mainly came from Japan, Germany and China, the number of research on carbon ions were more than the number of research on neon ion and helium ion (Figure 1); the published paper focused on the clinical research on the effectiveness of heavy ion for cancer, at the same time, heavy ions of animal, tumor cells and equipment design were also concerned, 30 kinds of tumor were researched. Cooperation degree of different researchers is not enough (Figure 1).

Conclusion: The number of research on heavy ion are increased, but there is an imbalance in regional development, the research topic focused on the clinical research and basic research topics, at the same time, the equipment and design of heavy ion are concerned.

EP-1454
Analysis on research status of proton
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Purpose or Objective: To analyze the status of research on proton using the social network analysis methods and analytical methods bibliometric methods.

Material and Methods: We searched Pubmed and EMBASE database by “proton OR proton radiation OR proton beam therapy OR proton beam radiotherapy OR proton irradiation”, to collect all relevant research on proton. The related software was used to extract the information of author, country, year of publication, publication year, MeSH terms and journal name. SPSS17.0 was used to analyze the frequency and percentage. NetDraw software was used to draw the social network plot.

Results: 2637 studies were retrieved. The number of studies on proton from one study in 1975 to 556 studies in 2014. Figure showed the research in the global distribution. As for different parts of the tumor, mainly for urinary reproductive system tumor (n=349), soft tissue tumor (n=37), skin tumor (n=100), the reticular endothelial cell tumor (n=85), respiratory system tumor (n=232), pelvic tumors (n=10), nervous system tumors (n=531), thoracic and the chest tumor (n=15), the lymphatic system (n=85), the motor system tumor (n=150), the hematopoietic system tumor (n=14), head and neck cancer (n=269), digestive system tumors (n=318), cardiovascular system tumor (n=185), breast tumor (n=211), and abdominal tumor (n=12). As for benign tumors, mainly for epidermoid tumor, epidermoid cyst, ventricle meningioma, cystadenoma, dyeing neoplasia, choroid plexus papilloma, chondroma, cartilage tumor, cavernous hemangioma, inverted papilloma of the mammary gland, mammary gland fibroma and breast fibroadenoma, adenoma and acoustic neuroma. As for type of study, conference abstract (48.24%), conference paper (1.93%), study (38.36%), review (7.61%), letter (1.22%) and comments (1.22%), editor’s note (0.59%), short-term observation (1%), and conference review (1%).

Conclusion: The number of studies on proton are increased, but the research in the global distribution is imbalance, many studies focus on the nervous system tumor, urogenital system tumor and digestive system tumor. About 50% published papers were conference abstract/paper.

EP-1455
Impact of the implementation of the radiotherapy workflow optimization software RT-Flow
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Purpose or Objective: Workflow in radiotherapy involves a lot of different actors and different steps. Subsequently, the management of agendas, schedules and prioritization becomes difficult in a busy department. This results in delays and (first) sessions being delayed or cancelled without being able to be replaced. RT-Flow is a workflow optimization and visualization application (web based), supporting different workflows and clinical prioritization schemes. Our department works with both conventional retro scheduling and industry-based ConWip (management of a Constant Work-In-Progress rather than agendas) workflow [1].

Material and Methods: RT-Flow was implemented in 2014 (3 tomos, 2 clinacs and 1 cyberknife). All evaluations were performed by year-to-year comparison: between 01/08 of 2013, 2014 and 2015 (+·2500 patients/year). All numbers have been normalized to worked days, excluding breakdowns, holidays and maintenances for fair comparison. Productivity gain was evaluated for the following parameters: machine occupancy and number of first treatment sessions being delayed. Time between CT and prescription finalization has been evaluated before and after implementation of RT-Flow.

Results: Total machine utilization (fractions per worked day, excluding maintenances and failures) rose with >2% in saturated machine conditions. The number of delayed first sessions (all 6 machines combined, all reasons confounded) was halved from 23.6/month to 12.2/month. This was an indirect gain of productivity, as the time slot was most of the time not recovered from late delays. For the specific ConWip organized Cyberknife, machine utilization raised with 6% (on top of the earlier 30% increase due to the ConWip organization [1]). This increase was due to the better specific workflow and occupation management by RT-Flow, but also due to a slight change in case mix (3% less liver treatments for example). Mean time between CT and prescription
Mallick, R.K. Shrimali, S. Chatterjee

**Conclusion:** Implementation of the workflow optimization software RT-Flow has reduced the delays and improved productivity, whilst giving users better control over work and better prioritization for patients. Both conventional workflow and ConWip workflows but also personnel stress levels have proven to be improved. Future work will focus on population TCP optimization and booking curves.


