INTERVENTION NEEDED TO OPTIMIZE INSULIN PUMP USE

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BACKGROUND

Insulin pumps simulate pancreatic actions through continuous insulin delivery and bolus dosing, which eliminates the need for individual insulin injections. Advantages of insulin pump use include more accurate delivery of insulin, decreased blood glucose excursions, and greater mealtime flexibility and bolus delivery. However, the performance of the insulin pump can only be as good as the decision making abilities of its user.

Insulin pumps are unique because they permit objective measurement of several behavioral indicators of insulin adherence. Insulin pump adherence is comprised of fundamental blood glucose monitoring-insulin bolus behaviors (BGM-BOLUS): 1) blood glucose monitoring (BGM); 2) insulin bolusing; and 3) the sophisticated relationship between BGM and insulin bolusing (hereafter referred to as BGM-BOLUS LINK behaviors) which includes: 3a) BGM before insulin bolusing; and 3b) insulin bolusing following a high (150-249 mg/dL) or very high (>250 mg/dL) BGM reading. Insulin pumps provide unique opportunities to assess understanding of these BGM-BOLUS adherence behaviors because BGM and insulin data can be downloaded to software programs that generate summary reports. A significant weakness of these reports is that they cannot be customized to provide summary statistics of BGM-BOLUS LINK behaviors. Studies of insulin pump adherence have only focused on BGM or insulin bolusing frequency; none have investigated BGM-BOLUS LINK behaviors. The purpose of this study was to provide preliminary data describing BGM-BOLUS LINK behaviors.

RESULTS

Overall Adherence to BGM-BOLUS Behaviors. Figure 1 demonstrates that across 3 clinic visits, participants performed BGM and insulin bolusing an average of 5 times/day (range = 1-11). Figure 2 demonstrates that across 3 clinic visits, on average the participants performed BGM prior to administering an insulin bolus 46% of the time (range = 43-47%). In addition, they administered an insulin bolus after a high BG reading (150-249 mg/dl) 55% of the time (range= 49-61%) and an insulin bolus after a very high BG reading (>250 mg/dl) only 68% of the time (range = 66-72%).

Target Adherence to BGM-BOLUS Behaviors. Because it is unreasonable to expect 100% adherence and there are times when it is appropriate to not administer insulin after a very high BG (e.g., prior to exercise), we surveyed T1D providers (e.g., nurses, certified diabetes educators, endocrinologists; n=7) about targets for BGM-BOLUS adherence behaviors and determined the following target rates of adherence:

1. BGM ≥4 times/day ≥90% of the time
2. Insulin bolusing ≥3 times/day ≥90% of the time
3. BGM occurs prior to insulin bolusing ≥70% of the time
4. Insulin bolusing following high (150-249 mg/dl) or very high (≥250 mg/dl) BG readings ≥70% of the time.

The percentage of participants who met these target adherence rates is found in Table 1. About two-thirds were adherent to BGM and insulin bolusing frequency. However, very few participants met the target criteria for BGM prior to insulin bolusing and very few met the target for bolusing after a high BG. We also found that all participants needed intervention targeting >1 BGM-BOLUS adherence behavior and most needed intervention for >2 BGM-BOLUS adherence behaviors (see Table 2).

CONCLUSIONS

Taken together, these data suggest that intervention is especially needed to improve BGM-BOLUS LINK behaviors. If insulin pump users are not using their pumps to their full advantage, then achieving near-normal glycemia is not likely despite the sophistication of insulin pump technology.

