Customized Optimal Medical Plan

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Problem Description

- On average, patients with diagnosed diabetes have medical expenditure 2.6 higher than would be expected without diabetes
- Many patients with diabetes cannot afford their medications
- Uncontrolled diabetes can lead to serious complications such as heart diseases, stroke, kidney disease, skin problems, eye complications and more

https://diabetes.org/newsroom/press-releases/new-american-diabetes-association-report-finds-annual-costs-diabetes be#:~:text=On%20average%2C%20people%20with%20diagnosed,to%20%2422.3%20billion%20in%202022.

Project Goal

- To create an online tool for diabetes management that allows the prescriber to optimize the medication therapy for a patient with diabetes by choosing the cheapest options on the formulary

Optimization Model

- **Decision Variable:** Assign cheapest medications (i)from the formulary to the patient (j)
- **Objective:** Optimize the therapy for patients with diabetes by choosing the cheapest therapy from the formulary
- **Constraints:**
  - The patient needs to have at least 1 medication but not more than 3
  - The A1C goal is 7%. The model will pick medications that will get the patient to that goal by recommending the correct and cheapest therapy not cause hypoglycemia (low blood glucose)
  - The minimal A1C level is 4%. The post-treatment A1C level should higher than 4%.
  - There are no restrictions for gender
  - Only some medications from the formulary can be recommended for a pregnant women

Input parameters

Formulary

Drug Generic Product Name	Copay	A1C Reductio	Ok to use in pregnancy	use_for_pregnancy
ACARBOSE TAB	$5	0.50%	No	0
BROMOCRIPTINE MESYLATE TAB	$50	0.50%	No	0
DAPAGLIFLOZIN PROP-METFORMIN HCL TAB ER 24HR	$35	2.00%	No	0
DAPAGLIFLOZIN PROPANEDIOL TAB	$35	2.00%	No	0
DULAGLUTIDE SOLN PEN-INJECTOR	$35	1.50%	No	0
EMPAGLIFLOZIN TAB	$35	2.00%	No	0
EMPAGLIFLOZIN-LINAGLIP-METFORMIN TAB ER	$35	2.00%	No	0
EMPAGLIFLOZIN-LINAGLIPTIN TAB	$35	1.50%	No	0
EMPAGLIFLOZIN-LINAGLIPTIN-METFORMIN TAB ER	$35	2.00%	No	0
EMPAGLIFLOZIN-METFORMIN HCL TAB	$35	2.00%	No	0
EMPAGLIFLOZIN-METFORMIN HCL TAB ER	$35	2.00%	No	0
EXENATIDE SOLN PEN-INJECTOR	$50	1.50%	No	0
GLIMEPIRIDE TAB	$5	0.50%	No	0
GLIPIZIDE TAB	$5	0.50%	No	0
GLIPIZIDE-METFORMIN HCL TAB	$5	2.00%	No	0

Lists of Patients

Patient	Current A1C Level	Gender	Pregnant
1	13.50%	M	No
2	8.50%	F	Yes
3	9.00%	F	No
4	10.20%	M	No
5	11.20%	M	No
6	12.90%	M	No

Sample Output

A	B	C	D
Patient	Current A1C Level	Gender	Pregnant
1	13.50%	M	0
2	8.50%	F	1
3	9.00%	F	0
4	10.20%	M	0

```
[108] print(patient)

   Patient  Current A1C Level Gender   Pregnant  \
0        1              0.135       M         0
1        2              0.085       F         1
2        3              0.090       F         0
3        4              0.102       M         0
4        5              0.112       M         0
5        6              0.129       M         0

                                              solution
0  (35.0, [INSULIN GLARGINE-LIXISENATIDE SOL PEN-...
1                  (5.0, [GLYBURIDE-METFORMIN TAB ])
2                  (5.0, [GLYBURIDE-METFORMIN TAB ])
3  (15.0, [GLYBURIDE-METFORMIN TAB , METFORMIN HC...
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The model recommended INSULIN GLARGINE-LIXISENATIDE SOL PEN-INJ medication for the 1st patient. The copay is $35 per month and the patient is not pregnant. This is the correct choice.

Online Tool

- Hypothetical Clients:
  - Outpatient clinics
  - Hospitals
  - Managed Care Organizations/PBMs
- Online app/SaaS: The provider can use this tool to choose the cheapest therapy from the patient's formulary

Benefits

- Choosing medications from the lowest tier benefits the patient and prevents disruption of therapy due to cost
- Speeding up the process at the clinic/hospital makes it easy for the prescriber who has to deal with various formularies daily
- Choosing the cheapest therapy improves patient's adherence and health outcomes

Next steps

- Make the model more complex by adding different therapies to a patient with diabetes (e.g., hypertension, cholesterol, etc.)
  - For example, patients with diabetes often also have high cholesterol and hypertension. Future projects could optimize the therapy for all three disease states by picking the cheapest therapy from the formulary