# White Paper: Radiation Oncology and the Challenges of Technology Advancements

## For Health Plans, Medical Management Organizations and TPAs

### Introduction

Advances in imaging techniques and computer software have led to significant improvements in the accuracy of radiation therapy, allowing more accurate targeting of tumors. These advances have provided improved outcomes and better quality of life for patients with cancer, but they have also led to the overutilization of new technologies.

Ongoing innovations in radiation therapy present the challenge for healthcare policy-makers and providers to develop the most effective, efficient, and safe treatments for patients, as well as to integrate these innovations into routine practice, guidelines, and coverage. Keeping up-to-date on clinical guidelines and new technologies and applications may play a key role in reducing overutilization. This paper will review 4 radiotherapies: intensity-modulated radiation therapy (IMRT), stereotactic radiosurgery (SRS), stereotactic radiotherapy (SRT), and stereotactic body radiation therapy (SBRT).

### Oncology Case Management: The Role of Independent Medical Review

Continual technological developments often complicate the process of establishing evidence-based criteria for practice guidelines and reimbursement for new procedures and treatments. Clinicians may attempt to justify using a new technology by citing studies that are too small and lack statistical power. An independent medical review, which is normally used by healthcare payers, looks at whether or not a specific procedure was medically necessary. The physician specialists who work with independent review organizations keep up-to-date with the latest medical research literature and with the latest standard of care. This is especially important in oncology, which utilizes continually evolving technology and involves numerous treatments that frequently go from being experimental/investigational to the standard of care. For example, some clinicians may attempt to justify the use of SBRT in the treatment of pancreatic cancer or prostate cancer based on encouraging results from single-institution studies.2,3 However, these small studies do not provide sufficient data to support the use of SBRT in these cancers at this time. Physicians who review cases for independent review organizations stay on top of these treatments as they are studied more extensively and potentially accepted into clinical guidelines. On the other hand, plenty of data exist for the successful treatment of brain tumors with SRT or SRS.4,5

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Independent medical reviews also avoid conflicts of interest, which can relate to economics, lack of specialists to review cases, or having the same doctor who denied a case review an appeal. Independent medical review facilitates effective treatment of patients with cancer, which requires an in-depth understanding of the radiation treatment planning process so that treatments can be individualized for each patient.

### IMRT, SRS, SRT and SBRT

Intensity-modulated radiation therapy, SRS, SRT, and SBRT are all non-invasive treatments that precisely deliver high doses of focused radiation beams to tumors.

***IMRT***

Intensity-modulated radiation therapy utilizes computer-controlled linear accelerators to deliver precise doses of radiation to a malignant tumor or specific areas within the tumor. Controlling the intensity of the radiation beam in multiple small volumes allows the radiation dose to conform more precisely to the 3-dimensional (3D) shape of the tumor. IMRT allows higher radiation doses to be focused to the regions within the tumor while minimizing the dose to surrounding critical structures. Treatment planning involves using 3D computed tomography (CT) images of the patient in combination with computerized dose calculations to determine the dose-intensity pattern that will best conform to the tumor shape. The multileaf collimators used to shape and focus the radiation beams can be adjusted during the treatment session, allowing the radiation beam to be divided in real time into several individual beams, each of which may be individually turned on or off during the treatment. Combinations of several intensity-modulated fields coming from different beam directions produce a custom-tailored radiation dose that maximizes the dose to the tumor while minimizing the dose to adjacent normal tissues. The increased accuracy of the radiation beam makes it possible to use higher radiation doses, which may be more effective at killing cancer cells, with fewer side effects compared to conventional radiotherapies.

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Intensity-modulated radiation therapy is used most extensively to treat cancers of the prostate, head and neck, and central nervous system. It has also been used in limited situations to treat breast, thyroid, lung, gastrointestinal, and gynecologic malignances, and certain types of sarcomas.

***Stereotactic Radiation Therapies***

Stereotactic radiation therapy (i.e., SRS, SRT, and SBRT) utilizes specific image guidance for exact localization of tumors or areas of concern in the body or brain. It delivers high-dose radiation to a small highly precise treatment field, excluding normal surrounding tissues and organs better than conventional radiotherapy.

***SRS***

Stereotactic radiosurgery utilizes an IMRT plan that delivers a large, single intracranial dose of radiation on a single day. It targets a tumor from many different directions so that the beams of radiation converge on the tumor. High doses of radiation can be delivered with millimeter accuracy because either a positioning frame is secured to the patient's skull or body, or a stereotactic image-guidance system is used.

Lesions treated with SRS include acoustic neuromas, meningiomas, recurrent gliomas, glomus jugulare tumors, arteriovenous malformations, and brain metastases.

***SRT***

Stereotactic radiotherapy utilizes an IMRT plan with intracranial hypofractionation, delivering 2 to 5 treatments. The primary advantage of this is that it results in the highest "therapeutic ratio," that is, the highest destruction of tumor cells with the lowest effect on normal adjacent tissue and structures. The multiple smaller doses of radiation can destroy tumor cells while sparing normal tissues.

***SBRT***

Stereotactic body radiation therapy (SBRT) utilizes an IMRT plan for body lesions, and it refers to the use of SRT at any extracranial site. Unlike tumors within the CNS, tumors and organs throughout the body can potentially move with breathing and other factors. Therefore, SBRT requires accurate and custom mapping for each individual patient's

anatomy and organ motion in order to optimally target the tumor while sparing the surrounding normal tissue. Some lesions require fiducial marker placement for improved image-guided accuracy.

Palliative use of SBRT may be considered for patients with lung or liver cancer, or cancer of the spine. In addition, curative use of SBRT has been proven for stage I nonsmall cell lung cancer.1

## Examples of Available Technologies

Among the most widely used technologies for radiation therapy are multileaf collimator-based linear accelerators, the CyberKnife®, Gamma Knife®, and TomoTherapy®.

***CyberKnife***

The CyberKnife system is used primarily for stereotactic approach to brain or body lesions. It is a specialized linear accelerator system that uses a single high-energy photon beam fixed to a robot arm that moves the beam to different positions during the course of treatment, all converging in the treatment area. The system eliminates the need for immobilization frames. In order to compensate for functional body movements, the CyberKnife incorporates real-time imaging and fiduciary placement markers that are used to continually triangulate the geometric position of the target lesion within the body. A microprocessor calculates fiduciary displacement caused by movement and compensates for radiation delivery during the treatment process.

***Gamma Knife***

Unlike the CyberKnife, the Gamma Knife delivers multiple beams of gamma radiation converging in 3 dimensions to focus precisely on a small volume (e.g., a tumor). It is almost exclusively used for intracranial lesions. Accuracy of the Gamma Knife is achieved by using a skeletal frame to immobilize the target area. Imaging studies, such as magnetic resonance imaging (MRI), CT, or angiography are obtained for the treatment planning process. Treatment with the Gamma Knife is generally limited to a single dose.

***TomoTherapy***

TomoTherapy integrates CT imaging and treatment delivery into one machine, utilizing photon radiation produced by a linear accelerator. It is a form of CT-guided IMRT that delivers radiation slice-by-slice. The system delivers IMRT with a helical, or spiral, delivery pattern, allowing continuous radiation delivery from all angles around the patient.

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