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Evaluation of Diabetic Ketoacidosis Management: Comparing the Effectiveness of Computer Program-Directed vs Physician-Directed Intravenous to Subcutaneous Insulin

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OBJECTIVE

- To compare effectiveness of computer-directed versus physician-directed intravenous (IV) to subcutaneous (SC) insulin transition in patients with diabetic ketoacidosis (DKA) by retrospectively reviewing blood glucose values and DKA recurrence.

BACKGROUND

- DKA occurs when there is an insulin deficiency that leads to lipolysis, eventually causing a state of ketoacidosis.
- Clinical criteria for DKA includes blood glucose >250 mg/dL, arterial pH <7.30, serum bicarbonate <18 mEq/L, ketonemia or ketonuria, anion gap >10, and altered mental status.
- It is critical to ensure resolution of ketoacidosis with IV insulin before transitioning to a SC regimen.
- Ketoacidosis is resolved when blood glucose is below 200 mg/dL, and 2 of the 3 following criteria are met: serum bicarbonate level \geq 15 mEq/L, serum pH >7.3, and anion gap \leq 12 mEq/L.¹
- Computer-directed programs use real-time and historical data to personalize insulin regimens. Physician-directed management is based on the physician's clinical judgement.
- Prior to transition from IV to SC insulin, computer programs assess technical readiness, which includes blood glucose level and minimum duration of IV insulin treatment of 6 hours. Additional clinical readiness criteria such as anion gap, pH, and bicarbonate should be assessed by a provider prior to transition. If technical readiness criteria are not met, providers may choose to override the program.
- When a patient transitions to SC insulin at Parkview Health, providers may use the computer-directed or physician-directed method.

METHODS

- Retrospective chart review of patients \geq 18 years of age admitted to Parkview Regional Medical Center between January 1, 2020 and June 30, 2022 with a primary diagnosis of DKA.

Outcomes

Primary Endpoints	Percent of patients with \geq 1 incident of hyperglycemia after transition to SC insulin
Secondary Endpoints	<ul style="list-style-type: none"> Distribution of first hyperglycemia blood glucose value Percent of patients with \geq 1 incident of hypoglycemia after transition to SC insulin Reversion back into DKA Patients who met clinical readiness criteria for transition Time from transition to discharge Appropriate transition overlap time of IV and SC insulin

Definitions

Clinical Readiness Criteria	Blood glucose <200 mg/dL, and 2 of the 3 following criteria met: serum bicarbonate level \geq 15 mEq/L, serum pH >7.3, and anion gap \leq 12 mEq/L
DKA Reversion	Blood glucose > 200 mg/dL and 2 of 3 criteria met: serum bicarbonate level \leq 15 mEq/L, serum pH <7.3, and anion gap \geq 12 mEq/L.
Hyperglycemia	Blood glucose > 180 mg/dL
Hypoglycemia	Blood glucose < 70 mg/dL
Appropriate Transition Overlap Time	2-4 hours overlap of IV and SC insulin

RESULTS

Table 1: Patient Demographics (n=165)

	Physician-Directed (n=73)	Computer-Directed (n=92)
Male sex	54.7% (40)	42% (39)
Mean age (years)	37 (SD 16.7)	39 (SD 17.7)
Mean A1c	11.3%	11.6%

