important to reinforcing key ideas.

In conclusion, we feel that distance education for graduate level medical physics is feasible.

…

Comment on the 2001 CCPM Membership Examination

By Ervin B. Podgorsak
McGill University

Twelve candidates wrote the 2001 CCPM membership examination in the Radiation Oncology specialization. As often in previous examinations, one of the questions required the candidates to calculate, for a cobalt-60 beam in a water phantom, the dose rate at a specified point A on the beam central axis from the known dose rate at a different point B on the beam central axis. The depths, field sizes, and source-surface distances for irradiation of points A and B were given. Also given were percent depth dose *(PDD)* and tissue-air ratio *(TAR)* tables and a graph depicting the collimator factor *(CF)* and the relative dose factor *(RDF).*

The **question**, as it appeared on the examination paper, is given below:

Given $\dot{D}(15,15,80,Co) = 200$ cGy/ min calculate $\dot{D}(10,20,140,Co)$

Clearly indicate and define all steps and parameters involved in your calculation.

NOTE 1: $\dot{D}(10,20,140,Co) = \dot{D}(d, A, f, Co)$ stands for the dose rate in cGy/min in a cobalt beam in a water phantom at a depth d = 10 cm, field size A = 20×20 cm^2, and source-surface distance f = 140 cm.

NOTE 2: Relevant percent depth dose (*PDD*) and tissue-air ratio (*TAR*) tables (source: Brit. J. Radiol., Suppl. No. 25) are enclosed.

NOTE 3: Graphs depicting the relative dose factor *RDF* (total scatter factor $S_{c,p}(A)$ in Khan's notation) and collimator factor *CF* (collimator scatter factor $S_c(A)$ in Khan's notation) are enclosed.

The general **answer** to the problem is as follows:

The problem can be solved using either the SSD approach or the SAD approach and the candidates were expected to use one of the two approaches to arrive at the final answer.

The general answer resulting from the SSD approach is:

$$\dot{D}(10,20,140,Co) = \dot{D}(15,15,80,Co) \times \frac{PDD(10,20,140)}{PDD(15,15,80)} \times \frac{RDF(20)}{RDF(15)} \times \frac{CF(11.4)}{CF(20)} \times \left(\frac{80.5}{140.5}\right)^2$$

The general answer using the SAD approach is:

$$\dot{D}(10,20,140,Co) = \dot{D}(15,15,80,Co) \times \frac{TAR(10,21.4)}{TAR(15,17.8)} \times \frac{CF(11.4)}{CF(15)} \times \left(\frac{95}{150}\right)^2$$

Both approaches should give essentially the same answer of **101 cGy/min**.

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2000 Professional Survey

By Richard Hooper

For the Professional Affairs Committee, COMP

The format and data collection procedure for the 2000 COMP Professional Survey was similar to that used for the 1999 survey. Approximately 250 questionnaires were mailed out to all COMP full members currently residing in Canada, and 129 surveys were returned to the COMP Secretariat. All survey responses were handled in the strictest confidence so as to ensure the anonymity of respondents. Responses are summarized by geographic area and degree/certification in tables 1 and 2 below. Two surveys were incomplete and were excluded from further analysis.

Salaries

In this year's survey respondents were asked to include bonuses and market supplements as part of their income, but to exclude compensation received in 2000 for work done prior to 2000 (e.g., retroactive salary settlements).

A summary of the salary data for Medical Physicists working in Canada is provided in table 3 below. Full statistics are provided for groups with at least 11 respondents. Only average and median results are provided for groups of 5 to 10 respondents. Data for groups of fewer than 5 could jeopardize confidentiality and thus are not listed.

A comparison of average and median salaries for 1999 and 2000 is provided in table 4. Only groups with at least 11 respondents in both years are included in this table. Figure 1 depicts percentile ranges of primary income from 1996 through 2000 for all Medical Physicists working in Canada, and also for subgroups by degree and certification.

Individuals were asked to specify by what percentage their salaries increased or decreased between 1999 and 2000. Of the respondents who had at least three years experience in medical physics, worked as full-time employees, and had not changed jobs in the past two years, no one reported that their salary decreased, 6% reported that their income did not change, and 94% reported that their income increased. For the 94% who reported an increase in income the average increase was 15.8% and the median increase 10.0%.

The regular hours of work specified in employment contracts for full-time employees was, on average, 37.3 hours per week.

