Association of Tracheostomy with Changes in Sedation During COVID-19: A Quality Improvement Evaluation at University of Michigan

Supplemental Appendix: Analytical Code

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```stata
1    /* Code to analyze the association of Perc Trachs with sedation of
     patients
2       with COVID-19
3
4       Trachs by Pepe Cardenas + ENT Colleagues
5       ICU care supervised by Jake McSparron, Ross Blank, and Dru Claar
6       Data abstracted by Leigh Cagino, Michael Kenes, and Jacqueline
     Kercheval
7       Analytic code by Jack Iwashyna
8
9       Cleaning runs
10      v01 30 April 2020
11      v02 1 May 2020
12      v03 4 May 2020
13
14      Cleaning and Analysis
15        * already reconciled data
16      v01 26 May 2020
17      v02 8 June 2020
18
19   */
20
21   set more off
22   clear
23
24   /* net install cleanplots,
     from("https://tdmize.github.io/data/cleanplots") */
25   /* think about finding uncluttered
     https://github.com/graykimbrough/uncluttered-stata-graphs
26   and colorblind */
27   /* ssc install catplot */
28   /* ssc install splitvallabels */
29
30   set scheme cleanplots
31
32   import delimited "/Users/tiwashyn/Documents/Documents - MacBook
     Air 2019 the replacement/COVID19/Perc Trachs and
     Sedation/data/Perc trach data FINAL.csv"
33
34   /* other errors corrected below */
35   /*
36   versed doses present twice when versed_admin ==1 */
37
38   drop if missing(record_id)
39
40   /* Correct known errors */
41   replace fentanyl_dose_bt5=3752.5 if record_id==13
42   replace fentanyl_dose_at5=1 if record_id==3
```

```
49    gen date_trach = date(pt_trach_date, "MDY", 2020)

50

51    gen days_admit_to_trach = date_trach - date_admit
52    gen days_tube_to_trach = date_trach - date_intubate
53    gen male = (pt_sex=="M") if !missing(pt_sex)

54

55    sum pt_age days_admit_to_trach days_tube_to_trach male
      sedative_indicated

56

57    drop if sedative_indicated
58    sum pt_age days_admit_to_trach days_tube_to_trach male
      sedative_indicated

59

60

61

62    drop rass_time*
63    drop camicu_time*
64    drop after*
65    drop before*
66    drop indication*

67

68    rename *bt5 *_1
69    rename *bt5___1 *_1_1
70    rename *bt4 *_2
71    rename *bt4___1 *_1_2
72    rename *bt3 *_3
73    rename *bt3___1 *_1_3
74    rename *bt2 *_4
75    rename *bt2___1 *_1_4
76    rename *bt1 *_5
77    rename *bt1___1 *_1_5

78

79    rename *t0 *_6
80    rename *t0___1 *_1_6

81

82    rename *at1 *_7
83    rename *at1___1 *_1_7
84    rename *at2 *_8
85    rename *at2___1 *_1_8
86    rename *at3 *_9
87    rename *at3___1 *_1_9
88    rename *at4 *_10
89    rename *at4___1 *_1_10
90    rename *at5 *_11
91    rename *at5___1 *_1_11

