Time-Driven Activity-Based Costing in Health Care

Strategy in Health Care Delivery, January 2020

Professor Robert S. (Bob) Kaplan
Outcome measurement EQ-5D (quality of life): Neustadt with significant higher level than the other Schön hospitals
Outcome measurement WOMAC (functionality): Neustadt again with significant better results

WOMAC after 3 months (average)
And Schön Klinik Neustadt spends considerable less resources than Schön Klinik München Harlaching (direct costs\(^{(1)}\))

<table>
<thead>
<tr>
<th></th>
<th>Schön Klinik Neustadt</th>
<th>Schön Klinik München Harlaching</th>
</tr>
</thead>
<tbody>
<tr>
<td>TKR acute</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personnel costs</td>
<td>2.058 $</td>
<td>2.988 $</td>
</tr>
<tr>
<td>Material costs</td>
<td>2.139 $</td>
<td>2.108 $</td>
</tr>
<tr>
<td>Indirect costs</td>
<td>1.246 $</td>
<td>2.758 $</td>
</tr>
<tr>
<td>Sum</td>
<td>5.443 $</td>
<td>7.854 $</td>
</tr>
</tbody>
</table>

\(^{(1)}\) numbers disguised
Total Knee Replacements at Schön Klinik: Outcomes and Cost

1/Personnel Costs (normalized)

WOMAC score (normalized)

EQ-5D score

Neustadt
Munich
## Personnel Time and Cost Variances: Neustadt versus Munich

<table>
<thead>
<tr>
<th></th>
<th>Neustadt</th>
<th>Munich</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personnel Costs</td>
<td>€ 2,058</td>
<td>€ 2,988</td>
<td>€ 930. U</td>
</tr>
<tr>
<td>Personnel Minutes</td>
<td>1,392</td>
<td>2,043</td>
<td>€ 962.5 U</td>
</tr>
<tr>
<td>Average Cost/Minute</td>
<td>€ 1.48</td>
<td>€ 1.46</td>
<td>€ 32.5 F</td>
</tr>
</tbody>
</table>

The 45% cost difference (unfavorable cost variance of €930) is caused by the unfavorable personnel productivity variance at Munich.
We can view the variance analysis graphically.
Comparing the Personnel Costs for CABG

- NH Personnel Cost: $7.4
- NH pays its personnel at IMC compensation levels: $68.6
- NH personnel work same hours as IMC personnel: $29
- NH uses same skill mix as IMC: $22
- NH personnel have same productivity as IMC: $87

IMC Personnel Cost: $109
Benefits from Variance Analysis

1. **Price**: Difference in $/min for each Personnel Type

2. **Quantity**: Difference in Number of Minutes (activity duration and LOS)

3. **Mix**: Difference due to task downshifting or upshifting
Measuring Costs: We must overcome several health care costing problems.

# 1: Confusion of Costs with Prices (Charges)
- Currently, provider expenses are allocated to patient care based on charges or “relative value units”—neither of which is a good surrogate for the actual costs incurred.
- Costs are not assigned to unbilled or unreimbursed processes and procedures.

# 2: Wrong Unit of Analysis for Measuring Costs
- Currently, costs are measured for organizational units, clinicians, or individual procedures and events, not for the full cycle of care to treat a patient’s medical condition.

# 3: Economists, administrators, and policy makers believe many health care costs are “fixed”
- We wish! If health care costs were fixed, we wouldn’t have a health care cost crisis.
Time-Driven Activity-Based Costing (TDABC)

1. Determine the Care Process
   - What activities are performed over the care cycle for a medical condition?
   - Who performs each activity?
   - How long does each activity take?

2. Calculate Cost Rates
   - What is the cost per unit of time for each type of personnel?

3. Account for Consumables
   - What materials, supplies, and drugs are consumed during the care cycle?

4. Allocate Indirect Costs
   - What are the drivers that determine the workload for each indirect department/area?
TDABC Step 1: Develop process maps for the care cycle

**Level 1: Overall care cycle**

- Patient problem → MD encounter → Possible need for procedure
- Assess appropriateness → Shared decision making → Pre-procedure testing → Tier 1,2 outcome measures
- Assess risk → Procedure
- Schedule OR → Tier 3 outcome measures
- Recovery

**Level 2: Study care cycle**

- Map 1: Surgical consultation
- Map 2: Pre-operative testing
- Map 3: Day of surgery pre-operative prep
- Map 4: Operation
- Map 5: Post-anesthesia care unit
- Map 6: Discharge
- Map 7: Rehabilitation
- Map 8: Follow-up visit

