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Mobile phone technology in the management of asthma

D Ryan¹, W Cobern², J Wheeler³, D Price¹ and L Tarassenko²

1 Department of General Practice and Primary Care, University of Aberdeen, UK

2 Department of Engineering Science, University of Oxford, UK

3 The William Symons Medical Centre, Maidenhead, UK

Correspondence:

Woodbrook Medical Centre
28 Bridge St
Loughborough
LE11 1NH
UK.
Fax: +44 1509 239649
Email: dermotryan@doctors.org.uk

Summary

Peak flow monitoring as part of a self-management plan for asthma is widely recommended. Manual recording is cumbersome and liable to falsification. Compliance with paper recording is poor in practice.

We describe a telemedicine observational study using electronic peak flow monitoring and mobile phone technology in a UK general practice population over a nine-month period. Patients between 12 and 55 years of age, requiring treatment with regular inhaled steroids and (as needed) bronchodilators, were recruited from nine general practices. Patients were included if their asthma was considered stable with no history of exacerbation in the previous 3 months. No therapeutic intervention was proposed.

The primary outcome measure was compliance. 69% of the 46 participants who filled in the post-study questionnaire were “satisfied” or “very satisfied” by the study, citing the ease of use and the increased autonomy and understanding of asthma as the main advantages. 74% indicated that the system had helped to improve their ability to manage their symptoms, with no patients indicating a negative impact.

Introduction

If telemedicine is to be used on a large scale by people with chronic conditions such as asthma, technology will be required that is easy to use. Peak flow monitoring is widely recommended in national [1] and international [2] asthma guidelines, but adherence to traditional pen and paper recording has been persistently poor [3]. We have conducted an observational study using electronic peak flow monitoring and mobile phone technology in a UK general practice population.

Methods

The study was conducted over a nine-month period in 2003. Patients were judged by their GP to have mild-to-moderate asthma, were taking regular inhaled glucocorticosteroids, and were well controlled. Patients between 12 and 55 years of age, requiring treatment with regular inhaled steroids and (as needed) bronchodilators, were recruited from nine general practices in the Slough and Maidenhead area (west of London). Patients were included if their asthma was considered stable with no history of exacerbation in the previous 3 months. There was no scheduled review and no intervention was offered. Ethics committee approval was obtained and patients or their parents gave informed consent. The primary outcome measure was compliance. Secondary outcomes were use of a telephone helpline (providing technical support only) and response to a questionnaire that examined patient satisfaction and the key benefits and drawbacks of the system.

A handheld electronic peak flow meter was used (PEF/FEV₁ Diary, Vitalograph, Bucks, UK) which was connected to a mobile phone (the O₂ XDA). Patients were instructed in the use of the system and advised to complete peak flow readings in the morning and evening. Software on the mobile phone (e-San Ltd, Oxon, UK) transmitted the readings via the GPRS network to a secure server in Oxford as the peak flows were recorded. Immediate feedback, in the form of asthma trend analysis, was sent back to the phone and displayed on its colour screen.

Four indices of patient compliance were calculated: at least one reading taken everyday, at least two readings taken everyday, at least one morning reading and at least one evening reading taken. Study questionnaires were distributed to participants within one month of the end of the study.

Results

91 patients who met the study criteria were recruited. 38 subjects (42%) were under 18 years by study completion and 53 (58%) were over 18. The mean duration, calculated between the first and last recorded data, across all 91 patients, was 203 days (SD 94).

Compliance

The 38 minors and 53 adults sent peak flow readings once a day for 68% of the time and twice a day for 55% of the time (mean values). The median values are shown in Table 1. Within the group of 91 patients, there were three distinct sub-groups:

Sub-group 1: the patients whose data have at least one large gap during the study, mostly due to significant technical problems. There were 13 such patients (7 minors, 6 adults), i.e. 14% of the total. The three main technical problems were loss of battery power, damage to the cable connecting the peak flow meter to the mobile phone and persistent lack of GPRS connectivity.

Sub-group 2: the patients who sent fewer than 100 readings in total during the study. These were the occasional users or low-compliance patients. It is not known whether their low compliance was due to technical problems, such as loss of GPRS network connectivity. There were 20 patients in this sub-group (9 minors, 11 adults), i.e. 22% of the total.

Sub-group 3: these patients were highly compliant and dedicated users of the system. They represented 64% of the total (22 minors, 36 adults).

The compliance for the 58 patients in sub-group 3 is summarised in Table 2. There was no significant significance in the pattern of readings (morning or evening) for any of the three categories in the table (minors, adults or all patients). When comparing adults and minors, there was a significant difference ($P < 0.05$, Mann Whitney test) for the once-a-day, twice-a-day and am readings, but not the pm readings