Figure 1: \geq 1 Incident of Hyperglycemia After Transition

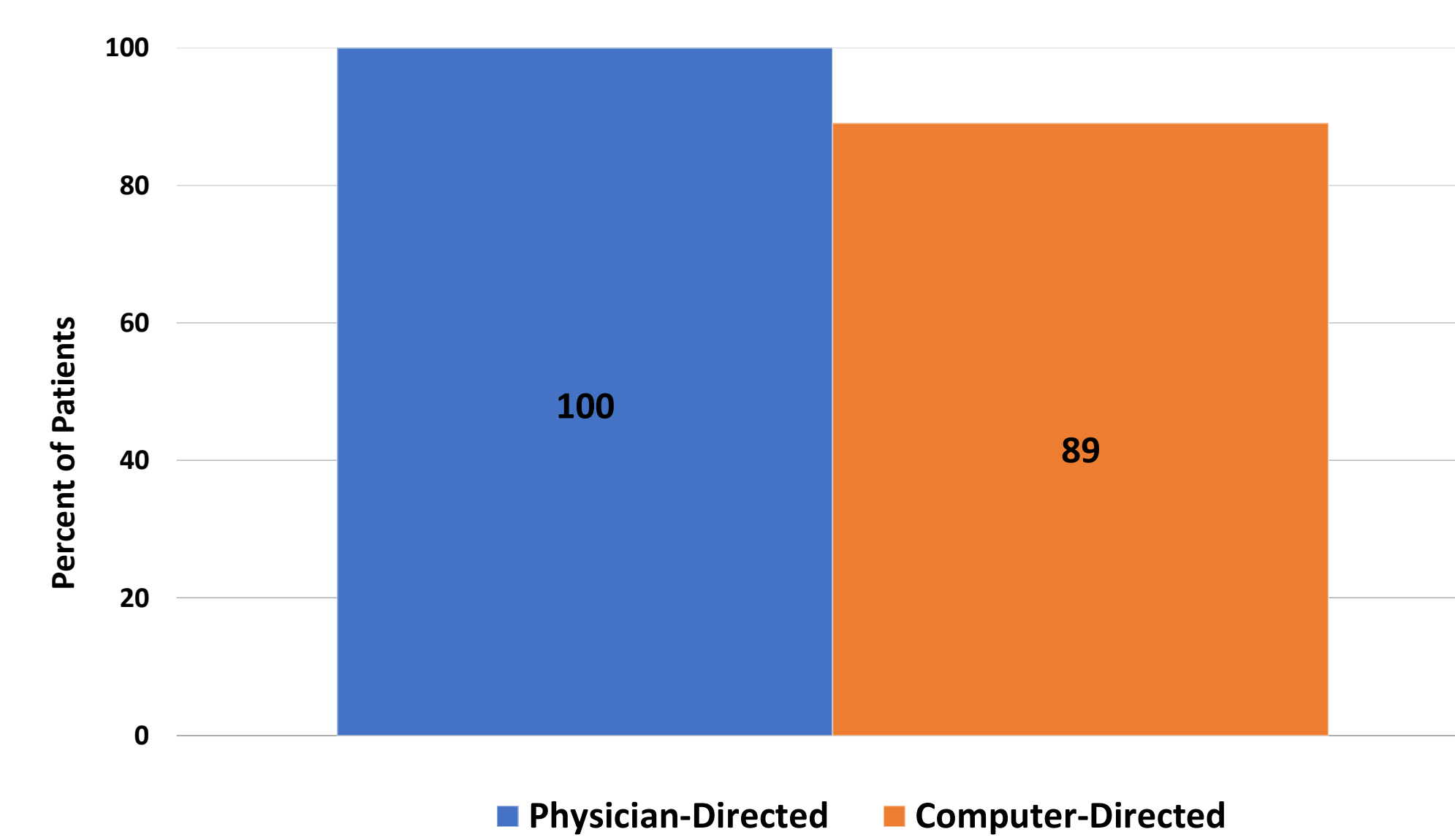


