```
*-----------------------------------------------------------------
* Risk of airway fire with the use of KTP laser and high flow humidified oxygen
delivery in a laryngeal surgery model
* Lucy Huang, Department of Otolaryngology Head and Neck Surgery, Flinders
Medical Centre, Bedford Park, Australia
*-----------------------------------------------------------------

**********/

* basics
*********

version 16.1
clear all
set more off
global outfile "/Users/ulla0004/OneDrive - Flinders/project/Adam Badenoch/
data"

******************
* import data
******************

import excel using "$outfile/thrivedata.xlsx", sheet("Sheet1") firstrow
case(lower) clear
save "$outfile/Shahid_data_14_2_2020", clear


******************
* SPARK
*****************************************************************
* Cumulative hazard curves
**********************************

use "$outfile/Shahid_data_14_2_2020", clear

* risk interval
replace TimetofirstSparkcensoredat=0.1 if TimetofirstSparkcensoredat==0
stset TimetofirstSparkcensoredat, id(id) fail(spark) noshow

****************************
* Tissue oxygen concentration
*******************************

gen byte TOC60=TissueOxygenConcentration>=60 & !
```

```
missing(TissueOxygenConcentration)
lab define TOC60 0 "<60" 1 ">=60", replace
lab val TOC60 TOC60

sts graph, ///
risktable(0(5)60, size(medsmall) order(2 ">60" 1 "<=60")) ///
cumhaz  by(TOC60)  ///
plot1opts(msymbol(smsquare ) lcol(blue) lpat(dash) mcol(blue) msize(vsmall)
mlwidth(thin)) ///
plot2opts(msymbol(smtriangle ) lcol(red) lpat(dash) mcol(red)
mlpat(shortdash) msize(vsmall) mlwidth(thin)) ///
title(Tissue-Oxygen concentration (spark), size(medsmall)) ytitle(Cumulative
hazard, size(medsmall)) ///
xtitle(Time to first spark (seconds), size(medsmall)) ///
text(0.24 1.5 ">=60: HR=23.0, 95% CI 10.3-51.5, P<0.001", place(e)
size(medsmall)) ///
text(0.22 2.3 "<60: Reference", place(e) size(medsmall)) ///
ylab(0(.05)0.25, angle(0)) xlab(0(5)60, angle(0)) ///
graphregion(color(white)) ///
legend(order(2 ">=60" 1 "<60") pos(6) cols(2))
graph save "$outfile/S1",replace

***************
*  Laser mode
*****************

sts graph, ///
risktable(0(5)60, size(medsmall) order(1 "Continuous 2.6W" 2 "Continuous 5W"
3 "Pulsed 26W" 4 "Pulsed 35W")) ///
cumhaz  by(Las_Mode)  ///
plot1opts(msymbol(smcircle) lcol(red) lpat(desh) mcol(red) msize(vsmall)
mlwidth(thin)) ///
plot2opts(msymbol(smdiamond) lcol(black) lpat(dash) mcol(black)
msize(vsmall) mlwidth(thin)) ///
plot3opts(msymbol(smsquare ) lcol(green) lpat(shortdash) mcol(green)
msize(vsmall) mlwidth(thin)) ///
plot4opts(msymbol(smtriangle ) lcol(blue) lpat(longdash) mcol(blue)
mlpat(longdash) msize(vsmall) mlwidth(thin)) ///
title(Laser mode (spark), size(medsmall)) ytitle(Cumulative hazard,
size(medsmall)) ///
xtitle(Time to first spark (seconds), size(medsmall)) ///
ylab(0(.05)0.25, angle(0)) xlab(0(5)60, angle(0)) ///
text(0.24 1.2 "Continuous 2.6W: HR=25.7, 95% CI 7.6-87.8, P<0.001", place(e)
size(medsmall)) ///
text(0.22 1.2 "Continuous 5W: HR=16.5, 95% CI 5.4-50.7, P<0.001", place(e)
size(medsmall)) ///
```

```
text(0.20 1.3 "Pulsed 35W: HR=3.9, 95% CI 1.3-12.0, P=0.02", place(e)
size(medsmall)) ///
text(0.18 2 "Pulsed 26W: Reference", place(e) size(medsmall)) ///
graphregion(color(white)) ///
legend(order(1 "Continuous 2.6W" 2 "Continuous 5W" 3 "Pulsed 26W" 4
"Pulsed 35W") pos(6) cols(2))
graph save "$outfile/S2",replace

*****************
*  Tissue type
******************

sts graph, ///
risktable(0(5)60, size(medsmall) order(1 "Muscle" 2 "Adipose")) ///
cumhaz  by(Tis_Fat)  ///
plot1opts(msymbol(smcircle) lcol(blue) lpat(dash) mcol(blue) msize(vsmall)