92

93    forvalues dd=1/11{
94        forvalues xx=1/5 {
```

```
100             quietly: rename camicu_score`xx'__`dd'_temp
     camicu_score`xx'__`dd'
101             /* di "changed it" */
102             }
103         }
104     }
105
106 forvalues dd=1/11{
107     forvalues xx=1/5 {
108         gen cam`xx'__`dd'=ustrtrim(camicu_score`xx'__`dd')
109         replace cam`xx'__`dd'="POS" if cam`xx'__`dd'=="pos"
110         drop camicu_score`xx'__`dd'
111         }
112     }
113
114 foreach dd in 1 2 3 4 5 6 8 9 10 11{
115     gen rass_score21__`dd'=.
116     gen rass_score22__`dd'=.
117     gen rass_score23__`dd'=.
118     }
119
120 reshape long fentanyl_dose__ fentanyl_admin__1_ ///
121     prop_dose__ prop_admin__1_ versed_dose__ versed_admin__1_ ///
122     prec_dose__ prec_admin__1_ ketamine_dose__ ketamine_admin__1_
     ///
123     pheno_dose__ pheno_admin__1_ oxy_dose__ oxy_admin__1_ ///
124     oralmorph_dose__ oralmorph_admin__1_ ivmorph_dose__
     ivmorph_admin__1_ ///
125     dilaudid_dose__ dilaudid_admin__1_ ivdilaudid_dose__
     ivdilaudid_admin__1_ ///
126     ativan_dose__ ativan_admin__1_ ivativan_dose__
     ivativan_admin__1_ ///
127     diazepam_dose__ diazepam_admin__1_ ivdiazepam_dose__
     ivdiazepam_admin__1_ ///
128     xanax_dose__ xanax_admin__1_ ivxanax_dose__ ivxanax_admin__1_
     ///
129     ivhaldol_dose__ ivhaldol_admin__1_ oralhaldol_dose__
     oralhaldol_admin__1_ ///
130     seroquel_dose__ seroquel_admin__1_ ivseroquel_dose__
     ivseroquel_admin__1_ ///
131     remeron_dose__ remeron_admin__1_ zyprexa_dose__
     zyprexa_admin__1_ ///
132     ivzyprexa_dose__ ivzyprexa_admin__1_ ///
133     neuromusc_blockade__ pressors__ sat__ sbt__ mask_trial__ ///
134     physical_therapy__ vent__ pressure_support__
     sevenday_survival__ ///
135     rass_score1__ rass_score2__ rass_score3__ rass_score4__
     rass_score5__ ///
```

```
141
142   gen daycentered = day-6
143   label var daycentered "Days to/from Trach"
144
145   egen rass_mean = rowmean(rass_score*__)
146   egen rass_min = rowmin(rass_score*__)
147   egen rass_max = rowmax(rass_score*__)
148   gen rass_var=rass_max-rass_min
149
150   gen nocoma_min=(rass_min>=-2)
151   gen nocoma_max=(rass_max>=-2)
152   gen nocoma_min4=(rass_min>-4)
153   gen nocoma_max4=(rass_max>-4)
154   gen notdelirious_ever = (cam1__=="NEG") | (cam2__=="NEG") | (cam3__
      =="NEG") ///
155       | (cam4__=="NEG") | (cam5__=="NEG")
156
157   gen notdelirious_wholeday = (cam1__=="NEG")
158   replace notdelirious_wholeday = 0 if notdelirious_wholeday==1 & ///
159       ((cam2__=="NEG" & !missing(cam2__)) | missing(cam2__))==0
160   replace notdelirious_wholeday = 0 if notdelirious_wholeday==1 & ///
161       ((cam3__=="NEG" & !missing(cam3__)) | missing(cam3__))==0
162   replace notdelirious_wholeday = 0 if notdelirious_wholeday==1 & ///
163       ((cam4__=="NEG" & !missing(cam4__)) | missing(cam4__))==0
164   replace notdelirious_wholeday = 0 if notdelirious_wholeday==1 & ///
165       ((cam5__=="NEG" & !missing(cam5__)) | missing(cam5__))==0
166
167   gen agitated=(rass_max>=3)
168
169   replace fentanyl_dose__ = 0 if missing(fentanyl_dose__) &
      fentanyl_admin__1_==1
170   replace ivdilaudid_dose__=0 if ivdilaudid_admin__1_==1
171   replace oxy_dose__=0 if oxy_admin__1_==1
172   replace oralmorph_dose__=0 if oralmorph_admin__1_==1
173   replace ivmorph_dose__=0 if ivmorph_admin__1_==1
174   replace dilaudid_dose__=0 if dilaudid_admin__1_==1
175
176
177   replace prec_dose__ = 0 if missing(prec_dose__) & prec_admin__1_==1
178   replace prop_dose__ = 0 if missing(prop_dose__) & prop_admin__1_==1
179
180
181   gen num_opiates = (fentanyl_dose__>0 & !missing(fentanyl_dose__))
      ///
182       + (oxy_dose__>0 & !missing(oxy_dose__)) + (oralmorph_dose__>0 &
      !missing(oralmorph_dose__)) ///
183       + (ivmorph_dose__>0 & !missing(ivmorph_dose__)) + (
      dilaudid_dose__>0 & !missing(dilaudid_dose__)) ///
```

