| Key messages |
| --- |
| • Current leg ulcer care is expensive and ineffective |
| • The introduction of community leg ulcer clinics improved care and resulted in lower costs than the traditional approach that the clinics replaced |
| • Planned and coordinated programmes of care can reduce costs substantially while improving healing rates |
| • Community units and general practitioners should be encouraged to seek alternatives to the standard care for leg ulcers |

four layer system was not prescribable on the NHS; access to the appropriate materials, equipment, and training are therefore essential to achieve real improvements in care. Furthermore, we understand that the substantial increase in hospital inpatient care in Trafford in 1994 was a direct result of increased awareness of four layer compression, which was unavailable in the community but which could be obtained in hospital.

The 1994 study was undertaken only six months after opening the fifth and last community leg ulcer clinic in Stockport. Each clinic could see a maximum of three new patients at any one time with initial waiting lists of patients for treatment and nurses for training. Despite this, the prevalence of active leg ulcers in Stockport fell between 1993 and 1994. Studies of ulcer prevalence undertaken on the basis of patients receiving treatment are always liable to underestimate numbers of patients, but the increased profile of leg ulcer care in Stockport after the introduction of community clinics during this project probably increased the number of patients who came forward in 1994. This reduction in prevalence should progress as more chronic ulcers heal and improved health education results in earlier presentation of any recurrences that do occur.[5] After four years, the prevalence of leg ulcers in the population served by the Riverside community leg ulcer project fell by over 75%.[6]

Community leg ulcer programmes have proved difficult to introduce in the NHS as managers are fearful that multilayer compression systems will incur increased cost. No other community based approach has achieved comparable outcomes; a systematic review of the literature on leg ulcers reflected the paucity of quality studies in this field and failed to offer clear solutions.[7] The results of this study should convince managers that a cost effective and community based strategy is available. The frequency of treatments and cost of materials each week in those patients treated with the four layer bandage is considerably less than that previously used in Stockport and much cheaper than care in Trafford. Substantial savings can therefore be made even if no additional ulcers are healed. The greatest savings, however, accrue through progressively healing most of the patients with ulcers and thereby reducing demands on both materials and hard pressed staff.

On the basis of the results of the 1993 study we calculated that leg ulcer care in the United Kingdom was costing £236m annually.[1] To ease comparison between the two studies we have used 1993 costs throughout. Community leg ulcer clinics combine staff training and effective research based practice for all patients to improve healing. As is often the case best care costs less so that a national implementation of this approach, which reduced expenditure in Stockport by 38.2%, could achieve savings of at least £90m annually while also relieving patients of this unpleasant, debilitating problem.

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Conflict of interest: None.

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# Improving vaccine storage in general practice refrigerators

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Vaccines are biological products and are susceptible to fluctuations in temperature. In many general practices vaccines are exposed to adverse temperatures.[1 2] The aim of this study was to determine whether educating one staff member in each practice about correct vaccine storage conditions and nominating that staff member to monitor the refrigerator's temperature would improve vaccine storage in general practices.

## Methods and results

A random sample of general practices in a metropolitan division of Western Australia and all general practices in a rural division were invited to participate in the study. Those that already monitored their refrigerators with a maximum-minimum thermometer or did not store vaccines were excluded.

Practices were randomised into control and intervention groups, and their vaccine refrigerators were monitored for 30 days with a computerised temperature logger. The staff member most responsible for vaccine storage in each practice was then interviewed. In the intervention practices this staff member was educated, given a digital maximum-minimum thermometer, and allowed up to 14 days to adjust refrigerator temperatures if necessary. All practice refrigerators were subsequently remonitored with the computerised temperature loggers for a further 30 days. Monitoring occurred between October 1994 and January 1995.

A refrigerator was designated unacceptable if, during a 30 day monitoring period, more than eight days of logger readings were above 12°C or more than one hour of readings were below −0.5°C. These criteria were chosen to reflect exposure levels that may compromise the potency of vaccines.[2-4]

McNemar's test was used to assess whether refrigerator temperatures changed from baseline. Logistic regression with random effects[5] was used to model the

**Table 1**—*Number of vaccine refrigerators with unacceptable temperatures at baseline and follow up in general practices in Western Australia, October 1994 to January 1995*

| | Unacceptable at baseline | Unacceptable at follow up | Improved | Deteriorated |
|---|---|---|---|---|
| Intervention (n = 25)* | 12 | 3 | 10 | 1 |
| Control (n = 25)† | 6 | 9 | 2 | 5 |

*P = 0.02, † not significant; McNemar's test.

probability of a refrigerator being acceptable, accounting for group status (control or intervention) and repeated measurements (baseline and follow up).

