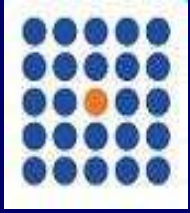




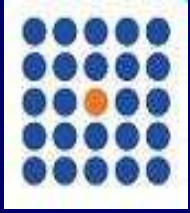
# Protons in the Clinic: Another Tool or Universal Solution?

**Nancy Price Mendenhall, M.D.**  
**PTCOG, Heidelberg**  
**October 1, 2009**



# Protons: Another Tool or Universal Solution

- The Therapeutic Ratio
- Technology
- Economics



# The Therapeutic Ratio



Factors impacting the ratio of probability of cure and probability of complication:

**Total dose**

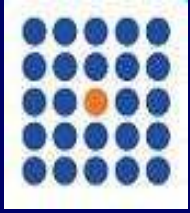
**Fraction size**

**Overall time**

**Inter-fraction interval**

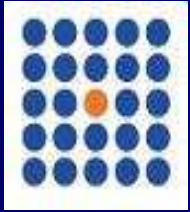
**Volume of tissue**

**Response Modifiers**



# The Therapeutic Ratio

- It's all about dose distribution...
- Most of the dose with X rays will go to non-targeted tissue...
- Most of the dose with Protons goes to targeted tissue....



# Protons: Another Tool or Universal Solution?





# The Therapeutic Ratio

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- With appropriate technology, protons will always produce a higher therapeutic ratio.



# Timing and Technology

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# Technology

- In some clinical situations, we must await further imaging developments to refine our definition of the target maximize the potential of proton therapy
  - Nuclear imaging
  - Hypoxic imaging
  - MR spectroscopy and diffusion imaging
  - Lymphotropic nanoparticle imaging

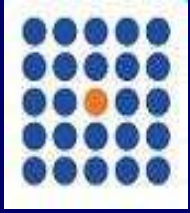




# Technology

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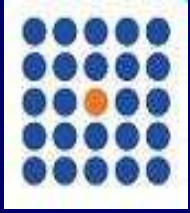
- In some clinical situations, we must await the development of more accurate treatment planning systems to maximize the potential of proton therapy
  - To maximally minimize “margins” we must have a better prediction of proton range



# Technology

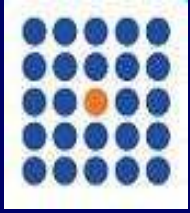
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- In some clinical situations we must await the development of more sophisticated treatment delivery modalities to maximize the potential of proton therapy
  - Scanning beam/IMPT
  - Faster delivery to reduce “margin expansion” required for organ motion



# Technology

- In some clinical situations, we must await the development of more sophisticated tools for measuring clinical endpoints to prove the potential of proton therapy.
  - Neurocognitive
  - Soft tissue growth/replacement potential
  - Quality of life endpoints
  - Subjective elements of toxicity grading



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# Economics



# Economics

**Ideal: focus on science and patients.**

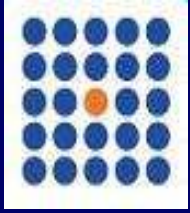
**Reality: cost effectiveness of protons?**

- **NCI**
- **Medicare/3<sup>rd</sup> party payors**
- **Other Medical specialists**
- **Other Radiation Oncologists**



# Grander Scale





# Grander view of individual health care cost

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**Not just the cost of an episode of treatment, but the lifelong cost of a management decision**

- **Cost of treatment**
- **Cost of disease recurrence**
- **Cost of complication**
- **Cost of less functional outcome**



# Foresight and Farsight

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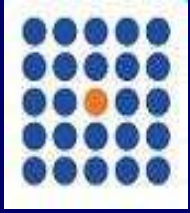


# Longer Term Vision

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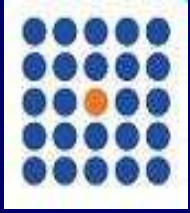
## New Partners

- Public/private partners with greater resources
- Interest in long-term health of citizens
- In many cases, non-profit



# Longer Term Vision

- **Built for Efficiency**
  - Facilities with full scale applications and high throughput
  - Work organized around beam time
- **Built to last**
  - De-emphasis on rapid ROI
  - Continued re-investment in technology
  - Durable and upgradable product
  - User-vendor technology guidance



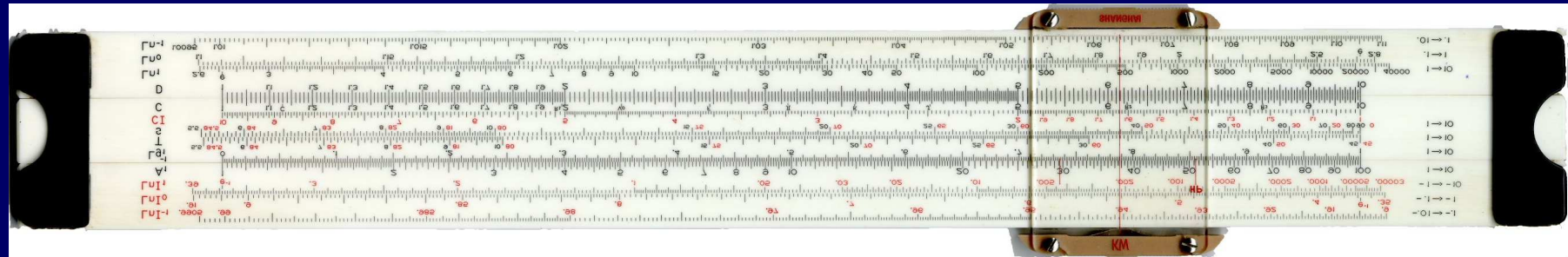
# Foresight and Farsight

If proton therapy improves the therapeutic ratio...