mlwidth(thin)) ///
plot2opts(msymbol(smdiamond) lcol(red) lpat(dash) mcol(red) msize(vsmall)
mlwidth(thin)) ///
title(Tissue type (spark), size(medsmall)) ytitle(Cumulative hazard, ///
size(medsmall)) xtitle(Time to first spark (seconds), size(medsmall)) ///
ylab(0(.05)0.25, angle(0)) xlab(0(5)60, angle(0)) ///
text(0.24 1.5 "Adipose: HR=5.8, 95% CI 2.4-13.6, P<0.001", place(e)
size(medsmall)) ///
text(0.22 2.3 "Muscle: Reference", place(e) size(medsmall)) ///
graphregion(color(white)) ///
legend(order(1 "Muscle" 2 "Adipose") pos(6) cols(2))
graph save "$outfile/S3",replace


**********************
*  Tissue condition
************************

sts graph, ///
risktable(0(5)60, size(medsmall) order(1 "Uncharred" 2 "Charred")) ///
cumhaz  by(Tis_Charred)  ///
plot1opts(msymbol(smcircle) lcol(blue) lpat(dash) mcol(blue) msize(vsmall)
mlwidth(thin)) ///
plot2opts(msymbol(smdiamond) lcol(red) lpat(dash) mcol(red) msize(vsmall)
mlwidth(thin)) ///
title(Tissue condition (spark), size(medsmall)) ytitle(Cumulative hazard,
size(medsmall)) ///
xtitle(Time to first spark (seconds), size(medsmall)) ///
ylab(0(.05)0.25, angle(0)) xlab(0(5)60, angle(0)) ///
text(0.24 1.5 "Charred: HR=28.3, 95% CI 13.2-50.8, P<0.001", place(e)
```

```
size(medsmall)) ///
text(0.22 2.3 "Uncharred: Reference", place(e) size(medsmall)) ///
graphregion(color(white)) ///
legend(order(1 "Uncharred" 2 "Charred") pos(6) cols(2))
graph save "$outfile/S4",replace

**************************
*  Smoke evacuation
**************************

sts graph, ///
risktable(0(5)60, size(medsmall) order(1 "No" 2 "Yes")) ///
cumhaz  by(Smoke_evacuation_on)  ///
plot1opts(msymbol(smcircle) lcol(blue) lpat(dash) mcol(blue) msize(vsmall)
mlwidth(thin)) ///
plot2opts(msymbol(smdiamond) lcol(red) lpat(dash) mcol(red) msize(vsmall)
mlwidth(thin)) ///
title(Smoke evacuation (spark), size(medsmall)) ytitle(Cumulative hazard,
size(medsmall)) ///
xtitle(Time to first spark (seconds), size(medsmall)) ///
ylab(0(.05)0.25, angle(0)) xlab(0(5)60, angle(0)) ///
text(0.24 1.5 "Yes: HR=0.81, 95% CI 0.33-1.96, P=0.64", place(e)
size(medsmall)) ///
text(0.22 2.3 "No: Reference", place(e) size(medsmall)) ///
graphregion(color(white)) ///
legend(order(1 "No" 2 "Yes") pos(6) cols(2))
graph save "$outfile/S5",replace


**************************
*Cox regression model
**************************

gen TissueOxygenConcentration10=TissueOxygenConcentration/10

mkspline2 O2sp1 6 O2sp2=TissueOxygenConcentration10, displayknots
mat O2knots = r(knots)

stcox O2sp* b3.Las_Mode i.Tis_Fat i.Tis_Charred, shared(exp_group)
baselevel   /* Full, stratified model */

estat concordance
estimate store malspark

* coefficient plot
```

```
coefplot ///
   (malspark, keep(O2sp1) ///
       rename(O2sp1 = "Tissue-O2 concentration <60 (/10 unit)") ///
       mlabel(string(@b, "%2.1f") + " (" + string(@ll, "%2.1f") + ", " + string(@ul,
"%2.1f")+ ")" + "***") ///
       mlabcol(black) mlabgap(*1) offset(0) mlabsize(medsmall) mcol(black)
ciopts(recast(rcap) lcol(black))) ///
   (malspark, keep(O2sp2) ///
       rename(O2sp2 = "Tissue-O2 concentration >=60 (/10 unit)") ///
       mlabel(string(@b, "%2.1f") + " (" + string(@ll, "%2.1f") + ", " + string(@ul,
"%2.1f")+ ")" + "***") ///
       mlabcol(black) mlabgap(*1) offset(0) mlabsize(medsmall) mcol(black)
ciopts(recast(rcap) lcol(black))) ///
   (malspark, keep(1.Las_Mode) ///
       rename(1.Las_Mode = "Laser setting - Continuous 2.6W") ///
       mlabel(string(@b, "%2.1f") + " (" + string(@ll, "%2.1f") + ", " + string(@ul,
"%2.1f")+ ")" + "***") ///
       mlabcol(black) mlabgap(*1) offset(0) mlabsize(medsmall) mcol(black)
ciopts(recast(rcap) lcol(black))) ///