Of the 36 metropolitan practices randomly selected, 29 were eligible and 25 agreed to participate. Of the 28 rural practices identified, all 25 eligible practices agreed to participate, giving a total of 50 practices. Only five of the staff members responsible for vaccine storage in these 50 practices knew the recommended maximum and minimum temperatures for vaccine storage and only two knew which vaccines were damaged by freezing.

Changes in the acceptability of refrigerator temperatures at baseline and follow up are shown in table 1. Logistic regression analysis showed that the odds ratio of a refrigerator in the intervention group being acceptable at follow up relative to baseline was 6.8 (95% confidence interval 1.9 to 24.3), while in the control group the odds ratio was 0.6 (0.2 to 1.7). The interaction between group status and acceptable temperature at follow up was statistically significant ($\chi_1^2 = 8.4$; P = 0.004). Of the 30 unacceptable refrigerator recordings at baseline and follow up, 26 recorded more than one hour below −0.5°C.

## Comment

Eighteen (36%) practice refrigerators recorded unacceptable temperatures at baseline: most of these refrigerators recorded temperatures that may have frozen vaccines and consequently damaged them. The staff members responsible for vaccine storage had poor knowledge about recommended temperatures and were unaware of their refrigerator's temperatures. This randomised controlled trial shows that educating a staff member in each practice on correct vaccine storage conditions and nominating that staff member to monitor the refrigerator's temperature with a digital maximum-minimum thermometer improved vaccine storage. Selection bias was minimised as only four eligible practices refused to participate. Blinding was considered unnecessary as recordings were by a computerised device, and though only a small sample was studied a significant improvement was nevertheless observed. The widespread implementation of this simple and inexpensive intervention should result in better vaccine storage conditions and fewer vaccine failures in general practices.

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# High ambient temperature: a spurious cause of hypokalaemia

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During the exceptionally hot summer of 1995 we noticed an increase in the number of cases of hypokalaemia reported by this laboratory among patients seen in general practice, though quality control data showed that the laboratory's methods and performance had not changed. Samples are collected from surgeries once a day and delivered by van to the laboratory, often several hours after venepuncture. We postulated that the high ambient temperature in the interim was directly responsible for the increase in hypokalaemia by stimulating cellular uptake of potassium.

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## Subjects, methods, and results

Daily means for plasma potassium concentrations for samples from this hospital and general practices were obtained separately from the laboratory computer for the period 1 January to 10 August 1995. These means were compared with the maximum daily dry bulb temperatures recorded at the Nottingham and Warsop weather stations (data were supplied by the Meteorological Office at Bracknell).

Venous blood was collected from five healthy, non-fasting volunteers at 9 am and aliquoted into Vacutainers (Becton Dickinson, Oxford) containing lithium heparin. Samples were kept unseparated at 4°C, 37°C, and 23°C (the temperature of an airconditioned room). Plasma potassium was measured on an Olympus AU 800 analyser after 0, 4, and 24 hours. Changes at the higher temperatures were investigated further with another 10 volunteers, storing aliquots at 23°C and 37°C and measuring potassium after 0, 0.5, 1, 2, 3, 4, 5, and 8 hours. The effect of continuous sample mixing, as might occur during transit in a van, was investigated with samples from a further five volunteers, divided equally between two 37°C water baths, one with motorised sample agitation. Differences were compared to baseline by analysis of variance; results from different experiments were combined when measurements were made at the same temperature and time points.

The daily mean potassium concentration for hospital patients was relatively constant over the period 1 January to 30 June, with a slight fall in July and August (fig 1). The daily mean for general practice patients, however, was highly significantly correlated with maximum daily temperature (r = −0.91, P<0.0001). The widest divergence between the two populations coincided with the highest temperatures.

In all the stability experiments, baseline potassium concentrations were in the range 3.83–4.50 mmol/l. Potassium rose rapidly when samples were kept at 4°C, as previously reported.[1 2] After 4 hours the mean rise was 1.00 mmol/l (95% confidence interval 0.56 to 1.44; P<0.001). At 23°C potassium did not change significantly for up to 8 hours. After 24 hours, however, there was a mean increase of 1.12 mmol/l (0.87 to 1.37; P<0.001). At 37°C potassium showed a small initial fall of −0.22 mmol/l at 4 hours (−0.44 to −0.01; P<0.001) but a rise at 24 hours of 6.27 mmol/l (6.02 to 6.53; P<0.001). No differences were found between agitated and static samples.

## Comment

Delayed sample separation is a well recognised cause of spurious hyperkalaemia. In hot weather it should be