Benefits

The average annual vacation allotment was 22.5 days per year.

Some employers allocate each of their physicists an annual personal travel and/or professional expense allowance, while other employers reimburse these expenses on an ad-hoc basis. Of all the respondents who listed themselves as full-time employees, 75% reported receiving reimbursement of at least $1,000 while 23% either did not answer the question or reported receiving no reimbursement. For those receiving at least $1,000 the average allocation was $3,165 and the median allocation $2,500.

Other benefits data is summarized in table 5.

Additional information regarding salaries or benefits, such as a detailed summary for a particular geographical region, is available upon request provided the data can be reported without jeopardizing confidentiality. Requests for further information or comments regarding the survey should be directed to Richard Hooper (rick.hooper@cancerboard.ab.ca).

REGION	Number of Responses
British Columbia (BC)	15
Alberta (AB)	10
Saskatchewan (SK)	7
Manitoba (MB)	5
Ontario (ON)	62
Quebec (PQ)	22
New Brunswick (NB)	3
Nova Scotia (NS) and Prince Edward Island (PE)	3
Newfoundland (NF)	1
Not Specified	1
Total	129

Table 1: COMP 2000 Professional Survey responses by geographical region.

	Certification				
Degree	None	CCPM(M)	CCPM(F)	Other	Total
Bachelors	1	0	3	0	4
Masters	20	11	12	3	46
Doctorate	35	9	29	6	79
Other	0	0	0	0	0
Total	56	20	44	9	129

Table 2: COMP 2000 Professional Survey responses by degree and certification

2000 Professional Survey cont.

			PRIMARY INCOME							
		Ave Yrs	Average	Percentiles						
	Number	Exper.	Income	20th	Median	80th	Income	20th	Median	80th
OVERALL (Canada)	127	12.0	86.0	62.7	85.0	105.1	88.4	64.8	87.0	109.0
PROVINCE										
BC + AB + SK + MB	37	12.9	92.6	81.7	95.0	105.2	93.7	81.7	96.0	106.8
ON	61	12.2	87.6	59.7	90.0	108.0	91.8	59.7	93.0	111.2
PQ	21	9.6	69.6	60.7	70.0	80.0	69.8	60.7	70.0	80.0
NB + NS + PE + NF	7	11.7	82.5		76.0		83.4		82.0	
EMPLOYER										
General Hospital	33	11.1	75.2	60.3	75.0	82.9	79.9	62.9	75.0	96.0
Cancer Institute	74	11.6	92.6	69.8	95.0	109.7	94.2	69.8	95.0	110.0
University or Government	15	14.9	75.8	60.5	76.0	95.5	76.7	60.5	76.0	97.0
FUNCTIONS (>= 50%)										
Clinical Service	81	9.5	82.7	59.7	83.0	101.2	83.5	60.0	85.0	102.1
Teaching + R&D	28	13.5	82.9	66.2	77.3	103.0	91.0	68.0	82.3	113.6
Administration	17	21.6	107.7	81.5	113.5	128.0	111.0	82.0	113.5	134.1
SPECIALTIES (>= 50%)										
RT	92	10.7	87.9	64.8	88.3	107.1	88.7	64.8	88.3	108.1
DR + NM + MR	26	15.4	81.8	64.5	79.8	98.6	89.6	67.1	84.5	110.0
RP	6	12.8	82.0		76.0		83.3		76.0	
YEARS EXPERIENCE										
< 5	30	2.7	65.7	55.5	59.0	75.0	66.1	55.5	60.0	75.0
5 - 9.9	28	6.9	79.5	63.2	81.0	94.8	79.9	63.2	82.0	94.8
10 - 14.9	27	11.4	88.0	77.1	87.0	99.6	89.8	79.8	90.0	101.1
15 - 19.9	14	16.7	106.4	89.8	109.0	122.3	109.3	101.2	110.0	122.9
20 - 24.9	11	21.7	98.9	84.1	105.1	115.4	110.3	86.0	105.1	144.0
25+	17	27.7	104.3	89.2	104.5	120.8	108.3	89.2	109.1	128.6
DEGREE/CERTIFICATION										
Bachelors/all	3									
Masters/all	45	12.1	79.1	57.8	75.0	98.8	79.4	57.8	75.0	98.8
Masters/no cert.	19	7.1	65.7	52.3	59.0	79.1	65.7	52.3	59.0	79.1
Masters/CCPM(M)	11	9.6	79.7	68.0	74.0	92.4	80.1	68.0	74.0	92.4
Masters/CCPM(F)	12	20.7	101.5	81.8	103.0	128.1	102.1	81.8	103.0	128.6
Masters/CCPM(M or F)	23	15.4	91.1	72.2	85.0	107.7	91.5	72.2	86.0	107.7
Masters/other cert.	3									
Doctorate/all	79	11.5	90.4	70.0	90.5	107.7	94.0	70.6	94.0	112.4
Doctorate/no cert.	35	7.7	77.7	58.3	76.0	95.5	79.1	58.8	76.0	97.0
Doctorate/CCPM(M)	9	9.9	87.1		89.7		94.6		95.0	
Doctorate/CCPM(F)	29	16.8	105.1	90.9	105.0	116.0	111.1	93.3	110.0	125.4
Doctorate/CCPM(M or F)	38	15.2	100.9	89.7	102.3	113.1	107.2	91.2	105.0	117.8
Doctorate/other cert.	6	10.5	97.8		96.8		97.8		96.8	
DEGREE/YEARS EXPER.										
Masters/< 10	22	4.6	62.8	52.8	61.2	74.1	63.0	52.8	61.2	74.1
Masters/10+	23	19.3	94.7	80.0	95.0	107.7	95.1	80.0	95.0	107.7
Doctorate/< 5	18	2.6	70.2	56.1	67.0	79.6	70.9	57.1	67.0	79.6
Doctorate/5 - 9.9	18	7.0	86.2	76.1	89.8	99.5	86.5	77.3	89.8	99.5
Doctorate/10 - 19.9	28	13.1	96.4	82.1	95.5	110.0	99.7	85.2	101.2	114.5
Doctorate/20+	15	24.5	108.3	99.0	107.0	118.0	120.3	104.8	114.0	144.0

