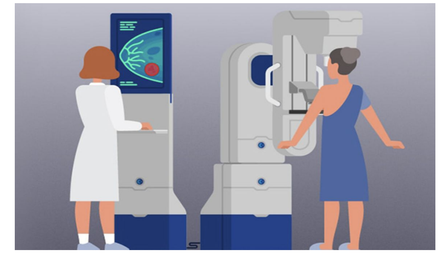
Study of Interventions Effects on Breast Cancer Screening Compliance and Cognitive Stages

Ruoer Bei, Shiyang Li, Yang Meng, Xintong Zhai

Department of Biostatistics, University of Michigan, Ann Arbor, MI



Introduction

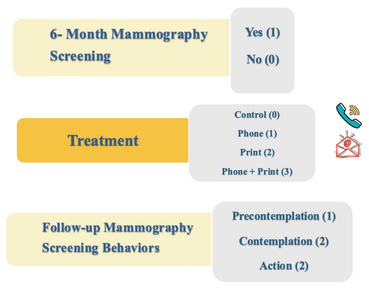
The Problem

- Breast cancer is the leading death among US women. Despite the effectiveness of mammography screening, adherence is challenging.

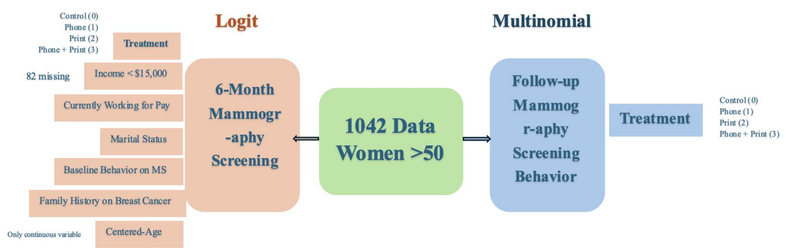
Scientific Questions

① Would the three interventions increase mammography screening compliance evaluated at month 6 (**Resp6**)? **Logistic Regression**

② Would these interventions increase the odds of advancing through the cognitive stages of mammography screening (**Stagefwup**)? **Multinomial Logistic**



2. Data Description



Data Processing

- **EducmorethanHSdegree**, **Docnursespoken2years**:
  - large collinearity → were not selected
- Final study population: 960 participants (deleted missing data from **Inclt15k**)
- Centered Age: subtracting 50

3. Models

Outcome 1 (Resp6): Logistic Regression Model

- $\text{logit}(\pi_i) = \beta_0+\beta_1\cdot(\text{treatment1}_i)+\beta_2\cdot(\text{treatment2}_i)+\beta_3\cdot(\text{treatment3}_i)+\beta_4\cdot(\text{age\_center}_i)+\beta_5\cdot(\text{inclt15k}_i)+\beta_6\cdot(\text{workpay}_i)+\beta_7\cdot(\text{married}_i)+\beta_8\cdot(\text{stagebase}_i)+\beta_9\cdot(\text{fdrhistory}_i)$
- where π_i=P(Resp6_i=1 | treatment1_i, treatment2_i, ……, stagebase_i, fdrhistory_i)

Outcome 2 (Stagefwup): Multinomial Logistic Model

$\log\{P(Y_i \le j)/P(Y_i > j)\}=\gamma_{0j}+\gamma_1(\text{treatment1}_i)+\gamma_2(\text{treatment2}_i)+\gamma_3(\text{treatment3}_i)$

- where Y_i represents follow-up mammography screening behavior of i-th patient
- j=0/j=1 represents least/moderate probability of follow-up mammography screening

4. Results

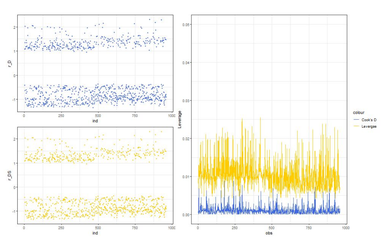
Outcome 1 (Resp6): Logistic Regression Model