   (malspark, keep(2.Las_Mode) ///
       rename(2.Las_Mode = "Laser setting - Continuous 5W") ///
       mlabel(string(@b, "%2.1f") + " (" + string(@ll, "%2.1f") + ", " + string(@ul,
"%2.1f")+ ")" + "***") ///
       mlabcol(black) mlabgap(*1) offset(0) mlabsize(medsmall) mcol(black)
ciopts(recast(rcap) lcol(black))) ///
   (malspark, keep(3.Las_Mode) ///
       rename(3.Las_Mode = "Laser setting - Pulsed 26W") ///
       mlabel(string(@b, "%2.0f")) mlabcol(black) mlabgap(*1) offset(0)
mlabsize(medsmall) mcol(black)) ///
   (malspark, keep(4.Las_Mode) ///
       rename(4.Las_Mode = "Laser setting - Pulsed 35W") ///
       mlabel(string(@b, "%2.1f") + " (" + string(@ll, "%2.1f") + ", " + string(@ul,
"%2.1f")+ ")" + "**") ///
       mlabcol(black) mlabgap(*1) offset(0) mlabsize(medsmall) mcol(black)
ciopts(recast(rcap) lcol(black))) ///
   (malspark, keep(0.Tis_Fat) ///
       rename(0.Tis_Fat = "Muscle tissue") ///
       mlabel(string(@b, "%2.0f")) mlabcol(black) mlabgap(*1) offset(0)
mlabsize(medsmall) mcol(black)) ///
   (malspark, keep(1.Tis_Fat) ///
       rename(1.Tis_Fat = "Fat tissue") ///
       mlabel(string(@b, "%2.1f") + " (" + string(@ll, "%2.1f") + ", " + string(@ul,
"%2.1f")+ ")" + "***") ///
       mlabcol(black) mlabgap(*1) offset(0) mlabsize(medsmall) mcol(black)
ciopts(recast(rcap) lcol(black))) ///
   (malspark, keep(0.Tis_Charred) ///
```

```
        rename(0.Tis_Charred = "Fresh tissue") ///
    mlabel(string(@b, "%2.0f")) mlabcol(black) mlabgap(*1) offset(0)
mlabsize(medsmall) mcol(black)) ///
       (malspark, keep(1.Tis_Charred) ///
        rename(1.Tis_Charred = "Charred tissue") ///
        mlabel(string(@b, "%2.1f") + " (" + string(@ll, "%2.1f") + ", " + string(@ul,
"%2.1f")+ ")" + "***") ///
        mlabcol(black) mlabgap(*1) offset(0) mlabsize(medsmall) mcol(black)
ciopts(recast(rcap) lcol(black))), ///
headings(0.Las_Mode="Laser type" ///
        -1.Tis_Fat="{bf:Tissue type}" ///
              -1.Tis_Charred="{bf:Tissue charring}") ///
xline(1, lcol(black) lwidth(thin) lpattern(dot)) drop(_cons) keep(*:) omitted
baselevels eform  ///
xtitle("Hazard Ratio (log scale)", size(medsmall)) graphregion(color(white))
legend(rows(2) cols(2))  ///
xscale(log) xlabel(1 2 3 5 10 20 50 100 200, angle(0) labsize(medsmall)
format(%2.0f)) ///
ylabel(,labsize(medsmall)) legend(off) graphregion(color(white))
mlabposition(12) mlabsize(medsmall) ///
title(Spark 60 seconds, size(medsmall)) note("*** p<0.001; ** p<0.01",
size(medsmall))
graph save "$outfile/S6",replace

**************************
*clinical risk estimates
**************************

mkspline2 O2sp=TissueOxygenConcentration, cubic knots(40 50 60)
displayknots
*mkspline2 O2sp = TissueOxygenConcentration, cubic nknots(4) displayknots
mat O2knots = r(knots)

stcox O2sp* b3.Las_Mode i.Tis_Fat, shared(exp_group) baselevel   /* Full,
stratified model */

*** EXTRACT LINEAR PREDICTOR & ESTIMATE OF BASELINE SURVIVAL ***
predict double xbeta, xb /* Get linear predictor from fitted model */
summ xbeta, detail       /* check distribution, should not be centered */

predict double basesurv, basesurv
line basesurv _t, sort    /* Assess baseline survival curve */

** FIND BASELINE SURVIVAL AT TIME = 5 seconds

sum basesurv if _t<=5
```

```
scalar base5s=r(min)    /* Take minimum baseline survival value nearest to 5-years */

gen risk5s=1 - base5s^exp(xbeta) /* Generate 10 seconds Risk using baseline survival */
gen survrisk=1-risk5s           /* Generate 10 seconds Survival as complement of 5-year Risk */

adjustrcspline, custominvlink(1-base5s^(exp(xb(#1)))) at(Las_Mode=2 Tis_Fat=1 Tis_Charred=1) generate(p l u)

