

Influential Factors of Patients' Serious Adverse Effects

Key words: Patient Safety, Adverse Effects, Logistic Regression

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Motivation

Patient safety is the fundamental component in healthcare services. According to World Health Organization, the occurrence of adverse events due to unsafe care is likely one of the 10 main causes of death and disability in the world. Hartwig's scale states that **46.03%** of adverse reaction (ADRs) were classified as unpreventable, while **48.81%** as probably preventable ADRs, and **5.16% as definitely preventable ADRs**. The objective of this project is to analyze the association between factors, aiming to develop an effective model to decrease possible preventable ADRs rate in practice.



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Research Questions

- Could we identify the correlation between different features?
- Could we find determinants for patient's advert effect's seriousness level?
- Could we build the effective model to examine these effects?



Data

- There are 9990 observations with 17 variables in raw data
- After data cleaning and processing, the dataframe involved in this project contains 7425 observations with 8 created variables.

```
df.head()
```

	patientonsetage	patientonsetageunit	patientagegroup	patientsex	reaction	drug	summary	patientweight	reaction_count	drug_count	seriousness	seriousness
0	42.0	801.0	5.0	1.0	Headache	[{'drugcharacterization': '1', 'medicinalprodu...	NaN	NaN	2	5	0	
1	53.0	801.0	NaN	1.0	Headache	[{'drugcharacterization': '1', 'medicinalprodu...	NaN	NaN	8	3	1	
2	69.0	801.0	6.0	2.0	Headache	[{'drugcharacterization': '1', 'medicinalprodu...	NaN	NaN	1	2	0	
3	53.0	801.0	NaN	2.0	Headache	[{'drugcharacterization': '1', 'medicinalprodu...	NaN	NaN	6	2	1	
4	44.0	801.0	5.0	2.0	Headache	[{'drugcharacterization': '1', 'medicinalprodu...	('narrativeincludeclinical': 'CASE EVENT DATE:...	NaN	7	1	0	

