# THE COST OF PERFUSING ORGANS- IS IT WORTH IT? – LIVER PERFUSION

ASHISH SAHARIA, MD, FACS
JC WALTER TRANSPLANT CENTER
SHERRIE AND ALAN CONOVER CENTER FOR LIVER DISEASES AND TRANSPLANTATION
HOUSTON METHODIST HOSPITAL

HOUSTON Methodist
J.C. WALTER JR. TRANSPLANT CENTER

# DISCLOSURES

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- Was a PI for OCS transmedics for Houston Methodist

# BUSINESS MODEL

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- Business models are, at heart, stories that explain how enterprises work. Like a good story, a robust business model contains precisely delineated characters, plausible motivations, and a plot that turns on an insight about value. It answers certain questions: Who is the customer? How do we make money? What underlying economic logic explains how we can deliver value to customers at an appropriate cost?
- Magretta J. Why business models matter. Harv Bus Rev. 2002 May;80(5):86-92, 133. PMID: 12024761

# COST EFFECTIVE ANALYSIS

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- This is measured by Quality-Adjusted life years (QALY)
- If a person lives in perfect health for one year, that person will have 1 QALY. ...
- If a person lives in perfect health but only for half a year, that person will have 0.5 QALYs. ...
- Conversely, if a person lives for 1 year in a situation with 0.5 utility (half of perfect health), that person will also have 0.5 QALYs. ...

# COST BENEFIT ANALYSIS

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- Adds a dollar value to the analysis

# MARKOV MODEL VS MICROSIMULATION STUDY

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- A Markov cohort model is **"memoryless**," while a microsimulation model is not subject to this limitation. "Memoryless" is a defining feature of a Markov model, and indicates that the transition probabilities do not depend on history
- In a Markov model the probability of any event stays constant vs microsimulation study is more realistic accounting for variations, although in small numbers.

# MARKOV MODEL EFFECTIVENESS

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- It is based on an assumption made by experts of the potential benefits of an intervention.
- For ex. – an expert predicts that we would do 5 extra donors per year for 5 years using the machine perfusion.

# THEORETICAL ADVANTAGES OF A LIVER PUMP

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- Increased transplant volume
- Reduced post transplant cost
- Wait list management
- Benefits the OPO
- Procurement and recipient operating room logistics

# INCREASED TRANSPLANT VOLUME

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- Increases rate of DCD, ECD liver transplantation
- Allows for active organ assessment of viability ensuring organ usability

# REDUCED POST TRANSPLANT COST

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- Likely reduction in complication rates and length of hospital stays.
- Increased quality-adjusted life years (QALY)

# BENEFITS TO THE OPO

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- Increased organ utilization rates will likely help OPOs meet their costs ( more organs procured per encounter)

# MANAGEMENT OF WAIT LIST

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- Increased utilization of DCD and ECD livers may help move the wait list faster, specially when the cancer patients wait for longer periods.

# COST OF HOSPITAL BED, COST OF A LIVER TRANSPLANT (HMH DATA)

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- Private: $1,565
- Telemetry: $3,042
- Intermediate: $4,787
- ICU: $8,548

- Average hospital bill for liver transplant: 550,000.
- Average length of stay-  36 days with 23 ICU days

# AVERAGE LENGTH OF ICU STAY BEFORE AVAILABILITY OF A LIVER

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- For MELD >30: 10 days
- For MELD 27-30: 17 days

# COST OF OCS, TRANSMEDICS MACHINE

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- $69,000 for the disposables and fluids (No charge for the machine)
- $11,000 for the blood and other medications
- $ 20,000 for personnel

# COST REDUCTION, OCS TRANSMEDICS DATA

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- Average cost reduction of 33,662
- Savings for post procedure inpatient bed cost only and does not account for savings from wait-list time and other post-transplant admission care. Cost data was obtained from the CMS Medicare Cost report results as of 05.03.2021 period

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ORIGINAL ARTICLE

AJT

# Cost-utility analysis of normothermic machine perfusion compared to static cold storage in liver transplantation in the Canadian setting

