



Sustainability in Ophthalmology

Executive Summary

Global resources are finite; as this becomes more apparent and the consequences of global warming start to affect more of the world's population the concept of sustainability in healthcare is becoming more important. Ophthalmology is no exception and this paper has been created by a group of people from a wide variety of disciplines to inform, guide, provoke thought and offer practical solutions to some of the sustainability issues within ophthalmology.

At the present time changes to practice that improve sustainability are voluntary but the NHS has ambitious targets and there may come a time when decreasing our carbon footprint is no longer optional. As a profession ophthalmology should be ready for this and lead the way with carbon reduction initiatives that also improve the standard of patient care.

The College calls for [leadership](#) from the profession and the healthcare industry to develop best practice and integrate these into our service redesign. It provides suggestions to improve the sustainability of ophthalmology services e.g. mobile operating theatres ([section 4](#)), administrative efficiency. [Section 5](#) discusses the potential benefits of Glaucoma Referral Refinement. [Section 6](#) explores building energy improvements. [Section 7](#) covers the importance of information technology and solutions which will in the long term save money by reducing energy costs. Procurement and industry relationships are examined in [Section 8](#) e.g. efficient ordering of IOLs. [Section 9](#) calls for medical schools to include sustainability in undergraduate curricula. [Section 10](#) explores the evidence base for sustainable healthcare and [section 11](#) provides examples of existing initiatives.

This is a position paper from The Royal College of Ophthalmologists designed for Ophthalmologists, allied professions, other medical specialties and interested lay parties.



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1. Introduction

The term “sustainability” has many meanings. In health care it usually implies a reconciliation of those environmental, social, and economic demands which determine resource usage, so as to enable “sustainable development”— the model of resource use that permits delivery of current health care needs while maintaining the environment in a way which does not prejudice the needs of future generations (United Nations 1987).

The world’s biophysical and ecological systems are increasingly threatened by population growth and intensified economic activity. Unrestricted climate change poses the most urgent and severe threat to global health. Changing patterns of disease and mortality will result from uncertainty over food and water supplies, extremes of climate (e.g. flooding, heat waves, wildfires, and tornados), and changes in the distribution and nature of infectious diseases. Some settlements will suffer directly, and the ensuing population migration will then affect many other regions. The resulting pressures may trigger conflict and even war (Costello et al 2009).

The interactions between health, healthcare, and greenhouse gas emissions are extremely complex. Not only will unrestricted generation of greenhouse gases [GHGs] impact on global health, as mentioned earlier, but the causes of those emissions will contribute very significantly to many more immediate epidemics of disease. The replacement of physically active methods of transport such as cycling and walking by increasing motorisation, which accounts for almost half of all oil use worldwide, contributes to both climate change and to the epidemic of obesity. Lower levels of vehicle gasoline use per capita correlate with lower average levels of body mass index. Likewise, an increasing appetite for red meats and dairy products have led to progressive industrialisation in agriculture which is now responsible for between a quarter and a fifth of all global greenhouse gas emissions.



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These lifestyle choices have increased the prevalence of diabetes, which is now a major cause not only of eye disease but also of vascular and kidney problems. More sustainable life-styles might be expected to slow the increasing prevalence of all these complications. Prevention is always the best form of medicine, and, at a population level, what is good for health is always good for the climate.

It has been argued that the health sector has been slow to recognise the impact of climate change upon health. This is unfortunate as the delivery of healthcare does itself result in substantial GHG emissions. GHG emissions attributable to the National Health Service (NHS) in England alone constitute 25% of the carbon footprint of the public sector in the entire United Kingdom. Therefore health care professionals should not only lobby for global strategies to address climate change but must also seek to reduce the emissions which result from their own organisations and medical practices (Sustainable Development Commission 2008).

The NHS Carbon Reduction Strategy has set targets for the reduction of GHG emissions within the NHS. Taking 2007 levels as the baseline, the strategy requires a 34% reduction as early as 2020, now only seven years away, and a total reduction of 80% by 2050 (NHS Sustainable Development Unit 2009).

These challenging targets will require that rationing of health care be determined by carbon resources as well as by financial resources. Clinicians need not be alarmed by this because sustainability and clinical agendas often coincide.

It is difficult to imagine that carbon rationing will directly influence the delivery of most healthcare services in the immediate future, and other means of incentivizing the delivery of sustainable health care must therefore be devised. In the meantime everyone with an interest in this area should look for sustainable health care opportunities that arise from service reconfigurations which are driven by other influences, such as patient safety, to give just one example.