- **Actual individual patient costs will decrease**
  - Fewer recurrences
  - Fewer complications
  - Fewer late effects
  - Potential for hypofractionation
- **Technology will evolve...**
  - More efficient
  - Less expensive



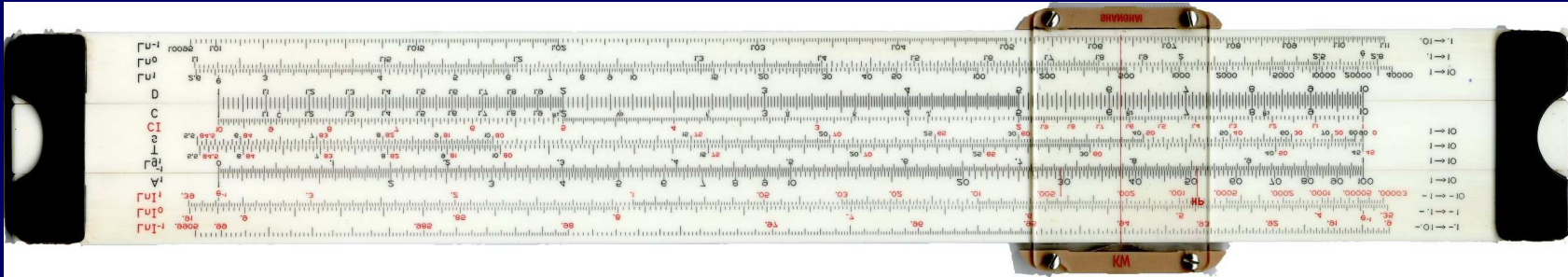
# The Slide Rule



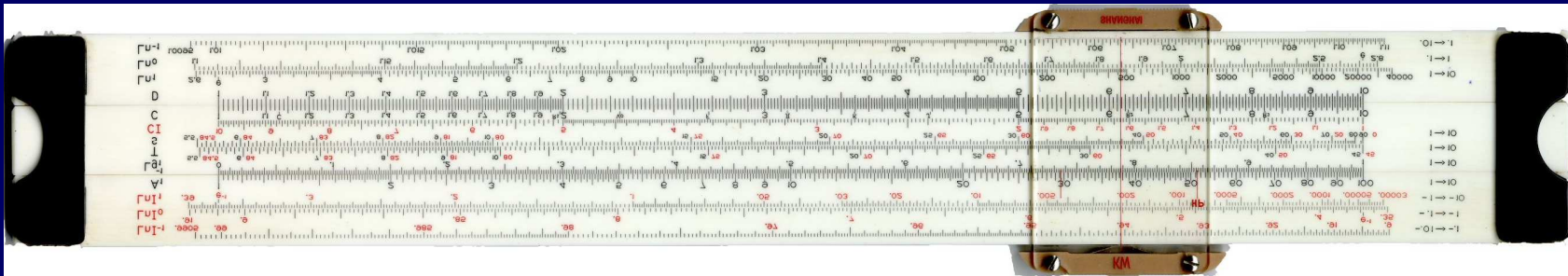
**February 1, 1972: \$12.50**



# The Slide Rule



**February 1, 1972: \$12.50**



**May 5, 2009: \$33.00**



# The Hewlett-Packard HP-35



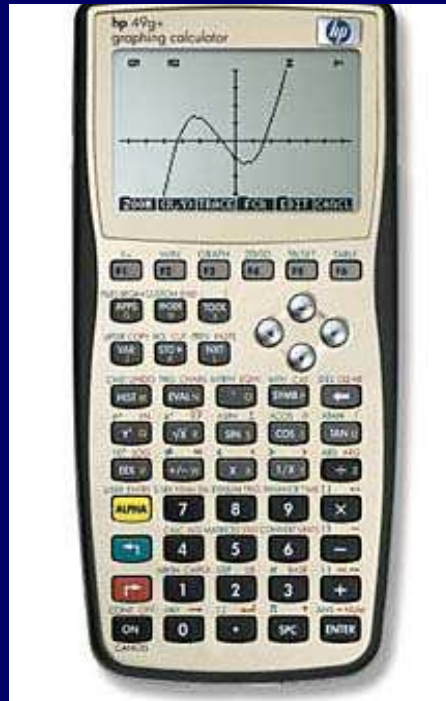
**February 1, 1972: \$399.00**



# The Hewlett-Packard HP-35



**February 1,  
1972:  
\$399.00**



**May 4,  
2009:  
\$79.99**



**Walmart Price  
May 4, 2009:  
\$7.99**



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So...

**Are protons (particles)  
just another tool in the  
clinic or a universal  
(external beam) solution?**





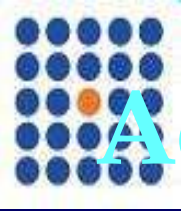
# Foresight and Farsight

- Protons will ultimately produce the highest therapeutic ratio because of the better dose distribution.
- Technology will increase applicability and maximize proton therapy potential for increasing the therapeutic ratio.
- Economics will evolve to focus on long-term outcomes and new financing and operational models as well as new technology will improve the “cost-effectiveness.”



**Protons will  
become the  
universal  
solution for  
external  
beam  
radiation  
therapy.**





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