[2]University Hospital Galway, Dept Medical Physics & Bioengineering, Galway, Ireland Republic of

**Purpose/Objective:** The purpose was to design and implement a comprehensive computerised calculation program to execute radiation-shielding evaluations for radiotherapy. The program addresses both individual and collective contributing factors that are intrinsic to shielding calculations e.g. building construction, treatment equipment and delivery techniques, workload and occupancy. It incorporates modern and emerging novel treatment delivery techniques and the resulting overall effects on radiation protection required. The secondary aim was to verify the shielding program by applying it to existing bunkers where measurements of photon and neutron doserate were made and to identify its advantages for modelling future radiotherapy bunkers.
**Materials and Methods:** The calculation methods used to establish the photon and associated neutron dose rates employ the theoretical approach from the NCRP Report 151, and the IAEA Safety Report No. 47, among others. The advantage of including new treatment techniques (extra-cranial stereotactic and ablative RT,VMAT, FFF, robotic radio-surgery) and newly available constructional materials improves the usefulness of the program for any radiotherapy centre. The program can evaluate existing bunkers for changes in workload, treatment technique or delivery. It contains all variables to enable modelling of a new build using concrete,high-density materials and layered materials. Calculations using actual workload compared to 'worst -case' scenarios and the consequences on construction costs were evaluated. The contributions of photon, neutron scatter and neutron capture gamma rays were investigated with differing maze geometries. Special topics such as skyshine and ozone production were included too. The program includes all necessary TVLs and other intrinsic data, for modelling the spectrum of nominal photon energies clinically available, including flattened and flattening-filter-free (FFF) beam data.
**Results:** The program's logic and accuracy was successfully validated by comparison to literature and using measurements taken at two sites with different bunker designs. The program was used to calculate potential shielding changes to an existing bunker due to increasing the beam energy. The results showed adequate shielding except at the maze entrance. The impact of actual workloads versus theorised workload was also investigated. There was a 10-20% reduction in shielding when the workload theorised in 2003 was compared to actual 2012 workload for three bunkers, which could reduce the building costs by 10%.
**Conclusions:** A comprehensive calculation program for bunker shielding was developed to include contemporary and emerging treatment methods. Its accuracy and functionality were proven in the case studies. It is more functional and manageable than previous programs used at the institution.

## POSTER: PHYSICS TRACK: PROFESSIONAL AND EDUCATIONAL ISSUES

**PO-0896**
**Treatment planning training for a large group in geographically spread centres**

I. Kristensen[1], C. Vallhagen Dahlgren[2], H. Nyström[2]
[1]Skåne University Hospital, Radiaton Physics, Lund, Sweden
[2]Skandion Clinic, Radiaton Physics, Uppsala, Sweden

**Purpose/Objective:** To teach and train a large group of medical physicists, dosimetrists and radiation oncologists, working in different centres, in proton treatment planning.
**Materials and Methods:** A common treatment planning system (TPS) for protons is since January 2012 installed and accessible for users in seven hospitals. We formed a school to provide the group with a common knowledgebase in proton treatment planning. The school started with a face-to-face meeting with lectures and workshops and continued with biweekly teleconferences. Prior to the teleconference the centres were expected to create treatment plans for selected patient cases in the common TPS. During the teleconferences, led by a chairman, the desktop of the common TPS was shared for everyone to view. The teleconferences consisted mainly of discussions about the suggested plans, patient fixation, VOI margins, dose distributions and plan robustness. We used a check-list to make sure we evaluated most relevant issues. After half a year, we changed focus and each centre in turn presented a case from their own database. A proton plan was created and compared with the actually given photon plan. Also here a checklist was used. To prepare for these sessions a number of scientific articles regarding related topics were distributed for discussions in the group. The TPS vendor also provided a proton planning course for this group. A second face-to-face meeting will deal with topics like creating common methods for different treatment sites, CT calibration, target delineation and study protocols. Yet another issue will be to plan future projects for the school, e.g. the possibility to invite external lecturers to the school.
**Results:** The school has worked out well. All centres have participated actively both in planning and discussing, helping each other in gaining experience in a field where we are novices, and where the experience of this TPS varied within the group. It has been demanding to get the radiation oncologists involved. There may be several reasons for this; lack of staff, the school has not been properly entered into their work schedule or that they are merely used to evaluate plans, rather than to discuss the planning process itself, which has been an important part of the school.
**Conclusions:** The concept is good for any topic were a common base line in knowledge is needed, but also as a mean to raise this level. It can be used for almost any topic, any number of participants and from any computer with a web camera to a conference room with a full scale teleconference system. Nevertheless the initial form may need revision over time to fit the purpose and the participants. A high standard of the teleconference systems is helpful when many people are participating.

