Workshop on Methods of Evaluating Cost Effectiveness in Team Based Integrated Healthcare Settings

Jennifer Rolfes

Building the Team in Team-based Integrated Health Care
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LEARNING OBJECTIVES

At the conclusion of this session, the participant will be able to:

Learning Objective 1: Participants will learn about the statistical methodology* used to estimate mean healthcare costs, time to disease recurrence and cost effectiveness in an integrated healthcare setting with competing treatment protocols.

Learning Objective 2: Participants will learn how to use the hcost command in Stata and the available customization options.

Learning Objective 3: Participants will learn how to develop a business case for behavioral health interventions that include cost savings components

***The methodology presented is based on work done by Dr. Hongwei Zhao and Dr. Lily Tian. The implementation of the estimators in Stata was started when Jenn Rolfes studied with Dr. Zhao and completed by Dr. Shuai Chen while she studied with Dr. Zhao**

What is cost effectiveness and why does it matter?

- **As a clinician, you likely have some great ideas that you want to study**
- **You need to convince the leadership that your idea is financially feasible**
  - You develop a business case based on previous research and build in **reasonable** assumptions related to your study to show improved patient outcomes **and** cost savings (positive ROI)
  - You're proposal is accepted!
- **What do you do now?**
  - Make sure that your research questions and study design are appropriately structured
  - Talk to a statistician to help you:
    - **Develop the hypotheses that you want to test**
    - **Determine what data you need to collect to test the hypotheses**
  - Proceed with your study
  - Have a statistician use the appropriate software, and interpret the output, to determine if your study improved patient outcomes **and/or** provided for cost savings

Case study

- **Setting**
  - Primary Care Clinics
- **Population**
  - Patients with chronic pain diagnoses and depression
- **Inclusion Criteria**
  - Chronic pain must be present for more than six months
  - Dual diagnosis of depression
  - Opioid naïve patients and those with long term opioid use (> 90 days) will be studied separately
- **Instrument used to measure depressive symptoms**
  - Patient Health Questionnaire – 9 (PHQ-9).
  - You may also be interested in anxiety or quality of life measurements in which case, you might consider
    - Generalized Anxiety Disorder – 7 (GAD-7)
    - Health Related Quality of Life Index (HRQOL)

Research Questions

Research questions need to be well defined so that hypothesis tests can be developed from them

1. Will patients who suffer from chronic pain with long term opioid use and depression, who are given alternative treatments such as physical therapy, nutrition, and cognitive behavioral therapy, have lower total health care costs and better outcomes than those who did not receive alternative therapies?
2. Will opioid naïve patients with chronic pain, who are given alternative treatments such as physical therapy, nutrition, and cognitive behavioral therapy, have lower total health care costs and better outcomes than those who did not receive alternative therapies?

Interventions to be tested

While we are interested in patient improvements, interventions should also include cost saving components

1. Patients with chronic pain and depression, resulting in long term opiate use (> 90 days), will be given alternative treatments i.e., physical therapy, nutrition, cognitive behavioral therapy. The intervention will lead to fewer symptoms of co-occurring chronic pain, anxiety and depression, **lowering the total cost of treatment.**

2. Opioid naïve patients with chronic pain and depression will be given access to alternative treatments i.e., physical therapy, nutrition, cognitive behavioral therapy as a first line treatment, **reducing future costs of chronic pain treatment, reducing depressive symptoms and avoiding the tremendous costs of opioid addiction**.

* Opioid naïve patients are separated from those with long term opioid use (> 90 days) to control for the impact that long term use has on patients

Research Design

Assignment of patients to treatment/control

Patients will be randomly assigned to a treatment or control group with the control group receiving the current treatment protocol and the treatment group receiving the intervention. The intervention for both of the treatment groups will consist of cognitive behavioral therapy, physical therapy, nutrition education and stress reduction techniques.

Research Design

This will be a prospective treatment/control experimental design. Data collected will include day of depressive symptom recurrence (if applicable), demographic information (gender, age, etc.), existence of other chronic disease, total cost of care, and two indicator variables that will track whether the patient is opioid naïve and if they are in the intervention group. These will be 0/1 indicator variables.

