Schweizerische Gesellschaft für Strahlenbiologie und Medizinische Physik
Société Suisse de Radiobiologie et de Physique Médicale
Società Svizzera di Radiobiologia e di Fisica Medica

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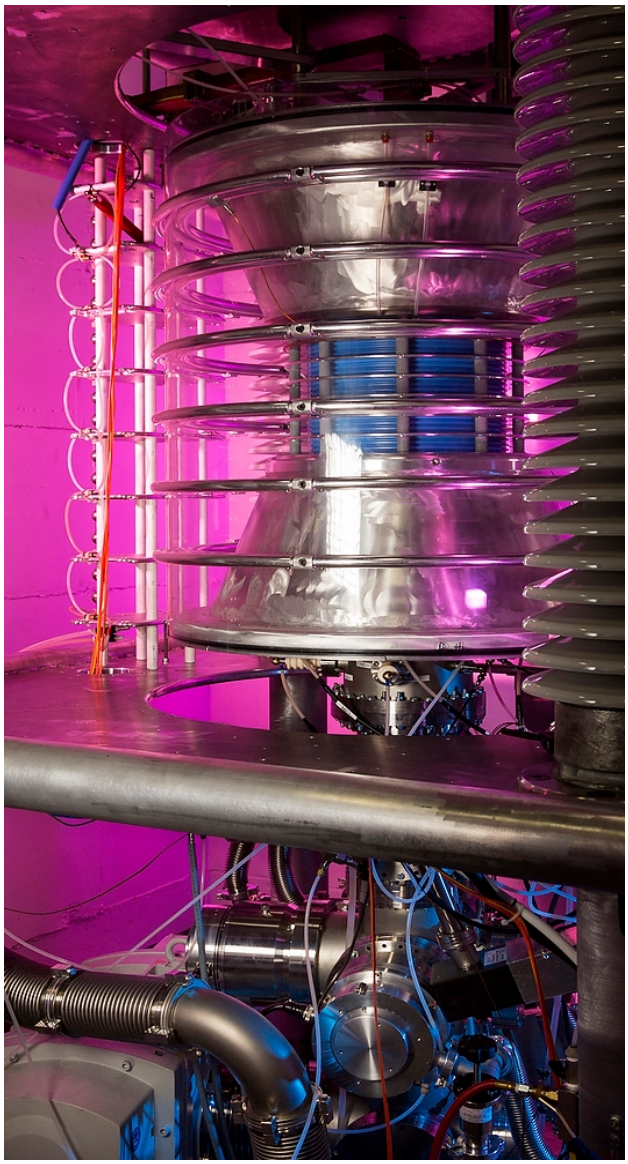

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BULLETIN 79

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Cover image:

Prototype neutron generator developed by Phoenix Nuclear Labs for the SHINE Medical Technologies Mo-99 production facility. The neutron generation is based on the deuterium-deuterium fusion reaction. Photo provided by Ross Radel, president of PNL.

Read more: http://phoenixnuclearlabs.com/products/neutron-generators/

LETTER FROM THE EDITORS

Dear Colleagues,

As a relatively new physicist to the SSRMP community, having arrived in Lugano in January 2011, I would like to introduce myself. I did my postgraduate studies at the University of Wisconsin-Madison medical physics program where I specialized in radiation therapy. Most recently before coming to Switzerland I worked as a clinical medical physicist at Beth Israel Medical Center in NYC. I look forward to meeting those of you whom I have not yet met and to sharing many fruitful collaborations in the future.

I want to thank the SSRMP board and my fellow editors for allowing me to participate, and I hope to bring more energy to the group in its preparation and care of the SSRMP bulletin.

Kind regards,

Nathan Corradini

Dear Colleagues,

Springtime has arrived in Switzerland with its blossoming colors of wild primrose, crocus, and forsythia! Such a wonderful annual event beckons us to the mountains to hike and to enjoy other natural escapades.

We want to thank everyone who has contributed to this issue. It is only with such contributions that the bulletin may remain an active means of communication within our society and a valuable font of professional interest and collaboration. With this said, we ask that everyone contribute when they are able to, whether it be by providing reviews of attended conferences, working group updates, member updates, or just general articles of interest. All contributions are welcome!

In an attempt to familiarize the Swiss radiation oncology community to one another's centers we will be starting a new section in the bulletin entitled "Spotlight on". In each issue, one center will be featured in which they describe their center and anything of interest that they would like others to know, e.g. who works there, technologies implemented, and current activities. An example of the "Spotlight on" section is included in this bulletin for everyone to view. If you are interested in having your center be featured then please send an email to one of the editors.

Until the next issue we wish everyone much sun and many springtime barbeques!

Nathan Corradini, Shelley Bulling, and Regina Müller

President's letter

Dear colleagues,

The new radiation protection ordinance will soon be submitted for the consultation process. However, before that phase begins, BAG has asked SSRMP to propose a definition of what is a medical physicist. The proposition is the following:

*"Wer einen Bachelor of Science in Physik **und** einen Master of Science in Naturwissenschaften an einer Universität (oder ETH) oder eine gleichwertige Ausbildung **erlangt hat** und die eidgenössische* Fachanerkennung in Medizinischer Physik besitzt, erfüllt die Voraussetzungen, um die Funktion eines Medizinphysikers gemäss Artikel 65 auszuüben."*

- ** bedeutet, dass die eidgenössische Anerkennung noch zu erlangen ist. Dazu müsste z.B. zum Staatssekretariat für Bildung, Forschung und Innovation (SBFI), http://www.sbfi.admin.ch/org/index.html?lang=de der Kontakt aufgenommen werden.*
- *Die Festlegung der Inhalte der Weiterbildung **zur Fachanerkennung würde** in den (zukünftigen) Richtlinien zur eidgenössischen Fachanerkennung erfolgen.*
- *Mit der oben stehenden Formulierung wäre auch der Fall eines Masters in Medizinischer Physik (was auch eine Ausbildung in Physik wäre) mit eingeschlossen. Die verlangte Weiterbildung wäre entsprechend etwas schlanker wie z.B. für einen Teilchen- oder Festkörperphysiker.*
- *Der MAS wäre (wie bis anhin) eine Option für die Absolvierung der Weiterbildung.*
- *Wie bis anhin müssten die Fälle in denen kein Physikstudium ausgewiesen werden kann und/oder die Ausbildung an einer nicht-universitären Institution erfolgt ist unter der Option "gleichwertige Ausbildung" bewertet werden.*

Concerning the specialization, the board has contacted the Swiss Society for Radiation Oncology (SRO) to ask them if they would agree to organize an education course about clinical radiotherapy for our colleagues in training. The SRO answered very favorably and a course should be organized for this autumn.

The SRO and SSRMP have also agreed to organize a shared continuing education day with the topic "Hypofractionation and stereotactic irradiation". Stay tuned for more information.

These two collaborations with our medical colleagues are an important step toward a common point of view concerning education. This is hopefully the beginning of a closer collaboration between the two Societies, which is clearly needed.

Another common point of view with the SRO is the importance of the SSRMP intercomparison. While SSRMP will remain the organizer of the intercomparison, the SRO will strongly encourage all centers to pay the 500 CHF fee to participate. It has become necessary to charge a fee for the intercomparison because it costs approximately 10'000 CHF per year, and our society is not able to support this cost every year. I would like to thank Hans Schiefer and the whole team at St. Gallen for the organization of the 2014 edition. In the future, Claude Bailat, head of the radiometrology group at the IRA in Lausanne, has agreed to organize the intercomparisons. This is really good news and I would also like to thank him for agreeing to do this work for the SSRMP.

The "Dreiländertagung" will take place in Zürich from September 7th to 10th. **Hope to see you there!**

The 50th anniversary of our Society will take place in Luzern on the 12th of November. Werner Roser and the organizing committee have set up a very nice and interesting program, where the past and future will be mixed. Don't miss out on what is shaping up to be a very enjoyable day - save the date in your agenda!

As in each edition, there is a lot of information from our Society and interesting content in the Bulletin.

Do not hesitate to participate by sending reports, reviews, information, etc... The Bulletin editors want to encourage more news from around Switzerland and propose to create a new column called “Spotlight on…”, where a center will be interviewed in each edition. The idea is to know each other better. Therefore, if one of you would be interested in starting, please volunteer by contacting the editors.

As usual, I would like to acknowledge our editors for the work that they do to compile the Bulletin and this time, a special thank you to Nathan Corradini who has joined the editorial board.

Enjoy your Bulletin and meilleures salutations de Lausanne!

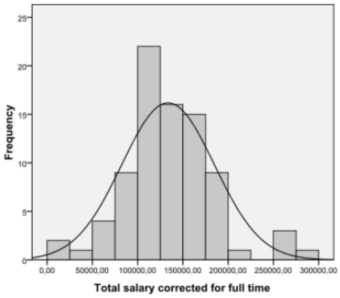
Raphaël Moeckli

Proceedings for the 2010 annual meeting

The proceedings for the 2010 annual meeting are now available online in pdf format

http://www.sgsmp.ch/histor-d.htm#Kongresse

Professional Affairs Committee
2014 Salary Survey



Dear colleagues,

The Professional Affairs Committee will organise a new salary survey this year.

As in 2011, we will put the survey on the web to use a statistics software tool for analyzing data. The purpose is to speed up the whole procedure. As was done for the last survey, a summary of the results will be published in the SSRMP bulletin. All SSRMP members will be invited to participate in the survey and will receive an invitation during April 2014.

The aim of the committee is to complete analysis as soon as possible; hopefully early enough to negotiate your salary for 2015 with your employer, if necessary.

We hope that a majority of colleagues will support this new survey in order to have a complete view of our salary situation.

For any questions or suggestions, feel free to contact us.

On behalf of the committee

F. Corminboeuf, La Source Lausanne

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SSRMP Education Course on "Medical Physics in Radiology and Nuclear Medicine"

Dear colleagues,

In April 2014, the SSRPM planned to offer two days of courses for medical physicists who are involved or getting involved in medical physics in the fields of diagnostic radiology or nuclear medicine.

The aim of the course was to review the physics of diagnostic radiology and nuclear medicine to ensure that the education of the SSRPM certified medical physicists complies with article 74.7 of the Swiss Radiological Protection Ordinance requirements

Due to the lack of participants, SSRPM's board has decided to cancel the radio-diagnostic and nuclear medicine course for medical physicists and to postpone them until the end of 2014 for nuclear medicine and mid-February 2015 for radio-diagnostics.

A new announcement will be published in the Bulletin as soon as we have new dates for the different parts of the courses.

