Supplementary Materials: Propensity Score Analysis for VAP/VAPBACT and Mortality

Goal: Estimate effect of VAP + Bacteremia over VAP alone on hospital mortality in absence of randomization. Adjust for potential bias due to confounding using propensity score analysis.

Relevant covariates include:

- Age Gender
- Race (coded as white/non-white)
- Initial base deficit (>=6 vs. < 6)
- Blood transfused in first 24 hours
- APS
- Pulmonary contusion
- Injury severity score (ISS)
- Body region abbreviated injury scale scores (AIS)
- Mechanism of injury (blunt vs. other)
- Co-morbidities

Covariate list
AGECAT: age categorized in empiric quartiles (0-25, 25-40, 40-55, >55)
GENDERM: Sex (male =1)
WHITE: white vs. non-white with unknown race coded as white
FIRSTBDE6 - initial base deficit coded >= 6meq/l (yes = 1) or <=
(Assuming normal if not measured)
BLOODCAT: blood transfusions in the first 24 hours categorized in quartiles (0, 1-5, 6-15, >15), but used as a continuous variable)
APSQ: APS coded in empiric quartiles (but used as a continuous variable)
ISSQ: ISS as a continuous variable or coded in empiric quartiles (but used as a continuous variable)
Co-morbidities with adequate data (cardiovascular, diabetes, respiratory disease)
AISHEAD, AISABD , AISCHEST, AISSPINE, AISUE, AISLE—body region injuries coded as less severe (0-2) or more severe (>=3)
PULCONT—pulmonary contusion

Hospital Mortality (Raw)

Outcome	VAP	VAP + Bacteremia
Survived	424	55
Died	56	19
Hospital mortality rate	11.7%	25.7%

The unadjusted relative risk of death associated with VAP + Bacteremia is 2.20.

The odds ratio is 2.62 with a 95% confidence interval (1.45, 4.72).

The absolute increase in mortality rate associated with VAP + Bacteremia is 14.0% with a 95% confidence interval (2.9%, 25.1%).

Propensity Score

Compute propensity scores to balance prognostic variables across VAP and VAP + Bacteremia groups

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Deviance Residuals:
    Min       1Q   Median       3Q      Max
-0.9940  -0.5660  -0.4600  -0.3562   2.5623

Coefficients:
               Estimate Std. Error z value Pr(>|z|)
(Intercept)    -2.84657    1.12584  -2.528   0.0115 *
AGECAT          0.13205    0.14351   0.920   0.3575
GENDERM         0.28460    0.32949   0.864   0.3877
WHITE           0.46566    0.39630   1.175   0.2400
FIRSTBDE6YES    0.26180    0.30744   0.852   0.3944
BLOODCAT        0.03428    0.15000   0.229   0.8192
APSQ            0.22265    0.14641   1.521   0.1283
ISSQ           -0.14536    0.17131  -0.849   0.3961
CISCVYES        0.32713    0.33028   0.990   0.3219
CISDIABETESYES  0.56547    0.45966   1.230   0.2186
CISLUNGYES     -0.12162    0.42445  -0.287   0.7745
AISHEADLOW     -0.04076    0.32762  -0.124   0.9010
AISABDLOW      -0.08271    0.35120  -0.235   0.8138
AISCHESTLOW    -0.35120    0.37077  -0.947   0.3435
AISSPINELOW    -0.51276    0.28627  -1.791   0.0733 .
AISUELOW        0.02928    0.39990   0.073   0.9416
AISLELOW       -0.05369    0.29951  -0.179   0.8577
PULCONTYES     -0.09314    0.34270  -0.272   0.7858
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Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

(Dispersion parameter for binomial family taken to be 1)

    Null deviance: 384.14  on 491  degrees of freedom
Residual deviance: 363.76  on 474  degrees of freedom
AIC: 399.76

Number of Fisher Scoring iterations: 5

> summary(pscore$ps2)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
0.02994 0.07973 0.11690 0.13250 0.16270 0.48780
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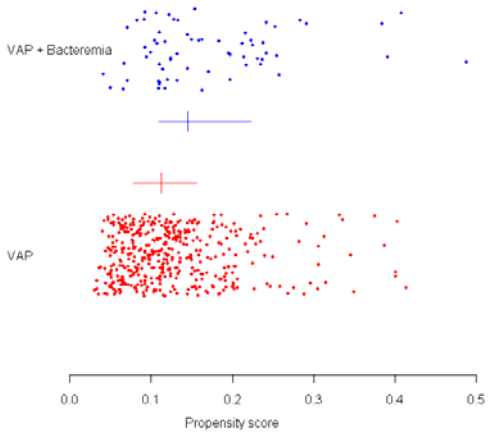
Assessment of the effect of the propensity score model in adjusting for the risk for bacteremia