Table 3: Salary data for Medical Physicists working in Canada. Salaries are in thousands of dollars. In order to ensure confidentiality, data are not listed for subgroups of less than 5, and only average and median values are reported for groups of 5 to 10 respondents.

2000 Professional Survey cont.

	PRIMARY INCOME 1999		PRIMARY INCOME (% of 1999 Income)		CHANGE IN PRIMARY INCOME (% of 1999 Income)	
	Average	Median	Average	Median	Average	Median
OVERALL (Canada)	73.7	72.0	86.0	85.0	16.7%	18.1%
PROVINCE						
BC + AB + SK + MB	78.7	78.0	92.6	95.0	17.7%	21.8%
ON	77.1	75.0	87.6	90.0	13.6%	20.0%
PQ	59.7	60.0	69.6	70.0	16.6%	16.7%
EMPLOYER						
General Hospital	65.6	60.0	75.2	75.0	14.6%	25.0%
Cancer Institute	79.3	75.0	92.6	95.0	16.8%	26.7%
University or Government	70.4	75.0	75.8	76.0	7.7%	1.3%
FUNCTIONS (>= 50%)						
Clinical Service	69.3	70.0	82.7	83.0	19.3%	18.6%
Teaching + R&D	76.1	75.0	82.9	77.3	8.9%	3.1%
Administration	89.4	97.3	107.7	113.5	20.5%	16.6%
SPECIALTIES (>= 50%)						
RT	74.5	70.6	87.9	88.3	18.0%	25.1%
DR + NM + MR	74.4	75.0	81.8	79.8	9.9%	6.4%
YEARS EXPERIENCE						
< 5	50.2	51.0	65.7	59.0	30.9%	15.7%
5 - 9.9	68.8	70.0	79.5	81.0	15.6%	15.7%
10 - 14.9	77.1	74.3	88.0	87.0	14.1%	17.1%
15 - 19.9	90.8	88.4	106.4	109.0	17.2%	23.3%
20 - 24.9	86.8	92.0	98.9	105.1	13.9%	14.2%
25+	92.4	89.5	104.3	104.5	12.9%	16.8%
DEGREE/CERTIFICATION						
Masters/all	66.5	65.5	79.1	75.0	18.9%	14.5%
Masters/no cert.	54.6	51.9	65.7	59.0	20.3%	13.7%
Masters/CCPM(M or F)	76.6	72.3	91.1	85.0	18.9%	17.6%
Doctorate/all	78.3	75.0	90.4	90.5	15.5%	20.7%
Doctorate/no cert.	68.3	63.5	77.7	76.0	13.8%	19.7%
Doctorate/CCPM(M or F)	83.7	78.0	100.9	102.3	20.5%	31.2%
DEGREE/YEARS EXPER.						
Masters/< 10	56.0	52.8	62.8	61.2	12.1%	15.9%
Masters/10+	78.0	72.0	94.7	95.0	21.4%	31.9%
Doctorate/< 5	51.3	55.0	70.2	67.0	36.8%	21.8%
Doctorate/5 - 9.9	69.8	71.0	86.2	89.8	23.5%	26.5%
Doctorate/10 - 19.9	87.3	86.0	96.4	95.5	10.4%	11.0%
Doctorate/20+	96.1	96.9	108.3	107.0	12.7%	10.4%

