An Information and Communication Technology System to Detect Hypoglycemia in People with Type 1 Diabetes

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Diabetes is a disease where people have abnormal high blood glucose levels – hyperglycaemia.

- **346 million people** world-wide suffer from diabetes.¹
  - 550 millions in 2030.²

Complications are acute and long-term.

- **Insulin** therapy lowers blood glucose
  - Increases risk of **hypoglycaemia** (blood glucose ≤ 3.9 mmol/l).

- **Hypoglycaemia** is an uncomfortable and feared condition.
  - 66% of relatives fear nocturnal hypoglycaemia.⁴

- Blood glucose can be monitored with **CGM**.

- Hypoglycaemia can maybe be predicted or detected.
  - Factors: Insulin, meals and exercise.

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System architecture
Algorithm in smartphone

CGM signal

Insulin information

Feature extraction

762 features

SEPCOR

Remaining features

Forward Selection

SVM

Best model

Patient
Algorithm

- Algorithm was trained and cross-validated on 10 subjects experiencing 17 hypoglycaemia events.
- Detected 17/17=100% events vs 12/17=71% of orig. CGM.
- Produced 1 false alert vs 0 false alerts of orig. CGM.
- Increased lead time from 0 (±11) to 14 (±20) minutes.
Smartphone app

**Save data**
Save insulin or carbohydrates.

**View data**
See graph, table, average etc.

**Settings**
Change graph view, targets etc.

**Logout**
Logout of applicationen

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**Date:**
05-12-2012, 09:18

**Insulin:**
22 IU Aspart

**Carbohydrate intake:**
15 g

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**Readings in 1 day interval**

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**WARNING!**
The system has detected an incoming hypoglycemia and you are recommended to take preemptive actions or contact medical assistance:

Dr. John Doe
T: +45 2243 5434

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**Logout**
Logout of applicationen
Smartphone app

- The user-interface needs to undergo usability testing.
- Communication protocols.
  - CGM, use bluetooth?
  - Insulin (pens with memory function).
  - Clever carbohydrate counting? Image analysis?
  - Inclusion of exercise registration through FitBit or CalFit.

Algorithm

- Sensitivity of 100% and 1 FP is better than a recent study\(^1\) with sensitivity of 89% and 6 FPs.
- Algorithm needs to be validated on more data.
- For prediction, the algorithm should probably include meal and exercise information.

Conclusion

- Promising but usability testing and more validation on more data is necessary.

QUESTIONS?