Figure 2: Distribution of Blood Glucose Values First Incident of Hyperglycemia

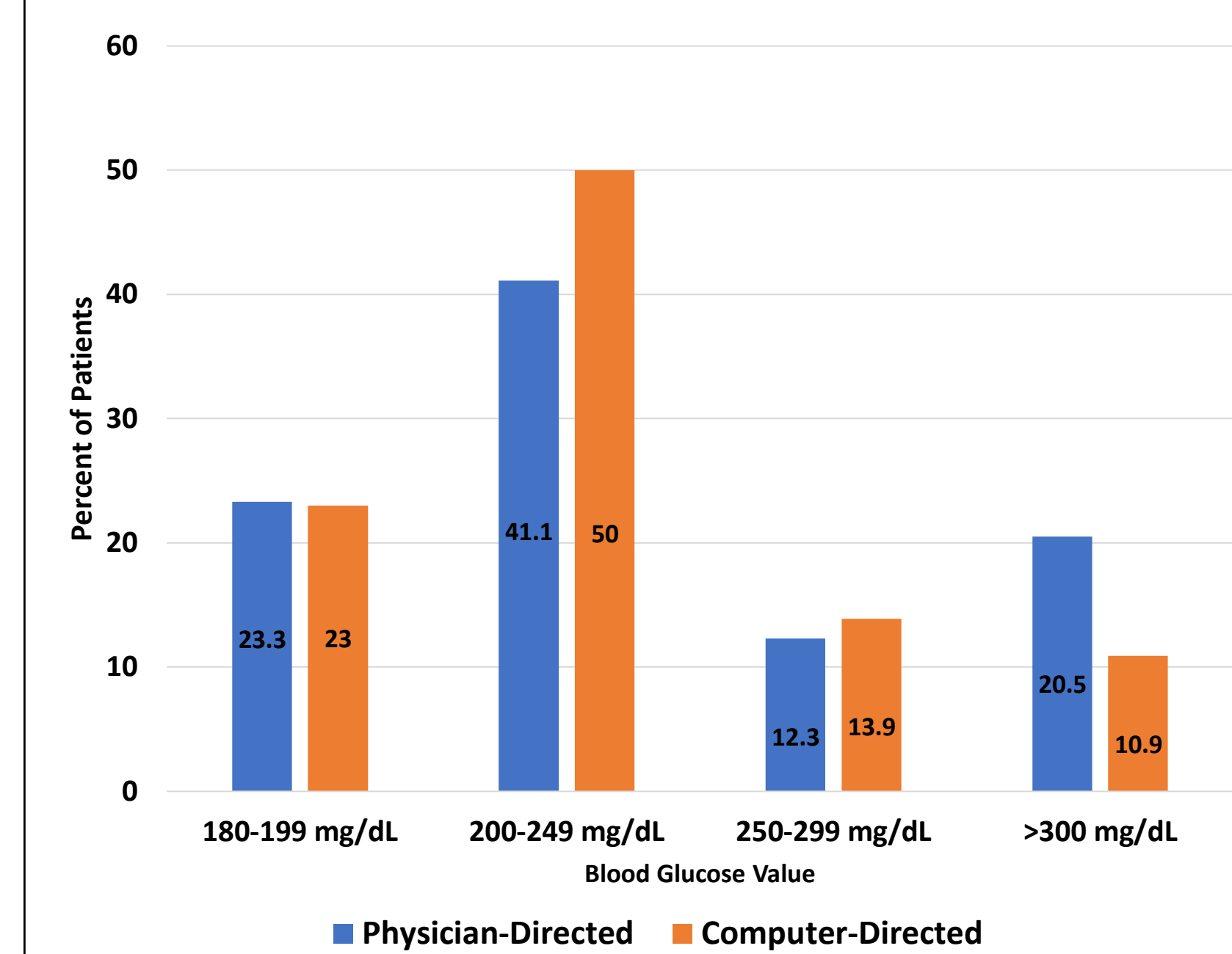


