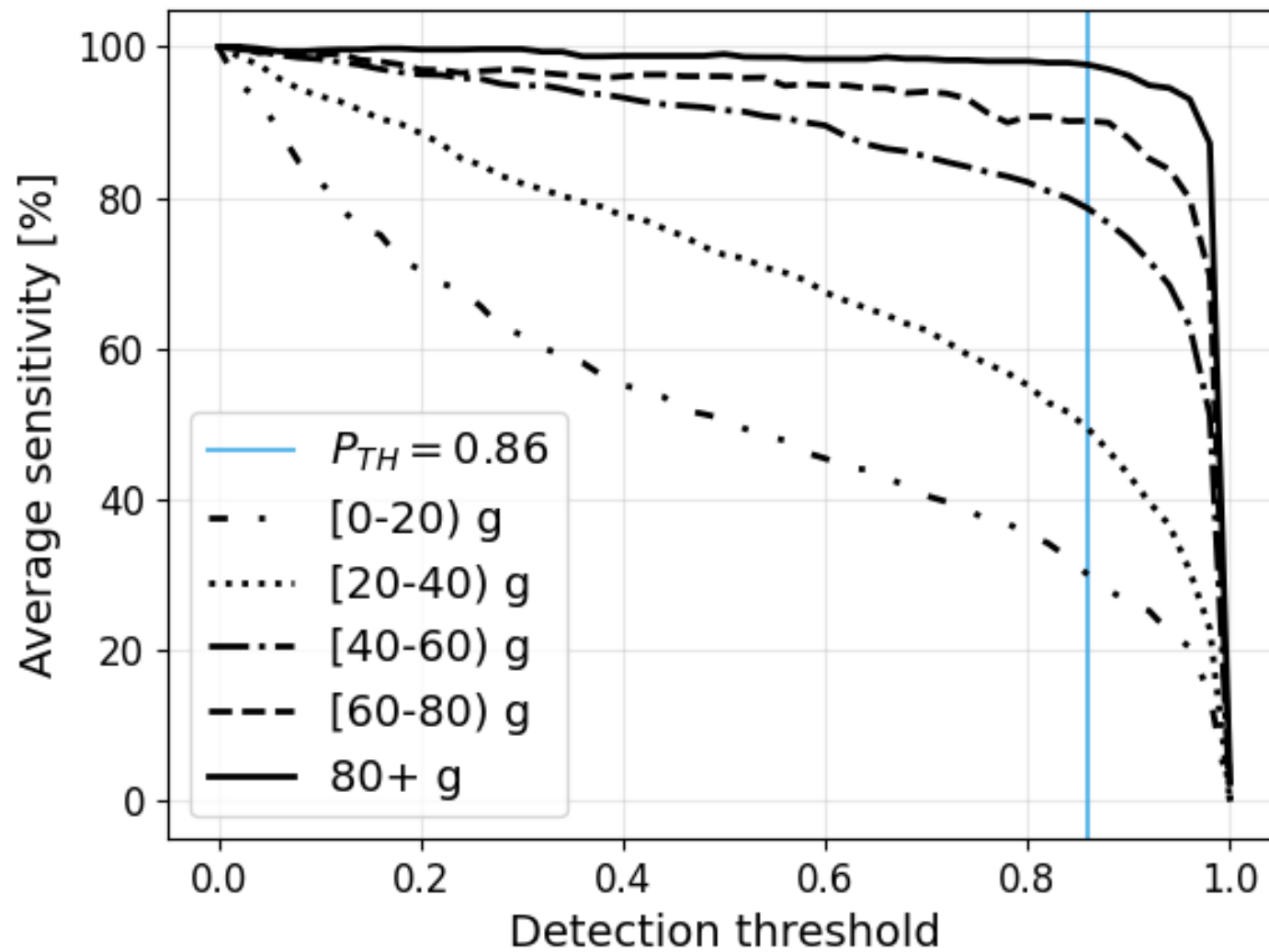
