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the Best"  
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# High Dose per Fraction, Hypofractionated Treatment Effects in the Clinic

## HyTEC

Jimm Grimm, PhD

AAPM 2021

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HEALTHCARE SYSTEM

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Caring



From Coal Miner  
to Data Miner  
in 3 Generations

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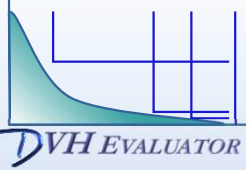
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Caring

Dr. Grimm designed and holds intellectual property rights to the  
**DVH Evaluator software tool**  
(www.DiversiLabs.com) which is an FDA-cleared product in commercial use, and which has been used for this analysis

Funding from Accuray, NovoCure

Conflicts of Interest



**DVH EVALUATOR**

FDA 510k Number K092928 Rx Only US Patents 9,019,307 & 9,192,782  
www.DiversiLabs.com service@DiversiLabs.com  
Soli Deo Gloria

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### Why is HyTEC in the Red Journal?

The next 5 slides will explain this precedent that was already set by Rubin, Emami, and QUANTEC in Red Journal:

*International Journal of Radiation Oncology • Biology • Physics (IJROBP)*  
known in the field as the  
**Red Journal**

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- The History and Future is explained in the Red Journal Podcast:

June 1HyTEC Special IssueApril 1

0:00 / 0:00

HyTEC Special Issue



In this episode of the Red Journal podcast, Anthony Zietman, MD, Editor in Chief, interviews members of the HyTEC steering committee: Jimm Grimm, PhD, Larry Marks, MD, Ellen Yorke, PhD, and Andrew Jackson, PhD. The panelists discuss the origins of HyTEC, the approach used to develop their reports, how the team integrated models and clinical data, and what projects following HyTEC might look like. The HyTEC special issue of the Red Journal is available now online at [redjournal.org](http://redjournal.org).

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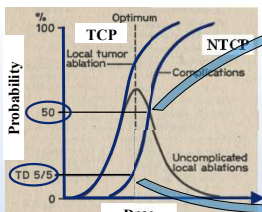
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**TD 5/5 and TD 50/5 Defined, by Dr. Phil Rubin, Founding Editor, Red Journal**



Organ	Injury at 5 years	TD <sub>5/5</sub>	TD <sub>50/5</sub>	Volume or length
Skull	Ulcer, severe fibrosis	5,500	7,000	100 cm <sup>3</sup>
Oral mucosa	Ulcer, severe fibrosis	6,000	7,500	30 cm <sup>2</sup>
Esophagus	Ulcer, stricture	6,000	7,500	75 cm <sup>3</sup>
Stomach	Ulcer, perforation	4,500	7,000	100 cm <sup>3</sup>
Intestine	Ulcer, stricture	4,500	6,500	100 cm <sup>3</sup>
Colon	Ulcer, stricture	4,500	6,500	100 cm <sup>3</sup>
Rectum	Ulcer, stricture	5,500	6,000	100 cm <sup>3</sup>
Salivary glands	Xerostomia	5,000	7,000	30 cm <sup>3</sup>

TD<sub>5/5</sub>: 5% Tolerance Dose for 5 years  
TD<sub>50/5</sub>: 50% Tolerance Dose for 5 years  
Rubin & Casper Textbook, 1974 Edition

"Optimal time-dose-volume relationships can be determined by plotting failures and complications against increasing biologic doses"

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**Emami Paper, May 1991, Normal Tissue Tolerance, Part of a full issue of the Red Journal**


*The landmark work relating NTCP to dose distributions in the 3DCRT era that preceded QUANTEC and HyTEC*

Emami B, Lyman J, Brown A, Coia L, Goitein M, Munzenrider JE, Shank B, Solin LJ, Wesson M.

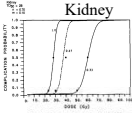
Tolerance of normal tissue to therapeutic irradiation.

Int J Radiat Oncol Biol Phys. 1991;21:109-122.

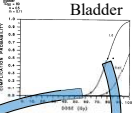
**Bahman Emami, MD**



**Kidney**



**Bladder**



**Models from Burman 1991 (eye fitting)**

Fig. A12: Complication probability vs. dose for the kidney. Fig. A13: Complication probability vs. dose for the bladder.