**Level 3: Process maps**

Map 2
A Process Map for a Pre-Surgical Office Visit

- **Process-Steps**: All the administrative and clinical process-steps used over a patient’s complete cycle of care for a medical condition

- **Resources**: Personnel, equipment, consumable medicines and supplies – used at each process step

- **Time Estimates**: The personnel and equipment time used at each process step for that patient
Developing a Process Map

Range of Approaches

- **Surveys**
  - Polling large groups
  - Independent results

- **1-on-1 meetings**
  - Easier scheduling
  - Especially useful for physicians

- **Group meetings**
  - Project team & content experts
  - Engagement in process

- **Shadowing**
  - Often quickest approach
  - Patient & non-patient processes must be covered
  - Less bias
  - Manual time stamping
  - Existing electronic time data
  - Electronic shadowing with RFID

- **RFID Tags**
  - EPIC timestamps
Communicating about TDABC to clinicians

• The goal of the project is to better understand all of the personnel time and resources that we use today to care for a patient with a particular medical condition

• You will not be evaluated at all based on the answers that you provide (may need to say this 7 times 7 different ways)

• We are simply looking for your estimates and best guesses—it is ok if you do not know a number exactly

• While we are primarily trying to gain a better understanding of all of the work and resources that are currently involved in the care cycle, we would love to hear your ideas and suggestions for how we could be providing care more efficiently and effectively
TDABC Step 2: Calculate the Capacity Cost Rate for each type of personnel and resource

• Costs: All the costs (salary, fringe benefits, occupancy, support resources) associated with having that person (or piece of equipment) available to treat patients

• Capacity: The capacity (time) that each resource (personnel, equipment) has available for treating and caring for patients
  o Number of days person shows up, available for clinical work
    ...multiplied by...
  o Number of minutes available per day for patient-related work (net of breaks, meetings, training, education, etc.)

• Capacity Cost Rate ($/minute) = Resource Cost/ Resource Capacity
## Calculate the Capacity Cost Rates (CCR)

*Data are illustrative*

<table>
<thead>
<tr>
<th></th>
<th>Surgeon</th>
<th>Physician Assistant</th>
<th>RN</th>
<th>X-Ray Tech</th>
<th>Scribe</th>
<th>Office Assistant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Clinical Costs</td>
<td>$546,400</td>
<td>$120,000</td>
<td>$100,000</td>
<td>$64,000</td>
<td>$51,000</td>
<td>$61,000</td>
</tr>
<tr>
<td>Personnel Capacity (minutes)</td>
<td>91,086</td>
<td>89,086</td>
<td>89,086</td>
<td>89,086</td>
<td>89,086</td>
<td>89,086</td>
</tr>
<tr>
<td>Personnel Capacity Cost Rate</td>
<td>$6.00</td>
<td>$1.35</td>
<td>$1.12</td>
<td>$0.72</td>
<td>$0.57</td>
<td>$0.68</td>
</tr>
</tbody>
</table>
Compute total patient care costs by multiplying resource capacity cost rate by process times & summing across each patient’s cycle of care

<table>
<thead>
<tr>
<th>Initial consultation</th>
<th>Minutes</th>
<th>Cost/minute</th>
<th>*Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>MD (X_1) (Y_1)</td>
<td>136.13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RN (X_2) (Y_2)</td>
<td>68.04</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CA (X_3) (Y_3)</td>
<td>6.17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASR (X_4) (Y_4)</td>
<td>15.74</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td>$266.08</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Surgical procedure</th>
<th>Minutes</th>
<th>Cost/minute</th>
<th>*Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>MD (X_1) (Y_1)</td>
<td>584.99</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anes. (X_2) (Y_2)</td>
<td>603.89</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RN (X_3) (Y_3)</td>
<td>136.29</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tech (X_4) (Y_4)</td>
<td>97.82</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OR (X_5) (Y_5)</td>
<td>329.16</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td>$1752.15</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Follow-up or post-operative visit</th>
<th>Minutes</th>
<th>Cost/minute</th>
<th>*Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>MD (X_1) (Y_1)</td>
<td>55.19</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RN (X_2) (Y_2)</td>
<td>13.61</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CA (X_3) (Y_3)</td>
<td>3.09</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASR (X_4) (Y_4)</td>
<td>1.77</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td>$73.66</td>
</tr>
</tbody>
</table>

