
UCLA SCC Technical Report
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Neonatal Candidiasis Risk Factors

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Abstract

Medical researchers at UCLA Medical Center are studying the risk factors for neonatal candidiasis. Using generalized linear models we investigate the risk factors for neonatal candidiasis.

1 Introduction

This study aims to investigate the risk factors for neonatal candidiasis.

Out of 63 patients, 41 survived (23 female and 18 male) and 22 died (9 female and 13 male).

In this report we aim to answer the following research questions based on this data set:

1. Which factors are significant predictors for survival of patients with neonatal candidiasis?
2. Does excluding patients whose only culture was from a respiratory source change the response to above question?

2 Methodology

All analyses were done using R statistical software. For both research questions a binomial generalized linear model with a logit link was fit using the `glm` function in R.[1]

The process for model selection started with the fully specified model that included number of positive fungal cultures, platelet count nadir during IFI (1000 cells / mm³), NICU stay at time of first positive fungal culture (days), gestational age (categories: less than or equal to 26 weeks, 27 to 32 weeks, 33 to 37 weeks, greater than or equal to 38 weeks), gender, whether or not the patient has congenital heart disease, age at time of first positive (days), time with CVC before first positive fungal culture (days) and time between first positive culture and initiation of therapy (days).

A backwards model selection approach was then employed to remove one predictor at a time from the model based on their p-values. This process was then continued with model fit being assessed by AIC, and the model resulting in the lowest AIC was selected.

Odds ratios for covariates were calculated as the exponential of the estimated coefficient for that variable and confidence intervals were calculated using the standard errors of the coefficients. For example, if gestational age were a covariate of interest the odds ratio for gestational age+1 vs gestational age would be calculated as $\exp(\beta_{\text{gestational age}})$ and the confidence interval is calculated as $\exp(\beta_{\text{gestational age}} \pm 1.96 * se(\beta_{\text{gestational age}}))$.

3 Results

Results for each research question are presented below. Significance of predictors is assessed using $\alpha = 0.05$.

3.1 Which factors are significant predictors for survival of patients with neonatal candidiasis?

The backward selection algorithm yielded a model including number of positive fungal cultures, platelet count nadir during IFI, NICU stay at time of first positive fungal culture, gender and time between first positive culture and initiation of therapy.

Table 1 displays odds ratios and confidence intervals along with p-values of the coefficients. A complete model output is included in the appendix.

Table 1: Generalized linear model for entire data set

| | OR | 95% CI | Pr(> z) |
|-----------------------------------|-------|-----------------|----------|
| number of positive cultures | 1.357 | (0.969, 1.900) | 0.0752 |
| platelet count | 0.986 | (0.966, 1.007) | 0.2024 |
| NICU stay before positive culture | 1.022 | (1.001, 1.043) | 0.0391 |
| gender | 2.898 | (0.678, 12.399) | 0.1512 |
| time between culture and therapy | 1.060 | (0.974, 1.153) | 0.1783 |

- The odds ratio of number of positive fungal cultures is 1.357 indicating that a one unit increase in the number of positive cultures is expected to increase the odds of death by a factor of 1.357. However number of positive cultures is not a significant predictor ($z = 1.78, p - value = 0.0752$). This implies that number of positive cultures has no significant effect on whether or not the patient dies.
- The odds ratio of number of platelet count nadir during IFI is 0.986 indicating that a one unit increase in the platelet count is expected to decrease the odds of death by a factor of 0.986. However platelet count is not a significant predictor ($z = -1.27, p - value = 0.2024$). This implies that platelet count has no significant effect on whether or not the patient dies.
- The odds ratio of NICU stay at time of first positive fungal culture is 1.022 indicating that a one day increase in NICU stay is expected to increase the odds of death by a factor of 1.022. NICU stay has a significant effect on whether or not patients die ($z = 2.06, p - value = 0.0391$). Hence we conclude that patients who have a longer NICU stay before first positive culture are more likely to not survive neonatal candidiasis.
- The odds ratio of gender is 2.898 indicating that males are expected to be 2.898 times more likely to die than females. However gender is not a significant predictor ($z = 1.44, p - value = 0.1512$). This implies that gender has no significant effect on whether or not the patient dies.
- The odds ratio of time between culture and therapy, which measures delay in treatment, is 1.060 indicating that a one day increase in time between culture and therapy is expected to increase the odds of death by a factor of 1.060. However time between culture and therapy is not a significant predictor ($z = 1.35, p - value = 0.1783$). This implies that delay in treatment has no significant effect on whether or not the patient dies.