```stata
189         + (ivdiazepam_dose__>0 & !missing(ivdiazepam_dose__)) ///
190         + (xanax_dose__>0 & !missing(xanax_dose__)) ///
191         + (ivxanax_dose__>0 & !missing(ivxanax_dose__)) ///
192         + (versed_dose__>0 & !missing(versed_dose__))
193
194     gen num_antipsych = (ivhaldol_dose__>0 & !missing(ivhaldol_dose__))
         ///
195         + (oralhaldol_dose__>0 & !missing(oralhaldol_dose__)) ///
196         + (seroquel_dose__>0 & !missing(seroquel_dose__)) ///
197         + (ivseroquel_dose__>0 & !missing(ivseroquel_dose__)) ///
198         + (remeron_dose__>0 & !missing(remeron_dose__)) ///
199         + (zyprexa_dose__>0 & !missing(zyprexa_dose__)) ///
200         + (ivzyprexa_dose__>0 & !missing(ivzyprexa_dose__))
201
202     gen any_antipsych = num_antipsych>0
203
204     gen num_others = (prop_dose__>0 & !missing(prop_dose__)) ///
205         + (prec_dose__>0 & !missing(prec_dose__)) + (ketamine_dose__>0
         & !missing(ketamine_dose__)) ///
206         + (pheno_dose__>0 & !missing(pheno_dose__))
207
208     gen num_drugs = num_opiates + num_others + num_benzos +
         num_antipsych
209
210     label var num_opiates "Opiates"
211     label var num_drugs "All Sedatives"
212     label var num_others "Newer Agents"
213
214     gen fentanyl_equiv = (fentanyl_dose__ + ((100/1.5) *
         ivdilaudid_dose__) + ((100/20) * oxy_dose__) ///
215         + ((100/30) * oralmorph_dose__) + ((100/10) * ivmorph_dose__ )
         + ((100/5) * dilaudid_dose__)) / 1000
216
217     gen noopiates=(fentanyl_equiv==0)
218
219     replace ivativan_dose__=0 if ivativan_admin__1_==1
220     replace ativan_dose__=0 if ativan_admin__1_==1
221     replace versed_dose__=0 if versed_admin__1_==1
222     replace diazepam_dose__=0 if diazepam_admin__1_==1
223     gen ativan_equiv = ativan_dose__ + ivativan_dose__ + (0.2*
         diazepam_dose__) + (0.5*versed_dose__)
224
225     gen nobenzo = ativan_equiv==0 & ! missing(ativan_equiv)
226
227     gen any_benzo = ativan_equiv>0 | missing(ativan_equiv)
228
229     gen nofentanyl=(fentanyl_admin__1_==1) if !missing(
         fentanyl_admin__1_)
```

