countries devote around 6,000€ per capita annually, compared to others that only spent as little as 350€. These increases, along with the global economic crisis, have stimulated the interest for more accurate information about the exact health care costs and on the way we spent our money. Health services research (HSR), a “multidisciplinary field of scientific investigation that studies how social factors, financing systems, organizational structures and processes, health technologies, and personal behaviors affect access to health care, the quality and cost of health care, and ultimately, our health and well-being” is intended to guide the decisions of managers and policy makers about the design and implementation of health care programs. Health Technology Assessment (HTA), one component of HSR, addresses five central questions related to efficacy, effectiveness, efficiency, availability and distribution of health care and thus plays an essential role in modern health care by supporting evidence-based decision-making in policy and practice. Answers to the question of efficiency - or cost-effectiveness - are typically given by economic evaluations (EE). Full EEs involve the quantitative evaluation of both costs and outcomes, or consequences, of competing interventions. An appropriately performed EE is incremental, that is, it measures the extra cost incurred in order to obtain the incremental improvement in outcome. Understandably, the inputs used to perform such EEs have to be chosen with care if one wants to derive results that correctly support decision-making on resource allocation. Apart from the indispensable data on effectiveness, the accurate computation of the cost component is equally important. The presentation will zoom in on the above aspects of HSR through examples from radiation oncology and evaluate why it is important to invest on this type of research.

**SP-0374**

How to incorporate cost calculation into our research?  
N. Defourny1  
1ESTRO, Hero, Brussels, Belgium

The methodology used to measure cost in economic evaluations in healthcare, as in clinical studies, is key to determine the health economic study’s robustness. On-going literature review, investigating how costing is conducted in radiotherapy shows that one third of selected articles did not implement costing exercises in a clinical study [Kaplan, 2014]. This demonstrates the absence of clear understanding the influence of a cost calculation method on final cost results [Kaplan, 2014]. Conclusively, the relevant evaluation choice comes down to what the study wants to determine. The method’s choice influences the cost result [Mercier, 2014]. Authors have to decide on the appropriate costing method to use. The choice of sound methodologies will facilitate comparisons across studies. Cost accounting methods for cost calculation are categorized by an axis linking two distinct margins: top-down (activity-based costing, ABC) and bottom-up (micro costing). The top-down method uses total department expenses as first step to untangle the different resource’s costs. The bottom-up approach records individual expenses and cumulates it per resource types. The advantages of the bottom-up approach were merged in a top-down framework in the time-driven activity-based costing (TDABC). ABC and micro-costing methods assume inherently full resources utilization, only if it can be established that the actual number of treatment courses delivered by an RT unit is using all the available resources, is the result of these cost accounting models robust. In contrast, TD ABC method does not start off with this premise. By incorporating the actual resource usage rate with the state of the art one, this cost method reveals areas for the improvement in the allocation of resources. Developing a study calculating the real cost of delivering an intervention will contribute to “solving the healthcare expenses crisis” [Kaplan 2014].

To conclude, costing methods have to be relevant, sound and transparent to be a useful tool to decision maker [Sullivan, 2011].

**SP-0375**  
How to calculate cost-effectiveness?  
J.P.C. Grutters1  
1Radboud University Medical Center, Department for Health Evidence, Nijmegen, The Netherlands

The field of radiotherapy is innovating rapidly. These innovations are often associated with better health, but also with higher costs. As healthcare budgets are scarce, we are increasingly asked to show that the effects of new radiotherapy techniques are worth the extra costs. In this presentation I will explain how to undertake such an analysis. This presentation provides an introduction to the principles and practice of economic evaluation. Topics include different types of economic evaluation, trial-based and model-based economic evaluation, use of quality-adjusted lifeyears and interpreting and presenting evidence. Throughout the presentation I will provide practical examples from the field of radiotherapy.