2. The carbon footprint of ophthalmology in context

Between 2010 and 2011, problems of vision accounted for £2.14 billion expenditure in healthcare equating to a carbon footprint of approximately 1.175 million tonnes CO₂ equivalents per year. Ophthalmology is one of the highest volume outpatient specialties with many patient journeys for chronic diseases often from remote areas with resultant carbon footprints which may be minimised by service re-design and decentralisation. Similarly, Ophthalmology has a high surgical throughput, with cataract surgery being the commonest elective procedure in the NHS, usually performed with a high disposable instrument and supporting materials component also increasing carbon footprint. Given that over 300 000 cataract surgeries are performed in the UK each year, this is an ideal area in which to target carbon reduction strategies.

To date, various studies have demonstrated potential opportunities for the execution of sustainable eye care. Somner et al highlighted that during cataract surgery, small incision surgery produced less CO₂ emission than phacoemulsification techniques (Somner et al 2009). Similarly, it has been postulated that simple technological strategies such as re-designing of taps used for surgical scrubbing can significantly decrease the amount of water wasted during surgical procedures (Somner et al 2008). Whilst more research is required to strengthen the evidence base for sustainable eye care, recent publications have highlighted new opportunity areas for innovating eye care services and eliminating wasteful processes.

The carbon and sustainability agendas are convergent with NHS priorities on quality and value, and the move to user-centred services closer to home. As such, many ophthalmologists have recently collaborated with public health specialists, pharmaceutical representatives and key NHS bodies in order to drive forwards the sustainability movement and streamline the delivery of eye care.



3. Delivering sustainability in ophthalmology in the NHS

When working towards implementing sustainable healthcare, it is important to understand the perspective of the people you are working with and appeal to their priorities, in order to best influence them and persuade them about the importance of sustainability. Sustainable healthcare should appeal to a wide audience as it can also improve patient care, reduce costs and improve business credentials through improving corporate responsibility. Understanding the priority of your colleagues will help you to gain their attention and engage them in the process.

Improving care: Improving patient care is the top priority for the NHS. Prevention of disease is the best way to reduce the carbon footprint of the NHS and keep the population healthy. Therefore, this should be a key focus when developing sustainable ophthalmology services, with opportunities for brief intervention and follow-up for smoking and obesity in primary care, such as optometry services. In addition, through adopting evidence-based practice, ensuring that patient pathways are streamlined, with a focus on providing care in the community, this can improve patient outcomes and experience for those requiring investigation and treatment.

Reducing costs: In this time of austerity, NHS budgets are tight and delivering value for money is pivotal (<http://www.rightcare.nhs.uk/>). Providing more sustainable healthcare can lead to reductions in costs, for example through streamlining pathways. This reduction of cost can be a useful driver towards developing more sustainable healthcare. In addition, the Carbon Tax, introduced in April 2012, is charged depending on the amount of carbon emissions that an organisation produces, and so can provide a further driver towards energy efficiency, and can assist the development of sustainable healthcare.

Improving business credentials: Businesses enjoy being able to showcase their successes, for example a number of organisations have been labeled 'Mindful Employers' due to their success in managing mental health issues in staff



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(<http://www.mindfulemployer.net/>) These awards and labels can attract people to work in or utilise services and can help to drive innovation. The Centre for Sustainable Healthcare has an annual Sustainable Hospitals Award (<http://sustainablehealthcare.org.uk/sustainable-hospitals>), the NHS Sustainable Development Unit had its first Public Sector Sustainability Awards in 2011 (<http://www.sdu.nhs.uk/news-events/awards/9/Public-Sector-Sustainability-Awards-2011-Launched>) and there are a variety of others that can motivate organisations to develop sustainable ways of working. This is increasingly important as Foundation Trusts and GP practices are becoming individually functioning organisations within the NHS and may be competing with other organisations for services.

4. Surgery, out-patients and administration: Suggestions for change.

"It has taken me two hours to get here today"... "Me too" - Comments from my fellow patients that made me think whether we could organise ophthalmic services so that they are more convenient for patients but also more environmentally friendly. Global warming is a major issue for the NHS, which is responsible for 25% of all public sector emissions.

As a specialist service, many ophthalmic services have a large catchment area. In some cases patients travel long distances and in others peripheral clinics are undertaken. Models of care requiring less patient travel might reduce adverse emissions. In calculating the carbon foot print of a service we need to consider not only the travel of the patients but the goods (transport, procurement, manufacture and wastage) and staff. Methodologies have been described in a project measuring the carbon foot printing of dialysis services, which also highlighted that home services can have clinical impact as well as environmental (Connor et al 2011).