Source: Meg Abbott, MD & John Meara, MD Boston Children’s Hospital
## Advancing the TDABC toolkit

<table>
<thead>
<tr>
<th>TDABC 1.0</th>
<th>TDABC 2.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Estimates and observations</td>
<td>• Time stamp data</td>
</tr>
<tr>
<td>• Conducting measurement at one point in time</td>
<td>• Analysis refreshed monthly with new data</td>
</tr>
<tr>
<td>• Examining average patient</td>
<td>• Examining patient and physician level variation</td>
</tr>
<tr>
<td>• Developing process maps from scratch</td>
<td>• Utilizing process map templates in software</td>
</tr>
</tbody>
</table>
How does TDABC help providers manage their costs

- **Eliminate** process steps and variations that **do not** contribute to improved patient outcomes
- **Redesign** processes to **reduce waste and idle time**
- **Optimize** processes and interventions over a **complete cycle of care**
- All clinicians work at the “top-of-their license”

- Understand costs over the full care cycle to prepare for **bundled payment** contracts
TDABC projects supported by HBS team

Australia

The Alfred
Heart Failure Project (Adelaide)
- Provider (GenesisCare)
- Hospital (St. Andrews)
- Payer (BUPA)

Suppliers
- Medtronic
- Novartis
- Siemens

Diabetes Type I
- Heart Failure
- Chest Pain Management /Angina

Haiti

Partners In Health

Europe

Hôpitaux Universitaires La Pitié salpêtrière - Charles Foix
- GIG NHS Wales
- Erasmus MC
- Diabeter
- National diabetes centre
Indexed TKA Total Personnel and Consumable Costs at U.S. Organizations

N = 27; scope of care is decision for surgery through discharge plus follow-up visits within 90 days
The financial opportunity from using best practices to move to the next bracket.

### Total Personnel and Consumable Costs

**Percentage Savings**

<table>
<thead>
<tr>
<th>Improvement</th>
<th>TKA</th>
<th>THA</th>
</tr>
</thead>
<tbody>
<tr>
<td>90th to 75th</td>
<td>15%</td>
<td>14%</td>
</tr>
<tr>
<td>75th to 50th</td>
<td>8%</td>
<td>16%</td>
</tr>
<tr>
<td>50th to 25th</td>
<td>13%</td>
<td>13%</td>
</tr>
<tr>
<td>25th to 10th</td>
<td>12%</td>
<td>12%</td>
</tr>
</tbody>
</table>

Moving to next bracket produces an annual savings of > $1 million for an organization performing 800 TJRs.
Examples of Current and Recent Projects

- Opioid Use Disorders at MGH Bridge Clinic, and Century Health in Hancock County, Ohio for integrated care, using MAT and behavioral and social services interventions.

- Veterans Administration Tennessee region; Behavioral Health Interdisciplinary Program (BHIP). Goal to reduce suicide-related patient events by 28% with simultaneous reduction in costs by up to 16%.

- Comparing ECMO outcomes and costs at three centers, Cedars-Sinai (Los Angeles), Paris, and Melbourne.

- Cost of an IPU for Pediatric Aerodigestive Disorders (co-locate ENT, G/I, Pulmonologist and Speech and Swallow).

- Suppliers (Medtronic, Siemens Healthineers) to estimate improvements in patient outcomes and costs from use of their products/services.
Two of our students studied the cost of TB Care in Zimbabwe

“We worked with The Global Fund to Fight AIDS, Tuberculosis, and Malaria (the Global Fund) and Ministry of Health and Child Care in Zimbabwe to pilot the concept of TDABC to estimate time and costs associated with diagnosis and treatment for TB patients and assess the applicability of this approach to low-resource settings.”

Bodnar, Katharine
MBA/MPA 2019

Desai, Pratna
MBA/MPA 2019
Process map for diagnosis of potential TB patient

1. **Step 1** Waiting room
   - Registration

2. **Step 2** Waiting room
   - Vital signs observations (BP; HT; WT; Temp)

3. **Step 3** Consultation room
   - Consultation
   - HIV testing (X%)
   - DM testing (X%)
   - TB screening (X%)

4. **Step 4** Lab
   - Sputum processing
   - Receiving and recording specimens on/off-site lab

5. **Step 5** Lab
   - Sputum collection

6. **Step 6** Lab
   - Consultation 2
   - Yes (X%)

7. **Step 7** Consultation
   - X-ray
   - “Did we get the sputum?”
   - No (X%)

8. **Step 8** Consultation
   - Consultation 3
   - Review of results & X-ray

9. **Step 9** Consultation room
   - Clinical TB diagnosis?
   - Yes (X%)
   - Initiation

10. **Step 10** Consultation room
    - Recording & Reporting

11. **Step 11** Consultation room
    - Patient collects medicine

12. **Step 12** Pharmacy

**KEY**
- Clerk
- Nurse
- Pharmacy personnel
- Lab personnel

**HARVARD BUSINESS SCHOOL**

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Applying TDABC to the Billing Process

Simplified Billing Process Map - Illustration
Most hospital billing processes involve four categories of tasks – eligibility, coding, submission, and rework.