3.2 Does excluding patients whose only culture was from a respiratory source change the response to above question?

When patients whose only culture was from a respiratory source are excluded, there remains 51 patients in the data set (12 excluded). This does change the results slightly. The backward selection algorithm yields a model including number of positive fungal cultures, platelet count nadir during IFI, NICU stay at time of first positive fungal culture, gestational age and gender.

Table 2 displays odds ratios and confidence intervals along with p-values of the coefficients. A complete model output is included in the appendix.

Table 2: Generalized linear model excluding patients whose only culture was from a respiratory source

| | OR | 95% CI | Pr(> z) |
|-----------------------------------|--------|-----------------------|----------|
| number of positive cultures | 1.687 | (0.979, 2.905) | 0.0591 |
| platelet count | 0.981 | (0.962, 1.000) | 0.0545 |
| NICU stay before positive culture | 1.026 | (1.003, 1.049) | 0.0257 |
| gestational age | | | |
| <i>27 - 32 weeks</i> | 0.189 | <i>extremely wide</i> | 0.7994 |
| <i>33 - 37 weeks</i> | 22.000 | (0.099, 486.693) | 0.0504 |
| <i>≥ 38 weeks</i> | 7.050 | (0.602, 82.552) | 0.1197 |
| gender | 17.444 | (1.709, 177.996) | 0.1512 |

NICU stay before positive culture is once again a significant predictor however gender, which was not a significant predictor in the model for the entire data set, is a significant predictor in the model when patients whose only culture was from a respiratory source are excluded. Also, even though at a strict $\alpha = 0.05$ level platelet count is not significant, it should be noted that the p-value is only slightly over 0.05.

4 Summary

In this analysis we did not find very many significant predictors for survival of patients with neonatal candidiasis however it appears that the model may be a better fit when patients with patients whose only culture was from a respiratory source are excluded.

5 References

[1] <http://stat.ethz.ch/R-manual/R-patched/library/stats/html/glm.html>.

A Appendix

A.1 Which factors are significant predictors for survival of patients with neonatal candidiasis?

| | Estimate | Std. Error | z value | Pr(> z) |
|--------------------|----------|------------|---------|----------|
| (Intercept) | -2.7751 | 1.0923 | -2.54 | 0.0111 |
| noPosFungalCX | 0.3054 | 0.1717 | 1.78 | 0.0753 |
| plts | -0.0137 | 0.0108 | -1.27 | 0.2024 |
| daysICUbeforePosCX | 0.0215 | 0.0104 | 2.06 | 0.0391 |
| gender | 1.0643 | 0.7415 | 1.44 | 0.1512 |
| daysDelay | 0.0580 | 0.0431 | 1.35 | 0.1783 |

A.2 Does excluding patients whose only culture was from a respiratory source change the response to above question?

| | Estimate | Std. Error | z value | Pr(> z) |
|--------------------|----------|------------|---------|----------|
| (Intercept) | -5.2416 | 1.8741 | -2.80 | 0.0052 |
| noPosFungalCX | 0.5231 | 0.2772 | 1.89 | 0.0592 |
| plts | -0.0192 | 0.0100 | -1.92 | 0.0545 |
| daysICUbeforePosCX | 0.0257 | 0.0115 | 2.23 | 0.0257 |
| gaCat1 | -1.6663 | 6.5579 | -0.25 | 0.7994 |
| gaCat2 | 3.0911 | 1.5799 | 1.96 | 0.0504 |
| gaCat3 | 1.9531 | 1.2553 | 1.56 | 0.1197 |
| gender | 2.8590 | 1.1851 | 2.41 | 0.0158 |