Environmental aspects of health care in the Grampian NHS region and the place of telehealth

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Summary
Detailed information about the composition of the carbon footprint of the NHS in the Grampian health region, and in Scotland generally, is not available at present. Based on the limited information available, our best guess is that travel emissions in Grampian are substantial, perhaps 49,000 tonnes CO₂ per year. This is equivalent to 233 million km of car travel per year. A well-established telemedicine network in the Grampian region, which saves over 2000 patient journeys a year from community hospitals, avoids about 260,000 km travel per year, or about 59 tonnes CO₂ per year. Therefore using telehealth as it has been used historically (primarily to facilitate hospital-to-hospital interactions) seems unlikely to have a major environmental impact – although of course there may be other good reasons for persevering with conventional telehealth. On the other hand, telehealth might be useful in reducing staff travel and to a lesser extent, visitor travel. It looks particularly promising for reducing outpatient travel, where substantial carbon savings might be made by reconfiguring the way that certain services are provided.

Introduction
Until recently there has been little readily-available information about the composition of the carbon footprint of the NHS in Scotland. It is therefore difficult to know what influence telehealth presently has, or might have in future. Such information is a pre-requisite for any kind of planning work about how telehealth might be developed for NHS purposes.

Detailed information about the carbon emissions resulting from NHS work in England was published in 2008.† We have used this information to extrapolate to the case of Scotland. A recently published report also provides estimates of the carbon footprint of NHS Scotland. The two estimates combined can be used as a ‘best guess’ at the true figure.

Using the best-guess figure for NHS Scotland allows the travel emissions from the Grampian health region to be estimated. This region contains some well-established telehealth applications, and the resultant carbon savings can be calculated fairly accurately. These telehealth carbon savings can then be viewed in the context of the emissions from the Grampian region as a whole.

The NHS and the environment
The NHS is a large organization and consequently it has a substantial impact on the environment. There are three sources of carbon emissions that make up the carbon footprint of the NHS. The largest source is the ‘embodied’ carbon emissions, i.e. those resulting from the goods and services consumed by the NHS. Second, there are the direct carbon emissions associated with buildings, and finally there are the carbon emissions resulting from travel connected with NHS activities. In England, roughly half of the CO₂ emitted comes from the first source, called procurement. About a quarter each comes from building energy use and from travel (see Figure 1).

Carbon reduction to date
Although procurement represents the largest component of the carbon footprint, efforts to reduce it are only just being made. It remains to be seen what can actually be achieved in practice.

On the other hand, the NHS has made continual attempts to reduce energy consumption. Since 1985, the target has been a 2% reduction in energy consumption per year. This has been achieved by switching from the use of coal and oil as energy sources to natural gas, by installing more modern plants and by improving the energy efficiency of buildings.
Travel

Travel emissions in England

The final component of the carbon footprint is due to travel. Here, roughly half of the CO₂ emitted is due to staff, either commuting to work or conducting business-related travel (see Figure 2). Most of the rest is due to the patients, although about 10% of the total is due to visitors.¹

Travel emissions in Scotland

At the time the present study began (2008), information on NHS travel emissions in Scotland was not readily available, and we therefore estimated it from the case of England. The building energy emissions of the NHS in Scotland are about 10% of those of the NHS in England.⁴ Suppose that NHS travel in Scotland is in the same proportions as the NHS in England, then the total travel emissions would amount to 337,706 tonnes per year (estimate A). By analogy with England, the breakdown would be as shown in Table 1. Note that the average population density in Scotland is much lower than in England (65 /km² vs 383 /km²),⁵ which may affect these estimates.

Since these estimates were made, NHS Scotland has commissioned a carbon footprint report from external consultants.² The overall travel emission (estimate B) is approximately twice as high as our own (see Table 1). The Health Facilities Scotland report states that its values are likely to contain considerable uncertainties because of the way they were derived. For the purposes of the subsequent discussion here, we will use the mean of the two estimates as the best guess at the true carbon emissions of NHS Scotland.