- Patient checks in
- Eligibility (verification of coverage and benefits)
- Coding (description of services provided)
- Submission (claim development and submission to payer or patient)
- Rework (Investigating errors and rejections)
- Payment received

Questions or errors raised?

Yes

No
### Estimated Billing and Insurance-Related Administrative Costs

<table>
<thead>
<tr>
<th>Encounter</th>
<th>Pre- and Intra-Encounter Costs, $</th>
<th>Post-Encounter Costs, $</th>
<th>Process Time, min</th>
<th>Overhead, $</th>
<th>Total Cost, $</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Registration</td>
<td>Professional Billing</td>
<td>Hospital Billing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary care visit</td>
<td>3.82</td>
<td>6.26</td>
<td>4.22</td>
<td>13</td>
<td>6.10</td>
</tr>
<tr>
<td>Emergency department visit</td>
<td>5.58</td>
<td>10.97</td>
<td>11.72</td>
<td>32</td>
<td>19.57</td>
</tr>
<tr>
<td>Ambulatory surgery</td>
<td>16.48</td>
<td>51.20</td>
<td>45.55</td>
<td>75</td>
<td>39.72</td>
</tr>
<tr>
<td>Inpatient surgery</td>
<td>16.48</td>
<td>51.20</td>
<td>45.55</td>
<td>100</td>
<td>57.43</td>
</tr>
<tr>
<td>General inpatient stay</td>
<td>16.48</td>
<td>13.29&lt;sup&gt;b&lt;/sup&gt;</td>
<td>4.22&lt;sup&gt;b&lt;/sup&gt;</td>
<td>73</td>
<td>45.84</td>
</tr>
</tbody>
</table>


Currently, we are extending this billing cost study to hospitals in Australia, Singapore, Germany, Ireland, UK, Netherlands, and Canada.
T.H.R.I.V.E.

*Transforming Healthcare Results by Investing in Value & Excellence*

A collaborative to promote solutions for value-based healthcare
Project Overview

Implement comparable outcome and cost measurement sets in select conditions at leading providers throughout the U.S. and create risk adjusted benchmarks to generate systems improvement and reward high value providers.

**Conditions**
- 3 Surgical Conditions
  - Colon Cancer
  - Breast Cancer
  - Morbid Obesity
- Full cycle of care (including key surgical, medical, behavioral and social elements of care)

**Sites**
- 10-15 Sites per condition
- Leading Centers of Excellence across the U.S.

**Measurement**
- Measure outcomes and cost at the condition level
- Create playbook for implementation
- Develop scalable approach for risk adjusted benchmarking and systems improvement
- Inform value-based payments
## Elements of the ideal partner organization

<table>
<thead>
<tr>
<th>Strong Leadership Support</th>
<th>Exceptional Project Team</th>
<th>Alignment of Goals</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Senior leadership is committed to improving the value of care that it delivers and to pursuing value-based payment mechanisms</td>
<td>• Project leader, respected by both Finance and clinicians; strong project management skills are essential; basic familiarity with medical condition</td>
<td>Partner organization</td>
</tr>
<tr>
<td>• Finance organization recognizes the potential benefits from adopting TDABC for measuring costs over a complete care cycle</td>
<td>• Financial analyst who has ability to access necessary data</td>
<td>• willing to act on TDABC information to reduce costs, improve outcomes, redesign processes, and introduce value-based (bundled) payments.</td>
</tr>
<tr>
<td>• Clinical leader excited to understand cost drivers and explore performance improvement opportunities</td>
<td>• Clinical operations/ performance improvement person familiar with the medical condition</td>
<td>• excited to collaborate with HBS to achieve its clinical and management objectives</td>
</tr>
<tr>
<td></td>
<td>• Physician adviser</td>
<td>• interested in collaborating with HBS to produce publications and cases</td>
</tr>
</tbody>
</table>
Publications with HBS team on applying TDABC in Practice: 2014-present

"How Cleveland Clinic Used TDABC to Improve Value" HFM (June 2014)


"Time-driven activity-based costing: a driver for provider engagement in costing activities and redesign initiatives" *Neurosurgical Focus* (Nov 2014).