Motivation

Questions

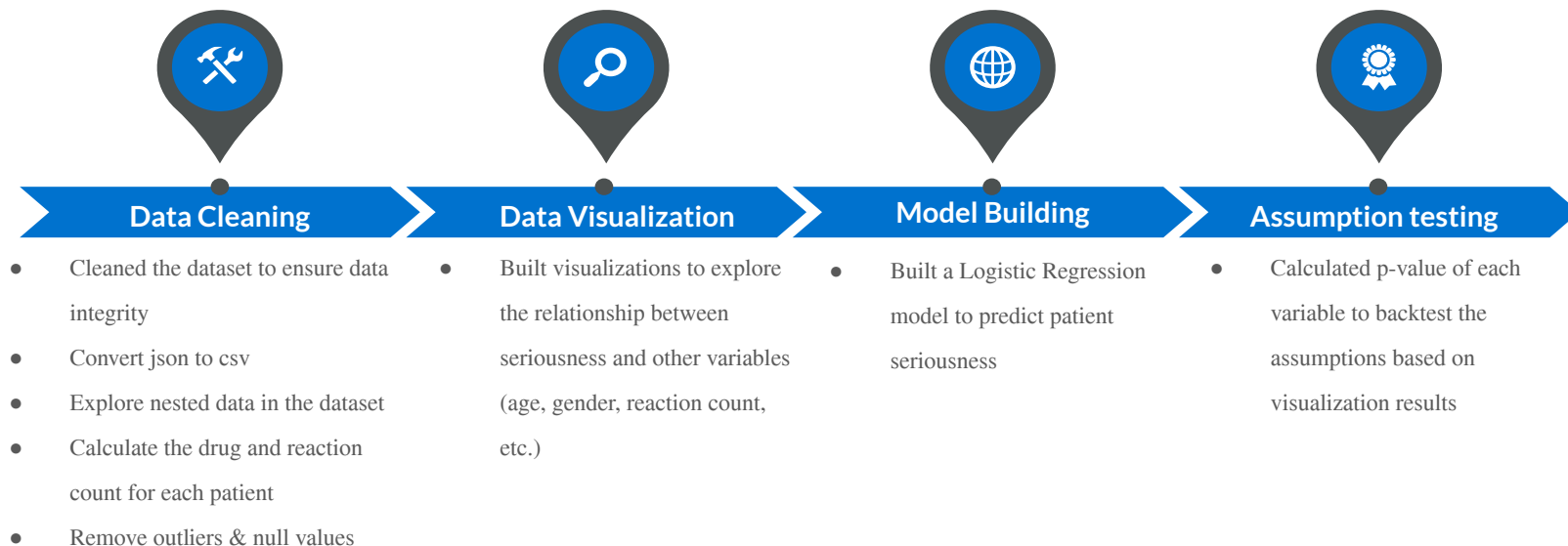
Data

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Methodology



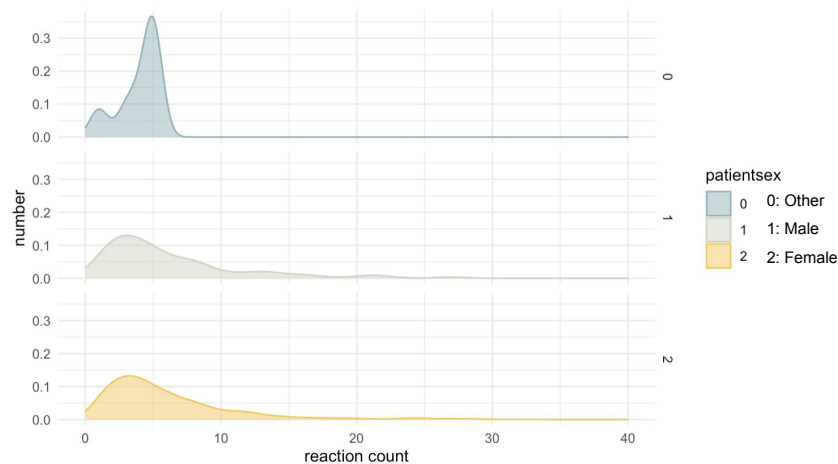
$$\text{logit}(P_i) = \ln(P_i/(1 - P_i)) = \beta_0 + \beta_1 \text{PatientAge}_i + \beta_2 \text{PateintMale} + \beta_3 \text{PatientFemale} + \beta_4 \text{ReactionCount} + \beta_5 \text{DrugCount}$$



Findings

Although the correlation between reaction count is weak related to seriousness level (left table), there is significant correlation with seriousness level = 1 when reaction count exceed certain threshold (right image).

	Reaction Count	Drug Count	Seriousness
Reaction Count	1.0000	0.3509	-0.1113
Drug Count	0.3509	1.0000	-0.0631
Seriousness	-0.1113	-0.0631	1.0000



Source: FDA's Adverse Drug Events database, retrived Feb.11, 2023

Motivation

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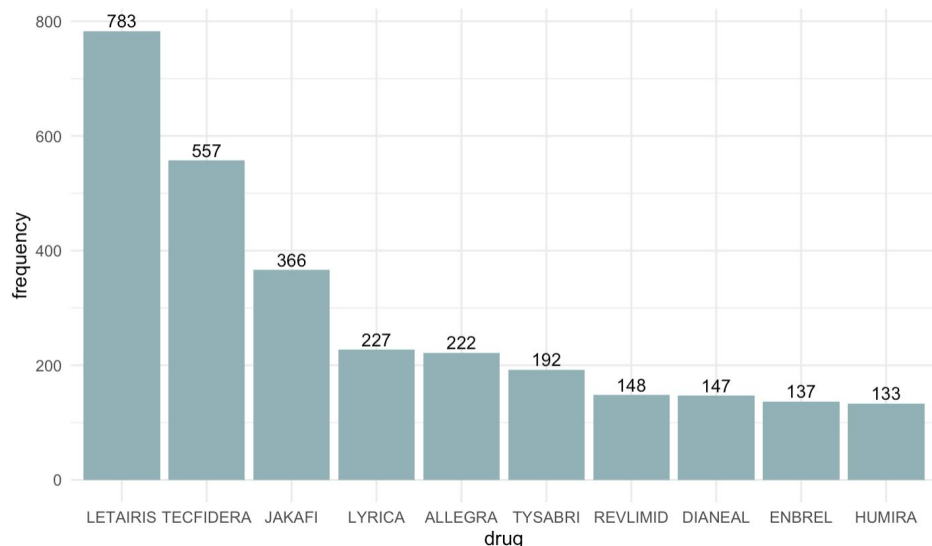
Data

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The Most Suspected Drugs that Caused Advert Effects by Frequency



Source: FDA's Adverse Drug Events database, retrieved Feb.11, 2023

Some drugs are labeled as “Suspected” about causing the adverse effects in the dataset, we notice that some of them are significantly common than other drugs (For example, Letairis occurs ~8% in the dataset which covers more than 1000 different drugs).

Though we cannot explicitly deduce causal inference between certain drugs and adverse effects, these top drugs should be pay special attention [Might be included in future studies].