Table 4: Comparison of average and median values for primary income in 1999 and 2000. Income values are in thousands of dollars, and change in income is specified as percentage of primary income in 1999. Only groups with at least 11 respondents in both years are included in this table.

2000 Professional Survey cont.

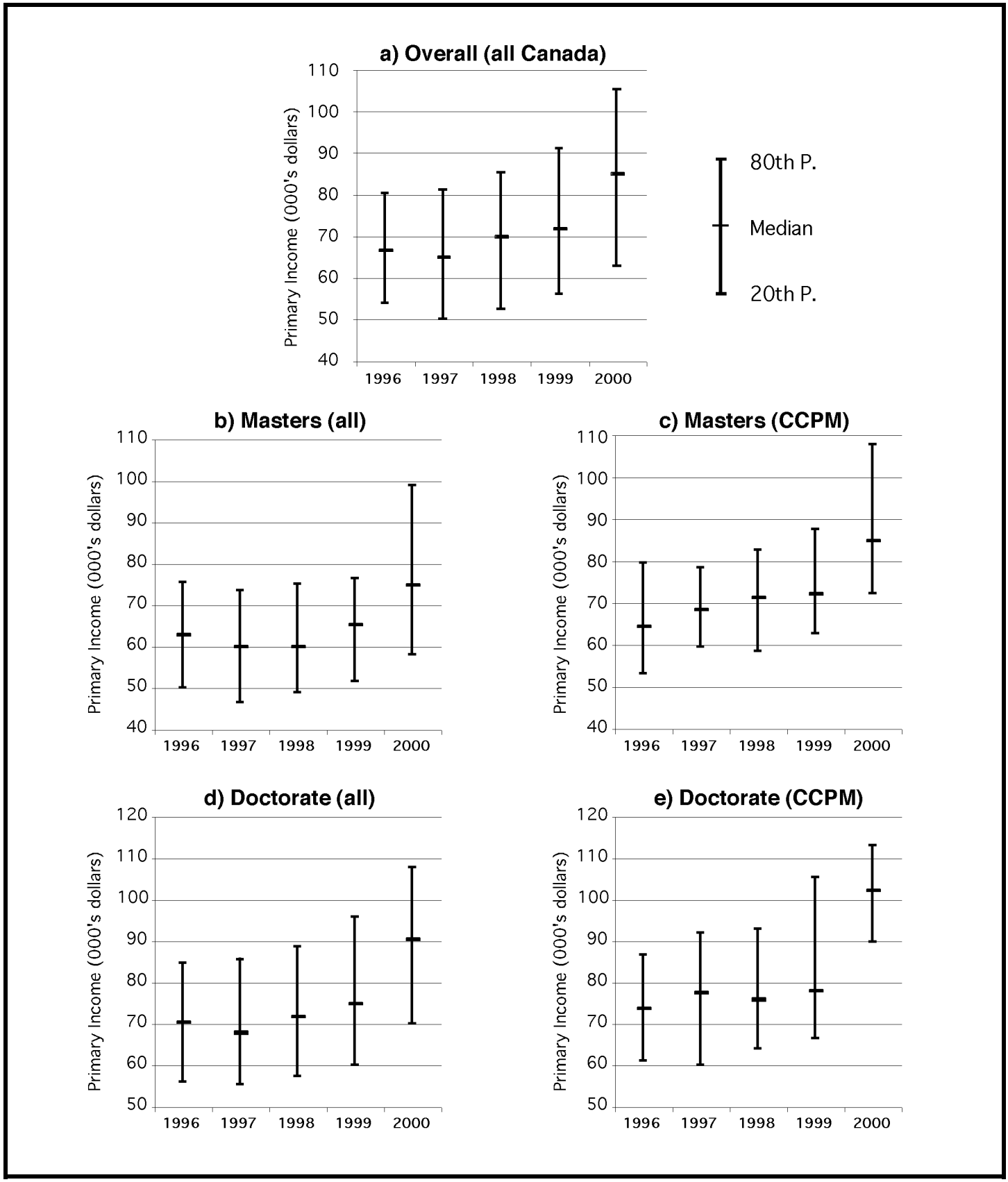

Figure 1: Percentile ranges of primary income from 1996 through 2000 for all Medical Physicists living in Canada, and for subgroups by degree and certification. CCPM designation includes both members and fellows.

2000 Professional Survey cont.

Benefit	Yes (%)	No (%)	Unknown or N/A (%)
Medical coverage	83	9	9
Dental coverage	79	15	6
Term life insurance	72	15	14
Disability insurance	65	21	15
Retirement pension plan (exclusive of CPP or QPP)	85	9	6
Sabbatical leave	26	55	20
Tuition benefits (self)	18	66	16
Tuition benefits (dependent)	5	76	19

Table 5: Percentage of full-time employees who received at least 50% funding from their employer for the listed benefits. Due to roundoff error, totals do not necessarily add up to 100%.

2001 CCPM Exam (Continued from page 89)

The question ties together the basic functions and parameters routinely used in external beam radiotherapy, and as such should present no problem to candidates. Not so. Of the 12 candidates, one obtained no answer and the answers from the remaining 11 ranged from 37 cGy/min to 330 cGy/min as follows: (35, 54, 75, 100, 101, 103, 105, 106, 112, 117, and 330 cGy/min). The correct answer was 101 cGy/min and only 3 candidates obtained the correct answer within the standard ±2%.

This is obviously a disappointing result that should elicit concern in medical physics circles. After all, the candidates have been employed as medical physicists for at least 2 years before taking the exam, and they are most likely involved with dose delivery to patients. If the basics of dosimetry are not understood well, how can the candidates do complicated treatments, like intensity modulated radiotherapy, dynamic wedge or radiosurgery that are becoming almost routine in most Canadian radiotherapy centres?

On the other hand, it is also possible that the exam, in addition to testing a candidate's knowledge, also tests a candidate's ability to race against time, and some candidates, despite having the knowledge, might not have the necessary speed. Only five hours allotted for completion of all four parts of the examination are most likely not sufficient for the majority of candidates to allow them to think about the problems and reflect upon their answers.