Formal Hypotheses to be tested for opioid naïve patients

Statement of hypothesis and test development

Patients with chronic pain, who are also opioid naïve and given alternative treatments, will have lower total health care costs than those who suffer from chronic pain and are treated with only opioids. This will be measured by collecting all insurance claims to capture costs across disparate systems. Other data collected will include demographics such as gender, age, and any chronic medical conditions to ensure that confounding variables can be controlled for. The dependent variable will be total costs and the independent variables will be demographics, presence of other chronic conditions, and whether they received the intervention.

$$\boldsymbol{Test}\colon \boldsymbol{H_0}\colon \boldsymbol{\mu_2 - \mu_1 = 0\ vs.\ H_1^*}\colon \boldsymbol{\mu_2 - \mu_1 \neq 0}$$

Where μ_1 is the average total cost for the control group and μ_2 is the average total cost for the treatment (intervention) group

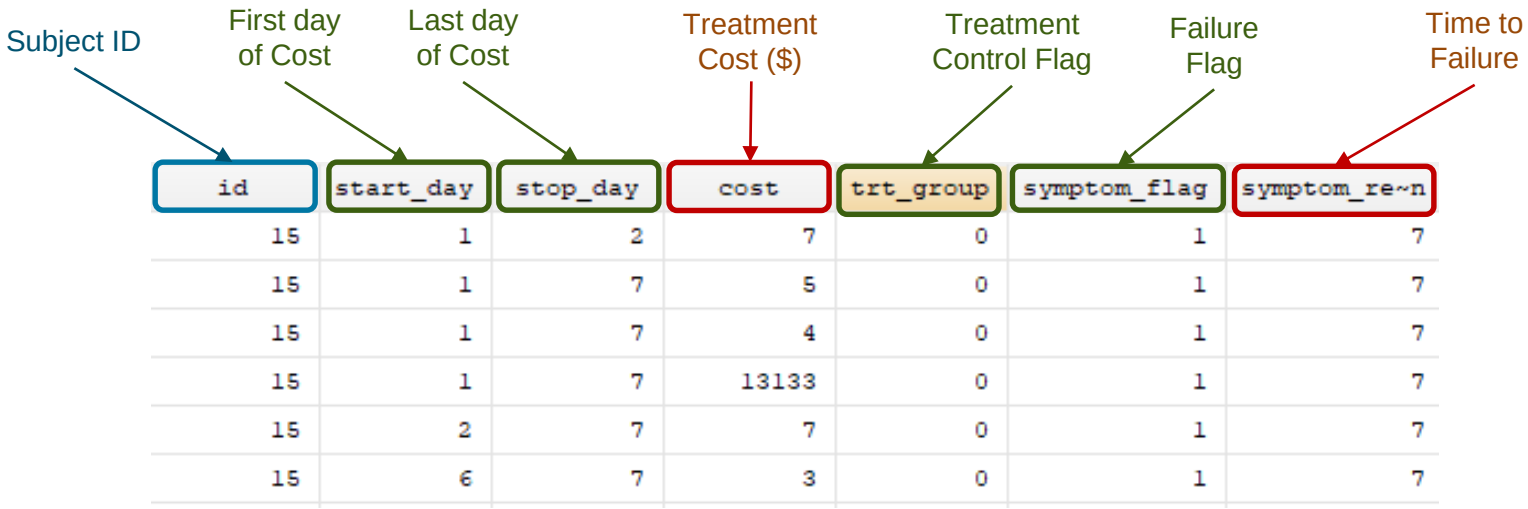
* Note that we could just test the alternative that $\mu_2 < \mu_1$, since we hope that the costs are lower, but it is equally as important to know if the costs were significantly higher.