Figure 3: \geq 1 Incident of Hypoglycemia After Transition

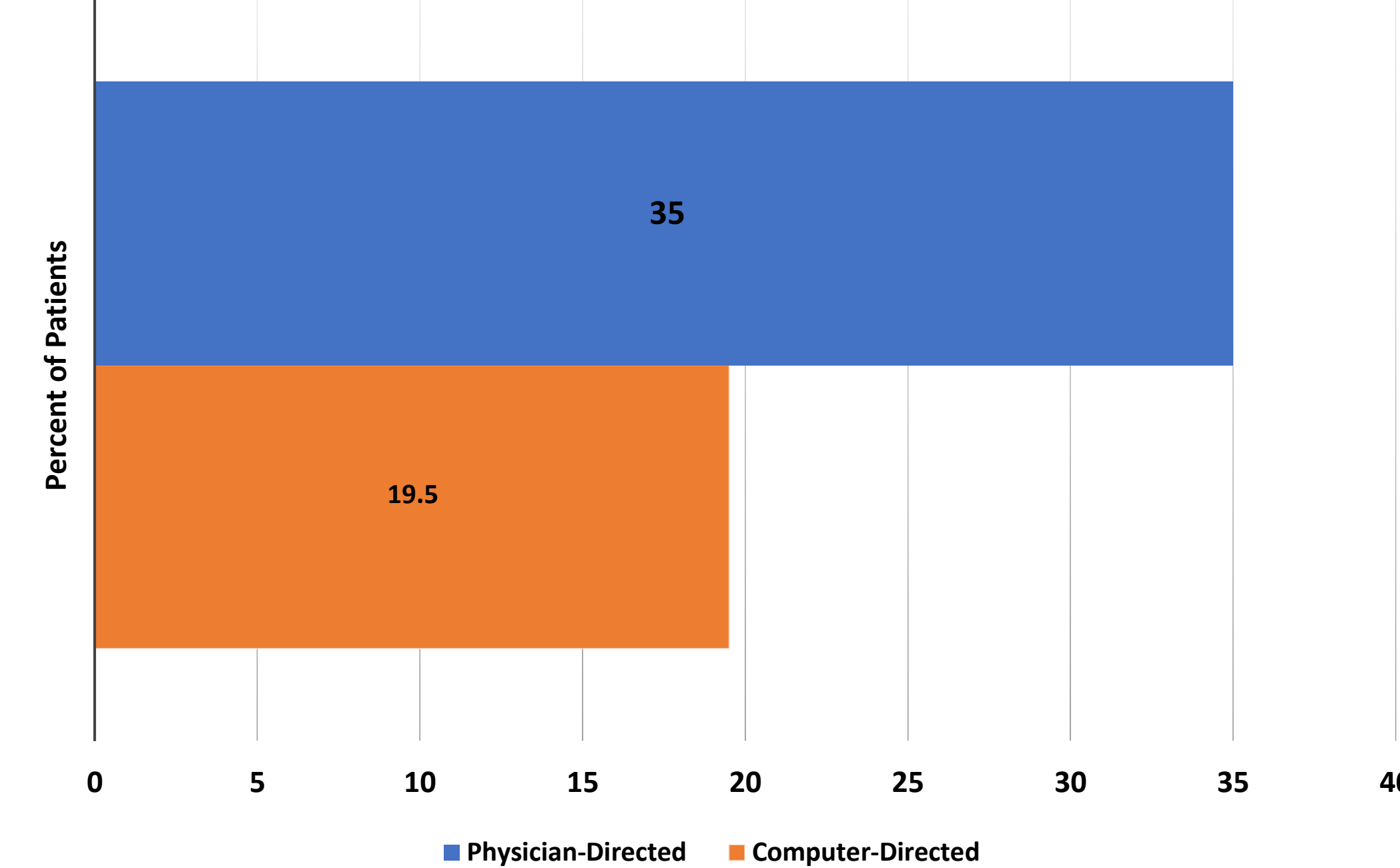