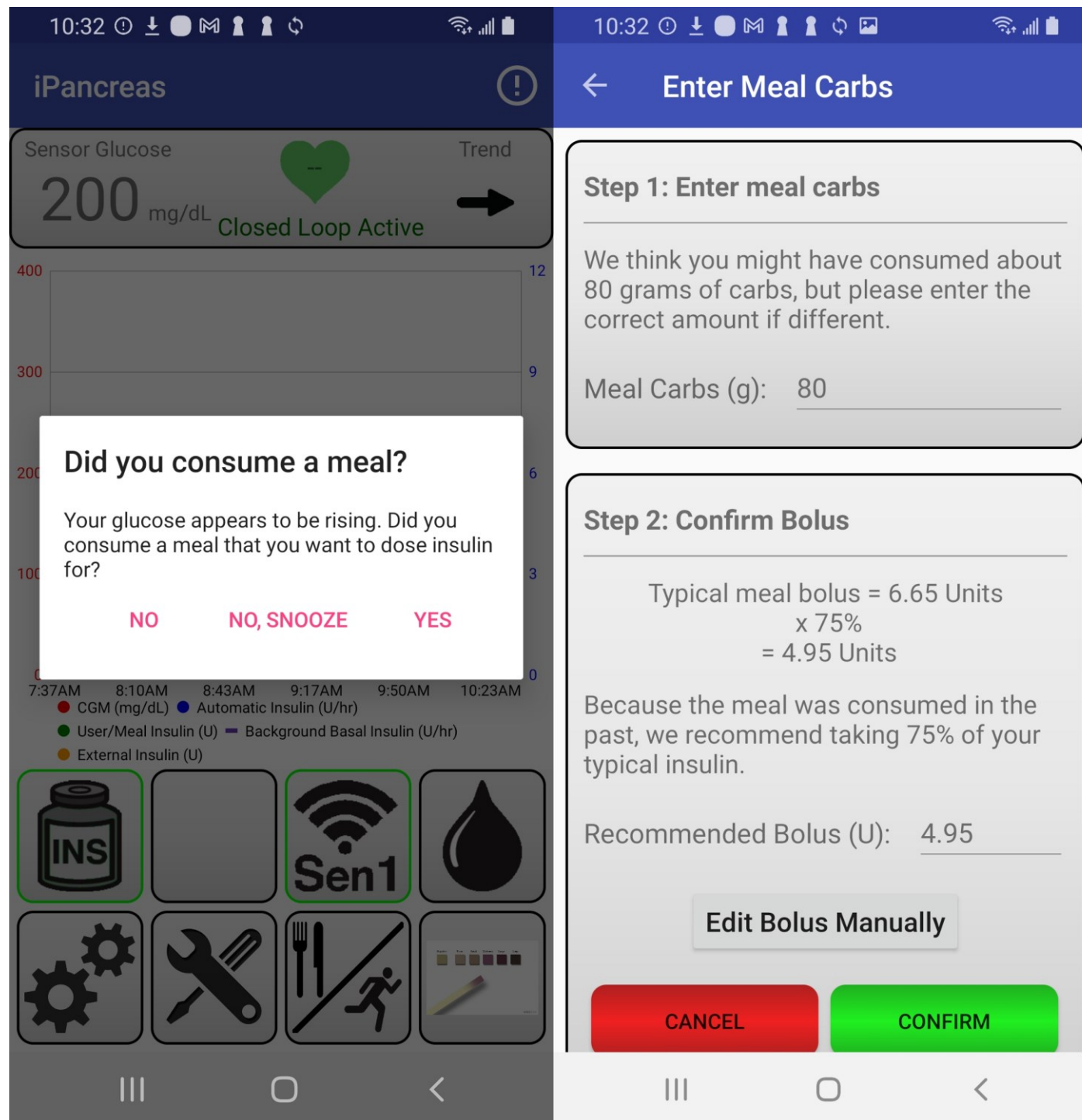