Questionnaire analysis

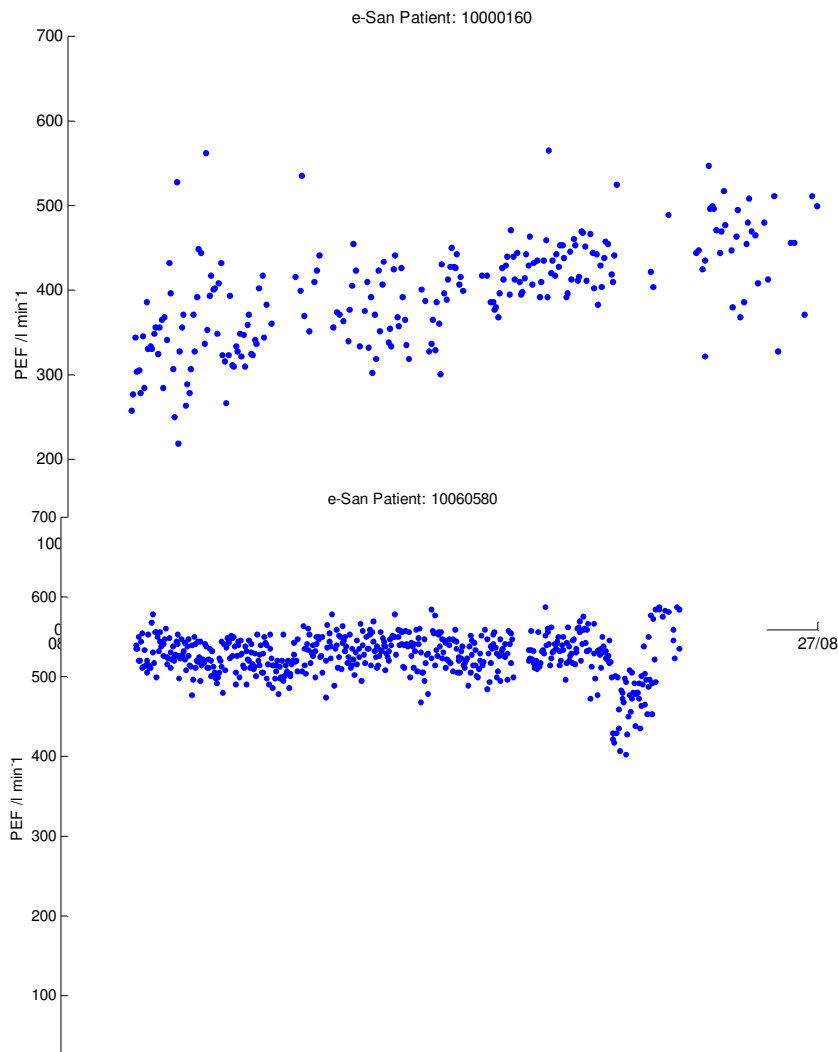
46 participants filled in the questionnaire (51% response for the study group). 69% of the respondents were satisfied or very satisfied by the study, citing the ease of use and the increased autonomy and understanding of asthma that the enhanced ability to monitor peak flow provided. Patients generally found the phone software easy to use: 68% reported that it easy or very easy, and 13% deemed it not easy to use. The e-San helpline also proved to be a useful support feature, with 88% of the patients using the facility. 59% of respondents called between one and five times, and 28% called more than 5 times. 74% indicated that the system had helped to improve their ability to manage their symptoms, with no patients indicating a negative impact. The most positive features of the telemedicine system were described as: increased awareness and information about asthma, improved ability to monitor/manage the condition with availability of feedback screens on mobile phone and ease of use.

Discussion

The present study was devised to assess patient compliance with electronic peak-flow recording with contemporaneous transmission of data and immediate feedback on the mobile phone screen. There was a high level of compliance in about two-thirds of users, but there were also technical difficulties (sub-group one) and poor compliance, for reasons not identified (sub-group 2).

The system provided peak flow readings, which were date- and time-stamped. A retrospective analysis of the readings from the patients in sub-group 3 showed that about half of the 58 patients were unstable asthmatics throughout the study. This is the case, for example, for the patient shown in Figure 1, which shows a high variability in peak flow values throughout the study. In contrast, the patient in Figure 2 is stable, which makes it possible to identify clearly the exacerbation which occurred towards the end of the study.

Compliance with the monitoring system was acceptable in the majority of users. Although the participants in the study were judged to be mild sufferers on regular prophylactic medication, the accurate and regular data collected during the study showed that many patients with asthma were in fact poorly controlled, according to peak flow criteria. A server-based peak flow asthma telemedicine system that analyses peak flow values in real time and feeds information back to the patient within seconds would be a valuable tool to enhance self-management.



Acknowledgements:

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References

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Table 1. Use of the system by all 91 patients.

	Minors		Adults		All patients	
	Median (%)	IQR (%)	Median (%)	IQR (%)	Median (%)	IQR (%)
Once a day	66	45 – 80	81	58 – 90	72	53 – 87
Twice a day	51	29 – 65	62	42 – 79	58	36 – 73
am readings	52	30 – 66	67	36 – 80	56	33 – 78
pm readings	49	28 – 65	61	42 – 79	57	37 – 76

Table 2. Use of the system by 58 highly compliant patients (sub-group 3).

	Minors		Adults		All patients	
	Median (%)	IQR (%)	Median (%)	IQR (%)	Median (%)	IQR (%)
Once a day	91	85 – 93	96	91 – 98	93	89 – 98
Twice a day	75	66 – 85	83	75 – 91	80	71 – 89
am readings	73	66 – 86	86	76 – 91	84	69 – 89
pm readings	80	68 – 85	85	69 – 92	82	69 – 90

Note to editor: the Vitalograph is manufactured to supply a reading within pre specified tolerances of approx +/-10%. Nothing was done to try and refine these readings

Figure legends

- 1 Patient 1 (unstable) Peak flow readings versus time for the duration of the study
- 2 Patient 2 (stable) Peak flow readings versus time for the duration of the study