Background on statistical methodology used in case study

- One challenge in prospective studies is that patients are often lost to follow up (censored)
- Censoring occurs when patients no longer participate in a study, and their information, is therefore incomplete
- The Zhao-Tian estimator (ZT estimator) is consistent and asymptotically normally distributed, allowing for a more efficient estimation of the mean cost, when censored observations are present (Chen, Rolfes, & Zhao, 2015).
- The example we've developed uses a simulated data set that illustrates the ZT estimator for mean costs, mean time to the recurrence of depressive symptoms and the incremental cost effectiveness ratio (ICER)
- The ZT estimator has been implemented in Stata be way of the **hcost** command
  - hcost is a user-written command that is available for installation from within Stata (instructions provided on slide 16)

Data Structure and Using Stata

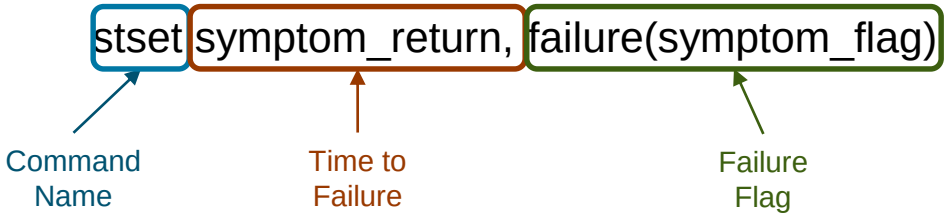
- The command **hcost** was developed in Stata to calculate the ZT estimator for mean costs, the mean time to the event of interest (death, disease recurrence etc.) and ICER for competing treatments
- Discounting of both costs and survival are available as options
- Multiple records per subject can be used with costs and the time horizon for each record



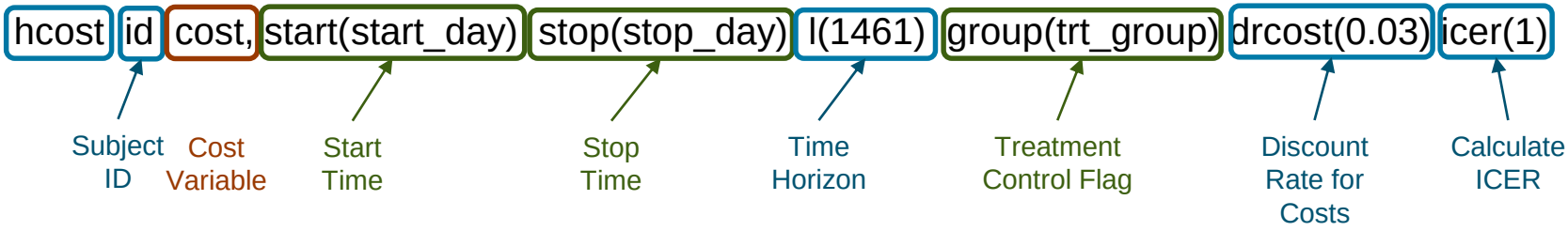
id	start_day	stop_day	cost	trt_group	symptom_flag	symptom_re~n
15	1	2	7	0	1	7
15	1	7	5	0	1	7
15	1	7	4	0	1	7
15	1	7	13133	0	1	7
15	2	7	7	0	1	7
15	6	7	3	0	1	7

Command Structure and Using Stata

Data must be declared as survival data to take advantage of built-in functionality



The command structure for hcost is as follows



*Note that all times are in days in this example

Interpreting the output

- Estimation of the treatment and control group costs and time to recurrence of depressive symptoms for long term opioid use patients

Estimates for Group 1 (Control)

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
cost	26562.90	1008.129	26.34	0.000	24586.97	28538.83
Time to recur	314.6011	12.08866	26.02	0.000	290.9078	338.2944

Estimates for Group 2 (Treatment)

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
cost	23764.55	1106.112	21.48	0.000	21596.57	29532.53
Time to recur	359.2859	3.23573	111.04	0.000	352.944	365.6278

Interpreting the output

- The difference between the treatment and control groups is of primary interest

```
Estimates for Difference Between Groups (Treatment - Control)
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        cost |   -2798.35   1159.323    -2.41   0.008     -5250.62     -706.08
Time to recur|   44.68482   12.51422     3.57   0.000      20.1574     69.21223
------------------------------------------------------------------------------
```