Traditionally the decision on remote services has been based on the cost effectiveness, staff utilisation and equipment availability. But these elements are interlinked. The cost of fuel means this is a major factor in cost effectiveness, but can



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be perverse as centralised units may mean that patients incur the transport costs rather than the NHS. Similarly it may be possible to have greater staff utilisation by bringing everyone to the staff, ignoring the economic impact to the patient and society of their lost time. Ophthalmology also uses specialist and expensive equipment so we need systems that ensure that equipment utilisation is increased. But there is also an element of traditionalism that perpetuates many NHS current models despite the innovations that can support alternative models.

A few potential models are described below, some are already used in some parts of the UK but how many more services could utilise them to improve the patient experience, make care more convenient and more environmentally friendly, whilst also maintaining, if not improving, clinical outcomes?

Surgery

There are already many high profile examples of how surgery can be delivered to low income and remote communities using mobile operating theatres and teams. Within the UK, should we be exploring how many more operations could be undertaken at local hospitals - alternatives of mobile operating theatres or a mobile team with their equipment using a local theatre may be applicable in differing circumstances. As equipment develops, could manufacturers increase their focus on portability to make this easier?

Modern operating theatres use large amounts of disposable equipment with major environmental impact. Where does the balance lie between safety and environmental impact? New technologies that allow more effective sterilisation near to the theatre and using less toxic chemicals (e.g. peroxide gas plasma) have the potential to reduce costs and environmental impact whilst also improving infection risk.



Out Patients

All specialties have had pressure to reduce the number of reviews. Obviously eliminating a clinic appointment is the best way of reducing the carbon footprint, when it is clinically appropriate. Some clinicians are using web based consultations using software, such as Skype or Webex, to reduce time wastage and travelling time. But ophthalmology often needs a clinical examination. How long before some of that imaging can be done remotely? Dermatologists already look at lesions via a webcam, diabetic retinopathy screening is using static image analysis, my optician shows me a picture of my retina but my ophthalmologist tells me what he has seen. Dynamic imaging inside the eye is more difficult but technology is rapidly advancing. In the meantime, how many people could have static images undertaken at their local opticians and made available for their virtual clinic appointment?

Administration

With increasing use of mobile technologies, administrative functions can be centralised without loss of function. An increasing number of organisations are having their workforce working remotely e.g. from home. This requires excellent IT services and support but also needs consideration of how much administrative work does benefit from personal contact.

Perhaps simpler is taking an approach that reduces steps in every process. For example, how much work, cost and carbon does your current appointments system generate? Direct booking at the end of the clinic or by the patient on line could remove a long existing process involving many carbon producing steps. Many people prefer e-mail and text for communication (and accept the security implications) and yet we still send out vast amounts of letters every day. I am expected to bring my letter before I can register at clinic but I can swipe my smartphone to book in at the airport.

There are many opportunities to improve the efficiency of care and reduce the carbon footprint of ophthalmology services. Some of these will have obstacles to



introduce them, including issues of confidentiality and convenience to staff. It will not be suitable for all patients but shouldn't we look at designing the system for the majority and then developing methods to account for the minority, not allowing a minority to allow a non sustainable system that also accelerates the adverse health effects of global warming.

5. Referral refinements to improve sustainability in Ophthalmology

The UK Government has an ambition for community care, enabling of health, independence and wellbeing, better access to community services, support for people with longer term needs, and care closer to home. The NICE Guidelines for glaucoma stated "Service Provision" as one of its research recommendations.

Glaucoma referral refinement (GRR) offers patients that have been referred by the primary care optometrist for suspected glaucoma the opportunity to be reviewed by an accredited optometrist in the community setting if appropriate. The accredited optometrist may then discharge the patient or refer the patient to the hospital service if there is a genuine cause for concern. This model of care offers a different pathway to the traditional pathway in which an optometrist refers all patients suspected of glaucoma direct to the hospital service. The Health Innovation and Education Cluster (HIEC) Glaucoma Pathways project has shown GRR is effective at reducing 'false positive' referrals with resultant cost savings to hospitals (Bourne et al 2010, Ratnarajan et al 2012, Ratnarajan et al 2013).

It has been reported that people from areas of greater social deprivation have poorer access to primary care optometry services and also present with more advanced glaucoma (Day et al 2010, Fraser et al 2001). Though GRR cannot address this nor increase uptake of routine sight-testing it is hoped, by providing a local service, that these schemes will lead to easier access and cost savings for the patient compared to a hospital out-patient visit and is currently being researched by the HIEC Glaucoma team.



Equity profile mapping based on Index of Multiple Deprivation and distance to an accredited optometrist involved in a GRR scheme serves as an effective tool to ensure commissioned schemes offer adequate access to those from areas of highest deprivation.