replace l=0 if l<0
replace u=1 if u>1
keep if TissueOxygenConcentration<=90 & Las_Mode==2 & Tis_Fat==1 & Tis_Charred==1
twoway rarea l u TissueOxygenConcentration, sort color(gs14) || line p TissueOxygenConcentration, sort color(gs10) ylabel(0(.1)1, angle(0) format(%04.2f) labsize(medsmall)) xtitle("Tissue oxygen concentration", size(medsmall)) title("Risk of spark in 5 seconds", size(medium)) ytitle("Risk", size(medsmall)) xlabel(25(5)90, angle(0) labsize(medsmall)) graphregion(color(white)) tline(40 50 60 90, lp(dot) lw(thin) lc(black) lstyle(grid) axis(1)) text(0 40 "1.8% (0-9.8%)", place(nw) size(medsmall) orient(vertical)) text(0 50 "8.7% (0-52.3%)", place(nw) size(medsmall) orient(vertical)) text(0 60 "20.6% (0-100%)", place(nw) size(medsmall) orient(vertical)) text(0 90 "89.4% (0-100%)", place(nw) size(medsmall) orient(vertical)) legend(off) text(1 25 "Continuous 5W" "Adipose & charred tissue", place(se) box bcolor(gs14) just(left) margin(l+4 t+1 b+1) width(40) size(medsmall))
graph save "$outfile/S9",replace


adjustrcspline, custominvlink(1-base5s^(exp(xb(#1)))) at(Las_Mode=3 Tis_Fat=0 Tis_Charred=0) generate(p l u)

replace l=0 if l<0
replace u=1 if u>1
keep if TissueOxygenConcentration<=90 & Las_Mode==3 & Tis_Fat==0 & Tis_Charred==0
twoway rarea l u TissueOxygenConcentration, sort color(gs14) || line p TissueOxygenConcentration, sort color(gs10) ylabel(0(.1)1, angle(0) format(%04.2f) labsize(small)) xtitle("Tissue oxygen concentration", size(medsmall)) title("Risk of spark in 5 seconds", size(medium)) ytitle("Risk", size(medsmall)) xlabel(25(5)90, angle(0) labsize(medsmall)) graphregion(color(white)) tline(40 50 60 90, lp(dot) lw(thin) lc(black) lstyle(grid) axis(1)) text(0 40 "0.01% (0-0.04%)", place(nw) size(medsmall) orient(vertical)) text(0 50 "0.03% (0-0.2%)", place(nw) size(medsmall)
```

```
orient(vertical)) text(0 60 "0.09% (0-0.5%)", place(nw) size(medsmall)
orient(vertical)) text(0 90 "0.9% (0-4.8%)", place(nw) size(medsmall)
orient(vertical)) legend(off) text(1 25 "Pulsed 26W" "Muscle & Uncharred
tissue", place(se) box bcolor(gs14) just(left) margin(l+4 t+1 b+1) width(40)
size(medsmall))
graph save "$outfile/S7",replace


adjustrcspline, custominvlink(1-base5s^(exp(xb(#1)))) at(Las_Mode=3
Tis_Fat=1 Tis_Charred=0) generate(p l u)

replace l=0 if l<0
replace u=1 if u>1
keep if TissueOxygenConcentration<=90 & Las_Mode==3 & Tis_Fat==1 &
Tis_Charred==0
twoway rarea l u TissueOxygenConcentration, sort color(gs14) || line p
TissueOxygenConcentration, sort color(gs10) ylabel(0(.1)1, angle(0)
format(%04.2f) labsize(medsmall)) xtitle("Tissue oxygen concentration",
size(medsmall)) title("Risk of spark in 5 seconds", size(medium)) ytitle("Risk",
size(medsmall)) xlabel(25(5)90, angle(0) labsize(medsmall))
graphregion(color(white)) tline(40 50 60 90, lp(dot) lw(thin) lc(black)
lstyle(grid) axis(1)) text(0 40 "0.05% (0-0.3%)", place(nw) size(medsmall)
orient(vertical)) text(0 50 "0.3% (0-1.5%)", place(nw) size(medsmall)
orient(vertical)) text(0 60 "0.6% (0-3.9%)", place(nw) size(medsmall)
orient(vertical)) text(0 90 "6.1% (0-34.5%)", place(nw) size(medsmall)
orient(vertical)) legend(off) text(1 25 "Pulsed 26W" "Adipose & Uncharred
tissue", place(se) box bcolor(gs14) just(left) margin(l+4 t+1 b+1) width(40)
size(medsmall))
graph save "$outfile/S8",replace

**********************************
* FLAME
**********************************************

use "$outfile/Shahid_data_14_2_2020", clear

* risk interval
replace Timetosustainedflamecensore=0.1 if Timetosustainedflamecensore==0
stset Timetosustainedflamecensore, id(id) fail(flame) noshow

gen byte TOC60=TissueOxygenConcentration>=60 & !