**Supplementary Fig. 1** Architecture of the multioutput neural network designed for meal detection and meal size estimation.



**Supplementary Fig. 2** *In silico* sensitivity of the proposed machine learning meal detection algorithm for meals with varied carbohydrate content.



**Supplementary Fig. 3** *iPancreas* screens for notifying the participant of a missed meal insulin detection.

**Supplementary Table 1.** Features used for meal detection and meal size estimation.

| Description  | Number of features | Specification / Calculation  |
|--|--------------------|--|
| <b>Glucose features</b>  |                    |  |
| Glucose at the time of prediction  | 1                  | $f_1 = CGM_k$  |
| Time series of glucose measurements corresponding to one-hour worth of data prior to the prediction time   | 12                 | $f_{2-13} = CGM_{k-h}$<br>$h \in \{1,2,3, \dots, 12\}$   |
| Glucose rate of change (GROC) <sup>1</sup> at the time of prediction   | 1                  | $f_{14} = \frac{CGM_k - CGM_{k-1}}{\Delta t}$  |
| Average GROC during the hour prior to prediction.  | 1                  | $f_{15} = \frac{1}{13} \sum_{h=0}^{12} GROC_{k-h}$   |
| Count of GROC values over the hour prior to prediction that are greater than pre-defined thresholds.   | 8                  | $f_{16-24} = \sum_{h=0}^{12} f(GROC_{k-h})$<br>$f(GROC_{k-h}) = \begin{cases} 1, & \text{if } GROC_k > th \\ 0, & \text{otherwise} \end{cases}$<br>$th \in \{0.0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 6.0\}$ |
| Average glucose over one hour prior to prediction time   | 1                  | $f_{24} = \frac{1}{13} \sum_{h=0}^{12} CGM_{k-h}$  |
| Average glucose calculated from two hours to one hour prior to prediction time   | 1                  | $f_{25} = \frac{1}{12} \sum_{h=13}^{24} CGM_{k-h}$   |
| Difference in average glucose during the last half hour vs. the preceding half hour  | 1                  | $f_{26} = \frac{1}{6} \sum_{h=7}^{12} CGM_{k-h} - \frac{1}{7} \sum_{h=0}^6 CGM_{k-h}$  |
| Average difference between glucose over 30 minutes prior to prediction with respect to the glucose value exactly 30 minutes prior to prediction time | 1                  | $f_{27} = \frac{1}{6} \sum_{h=0}^5 (CGM_{k-h} - CGM_{k-6})$  |
| Binary value, set to 1 if the ROC at prediction time is greater than 5 mg/dL/min   | 1                  | $f_{28} = \begin{cases} 1, & \text{if } GROC_k > 5 \\ 0, & \text{otherwise} \end{cases}$   |
| Binary value, set to 1 if the ROC at prediction time is greater than 7 mg/dL/min   | 1                  | $f_{29} = \begin{cases} 1, & \text{if } GROC_k > 7 \\ 0, & \text{otherwise} \end{cases}$   |
| <b>Insulin features</b>  |                    |  |
| Insulin availability calculated 60 minutes prior to prediction time  | 2                  | $f_{30} = I_{k-12}$  |
| <b>Time features</b>   |                    |  |
| Time of day (hour, 0-23)   | 2                  | $f_{31} = \cos\left(2\pi \frac{hour}{24}\right)$<br>$f_{32} = \sin\left(2\pi \frac{hour}{24}\right)$   |

<sup>1</sup> GROC is computed using second-order central differences in the interior points and first order forward or backwards differences at the boundaries.

**Supplementary Table 2.** RAP bolus recommendations and bolus delivered. True positive detections shown (11 out of 13 breakfast meals were detected).

| <b>Participant ID</b> | <b>RAP recommended bolus [U]</b> | <b>Delivered bolus [U]</b> | <b>Absolute difference</b> |
|-----------------------|----------------------------------|----------------------------|----------------------------|
| <b>Breakfast</b>      |                                  |                            |                            |
| 501                   | 4.30                             | 5.00                       | 0.70                       |
| 502                   | 6.55                             | 6.55                       | 0.00                       |
| 504                   | 5.80                             | 5.80                       | 0.00                       |
| 505                   | 7.50                             | 6.00                       | -1.50                      |
| 507                   | 2.75                             | 2.75                       | 0.00                       |
| 508                   | 3.35                             | 5.00                       | 1.65                       |
| 509                   | 4.10                             | 4.50                       | 0.40                       |
| 510                   | 5.50                             | 5.50                       | 0.00                       |
| 512                   | 3.15                             | 5.00                       | 1.85                       |
| 513                   | 3.30                             | 4.00                       | 0.70                       |
| 514                   | 3.80                             | 3.80                       | 0.00                       |
| <b>MEAN ± STD</b>     | <b>4.55 ± 1.56</b>               | <b>4.90 ± 1.09</b>         | <b>0.35 ± 0.91</b>         |