While there is nothing wrong with the level of the CCPM membership examination questions or size of the examination, I believe that considerably more time should be given to the candidates to write the examination. This would allow them to show what they know rather than testing how fast they can shovel the answers together. After all, during our daily work, most of us are allowed sufficient time to solve a problem, and very rarely is anybody accused of incompetence for simply working too slowly. A longer examination time would also remove any possible excuse that some candidates can use now to explain their failure.

Letter from John Cameron on Virtual Radiation Museum

Dear Colleagues,

I propose to initiate a Virtual Radiation Museum (VRM) on the web. This letter is to solicit suggestions and collaboration. I hope that it will become part of a much larger Virtual Science Museum (VSM). The need for education about radioactivity is urgently needed. The U.S. National Research Council questioned a random sample of Americans with 10 science questions. 72% agreed to the statement "All radioactivity is man-made." (I would expect Canadians to do better.) Do you wonder why the public is so upset with nuclear waste? COMP members who wish to help initiate or maintain the VRM, please contact me. At age 79, I can hope to do little more than initiate the VRM. There is much information already on the web. I tried the key words "radiation and radioactivity" on two search engines and had about 100,000 hits! The problem is to locate URLs that contain education material and then organize them into appropriate groups for different educational levels on various radiation topics. Each URL will be considered a "room" in the VRM. If a person enters any "room" of the VRM there should be a link to the home page, so that any individual can find scientific information at their educational level. I hope that eventually, the VRM will be one "wing" of a VSM -- a Virtual Science Museum.

I welcome your suggestions and collaboration.

John R. Cameron (jrcamero@facstaff.wisc.edu)
PO Box 405, Lone Rock,WI 53556
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(until about Oct. 15)

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(352) 371-9865
Fax (352) 371-9866
(October to end of April)

PS My article "Is radiation an essential trace energy?" is scheduled to appear in the July 2001 issue of Physics and Society. It will be on their web page after it is published. It is available by sending me an e-mail request.