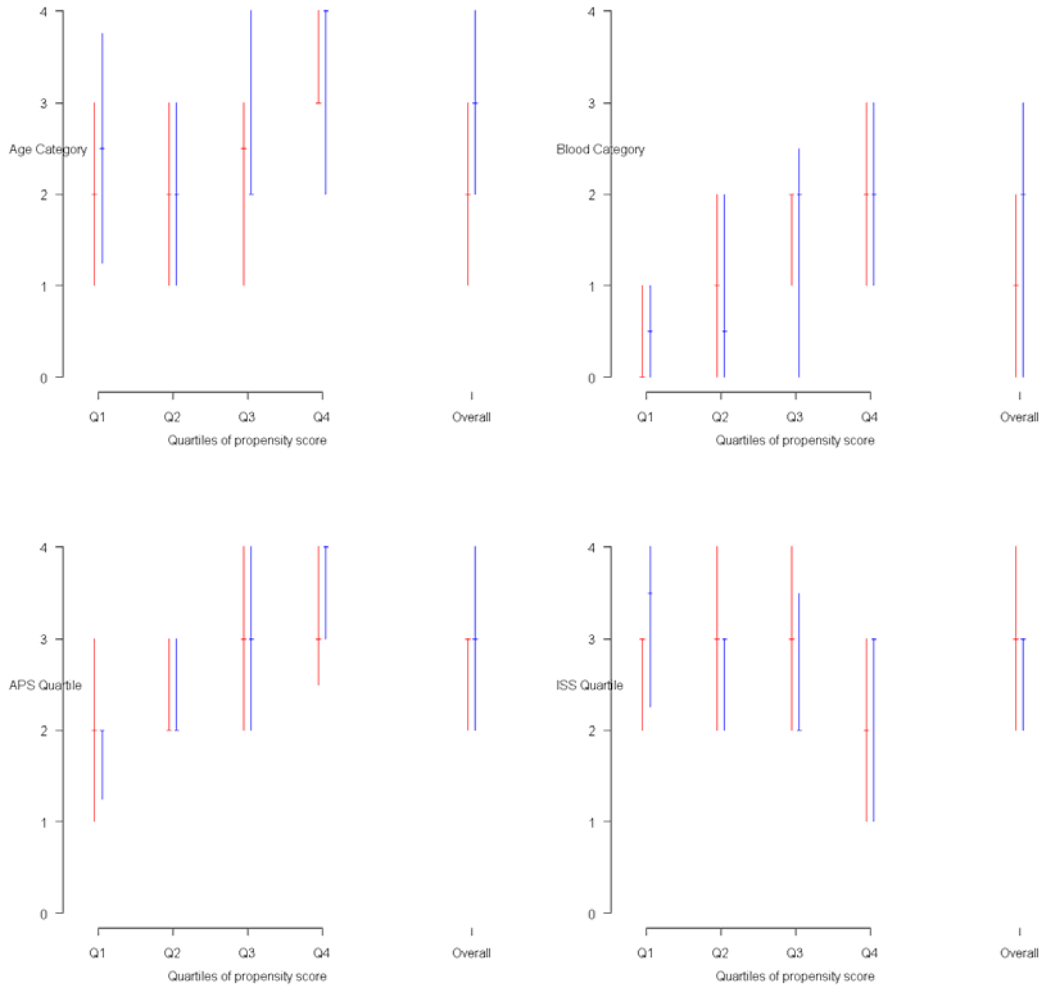
Model propensity scores range from .03 to .49.
Compare the distribution of scores in the 2 groups:

As expected, the propensity scores are on average slightly higher in the VAP + Bacteremia group with a good degree of overlap.



Check the distribution of explanatory variables by plotting the median and IQR of continuous variables in each propensity score quartile. Compare t-statistics before and after adjusting for the propensity score. Examine distribution of categorical covariates in propensity score quartiles. Run stratified logistic models to check balance for categorical variables.

