Health Economics of Hepatitis Therapy
6th International Workshop on Clinical Pharmacology of Hepatitis Therapy
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Suppose a Treatment “Purchases” Added Years at a Price of $250,000 per Added Life-year

- **Option A:** American society should purchase that added life-year for all afflicted patients . . . This would mean that taxpayers should be compelled to pay extra taxes to cover the cost of these added life-years.

- **Option B:** Taxpayers should not be asked to purchase such expensive, added life-years for their low-income fellow citizens, but Americans with the means to purchase them with their own resources, or who have private health insurance, should be afforded the opportunity to purchase those added life-years for themselves or their families.

Health Budget Limitations

• 2010 U.S. health care expenditures estimated to be $2.6 trillion or >17% of GDP
  – 40% more on health care: ~$740 billion
• “Every country spends 100% of its gross domestic product on something”
• What is important is the value obtained by the spending: opportunity costs
• Family earning $60,000 “gross wage base” would spend 41% of wages on health care in 2017

http://www.census.gov/compendia/statab/cats/health_nutrition/health_expenditures.html
What is the Economic Burden of Chronic HBV and Chronic HCV?
HBV Economic Burden

- Direct medical care costs $205 million-$1.2 billion in 2004
- Anti-HBV medications (excluding interferon products) grew 50% annually from 2006 through 2008
- Extrapolated $328 million for 2008

Kim WR, Hepatology 2009;49 (suppl):S28-34

Presented at the 6th International Workshop on Clinical Pharmacology of Hepatitis Therapy, 22-23 June 2011, Cambridge, USA
HCV in Japan

• Molecular genetic analysis of HCV
  – Divergence time: 1882 in Japan and 1910 in US
  – Rapid spread: 1930-40’s in Japan vs 1960’s in US

• Societal events
  – Japan: IV treatment for schistosomiasis, injection metamphetamine, paid blood donors 1920-40’s
  – US: injection drug use in 1960’s

• Epidemiology
  – Japan: rise in HCC in 1980
  – US: will HCC rise next 2-3 decades?

Yoshizawa H Oncology 2002;62(suppl):8-17; Tanaka Y et al PNAS 2002;99:15584-89

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HCC and HCV in Japan

- 1950-60s voluntary blood donation and penalties for amphetamine use

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Prevalence of HCV Antibody
NHANES III

3.9 million HCV Antibody positive
2.7 million RNA positive
2.0 million RNA positive & elevated LFT’s

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Markov Model

Wong JB et al JAMA 1998;280:2088-93

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HCV Economic Burden

• Projections 2010-2019
  – 1 million years of advanced liver disease
  – Loss of 3 million years of life
• Annual medical care costs
  – $1.1 billion direct
  – $7.5 billion Indirect from premature mortality & disability
  – US managed care $6864 HCV-related costs per HCV patient = 1/3rd all costs (26% ↑ vs. controls)
• $279 million of peginterferon annually (02-07)


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Public Health Burden of HCV

- Simulations suggest that HCV mortality and morbidity will increase over next 10 years (US, France, Australia, Canada and Spain, England, except Italy)
- Demonstrated increased HCV related morbidity and mortality (US, Canada, Sweden)


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1-Year Average Wholesale US HBV Drug Costs

<table>
<thead>
<tr>
<th>Drug</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lamivudine</td>
<td>$2,631</td>
</tr>
<tr>
<td>Emtricitabine</td>
<td>$5,320</td>
</tr>
<tr>
<td>Tenofovir</td>
<td>$9,387</td>
</tr>
<tr>
<td>Entecavir</td>
<td>$10,354</td>
</tr>
<tr>
<td>Telbivudine</td>
<td>$9,754</td>
</tr>
<tr>
<td>Adefovir</td>
<td>$11,871</td>
</tr>
<tr>
<td>PegIFN2a</td>
<td>$32,932</td>
</tr>
</tbody>
</table>

Drug Red Book 2010
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24-Week Average Wholesale Drug Costs HCV GT2-3

Drug Red Book 2010

Peg-IFN-α-2a + ribavirin

Peg-IFN-α-2b + ribavirin

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48-Week Average Wholesale Drug Costs HCV GT1-4

<table>
<thead>
<tr>
<th>Weight Range</th>
<th>Peg-IFN-α-2a + ribavirin</th>
<th>Peg-IFN-α-2b + ribavirin</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;75 kg</td>
<td>$55,922</td>
<td>$55,922</td>
</tr>
<tr>
<td>≥75 kg</td>
<td>$61,027</td>
<td>$61,027</td>
</tr>
<tr>
<td>&lt;40 kg</td>
<td>$40,805</td>
<td>$40,805</td>
</tr>
<tr>
<td>≤65 kg</td>
<td>$42,130</td>
<td>$42,130</td>
</tr>
<tr>
<td>≤85 kg</td>
<td>$47,086</td>
<td>$47,086</td>
</tr>
<tr>
<td>≤105 kg</td>
<td>$52,111</td>
<td>$52,111</td>
</tr>
<tr>
<td>&gt;105 kg</td>
<td>$55,672</td>
<td>$55,672</td>
</tr>
</tbody>
</table>

Drug Red Book 2010

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HCV Viral Kinetics with Interferon α

Zeuzem S J Hepatology 2002;37:151-3

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Viral Kinetics

- **RVR (rapid virological response)**
  - 4 week viral negative
  - 91% SVR in GT 1 if 24 week viral negative
- **Complete EVR (early virological response)**
  - 12 week viral negative
  - 75% SVR in GT 1 if 24 week viral negative
- **EVR**
  - 12 week 2-log reduction
  - 45% SVR in GT 1 if 24 week viral negative

Management Algorithms decrease drug costs by ~43%

Is anti-viral treatment of hepatitis B or C cost-effective?

