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GOAL RANGE EFFECT ON HYPOGLYCEMIA INCIDENCE FOR INTRAVENOUS INSULIN DOSING

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PURPOSE

The purpose of this retrospective study is to examine the effect of goal range on the incidence of hypoglycemia in patients receiving intravenous insulin therapy.

BACKGROUND

Intravenous insulin therapy using paper protocols or electronic glucose management systems (eGMS) represent the standard of care for critically ill patients. Target blood glucose (BG) values vary[1,2], and most paper protocols or eGMS require users to set the upper goal and lower BG goal, known as the goal range. Typically, these dosing algorithms increase the insulin dosing model when the BG reading is above the upper goal and reduce the dosing model when the BG is below the lower goal. The methodology to raise or lower the dosing model varies between protocols. The upper goal is often set as the primary controller[1] to prevent the incidence of hypoglycemia, which is defined as BG less than 70 mg/dL. There is little research that reports the effect of goal range on hypoglycemia outcomes for intravenous insulin dosing. This work focused on the potential effect of the goal range on hypoglycemia by analyzing a large database from five hospital systems using the same eGMS for intravenous (IV) insulin dosing.

METHOD

Analysis was applied to a database of nearly one million BG readings of de-identified data without exclusions from 5 unaffiliated hospital systems using the same eGMS. The data was accumulated from January 2015 to November 2017 and included approximately 45,000 patients. The analysis was stratified for two upper goal ranges: Set-1, 100 to 140 mg/dL (807,873 BGs), and Set-2, 160 to 200 mg/dL (127,647 BGs). For this retrospective study, the observed incidence of hypoglycemia was calculated based on the prior BG values, which were allocated in sub-ranges of 10 mg/dL increments for each Set.

RESULTS

FIGURE 1

Hypoglycemia Incidence vs. Range of Prior BG

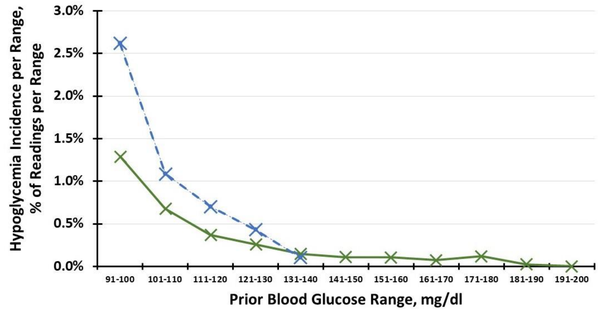

FIGURE 1

- Incidence of hypoglycemia is stratified based on the prior BG in 10 mg/dL sub-ranges for both Set-2 in green compared to Set-1 in blue.
- The overall incidence of hypoglycemia for Set-2 is less than Set-1, 0.22% vs 0.34%, respectively.
- For Set-1, there was an 11-fold increase in hypoglycemia comparing the hypoglycemia episodes (0.1%) from the upper quartile (130-139 mg/dL) to the hypoglycemia episodes (1.1%) from the lower quartile (100-109 mg/dL).
- For Set-2, there was little clinical difference in hypoglycemia incidence across the goal range.

FIGURE 2

Distribution of Hypoglycemia Events Related to Prior Reading

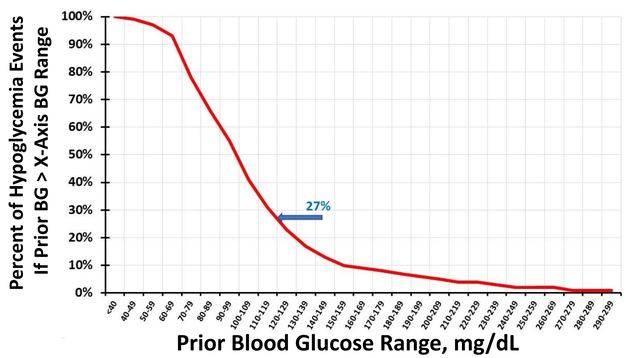

FIGURE 2

- FIGURE 2 represents the relationship between the prior BG sub-range and incidence of hypoglycemia.
- 27% of hypoglycemic events occurred following a BG greater than 120 mg/dL.
- 73% of the observed hypoglycemia events occurred with the prior glucose of less than 120 mg/dL.
- Increasing the lower goal for Set-1 to 120mg/dL, down regulation occurs below 120mg/dL (instead of 100 mg/dL) which potentially reduces up to 73% of the observed hypoglycemia episodes, paralleling Set-2's trajectory in FIGURE 1.

DISCUSSION

Based on these observations:

- A reduced range when the upper goal is 140 mg/dL, such as setting the lower goal to 120 mg/dL, will reduce or further the reduction of the insulin dosing model for BGs less than 120 mg/dL.
- The potential reduction in hypoglycemia may be 73%, which would be a significant reduction in overall hypoglycemic events.
- Reducing the goal range spread is likely to increase the mean BG after first reaching goal.

CONCLUSIONS

With a goal range spread of 40 mg/dL, when the upper goal of 200 mg/dL, there is minimal hypoglycemia across the goal range. However, with an upper goal of 140 mg/dL, significant increase in hypoglycemia events occur when the prior glucose was in the lower portion of the goal range.

The observations from this work generate the hypothesis that as the upper goal is reduced, the incidence of hypoglycemia is likely to be reduced significantly by reducing the goal range spread. Further studies to test this hypothesis are needed.

ACKNOWLEDGEMENTS

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