On behalf of the education and professional affairs committee,

F. Corminboeuf
Clinique La Source, Lausanne

Venue
University of Zurich – Campus Irchel
Winterthurerstraße 190 • 8057 Zurich/CH

Date
7-10 September 2014

Scientific Organiser
Swiss Society of Radiobiology and Medical Physics
Schweizerische Gesellschaft für Strahlenbiologie und Medizinische Physik (SGSMP)
German Society of Medical Physics
Deutsche Gesellschaft für Medizinische Physik e. V. (DGMP)
Austrian Society for Medical Physics
Österreichische Gesellschaft für Medizinische Physik (ÖGMP)

Conference Chair
Dr. Stephan Klöck
UniversityHospital Zurich/Division of Radio-Oncology/Medical Physics
Rämistraße 100 • 8091 Zurich/CH

Deadlines
Deadline for abstract submission: 31 March 2014
Early bird registration: 1 July 2014

Conference Organisation on behalf of the SSRMP
Conventus Congressmanagement & Marketing GmbH
Phone +49 3641 31 16-360 • Fax +49 3641 31 16-243
julia.gruner@conventus.de • www.conventus.de

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Postkonto: 10-14793-4
IBAN: CH57 0900 0000 1001 4793 4
BIC: POFICHBEXXX

Dr. Werner Roser, Kassier

Paul Scherrer Institut
CH-5232 Villigen PSI
Tel. 056 310 3514
E-Mail: werner.roser@psi.ch

to all SSRMP members

Villigen PSI, April 2014

Win a free SSRMP membership in 2015!

Dear members of SSRMP

In the last bulletin, I announced that bills for the membership fee of 2014 were included in the bulletin. However, the bulletin was printed faster than expected and the bills were not ready in time. As a consequence, only 10% of our membership has paid its membership fee right now. So I'll extend the "qualification period" for winning a free membership in 2015 until mid-May.

Now the bills are included in this issue in those 90%, where the membership fee for 2014 is still open.

A free membership for 2015 will therefore be raffled among those ordinary members of SGSMP, who will pay their membership fee for 2014 of **Fr. 50.--** no later than May 15th, 2014 (receipt as non-cash on our account; because cash deposits produce bank charges and are thus excluded from the lottery).

The lucky winner will be announced in the next bulletin.

Werner Roser

Report of SSRMP Research Grant 2011

PTV subtraction from the skin and its effect on inverse planning: Evaluating optimal margin

Nathan Corradini[1], Stefano Presilla[1], Manfred Sassowsky[2], Karin Schombourg[1]

[1] Clinica Luganese, Radiation Therapy Center, Lugano, Switzerland
[2] Inselspital, Radiation Oncology, University of Bern, Division of Medical Physics and Department of Medicine, Bern, Switzerland

Introduction

There is known uncertainty in buildup and surface doses calculated in treatment planning systems (TPSs).[1-7] Discrepancies in dose calculation and measurement seen at near-surface depths are a result of several factors. If one were wanting, these factors could be classified into four potential groups: the models of physical processes with inherent uncertainties, the TPS's ability to calculate these basic processes, user-dependent variables affecting the TPS calculation, user-dependent variables that affect results in measurement. Evaluation of how well a TPS calculates superficial dose is theoretically possible by minimization of the last two user-dependent variables while also taking into account inherent limits of the studied process. Furthermore, a TPS algorithm's calculation accuracy can be tested as a function of one of the variables, e.g. planning target volume (PTV) subtraction from the skin, while making sure to control all other variables.

Modern intensity-modulated radiation therapy (IMRT) treatments use TPSs with inverse planning algorithms. These algorithms optimize beam delivery modulation to give more conformal dose to the PTV while also sparing the surrounding normal tissue. Superficial PTVs that extend to the skin pose a great difficulty for inverse planning algorithms. The calculated doses can be highly erroneous near the surface.[1-3] Radiation therapy departments often have their own unique protocol to arrive at a "correct" dose distribution to avoid such algorithm-dependent results. A typical protocol may consist of subtracting a predefined amount of the PTV from the patient's skin. The AAPM radiation therapy IMRT subcommittee recommends adding bolus when in doubt of adequate dose coverage in the buildup region.[8] The reasoning behind both these methods is to ensure a more correct dose calculation in the near surface depths and to provide adequate coverage of the PTV. These basic concerns are made more relevant when taking into account further error-introducing variables such as patient motion and plan robustness, which are beyond the scope of this study.

A planner's choice of PTV subtraction from the skin is very important in the algorithm's ability to calculate the dose near the surface. Therefore, it is necessary to have an adequate knowledge of each TPS and how well its inverse planning algorithm functions in conditions involving superficial PTVs. Knowledge of the TPS's inherent limits then allows the radiation therapy team to anticipate possible dose discrepancies and thereby plan accordingly to deliver the correct dose to the PTV.

The goal of this study was to produce a clear set of recommendations that may be used by other clinics utilizing TomoTherapy and/or Varian systems for the treatment of superficial PTVs. The study was carried out with two questions in mind:

- What optimization strategy provides the best agreement between measurement and dose calculation in the buildup region?
- As a reference, what PTV subtraction margin provides optimal coverage of a superficial target 2mm from the skin?

Materials and Methods

- Materials -

The study was conducted on a TomoTherapy Hi-Art® System (Accuray®, Sunnyvale, CA) and a Clinac® iX 2300 System (Varian Medical Systems, Palo Alto, CA). Plans were optimized using the TomoTherapy TPS (Ver. 4.0.3) and Varian Eclipse™ TPS (Ver. 10.0.39). A cylindrical solidwater TomoPhantom™ with diameter of 30cm and length of 18cm was used in simulation of a patient. The phantom is composed of two semi-cylindrical halves allowing film measurement in the sagittal plane (Photos 1 & 2). Measurements were made using Gafchromic® EBT2 films (ISP Inc, Wayne, NJ) from film lot#: A08151101A (Exp. Date: Aug. 2013). An Epson Expression® 10000XL scanner was used to digitize films. ImageJ, MATLAB, and TableCurve software were used for post-processing and data analysis. The recommendations of AAPM TG-55 on radiochromic film were followed throughout the study.[9]

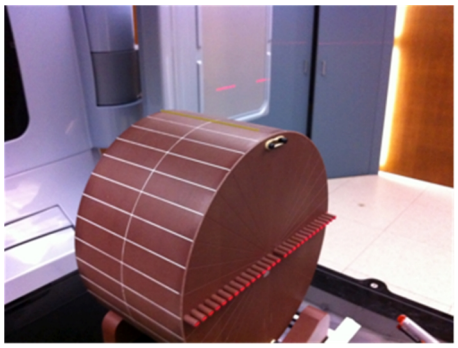


Photo 1. (Left) Photo showing one half oft he TomoPhantom rotated 90º with a film ready for irradiation.

Photo 2. (Right) The photo shows the TomoPhantom with both halves together and film in place. The phantom has been rotated to allow film measurement in th sagittal plane

- CT Setup and Plan Optimization -

A planning kVCT was taken of the phantom with 1x1x1mm^3 resolution. A superficial PTV with a depth of 4cm and length of 4cm was centered along the upper edge of the TomoPhantom using Eclipse. The PTV was designated as a high-resolution structure and a series of six margins were subtracted from the skin: 0, 1, 2, 3, 4, 5 (mm) (Figs. 1 & 2). No other structures were designed with the intent to diminish other variables during optimization. The kVCT with structures was sent to the TomoTherapy TPS as well as to the Varian Eclipse planning station for plan optimization.

The study was done using a 6MV photon energy for both systems. TomoTherapy Direct (TD) and Helical (TH) treatments were optimized for each modified PTV volume for a total of 12 plans. Varian sliding-window IMRT (VI) and RapidArc® (VR) treatments were optimized for each modified PTV volume for a total of 12 plans as well. Subsequently, the optimizations were calculated using AAA and Acuros for the Varian treatments, a total of 24 calculations. AAA and Acuros calculations were used in the study to help investigate uncertainties due to calculation rather than optimization. TomoTherapy treatments used the 2.5cm beam width and a 0.287 pitch was used for helical delivery. The TD and VI plans used identical beam arrangements of seven static fields: 278°, 285°, 320°, 0°, 40°, 75°, 82°. The VR plans used two 180° arcs. One arc travelled from 270° to 90° with the collimator rotated at 30° and the other from 90° to 270° with a collimator rotation of 330°. Varian treatments were planned and delivered using a dose rate of 600 MU/min while TomoTherapy treatments were planned and delivered with the fixed dose rate of 850 MU/min. Skin flash was not used in planning.

Treatments were optimized to deliver a median prescription dose of 2Gy to the PTV. Furthermore, plan optimization was carried out using similar criteria to the ICRU recommendations for plan acceptance, i.e. $D_{98\%} \geq$ 95% of prescription dose and $V_{107\%} \leq 1cm^3$. In addition, a general guideline was followed to stress the optimizer as one would for a real clinical patient. No post-optimization fluence adjustments were made for Eclipse treatment plans.

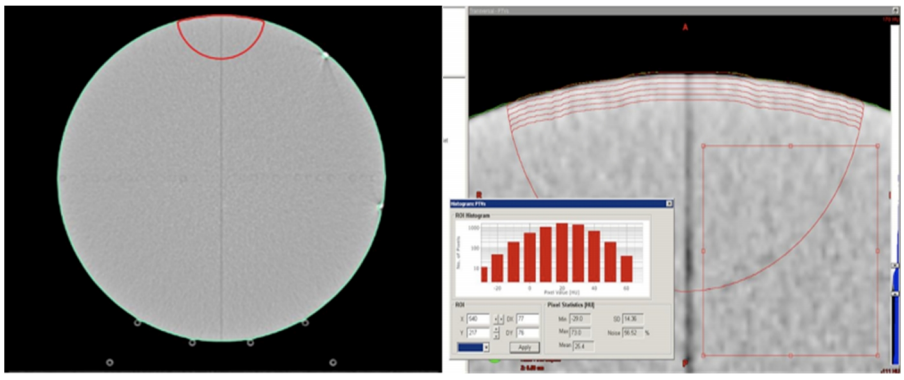
Lastly, a percent depth dose (PDD) measurement was planned on the Varian system. The PDD plan was set up to deliver 2Gy at D_{max} using a 10x10cm^2 field size at a source-to-surface distance (SSD) of 98.5cm. The plan was delivered onto the phantom and not a flat surface with the intent to measure under the exact conditions used in the PTV study. The PDD measurement was used to give an overall evaluation of the dosimetry method given a simple case.

- Film Setup and Measurement -

The films were cut to a dimension of 16cm width by 8.4cm height. A hole-puncher was used to mark the films in the upper right hand corner to aide in setup and film processing alignment. The hole allowed precise placement of the films by attaching to a peg of equal dimension in the sagittal plane of the phantom, as can be seen in Photo 1. The setup affixed the film such that 2mm of its edge extended outside the phantom surface. A razorblade was then used to mark the surface position onto the films (Photo 3).

Figure 1. (Left) kVCT image of the phantom showing the body and PTV contours. The PTV has a depth of 4cm from the surface.

Figure 2. (Right) Close up view of the PTV surface with subtraction margins. The image also shows the ROI measurment to establish the phantom HU value used in surface pixel determination.



Phantom positioning and overall setup were verified before film measurement. For the Varian system, this meant phantom alignment to isocenter lasers and SSD verification using a front pointer. For the TomoTherapy system, this meant alignment to isocenter lasers and an MVCT of the phantom prior to the first treatment of each film set. In addition, an external self-leveling laser was used as an independent check for both systems.

Sets of 5 films were measured for each treatment plan with 12 plans per system. A total of 60 film measurements were made for each treatment system equaling 120 PTV measurements in all. The Varian PDD case was measured with a set of 5 films as well.