"Time-driven activity-based costing of multi-vessel coronary artery bypass grafting across national boundaries to identify improvement opportunities:" *BMJ Open*. 2015

"Defining the Value Framework for Prostate Brachytherapy using Patient-Centered Outcome Metrics and Time-Driven Activity-Based Costing" Brachytherapy 2016


"Variation in the cost of care for primary total knee arthroplasties,” Arthroplasty Today (2016), http://dx.doi.org/10.1016/j.artd.2016.08.001

"Time-Driven Activity-Based Costing of a Post-acute Care Transitions Program in a Primary Care Practice,” *HFM Magazine* (July 2016).


"Time-Driven Activity-Based Costing to Estimate Cost of Care at Multidisciplinary Aerodigestive Centers,” *The Laryngoscope* (21 June 2017)


"Hospital Budget Systems are Holding Back Innovation," HBR Insight Center (March 29, 2018).

"Administrative Costs Associated with Physician Billing and Insurance-Related Activities at an Academic Health Care System,” *JAMA* (February 20, 2018).


"Hospital Budget Systems are Holding Back Innovation," *HBR Insight Center* (March 29, 2018)

"Navy Medicine Introduces Value-Based Health Care,” *Health Affairs* (August 2019) 38:8


"Using Time-Driven Activity-Based Costing to Demonstrate Value in Perioperative Care: Recommendations from the Society for Perioperative Assessment and Quality Improvement,” *Journal of Medical Systems* (December 2019).
Initial project timeline

• 1-2 months to prepare for project
  - Set objectives, scope, and timeline; ensure relevant parties bought in
  - Staff project team

• 3-4 months to execute on project
  - Aim for about 1 week per process that is being mapped
  - Schedule midpoint and final meetings in advance
### Charter Template for a TDABC Project

<table>
<thead>
<tr>
<th><strong>Project Name:</strong></th>
<th>(please use italics for responses)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>What is the overview of the project?</td>
</tr>
<tr>
<td><strong>Medical Condition</strong></td>
<td>Unit of analysis is a medical condition (or an indirect department)</td>
</tr>
<tr>
<td><strong>Problem Statement</strong></td>
<td>What is the opportunity?</td>
</tr>
<tr>
<td><strong>Outcomes</strong></td>
<td>How will outcomes be maintained or improved as we change the process?</td>
</tr>
<tr>
<td><strong>Reference Point</strong></td>
<td>Comparing multiple sites or different treatment pathways helps create case for change.</td>
</tr>
<tr>
<td><strong>Care Cycle Scope</strong></td>
<td>Which treatments, and how much of the care cycle for each is within scope?</td>
</tr>
<tr>
<td><strong>Scope of Types of Costs</strong></td>
<td>Which types of costs are in scope? Personnel costs are typically larger than consumables costs, which are typically larger than facility costs.</td>
</tr>
<tr>
<td><strong>Level of Detail</strong></td>
<td>The level of detail depends on the problem you are solving. The primary choice is between the process (higher) level of detail and activity (lower) level of detail.</td>
</tr>
<tr>
<td><strong>Implementation</strong></td>
<td>What are the actionable steps? How will it be implemented? Form project team in XX/XXXX; conduct data collection and analysis XXXX-XXXX. Implement TDABC approach in XXXX</td>
</tr>
<tr>
<td><strong>Publication</strong></td>
<td>What is being published? Where is it being presented?</td>
</tr>
</tbody>
</table>

### Project Leadership and Team

<table>
<thead>
<tr>
<th><strong>Executive Sponsor</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Steering Committee</strong></td>
</tr>
<tr>
<td><strong>Project Manager/Leader</strong></td>
</tr>
<tr>
<td><strong>Physician Lead</strong></td>
</tr>
<tr>
<td><strong>Finance Analyst</strong></td>
</tr>
<tr>
<td><strong>Process Mapper/Process Engineer/Value Engineer</strong></td>
</tr>
<tr>
<td><strong>Additional Team Members</strong></td>
</tr>
</tbody>
</table>
Questions

Dr. Mahek Shah          mashah@hbs.edu
Dr. Syed Shehab         sshehab@hbs.edu