Target Insight *(Continued from page 85)*

volume', Clifton stressed that although we now have the ability to 'sculpt' radiation dose in 3D, we require greater knowledge of a tumour's physical and biological properties before one can best determine how to 'sculpt' the dose. The target of the future may be mapped not only by anatomy, but also with regions of known hypoxia, angiogenesis, biochemical markers and other parameters. All of which would be incorporated in planning and targeting for cancer treatments.

On the final morning, despite a glorious warm, sunny day in Toronto, informal discussions over breakfast were well attended and lively. Two focus groups, one on targeting with biomarkers and one on targeting with functional imaging, met and there was ample opportunity for all participants to discuss the application, implementation, and clinical interpretation of these new technologies as well as discuss potential collaborative research. Overall the symposium a great success, offering new insight for the radiation oncologists, the physicists, the clinical scientists, and the radiation therapists. I can sum it all up as being very "Target Insightful".

In Brief

Nova Scotia welcomes new physicist

Medical physicists in Nova Scotia are pleased to introduce a new colleague and COMP member. Mr. Amjad Waheed joined the Medical Physics Department at the Queen Elizabeth II Health Sciences Centre April 2001 to work full time at the Cape Breton Cancer Centre. Amjad recently immigrated to Canada from Lahore, Pakistan where he served for six years as a physicist manager at the Shaukat Khanum Memorial Cancer Hospital and Research Centre.

John B. Grant

NetWorthy by Darcy Mason

Free and Open

For a while there, the mainstream media were caught up with the notion of "Open Source" software, and its possibilities for toppling the big name-brand software. Me, I didn't think there was much substance to it; just the media looking for a story. Now that the hype has subsided, though, I have slowly realized that there are some good packages out there in this category.

Below I highlight a few packages that have caught my attention recently. Not all of these items discussed here are completely free and open, so see the copyright statements for each. First, though, is a link submitted by Larry Watts:

CTSim - "The Open Source Computed Tomography Simulator" (www.ctsim.org)

From the introduction on the website: "`CTSim` simulates the process of projecting X-rays through a phantom object. `CTSim` can then reconstruct the interior of the object from those projections. `CTSim` integrates numerous visualization and analytic tools". Larry's comment on submitting this link was "Unfortunately the demo isn't ideal in that it doesn't simulate the effects of noise and polychromatic Energy spectrum(beam hardening). The SNARK 77 and 93 packages referenced in his links are more complete but they cost money ($300-$500)."

Linux and Desktop software

The mother of all open source is Linux, the Unix operating system which runs on PCs. If you want to try Linux, I suggest paying for one of the "commercial" distributions. In my case, I bought a $40 book with a Red Hat linux CD included. The really interesting thing to me is not Linux itself, but the graphical user interfaces now available - the Gnome desktop (www.gnome.org), and the KDE desktop (www.kde.org). If you haven't seen these, it's worth a look.

Databases

Databases are a staple of modern computing. Many sizeable modern applications use a database as part of their design. And now there are a couple of choices in the free category: mySQL (www.mysql.com), and PostgreSQL (www.postgresql.org). I tried mySQL and it installed and ran easily. Haven't done much with it, but I followed a couple of examples without problem. It apparently also has ODBC drivers and a graphical interface.

Programming

There have been a variety of open-source or free languages over time, but these usually required a lot of effort to install or use. Now, there is a simple, yet reasonably powerful language which is gaining ground: **Python** (www.python.org). I've been playing with Python for a couple of months, and I'm becoming a big fan of this language. Python code runs on Unix variants, Windows, and Mac, essentially unchanged (if you are Windows user, try the ActivePython package (www.activestate.com)), Python has the object-oriented abilities of any of the major languages. It's variables are "typeless"- ints, floats, lists, strings, objects can all be stored in any variable. Very useful lists and dictionaries are built into the core language.

Of interest to Medical Physicists: there are Python modules for number-crunching, image manipulation, plotting, etc. (see www.python.org/topics/scicomp/).

StarOffice

StarOffice tries to provide programs equivalent to that other Office suite (word processing, spreadsheet, database, email, presentation program, etc). I only glanced at it quickly, but the spreadsheet program flawlessly imported an Excel file. Looks promising. (www.sun.com/products/staroffice/).