- Absolute Dose Calibration -

Film calibration was performed at an SSD of 85cm and irradiated using the $5x40cm^2$ field width on the TomoTherapy system. An A1SL ionization chamber (Standard Imaging, Madison, WI) and TomoElectrometer were used in dose measurement. Absolute dose calibration was performed in accordance with the IAEA TRS 398 dosimetric code of practice, and is metrologically traceable to the Swiss national primary standard, a water calorimeter.[10] Ten dose levels were irradiated with two film measurements per level.

Each film used in the calibration and subsequent dosimetry was positioned on the scanner bed using an in-house film holder. Films were scanned prior to being irradiated and post-irradiation. The net optical density (OD) of the red color channel corrected by the post-irradiation blue signal ($_{net}OD_{red,c}$) was used to correlate film readings to dose. The $_{net}OD_{red,c}$ signal was calculated using the original method proposed by the film manufacturer, with exception to the substitution of the red channel net OD for the post-irradiation OD.[11] Films were scanned, 66hrs post-irradiation, in portrait orientation using transmission mode at a resolution of 150 dpi with no post-processing to the obtained image. The measurement signal was taken using a $1x1cm^2$ square region of interest (ROI) from the center of irradiated films.

- Film Processing and Analysis -

A scanner response kernel, K_{sc}, was created to correct spatial inhomogeneities in scanner response to film optical density. A set of 17 transparencies was scanned, each transparency of a different uniform optical density. Images were then smoothed using a $3x3mm^2$ moving median filter. Images were normalized to the median value obtained in the central $1cm^2$, the same ROI used for signal extraction in calibration. Image normalization used the same ROI as calibration to keep dose reference consistent. In the final step, the normalized images were linearly fit pixel-by-pixel as a function of the value measured in the central ROI sample. The resulting K_{sc} consisted of two matrices equal in dimension to the film size, one providing a linear response with respect to OD and one providing the base OD response.

Film measurement images were convolved with the K_{sc} to correct scanner inhomogeneities. Images were rotated using the razorblade surface marks on the irradiated films to aide in the analysis and alignment. Images were smoothed using a $1x1mm^2$ median of the neighboring pixels to remove any perturbations such as dust particles.

The surface edge for each measurement was taken to be the pixel subsequent to the line between the razor marks. The central axis of the PTV was geometrically calculated from the film hole aligned with the peg in film placement. The depth profile for each film measurement was taken as the median of a 1cm-wide profile along the central beam axis. The median of each set of 5 film measurements was used as the official depth profile for the treatment plan. The calculation profile used for comparison against measurement was taken as the median of a 1cm-wide central depth profile as well.

Shifts in the official profile measurements were made to provide the best agreement between measurement and calculation. The shift was found to be acceptable due to known uncertainties in the study setup, specifically possible error in film scoring with the razorblade. An analysis of all the shifts in the study was used as an estimation of the accuracy in surface alignment. The optimal shift for each profile was determined using the buildup and distal edge gradients as indicators. Also, each optimal shift was chosen in conjunction with a gamma analysis of the full profile. During optimal shift selection, the gamma analysis dose difference (DD) criterion was lowered to give more importance to the distance-to-agreement (DTA) criterion.

Each plan profile measurement was renormalized by its respective mean percent dose difference, $DD_{\%}$ (Eq. 1), calculated between 10mm and 30mm. The decision to renormalize the profile measurements was due to the large error found in the film accuracy as a result of scanner heating issues. The renormalization of the data is discussed in detail within the results and discussion section.

An estimation of accuracy and precision was performed for the film method. Film precision in the method was estimated as the average in profile standard deviations (STDs) within each set of five film profile measurements for the 25 plans. Error in film precision was estimated as the STD in average profile STDs for the sample of 25 plans. The STD from the mean profile of each set was calculated for each point of film measurements for the full length of the profiles, i.e. 0mm to 50mm. The average of the STDs along the profile was then taken as the value for each set.

Film accuracy in the method was estimated using the mean $DD_{\%}$ between calculated and measured plan depth profiles for the sample of 25 plans. Error in film accuracy was estimated as the STD in the mean $DD_{\%}$ within the

sample of 25 plans. The $DD_{\%}$ was calculated for all points between the depths of 10mm and 30mm. The range used in estimation was chosen because it was considered to be the flattest and most stabile part of the profiles.

$$DD_{\%} = \frac{(D_{calc} - D_{meas})}{D_{calc}}, \quad \text{(Eq. 1)}$$

where D_{calc} is the TPS calculated dose and D_{meas} is the measured dose.

Each plan profile measurement was compared against its calculation using a global gamma analysis and percent dose difference with respect to the prescription of 2Gy, $DD^{m}_{\%}$ (Eq. 2). The gamma analysis was calculated for the full profile, i.e. from the phantom surface to 10mm past the distal edge of the PTV. The DTA criterion was 0.5mm and the DD criterion was 2%. The $DD^{m}_{\%}$ was calculated for each point in the full profile,

where

$$DD^{m}_{\%} = \frac{(D_{meas} - D_{calc})}{D_{pres}}, \quad \text{(Eq. 2)}$$

and D_{pres} is the prescription dose of 2Gy.

An evaluation of $DD^{m}_{\%}$ was performed separately for the buildup region between phantom surface and 10mm depth. Points in which the $DD^{m}_{\%}$ was greater than ±3% were counted and considered to show a notable difference in measurement and calculation.

Results and Discussion

- Renormalization of Film Profiles -

A trend in the absolute dose was noticeable in some of the film measurements (Fig. 3). The error in absolute dose in the film measurements is now known to be a temperature effect due to the scanner as it heats up over a long period of time, i.e. greater than 1hr. As the scanner heats up so does the temperature of the film during readout, which affects the absolute dose measurement. Discussion of reading out temperature and its effect on radiochromic film dose measurement has been mentioned in the published literature.[9] However, a continual heating of the scanner was not forseen and it was assumed that the scanner temperature would stabilize thereby limiting any temperature-dependent response. The effect was observed and understood after having performed the long scan sessions necessary in this study, i.e. up to 10hrs, due to the multicenter collaboration and film readout at only one site.

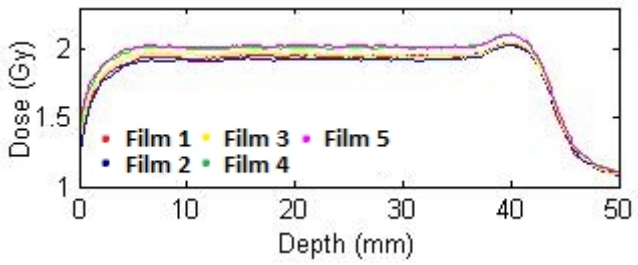


Figure 3. The graph shows a set of 5 individual profile measurements for a plan. An increase in absolute dose, ~12cGy, can be seen with successive film measurements due to the continual scanner heating.

Rescaling the official measurement profiles by the mean $DD_{\%}$ was deemed acceptable. The decision to rescale was based on several positive findings such as the low mean STD in absolute dose observed within the plans and a near-zero mean $DD_{\%}$ for the 25 film sets.

Findings suggested the scanner heating affects the overall dose scaling but not the relative OD-to-dose response of the measurement. This dose scaling effect can be seen in Figure 3 with the five measurements maintaining the same shape but a different absolute dose. Thereby, a rescaling of the official profile measurements was an effective solution to allow comparison of the calculated and measured doses in the buildup region.

- Scanner Response Kernel -

The idea of a scanner response kernel, $K_{sc,}$ was developed and implemented during the study. It was an attempt to provide a mathematical correction to completely separate the scanner-induced dose-dependent inhomogeneities from those that are independent of dose. The kernel itself is completely independent from the type of film used, e.g. Gafchromic EBT2, and is only a characterization of the relative scannerbed spatial response.

Initial investigations into the K_{sc} idea showed amelioration in 2D dose measurements however its use in this study did not show significant corrections in the scanner response. The implementation of the K_{sc} is still under study.

- Film Analysis Results -

One film was irradiated incorrectly and one deemed as a possible error in irradiation. Both films were removed from analysis. A total of 123 of 125 measurements were evaluated.

The average in profile STDs observed within each film set was 1.0%. The deviation in average STD was calculated to be 0.5% for the sample of 25 sets. The overall mean $DD_{\%}$ was -0.1% for the full sample of 25 plans. A STD of 3% in mean $DD_{\%}$ was observed within the 25 plans. A maximum mean $DD_{\%}$ of 7.6% was observed in plan

sets. A near-zero mean $DD_{\%}$ indicates that absolute dose readings were in agreement with calculations for the 25 film sets overall. However, a STD of 3% in the mean $DD_{\%}$ demonstrates the large error in absolute dose that was observed in individual plan measurements.

An average shift of -1.1 pixels (-0.2mm) with a STD of 1 pixel (0.2mm) was observed within the sample of 25 plans. A maximum shift of -3 pixels or -0.5mm was observed three times. VI showed the least setup error, one profile measurement was shifted -1 pixel while the other four were not shifted within the set. TD showed the most setup error with an average shift of -1.7 pixels (-0.3mm).

- Measurement Results -

The average difference in measurement from calculation in the PDD plan was 0.2% for AAA and -0.3% for Acuros, shown in Figure 4. Measurement was 5.4% and 3.3% greater than the AAA and Acuros calculations at phantom surface. Acuros calculation showed better agreement with measurement in the dose buildup region and the whole profile. After the surface pixel, measurement was within 1% of Acuros calculation. Good agreement between measurement and calculation in the PDD case was a validation of the dosimetry and analysis method implemented in the study.

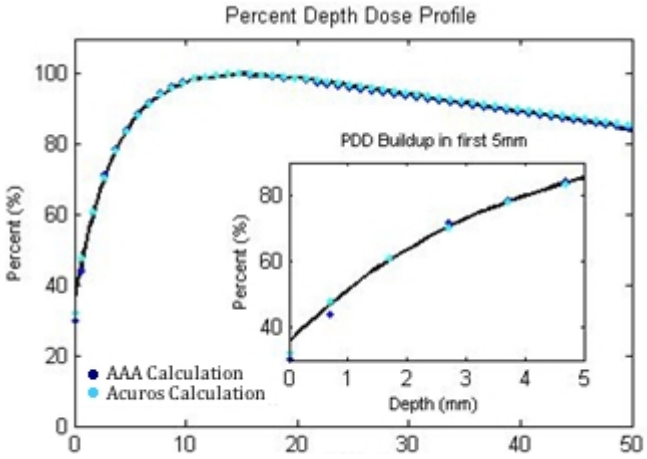


Figure 4. The PDD graph is shown with a zoom of the buildup in the first 5mm.

Figure 5 shows the $DD^{m}_{\%}$ and gamma analysis results for the full profiles, and Figure 6 shows the $DD^{m}_{\%}$ for the buildup region. TomoTherapy plans showed very good agreement between calculation and measurement. The $DD^{m}_{\%}$ was within 3% for all but 10 of 132pts evaluated in the TD and TH plans' buildup region. Five of the ten erroneous points were in the TH plan with 0mm subtraction margin. Interestingly, no TomoTherapy plan calculation met the 2Gy prescription dose at the specified PTV margin depth. Prescription dose was not met at the 2mm reference depth either, with the 0mm margin plans coming closest at -4.7% and -4.4% of prescription dose for TD and TH respectively. Hardcastle *et al*[5] reported that the Tomotherapy system calculation was within 2.5% of measurement for superficial doses and our results are in overall agreement with their finding.

