Economics of Proton Therapy

Peter A. S. Johnstone, M.D., FACR

Chair and William A. Mitchell Professor of Radiation Oncology

President & Chief Executive Officer, IU Health Proton Therapy Center

Director, IU Cyclotron Operations

INDIANA UNIVERSITY

DEPARTMENT OF RADIATION ONCOLOGY

School of Medicine

Disclaimer/COI

The IUH Proton Therapy Center & IU Cyclotron Operations contribute funds to the IU radiation oncology practice plan towards my salary.


NOTICE

Questions for finance/business

- Getting the right treatment to the right patient
- Getting paid for it

Acta Oncologica, 2005; 44: 836–849

Taylor & Francis
Taylor & Francis Group

ORIGINAL ARTICLE

Number of patients potentially eligible for proton therapy

BENGT GLIMELIUS[1], ANDERS ASK[2], GÖRAN BJELKENGREN[3], THOMAS BJÖRK-ERIKSSON[4], ERIK BLOMQUIST[1], BENGT JOHANSSON[5], MIKAEL KARLSSON[6] & BJÖRN ZACKRISSON[7]

[1]*Department of Oncology, Radiology and Clinical Immunology, Akademiska sjukhuset, Uppsala and Department of Oncology and Pathology, Karolinska Institutet, Stockholm,* [2]*Department of Oncology, University Hospital, Lund,* [3]*Department of Oncology, University Hospital, Malmö,* [4]*Department of Oncology, University Hospital, Gothenburg,* [5]*Department of Oncology, University Hospital, Örebro,* [6]*Department of Radiation Physics, University Hospital, Umeå and* [7]*Department of Oncology, University Hospital, Umeå, Sweden*

Abstract

A group of Swedish radiation oncologists and hospital physicists have estimated the number of patients in Sweden suitable for proton beam therapy in a facility where one of the principal aims is to facilitate randomized and other studies in which the advantage of protons can be shown and the magnitude of the differences compared with optimally administered conventional radiation treatment, also including intensity-modulated radiation therapy (IMRT) and brachytherapy, can be shown. The estimations have been based on current statistics of tumour incidence in Sweden, number of patients potentially eligible for radiation treatment, scientific support from clinical trials and model dose planning studies and knowledge of the dose-response relations of different tumours together with information on normal tissue complication rates. In Sweden, it is assessed that between 2200 and 2500 patients annually are eligible for proton beam therapy, and that for these patients the potential therapeutic benefit is so great as to justify the additional expense of proton therapy. This constitutes between 14–15% of all irradiated patients annually.

Evaluation of Potential Proton Therapy Utilization in a Market-Based Environment

Tomas Dvorak, MD[a,b], David E. Wazer, MD[a,b]

Purpose: Proton therapy is an increasingly prominent radiation treatment modality. Market-driven adoption of proton therapy into routine clinical practice may have a significant economic impact. The aim of this study was to estimate the proportion of patients who could potentially be treated with proton therapy by evaluating the utilization of existing highly conformal photon therapy as a proxy.

Methods: All patients treated in 2007 with radiation therapy at the authors' institution were evaluated. Treatment technique was categorized using Current Procedural Terminology® codes as conventional radiation therapy, intensity-modulated radiation therapy, Gamma Knife radiosurgery, stereotactic body radiation therapy, and brachytherapy. Medicare 2008 codes were used to estimate cost impact.

Results: One thousand forty-two patients were treated using 19,749 treatment fractions. As a potential proxy for proton therapy, highly conformal external-beam photon techniques were delivered in 31% of all fractions (intensity-modulated radiation therapy in 30%, stereotactic body radiation therapy in <1%, and Gamma Knife radiosurgery in 1%). Most were used for prostate cancer (37%), gliomas (17%), and head and neck cancers (16%). Pediatric patients were a small proportion (2%) of treatments. Proton therapy, if delivered instead of highly conformal photon therapy, could increase annual cost for radiation therapy at the authors' institution by $1.3 million (22%) and require approximately 1.4 gantries to deliver.