Figure 4: DKA Reversion After Transition

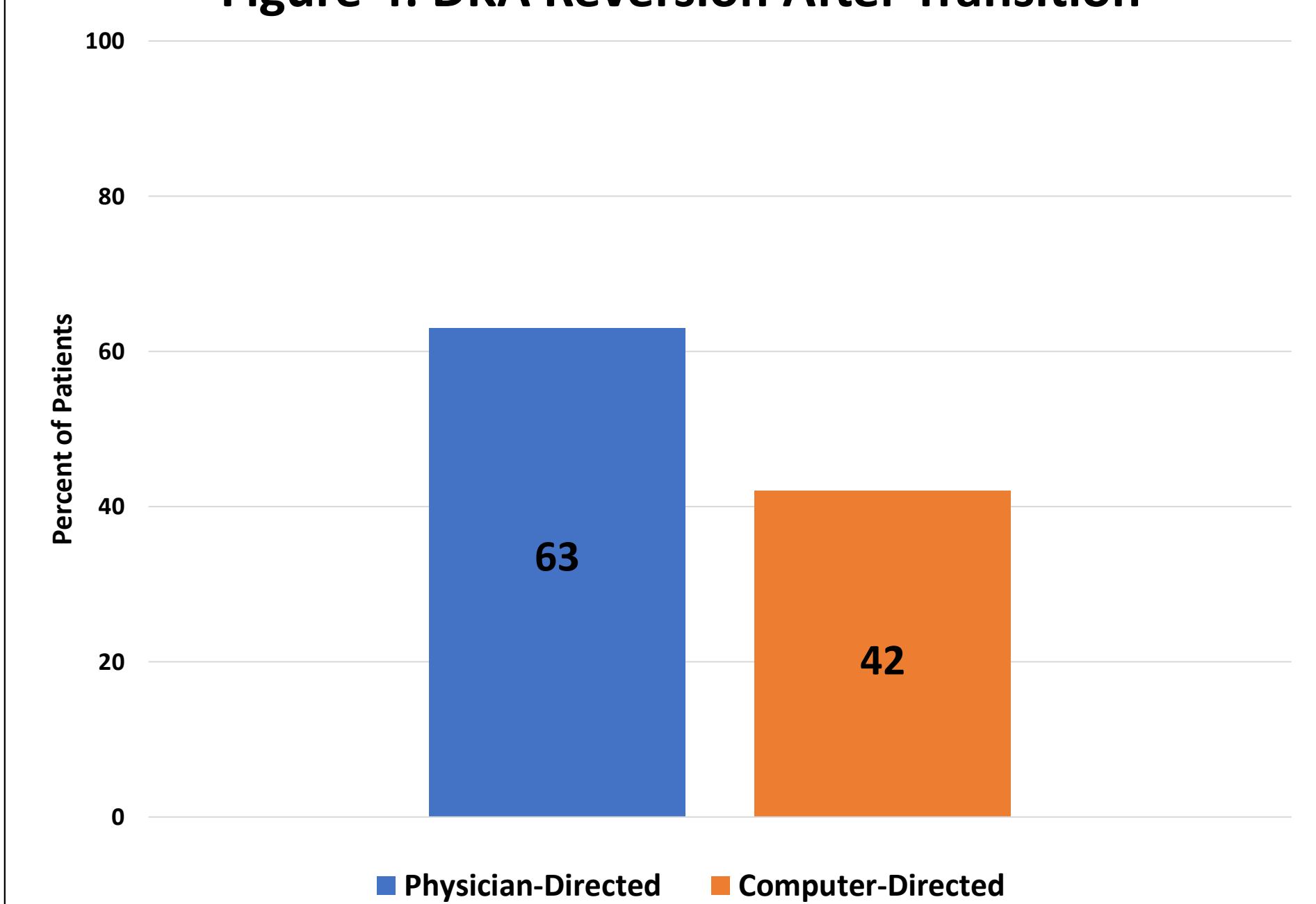