Varian plans showed large discrepancies in comparison of calculation and measurement in the buildup region. The $DD^{m}_{\%}$ criteria of 3% was not met in 34 of 132pts (AAA) and in 44 of 132pts (Acuros). Acuros showed better agreement for IMRT plans with small subtraction margins, i.e. 0, 1, and 2mm. Though, AAA calculation showed better agreement with large subtraction margins for IMRT and Rapid Arc plans. Overall, agreement between calculation, AAA and Acuros, and measurement was better for Rapid Arc compared to IMRT. Measurement differences from calculation were observed of up to 25% in the IMRT plans. These findings are very similar to the dose differences reported by other authors.[1-3,7]

The discrepancies observed in the buildup region for Varian IMRT plans with small subtraction margins could be due the plans' limited robustness with respect to geometrical displacements. Dose deposition in the buildup region by tangential beamlets is sensitive to an eventual vertical displacement. Given the good agreement observed in the PDD plan, it seems improbable that the dose calculation algorithm itself is the reason for the discrepancy. Plan robustness with respect to setup uncertainty is not within the scope of this study, however it remains important in treatment planning, especially in cases involving superficial PTVs.

Conclusions

In conclusion, the TomoTherapy TPS calculations and measurements were in very good agreement, including within the buildup region. The system's underdosage at subtraction margin seems to be independent of the margin size and therefore is not due to inadequate dose buildup. It is hypothesized that the observed effect could be a dose limit due to field edge definition near the PTV surface.

In response to the original questions, it was observed that all subtraction margins can be used to provide good agreement between dose calculation and measurement. Optimal PTV coverage in the buildup region can be attained by highly stressing the TPS optimizer and/or expanding the PTV used in optimization with respect to the actual PTV. It was shown that the addition of bolus to the plan will not ameliorate the dose delivered to the defined PTV

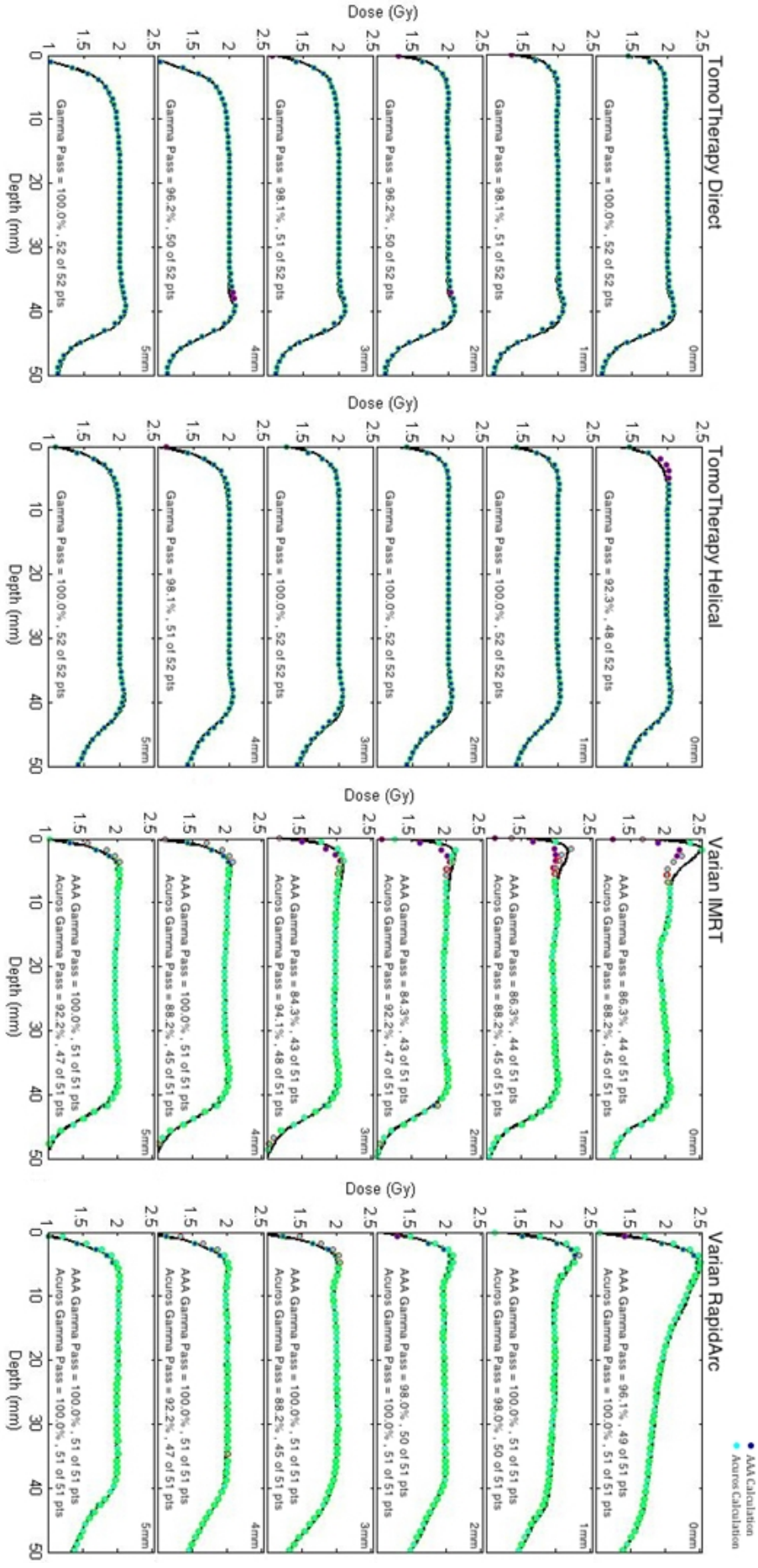


Figure 5. The figure shows the measurement vs calculation profiles with gamma analysis results for all PTV plans. The gamma analysis pass results for DTA = 0.5mm and DD = 2% are shown on the graphs.

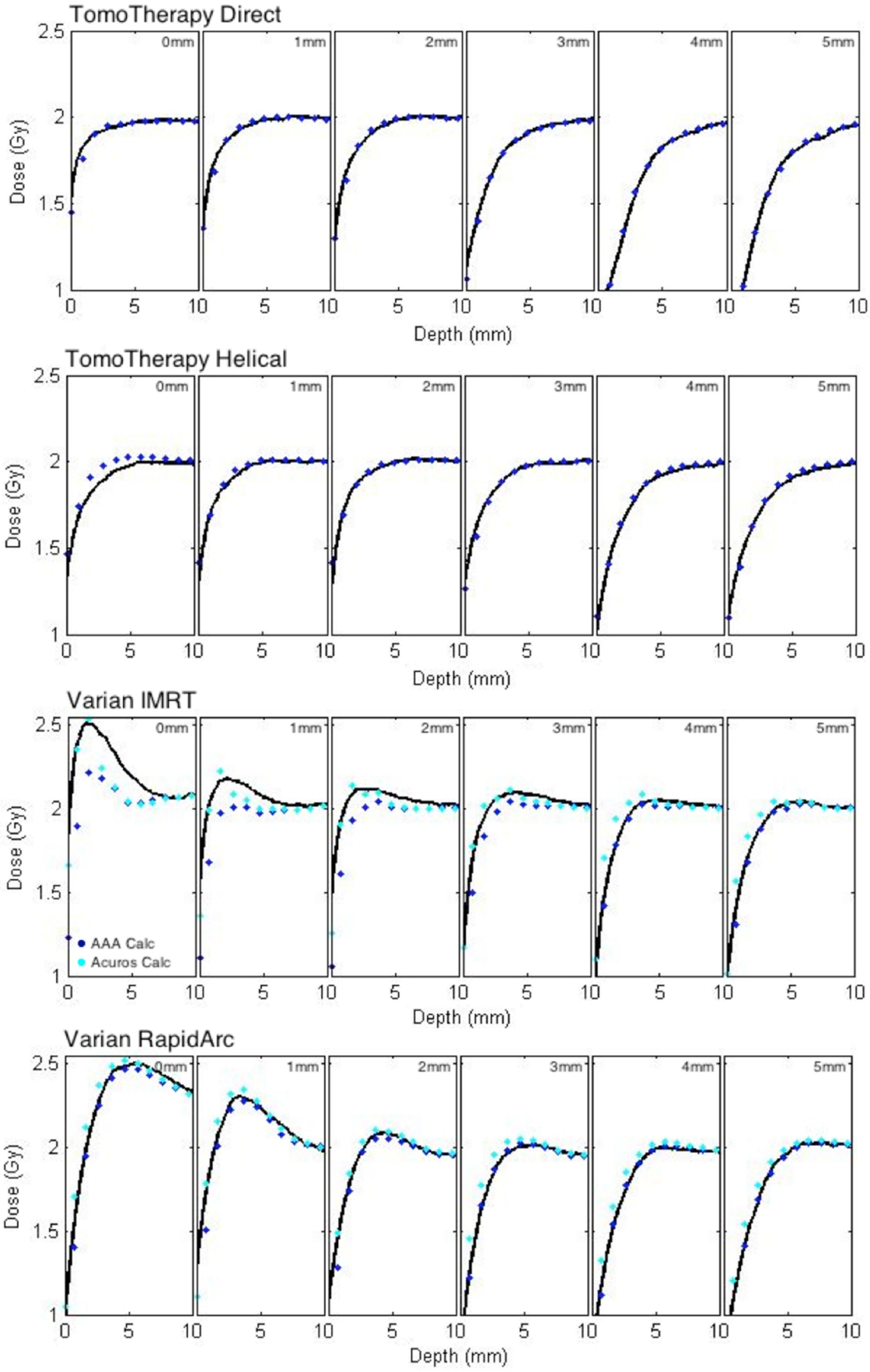


Figure 6. The figure shows the $DD^{m}_{\%}$ measurements in the buildup region for all plans.

reference, a PTV with 0mm subtraction margin would have been used in optimization with a high stress on the optimizer.

The Varian system showed pronounced differences between calculated and measured doses close to the surface for plans with small PTV subtraction margin. The Varian system was able to meet the dose prescription at small subtraction margins, however at the cost of dose uniformity within the PTV. Strengths and weaknesses of the AAA and Acuros algorithms could be masked by uncertainty in setup and therefore the authors refrain from drawing firm conclusions upon which of the two is better at calculating the buildup dose.

In response to the original questions, two different methods have been recommended depending on treatment technique. For IMRT, a PTV subtraction margin of at least 3mm should be used to provide good agreement between calculation and measurement in the buildup region. This is the same recommendation as A. Shiau *et al*[7] based on their findings. Optimal PTV coverage in buildup can be attained by avoiding small PTV subtraction margins to avoid introducing dose inhomogeneity in the volume. For RapidArc, all PTV subtraction margins can be used to provide good agreement between calculation and measurement. However, as for IMRT, 0mm and 1mm PTV margins should be avoided during optimization to avoid dose inhomogeneity in the volume. If the PTV is within 3mm of the skin then the addition of bolus is an effective solution and should be included during optimization. It is also recommended to avoid stressing the optimizer too much to avoid introducing dose inhomogeneity. For the 2mm reference, a bolus would have been used during optimization so as to guarantee 3mm margin to the true PTV surface.