**Table 1. Normal tissue tolerance to therapeutic irradiation**

Organ	TD 5/5 Volume			TD 50/5 Volume			Selected endpoint
	1/3	2/3	3/3	1/3	2/3	3/3	
Kidney I	5000	3000*	2300	—	4000*	2800	Clinical nephritis
Kidney II	N/A	8000	6500	N/A	8500	8000	Symptomatic
Bladder	N/A	8000	6500	N/A	8500	8000	Symptomatic

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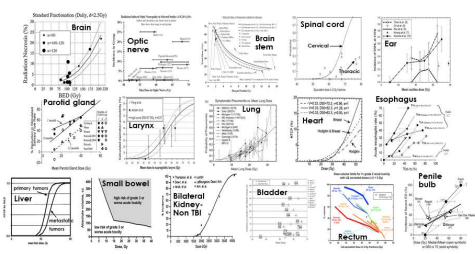
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**QUANTEC: Quantitative Analysis of Normal Tissue Effects in the Clinic**



**QUANTEC**

was the

March 2010

Full Issue

of the

Red Journal

**Guest Editors:**

Lawrence B. Marks, M.D.    Randall K. Ten Haken, Ph.D.    Mary K. Martel, Ph.D.

**Associate Guest Editor:**

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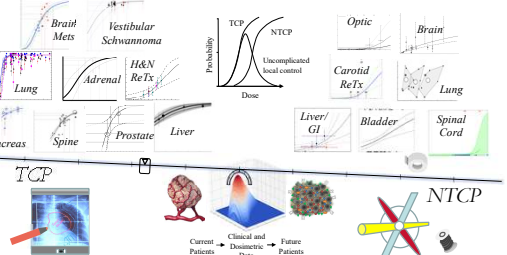
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**HyTEC: 'Hy' Dose per Fraction, Hypofractionated Treatment Effects in the Clinic**



**HyTEC**

is the

May 2021

Full Issue

of the

Red Journal

**Steering Committee:** Jimm Grimm, Ph.D.    Ellen Yorke, Ph.D.    Lawrence B. Marks, M.D.    Andrew Jackson, Ph.D.    Brian D. Kavanagh, M.D.    Jinyu Xue, Ph.D.

AAPM Working Group on SBRT (WGSBRT), Biological Effects Subcommittee (BESC)

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Thank you and congratulations to all the HyTEC members and authors

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HyTEC Steering Committee  
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AAPM Leadership  
Biological Effects Subcommittee (BESC), Therapy Physics Committee (TPC), Science Council, EXCOM, and Especially:  
Jean Moran, PhD, Benedick Fraass, PhD, Salfat Hui, PhD

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	Stephen Kry, PhD	Michael T. Milano, MD, PhD	Sharon Qi, PhD	Ying Xiao, PhD

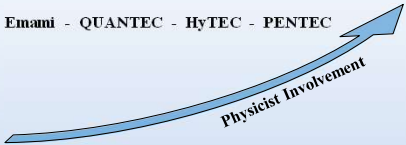
Due to the anonymous nature of the review process, we are still tracing several of the reviewers – if you reviewed a HyTEC paper please let JIB@AAPM.org know!

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These are all associated with the Red Journal – the precedent had already been set – now physicists have a growing role

Rubin - Emami - QUANTEC - HyTEC - PENTEC



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### Today's HyTEC Session, AAPM 2021

HyTEC Overview	Jimm Grimm, PhD
HyTEC: The Project and the Product	Ellen Yorke, PhD
Example of the HyTEC Process: Pancreas TCP	Anand Mahadevan, MD
Physicist Modeler's Perspective: Reporting Standards	Andrew Jackson, PhD
Physician's Perspective: Clinical Needs and Opportunities	Lawrence B. Marks, MD

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International Journal of  
Radiation Oncology • Biology • Physics

HyTEC ~  
"Hy" Dose per Fraction, Hypofractionated Treatment Effects in the Clinic

A Red Journal Special Issue: HyTEC

HyTEC Steering Committee:  
Jimm Grimm, PhD, Ellen Yorke, PhD, Lawrence B. Marks, MD,  
Andrew Jackson, PhD, Brian D. Karunagh, MD, Immy Ros, PhD  
AAPM Working Group on SBRT (WG0817): Biological Effects Subcommittee (BESG)

ASTRO

### Conclusions

- Basic reporting of dose, volume, fractionation and outcome per patient is feasible and needed
  - ♦ You can do it, please publish the details to help future patients!
- Rubin / Emami / QUANTEC / HyTEC / PENTEC / etc. are continually needed as new modalities emerge
- When you write papers, please add details per patient to make your results useful for future data pooling initiatives

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**This is not the end – just the beginning!**  
**If you treat patients you have data – let's analyze and publish it together!**

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