Darcy Mason
Cancer Centre for the Southern Interior
Kelowna, BC
DMason@bccancer.bc.ca

From the Editor:

I was looking over the AAPM newsletter the other day, and it struck me just how *Canadian* Interactions has become (even thought the person most responsible for shaping Interactions into what it has become is now residing south of the border). In a typical Canadian way, I do not even think I can properly explain what I mean by this statement. Perhaps Interactions looks less authoritative and more accessible than its American counterpart (*proof*: we have a Canadian, living in America, taking a poke at American beer and the Canadian Nuclear Safety Commission – thanks Brennan for your *Is it Physics or Funnies*). I think it is also typically Canadian that we look to improve our lot by realizing the importance of, and taking responsibility for, the education of our membership (proof: consider some of the excellent feature articles that provide a current review of some very hot medical physics topics). Without going too far with this, I would just like to say thank-you to all the contributors and ask them to give themselves a big pat on the back. I think they know they are appreciated by the COMP/CCPM membership even though the feedback may sometimes be mute.

I would like to tell you about changes in the production and distribution of the newsletter. We are now having our printers also handle the newsletter mailing. We have a publication number which enables us to take advantage of discount bulk mailing pricing from Canada Post. In fact, I am now able to FTP the finished newsletter file to the printers, a proof arrives by courier for approval, and the newsletters are mailed out without further handling or delay. This has helped reduce the time that the editor and COMP secretariat require to get Interactions to you, and I hope these steps will make the job of future editors much easier.

I hope your copy of Interactions makes it to you before the annual COMP meeting. This will not only bolster my confidence in the printing and mailing process but will give you something to read on the trip to Kelowna. If not, then I wish you all a great summer. Finally, I wish to thank the editorial board, Darcy Mason, John Schreiner, Gino Fallone, and all the contributers for making Interactions a uniquely Canadian publication.

Pat Cadman

The CCPM Exam

Medical physics professional certification
Means clearing this one little hurdle,
Candidates come with angst and trepidation,
For the exam makes gray matter curdle.

Months of reading, ideally, or two weeks of cramming,
Every colleague knows how best to prepare,
All this for a mere five hours examming,
With the outcome determined by prayer.

Their crania crowded with hard won facts,
With half-lives measured in days,
Long nights of study of dull medphys tracts,
A pity that so little stays.

With fretting and sweating and pounding of heart,
Mind racing from too much caffeine,
At the stroke of nine the ordeal starts,
As stomachs churn and faces turn green.

Tissue maximum ratios, P_{wall} and P_{ion},
Cross-sections and depth dose curves,
All these are handy, but the heart of a lion,
Is needed for the real foe: nerves.

S_p, TPR, mu upon rho and ALARA,
Bunker design! How unlucky, how cruel!
Scatter this, scatter that; bless dear old Aunt Clara,
Whose advice was to go to law school.

Five hours of scribbling at peak mental function,
On which hinges a medphys career,
A race to the finish, then excessive consumption,
Of large pitchers of ice-cold beer.

Dave Wilkins
Ottawa Regional Cancer Centre

P.S. Dave promises not to quit his day job

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mailto:gollaher@kodak.com

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mailto:JRoth@os.varian.com

Medical Physicist

The Department of Nuclear Medicine at the University of Alberta Hospital requires a Medical Physicist. Reporting to the Regional Administrative Director, you will have responsibilities in the Nuclear Medicine and Diagnostic Radiology quality assurance program and in the physics teaching program for Radiology and Nuclear Medicine residents and quality assurance Technologists.

You must possess a Ph.D or equivalent in Medical Physics, a minimum of two (2) years direct related experience, and knowledge of and experience with the imaging and physics aspects of X-ray, Nuclear Medicine and MRI imaging. In addition, you must be eligible for certification with the Canadian College of Physicists in Medicine.
Closing Date: May 7, 2001 Competition #JP-17506-UA-EJ

Please submit applications quoting the competition number to: Ms. Ellen Smith, Regional Administrative Director,Regional Imaging Rooms 8119A & B, Aberhart Centre One 11402 - University Avenue Edmonton Alberta T6G 2J3

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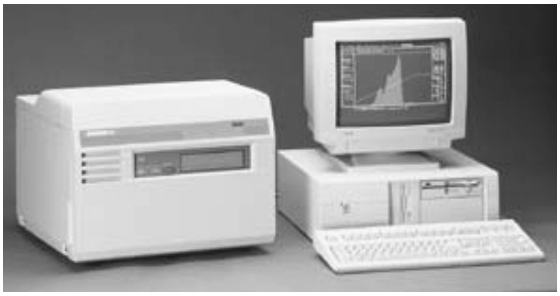

Look for our booth at COMP/OCPM in Kelowna!