Table 1 Estimated annual travel emissions from NHS Scotland. Estimate A is from the present paper (see text); Estimate B is from the recent Health Facilities Scotland report.² The best-guess value is the mean of the two estimates.

| Component       | Estimate A Tonnes CO₂ | Estimate B Tonnes CO₂ | Best guess Tonnes CO₂ |
|-----------------|-----------------------|-----------------------|-----------------------|
| Patient own     | 151,522               | 260,000               | 206,000               |
| Staff – commuting | 75,266                | 70,000                | 73,000                |
| Staff – business | 73,285                | 150,000               | 112,000               |
| Visitor         | 37,633                | 160,000               | 99,000                |
| Total           | 337,706               | 640,000               | 489,000               |

Table 2 Estimated annual travel emissions from the NHS Grampian region and the equivalent car-travel distance (assuming an average petrol car⁶)

| Component       | Tonnes CO₂ | Equivalent car-travel distance (km) |
|-----------------|------------|-------------------------------------|
| Patient own     | 20,576     | 98 million                          |
| Staff – commuting | 7,263     | 35 million                          |
| Staff – business | 11,164     | 53 million                          |
| Visitor         | 9,882      | 47 million                          |
| Total           | 48,885     | 233 million                         |

Telehealth

What part might be played by telehealth in reducing the carbon footprint of the NHS? Telehealth is the provision of health care at a distance. Thus a procedure involving telehealth will mean that travel is reduced or avoided – that is, travel on the part of the health-care worker, the patient or...
others. In principle, therefore, the use of telehealth is to be encouraged on environmental grounds (leaving aside awkward questions about resource allocation).

Examples of telehealth

Conventionally, telehealth has been used to improve the efficiency of health-care delivery. Most of the experience to date has been in the secondary or tertiary health sectors, where telehealth is often used to improve access to specialist opinions. This saves travel on the part of the patient or doctor. Examples of telehealth being used to reduce patient travel in the north east of Scotland, from which environmental savings can be calculated, include the Grampian minor injuries service and the specialist referral service for patients in the Shetland Islands.

Minor injuries

In the north east of Scotland, telehealth is used as a decision-support aid at units treating patients with minor injuries. These units are usually based in small, community hospitals and staffed by nurses rather than doctors. Obviously patients with significant injuries are not treated locally, but transferred to a larger hospital. Many of the minor injuries can be managed locally, by nurses working to pre-agreed protocols. In a proportion of cases, where the best course of action is not immediately clear, the nurse will request advice from doctors at the main centre, the Aberdeen Royal Infirmary.

Using a video link allows the doctor providing telehealth advice to see the patient and provide appropriate advice. In some 90–95% of these requests for telehealth advice, the result is that the patient does not need to be transferred to Aberdeen. Since relatively large numbers of patients are managed using telehealth, the avoided travel is substantial. There are, of course, other benefits, such as the convenience to patients.

During 2007 there were 2061 teleconsultations between the 14 minor injury units in the Grampian region and the main centre at the Aberdeen Royal Infirmary. This equates to avoided travel of some 260,000 km, or a saving of 55 tonnes of CO₂ per annum (Table 3).

| Unit       | Distance to ARI (km) | Cases during 2007 | Avoided travel (km) | Avoided CO₂ (tonnes) |
|------------|---------------------|-------------------|---------------------|----------------------|
| Banff      | 90                  | 443               | 75,753              | 15.9                 |
| Fraserburgh | 67                  | 455               | 57,922              | 12.2                 |
| Huntly     | 60                  | 117               | 13,338              | 2.8                  |
| Inverurie  | 24                  | 24                | 1094                | 0.2                  |
| Peterhead  | 52                  | 377               | 37,248              | 7.8                  |
| Turiff     | 53                  | 319               | 32,123              | 6.8                  |
| Other      | 75                  | 326               | 46,455              | 9.8                  |
| Total      | 2061                |                   | 258,978             | 55.4                 |

*The average distance of the other 8 units

Head and neck cancer

A more recent telehealth service allows patients in the Shetland Islands with suspected head and neck cancer to be assessed by a specialist without needing to make a journey to the Aberdeen Royal Infirmary. Use of a video link allows the specialist to decide whether local management is possible, or whether the patient needs to be referred to Aberdeen for treatment.

During 2007/08 there were 42 such teleconsultations, as a result of which 42 patient journeys were avoided. The trip from Shetland to Aberdeen requires two road journeys and a flight, resulting in an emission of 61 kg CO₂. The avoided travel amounts to a saving of 3.7 tonnes of CO₂ per annum.