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[5] N. Hardcastle, E. Soisson, P. Metcalfe, A. B. Rosenfeld, W. Tomé, "Dosimetric verification of helical tomotherapy for total scalp irradiation," Med. Phys. 35, 5061-5068 (2008)
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[8] Gary A. Ezzell, James M. Galvin, Daniel Low, Jatinder R. Palta, Isaac Rosen, Michael B. Sharpe, Ping Xia, Ying Xiao, Lei Xing, Cedric X. Yu, "Guidance document on delivery, treatment planning, and clinical implementation of IMRT: Report of the IMRT subcommittee of the AAPM radiation therapy committee", Med. Phys. 30, 2089-2115 (2003)
[9] AAPM Report No. 63, Radiochromic film dosimetry, 1998.
[10] IAEA TRS-398, Absorbed Dose Determination in External Beam Radiotherapy: An International Code of Practice for Dosimetry based on Standards of Absorbed Dose to Water, Vienna: IAEA, 2000; ISSN 1011-4289.
[11] Gafchromic EBT2 Self-Developing Film for Radiotherapy Dosimetry, ISP White Paper, Revision 1, February, 2009.

Working Group on Revision of Recommendation No. 11

The working group on the revision of Rec. 11 has finished its updates and has submitted the newly revised report to the SSRMP Scientific Committee. Its acceptance and publication are expected in the near future. Until then an overview of the changes is summarized in the table below.

Major Changes to Rec. No. 11

1. External dosimetry audit request for new installations

   "At the time of commissioning, **before the irradiation of the first patient**, the beam calibration has to be checked by an external beam dosimetry audit."

2. Tighter limits (Equal or greater than vendor specs for acceptance)
   - Mechanical precision
   - Output constancy

Type	Current	Revision
Rotation scales	1°	0.5°
Output factors (open)	2%	1%
Wedge factors	2%	1%
Profile constancy	3%	2%
Depth doses	2% (X) / 2mm (e)	1% (X) / 1mm (e)

3. No more weekly checks they are now monthly

4. Dynamic wedges as part of photon beam measurements (Baseline vs factor)

5. Checks on a rotational basis for dynamic wedge profiles

Type	Current	Revision
DW factors	d absolute (3%)	d constancy (3%) rotational a absolute (1%)
DW profiles	m all	m rotational all at least once a year measured
DW factor @ gantry angle	a 3%	a (1%)

6. MLC checks have been adapted (No moving MLCs are addressed)

   "The tests described **are intended for non-modulated techniques**. For modulated techniques, it is recommended to refer to the recommendations No 15.
   Leaf position accuracy
   Use a film/EPID to perform a matched segment or **"picket fence"** test e.g. several abutting long rectangular MLC fields, for **gantry angles 0, 90, 270 and 180**.
   Leakage between leaves
   Expose a detector with the MLC set to a long rectangular field (for which the long field edges are perpendicular to the direction of leaf movement). Measure the transmission between the leaves"

7. Adapted frequency for emergency off button testing

   "Performed on a rotational basis provided that all are tested at least once per year"

8. New numbering

Chapter	Current	Revision
1	introduction	introduction
2	mechanics	mechanics
3	X-rays with mech wedges	X-rays with all wedges
4	electrons	MLC
5	MLC	electrons
6	dynamic wedges	safety and integrity
7	safety and integrity	special modalities
8	special treatments	external dosimetry audit
9	tables & frequencies	tables & frequencies
10	references	references
11	glossary	glossary
12	members	members

Daniel Frauchiger, Inselspital Bern

Working Group on Medical Imaging Physics

Meeting notes from the first two meetings in 2013:

28 May 2013, Bern

The main discussion points were:

- Goals and task to be covered by "AMP Art74"
  - No specifics were discussed however the goal of AMP Art 74 will be to define which measurements must be performed and how they will be performed.

- Scientific issues: "Quo vadis CTDI"?
  - There was discussion on whether the CTDI is an adequate measurement (estimate) of the real dose received by the patient.
  - Further discussion on this topic in August.

- Information exchange: IVEU status
  - 1st set of results will be ready in August/September
  - If chosen, financing is needed for its maintenance and support. Who?

- Next steps
  - Next "AMP-Meeting Art. 74": August 20th
  - Different companies who have software for evaluating dose will be invited to the meeting.

20 August 2013, Bern

- Agenda for the meeting:
  - Opening presentation by Robert Schöpflin (KSSG)
    "Mapping of CT-protocols to CT-DRW, experiences and suggestions"
  - Presentations of software for dose evaluation
    - Fabian Schüepp (Raditec Medical AG) on "Ray Save S1"
    - Franziska Lauschner (GE) on "DoseWatch"
    - Dr. M. Walz (Arztliche Stellen für Qualitätssicherung Hessen, DE) on "IVEU"
    - Gerd Lutters (KSA/ZHAW) on "autom. DR-Statistics"
    - Marc Jopek (Bayer) on "eXposure"
  - Name for the SGSMP working group on Art. 74
    - Medical Imaging Physics

Karin Schombourg, Clinica Luganese

Minutes from SGSMP Medical Imaging Physics (MIP) Meeting

Jan. 7th 2014, 14:00; Berne (Uni Berne, H331)
Moderation: G. Lutters, Minutes: S. Scheidegger; 24 Participants

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1. Welcome (G. Lutters)
Staring time for the meeting in future will be 14:10 due to train arrivals
End will be planned for quarter to full hour in future

2. Input presentation by F. Verdun
Some selected important points:

- Unification of nomenclature to enable automatic dose registration / collection (CT and XRF / XRA)

- DRL updates: DRL should be indication oriented
- CTDI measurements in less standardized (clinic oriented) modes (wide beam, shuttle mode) and/or for a given (clinical) protocol
- Defining Reference Levels for XRF / XRA
- XRF / XRA: Effort should be put on unit quantification, Proposition of a national database
- Involvement in the discussion of exposed patients with K_{air} > 5 Gy (discussion with the operator, dose estimation, risk communication)
- Future challenges: surgeons, surgery
- XRF / XRA: monitoring the practice
- NUK: development of a SSRMP-phantom (using a ^{68}Ge – source?)
- Optimal use of TOF and PSF
- SIRT: strong implication in quantitative aspects of patient's dose estimation
- Link to RT

Discussion

Gerd Lutters: Points to be discussed (1) Education of Medical Physicist and (2) the actual discussion about how to proceed in Art.74 Abs 7 StSV is not matching the consensus paper (SSRMP Report No. 20: Medical physicist staffing for nuclear medicine and dose-intensive x-ray procedures)

"From machine QC oriented to clinical use QA oriented service" has been discussed

- Involvement into clinical aspects? How strong? Role in justification and optimisation? (delivering quantitative basis)

3. Formation of working groups (CT-group, XRF-group, NUK-group)
Initial question: Should such (sub-) groups be created? 18 yes, 1 no, 5 abstentions
Contra: We should first define the exact role for medical phycisist in diagnostics / NUK in general
More questions: What are the tasks of the working groups?
Developing a " tool boxes" (which may be close to recommendations)?
In the working groups, the medical partners should be involved (or in the discussion / development of methods and concepts) → How to involve physicians?
Definition of high- and low dose XRF- procedures (-disciplines?)? Dividing the topic in two parts (groups?)

➔ Start with one group for XRF and then separate the groups if needed (defined by the group itself), preparation of teaching material

Who has to perform acceptance test for PET (especially KP5)? There are divergent opinions about this point, some participants stated that FOPH inspectors are expecting the involvement of medical physicists, may be different for situations with in-house physicists and external service. Critical point which may motivate the involvement of medical physics is the use of radionuclides in open form and to ensure appropriate preparation of the phantoms. → this seems to be a clear motivation to engage a NUK-working group

Consensus paper: smooth transition to new recommendations? - or adapting the different task and give interpretation to the different tasks?

Propositions for possible tasks should be mailed to Gerd Lutters: gerd.lutters@ksa.ch or to the responsible of the different working groups.

Decisions:
Responsible CT group: Francis Verdun, IRA Lausanne
Responsible XRF / XRA – Group: Roland Simmler, Hirslanden Group
Responsible NUK – Group: Constantinos Ziambikis, NUK USZ
First job of responsible: find group members

4. Varia
Information about Eurados: Questionnaire about lens doses
Information about SSRMP teaching courses in Lausanne (CT) and Zurich (NUK)
BAG Sammelaktion www.bag.admin.ch/samak Deadline Feb. 7th 2014
Suggestions for next meeting: Use of protection devices for patients in CT
further topics can be mailed to Gerd Lutters: gerd.lutters@ksa.ch

End of meeting 16:30

Stephan Scheidegger, ZHAW School of Engineering

Conference Report: ICTR-PHE 2014

The second edition of the ICTR-PHE conference, organized by CERN, took place 10.2-14.2.2014 in Geneva. It brought together the International Conference on Translational Research (ICTR) and the Physics for Health (PHE) initiative. It aims at fostering collaborations between physics, biology and medicine to achieve further improvements in cancer treatment. The conference covered a wide range of topics from radiobiology, nuclear medicine, detectors and imaging, to new therapeutic targets for personalized medicine, and new ideas for radiosensitivity modulation. It is impossible to give a comprehensive summary here; instead we mention some of our personal highlights. If you want to get more information see: http://ictr-phe14.web.cern.ch/ICTR-PHE14/

Several groups presented their advances in in-vivo range verification of carbon ion beams. Two approaches are being explored: online measurement of prompt gamma rays emitted after inelastic hadronic interactions, and off-line reconstruction of electron-positron pairs using PET/CT. Challenges of the former method include the low counting rate, limiting the statistical uncertainty of the range estimate. The latter method is complicated by the signal decay and washout during transfer from the treatment table to the PET/CT. New ideas for optimizing these methods were presented, e.g. track reconstruction of prompt charged particles, or exploring alternative detector materials. A complementary approach presented is the Bragg peak localization in proton therapy using thermo-acoustic signals.

The further improvement of PET techniques was the topic of several presentations. New ideas for detector materials and geometries were presented, e.g. axial detector configurations for parallax-free reconstruction, and the optimization of time resolution for TOF-PET applications.

V. Bhadrasain from NIH and M. Dosanjh (CERN) moderated an interesting panel discussion about clinical trials in hadrontherapy. The experts pointed out several difficulties on why clinical trials are not easy to perform. Apart from financial issues one main reason is the rapid development of the technologies, i.e. remarkable changes occur during the running time of the trial. Another one is the definition of useful endpoints given the time frame needed to perform the trials. However, all agreed that clinical trials are necessary and essential in the field of particle therapy. Finally B. Bhadrasain announced that NIH might open a call to support 6 to 8 randomized clinical trials in proton radiotherapy and 1 to 2 in carbon radiotherapy and invited the experts to submit proposals.

CERN presented a design study to supplement their Low Energy Ion Ring (LEIR), used only part time as LHC ion pre-injector, with an additional extraction channel and beam line that can be used for radiobiological experiments. While a cost estimate was done, funding is still to be found.