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On the web at http://www3.sympatico.ca/hilferdine

POSITION: **Medical Physicist**

LOCATION: Windsor Regional Cancer Centre
Windsor, Ontario, Canada

The Windsor Regional Cancer Centre (WRCC) is seeking a medical physicist to join a progressive Medical Physics Program. WRCC has just moved into a beautiful new facility in April, 2001. The 6500 sq metre (69,000 Sq ft) centre houses three Siemens Primus linear accelerators, an Odelft simulator, orthovoltage, and HDR. There is an active brachytherapy program with HDR and seed program for prostate cancer patients. There are plans to add a CT simulator by year end. WRCC has one of the most innovative information systems in Canada.

The Radiation Oncology Program treats approximately 1200 new patients per year and enjoys a growing relationship with Windsor and Wayne State Universities. The Medical Physics Program has a staff of 8, complementing a staff of 5 Radiation Oncologists and 21 radiation therapists.

Applicants should have CCPM (or equivalent) certification with two year of clinical experience. Preference will be given to candidates with a Ph.D. and who have completed a physics residency.

The WRCC is part of the provincial organization of Cancer Care Ontario, which currently has 8 cancer centres in the province of Ontario. Windsor is a city of 300,000 located across the river from Detroit (a metro area of ~ 3 million) and is Canada's southernmost city. It offers small town charm while maintaining close proximity to major metropolitan areas.

Interested applicants should send a CV to:

Lorraine Monforton
Human Resources
Windsor Regional Cancer Centre
2220 Kildare Road
Windsor, Ontario, Canada N8W 2X3
Phone (519) 253 3191 x 58550 FAX (519) 255 8670
Email: lorraine.monforton@wrcc.on.ca

Johns Hopkins University, Division of Radiation Oncology

Baltimore, Maryland, USA

is currently seeking to recruit two

MEDICAL DOSIMETRISTS

to participate in the technically sophisticated and challenging work environment in the Medical Physics Section at Johns Hopkins. JHU is intellectually stimulating and has been rated nationally as the number one teaching hospital-medical school in the USA for the last ten years by US News and World Report. As part of the comprehensive cancer center (CCC), the division is housed in the newly constructed six level Weinberg Building on the downtown Medical Campus near the Inner Harbor and the Historic Fells Point area. Physics and dosimetry services are also provided to a satellite facility.

Combined equipment to treat 150 patients per day at all facilities includes: 5 Varian linacs (one equipped for gated therapy); all linacs equipped with MLC and EPI. Conventional and virtual simulation are done with Ximatron, Odelft, and AcQsim equipment. An active brachytherapy program with HDR (Nucletron) and LDR, including prostate seed implants is in place; program expansion of HDR in a shielded OR is imminent. Stereotactic Radiosurgery and Radiotherapy are carried out using fixed cones or microMLC on BrainLab and 3D line systems. Treatment planning is done with ADAC Pinnacle-3, ROCS-3D, PLATO, and MMS; an in-house program is used for Total Body Irradiation (TBI) planning. A Varis record and verify system integrated with Varis Vision is also in clinical use.

Currently, the Medical Physics Dosimetry Section consists of a collegial group of 3 Dosimetrists + 2 temporary Dosimetrists. Dosimetry applicants should have a strong foundation in basic dosimetry. Initially the dosimetrist would provide routine clinical service. The work would focus on high quality external beam planning- with 3D when appropriate. Opportunities for training in other areas will be provided as required.

In addition to a competitive salary, a $5000 sign on bonus, and excellent benefits, Johns Hopkins provides opportunities for achieving personal satisfaction and professional growth. Interested applicants should submit a resume and a list of 3 references to the listed contact. JHU is an equal opportunity/ affirmative action employer /educator.

CONTACT: Nicholas A. Detorie, Ph.D.
Interim Director of Medical Physics
Johns Hopkins Radiation Oncology
401 North Broadway, Suite 1440
Baltimore, MD 21231
E-mail: detorni@jhmi.edu

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