Conclusions: Using existing utilization patterns of highly conformal photon therapy as a proxy, approximately one-third of patients irradiated annually at the authors' institution could be treated with proton therapy, with an incremental cost of 20% across the entire treated patient population.

Key Words: Proton therapy, utilization, cost

J Am Coll Radiol 2010;7:522-528.

Determining your population

- Prostate?
- Peds?
- Skull base?
- Head and neck?
- Palliation?
- Liver?
- Lung?
- Breast?

Paths to Less Toxicity

THE VOICE OF EXPERIENCE

Overcoming the Learning Curve in Supine Pediatric Proton Craniospinal Irradiation

Madhavi Singhal, BS, Andrew Vincent, BS, Victor Simoneaux, BS, Peter A.S. Johnstone, MD, Jeffrey C. Buchsbaum, MD, PhD, AM

- Teamwork/training, etc

Paths to Less Toxicity

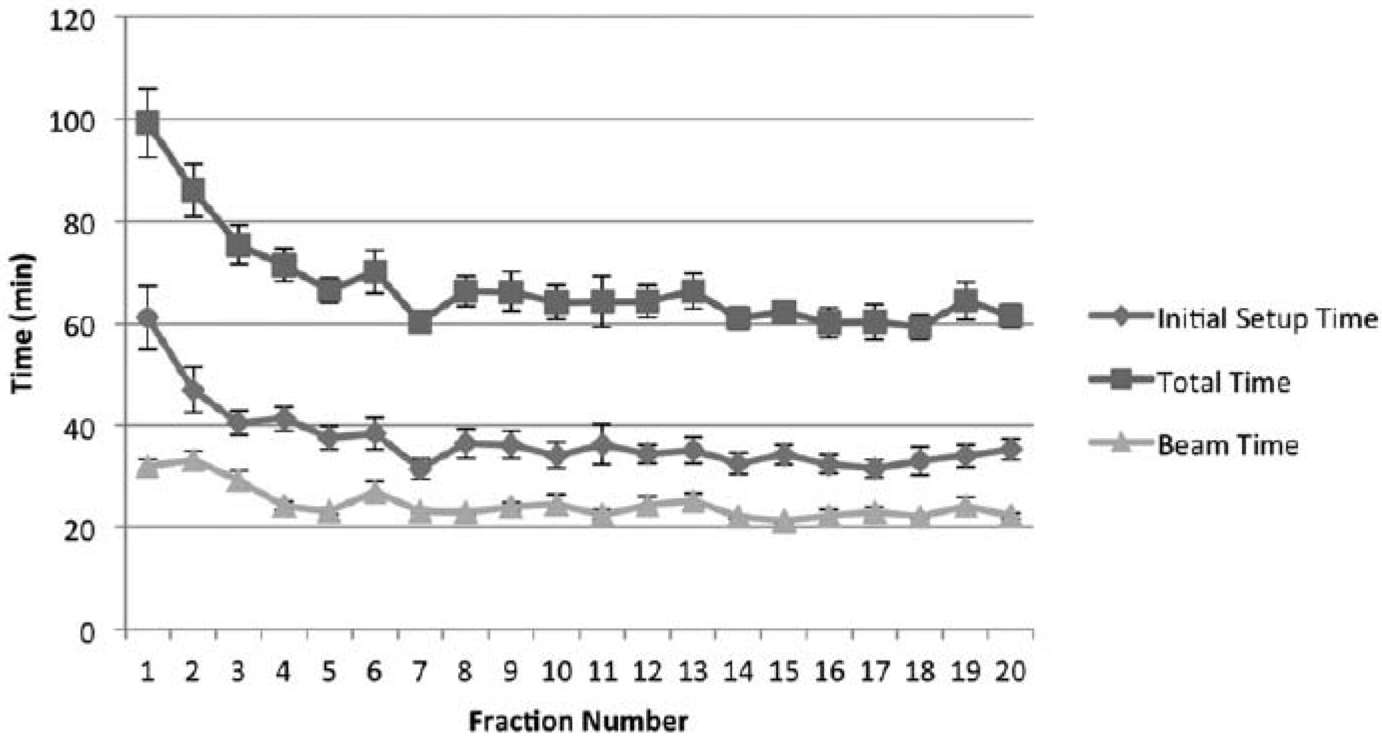


Fig 2. Average supine craniospinal irradiation procedure time per session number is shown, with error bars representing the standard deviation.