missing(TissueOxygenConcentration)
lab define TOC60 0 "<60" 1 ">=60", replace
lab val TOC60 TOC60

**************************
```

```
* Cumulative hazard curves
*********************************
*Tissue oxygen concentration
*********************************

sts graph, ///
risktable(0(5)60, size(medsmall) order(2 ">60" 1 "<=60")) ///
cumhaz  by(TOC60)  ///
plot1opts(msymbol(smsquare ) lcol(blue) lpat(dash) mcol(blue) msize(vsmall)
mlwidth(thin)) ///
plot2opts(msymbol(smtriangle ) lcol(red) lpat(dash) mcol(red)
mlpat(shortdash) msize(vsmall) mlwidth(thin)) ///
title(Tissue-Oxygen concentration (flame), size(medsmall)) ytitle(Cumulative
hazard, size(medsmall)) xtitle(Time to first flame (seconds), size(medsmall)) ///
text(0.24 1.5 ">=60: HR=47.7, 95% CI 16.1-141.5, P<0.001", place(e)
size(medsmall)) ///
text(0.22 2.3 "<60: Reference", place(e) size(medsmall)) ///
ylab(0(.05)0.25, angle(0)) xlab(0(5)60, angle(0)) ///
graphregion(color(white)) ///
legend(order(2 ">=60" 1 "<60") pos(6) cols(2))
graph save "$outfile/F1",replace

***************
*  Laser mode
**********************

sts graph, ///
risktable(0(5)60, size(medsmall) order(1 "Continuous 2.6W" 2 "Continuous 5W"
3 "Pulsed 26W" 4 "Pulsed 35W")) ///
cumhaz  by(Las_Mode)  ///
plot1opts(msymbol(smcircle) lcol(red) lpat(solid) mcol(red) msize(vsmall)
mlwidth(thin)) ///
plot2opts(msymbol(smdiamond) lcol(black) lpat(dash) mcol(black)
msize(vsmall) mlwidth(thin)) ///
plot3opts(msymbol(smsquare ) lcol(green) lpat(shortdash) mcol(green)
msize(vsmall) mlwidth(thin)) ///
plot4opts(msymbol(smtriangle ) lcol(blue) lpat(longdash) mcol(blue)
mlpat(longdash) msize(vsmall) mlwidth(thin)) ///
title(Laser mode (flame), size(medsmall)) ytitle(Cumulative hazard,
size(medsmall)) xtitle(Time to first flame (seconds), size(medsmall)) ///
ylab(0(.05)0.25, angle(0)) xlab(0(5)60, angle(0)) ///
text(0.24 1.2 "Continuous 2.6W: HR=57.0, 95% CI 11.4-285.2, P<0.001",
place(e) size(medsmall)) ///
text(0.22 1.2 "Continuous 5W: HR=21.4, 95% CI 4.8-95.9, P<0.001", place(e)
size(medsmall)) ///
text(0.20 1.3 "Pulsed 35W: HR=4.6, 95% CI 1.0-20.8, P=0.046", place(e)
```

```
size(medsmall)) ///
text(0.18 2 "Pulsed 26W: Reference", place(e) size(medsmall)) ///
graphregion(color(white)) ///
legend(order(1 "Continuous 2.6W" 2 "Continuous 5W" 3 "Pulsed 26W" 4
"Pulsed 35W") pos(6) cols(2))
graph save "$outfile/F2",replace

*****************
*  Tissue type
*****************

sts graph, ///
risktable(0(5)60, size(medsmall) order(1 "Muscle" 2 "Adipose")) ///
cumhaz  by(Tis_Fat)  ///
plot1opts(msymbol(smcircle) lcol(blue) lpat(dash) mcol(blue) msize(vsmall)
mlwidth(thin)) ///
plot2opts(msymbol(smdiamond) lcol(red) lpat(dash) mcol(red) msize(vsmall)
mlwidth(thin)) ///
title(Tissue type (flame), size(medsmall)) ytitle(Cumulative hazard,
size(medsmall)) xtitle(Time to first flame (seconds), size(medsmall)) ///
ylab(0(.05)0.25, angle(0)) xlab(0(5)60, angle(0)) ///
text(0.24 1.5 "Adipose: HR=13.4, 95% CI 4.4-40.6, P<0.001", place(e)
size(medsmall)) ///
text(.22 2.3 "Muscle: Reference", place(e) size(medsmall)) ///
graphregion(color(white)) ///
legend(order(1 "Muscle" 2 "Adipose") pos(6) cols(2))
graph save "$outfile/F3",replace

*******************
*  Tissue condition
************************

sts graph, ///
risktable(0(5)60, size(medsmall) order(1 "Uncharred" 2 "Charred")) ///
cumhaz  by(Tis_Charred)  ///
plot1opts(msymbol(smcircle) lcol(blue) lpat(dash) mcol(blue) msize(vsmall)
mlwidth(thin)) ///