```
235   table daycentered, c(mean ativan_equiv mean nobenzo) format(%9.2f)
236
237
238   xtset pt_mrn daycentered
239   gen aftertrach = daycentered
240   recode aftertrach (min/-1=0) (0=.) (1/max=1)
241   gen daycentered_nozero = daycentered if daycentered!=0
242   label var daycentered_nozero "Days to/from Trach"
243
244   /* REPORT ANALYSES */
245
246   /* H1 */
247
248   table aftertrach, c(median num_drugs mean num_drugs sd num_drugs)
      format(%9.2f) center
249   table aftertrach, c(median fentanyl_equiv mean fentanyl_equiv sd
      fentanyl_equiv mean neuromusc_blockade__) format(%9.2f) center
250   xtreg fentanyl_equiv aftertrach, fe
251   xtlogit noopiates aftertrach, fe
252
253   table aftertrach, c(median ativan_equiv mean any_benzo mean
      ativan_equiv sd ativan_equiv) format(%9.2f) center
254   table aftertrach, c(median prec_dose median prop_dose mean
      any_antipsych) format(%9.2f) center
255
256   xtlogit any_benzo aftertrach, fe
257   xtlogit any_antipsych aftertrach, fe
258
259   dotplot fentanyl_equiv, over(daycentered_nozero) ///
260       ytitle("mg Fentanyl Equivalents (Total Daily Opiate Dose)")
      center median bar ///
261       note("8 June 2020 10:30 a.m. -- Day of trach values not
      graphed")
262
263   /* H2 */
264
265   table aftertrach, c(median rass_mean mean rass_mean sd rass_mean )
      format(%9.2f) center
266   table aftertrach, c(mean nocoma_min mean agitated mean
      notdelirious_ever mean physical_therapy__) format(%9.2f) center
267   table aftertrach, c(mean physical_therapy__) format(%9.2f) center
268
269   xtreg rass_mean aftertrach, fe
270
271   xtlogit nocoma_min aftertrach, fe or
272   xtlogit agitated aftertrach, fe or
273   xtlogit notdelirious_ever aftertrach, fe or
274   xtlogit physical_therapy__ aftertrach, fe or
```

```
280   /* H3 */
281
282   mkspline daysall 0 daysafter = daycentered, marginal
283   xtreg fentanyl_equiv daycentered aftertrach daysafter, fe
284   xtreg rass_mean daycentered aftertrach daysafter, fe
285   xtlogit nocoma_min daycentered aftertrach daysafter, fe or
286   xtlogit agitated daycentered aftertrach daysafter, fe or
287   xtlogit physical_therapy__ daycentered aftertrach daysafter, fe or
288
289   /* explore variations suggested by Leigh and Jackie */
290
291   gen day21plus = days_tube_to_trach >21
292   sum day21plus
293
294   gen after_by_day21 = aftertrach * day21plus
295   xtreg fentanyl_equiv aftertrach after_by_day21, fe
296   xtreg fentanyl_equiv daycentered aftertrach after_by_day21, fe
297
298   xtreg fentanyl_equiv daycentered aftertrach if daycentered!=1, fe
299
300   /* requested at early July by coauthors */
301
302   dotplot ativan_equiv, over(daycentered_nozero) ///
303       ytitle("mg Ativan Equivalents (Total Daily Benzo Dose)") center
       median bar ///
304       note("8 June 2020 10:30 a.m. -- Day of trach values not
      graphed")
305
306   xtreg num_antipsych aftertrach, fe
307   table aftertrach, c(mean num_antipsych median num_antipsych) format
      (%9.2f) center
308
309   table aftertrach, c(mean num_antipsych median num_antipsych) format
      (%9.2f) center
310   table daycentered, c(mean sbt__) format(%9.2f) center
311   table aftertrach, c(mean sbt__) format(%9.2f) center
312
313   xtlogit sbt__ aftertrach, fe or
314   xtlogit sbt__ daycentered aftertrach daysafter, fe or
315
316   table aftertrach, c(mean nocoma_min4 mean nocoma_max4) format(%9.2f
      ) center
317   xtlogit nocoma_min4 aftertrach, fe or
318   xtlogit nocoma_min4 daycentered aftertrach daysafter, fe or
319
320   table daycentered, c(mean notdelirious_wholeday) format(%9.2f)
      center
321   table aftertrach, c(mean notdelirious_wholeday) format(%9.2f)
```