Paths to Less Toxicity

International Journal of Radiation Oncology biology • physics

www.redjournal.org

Clinical Investigation

Repetitive Pediatric Anesthesia in a Non-Hospital Setting

Jeffrey C. Buchsbaum, MD, PhD, AM,*,† Kevin P. McMullen, MD,*,†
James G. Douglas, MD, MS,*,† Jeffrey L. Jackson, MD,† R. Victor Simoneaux, RTT,†
Matthew Hines, RTT,† Jennifer Bratton, RN,† John Kerstiens, CPA,†
and Peter A.S. Johnstone, MD, FACR*,†

*From the *Department of Radiation Oncology, Indiana University School of Medicine, Indianapolis, Indiana; and †Indiana University Health Proton Therapy Center, Bloomington, Indiana*

- Teamwork/training, etc

JOURNAL OF APPLIED CLINICAL MEDICAL PHYSICS, VOLUME 13, NUMBER 6, 2012

Impact of proton beam availability on patient treatment schedule in radiation oncology

Eric D. Miller,[1] Vladimir Derenchuk,[2] Indra J. Das,[1]
Peter A. S. Johnstone[1,2a]
Indiana University Health Proton Therapy Center;[1] Bloomington, IN & Department of Radiation Oncology, Indiana University School of Medicine, Indianapolis, IN 46202, USA; Indiana University Cyclotron Operations,[2] Bloomington, IN 47408, USA
pajohnst@iupui.edu

Received 6 March, 2012; accepted 14 July, 2012

Proton beam therapy offers unique physical properties with potential for reduced toxicity and better patient care. There is an increased interest in radiation oncology centers to acquire proton therapy capabilities. The operation of a proton treatment center is quite different than a photon-based clinic because of the more complex technology involved, as well as the single proton beam source serving multiple treatment rooms with no backup source available. There is limited published data which investigates metrics that can be used to determine the performance of a proton facility. The purpose of this study is to evaluate performance metrics of Indiana University Cyclotron Operations (IUCO), including availability, mean time between failures, and mean time to repair, and to determine how changes in these metrics impact patient treatments. We utilized a computerized maintenance management system to log all downtime occurrences and servicing operations for the facility. These data were then used to calculate the availability as well as the mean time between failures and mean time to repair. Impact on patient treatments was determined by analyzing delayed and missed treatments, which were recorded in an electronic medical record and database maintained by the therapists.

