Electronic Health Records: The New Future of Healthcare?

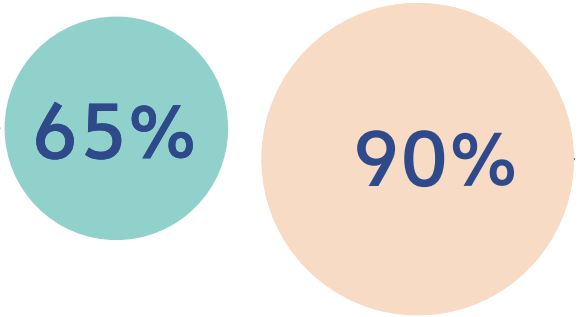
Cordelia Hume, Clare Sparling

Mentor: Yue Jiang

Duke University

Electronic Health Records

Technological Usage Gap



Older Populations

65+ who used internet regularly in 2016

Younger Adults

18+ who used internet regularly in 2016

(Hunsaker & Hargittai, 2018)

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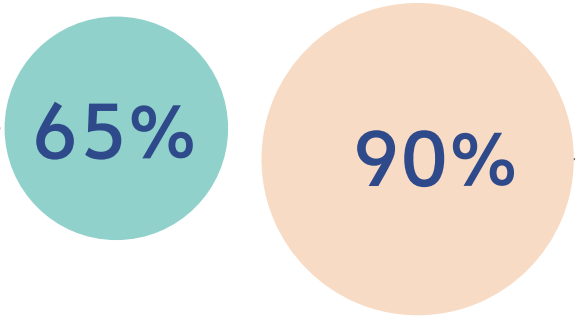

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65+ internet Health usage ≠ **Younger internet Health usage**

(Hunsaker & Hargittai, 2018)

RESEARCH QUESTION

Is there an association between PHR usage and diabetic outcome, and if so, does the association depends on the user's age?

Cleveland Clinic Dataset on electronic personal health records (PHR)

- PHR free to all patients
- Collected: PHR usage, health status, demographics
- Population: 19-77 years with actively managed diabetes
    - July 2008-June 2009

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METHODOLOGY

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I. DATA VISUALIZATION

Visualize the main predictor and outcome variables in our dataset, creating a combined histogram and scatter plot of the relationship between age and HbA1c% levels, stratified by usage status of the PHR system

II. LINEAR REGRESSION MODEL

Fit a multiple linear regression model with our interactions

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Outcome variable: HbA1c%

Predictors:

Continuous variables: BMI, age, and income

Categorical Variables: PHR user status, sex, and race

Interaction term: PHR user status and age

II. LINEAR REGRESSION MODEL

Assess Assumptions for Linear Model

1. Independence.

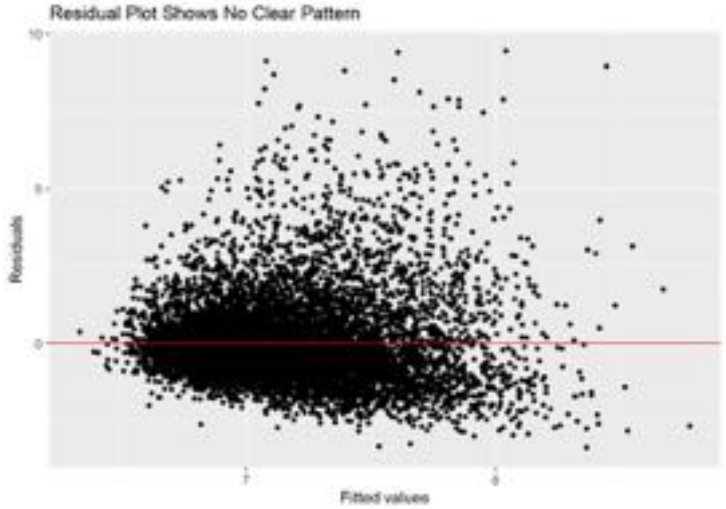
Study contained data from Cleveland Clinic patients who were not related and thus the observations from one individual should not impact the observations for another.

2. Linearity

Plotted residuals are mostly symmetric across the x-axis as demonstrated by the scatter plot.

3. Equal Variance

Range of residuals is mostly the same for all fitted values, as shown by the scatter plot which shows no clear pattern.



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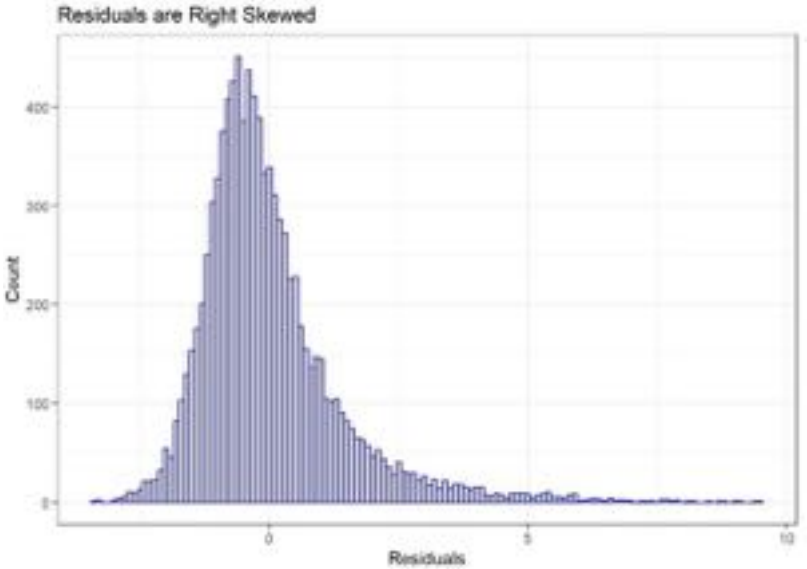
Assess Assumptions for Linear Model

4. Normally distributed residuals

The assumption of normally distributed residuals is not met in this analysis as the histogram of the residuals of this fitted model is right skewed



Statistical Significance: T-test

Test whether there was sufficient statistical evidence to reject the null hypothesis that the slope term = 0

- Degrees of freedom: 9969
- Significance level: $\alpha = 0.05$.