Since January a new CERN office for medical applications exists. Ideas about the work packages and organizational structure were presented. While CERN contributes the expertise in Detector and Accelerator Physics and Technology, input and participation by Medicine and Medical Physics are required.

“Physics is beautiful and useful” was the title of a highly inspiring public lecture given enthusiastically by U. Amaldi, highlighting the past spin-offs of fundamental physics to medicine.

The conference has been very stimulating and gave a taste what technological and radiobiological developments might find its way into the clinics in the next one or two decades.

M. Sassowsky, M.K. Fix, AMS Bern

JOURNAL OF APPLIED CLINICAL MEDICAL PHYSICS, VOLUME 15, NUMBER 1, 2014

The Meaning of a Master of Science Degree in Medical Physics

Michael D. Mills , PhD , Editor-in-Chief

For our international readers, this issue's editorial is concerned with the ongoing saga of the meaning of the MS degree in medical physics within the United States. And with that statement, I probably just lost two-thirds of my readers. Nevertheless, this is an issue that indirectly affects the international medical physics community, as the United States casts a long shadow. And for those of us within the US, we need to think carefully about the future of graduate medical physics education and speak honestly to our students who would honor us with their intention to join us as colleagues.

Most of us know the history all too well, and I will not bother to repeat it. 2014 has arrived, and medical physicists now will need to complete a CAMPEP-accredited residency program in order to sit for the Board Certifications offered by the American Board of Radiology (ABR) in the various medical physics subfields. Many medical physicists have taken advantage of the closing door, and the number of new ABR certificates awarded in the past five years has been quite impressive; this is especially true in therapy physics. Job creation in our field predictably follows cancer incidence and steadily provides a market of 150–175 new therapy physics jobs per year. This is not enough to employ all of the board-certified therapy physicists looking for positions and the oversupply is estimated in the hundreds. Following 2014, we may see this oversupply diminish, as there will not be a sufficient number of residency program graduates to meet demand. As the residency programs expand, we may see a "soft landing", as supply eventually balances demand a few years hence, but when we look around, we may not recognize the landscape.

The reason is there are four trends that are shaping the future of those who emerge from residency programs. And none of these trends favor those with a Master's degree in medical physics.

The first trend is the reality that students completing a CAMPEP PhD are better able to compete for residency positions. This is a simple statistical fact and well-supported from the information we have from CAMPEP. This is also not surprising. My personal experience as director of a CAMPEP therapy physics program is that I looked at both MS and PhD students each year, and tried to hire the best individual. We hired MS and PhD students in almost equal numbers over the past ten years. This year, we have two extraordinary MS students. However, many programs prefer PhD candidates, perhaps valuing the additional research experience and perhaps appreciating candidates of greater diversity as many have MS degrees from other physics disciplines. It is likely the trend of PhD candidates successfully competing for residencies will continue.

The second trend is the increasing visibility and greater numbers of individuals with the PhD degree who apply through the alternative pathway. Many of our most capable medical physicists and many who have positions of significant responsibility within our profession are those from the alternative pathway. Program directors are becoming aware that these students are truly exceptional. Some highly prominent physics residency programs specialize in accepting only candidates from the alternative pathway. We should therefore expect these students, all of whom have completed a PhD, to be successful competing for residency slots.

The third trend is the creation of Doctor of Medical Physics (DMP) programs. The DMP combines an academic CAMPEP Master's degree with a CAMPEP residency program. The degree awarded is a professional doctorate. Today, there are almost ten programs either in existence, undergoing CAMPEP review, or being planned. Some programs are converting CAMPEP residencies to DMPs. The obvious rationale is to guarantee both the academic program and a residency to the candidate upon admission to the program. This should be much more attractive than an alternative offer to matriculate in a Master's program for two years without a guarantee the student will compete for a residency, commence the certification process, and enter the profession.

The fourth and final trend involves money. Many students are leaving undergraduate schools with crushing debt. Master's degree programs may mean even more debt. DMP programs may mean significant debt. There is usually some support for students completing a PhD program, but not all can make the monthly debt payments of an undergraduate/graduate education while pursuing a PhD, considering the limited support usually available.

The conclusion is sobering for those of you entering a Master's program in medical physics, and especially so if you are assuming student loans for this education. Those with Master's degrees are facing stiff competition and may be squeezed out of the marketplace for residencies. Student debt may prohibit you from entering a PhD program once you graduate. Finally, there is the possibility that CAMPEP residencies will become completely dominated by PhDs and DMPs. At some point the system may simply make it policy that the MS degree is not a sufficient credential to enter a residency, in order to give validity to the reality that exists. MS degrees in medical physics are, for practical purposes, not a sufficient credential to admit you to a CAMPEP residency program and the medical physics profession. There is a balancing trend, however. Those residency programs that do look carefully at CAMPEP Master's students will find that those candidates at the top of the pile are extraordinary individuals, indeed.

The conclusion is those who want to enter the profession should consider very carefully their opportunities and their finances. The meaning of the Master's degree in medical physics today is that it represents an opportunity — but not a guarantee — to become a professional medical physicist. And this opportunity must be weighed against your personal potential as a scientist and a professional, and your finances must be considered soberly. Medical physics is an extraordinary profession, but it comes with extraordinary complexity. And that is (and will be) the meaning of the Master's degree in medical physics in 2014.

JOURNAL OF APPLIED CLINICAL MEDICAL PHYSICS, VOLUME 15, NUMBER 2, 2014

The meaning of the MS Degree in Medical Physics, Part 2

Michael D. Mills , PhD , Editor-in-Chief

Along with many of you, I read and followed with great interest the "MS vs. Ph.D. for Residency" topic on the AAPM Bulletin Board. My impression considering all of the contributions through January 31 is that there was general consensus that the trends I mentioned in the previous editorial (Part 1) are valid. Most everyone agrees there are too many CAMPEP MS graduates. In addition, a large number of residency programs are reserved for PhD students only and many of these are open to non-CAMPEP PhD graduates through the alternative pathway. The responses consisted largely of complaints, but there were a few helpful observations:

- A CAMPEP restriction on the number of academic program graduates might not stand in court
- Some residency programs face institutional restraints to admit only PhD residents
- Degree creep is expected for professions associated with lucrative compensation
- Note that even Universities do not require a PhD for doctors (physicians)
- CAMPEP MS programs should create CAMPEP residency positions for their graduates
- Aspiring physicians don't complete medical school only to find there are no internship and residency vacancies available to them
- A Master's with ABR cannot work at many University hospitals, while a PhD without ABR can
- The residency GME offices at university hospitals look at the medical physics field and, in the absence of an MD degree, have decided the PhD is the terminal degree
- The CAMPEP didactic training requirements do not vary much between PhD or MS
- The medical community is a world of doctors and more specifically a world of Professional Doctorates

I want to make it clear this list was posted by others in response to the editorial; I offer my thanks to those who shared these thoughts. I also want to thank George Starkschall for offering the following list of activities the AAPM is taking to address the problem of too many MS students (personal correspondence, January 23, 2014):

- CAMPEP requires that every graduate program posts on a publically-accessible website their program's track record in placement of their graduates
- In order to create more residency positions, the AAPM and RSNA are jointly funding an initiative in which they are providing 50% stipend support to new imaging physics residency programs
- CAMPEP is providing on its website a sample Self-Study and business plan for private practices who wish to apply for accreditation of their residency programs
- AAPM has held, and is planning to continue to hold, workshops to assist potential residency program directors in the development of Self-Studies, with special focus on hub-and-spoke programs that would involve private practices
- Recognizing that there will remain more students in MS programs than there are clinical job openings, the Students and Trainees Subcommittee of the AAPM is preparing a guide to non-clinical employment in medical physics

Consider the following professionals: physicians, dentists, podiatrists, optometrists, psychologists, pharmacists and audiologists. These folks all complete professional doctorate programs that consist of both academic courses and clinical competencies. When they graduate, they are fully qualified to practice, treat, and bill patients. Now consider these allied health workers: occupational therapists, physical therapists, nurses, radiation therapists, nuclear medicine technologists, dental hygienists, and speech language pathologists. These professionals complete BS and MS programs that also embrace both academic courses and clinical competencies. When they become program graduates, they are fully qualified to practice and treat patients, although they usually bill for services provided by the facility, depending on the employment arrangement. What both of these groups have in common is that the programs are professional and unified.

So why would medical physics operate under the radical model of separating into two programs the academic and residency portion of our training? Does this model benefit patients, employers, physician colleagues or the students our profession would attract in some unique manner? Additionally, the power to name our training lies with us. A master's degree plus a residency is the same training as a professional doctorate. Why would we choose to name this training deliberately to exclude our students from the professional staffs of many universities and academic centers? Indeed, in some centers, medical physicists cannot be trained as residents unless they possess a PhD.

It must be mentioned that many MS programs face huge hurdles if they wish to convert to DMP programs. Many do not have the resources to provide a residency experience to their students, and many others would face insurmountable challenges getting a professional doctorate program approved within the university and state academic processes.

It was pointed out that after the 33 or so residency positions reserved for PhD graduates are removed from consideration, that MS graduates have great success competing for the remaining slots. However, for these 33 positions, someone made the decision not to consider MS graduates in the first place; this is the trend I see. While a few MS programs that incorporate significant clinical training in their schedule are having great success seeing their graduates find residency slots, including their own, there are other programs whose entire graduating class was collectively unable to land a single residency position. In spite of this, there are a large number of new academic MS programs seeking and receiving CAMPEP accreditation each year.

TABLE 1. CAMPEP statistics from 2012.

	2009	*2010*	*2011*	*2012*
# Programs offering MS/MSc Degrees	28	31	32	39
# Programs offering PhD Degrees	21	22	24	29
# Programs offering DMP Degrees				1
Enrollment MS/MSc	333	431	450	466
Enrollment PhD	345	458	465	534
DMP				20
# Graduates MS/MSc Degrees	147	168	148	198
# Graduates PhD Degrees	63	68	67	80
# Graduates DMP				4
# Entering Residency MS/MSc	15	20	33	44
# Entering Residency PhD	10	22	23	24

Per Halvorsen, Chair of the Professional Council, shared this thought with me: "The meaning of this problem is that there is a mismatch between institutional and professional needs and priorities. It seems fairly clear that many residency programs are accepting PhDs exclusively or giving very strong bias toward PhD applicants based not on what the profession needs in terms of well-rounded clinical physicists, but on what that institution needs in terms of its research program. If this is as pervasive as the thread seems to imply, then we may indeed have a problem with the overall 'system' of preparing new clinical physics professionals."

The latest information I have from CAMPEP shows that the trend toward oversupply of MS training programs and students is expanding. This information was graciously supplied by Dr.Ed Jackson (personal correspondence, January 14, 2014).

Consider the following scenario. A large university center faced with new financial realities decides to downsize its Qualified Medical Physicist (QMP) staff in half — eliminating those it considers the least productive. Then it monitors the workload of the remaining physicists and adds physicist assistant positions one at a time. The new hires are the MS physicists who cannot land residency positions; the salary is less than half what they were paying for a QMP and two-thirds that of a medical dosimetrist. When the workload is acceptable in the eyes of administration, it stops hiring. Thereafter, when a QMP vacates a position, the replacement is a non-QMP who is grateful to have a job in the industry at between fifty and sixty thousand dollars per year. Without licensure and an associated legally defined scope of practice, there is no remedy to this eventuality. Is this the future of the profession?