plot2opts(msymbol(smdiamond) lcol(red) lpat(dash) mcol(red) msize(vsmall)
mlwidth(thin)) ///
title(Tissue condition (flame), size(medsmall)) ytitle(Cumulative hazard,
size(medsmall)) xtitle(Time to first flame (seconds), size(medsmall)) ///
ylab(0(.05)0.25, angle(0)) xlab(0(5)60, angle(0)) ///
text(0.24 1.5 "Charred: HR=74.7, 95% CI 26.0-214.3, P<0.001", place(e)
size(medsmall)) ///
text(.22 2.3 "Uncharred: Reference", place(e) size(medsmall)) ///
graphregion(color(white)) ///
```

```
legend(order(1 "Uncharred" 2 "Charred") pos(6) cols(2))
graph save "$outfile/F4",replace


*****************************
*  Smoke evacuation
**********************

sts graph, ///
risktable(0(5)60, size(medsmall) order(1 "No" 2 "Yes")) ///
cumhaz  by(Smoke_evacuation_on)  ///
plot1opts(msymbol(smcircle) lcol(blue) lpat(dash) mcol(blue) msize(vsmall)
mlwidth(thin)) ///
plot2opts(msymbol(smdiamond) lcol(red) lpat(dash) mcol(red) msize(vsmall)
mlwidth(thin)) ///
title(Smoke evacuation (flame), size(medsmall)) ytitle(Cumulative hazard,
size(medsmall)) xtitle(Time to first flame (seconds), size(medsmall)) ///
ylab(0(.05)0.25, angle(0)) xlab(0(5)60, angle(0)) ///
text(0.24 1.5 "Yes: HR=0.84, 95% CI 0.26-2.72, P=0.77", place(e)
size(medsmall)) ///
text(.22 2.3 "No: Reference", place(e) size(medsmall)) ///
graphregion(color(white)) ///
legend(order(1 "No" 2 "Yes") pos(6) cols(2))
graph save "$outfile/F5",replace

**************************
*Cox regression model
**************************

mkspline2 O2sp1 6 O2sp2=TissueOxygenConcentration10, displayknots
mat O2knots = r(knots)
*stcox O2sp*, shared(exp_group) baselevel
stcox O2sp* b3.Las_Mode i.Tis_Fat i.Tis_Charred, shared(exp_group)
baselevel   /* Full, stratified model */

estat concordance
estimate store malspark

* coefficient plot

coefplot ///
    (malspark, keep(O2sp1) ///
        rename(O2sp1 = "Tissue-O2 concentration <60 (/10 unit)") ///
        mlabel(string(@b, "%2.1f") + " (" + string(@ll, "%2.1f") + ", " + string(@ul,
"%2.1f")+ ")" + "***") ///
        mlabcol(black) mlabgap(*1) offset(0) mlabsize(medsmall) mcol(black)
```

```
ciopts(recast(rcap) lcol(black))) ///
   (malspark, keep(O2sp2) ///
       rename(O2sp2 = "Tissue-O2 concentration >=60 (/10 unit)") ///
       mlabel(string(@b, "%2.1f") + " (" + string(@ll, "%2.1f") + ", " + string(@ul,
"%2.1f")+ ")" + "***") ///
       mlabcol(black) mlabgap(*1) offset(0) mlabsize(medsmall) mcol(black)
ciopts(recast(rcap) lcol(black))) ///
   (malspark, keep(1.Las_Mode) ///
       rename(1.Las_Mode = "Laser setting - Continuous 2.6W") ///
       mlabel(string(@b, "%2.1f") + " (" + string(@ll, "%2.1f") + ", " + string(@ul,
"%2.1f")+ ")" + "***") ///
       mlabcol(black) mlabgap(*1) offset(0) mlabsize(medsmall) mcol(black)
ciopts(recast(rcap) lcol(black))) ///
   (malspark, keep(2.Las_Mode) ///
       rename(2.Las_Mode = "Laser setting - Continuous 5W") ///
       mlabel(string(@b, "%2.1f") + " (" + string(@ll, "%2.1f") + ", " + string(@ul,
"%2.1f")+ ")" + "***") ///
       mlabcol(black) mlabgap(*1) offset(0) mlabsize(medsmall) mcol(black)
ciopts(recast(rcap) lcol(black))) ///
   (malspark, keep(3.Las_Mode) ///
       rename(3.Las_Mode = "Laser setting - Pulsed 26W") ///
       mlabel(string(@b, "%2.0f")) mlabsize(medsmall) mlabcol(black)
mlabgap(*1) offset(0) mcol(black)) ///
   (malspark, keep(4.Las_Mode) ///
       rename(4.Las_Mode = "Laser setting - Pulsed 35W") ///
       mlabel(string(@b, "%2.1f") + " (" + string(@ll, "%2.1f") + ", " + string(@ul,