Alexandria N. Webb[1,2] | Erica L. W. Lester[1] | Andrew Mark James Shapiro[1] | Dean T. Eurich[2] | David L. Bigam[1]

# ORGANOX

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- Cost per run for the machine is $15,358-$16,720
- A decision analytic model using a Markov model was created comparing two different transplant strategies to estimate the costs and outcomes over a 5-year time

**TABLE 4.** Total OrganOx case cost per run

| Item | Total cost (2021 $US) | Breakdown cost (2021 $US) | |
|---|---|---|---|
| Operative room average cost | $1377.00 | -Salaries | -$1061.45 |
| | | -Supplies | -$315.55 |
| Regional hospital supply cost | $1336.00 | -Cefuroxime | -$3.59 |
| | | -Calcium gluconate | -$12.08 |
| | | -Heparin | -$8.10 |
| | | -Humulin insulin | -$3.10 |
| | | -Epoprostenol sodium (Flolan) | -$16.87 |
| | | -pH12 sterile diluent for Flolan | -$9.41 |
| | | -Sodium bicarbonate | -$29.52 |
| | | -Standard cold flush solution (HTK) | -$206.51 |
| | | -Packed RBCs | -$1045.76 |
| | | -Sodium chloride | -$1.06 |
| OrganOx LTD supply cost | $12 149.90 to $13 511.48 | -Sterile single use disposable set (cassettes) | -$9884.57 to $10 992.28 |

**TABLE 3.** Cost inputs

| Variable | Distribution | Base case | Standard deviation for sensitivity analysis | Reference |
|---|---|---|---|---|
| Strategy #1 – control | | | | |
| Waitlist cost per year | Gamma | 151 790.52 | 150 490.63 | DIMR |
| Year of death on waitlist cost | Gamma | 151 790.52 | 150 490.63 | DIMR |
| Transplant by SCS | Gamma | 93 762.01 | 80 575.93 | Micro-costing |
| Rest of transplant year | Gamma | 37 506.47 | 57 458.43 | DIMR |
| Survive post-transplant cost per year | Gamma | 18 753.24 | 28 730.04 | |
| Death post-transplant | Gamma | 119 144.82 | 3649.20 | Micro-costing |
| Strategy #2 – NMP | | | | |
| Transplant by NMP | Gamma | 118 563.85 | 84 164.05 | Micro-costing |
| Death post-transplant NMP | Gamma | 324 631.18 | 6155.27 | Micro-costing |

Abbreviation: DIMR, Data Integration, Measurement and Reporting.

- The cost of transplantation by NMP was $118 563 and by SCS was $93 762.
- The cost of death post-transplantation after NMP was $324 631 and after SCS was $119 144
- The cumulative cost for 100 hypothetical patients moving through each strategy over 5 years yields a cost of $4 559 174 060 for the NMP strategy and $5 228 333 033 for the control strategy

TABLE 5. Cost-utility analysis base case

| Strategy | Total | | Incremental | | Incremental cost-effectiveness ratio |
|---|---|---|---|---|---|
| | Cost (2021 $US) | QALY | Cost (2021 $US) | QALY | ($/QALY) |
| Strategy #1 – control | 519 222 | 3.17 | 62 767 | −0.32 | −198 577 (dominated)[a] |
| Strategy #2 – NMP | 456 455 | 3.48 | | | |

[a] Dominated ICER results when Strategy #1 – control is both less effective and more costly than Strategy #2 – NMP.

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# Cost-utility analysis of normothermic liver perfusion with the OrganOx *metra* compared to static cold storage in the United Kingdom

Mehdi Javanbakht[a,b], Atefeh Mashayekhi[a,b], Miranda Trevor[c], Michael Branagan-Harris[b], and Jowan Atkinson[b]

# UK STUDY

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- The total costs per patient were £37,370 vs £46,711, and the total effectiveness per patient was 9.09 QALYs vs 10.27 QALYs for SCS and OrganOx *metra* groups, respectively
- The estimated ICER (Incremental cost effectiveness ratio) was £7,876 per each QALY gained
- Results from the PSA (probability sensitivity analysis)showed that use of OrganOx *metra* has 99% probability of being cost-effective at a £20,000 willingness-to-pay threshold

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