Consider the dignity of that bright potential MS student who wishes to join you as your colleague. To be specific, we are talking about the opportunity to join you as a practicing professional specialist or expert — that is, as a QMP. Are you asking him to borrow twenty to forty thousand dollars for a one-in-four chance of entering the profession? Why would you do that when the competing medical professions offer a 100% chance of entry upon successful completion of a program? Yes, I hear the chorus of defenders of this arrangement saying no physician is guaranteed a radiation oncology residency. This disingenuous argument fails as follows: While a first-choice residency is not guaranteed, the physician is not prevented from competing for any other residency; MS graduates do not have the luxury of considering other types of residencies. Additionally, while the physician is not prevented from practicing medicine, that physician cannot practice radiation oncology and is not a threat to take away a position now occupied by a radiation oncologist or undermine their job security and lifestyle.

So what is the end result of our offer? Come join us as students and, if you are one of the chosen few, you may join us for a season and experience the undermining of our profession and the erosion of your lifestyle by your student colleagues who were not among the chosen? And if you are not successful, you can still join us in a lower non-professional capacity at much lower compensation and participate in the great leveling of the profession? I would love to hear a response to these questions that supports and affirms the dignity of our students, while also affirming the dignity of those who practice as our professional colleagues. Whatever answer is forthcoming will define the meaning of the MS degree in Medical Physics.

Articles reprinted with Dr. Michael Mills permission

CALENDAR 2014

27-29 March **Lugano**, CH	18th Annual SASRO Meeting *http://www.sasro.ch/2014/*
04-08 April Vienna, Austria	ESTRO 33 *http://www.estro.org/congresses-meetings/items/estro-33*
07-09 May Rovinj, Croatia	15th European ALARA Network Workshop "Improving ALARA Culture through Education and Training" *http://www.eu-alara.net/*
30 may-02 June Varna, Bulgaria	RPM 2014 International Conference on Radiation Protection in Medicine *http://www.rpm2014.org/*
04-06 June Deauville, France	53es Journées scientifiques de la Société Française de Physique Médicale *http://sfpm-js2014.sciencesconf.org/*
22-26 June Vermont, USA	2014 AAPM Summer School SRS/SBRT/SABR *http://www.aapm.org/meetings/2014SS/*
23-27 June **Geneva**, CH	4th European IRPA Regional Congress Radiation Protection – A Global Challenge *http://www.irpa.net/*
20-24 July Austin, TX, USA	AAPM 56th Annual Meeting *http://www.aapm.org/meetings/2014AM/*
07-10 September **Zurich**, CH	**Dreiländertagung** Joint Conference of the SGSMP, DGMP, ÖGMP *http://www.medphys-kongress.de/*
11-13 September Athens, Greece	8th European Conference on Medical physics *http://www.efomp-2014.gr/*

And please, if you participate in any conference / meeting, think of writing a few lines or sending a picture for the "recent meetings" section.

THANK YOU!

Your Institution

When was your center opened?

How many people work in your center? e.g. rad oncs, physicists, therapists, engineers, others *(A team photo is nice!)*

What collaborators in your center are involved with physics duties ? e.g. dosimetrists, engineers, IT, programmers, data managers, etc.

Are you involved in radiation oncology, nuclear medicine, radiology, radiation protection, other?

What technologies do you implement? How many machines? What kind of equipment?

Anything else of interest you would like to share? *(We encourage this part which makes the spotlight more interesting!)*

Possible topics:

- Techniques implemented in your clinic
- Research, projects, ….
- Collaborations
- Clinical trials in which your center is involved
- Internal projects
- Clinical interests
- News articles about your center
- Anything else that you feel interesting to talk about! ☺

More information: e.g. website, links to MedPhys news article from you, your contacts if you want to add them.

BBC NEWS Health

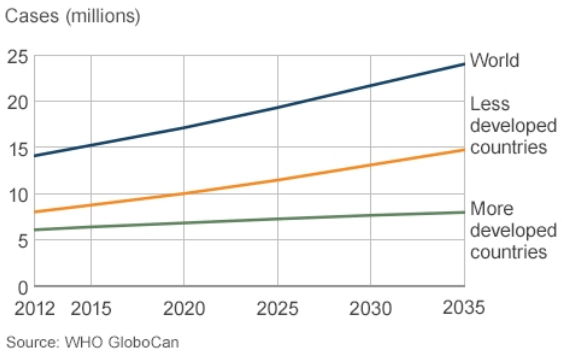
4 February 2014 Last updated at 06:33 GMT

Cancer 'tidal wave' on horizon, warns WHO

By James Gallagher Health and science reporter, BBC News

The globe is facing a "tidal wave" of cancer, and restrictions on alcohol and sugar need to be considered, say World Health Organization scientists. It predicts the number of cancer cases will reach 24 million a year by 2035, but half could be prevented. The WHO said there was now a "real need" to focus on cancer prevention by tackling smoking, obesity and drinking. The World Cancer Research Fund said there was an "alarming" level of naivety about diet's role in cancer. Fourteen million people a year are diagnosed with cancer, but that is predicted to increase to 19 million by 2025, 22 million by 2030 and 24 million by 2035. The developing world will bear the brunt of the extra cases.

Predicted global cancer cases



Chris Wild, the director of the WHO's International Agency for Research on Cancer, told the BBC: "The global cancer burden is increasing and quite markedly, due predominately to the ageing of the populations and population growth. "If we look at the cost of treatment of cancers, it is spiraling out of control, even for the high-income countries. Prevention is absolutely critical and it's been somewhat neglected."

The WHO's World Cancer Report 2014 said the major sources of preventable cancer included:

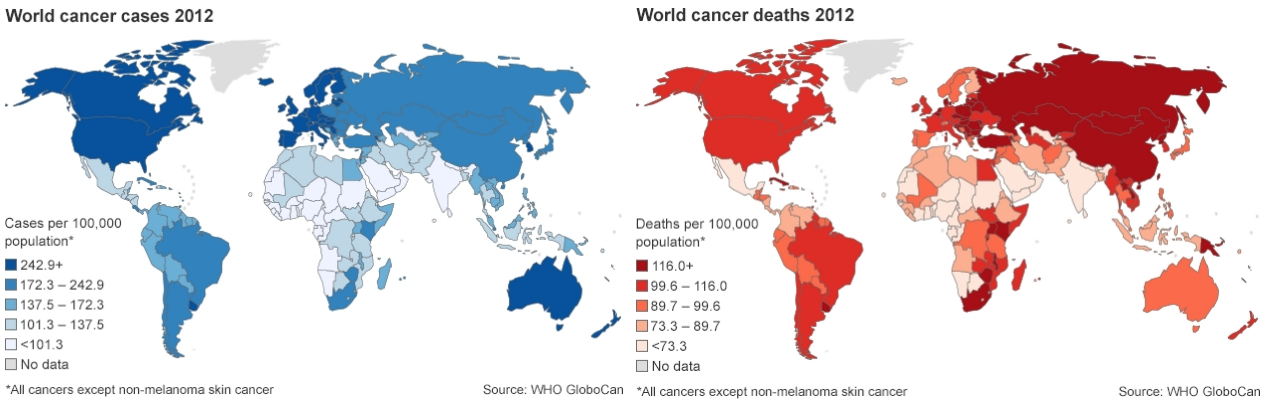
Smoking
Infections
Alcohol
Obesity and inactivity
Radiation, both from the sun and medical scans
Air pollution and other environmental factors
Delayed parenthood, having fewer children and not breastfeeding

For most countries, breast cancer is the most common cancer in women. However, cervical cancer dominates in large parts of Africa. The human papillomavirus (HPV) is a major cause. It is thought wider use of the HPV and other vaccines could prevent hundreds of thousands of cancers. One of the report's editors, Dr Bernard Stewart from the University of New South Wales in Australia, said prevention had a "crucial role in combating the tidal wave of cancer which we see coming across the world".

Dr Stewart said human behaviour was behind many cancers such as the sunbathe "until you're cooked evenly on both sides" approach in his native Australia. He said it was not the role of the International Agency for Research on Cancer to dictate what should be done. But he added: "In relation to alcohol, for example, we're all aware of the

acute effects, whether it's car accidents or assaults, but there's a burden of disease that's not talked about because it's simply not recognised, specifically involving cancer. "The extent to which we modify the availability of alcohol, the labelling of alcohol, the promotion of alcohol and the price of alcohol - those things should be on the agenda." He said there was a similar argument to be had with sugar fuelling obesity, which in turn affected cancer risk.

Meanwhile, a survey of 2,046 people in the UK by the World Cancer Research Fund (WCRF) suggested 49% do not know that diet increases the risk of developing cancer. A third of people said cancer was mainly due to family history, but the charity said no more than 10% of cancers were down to inherited genes. Amanda McLean, general manager for the WCRF, said: "It's very alarming to see that such a large number of people don't know that there's a lot they can do to significantly reduce their risk of getting cancer. "In the UK, about a third of



the most common cancers could be prevented through being a healthy weight, eating a healthy diet and being regularly physically active. These results show that many people still seem to mistakenly accept their chances of getting cancer as a throw of the dice, but by making lifestyle changes today, we can help prevent cancer tomorrow."

It advises a diet packed with vegetables, fruit, and wholegrains; cutting down on alcohol and red meat; and junking processed meat completely. Dr Jean King, Cancer Research UK's director of tobacco control, said: "The most shocking thing about this report's prediction that 14 million cancer cases a year will rise to 22 million globally in the next 20 years is that up to half of all cases could be prevented. People can cut their risk of cancer by making healthy lifestyle choices, but it's important to remember that the government and society are also responsible for creating an environment that supports healthy lifestyles. It's clear that if we don't act now to curb the number of people getting cancer, we will be at the heart of a global crisis in cancer care within the next two decades."

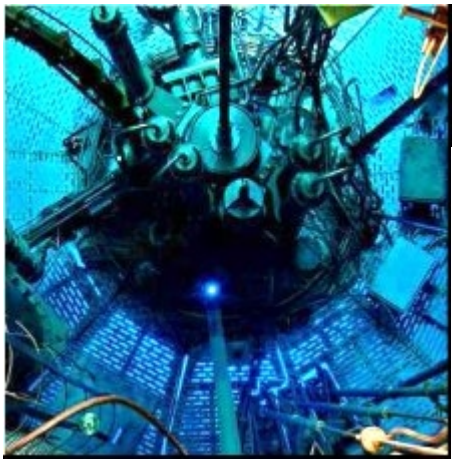
Sciences & Environnement

Le Temps
Samedi 22 février 2014

Des éléments radioactifs pour assaillir le cancer

Pascaline Minet

> Médecine : Des isotopes sont utilisés dans le diagnostic et le traitement des tumeurs
> La recherche vise à les rendre plus précis



Le réacteur de l'Institut Laue-Langevin à Grenoble, en France. Des isotopes destinés à l'oncologie, comme le lutétium 177, y sont produits. ARCHIVES

Non, la recherche en physique des particules n'aboutit pas qu'à d'énigmatiques découvertes sur les composants de la matière. Elle a aussi généré d'importantes avancées dans le domaine médical, en particulier en cancérologie. Substances radioactives et faisceaux de particules (voir complément) sont ainsi couramment employés contre le cancer. Et les chercheurs s'emploient à développer des techniques plus efficaces et plus ciblées. L'usage d'éléments radioactifs appelés radio-isotopes, à la fois pour le diagnostic ct pour le traitement des tumeurs, figure parmi les pistes prometteuses évoquées la semaine passée à Genève dans le cadre d'une conférence spécialisée.