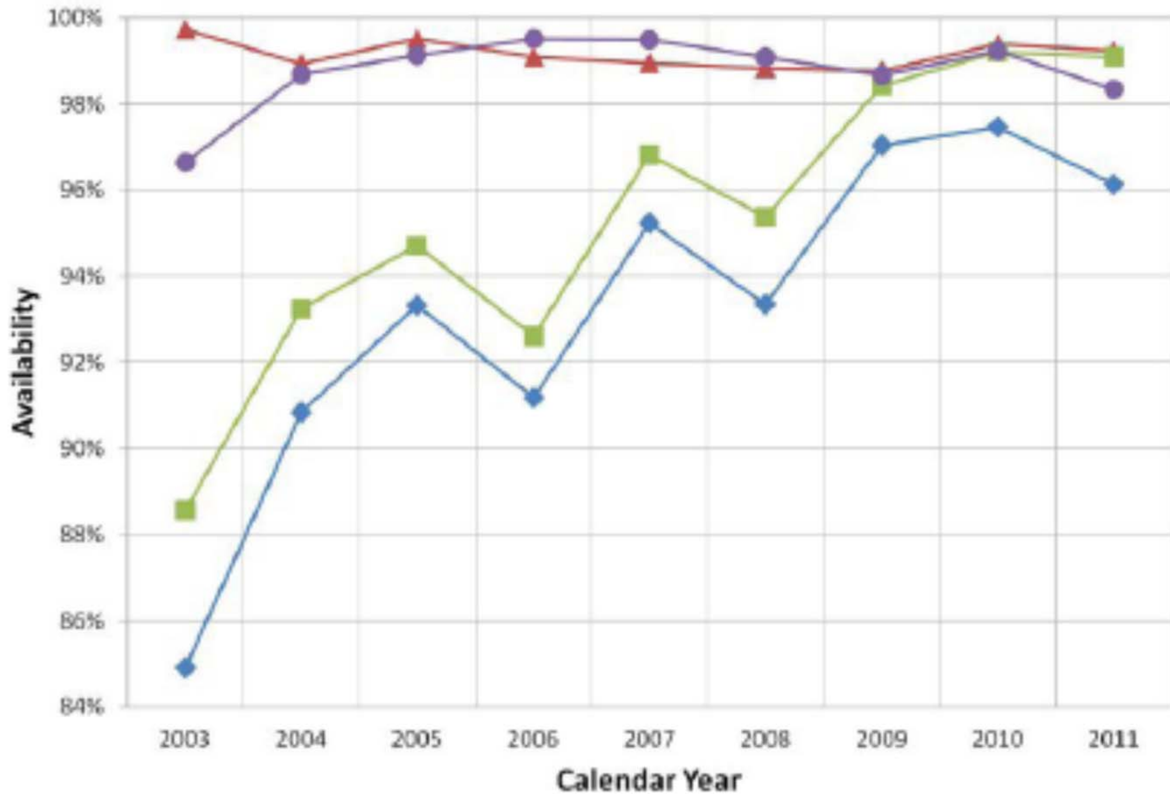


FIG. 1. Availability for calendar year 2003 to 2011. Data points correspond to overall availability (◆), availability for the treatment room systems from the kicker magnet through the nozzle and patient positioning system (▲), the cyclotron and beamlines alone (■), and external issues (●) which includes downtime related to power failures, weather related events, user errors, and failure of the X-ray system.

