

Predicting Readmission of Diabetic Patients

**Identifying risk factors leading to hospital
readmission of diabetic patients within 30
days**

Hailey D'Silva

Background

A photograph showing a woman's hands. Her left hand is held flat with her fingers spread, and a small drop of blood is visible on the tip of her index finger. Her right hand holds a white blood glucose testing device, which is positioned over the fingertip to collect the blood sample.

Diabetes is a progressive disease affecting about 9.3% of the U.S. population¹. Diabetes is associated with increased risk of hospital readmission¹.

Dataset: Hospital admission data from 130 U.S. hospitals between the years 1999 - 2008. Sourced from Kaggle.com.

1. Ostling S, Wyckoff J, Ciarkowski SL, et al. The relationship between diabetes mellitus and 30-day readmission rates. *Clinical Diabetes and Endocrinology*. 2017;3(3). <https://doi.org/10.1186/s40842-016-0040-x>. Accessed August 26, 2021.

Variables and Inclusion

Variables available in the dataset include:

- Patient demographics (e.g., age, gender, race)
- Admission and discharge details (e.g., department admitted to, location discharged to)
- Treatment details (e.g., days in hospital, number of lab tests, ICD-9 diagnosis codes)
- Change in medications (insulin, metformin, etc)
- Patient visit history (e.g., number of inpatient and outpatient visits in year preceding encounter)
- **Dependent variable: whether or not the patient was readmitted within 30 days**

Dataset included observations from 101,766 patients. I included observations that met the following criteria:

- did not result in death (100,114)
- were not transferred to inpatient care (98,909)
- did not have a planned readmission (98,906)
- were not missing admission and discharge details (83,994)
- had a diabetes-related ICD-9 code within the top three diagnoses (31,148)

Descriptive Statistics



Readmitted within 30 days

11% Yes, 89% No



Age

Min: 0-10y, Max: 90-100y
Median: 60-70y



Sex

54% Female, 46% Male



A1C result

22% Normal
17% Above 7
60% Above 8



Glucose serum result

10% Normal
1% Above 200
89% Above 300



Time in hospital

Min: 1 day, Max: 14 days
Mean: 3.9 days

Logistic Regression

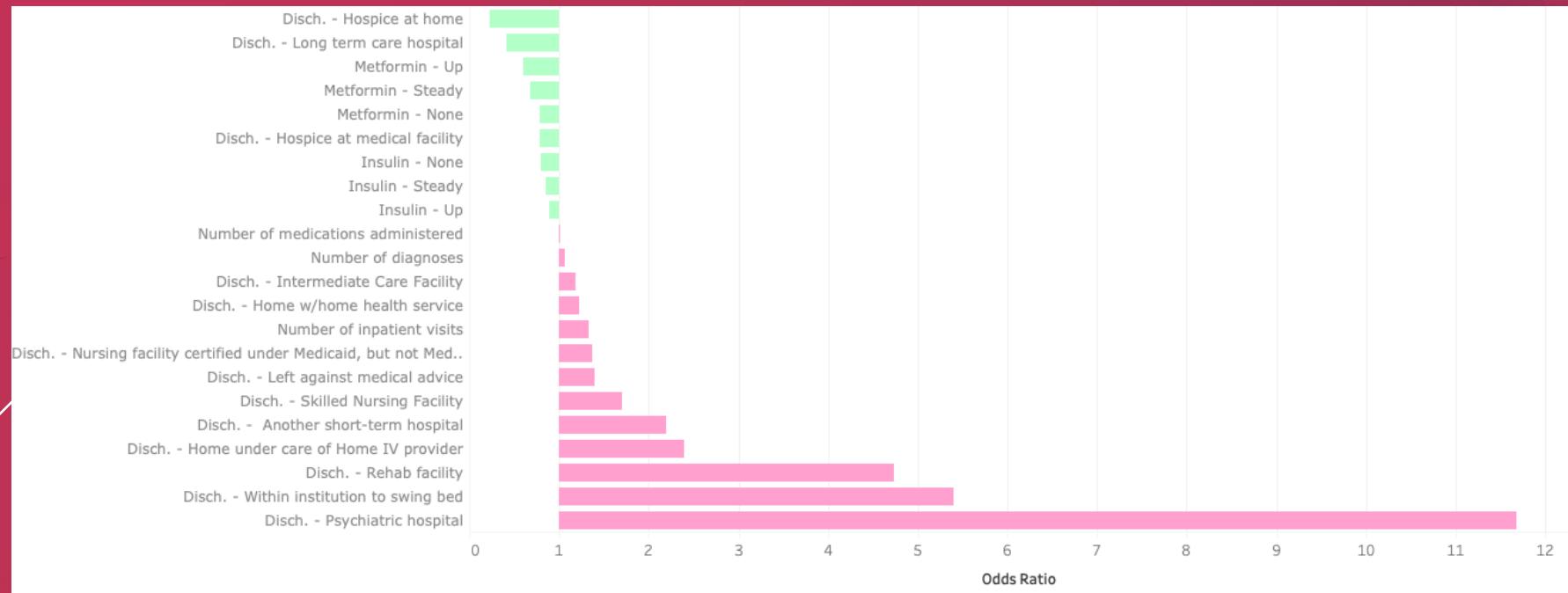
AUC = 0.69

Predictors

- Discharge location
- Change in Metformin dosage
- Change in Insulin dosage
- Number of medications administered
- Number of diagnoses input
- Number of inpatient visits in year leading up to encounter