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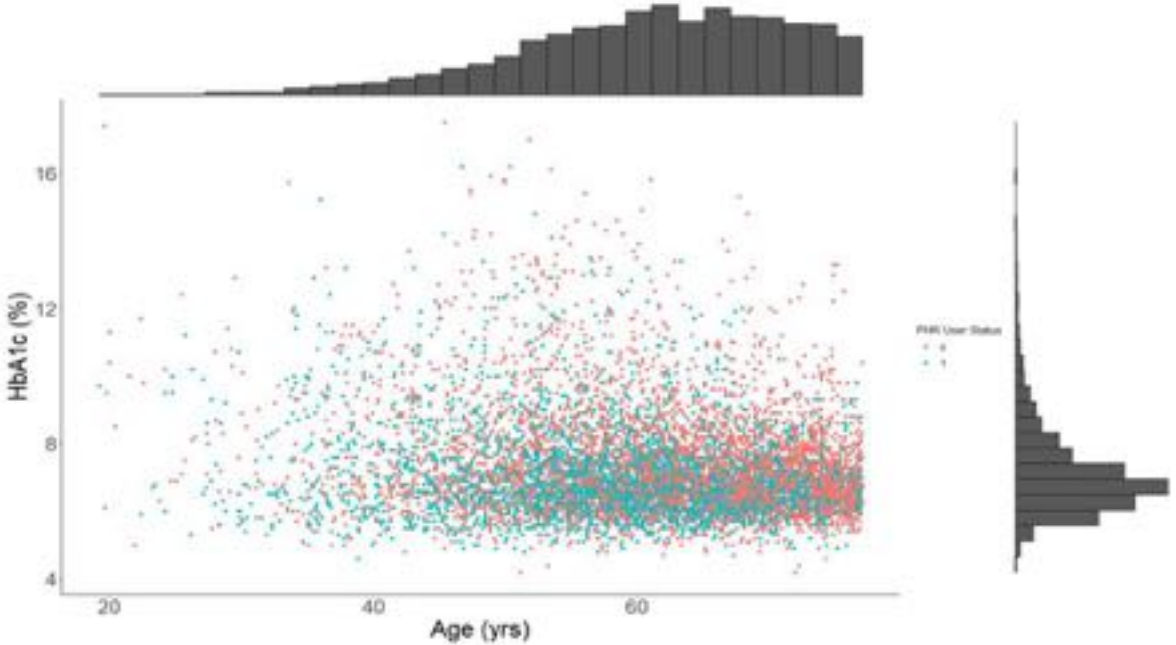
RESULTS

Relationship between age, HbA1C%, and PHR usage among patients

- Left skewed age distribution: largely older patients
- Majority of patients are diabetic (HbA1C% 6.5% or higher*)



*Diabetes UK. (n.d.). What is HbA1C? https://www.diabetes.org.uk/guide-to-diabetes/managing-your-diabetes/hba1c#:~:text=If%20you%20have%20diabetes%2C%20an,42mmol%2Fmol%20(6%25).

Estimated Regression Coefficients for the Linear Model

- There is an association between PHR usage and HbA1c%
- The expected HbA1c % is (0.713 - 0.007*Age) percentage points *lower* for a PHR user compared to a PHR nonuser, while adjusting for sex, race, income, and BMI
- The relationship between PHR user status and HbA1c% depends on age

Model Term	*Estimate*	*Standard Error*	*P-value*
Intercept	8.908	0.145	<0.001
PHR Status			
Non-User	(Ref.)	-	-
User	-0.713	0.175	<0.001
Age (years)	-0.026	0.002	<0.001
Income (10000 US dollars)	-0.035	0.010	<0.001
BMI (kg/m^2)	0.010	0.002	<0.001
Race			
Non-Caucasian	(Ref.)	-	-
Caucasian	-0.207	0.035	<0.001
Sex			
Male	(Ref.)	-	-
Female	-0.094	0.029	0.001
PHR User * Age	0.007	0.003	0.013

Expected differences in HbA1c% between PHR users and nonusers based on our model

	19.3 (minimum)	*54.3 (Q1)*	*61.9 (median)*	*68.8 (Q3)*	*77.0 (maximum)*
Expected adjusted difference in HbA1c% in PHR users v. nonusers	-0.575%	-0.326%	-0.272%	-0.223%	-0.164%

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Conclusion + Implications

PHR users have a lower expected HbA1c% than nonusers & Magnitude depends on user's age

- Greater benefit for younger individuals
  - Min age: users vs nonusers
    - HbA1c% difference between diabetic and non-diabetic
  - Max age: users vs non users
    - HbA1c% difference between diabetic and pre-diabetic
- Clinically useful for large age differences
  - Expected difference between HbA1c% in users for a 61.9 y/o vs 68.8 y/o
    - Little clinical significance

Limitations

- Normal distribution assumption violated
- HbA1c% imperfect measurement for diagnosing prediabetes or diabetes
- Confounding variables

Future Directions

- Include more variables
- Repeat with other PHR datasets
- Experimental studies

Conclusion

Association between an individual's usage of their Cleveland Health Clinic PHR and their health status, and that this association depended on the user’s age.

Increasing electronic healthcare for older populations = ensures best access and treatment for all who need it

Thank you!