Figure 5: Met Clinical Readiness Criteria for Transition to Subcutaneous Insulin

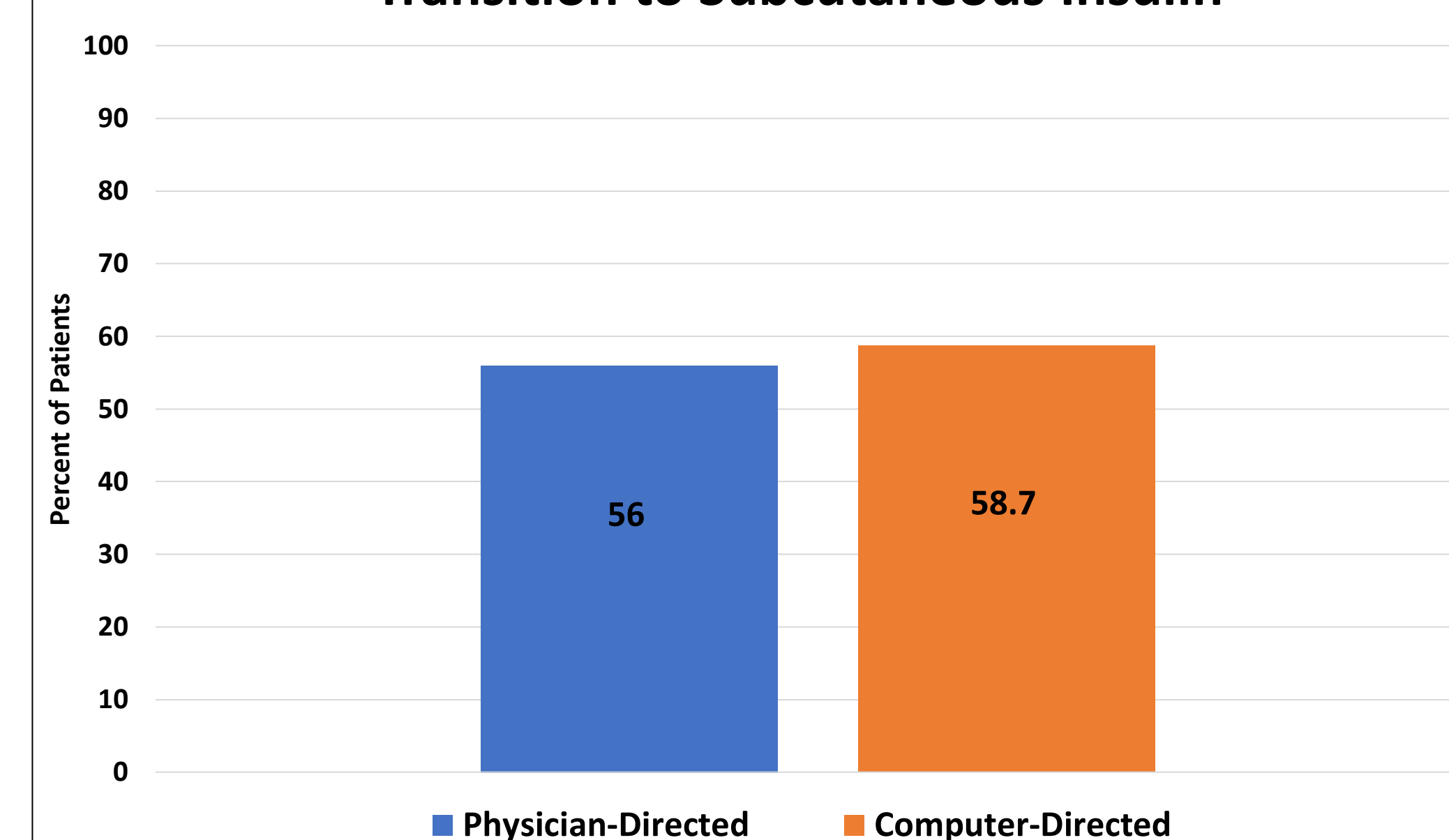