Telehealth in context

As shown above, the total travel emissions from the NHS in Grampian can be estimated to be about 49,000 tonnes of CO₂ per year. The total savings in avoided travel from the two telehealth examples cited above amount to 59 tonnes of CO₂, which is approximately 0.1% of the travel emissions in Grampian. This is not to imply that these savings are not worthwhile. Simply, that in relation to the overall carbon footprint of NHS Grampian, these two examples of telehealth are fairly insignificant.

What are the carbon savings resulting from all telehealth work currently being conducted in the Grampian region? At present, this is impossible to know since there is a dearth of quantitative data. However, even if there was ten times as much telehealth going on as the two examples quoted above (which seems unlikely), the avoided CO₂ would still only amount to 590 tonnes. It seems safe to conclude that telehealth, when used conventionally, is not likely to have a big influence on the environmental impact of the NHS.

Potential of telehealth

Can telehealth therefore be used in a different way? What is the scope for reducing travel emissions in the NHS? Obviously one strategy would be to improve the efficiency of travel generally, i.e. to provide better and more effective public transport. However, this is not really under the control of the health sector to any significant degree.

Other strategies specific to the NHS include:

1. Reducing staff travel, e.g. by the use of video meetings or by teleworking;
(2) Reducing patient travel, e.g. by holding outreach clinics instead of hospital outpatient clinics;
(3) Reducing visitor journeys to hospital, e.g. by use of ‘video visiting’ for relatives.

Staff travel and patient travel are the two big-ticket items, collectively responsible for about 80% of the travel emissions. Efforts should therefore be concentrated on them.

Staff travel
Teleworking and video meetings are used to some extent in NHS Scotland by staff for whom it is appropriate. Information about overall levels of usage is not presently collected. However, video linking is being promoted and improved facilities are being provided at a number of locations in the NHS Grampian region, for example.

More detailed information about travel associated with the patient travel scheme (PTS) and the ambulance service would be helpful in formulating suggestions for the future use of telehealth in Scotland.

Patient travel
Patient travel comprises that associated with primary care, e.g. visits to the general practitioner (GP), and with secondary/tertiary care, e.g. visits to hospital, either as an inpatient or an outpatient. In the Grampian region, the emissions resulting from all patient travel is estimated to be about 21,000 tonnes CO₂ per year (Table 2).

What is the composition of ‘patient-own travel’? For example, how much hospital travel represents travel for inpatient treatment and how much is travel to outpatient clinics? This information does not appear to be separately recorded for Scotland or for England at present. However, it is safe to assume that outpatient travel represents a substantial proportion of patient-own travel.

In the Grampian region, total patient travel for hospital outpatient appointments amounts to 17.6 million km

Table 4 Studies reporting avoided travel to hospital (e.g. for outpatient visits) as a result of telemedicine

| Specialty         | Referrers          | No. of patients | Duration of study | Modality                               | Avoided hospital visits, e.g. to the outpatient clinic |
|-------------------|--------------------|-----------------|-------------------|----------------------------------------|-------------------------------------------------------|
| Molinari, 2002    | Cardiology         | GPs             | 456               | 1 month                                | Telephone and phone- transmitted ECG                   |
| Granlund, 2003    | Dermatology        | GPs             | 23 videoconferencing, 25 face-to-face | 12 months                             | Videoconferencing                                     |
| Lamminen, 2001    | Dermatology        | GPs             | 25                | 8 months                               | Videoconferencing                                     |
| Made, 1999        | ENT                | GPs             | 32                | 21 months                              | Videoconferencing                                     |
| Bowater, 2001     | General            | Remote GP       | 90                | 24 months                              | Videoconferencing                                     |
| Harno, 2000       | General            | GPs             | 292               | 8 months                               | Intranet store-and-forward system                      |
| Chan, 2001        | Geriatrics         | Nursing home staff | 198              | 12 months                              | Videoconferencing                                     |
| Hui, 2002         | Geriatrics         | Nursing home staff | (1001 teleconsultations in seven disciplines) | 12 months                              | Videoconferencing                                     |
| Harno, 1999       | Internal medicine  and surgery | GPs | <30,000 referrals | 12 months                              | Electronic referral system                              |
| Paiva, 2001       | Neurology          | GPs             | 90                | 13 months                              | Videoconferencing                                     |
| Lamminen, 1999    | Ophthalmology      | GPs             | 24                | 10 months                              | Videoconferencing                                     |
| Hanson, 2008      | Ophthalmology      | Optometrists     | 171               | 24 months                              | Store-and-forward web-based system                     |
| Forrest, 2003     | Orthopaedics and radiology | GPs at a local hospital | 118          | 13 months                              | Videoconferencing and store-and-forward                |
| Trot, 1998        | Psychiary          | Local hospital | 240               | 6 months                               | Videoconferencing                                     |
| Worth, 2003       | Psychiatry         | GP              | 303 intended referrals (395 in all) | 12 months                              | Phone and email                                        |
| Aarnio, 2000      | Surgery            | GPs             | 50                | -                                     | Videoconferencing                                     |
| Jaatinen, 2002    | Surgery, geriatrics | GPs             | 93                | 5 months                               | Web-based store-and-forward system                     |
| Johnson, 1998     | Ultrasound         | Local hospital | 146               | -                                     | 48% of tele-referral group (n = 23) avoided hospital treatment |