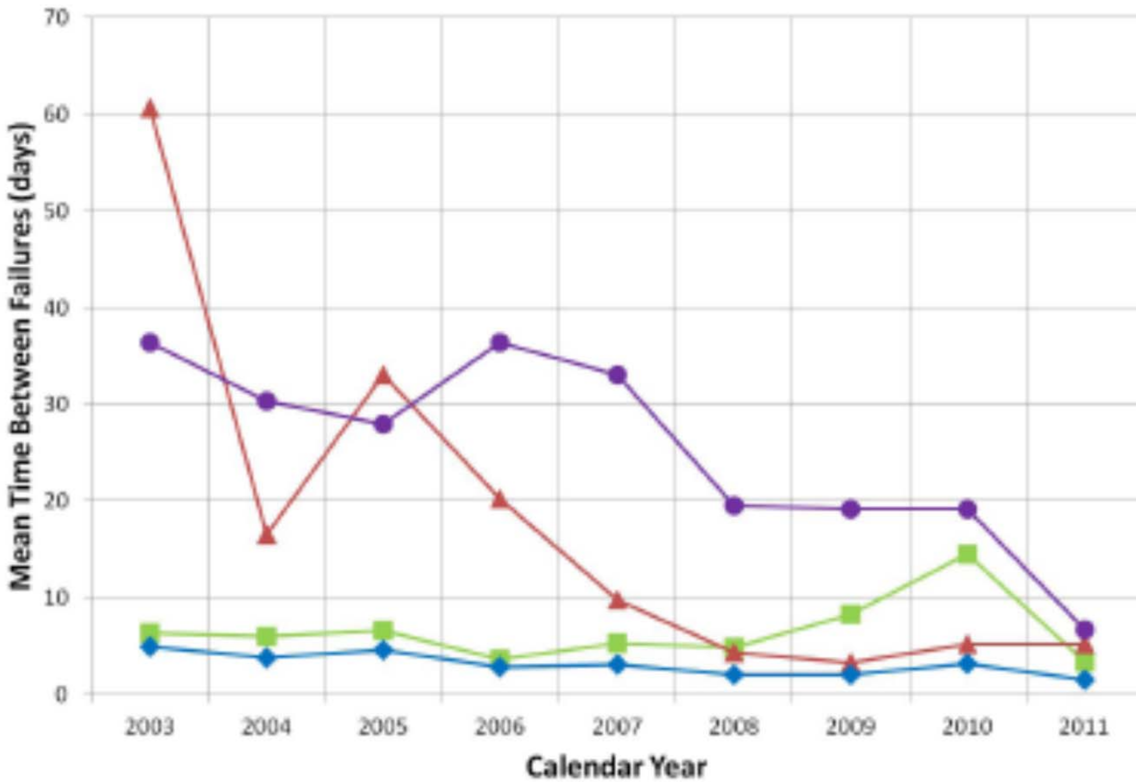


FIG. 2. Mean time between failures (MTBF) from 2003 to 2011. Data points correspond to the overall system (◆), the treatment room systems (▲), the cyclotron (■), and external issues (●) such as power failures and weather related events.