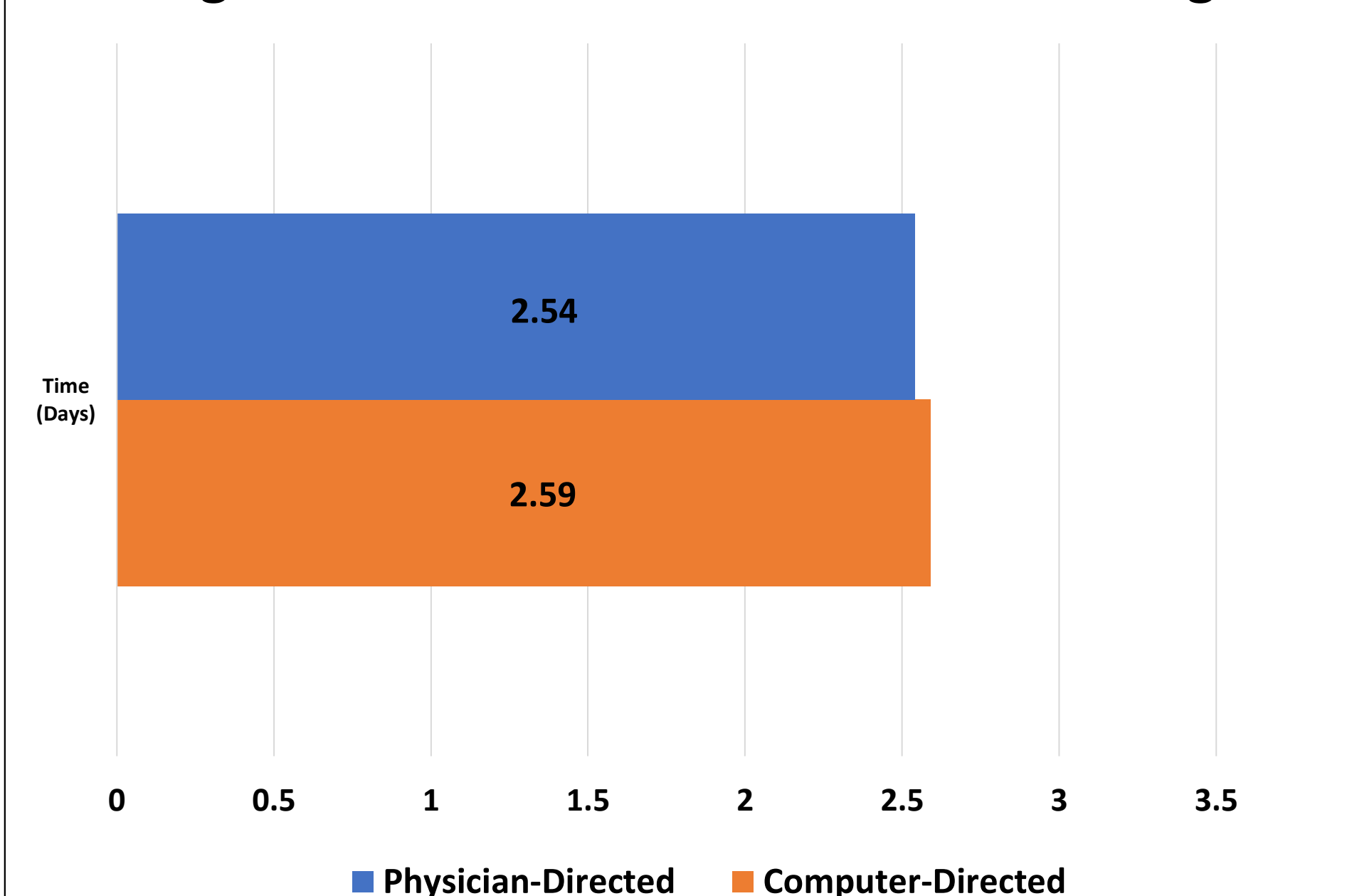
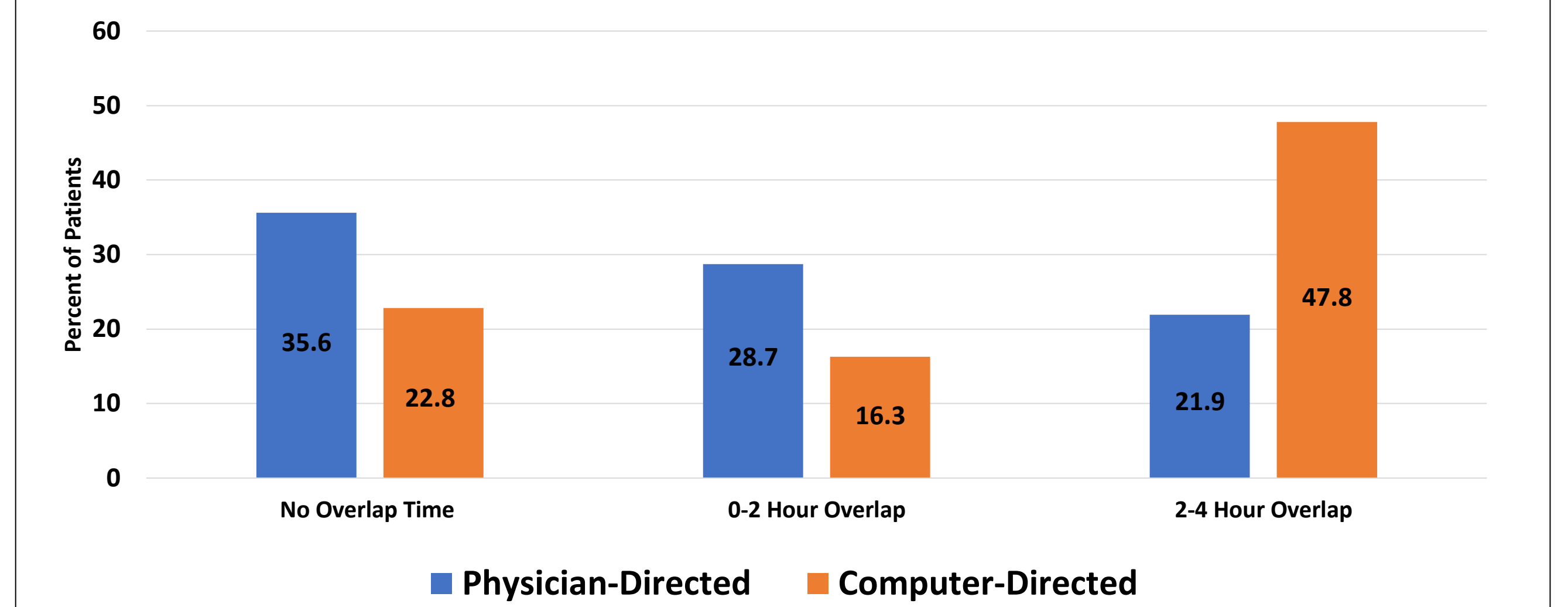