There is also emerging evidence for telephone follow-up in other areas, for example rheumatology, orthopaedics and hand surgery.
per year.9 This corresponds to the emission of approximately 3700 tonnes of CO₂ (using 0.21 kg/km). That amounts to about 20% of the estimated patient travel in Table 2. This implies that patient travel for inpatient and for primary care purposes is some four times larger than for outpatient appointments. Clearly more information is required before the plausibility of these figures can be judged.

Whatever the relative magnitudes of the patient travel components turn out to be, there is a compelling case that outpatient travel could be reduced by employing telehealth. Evidence from other countries shows that a substantial proportion of outpatient travel can be avoided by use of telehealth.10 In one Finnish study, over half of the teleconsultation patients could be treated by the GP and did not need to go to hospital, following telehealth advice from the consultant.11 In another Finnish study, almost all (98%) of general surgery patients were able to avoid a journey to hospital by using a telehealth link at their GP’s premises.12

Table 4 provides a summary of recent studies reporting avoided travel to hospital (e.g. for outpatient visits) as a result of telemedicine of various kinds.

What is the potential in Scotland? Suppose that 20% of outpatient visits in the Grampian region could be replaced by local telehealth, then the potential CO₂ saving would be 704 tonnes. This is 12 times as much as the two telehealth examples quoted above.

Visitor travel

Visitor travel is presently thought to be a minor component of the overall travel emissions, so it probably does not deserve a great deal of attention. On the other hand, visitor travel might be susceptible to reductions through telehealth. This would have benefits in terms of reduced CO₂ emissions, to say nothing of reduced demand for car parking at the major hospital sites. Unfortunately, there is a dearth of factual information about visitor travel, whether in England, in Scotland or in the Grampian health region, so it is impossible to estimate costs and benefits at present.

Conclusion

Obtaining accurate patient and visitor travel information would greatly enhance our understanding of the true carbon footprint of the NHS in Scotland. If detailed information about staff travel could also be obtained then a much better overall picture would result; this would allow rational planning about strategies for reductions. Accurate information is needed about all four components of travel:

(1) NHS business travel, including the patient travel scheme;
(2) Staff commuting;
(3) Patient (outpatient and inpatient) travel;
(4) Visitor travel.

This could be obtained by survey.

It would also be helpful to conduct some pilot work to establish the feasibility of peripheral outpatient clinics in certain specialties, i.e. outreach clinics supported by telehealth. This proposed work on travel reduction would build on earlier studies.

Using telehealth as it has been used historically (primarily to facilitate hospital-to-hospital interactions) seems unlikely to have a major environmental impact – although of course there may be other good reasons for persevering with conventional telehealth. On the other hand, telehealth might be useful in reducing staff travel and to a lesser extent, visitor travel. In the context of the NHS in Scotland, it looks particularly promising for reducing outpatient travel, where substantial carbon savings might be made by reconfiguring the way that certain services are provided.

The principal advantage of telehealth is in facilitating equitable access, so perhaps its main role is in providing certain specialties, i.e. outreach clinics supported by telehealth. This proposed work on travel reduction would greatly enhance our understanding of the true carbon footprint of the NHS in Scotland. If detailed information about all four components of travel:.

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The principal advantage of telehealth is in facilitating equitable access, so perhaps its main role is in providing services to disadvantaged peoples. The main environmental benefits lie in the form of avoided travel.



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