## POSTER: PREVENT TRACK: MODELLING AND PREDICTION OF NORMAL TISSUE RESPONSE

**PO-0897**
**SNPs in genes implicated in radiation response invoke roles as predictive and prognostic biomarkers**

G. Alsbeih[1]
[1]King Faisal Specialist Hospital, Biomedical Physics, Riyadh, Saudi Arabia

**Purpose/Objective:** To investigate the association between various risk factors, including single nucleotide polymorphisms (SNPs) in candidate genes involved in radiation response, and late complications to radiotherapy in nasopharyngeal cancer patients.
**Materials and Methods:** 155 patients were included in the study. Normal tissue fibrosis was scored using RTOG/EORTC grading system. 11 candidate genes (*ATM*, *XRCC1*, *XRCC3*, *XRCC4*, *XRCC5*, *PRKDC*, *LIG4*, *TP53*, *HDM2*, *CDKN1A*, *TGFB1*) were selected for their presumed influence on radiosensitivity. 45 SNPs (12 primary and 33 neighboring) were genotyped by direct genomic DNA sequencing.
**Results:** Patients with severe fibrosis (cases, G3-4, $n = 48$) were compared to controls (G0-2, $n = 107$). Univariate analysis showed significant association ($P < 0.05$) with radiation complications for 6 SNPs (*ATM* G/A rs1801516, *HDM2* promoter T/G rs2279744 and T/A rs1196333, *XRCC1* G/A rs25487, *XRCC5* T/C rs1051677 and *TGFB1* C/T rs1800469). In addition, Kaplan-Meier analyses have also invoked significant association between genotypes and length of patients' follow up after radiotherapy. Multivariate logistic regression has further sustained these results suggesting predictive and prognostic roles of SNPs.
**Conclusions:** Univariate and multivariate analysis suggest that radiation toxicity in radiotherapy patients are associated with certain SNPs, in genes involved in DNA repair pathways, including *HDM2* gene promoter studied for the 1st time. In addition, radiosensitive patients harbored significantly higher number of risk alleles than controls ($P < 0.001$). These results support the use of SNPs as genetic predictive markers for clinical radiosensitivity and the use of genotypes containing protective alleles as prognostic markers for patients' length of follow up after radiotherapy. Funded by KFSHRC grant 2000 031 and 2040 025.

**PO-0898**
**Extending RI-MODS: sensitivity of late-responding tissues to secondary insult following radiation**

J.P. Williams[1], M.K. O'Banion[2], J. Olschowka[2], E. Lord[3], J. Ryan[4], J. Palis[5], L. Calvi[6], J.N. Finkelstein[7]
[1]University of Rochester Medical Center, Radiation oncology, Rochester NY, USA
[2]University of Rochester Medical Center, Neurobiology & Anatomy, Rochester NY, USA
[3]University of Rochester Medical Center, Immunology, Rochester NY, USA
[4]University of Rochester Medical Center, Dermatology, Rochester NY, USA
[5]University of Rochester Medical Center, Hematology/Oncology, Rochester NY, USA