Figure 6: Time From Transition to Discharge



RESULTS

Figure 7: Transition Time Between Intravenous Insulin and Subcutaneous Insulin



DISCUSSION & CONCLUSIONS

- Computer-directed regimens caused less hyperglycemia and hypoglycemia after transition, which could be due to the program keeping data on personal response to insulin and making algorithm-based recommendations. Computer-directed programs also ensure blood glucose is at a certain level before transition, so they are more likely to start in their goal range whereas physicians may choose to transition regardless of blood glucose value.
- Hypoglycemia is a major safety concern with insulin dosing. The computer-directed regimen has a more favorable safety profile since the physician-directed group had almost double the incidence of hypoglycemia.
- Discontinuing IV insulin before initiating SC insulin overlap puts patients at risk for rebound hyperglycemia and DKA reversion. Computer-directed programs require \geq 2 hours overlap of IV and SC insulin before discontinuation of IV insulin.
 - Computer-directed regimens had a more appropriate overlap time during the transition period. Discrepancies may be due to charting errors or manual discontinuation.
 - Over half of the patients in the physician-directed group had suboptimal overlap time and had greater incidence of hyperglycemic blood glucose values >300 mg/dL.
- Providers may prefer to use physician-directed management over computer-directed due to ease of use and/or lack of familiarity with the program.
- Computer-directed programs do not replace clinical decision making; they are instead a tool to aid in decision making.

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Disclosure

The authors of this presentation have the following to disclose concerning possible financial or personal relationships with commercial entities that may have a direct or indirect interest in the subject matter of this presentation:
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