"%2.1f")+ ")" + "*") ///
       mlabcol(black) mlabgap(*1) offset(0) mlabsize(medsmall) mcol(black)
ciopts(recast(rcap) lcol(black))) ///
   (malspark, keep(0.Tis_Fat) ///
       rename(0.Tis_Fat = "Muscle tissue") ///
       mlabel(string(@b, "%2.0f")) mlabsize(medsmall) mlabcol(black)
mlabgap(*1) offset(0) mcol(black)) ///
   (malspark, keep(1.Tis_Fat) ///
       rename(1.Tis_Fat = "Fat tissue") ///
       mlabel(string(@b, "%2.1f") + " (" + string(@ll, "%2.1f") + ", " + string(@ul,
"%2.1f")+ ")" + "***") ///
       mlabcol(black) mlabgap(*1) offset(0) mlabsize(medsmall) mcol(black)
ciopts(recast(rcap) lcol(black))) ///
   (malspark, keep(0.Tis_Charred) ///
       rename(0.Tis_Charred = "Fresh tissue") ///
    mlabel(string(@b, "%2.0f")) mlabsize(medsmall) mlabcol(black) mlabgap(*1)
offset(0) mcol(black)) ///
       (malspark, keep(1.Tis_Charred) ///
       rename(1.Tis_Charred = "Charred tissue") ///
       mlabel(string(@b, "%2.1f") + " (" + string(@ll, "%2.1f") + ", " + string(@ul,
```

```
"%2.1f")+ ")" + "***") ///
        mlabcol(black) mlabgap(*1) offset(0) mlabsize(medsmall) mcol(black)
ciopts(recast(rcap) lcol(black))), ///
headings(0.Las_Mode="Laser type" ///
        -1.Tis_Fat="{bf:Tissue type}" ///
                -1.Tis_Charred="{bf:Tissue charring}") ///
xline(1, lcol(black) lwidth(thin) lpattern(dot)) drop(_cons) keep(*:) omitted
baselevels eform  ///
xtitle("Hazard Ratio (log scale)", size(medsmall)) graphregion(color(white))
legend(rows(2) cols(2))  ///
xscale(log) xlabel(1 2 3 5 10 20 50 100 200, angle(0) labsize(medsmall)
format(%2.0f)) ///
ylabel(,labsize(medsmall)) legend(off) graphregion(color(white))
mlabposition(12) mlabsize(medsmall) ///
title(Flame 60 seconds, size(medsmall)) note("*** p<0.001; *
p<0.05",size(medsmall))
graph save "$outfile/F6",replace

******************
*clinical risk estimates
**********************
*******************************

use "$outfile/Shahid_data_14_2_2020", clear

* risk interval
replace Timetosustainedflamecensore=0.1 if Timetosustainedflamecensore==0
stset Timetosustainedflamecensore, id(id) fail(flame) noshow

mkspline2 O2sp=TissueOxygenConcentration, cubic knots(40 50 60)
displayknots
*mkspline2 O2sp = TissueOxygenConcentration, cubic nknots(4) displayknots
mat O2knots = r(knots)

stcox O2sp* b3.Las_Mode i.Tis_Fat, shared(exp_group) baselevel nohr   /* Full,
stratified model */

*** EXTRACT LINEAR PREDICTOR & ESTIMATE OF BASELINE SURVIVAL ***
predict double xbeta, xb /* Get linear predictor from fitted model */
summ xbeta, detail       /* check distribution, should not be centered */

predict double basesurv, basesurv
line basesurv _t, sort    /* Assess baseline survival curve */

** FIND BASELINE SURVIVAL AT TIME = 5 seconds
```

```
sum basesurv if _t<=5
scalar base5s=r(min)    /* Take minimum baseline survival value nearest to 5-
years */

gen risk5s=1 - base5s^exp(xbeta) /* Generate 10 seconds Risk using baseline
survival */
gen survrisk=1-risk5s           /* Generate 10 seconds Survival as complement of
5-year Risk */

*****************************************
* Continuous 5W Adipose & charred tissue
*********************************************************

adjustrcspline, custominvlink(1-base5s^(exp(xb(#1)))) at(Las_Mode=2
Tis_Fat=1 Tis_Charred=1) generate(p l u)

replace l=0 if l<0
replace u=1 if u>1

keep if TissueOxygenConcentration<=90 & Las_Mode==2 & Tis_Fat==1 &
Tis_Charred==1