- The p-value for both cost and time to recurrence are significant meaning that there is a statistically significant difference between treatment and control for both outcomes
- The average cost savings for the treatment group is $2,798 with an increased time to recurrence of ~45 days
- The incremental cost effectiveness ratio is not necessary in this scenario, since there is a cost savings and time to recurrence improvement, but it can be calculated.
- The incremental cost effectiveness ratio is simply $\frac{-2798.35}{44.68482} = -\$62.62$*

*The hcost command will also provide a confidence interval for ICER if the option is specified

What if I am not a statistician or don't have Stata

- Seek out a statistician who is able to help with the analysis
  - Chances are they would be happy too
  - We LOVE this stuff!
- Talk to your colleagues if you don't know a statistician
- Write the software company who's product you are using
  - They have entire teams of statisticians that will help
- If it is a user-written command in Stata write the command's author
  - The author's name and contact information is in the help file for the command
- Again, we LOVE this stuff!

Demonstrating Value in our case study

- How else can we demonstrate to leaders that there is value in our program?
  - Consider future costs of opioid addiction that may be avoided. The average annual cost associated with opioid use and abuse ranges from $16,000 to $18,000, with a comparison group of non-abusers having an average cost of $1,800 to $2,000 (Strassels, 2009).
  - What is the population health benefit related to fewer long-term opioid users? These benefits tie in with the triple aim which suggests that healthcare systems should strive to improve patient quality and satisfaction, improve the health of populations and reduce the cost of care per capita (Robinson, P.J. and Reiter, J.T., 2016).
  - What is the ROI of the program? This is a simple calculation that is widely understood. It doesn't include avoided costs, so be sure that you present all of the evidence in your case.
  - What is the quality of life improvement of the patients who have had an improvement in their chronic pain and/or depressive symptoms? How does that translate to their ability to work, support their family, lead a productive life?
  - Can other behavioral health delivery mechanisms cut down on costs? Is there an opportunity for group therapy or telemedicine?

How do I install hcost in Stata

1. In the command box, type search hcost

```
Command
search hcost
```

2. Click on the package st0399

```
Web resources from Stata and other users

(contacting http://www.stata.com)

1 package found (Stata Journal and STB listed first)
-------------------------------------------------

st0399 from http://www.stata-journal.com/software/sj15-3
    SJ15-3 st0399. Estimation of mean health... / Estimation of mean health
    care costs within a / time horizon with possibly censored data / by Shuai
    Chen, Department of Statistics, Texas / A&M University, College Station,
    TX / Jennifer Rolfes, T-Mobile, Seattle, WA / Hongwei Zhao, Department of
```

3. install the package and the ancillary files if you want to recreate the examples

```
INSTALLATION FILES                                  (click here to install)
      st0399/hcost.ado
      st0399/hcost.sthlp
      st0399/lhcost.mlib

ANCILLARY FILES                                     (click here to get)
      st0399/example.dta
      st0399/combinedata.do
      st0399/testexample.do
```

Future enhancements to hcost

- The hcost command does not currently allow for covariates.
  - This is something that is actively being pursued by the authors of the command
- Quality of life adjusted survival is currently of great interest in medical studies.
  - The implementation of QOL adjusted survival times is also on the development list for updates to the command

Questions?

References

Chen, S., Rolfes, J., & Zhao, H. (2015). Estimation of mean health care costs and incremental cost-effectiveness ratios with possibly censored data. *Stata Journal*.

Robinson, P. J., & Reiter, J. T. (2016). *Behavioral consultation and primary care: A guide to integrating services*. 2nd Edition. New York, NY: Springer.

Strassels, S. A. (2009). Economic burden of prescription opioid misuse and abuse. *Journal of Managed Care Pharmacy, 15*(7), 556.

Center for Disease Control and Prevention. (2016). Health-Related Quality of Life (HRQOL). Retrieved from https://www.cdc.gov/hrqol/methods.htm

Kroenke, K., Spitzer, R. L., & Williams, J. B. W. (2001). The PHQ-9: Validity of a Brief Depression Severity Measure. Journal of General Internal Medicine, 16(9), 606–613. http://doi.org/10.1046/j.1525-1497.2001.016009606.x

Spitzer RL, Kroenke K, Williams JBW, Lowe B. A brief measure for assessing generalized anxiety disorder. Arch Inern Med. 2006;166:1092-10