Hypoglycemia is a common adverse effect of treatment for diabetes mellitus, resulting in significant short-term and long-term morbidities and economic burdens, particularly in Type 1 diabetes mellitus (T1DM). Glucagon rescue medication use is recommended in patients with Type 1 diabetes mellitus and Type 2 diabetes mellitus (T2DM), and it is also approved by the U.S. Food and Drug Administration for use in Type 2 patients with severe hypoglycemic events.

Glucagon rescue kits are available for use in hospitals and at home. The cost of glucagon rescue kits can range from $140.51 to $1,433. Medicare reimbursement rates vary from $110 to $129.70.

The most value from improved glucagon rescue medication use can be derived in the T1DM population, with Medicare reimbursement rates ranging from $110 to $129.70, which is significantly lower than the costs of glucagon rescue medication use in T2DM patients who are treatment-naive and for T2DM patients who have been treated for several years and are susceptible to severe hypoglycemia.

### Background

#### Clinical Presentation and Epidemiology of Hypoglycemia

Hypoglycemia is a condition with significant adverse effects and risks, resulting in significant short-term and long-term morbidities and economic burdens, particularly in Type 1 diabetes mellitus (T1DM). Glucagon rescue medication use is recommended in patients with Type 1 diabetes mellitus and Type 2 diabetes mellitus (T2DM), and it is also approved by the U.S. Food and Drug Administration for use in Type 2 patients with severe hypoglycemic events.

#### Glucagon Kits

The American Diabetes Association recommends that all patients with diabetes at a heightened risk of hypoglycemia carry glucagon rescue kits. However, these kits may not be used in all situations. Studies have shown that glucagon rescue medication use is underutilized in patients with diabetes mellitus, particularly in the T1DM population.

#### Methods

**Model Framework and Assumptions**

We conducted a decision analysis to assess the impact of glucagon rescue medication use on healthcare costs and outcomes in patients with diabetes mellitus. The model was developed using a Markov decision process, with a time horizon of 1 year. The model included the following states:

- Severe hypoglycemic event (SHE)
- Discharge
- ED visit
- Inpatient hospitalization costs
- Discharge
- ED visit
- Inpatient hospitalization costs
- Outpatient follow-up costs
- Inpatient hospitalization costs
- Cost of glucagon rescue medication

**Key Inputs**

- Cost of glucagon rescue medication
- Probability of subsequent SHE among successful and unsuccessful users
- Cost of ED and inpatient visits
- Percentage of glucagon rescue medication use
- Cost of outpatient follow-up

**Key Model Outputs**

- Healthcare costs
- Health outcomes
- Cost-effectiveness ratios

**Assumptions**

1. All ED and inpatient visits result in outpatient follow-up
2. Future SHEs are not affected by successful treatment of prior SHEs
3. All patients are treated in the same manner
4. The cost of glucagon rescue medication is not affected by its use.

**Results**

The analysis was conducted from a U.S. payer perspective, with indirect costs not included. The model estimated that the average costs of a severe hypoglycemic event assuming successful use and unsuccessful use of glucagon rescue medication for T1DM patients were $715.20 and $1,715.00, respectively. The cost difference between successful and unsuccessful use was $1,000 per event.

**Limitations**

- Limited data exists around the unsuccessful use of glucagon rescue medication. Furthermore, the clinical effectiveness of glucagon rescue medication use was not compared to other hypoglycemic agents.
- The model does not account for the potential impact of glucagon rescue medication on downstream healthcare costs.
- The model assumes that all patients with diabetes mellitus carry glucagon rescue kits.

**Conclusions**

- Increasing the success rate of glucagon rescue medication may have the potential to reduce healthcare costs and improve health outcomes in patients with diabetes mellitus.
- Further studies are needed to evaluate the clinical effectiveness and cost-effectiveness of glucagon rescue medication use.

References


Figure 1: Diagram of the decision analysis model. The model includes the following states:

- Severe hypoglycemic event (SHE)
- Discharge
- ED visit
- Inpatient hospitalization costs
- Discharge
- ED visit
- Inpatient hospitalization costs
- Outpatient follow-up costs
- Inpatient hospitalization costs
- Cost of glucagon rescue medication

Figure 2: Sensitivity Analysis: Average Diversion Savings Per Severe Hypoglycemic Event Among T1DM Patients

Figure 3: Sensitivity Analysis of Average Diversion Savings Per Severe Hypoglycemic Event Among T1DM Patients

Figure 4: Table 1: Key Model Inputs

Table 1: Key Model Inputs

<table>
<thead>
<tr>
<th>Input</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Cost of glucagon rescue medication</td>
<td>$140.51</td>
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<tr>
<td>Probability of subsequent SHE among successful and unsuccessful users</td>
<td>0.2 vs. 0.3</td>
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<tr>
<td>Cost of ED and inpatient visits</td>
<td>$715.20 vs. $1,715.00</td>
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<tr>
<td>Percentage of glucagon rescue medication use</td>
<td>0.02 to 0.10</td>
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<td>Cost of outpatient follow-up</td>
<td>$50 to $100</td>
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Figure 5: Table 2: Assumptions

<table>
<thead>
<tr>
<th>Assumption</th>
<th>Value</th>
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<tbody>
<tr>
<td>Future SHEs are not affected by successful treatment of prior SHEs</td>
<td>Yes</td>
</tr>
<tr>
<td>All patients are treated in the same manner</td>
<td>Yes</td>
</tr>
<tr>
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<td>Yes</td>
</tr>
</tbody>
</table>

Table 2: Assumptions

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