Motivation

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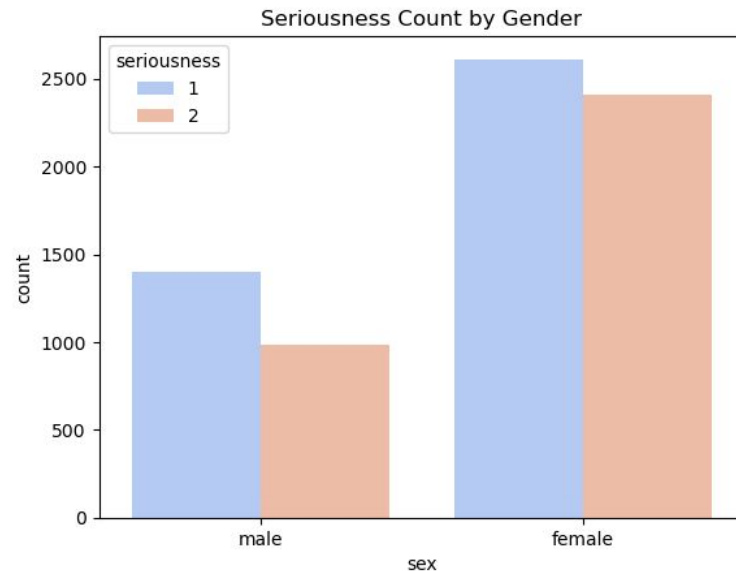
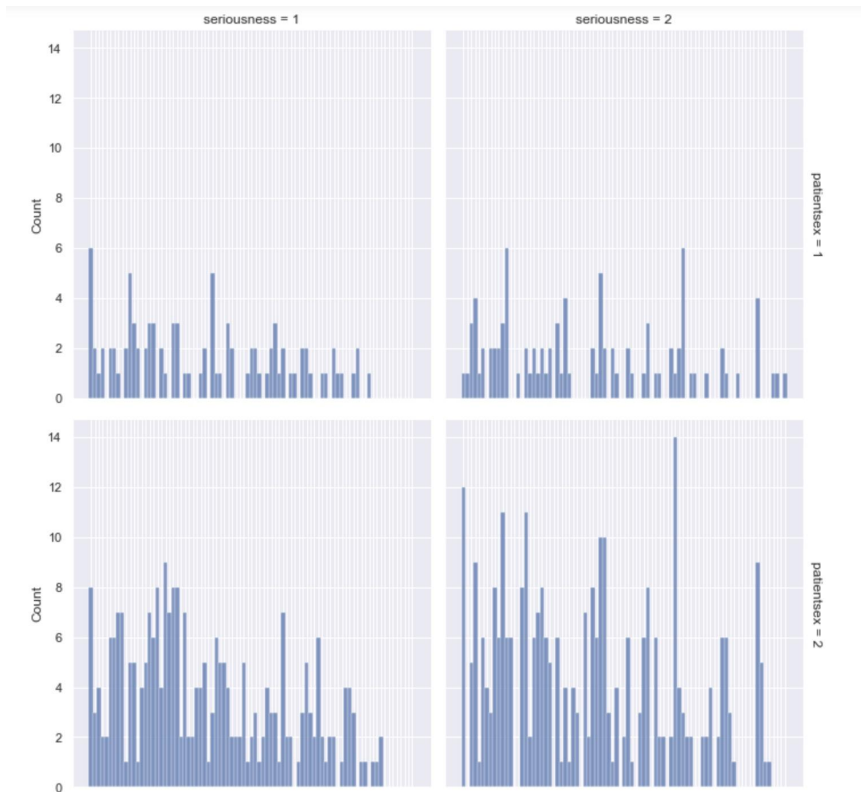
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Seriousness Count by Age and Gender



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Current function value: 0.677213

Iterations 5

Logit Regression Results

Dep. Variable:	seriousness	No. Observations:	7401
Model:	Logit	Df Residuals:	7395
Method:	MLE	Df Model:	5
Date:	Sun, 12 Feb 2023	Pseudo R-squ.:	0.01816
Time:	05:40:18	Log-Likelihood:	-5012.1
converged:	True	LL-Null:	-5104.7
Covariance Type:	nonrobust	LLR p-value:	3.832e-38

	coef	std err	z	P> z	[0.025	0.975]
Intercept	-0.5733	0.323	-1.776	0.076	-1.206	0.059
C(patientsex)[T.1.0]	0.2124	0.320	0.665	0.506	-0.414	0.839
C(patientsex)[T.2.0]	0.4715	0.318	1.482	0.138	-0.152	1.095
patientonsetage	0.0055	0.001	4.279	0.000	0.003	0.008
reaction_count	-0.0345	0.004	-8.931	0.000	-0.042	-0.027
drug_count	-0.0099	0.004	-2.271	0.023	-0.019	-0.001

Results of Logistic Regression

We mainly discuss effects of patient age, number of reactions and number of drugs on the seriousness level. All three of them have significant influences according to p-value, while an older patient would tend to have a higher seriousness level, the case is on the contrary for the other two factors.

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Conclusion

- By investigating patient conditions and behaviors, we find some drugs appeared very frequently in patient's adverse reaction record, which should be take special attention in the future.
- Further, we successfully build a logistic regression model that indicates significant variables (total number of drug intake, total number of reaction); thus, could intentionally decrease the probability of preventable adverse reaction
- We recommend that patients pay extra attention to their health and other important features to reduce the preventable adverse reaction (ADRs) to the max extent, and we should have risk disclosure in advance



Discussion and Future Work

- We tried various approaches to tackle this challenging dataset and successfully defined our problem statements
- Though we draw some solid conclusions, there are lots of things we can do
- There are plenty of data in the original dataset we can further utilize
- The connection between various adverse effects and drugs can be explored if we have time to construct a proper mapping/connection relationship between these two factors
- We can try more powerful models in the future



Reference

[1] <https://www.who.int/news-room/fact-sheets/detail/patient-safety>

Data Source: <https://open.fda.gov/apis/drug/event/how-to-use-the-endpoint/>

Thanks for Listening