• No longer sufficient to know about clinical indications, dosage, safety and monitoring

• Besides **Efficacy** and **Effectiveness**, must now understand **Economics** or **Efficiency** or **Cost-effectiveness**

• Does their clinical benefit justify their cost?
“Our advice: Beware of geeks bearing formulas.”

-Warren Buffett
Marginal or Incremental Cost-Effectiveness Analysis

Additional cost divided by additional benefit

\[
\text{Cost with New Drug} - \text{Cost with Standard Care} \\
\text{Effectiveness with New Drug} - \text{Effectiveness with Std Care}
\]
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Cost-effectiveness Analysis

• Considers costs of drugs plus drug monitoring and side effects, and tests and costs of the disease
• Savings from prevention or alleviation of disease complications
• Accounts for death, disability, discomfort, drug toxicity and dollars
Hepatitis C Costs


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Lifetime Costs

Antiviral Drug  Hepatitis C

$0  $5,000  $10,000  $15,000  $20,000  $25,000  $30,000  $35,000

No Rx  IFN+Riba  Peg+Riba


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Which Option Would You Prefer:

$100 Now  $100 in 1 Year

Annual discount rate = 3%
$10 000 10 years from now = $7441 now
Discounted Lifetime Costs

Would You Prefer to Live 1 Year With:

?-

<table>
<thead>
<tr>
<th>Perfect Health</th>
<th>Hepatocellular CA</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 quality-adjusted months</td>
<td>1 year</td>
</tr>
</tbody>
</table>

Quality weights adjust life expectancy for the morbidity or toxicity associated with the disease or drug.
Effectiveness

Life Expectancy ▬ Yellow
Quality-Adjusted Life Expectancy ▬ Red

No Rx IFN+Riba Peg+Riba


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Does HBV or HCV Treatment Provide Good Value?

<table>
<thead>
<tr>
<th>Condition</th>
<th>Cost per Life Year Gained</th>
</tr>
</thead>
<tbody>
<tr>
<td>HCV or HBV Rx</td>
<td>?</td>
</tr>
<tr>
<td>Colon CA Screen</td>
<td>$25,000</td>
</tr>
<tr>
<td>ART for HIV</td>
<td>$50,000</td>
</tr>
<tr>
<td>NIDDM</td>
<td>$75,000</td>
</tr>
<tr>
<td>Hemodialysis</td>
<td>$100,000</td>
</tr>
<tr>
<td>Fundoplication</td>
<td>&gt;$1 million</td>
</tr>
</tbody>
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Does HBV or HCV Treatment Provide Good Value?

Cost per Life Year Gained

- HCV Rx
- HBV Rx
- Colon CA Screen
- ART for HIV
- NIDDM
- Hemodialysis
- Fundoplication

$0
$25,000
$50,000
$75,000
$100,000
$1 million

Buying Health for $1 Million


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New Direct Acting Agents for HCV for Genotype 1

• “All of marketing comes to focus in the pricing decision” - Robert Corey
  – Teleprevir $49,200 for 12 weeks
  – Boceprevir $26,400 for 24 weeks, $35,200 for 32 weeks or $48,400 for 44 weeks

• When might they provide value — unmet need?
Most Likely Non-responders

- Genotype 1
- Blacks
- Older
- Cirrhosis
- High viral load
- Poor viral kinetic response

SPRINT-2: Boceprevir GT1 Treatment-Naïve

ADVANCE: Telaprevir GT1 Treatment-Naïve

97% 83% 89%
39% 50% 54%
33% 53% 62%
0% 20% 40% 60% 80% 100%
eRVR+ eRVR- Metavir 3 or 4

PR48  PR24T12  PR24T8

eRVR+ = undetectable at week 4 and 12
Jacobson IM et al AASLD #211 Hepatology 2010;52(suppl)427A
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Technology Appraisal

• NICE: “recommendations on a review of clinical and economic evidence”
• PBAC: “consider the effectiveness and cost of a proposed benefit compared to alternative therapies”
• CADTH: “evidence-based information to health care leaders about the effectiveness and efficiency of health technologies”
• AMCP: “standardized methodology for assessing drugs scientifically, based on the value they provide”

You learn that there is a 90% likelihood that you will die within six months.

What percentage of your net worth would you pay to shift that time to seven months?

- A 0%
- B 10%
- C 25%
- D 50%
- E All

Cost-effective but Affordable?

• Cost-effectiveness analysis
  – Takes societal and long-term time horizon
  – ↑ medication now ↓ hospital, outpatient future
  – Cost-effectiveness ≠ cost-savings

• Treating all untreated chronic HCV C (~3 million at $40,000) and HBV (~1 million at $10,000) = $130 billion

Conclusions

• HCV and HBV infections lead to substantial morbidity, mortality, and costs
• Prior economic evaluations suggest anti-HCV and HBV treatments are cost-effective
• Economic evaluations determine treatment value (efficient use of resources) and are increasingly used in technology assessment