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### **Technological Advances in Proton Therapy**

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Proton therapy has interested radiation oncologists since the 1946 paper by Robert R. Wilson describing the energy deposition of proton beams and suggesting it would be more suitable for radiation treatments than beams of x-rays. For all its proposed benefits, only 25,000 or so cancer patients worldwide have been treated with high-energy proton beams over the last fifty years. However, during the past decade that number has started to rapidly increase. In the United States alone the number of dedicated facilities has grown from two to five in the last three years and will likely double again by the end of the current decade. We will soon be treating as many patients in one year as was treated during the first fifty years of proton therapy. Surprisingly, the reason is because of what has been happening in x-ray radiotherapy. Conventional radiotherapy underwent a dramatic change during the past decade with the introduction of multiple advances in imaging technology and beam delivery methods. The imaging advances include both imaging for treatment planning (multislice CT systems, high resolution MRI, and increasing use of PET) and imaging of the target location in the treatment room. The treatment delivery advances, dominated by methods that permit intensity modulated beam delivery, were made possible by increased computational power and more computer control of the treatment delivery. These imaging and beam delivery advances should benefit proton therapy treatments even more than x-ray treatments because of the better conformation of dose to the target that one can achieve with proton beams. However, because of the small size of the proton therapy community it has had difficulty implementing some of the advances made in x-ray therapy. The treatment planning imaging is also used by proton therapy but the on-treatment imaging and the intensity modulation often must be specially developed for each proton therapy system. This talk will present the developments in these areas that are expected to be implemented in the next few years.