Continuous
AGECAT, BLOODCAT, APSQ, ISSQ



Before and after propensity score t-statistics:

	Before	After	p-Value After*
AGE	2.1514208	0.79975446	.42
Blood Units	1.6797357	0.28498955	.78
APS	1.7517384	0.42125266	.67
ISS	-0.4974791	-0.07058082	.94

Categorical data

GENDER, WHITE, FIRSTBDE6, CISCV, CISDIABETES, CISLUNG, AISHEAD, AISABD, AISCHEST, AISSPINE, AISUE, AISLE, PULCONT

Gender

	VAP		VAP + Bacteremia	
	Male	Female	Male	Female
Q1	79 (68%)	38 (32%)	5 (83%)	1 (17%)
Q2	73 (68%)	34 (32%)	12 (75%)	4 (25%)
Q3	86 (80%)	22 (20%)	11 (73%)	4 (27%)
Q4	76 (80%)	19 (20%)	22 (79%)	6 (21%)

p-Value = .83

White

	VAP		VAP + Bacteremia	
	White	Non-White	White	Non-White
Q1	65 (56%)	52(44%)	3 (50%)	3 (50%)
Q2	85 (79%)	22 (21%)	16 (100%)	0 (0%)
Q3	96 (89%)	12 (11%)	11 (73%)	4 (27%)
Q4	88 (93%)	7 (7%)	26 (93%)	2 (7%)

p-Value = .83

Initial Base Deficit

	VAP		VAP + Bacteremia	
	High	Low	High	Low
Q1	17 (15%)	100 (85%)	2 (33%)	4 (67%)
Q2	42 (39%)	65 (61%)	9 (56%)	7 (44%)
Q3	63 (58%)	45 (42%)	7 (47%)	8 (53%)
Q4	70 (74%)	25 (26%)	19 (68%)	9 (32%)

p-Value = .85

Cardiovascular Comorbidity

	VAP		VAP + Bacteremia	
	Yes	No	Yes	No
Q1	5 (4%)	112(96%)	1 (17%)	5 (83%)
Q2	23 (21%)	84 (79%)	2 (13%)	14 (87%)
Q3	31 (29%)	77 (71%)	5 (33%)	10 (67%)
Q4	60 (63%)	35 (37%)	19 (68%)	9 (32%)

p-Value = .74

Diabetes Comorbidity

	VAP		VAP + Bacteremia	
	Yes	No	Yes	No
Q1	0 (0%)	117(100%)	0 (0%)	6 (100%)
Q2	3 (3%)	104 (97%)	0 (0%)	16 (100%)
Q3	2 (2%)	106 (98%)	1 (7%)	14 (93%)
Q4	22 (23%)	73 (77%)	8 (29%)	20 (71%)

p-Value = .51

Respiratory Comorbidity

	VAP		VAP + Bacteremia	
	Yes	No	Yes	No
Q1	13 (11%)	104(89%)	1 (17%)	5 (83%)

Q2	15 (14%)	92 (86%)	3 (19%)	13 (81%)
Q3	8 (7%)	100 (93%)	1 (7%)	14 (93%)
Q4	18 (19%)	77 (81%)	3 (11%)	25 (89%)

p-Value = .72

AIS Head

	VAP		VAP + Bacteremia	
	High	Low	High	Low
Q1	86 (73%)	31 (27%)	4 (67%)	2 (33%)
Q2	75 (70%)	32 (30%)	12 (75%)	4 (25%)
Q3	59 (55%)	49 (45%)	7 (47%)	8 (53%)
Q4	50 (53%)	45 (47%)	13 (46%)	15 (54%)

p-Value = .56

AIS Abdomen

	VAP		VAP + Bacteremia	
	High	Low	High	Low
Q1	31 (27%)	86 (73%)	3 (50%)	3 (50%)
Q2	28 (26%)	79 (74%)	6 (37%)	10 (63%)
Q3	42 (39%)	66 (61%)	4 (27%)	11 (73%)
Q4	37 (39%)	58 (61%)	10 (36%)	18 (64%)

p-Value = .86

AIS Chest

	VAP		VAP + Bacteremia	
	High	Low	High	Low
Q1	46 (39%)	71 (61%)	3 (50%)	3 (50%)
Q2	67 (63%)	40 (37%)	8 (50%)	8 (50%)
Q3	76 (70%)	32 (30%)	11 (73%)	4 (27%)
Q4	74 (78%)	21 (22%)	22 (79%)	6 (21%)

p-Value = .86

AIS Spine

	VAP		VAP + Bacteremia	
	High	Low	High	Low
Q1	23 (20%)	94 (80%)	1 (17%)	5 (83%)
Q2	31 (29%)	76 (71%)	4 (25%)	12 (75%)
Q3	40 (37%)	68 (63%)	7 (47%)	8 (53%)
Q4	57 (60%)	38 (40%)	18 (64%)	10 (36%)