**EP-1456**

What is the cost of reducing cardiac morbidities when treating breast cancers with radiotherapy?

M. Arunsingh, A. Mahato, A. Sadhukan, R. Achari, I. Mallick, R.K. Shrimali, S. Chatterjee

**Purpose or Objective:** There is no threshold limit for radiation induced cardiac toxicity, making it especially relevant for cardiac sparing radiation delivery in adjuvant breast radiotherapy. Deep inspiratory breath hold (DIBH) technique is one method for reducing the heart dose, however, it is resource intensive. This study analyses the cost of cardiac sparing using DIBH and its associated benefits.

**Material and Methods:** DIBH technique using Varian RPM, was used to deliver radiotherapy for 50 consecutive patients of left sided breast cancer. The time required in minutes and the number of personnel involved during each step of the planning and the treatment (40Gy in 15 fractions) were recorded. Weighted person hours (WPH) for each step were calculated and all the steps were summed up to arrive at the WPH for each patient. Radiographers, medical physicists and radiation oncologists were given a weightage of 1, 2 and 3 respectively for calculating the WPH. The data was analysed to see if experience reduces the time required. We also calculated the average WPH required for reducing the heart dose by 1 Gy.

**Results:** The mean age was 51 years. 14 patients were known hypertensive on medications while none of them were known ischemic heart disease patients. Three were suffering from COPD. Twenty nine patients had breast conservation surgery while the remaining 21 patients underwent mastectomy. The mean WPH was 21.49 for the entire cohort. The average WPH required for reducing the heart dose by 1 Gy.

<table>
<thead>
<tr>
<th>Step</th>
<th>Average Person Hours</th>
<th>Medical Physicist</th>
<th>Radiation Oncologist</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIBH Technique</td>
<td>15.9 person hours</td>
<td>2.89 person hours</td>
<td>0.39 person hours</td>
</tr>
</tbody>
</table>

**Formulas**

\[
\text{Weighted Persons Hours} = \left( \frac{\text{Weightage of a Person involved a Time in Minutes}}{100} \right) \times \text{Patient treated by DIBH Technique}
\]

**Conclusion:** Although a resource intensive procedure, with practice the time required reduces with experience. On an average 10.25 WPH is required to reduce the MHD by 1 Gy, with 0.18 person hours of the oncologist versus 1.31 person hours of physician and 7.23 person hours of radiographers time.

**EP-1457**

Delineation of radiation treatment volumes: a regional network based on the software Radiotherap-e

P. Frano, F. Arcadipane, J. Di Muzio, U. Ricardi

**Purpose or Objective:** Modern radiotherapy is able to provide highly precise and focused dose delivery with simultaneous target volume coverage and normal tissue avoidance. Proper selection and accurate definition of treatment volumes is of paramount importance. Anatom-e (Anatom-e Informations System Ltd, Houston, Tx) is a new platform able to drive, simplify, accelerate and standardize the contouring process in different oncological scenarios. Radiotherap-e is an online upgraded version providing the possibility to create an online network to share, discuss, control and optimize clinical cases, radiological images, radiotherapy contours and treatment approaches. We worked on the implementation of the aforementioned software in the Oncological Regional Network of Piedmont, Italy.

**Material and Methods:** Four pilot centers within the Oncological Regional Network of Piedmont, Italy were connected with the online Radiotherap-e platform. Challenging clinical cases (head and neck, lung, esophageal and rectal cancers) were exchanged within the system (Figure 1). Treatment choices and volume delineation strategies were analyzed and compared before and after the use of the software.

**Results:** The use of a unified distribution platform was able to eliminate compatibility issues based on different equipment or different treatment planning systems from site to site. Creation of consensus guidelines and common approaches took about 4 hours. Variation of treatment policies and contouring approaches due to platform use is under evaluation.

**Conclusion:** The online software Radiotherap-e provided a common platform to share clinical, radiological and radiotherapeutic informations and allowed standardization and optimization of contouring strategies within a regional oncological network.

**EP-1458**

CBCT-Based On-site Simulation, Planning, and Delivery (OSPD) for whole brain radiotherapy

A. Pompos, A. Le, R. Timmerman, S. Jiang, H. Choy

**Purpose or Objective:** To demonstrate the feasibility of a CBCT-based on-site simulation, planning, and delivery (OSPD) for whole brain radiotherapy, in which all steps from imaging, planning to treatment delivery are performed at the treatment unit in one appointment time slot. This work serves as the proof of concept for future OSPD single fraction radiation therapy.