METHOD

Data from the insulin pumps of 23 children and adolescents with T1D (Mage=13.62 years+3.22; range=8.9-18.9 years; 78% 10-16 years of age); Mdiabetes duration=5.10 years+3.02) were downloaded during 3 diabetes clinic visits. These data were analyzed in two ways. First, we describe overall adherence to BGM-BOLUS behaviors: 1) average daily BGM; 2) average daily bolusing; and 3) average percentage of time BGM occurred prior to insulin bolusing; 3a) average percentage of time a high (150-249 mg/dl) and 3b) very high (>250 mg/dl) BG reading was followed by insulin bolusing. Then we describe the percentage of participants who meet specific adherence targets for these BGM-BOLUS behaviors.
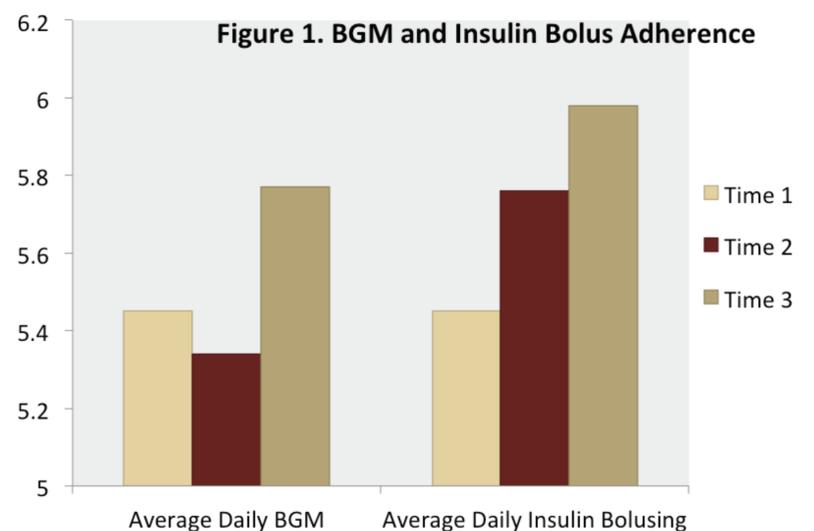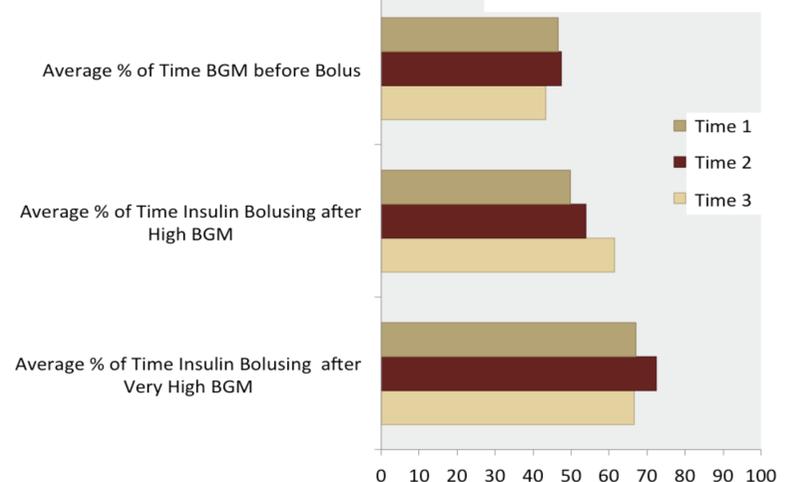

Figure 1. BGM and Insulin Bolus Adherence

Figure 2. BGM-BOLUS LINK Adherence Behaviors

Table 1. % of Children Meeting Target Criteria for BGM-BOLUS Adherence Behaviors	Time 1	Time 2	Time 3
Daily average BGM of ≥4 times per day ≥90% of the time	63.60%	68.00%	57.10%
Daily average insulin bolusing of ≥4 times per day ≥90% of the time	63.60%	64.00%	71.40%
BGM occurs prior to insulin bolusing ≥70% of the time	4.50%	8.00%	4.80%
Insulin bolusing follows a high (150-249 mg/dL) BG reading ≥70% of the time	36.40%	20.00%	14.30%
Insulin bolusing follows a very high (>250 mg/dL) BG reading ≥70% of the time	63.60%	68.00%	52.40%

Table 2. Number of Children Needing Intervention of BGM-BOLUS Adherence Behaviors	Time 1	Time 2	Time 3
# of participants needing NO intervention	0	0	0
# of participants needing intervention for 1 BGM-BOLUS behavior	4	1	0
# of participants needing intervention for 2 BGM-BOLUS behaviors	9	15	9
# of participants needing intervention for 3 BGM-BOLUS behaviors	5	4	9
# of participants needing intervention for 4 BGM-BOLUS behaviors	2	3	0
# of participants needing intervention for 5 BGM-BOLUS behaviors	2	2	3