p-Value = .67

AIS UE

	VAP		VAP + Bacteremia	
	High	Low	High	Low
Q1	8 (7%)	109 (93%)	3 (50%)	3 (50%)
Q2	21 (20%)	86 (80%)	1 (6%)	15 (94%)
Q3	16 (15%)	92 (85%)	3 (20%)	12 (80%)
Q4	13 (14%)	82 (86%)	3 (11%)	25 (89%)

p-Value = .80

AIS LE

	VAP		VAP + Bacteremia	
	High	Low	High	Low

Q1	29 (25%)	88 (75%)	3 (50%)	3 (50%)
Q2	41 (38%)	66 (62%)	5 (31%)	11 (69%)
Q3	49 (45%)	59 (55%)	7 (47%)	8 (53%)
Q4	55 (58%)	40 (42%)	16 (57%)	12 (43%)

p-Value = .90

Pulmonary Contusion

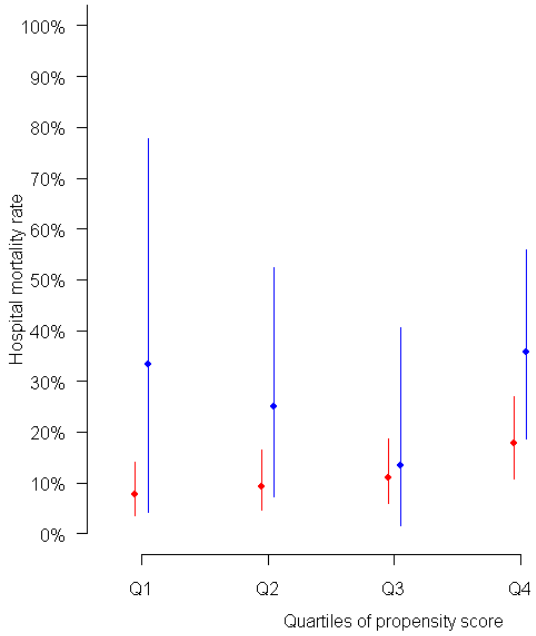
	VAP		VAP + Bacteremia	
	Yes	No	Yes	No
Q1	31 (26%)	86 (74%)	1 (17%)	5 (83%)
Q2	41 (38%)	66 (62%)	5 (31%)	11 (69%)
Q3	41 (38%)	67 (62%)	6 (40%)	9 (60%)
Q4	33 (35%)	62 (65%)	10 (36%)	18 (64%)

p-Value = .76

After adjusting for propensity score, there were no differences in the risk factors between patients with and without bacteremia. This indicates that the propensity score captures the risk for bacteremia associated with each of the variables included in the model.

Determine the risk for mortality associated with bacteremia after adjusting for propensity score quartile

1. Determine mortality rates within propensity score quartiles. Plot hospital mortality rates (with 95% confidence intervals) by VAP/VAP + Bacteremia in each propensity score quartile:
(VAP [red], VAP + Bacteremia [blue] in figure below)



This figure demonstrates that the case-fatality rate is generally higher for patients with bacteremia in each propensity score quartile. This difference is smaller in quartile 3 than in the other quartiles.

2. Estimate the effect of VAP/VAP + Bacteremia in logistic regression model adjusting for the propensity score in quartiles.

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Deviance Residuals:
    Min       1Q   Median       3Q      Max
-0.9426  -0.6271  -0.4545  -0.4194   2.2246

Coefficients:
             Estimate Std. Error z value Pr(>|z|)
(Intercept)    -2.3866     0.3185  -7.494 6.68e-14 ***
VAPTYPEBACVAP   0.9456     0.3261   2.899  0.00374 **
psgpM2Q2        0.1683     0.4293   0.392  0.69496
psgpM2Q3        0.1782     0.4288   0.416  0.67764
psgpM2Q4        0.8600     0.3935   2.185  0.02887 *
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Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

(Dispersion parameter for binomial family taken to be 1)

    Null deviance: 387.89  on 491  degrees of freedom
Residual deviance: 370.21  on 487  degrees of freedom
AIC: 380.21

Number of Fisher Scoring iterations: 5
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Bacteremia is associated with a 2.57 increased odds of death (95% confidence interval: 1.36 - 4.88) after adjustment for propensity quartile.