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# Predicting Basal Insulin Rates on Insulin Pumps in Indian Patients with Type 1 Diabetes: The Rule of 5

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## Abstract

**Aims:** To guide diabetes practitioners on setting up of basal rates in patients initiated on continuous subcutaneous insulin pump therapy (CSII) in India. **Methods:** Fifty patients on CSII for more than six months duration and stable glycemic control were analysed for mean basal rates. **Results:** Five basal rates per day with a thumb rule of 55% basal and 45 % bolus seems a good starting point for patients initiated on CSII therapy in the sub-continent. **Conclusions:** Our pilot study should guide medical professionals in setting up basal rates during CSII initiation to optimise glycemic control efficiently.

**Keywords:** Basal rates, Indian population, insulin pump, type 1 diabetes

## INTRODUCTION

The burden of type 1 diabetes is increasing exponentially in India with an (under) estimated 128,000 children and adolescents affected.<sup>[1]</sup> The numbers are increasing by 3%–5% per annum.<sup>[2]</sup> There is accumulating evidence for the benefit of continuous subcutaneous insulin infusion (CSII) for selected patients with type 1 diabetes in terms of reductions in glycosylated hemoglobin, recurrent hypoglycemia,<sup>[3]</sup> reductions in micro and macrovascular outcomes.<sup>[4,5]</sup> However, such therapy is vastly underutilized in a country like India due to a multitude of factors including costs but more importantly, poor awareness of insulin pump therapy among medical professionals dealing with type 1 diabetes. In our experience, one of the major reasons for patient dropout during the trial period of insulin pump therapy is erratic glucose fluctuations due to improper basal and bolus rate settings. Our aim is to give guidance to medical professionals on the basal rate settings for patients from the Indian subcontinent based on our experience, so that patient dropouts can be minimized during the initial 2 weeks of pump trial.

## METHODS

All the patients were selected from the type 1 diabetes database from Kovai Medical Center and Hospital, Coimbatore, India. Inclusion criteria were the following: patients on insulin pump

therapy for >6-month duration with a last value of glycosylated hemoglobin <7.5%, regular follow-up with no default in clinic attendances, and no major hospital admissions for the past 6 months of therapy. Excluded were patients on <6 months of therapy, glycated hemoglobin >7.5%, pregnant women, and those with comorbidities like advanced renal failure. Results were tabulated in Microsoft Excel 2010. Mean (standard deviation) was calculated. Paired *t*-test was used to estimate the differences between means and a *P* < 0.05 was considered statistically significant.

## RESULTS

A total of 50 patients were selected based on the inclusion and exclusion criteria [Table 1]. The mean age was 18.7 years (8.3) and the body mass index (BMI) was 19.0 (4.1). The mean duration of insulin pump therapy was 13.6 months (7.5). The last glycosylated hemoglobin was 7.1%. The mean total daily dose (TDD) was 47.3 units with a basal and bolus split of 25.8

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**Table 1: Baseline characteristics of the insulin pump cohort (n=50)**

| Baseline characteristics  | Mean (SD)   |
|---------------------------|-------------|
| Age (years)               | 18.7 (8.3)  |
| Duration of CSII (months) | 13.6 (7.5)  |
| Last HbA1c (%)            | 7.1 (0.8)   |
| TDD (units)               | 47.1 (14.1) |
| Total basal dose (units)  | 21.5 (6.7)  |
| Total bolus dose (units)  | 25.8 (9.9)  |
| Basal rate                |             |
| 12 mn-4 a.m.              | 0.77 (0.2)  |
| 4 a.m.-8 a.m.             | 0.83 (0.3)  |
| 8 a.m.-4 p.m.             | 1.0 (0.3)   |
| 4 p.m.-8 p.m.             | 0.9 (0.3)   |
| 8 p.m.-12 mn              | 0.83 (0.2)  |

Mean (SD). SD: Standard deviation, CSII: Continuous subcutaneous insulin infusion, TDD: Total daily dose, HbA1c: Glycated hemoglobin

and 21.5 units, respectively. The mean basal rates for 24 h were 0.8 units/h. The basal rates were largely split into 5 different time settings: 12–4 a.m., 4–8 a.m., 8–4 p.m., 4–8 p.m., and 8–12 midnight. The mean basal rates for these five settings were as follows: 0.77, 0.83, 1.0, 0.95, and 0.83, respectively. Data were analyzed for those <20 years of age versus patients >20 years of age on insulin pump therapy. There were no significant differences between different basal rates in both these groups: 0.76 versus 0.78 for 12–4 a.m. ( $p = 0.8$ ), 0.85 versus 0.82 for 4–8 a.m. ( $P = 0.7$ ), 0.97 versus 1.0 for 8–4 p.m. ( $p = 0.5$ ), 0.93 versus 0.97 for 4–8 p.m. ( $P = 0.7$ ), and 0.81 versus 0.84 for 8–12 midnight ( $P = 0.7$ ). There were no severe hypoglycemia recorded in the preceding 6 months of therapy. The number of self-reported hypoglycemia (mild) reduced significantly from 4 episodes per month on Multiple daily insulin injections (MDI) to 1.2 episodes per month post-CSII therapy ( $P < 0.01$ ) in the above cohort.

## DISCUSSION

We present the first preliminary data from India on the mean basal rates at different time points on patients with type 1 diabetes on more than 6 months of CSII and stable glycemic control. We hope that these data can guide medical professionals in setting up the basal rates during the trial period to ensure smooth glycemic control and prevent dropouts due to erratic basal settings.

There are multiple challenges in India in initiating insulin pump therapy in indicated patients. Apart from the challenge of convincing a patient from the Indian subcontinent with type 1 diabetes from even trying out an insulin pump due to various taboos, the initial step of getting the basal and bolus settings right is an added challenge to prove the therapy during the trial period. Anecdotally, we find doctors struggling to get the basal rates correct, leading to huge fluctuations in glucose levels that demoralize an already skeptical child or their family. The balance is fine as ideally one would expect the settings to be

less aggressive to prevent hypoglycemia and at the same time good enough to ensure rapid improvement in glycemic profile. There are considerable differences in calculating the basal rates (bodyweight vs. TDD) and initiating basal regimens (flat basal rates vs. different basal rates for different times of the day).

Our data show that five differential basal rates at different times of the day lead to smooth glycemic control over a period of time, as evidenced by a mean glycosylated hemoglobin of 7.1% with no severe hypoglycemia for at least 6 months of therapy. There was a small increase in basal rates at 4 a.m. consistent with the dawn's phenomenon. There were no significant differences in basal rates at ages <20 or >20 years. The mean bolus dose was 25.1 units spread across 5 boluses including three main meals and two snack boluses. A rough thumb rule of 55% basal and 45% bolus seems to be a good starting point, however, children going through puberty may have this percentage reversed.

## CONCLUSION

Overall, our pilot study should help medical professionals in India in initiating insulin pump therapy by giving an idea of the basal and bolus settings for a mean BMI of around 20, irrespective of age. While we totally agree that there may be huge individual variations based on multiple factors, some general pointers can be concluded based on our data. The rule of 5 is a simple thumb rule that providers can remember, five basal rates approximating to 0.8 units/h and five boluses for main meals and snacks. Further long-term follow-up of this cohort can be extremely helpful for creating algorithms for closed-loop pump settings in Indian population

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## Conflicts of interest

There are no conflicts of interest.

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