In the absence of a revised General Optic Service contract for routine sight-testing, GRR serves as an effective method to reduce referrals to secondary care whilst also providing a local service to patients. When commissioning these scheme equity profile mapping can help to ensure those from the most deprived areas have adequate access to good quality community based eye care.

6. Building energy use

The UK's healthcare sector spends more than £400 million per year on energy, a significant proportion of which is wasted. There are many simple opportunities for hospitals to reduce their energy use which not only helps the environment but also saves money, creates better conditions for patients and staff, improves morale and enhances their reputation.

Heating

An effective heating system is vital for keeping patients and staff comfortable; this requires an efficient responsive temperature control system. Temperature settings should reflect the activity taking place there, for example operating theatres are usually maintained at a lower temperature than wards. Simple time switches can allow areas to be heated only for the times when they are required, such as out-patient clinics. It is also important to keep heat in the hospital whilst maintaining easy access. Double sets of automatic doors to create a draught lobby are useful in busy areas.



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A detailed review of the different ways to generate heat is beyond the scope of this paper but boilers need to be serviced regularly and pipes well insulated. Hospitals should also consider biomass heating and combined heat and power (CHP) when replacing old systems. With CHP the heat generated when electricity is produced is used for space heating and hot water rather than being dissipated in cooling towers.

Hot water

Water is a metered and controllable resource so it is possible to save a significant amount of water with inexpensive measures such as tap restrictors, push taps, shower regulators and infra-red controllers. Once again regular maintenance is important and running regular awareness campaigns for staff is useful.

Ventilation and air conditioning

High rates of air change are important in the hospital setting to eliminate airborne bacteria, especially in operating theatres and wards. In clinical areas full fresh air must be used in ventilation with no recirculation; this is high in energy use and cost so it is important to differentiate clinical from non-clinical areas. Sometimes natural ventilation can be used but often mechanical ventilation is required. It is useful to have a system that that does not allow heating and cooling to operate at the same time and variable speed fans.

Lighting

Lighting accounts for over 35% of electricity used in a typical hospital. Good lighting design, use of appropriate bulbs and making staff responsible for switching off lights can significantly reduce lighting costs. Light switches should be labelled and lights should be upgraded to low-energy bulbs. Occupancy sensors are useful in zoned or intermittently used areas.



Office and small power equipment

Office and IT equipment is widely used in hospitals and accounts for 10% of total electricity use. Switching off equipment or using timers as well as keeping it well maintained will all help to reduce this load.

Catering

Efficient catering facilities can reduce the energy requirement per meal by as much as 40% and also improve the working environment for kitchen staff. Simple measures such as not overfilling pans and using lids make a huge difference in the long term. New equipment should be purchased with running costs in mind.

Specialist Equipment

Ophthalmology, like other specialties, relies on specialist equipment, some of which is energy intensive. Sterilisation and laundry services, for example, should not be ignored in sustainability strategies.

Building fabric

Two thirds of heat from a hospital is lost through the building fabric, whilst the remaining third is lost through air filtration and ventilation. Considering the age and outdated design of many hospital buildings, it is not surprising that some are inefficient; certainly during refurbishment more insulation should be installed. Improving building fabric in a hospital makes good sense on many levels as it also saves money and improves the environment for patients and staff.

The European Energy Performance of Buildings Directive requires hospitals with floor areas over 1000m² to produce and display energy performance certificates (<http://www.carbontrust.com/>).



Practical steps for improving hospital energy use:

1. Understand the current energy use
2. Identify opportunities for reduction
3. Prioritise actions and who has responsibility
4. Seek specialist help
5. Make changes and measure the savings
6. Continue looking for changes and managing energy use efficiently

7. Information Technology and sustainability

It is important to consider Information Technology (IT) when planning for sustainability in healthcare for two reasons. First, IT is already heavily used in the health care setting and this is only likely to increase as the NHS aims to “go paperless by 2015” (Limb 2012). Going paperless is known to increase energy use and computer waste in exchange for reductions in consumption of X-ray film, paper and petroleum (Turley et al 2011). Energy is a significant cost for NHS Trusts (approximately £400 million per annum) and it is therefore worth considering the environmental footprint of your IT system to reduce costs. Increasing requirements for transparency, pioneered in the wake of the Bristol heart enquiry (Tavare 2012) have led to proliferations of digital data and energy hungry data centres. Fortunately the British Computer Society champions “Green IT” and runs the Certified Energy Efficient Datacentre Award (CEEDA). This promotes best practice in reducing energy costs of data centres. The Sanger Centre and St Andrews University are already accredited and NHS Trusts should consider seeking accreditation for their data centres. Simple measures are also effective, for example turning off computers when not in use. NHS Oldham implemented a PC shutdown system which expected to reduce annual energy costs by £41,000 and to decrease the carbon footprint by 800 tonnes per year.