```
          trach values not graphed")
328
329   xtline fentanyl_equiv if daycentered!=0, overlay legend(off) ///
330       ytitle("Fentanyl Equivalents (Total Daily Opiate Dose)")  ///
331       note("VERY PRELIMINARY -- NOT FOR INTERPRETATION -- Day of
      trach values not graphed")
332
333   xtline ativan_equiv if  daycentered!=0, overlay legend(off) ///
334       ytitle("Ativan Equivalents (Total Daily Benzo Dose)")  ///
335       note("VERY PRELIMINARY -- NOT FOR INTERPRETATION -- Day of
      trach values not graphed")
336
337   xtline prop_dose__ if daycentered!=0, overlay legend(off) ///
338       ytitle("Propofol (Total Daily Dose)") ///
339       note("VERY PRELIMINARY -- NOT FOR INTERPRETATION -- Day of
      trach values not graphed")
340
341   xtline prec_dose__ if daycentered!=0, overlay legend(off) ///
342       ytitle("Dexmedetomidine (Total Daily Dose)") ///
343       note("VERY PRELIMINARY -- NOT FOR INTERPRETATION -- Day of
      trach values not graphed")
344
345   xtline rass_mean if daycentered!=0, overlay legend(off) ///
346       ytitle("RASS (daily mean of all recorded values))") ///
347       note("VERY PRELIMINARY -- NOT FOR INTERPRETATION -- Day of
      trach values not graphed")
348
349   /* stacked bar graphs */
350
351   catplot num_drugs daycentered, ///
352       percent(daycentered) ///
353       asyvars stack recast(bar) ///
354       bar(1, bcolor(sandb))  bar(2, bcolor(yellow)) bar(3,
      bcolor(orange_red)) ///
355       bar(4, bcolor(red)) bar(5, bcolor(purple)) bar(6,
      bcolor(brown)) ///
356       bar(7, bcolor(maroon)) bar(8, bcolor(gs7)) ///
357       bar(9, bcolor(black)) ////
358       legend(subtitle("Number of Drugs") order(9 8 7 6 5 4 3 2 1)) ///
359       ytitle("Percentage of Patients") ///
360       title("Agents Used") ///
361       note("VERY PRELIMINARY -- NOT FOR INTERPRETATION")
362
363   /* okay, let's do average doses across 5 days before versus 5 days
      after */
364
365   replace prec_dose__ = 0 if missing(prec_dose__) & prec_admin__1_==1
366   replace prop_dose__ = 0 if missing(prop_dose__) & prop_admin__1_==1
```

```
373  ** note that using aftertrach drops trach day on its own!
374  xtreg fentanyl_equiv aftertrach, fe
375  xtreg num_drugs aftertrach, fe
376  xtreg rass_mean aftertrach, fe
377
378  /* xtreg for dose over time */
379
380  xtreg fentanyl_equiv daycentered aftertrach, fe
381  xtreg num_drugs daycentered aftertrach, fe
382  xtreg rass_mean daycentered aftertrach, fe
383
384  mkspline daysall 0 daysafter = daycentered, marginal
385  xtreg fentanyl_equiv daysall aftertrach daysafter, fe
386  xtreg num_drugs daysall aftertrach daysafter, fe
387  xtreg rass_mean daysall aftertrach daysafter, fe
388
389  /* clogit for receipt and receipt over time */
390
391  xtlogit notdelirious_ever daysall aftertrach, fe
392  xtlogit notdelirious_ever daysall aftertrach daysafter, fe
393
394  xtlogit noopiates aftertrach, fe
395  xtlogit noopiate daysall aftertrach daysafter, fe
396
397  xtlogit nobenzo aftertrach, fe
398  xtlogit nobenzo aftertrach daycentered, fe
399  xtlogit nobenzo daysall aftertrach daysafter, fe
400
401  xtlogit sbt__ aftertrach, fe
402  xtlogit sbt__ aftertrach daycentered, fe
403  xtlogit sbt__ daysall aftertrach daysafter, fe
404
405  xtlogit neuromusc_blockade__ aftertrach, fe
406  xtlogit neuromusc_blockade__ aftertrach daycentered, fe
407  /* convergence error: xtlogit neuromusc_blockade__ daysall
     aftertrach daysafter, fe */
408
409  xtlogit physical_therapy__ aftertrach, fe
410  xtlogit physical_therapy__ aftertrach daycentered, fe
411  xtlogit physical_therapy__ daysall aftertrach daysafter, fe
412
413
414
```

414