**Poster Discussion: Dosimetry**

**PD-0378**

Proton range assessment using prompt gamma monitoring of realistic pencil beam scanning treatments  
G. Janssens1, J. Smeets1, F. Vander Steen1, D. Prieels1, I. Perali2, E. Clementel1, L. Hotoiu2, E. Sterpin1  
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The economic value of an expense, commonly known as the opportunity cost, is defined as the value of the benefit you could have realized by investing the same amount of money in taking the best alternative option. Economic theory measures item by item by capturing its opportunity cost in monetary terms. Given the interrelated heterogeneous costs in the healthcare sector, health economics recommends selecting the relevant costs that matches the costing study perspective. Taking all other perspectives into account, the societal perspective is the most comprehensive approach because it also includes the productivity loss of the patient [Drummond 2005]. When authors want to inform decision makers about the real cost of an intervention, the global cost involved in the delivering of treatment, has to be computed, only then is the information relevant to explore whether this intervention is cost-efficient [Kaplan, 2014]. Conclusively, the relevant evaluation choice comes down to what the study wants to determine. The method’s choice influences the cost result [Mercier, 2014]. Authors have to decide on the appropriate costing method to use. The choice of sound methodologies will facilitate comparisons across studies. Cost accounting methods for cost calculation are categorized by an axis linking two distinct margins: top-down (activity-based costing, ABC) and bottom-up (micro costing). The top-down method uses total department expenses as first step to untangle the different resource’s costs. The bottom-up approach records individual expenses and cumulates it per resource types. The advantages of the bottom-up approach were merged in a top-down framework in the time-driven activity-based costing (TDABC). ABC and micro-costing methods assume inherently full resources utilization, only if it can be established that the actual number of treatment courses delivered by an RT unit is using all the available resources, is the result of these cost accounting models robust. In contrast, TD ABC method does not start off with this premise. By incorporating the actual resource usage rate with the state of the art one, this cost method reveals areas for the improvement in the allocation of resources. Developing a study calculating the real cost of delivering an intervention will contribute to “solving the healthcare expenses crisis” [Kaplan 2014].

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Purpose/Objective: Range uncertainties in proton therapy can be reduced using in-vivo range verification based on prompt gamma (PG) imaging. In pencil beam scanning, PG emission can be measured for all pencil beams of the treatment and compared to the treatment planning in order to detect potential range discrepancies. This study proposes a strategy to analyze the large amount of PG profiles acquired during treatment using a priori simulations.

Materials and Methods: Pencil beam scanning treatments were planned on an anthropomorphic phantom. Brain, nasal cavity and lung cases were included in the study. The treatments were delivered to the anthropomorphic phantom at the Proton Therapy Center in Prague, and PG monitoring was performed using a knife-edge slit gamma camera. Both single fraction (2 Gy) and full treatment at once (60 Gy) were delivered and measured. A dedicated analytical PG simulator was used to compute the expected PG profiles for all pencil beams of the treatment in the planning configuration. Several scenarios, corresponding to several possible sources of range discrepancy (i.e. setup errors, CT calibration errors and energy errors), were simulated as well. The corresponding range shifts were computed based on CSDA approximation in order to estimate the range sensitivity.

The difference between CSDA-based shifts and shifts estimated from the simulated PG profiles defined the expected systematic error in range retrieval for each pencil beam. The actual range was then estimated based on the comparison of measured and simulated profiles. The range shifts were also retrieved from the comparison of 2 Gy and 60 Gy acquisitions in order to evaluate an occurrence of the random errors. In order to improve range assessment, a selection of the most reliable pencil beams was done based on weight and expected systematic errors.

Results: Realistic treatments were successfully delivered to an anthropomorphic phantom and monitored using the PG camera. Using all pencil beams, the average systematic range shift extracted from the comparison of the 60 Gy acquisition with the simulation were of 4.1, 5.8 and -4.0 mm for brain, nasal cavity and lung, respectively. The average random error was of 2.4, 4.5 and 2.2 mm. When selecting the pencil beams whose weight was higher than 0.3 MUs and whose systematic error was smaller than 1 mm, the systematic range shift was 4.1, 6.8 and -3.2, and the random errors went down to 1.6, 1.9 and 2.2 mm.