Les isotopes artificiels sont devenus des outils clés de la médecine depuis la création du premier d'entre eux par Irène et Frédéric Joliot-Curie en 1934. Leur particularité, par rapport à leurs homologues non radioactifs, est d'être instables et donc d'émettre un rayonnement en se désintégrant : une caractéristique notamment exploitée en imagerie, avec des techniques comme la scintigraphie ou la tomographie par émission de positrons (TEP). Toutes deux reposent sur le même principe: une substance contenant un isotope radioactif est injectée au patient; elle peut ensuite être suivie à la trace en détectant les rayonnements qu'elle émet à l'extérieur du corps.

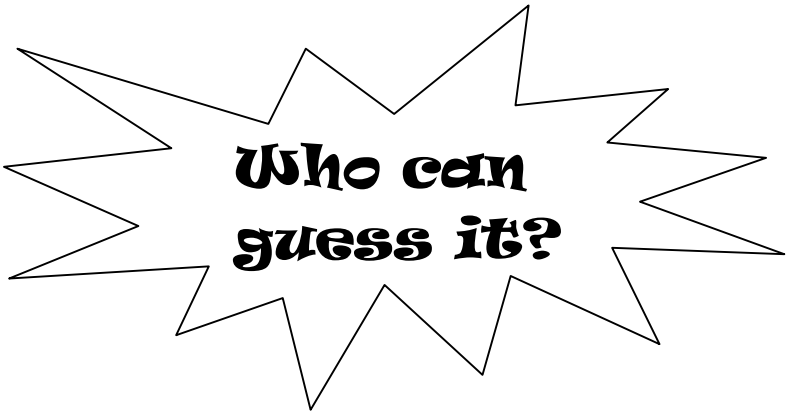
Pour repérer les tumeurs, les médecins utilisent le plus souvent un isotope du fluor, le fluor 18, qu'ils couplent avec un sucre proche du glucose. Les cellules cancéreuses étant de grandes consommatrices de sucre, le fluor radioactif s'y accumule, les rendant ainsi visibles par TEP. Plusieurs thérapies anticancéreuses font également appel à des radio-isotopes. C'est le cas de la curiethérapie, utilisée notamment pour traiter le cancer de la prostate, et qui consiste à insérer une source radioactive dans une capsule placée directement au contact de la zone à traiter. Dans une autre approche, les isotopes sont associés à des molécules, le plus souvent des anticorps, capables de reconnaître les cellules cancéreuses et de s'y fixer. L'irradiation est par conséquent beaucoup plus précise qu'avec une chimiothérapie classique. «Cette technique de «radio-immunothérapie» permet d'épargner davantage de cellules saines et donc de limiter les effets secondaires», explique le physicien Ulli Köster, de l'institut Laue-Langevin (ILL) à Grenoble, en France.

Les premières radio-immunothérapies mises au point utilisaient l'iode radioactif 131 pour traiter les cancers du système lymphatique. Mais cet isotope a l'inconvénient de produire un rayonnement dit «gamma», très pénétrant, ce qui implique d'isoler le patient dans une chambre blindée durant le traitement, afin d'éviter d'irradier le personnel soignant. C'est pourquoi les scientifiques tentent de développer des isotopes médicaux émettant des radiations plus courtes. Le réacteur nucléaire de l'ILL, principalement à la production de neutrons pour des études scientifiques, sert ainsi depuis quelques années à fabriquer un isotope appelé lutétium 177. «Cet élément émet des rayonnements bêta qui ne circulent que sur une distance de quelques millimètres, ce qui convient bien pour traiter les métastases de petite taille», indique Ulli Köster. Le lutétium est actuellement testé dans des essais cliniques contre certains types de cancer de l'intestin, de la prostate et du système lymphatique.

Plus récemment, des traitements à base d'isotopes émettant un rayonnement alpha ont également été conçus. Ces rayons parcourant des distances encore plus courtes que les bêta, ils permettent d'effectuer des irradiations avec une précision de quelques cellules. L'année dernière, un médicament à base de radium 223 a ainsi été mis sur le marché en Europe, pour traiter les métastases osseuses chez les patients atteints d'un stade avancé du cancer de la prostate. Dans ce traitement, l'isotope n'a pas besoin d'être accroché à un anticorps qui lui sert de vecteur; le radium ayant des caractéristiques similaires au calcium, il se fixe naturellement sur l'os en croissance dans les métastases. D'autres isotopes produisant des rayons alpha sont en cours d'évaluation, comme le plomb 212, produit en France par la société ArevaMed et couplé à des anticorps élaborés par Roche.

Le CERN possède lui aussi un projet de production d'isotopes, intitulé «Medicis». «Grâce à l'expérience Isolde, dont on fête cette année les 50 ans, et à son équipement unique, nous sommes capables de fournir plus de 1000 isotopes différents, dont certains très rares», relate Thierry Stora, le physicien responsable du projet. L'installation, qui génère des isotopes radioactifs en bombardant différents matériaux à l'aide d'un faisceau de protons, était jusqu'alors

essentiellement utilisée pour des études fondamentales. Dans le cadre de Medicis, l'expérience sera adaptée pour fabriquer des éléments intéressants d'un point de vue médical, qui seront ensuite testés en collaboration avec des hôpitaux de la région. «Nous sommes, à l'heure actuelle, les seuls au monde à fabriquer à des fins médicales le terbium 149, dont le potentiel thérapeutique a été identifié grâce à une collaboration avec les Hôpitaux universitaires de Genève», insiste Thierry Stora.
Le terbium, une terre rare, suscite beaucoup d'intérêt chez les physiciens. Selon l'isotope choisi, il peut en effet produire des rayonnements alpha, bêta ou gamma, et même émettre des électrons dits «Auger», qui agissent à un niveau encore plus local et qui ne sont pour l'heure testés qu'à un niveau expérimental. « Le terbium est un véritable couteau suisse de la médecine nucléaire», s'enthousiasme Ulli Köster, « qui génère également des isotopes de cet élément à l'ILL ». A terme, le terbium pourrait permettre aux médecins de visualiser les cellules cancéreuses en même temps qu'ils les irradient. Et d'offrir ainsi à leurs patients une thérapie encore plus puissante et mieux tolérée.



X-Ray Art

Interestingly, the Dutch medical physicist (and artist!) Arie van 't Riet uses the high-energy part of the electromagnetic spectrum in his photography. His work can be viewed on his website http://www.x-rays.nl/.

I encourage everyone to take a minute to view his artwork and enjoy a side of medical physics that is often overlooked!

So the question I have for everyone is how does he do it?...
i.e. what kind of x-ray system and setup does he use?

Arie was kind enough to answer my emails and I will share the answers in the next issue of the bulletin.

Nathan Corradini, Clinica Luganese

IMPRESSUM

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Editors:

Nathan Corradini
Clinica Luganese
Centro di Radioterapia
6900 Lugano

Tel. 091 960 81 28

nathan.corradini@clinicaluganese.ch

Shelley Bulling
Centre d'Oncologie des Eaux-Vives
26 rue Maunoir
1207 Genève

Tel. 022 319 77 30

sbulling@eaux-vives.com

Regina Müller
Paul Scherrer Institut
Schule für Strahlenschutz
5232 Villigen PSI

Tel. 056 310 24 80

regina.mueller@psi.ch

SSRMP Secretary: c/o Silvia Kleiner
Bernstr. 103a
3052 Zollikofen,

Daniel Vetterli
Radio-Onkologiezentrum Biel
Rebenweg 38
2501 Biel
Tel.: 032 366 8111
daniel.vetterli@radioonkologie.ch

CALL FOR AUTHORS

Also, you are invited to participate in the construction of our bulletins. Of desirability are all contributions that could be of interest to members of our society, such as

- ✓ Reports of conferences, working group meetings, seminars, etc.
- ✓ Reports on the work of various committees and commissions
- ✓ Succinct results of surveys, comparative measurements etc.
- ✓ Short portraits of individual institutions (E.g. apparatus equipment, priorities of work, etc.)
- ✓ Reports on national and international recommendations
- ✓ Short Press Releases
- ✓ Photos
- ✓ Cartoons & caricatures
- ✓ Announcement of publications (E.g. books, magazines)
- ✓ Announcement of all kinds of events (E.g. conferences, seminars, etc.)
- ✓ Short articles worth reading from newspapers or magazines (if possible in the original)
- ✓ Member updates (E.g. appointments, change of jobs, etc.)

The easiest way to send your document is as a MS Word document via email to one of the editor addresses above.

Deadline for submissions to Bulletin No. 80 (02/2014) : 06.2014

Title	Name (Function)	Professional Address	Tel. Office * = Sekretariat ** = Zentrale	E-Mail
PD MER Dr.	**Raphaël Moeckli** President	Inst. Univ. de Radiophysique (IRA) Rue du Grand-Pré 1 1007 Lausanne	021 314 46 18 021 314 80 68* & **	raphael.moeckli@chuv.ch
Dr.	**Stephan Klöck** Vice-president	Radio-Onkologie / Medizinische Physik Universitätsspital Zürich Rämistr. 100 8091 Zürich	044 255 34 62 044 255 29 31 * 044 255 11 11 **	stephan.kloeck@usz.ch
Dr. phil. nat.	**Daniel Vetterli** Secretary	Radio-Onkologiezentrum Biel Rebenweg 38 2503 Biel	032 366 81 15 032 366 81 11*	daniel.vetterli@radioonkologie.ch
Dr. phil. II	**Werner Roser** Treasurer	Paul Scherrer Institut 5232 Villigen PSI	056 310 35 14 056 310 27 20*	werner.roser@psi.ch
Dr. sc. nat.	**Peter Manser** Chair science committee	Abteilung für Medizinische Strahlenphysik Insel-spital - Universität Bern 3010 Bern	031 632 37 71 031 632 24 29 * 031 632 21 11 **	peter.Manser@insel.ch
Dr.	**Hans W. Roser** Chair education committee	Radiologische Physik Universitätsspital Basel Petersgraben 4 4031 Basel	061 328 61 42 061 265 25 25 **	Hans.Roser@usb.ch
Dr. rer. nat.	**Frédéric Corminbœuf** Chair Professional Affairs	Centre de Radio-Oncologie Clinique la Source Av. Vinet 30 1004 Lausanne	021 642 70 00	f.corminboeuf@lasource.ch
Dr. med.	**Markus Notter**	Service de Radiotherapie Hôpital Neuchâtelois 2303 La Chaux-de-Fonds	032 967 21 51* 032 967 21 11**	markus.notter@ne.ch
MSc.	**Jean-Yves Ray**	Service de radio-oncologie Hôpital de Sion Grand-Champsec 80 1951 Sion	027 603 45 12 027 603 45 00 * 027 603 40 00 **	jean-yves.ray@hopitalvs.ch