Discharge Location	N	Unadjusted			Adjusted			
		Predictor	Odds Ratio	95% CI	P	Odds Ratio	95% CI	
Home	22,619	1.00 (referent)				1.00 (referent)		
Another short-term hospital	479	2.30	1.80 – 2.89	< 1×10 ⁻¹¹ ***	2.20	1.72 – 2.79	< 1×10 ⁻⁹ ***	
Skilled Nursing Facility	2,991	1.96	1.76 – 2.18	< 1×10 ⁻¹⁶ ***	1.70	1.51 – 1.90	< 1×10 ⁻¹⁶ ***	
Intermediate Care Facility	237	1.31	0.86 – 1.93	.19	1.19	0.78 – 1.77	.39	
Home w/home health service	3,634	1.45	1.30 – 1.61	< 1×10 ⁻¹⁰ ***	1.22	1.08 – 1.36	< .001 ***	
Left against medical advice	275	1.64	1.14 – 2.28	<.01 **	1.40	0.96 – 1.98	.07	
Home under care of Home IV provider	52	2.74	1.34 – 5.15	<.01 **	2.39	1.13 – 4.60	.01 **	
Hospice at home	48	0.44	0.07 – 1.43	.26	0.23	0.03 – 0.80	.05 *	
Hospice at medical facility	38	0.88	0.21 – 2.43	.82	0.79	0.19 – 2.21	0.70	
Within institution to swing bed	18	6.50	2.39 – 16.51	<.001 ***	5.40	1.95 – 13.97	< .001 ***	
Rehab facility	618	4.85	4.06 – 5.77	< 1×10 ⁻¹⁶ ***	4.74	3.95 – 5.68	< 1×10 ⁻¹⁶ ***	
Long term care hospital	101	0.53	0.18 – 1.18	.17	0.41	0.14 – 0.91	.05 *	
Nursing facility certified under Medicaid, but not Medicare	7	1.70	0.09 – 9.97	.62	1.37	0.07 – 8.24	.77	
Psychiatric hospital	30	13.35	6.50 – 28.07	< 1×10 ⁻¹¹ ***	11.68	5.57 – 24.97	< 1×10 ⁻¹² ***	
Change in Metformin dosage	Down	229	1.00 (referent)			1.00 (referent)		
	Up	418	0.57	0.34 – 0.98	.04 *	0.60	0.35 – 1.03	.06
	Steady	6,499	0.65	0.45 – 0.99	.04 *	0.68	0.45 – 1.02	.05 *
	Not taking medication	24,002	0.88	0.61 – 1.33	.53	0.78	0.53 – 1.19	.23
Change in Insulin dosage	Down	4,623	1.00 (referent)			1.00 (referent)		
	Up	3,920	0.89	0.79 – 1.01	.07	0.89	0.78 – 1.02	.09
	Steady	10,050	0.70	0.63 – 0.78	< 1×10 ⁻¹⁰ ***	0.85	0.76 – 0.95	< .01 **
	Not taking medication	12,555	0.62	0.56 – 0.69	< 1×10 ⁻¹⁶ ***	0.80	0.71 – 0.89	< 1×10 ⁻⁶ ***
Number of medications administered	31,148	1.02	1.02 – 1.03	< 1×10 ⁻¹⁶ ***	1.01	1.00 – 1.01	< .01 **	
	Number of diagnoses	31,148	1.13	1.11 – 1.15	< 1×10 ⁻¹⁶ ***	1.06	1.04 – 1.08	< 1×10 ⁻⁹ ***
	Number of inpatient visits	31,148	1.35	1.33 – 1.38	< 1×10 ⁻¹⁶ ***	1.33	1.30 – 1.35	< 1×10 ⁻¹⁶ ***

Odds Ratio Visualization



Readmission Protective Factors

32-40%

Maintenance or
increase of Metformin

22% decrease if not taking
Metformin at all

11-15%

Maintenance or
increase of Insulin

20% decrease if not taking
Insulin at all

59%

Discharged to a Long
Term Care hospital

31-77%

Discharged to Hospice
care

77% decrease for a hospice facility
31% decrease for hospice at home

Readmission Risk Factors

5X Discharged to a Rehabilitation facility

12X Discharged to a Psychiatric hospital

33%

Inpatient visits

Increase per visit within the year prior to encounter

6%

Diagnoses

Increase per diagnosis input during encounter

Interpretations and Limitations

Interpretations:

- Decreasing Metformin and Insulin during patient encounters increases a patients likelihood of readmission with 30 days
- Diabetic patients in Long Term Care facilities may be receiving the needed healthcare support to reduce hospital readmissions
- Prediction models may help us in determining how many diabetic patients will be returning to improve availability and staffing estimates

Limitations:

- Missing data in important variables (weight, A1C readings, glucose serum results)
- Type 1 versus Type 2 diagnosis unavailable
- Medication dosage change details unavailable

THANKS

Do you have any questions?

CREDITS: This presentation template was created by [Slidesgo](#), including icons by [Flaticon](#) and infographics & images by [Freepik](#)
Please keep this slide for attribution