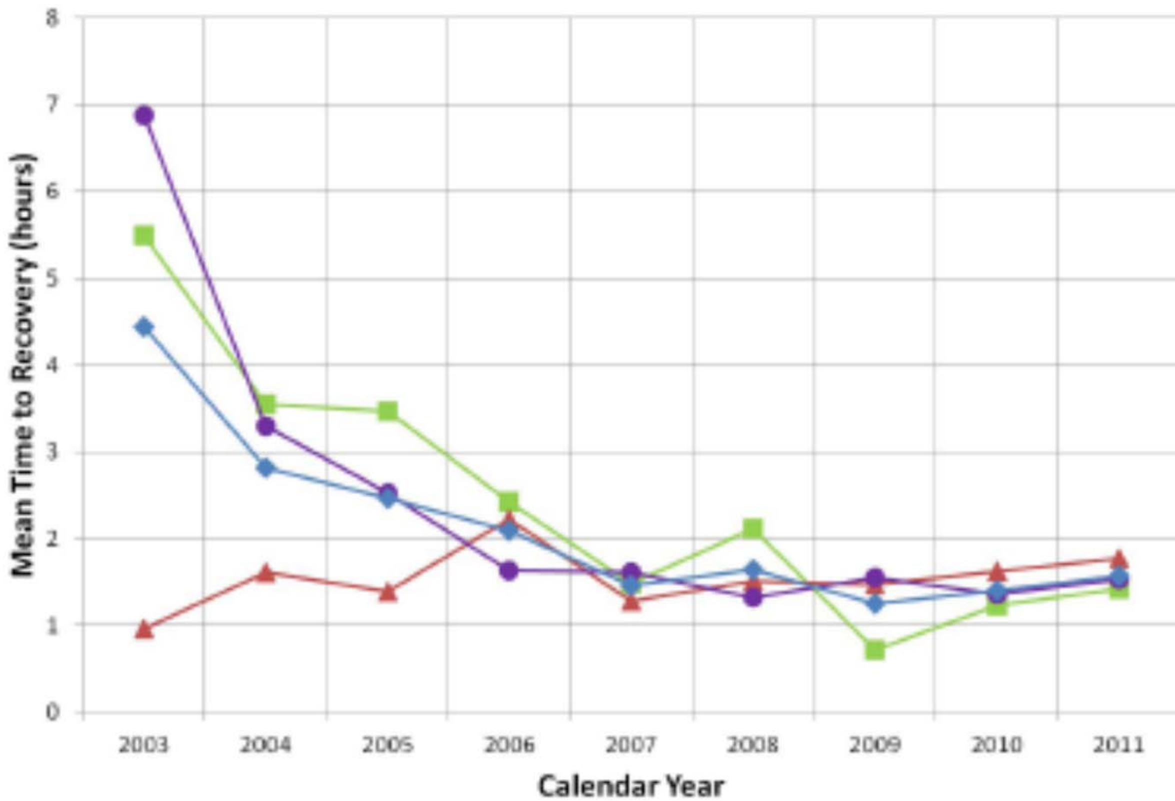
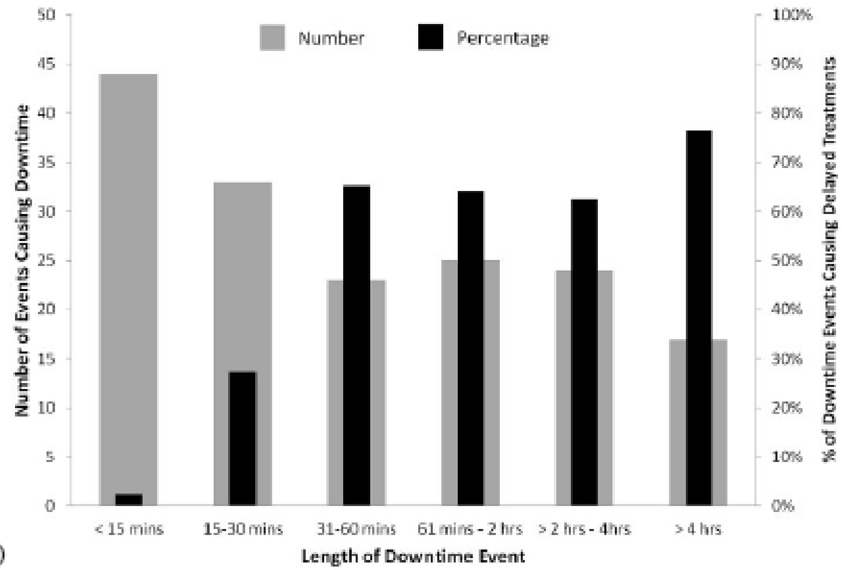
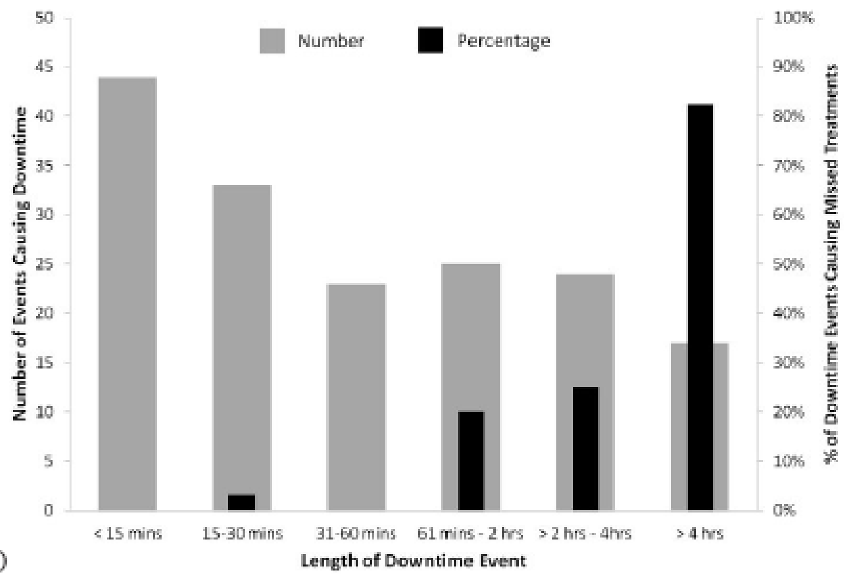


FIG. 3. Mean time to recovery (MTTR) from 2003 to 2011. Data points correspond to the overall system (◆), the treatment room systems (▲), the cyclotron (■), and external issues (●) such as power failures and weather related events.



