

Use of a digital device, known as Smart Peak Flow, to predict peak expiratory flow (PEF) zones of the next day in asthma



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Background

Asthma self-management includes early recognition of lung function decline by measuring PEF at patients’ home. A new smartphone PEF meter, known as Smart Peak Flow (SPF- see figure 1) has been developed not only to measure current PEF, but also aims to predict the PEF zones of the next day. This provides an early warning of degradation of lung function. This in turn can be used as an objective predictor of asthma worsening



Figure 1: The Smart Peak Flow

Methods

- Artificial neural network was used to develop the algorithm for predicting the green (>80% personal best PEF), yellow (60-80% of personal best PEF) and red (<60% of personal best PEF) PEF zones of the next day.
- Timestamps of minimum 15 PEF measurements over 21 days were obtained from 503 SPF users.
- Window filtering was used to remove non-physiological outliers.
- A “training set” was used for machine learning and a “test set” comprising of asthmatics was used to evaluate the prediction algorithm.
- Diagnostic statistics were sought to check the accuracy of the prediction algorithm.

Results

Out of 503 SPF users, 286 were females and the mean age (sd) of all users was 40.62 (19.99). The “training set” included 350 users while the “test set” involved 153 asthma users. The confusion matrix (see figure 2) revealed good accuracy (F1 0.808) for predicting the PEF zone of the next day. ROC curve (see Figure 3) showed that the predictive algorithm differentiated SPF users among the different PEF zones of the next day. The AUC was estimated for red, yellow and green zones as 0.923, 0.820 and 0.837

Almost Correct: 7261 (86.1%)

Red	38	48	8
RY	5	54	27
Yellow	17	727	706
YG	1	250	687
Green	1	373	5500
	Red	Yellow	Green

Figure 2: The Confusion matrix showing the true PEF measurements plotted against the predicted measurements

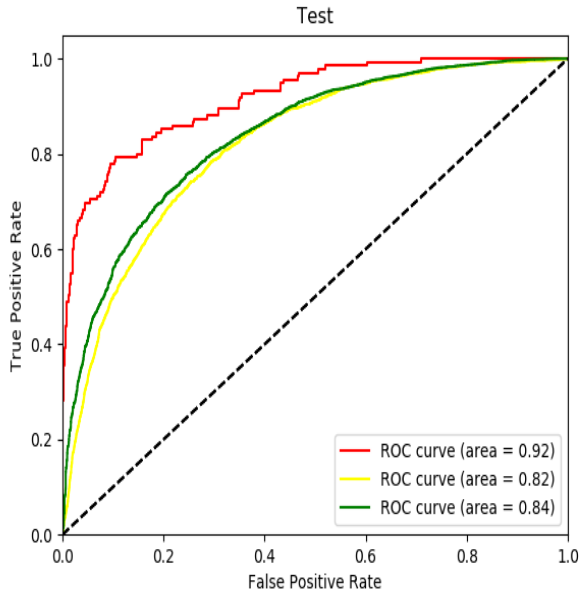


Figure 3: The Receiving operating curve with estimates of the area and the curve

Conclusion

- An algorithm used by the SPF has been found to predict the PEF zone of the next day with 90% accuracy.
- A minimum of 15 PEF measurements over 21 days are currently required for an accurate prediction.
- The SPF can become a tool for predicting asthma worsening giving asthma patients more time to prepare to manage their condition.

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