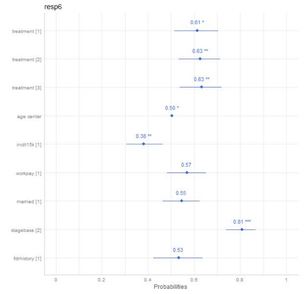
In there an effect of treatment on compliance with family history? → Interaction

- All the interaction term results with family history are not significant (p-value > 0.1)
- Returning back to the model without interaction terms **Outcome 1**

Diagnosis

- Likelihood Ratio Test: p-value = 0.26 → failed to reject the null
- Hosmer-Lemeshow (HL) goodness-of-fit : p-value = 0.99 → failed to reject the null
- Cox & Snell pseudo R^2: 0.18 → improvement from the intercept-only Model (1)
- Max Adjusted Cox & Snell R^2: 0.24
- Standard Pearson Residuals & Standard Deviance Residuals: horizontal band no curvature
- Cook's Distance and Leverages: no high-leverage or high-influence observations
- Variance Inflation Factors (VIFs): all values are between 1 and 5





Interpretation of $\exp(\beta_1)$, $\exp(\beta_2)$, $\exp(\beta_3)$

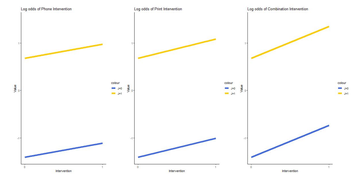
- **Meaning:** estimated odds ratio of mammography compliance at month 6 for the subgroup with different intervention versus the control intervention
- **Values:** 1.59, 1.68 and 1.72 respectively
- **Significance:** p-value < 0.05 → each coefficient of treatment is significant

Outcome 2 (Stagefwup): Multinomial Logistic Model

Diagnosis

- LRT: p-value=0.42 > 0.05 → no strong evidence that the proportionality assumption is not satisfied

	Coefficient	Significance level
intercept1	0.24	0.089
intercept2	1.97	0.015
phone	1.34	***
mail	1.49	***
phone + mail	1.96	***



Interpretation of $\exp(\gamma_1)$, $\exp(\gamma_2)$, $\exp(\gamma_3)$, $\exp(\gamma_{00})$, $\exp(\gamma_{01})$

- **Meaning:** estimated odds ratio of follow up stage of mammography screening behavior for three categories(precontemplation, contemplation and action), between the subgroups(phone intervention, mail intervention, phone and mail intervention) and the control subgroup.
- **Values:** 1.34, 1.49, and 1.96 respectively
- **Significance:** p-value < 0.05 → Three interventions significantly increase the odds of mammography cognitive stages by 34.4%, 49.4% and 95.8% separately.
- **Intercepts Meaning:** estimated baseline odds of follow up stage of mammography screening behavior for control group. Precontemplation: 0.244; Contemplation or Precontemplation: 1.972

5. Conclusion & Discussion

- Model (1) for **Resp6** and Model (2) for **Stagefwup**: three treatments all significantly enhance screening compliance and increase cognition compared to usual care.
- More tailored interventions → more effective in both models

Outcome \ Treatment	Resp6	Stagefwup
phone	1.59	1.34
mail	1.68	1.49
phone + mail	1.73	1.96

Increased effect

- Need for multiple imputation and EM algorithm to deal with missing data
- Diverse demographics may needed

6. Acknowledgment

We thank Dr. Veera Baladandayuthapani for his generous help!

References

1. Legler, Juliette. "The effectiveness of interventions to promote mammography among women with historically lower rates of screening." NIH, 9 November 2002, https://www.ncbi.nlm.nih.gov/books/NBK69215/.
2. Schueler, Kristin. "Factors Associated with Mammography Utilization: A Systematic Quantitative Review of the Literature." Mary Ann Liebert, 9 November 2007, https://www.liebertpub.com/doi/abs/10.1089/jwh.2007.0603?journalCode=jwh.