twoway rarea l u TissueOxygenConcentration, sort color(gs14) || line p
TissueOxygenConcentration, sort color(gs10) ylabel(0(.1)1, angle(0)
format(%04.2f) labsize(medsmall)) xtitle("Tissue oxygen concentration",
size(medsmall)) title("Risk of flame in 5 seconds", size(medium)) ytitle("Risk",
size(medsmall)) xlabel(25(5)90, angle(0) labsize(medsmall))
graphregion(color(white)) tline(40 50 60 90, lp(dot) lw(thin) lc(black)
lstyle(grid) axis(1)) text(0 40 "0.2% (0-1.6%)", place(nw) size(medsmall)
orient(vertical)) text(0 50 "1.7% (0-16.4%)", place(nw) size(medsmall)
orient(vertical)) text(0 60 "5.7% (0-56.7%)", place(nw) size(medsmall)
orient(vertical)) text(0 90 "73.0% (0-100%)", place(nw) size(medsmall)
orient(vertical)) legend(off) text(1 25 "Continuous 5W" "Adipose & charred
tissue", place(se) box bcolor(gs14) just(left) margin(l+4 t+0 b+1) width(40)
size(medsmall))
graph save "$outfile/F9",replace

*****************************************
* Pulsed 26W Muscle & Uncharred tissue
*****************************************
adjustrcspline, custominvlink(1-base5s^(exp(xb(#1)))) at(Las_Mode=3
Tis_Fat=0 Tis_Charred=0) generate(p l u)

replace l=0 if l<0
replace u=1 if u>1
keep if TissueOxygenConcentration<=90 & Las_Mode==3 & Tis_Fat==0 &
Tis_Charred==0
```

```
twoway rarea l u TissueOxygenConcentration, sort color(gs14) || line p
TissueOxygenConcentration, sort color(gs10) ylabel(0(.1)1, angle(0)
format(%04.2f) labsize(medsmall)) xtitle("Tissue oxygen concentration",
size(medsmall)) title("Risk of flame in 5 seconds", size(medium)) ytitle("Risk",
size(medsmall)) xlabel(25(5)90, angle(0) labsize(medsmall))
graphregion(color(white)) tline(40 50 60 90, lp(dot) lw(thin) lc(black)
lstyle(grid) axis(1)) text(0 40 "0.0003% (0-0.002%)", place(nw) size(medsmall)
orient(vertical)) text(0 50 "0.003% (0-0.03%)", place(nw) size(medsmall)
orient(vertical)) text(0 60 "0.01% (0-1.1%)", place(nw) size(medsmall)
orient(vertical)) text(0 90 "0.24% (0-2.2%)", place(nw) size(medsmall)
orient(vertical)) legend(off) text(1 25 "Pulsed 26W" "Muscle & Uncharred
tissue", place(se) box bcolor(gs14) just(left) margin(l+4 t+1 b+1) width(40)
size(medsmall))
graph save "$outfile/F7",replace

*****************************************
*Pulsed 26W Adipose & Uncharred tissue
*****************************************

adjustrcspline, custominvlink(1-base5s^(exp(xb(#1)))) at(Las_Mode=3
Tis_Fat=1 Tis_Charred=0) generate(p l u)

replace l=0 if l<0
replace u=1 if u>1
keep if TissueOxygenConcentration<=90 & Las_Mode==3 & Tis_Fat==1 &
Tis_Charred==0
twoway rarea l u TissueOxygenConcentration, sort color(gs14) || line p
TissueOxygenConcentration, sort color(gs10) ylabel(0(.1)1, angle(0)
format(%04.2f) labsize(medsmall)) xtitle("Tissue oxygen concentration",
size(medsmall)) title("Risk of flame in 5 seconds", size(medium)) ytitle("Risk",
size(medsmall)) xlabel(25(5)90, angle(0) labsize(medsmall))
graphregion(color(white)) tline(40 50 60 90, lp(dot) lw(thin) lc(black)
lstyle(grid) axis(1)) text(0 40 "0.001% (0-0.05%)", place(nw) size(medsmall)
orient(vertical)) text(0 50 "0.05% (0-0.5%)", place(nw) size(medsmall)
orient(vertical)) text(0 60 "0.2% (0-1.7%)", place(nw) size(medsmall)
orient(vertical)) text(0 90 "3.8% (0-36.0%)", place(nw) size(medsmall)
orient(vertical)) legend(off) text(1 25 "Pulsed 26W" "Adipose & Uncharred
tissue", place(se) box bcolor(gs14) just(left) margin(l+4 t+2 b+1) width(40)
size(medsmall))
graph save "$outfile/F8",replace
```