Number
Percentage
Number of Events Causing Downtime
% of Downtime Events Causing Delayed Treatments
< 15 mins
15-30 mins
31-60 mins
61 mins - 2 hrs
> 2 hrs - 4hrs
> 4 hrs
Length of Downtime Event

(a)



Number
Percentage
Number of Events Causing Downtime
% of Downtime Events Causing Missed Treatments
< 15 mins
15-30 mins
31-60 mins
61 mins - 2 hrs
> 2 hrs - 4hrs
> 4 hrs
Length of Downtime Event

(b)

INDIANA UNIVERSITY

Proton Facility Economics: The Importance of "Simple" Treatments

Peter A. S. Johnstone, MD[a,b], John Kerstiens, CPA[b], Richard Helsper, MBA[b]

Purpose: Given the cost and debt incurred to build a modern proton facility, impetus exists to minimize treatment of patients with complex setups because of their slower throughput. The aim of this study was to determine how many "simple" cases are necessary given different patient loads simply to recoup construction costs and debt service, without beginning to cover salaries, utilities, beam costs, and so on. Simple cases are ones that can be performed quickly because of an easy setup for the patient or because the patient is to receive treatment to just one or two fields.

Methods: A "standard" construction cost and debt for 1, 3, and 4 gantry facilities were calculated from public documents of facilities built in the United States, with 100% of the construction funded through standard 15-year financing at 5% interest. Clinical best case (that each room was completely scheduled with patients over a 14-hour workday) was assumed, and a statistical analysis was modeled with debt, case mix, and payer mix moving independently. Treatment times and reimbursement data from the investigators' facility for varying complexities of patients were extrapolated for varying numbers treated daily. Revenue assumptions of $*X* per treatment were assumed both for pediatric cases (a mix of Medicaid and private payer) and state Medicare simple case rates. Private payer reimbursement averages $1.75*X* per treatment. The number of simple patients required daily to cover construction and debt service costs was then derived.

Results: A single gantry treating only complex or pediatric patients would need to apply 85% of its treatment slots simply to service debt. However, that same room could cover its debt treating 4 hours of simple patients, thus opening more slots for complex and pediatric patients. A 3-gantry facility treating only complex and pediatric cases would not have enough treatment slots to recoup construction and debt service costs at all. For a 4-gantry center, focusing on complex and pediatric cases alone, there would not be enough treatment slots to cover even 60% of debt service. Personnel and recurring costs and profit further reduce the business case for performing more complex patients.

Conclusions: Debt is not variable with capacity. Absent philanthropy, financing a modern proton center requires treating a case load emphasizing simple patients even before operating costs and any profit are achieved.

Key Words: Protons, prostate cancer, health services research

J Am Coll Radiol 2012;9:560-563.

Reimbursement reductions

- 2012 CMS: $1183.77 – $1548.54/tx
- NGS thru 8/22/2012: $753-$951/tx
- WPS after 8/22/2012: $536 - $812/tx
- 2013 CMS: $682.36 - $1136.61/tx
- 2013 WPS: stable
- Under ACO: reimbursement could drop to IMRT levels ($510.31/tx) for sites where better outcomes are not evident.

International Journal of
Radiation Oncology
biology • physics

www.redjournal.org

Clinical Investigation

Proton Beam Therapy and Accountable Care: The Challenges Ahead

Shereef M. Elnahal, MD, MBA,* John Kerstiens, CPA,[†] Richard S. Helsper, MBA,[‡] Anthony L. Zietman, MD,[§] and Peter A.S. Johnstone, MD, MA[†,‖]

*Department of Medicine, Brigham and Women's Hospital, Boston, MA, [†]Proton Therapy Center, Indiana University, Bloomington, IN, [‡]Genesis HealthCare System, Zanesville, OH, [§]Department of Radiation Oncology, Massachusetts General Hospital, Boston, MA, and [‖]Department of Radiation Oncology, Indiana University School of Medicine, Indianapolis, IN

Received Jul 16, 2012, and in revised form Oct 13, 2012. Accepted for publication Oct 24, 2012