Such considerations represent the low hanging fruit for health informatics and sustainability. The second reason to consider sustainable health care and IT is more



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difficult, and relevant to ophthalmologists. Transformational changes can occur in clinical care through increased use of IT. Although these changes may not always result in more sustainable care, there are several examples of IT promoting more sustainable eye care models, some examples include:

- 1. Helping to maximise the use of available resources** – for example ensuring that the correct patients are seen by hospital eye services. A pilot teleophthalmology service incorporating digital images into optometry referrals resulted in a 37% reduction in hospital visits (Cameron et al 2009) while an OCT guided macular disease referral service resulted in 34% of cases being managed in the community (Kelly et al 2011). This approach not only ensures that the right patients are seen in hospital but also allows patients to be triaged faster than paper based systems. In the OCT pilot for example 68% of referrals received an answer on the same day and 96% within the next day. Patients with urgent presentations could therefore be seen quicker and significant morbidity prevented. Maximising the use of resources doesn't only apply to new patient referrals. Many ophthalmic patients have chronic disease which needs infrequent monitoring. This can lead to forgotten appointments, high rates of "DNAs" (Potamatis et al 1994) and waste of clinical resources. A simple system of SMS reminders at Portsmouth NHS Trust resulted in a 40% reduction in DNAs.
- 2. Making data publicly available** – this allows increased analysis of unwarranted variation in practice which can ensure that best practice is replicated leading to efficient resource use (Wennberg 2011).
- 3. Supporting different ways of working** - a virtual clinic can ensure that experienced staff are maximally utilised (Rathod et al 2010). This allows improved quality control and for diabetic retinopathy or ROP screening clinics has been demonstrated as a cost effective model of care (Au et al 2011).



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- 4. Clinical trial alerts** – these can be incorporated into electronic health records and can significantly increase trial recruitment thereby speeding innovation, reducing research costs and stewarding research resources (Embi et al 2005).

The use of IT in ophthalmology services should focus on implementing green IT solutions which will in the long term save money by reducing energy costs for NHS Trusts. Implementation of IT systems should not simply look at direct costs but also indirect costs to patients and the planet when designing new care pathways.

8. Industry and procurement considerations

Carbon footprinting studies in medicine show that procurement is often the largest culprit in terms of carbon cost. Ophthalmology is no exception and a recent study has shown that procurement makes up 53.8% of the carbon footprint of cataract surgery (Morris et al in press). It is therefore vital that the profession engages with our partners in industry and their regulators to improve sustainability.

Global issues

Firstly local production saves on transport related CO₂ e.g. Ireland vs. US production for European distribution. However many companies are shipping products into the UK in a relatively economical fashion to keep down costs.

Also most companies are trying to minimise packaging to keep down costs and shipping weights, but this desire is often at odds with regulators both from a product safety point of view and European Directives concerning multi-language packs.

Much has also been invested by regulators and health systems in developed countries around the “reuse is misuse” philosophy so therefore it is assumed that single use of surgical items where possible is both good practice and here to stay for



the foreseeable future.

These issues are therefore difficult to deal with on a local (UK) basis. Most companies find it in their best interests to work towards the most ecological solution possible as energy savings made in either production or international transportation will drop straight through to enhance profitability.

It should be noted that companies themselves have to comply with a number of environmental regulations, namely those of Packaging Waste (2007 No. 871) and that of Waste Electrical and Electronic Equipment (WEEE). Companies have to register and pay levies according to the weight of waste produced to comply with both these statutory requirements. For reputable companies that comply with the letter of the regulations this represents a substantial administrative and financial burden.

Local solutions

Green procurement solutions for the large part reside in the hospitals themselves in terms of being organised about ordering disposables such as intraocular lenses (IOL). There is an inherent conflict between the desire to become more green but still have just in time delivery to individual sites. Too often hospitals will need multiple deliveries in a week because of a lack of forward planning. Each delivery requires a separate van and hospitals sporadic ordering means that deliveries are often of two or three items at a time, when in the specific case of IOLs ten of them still weigh less than 1kg. Simple steps such as really considering how urgent orders are when placing them could make a huge difference. Orders often become urgent because of poor administration, or an urgent delivery is not actually needed for several days.

A small change in practice would be to choose and order the IOL when booking patients for cataract surgery so that a planned IOL delivery could be made for each week. This would be relatively easy for industry to service and would result in lower



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consignment stock of IOLs with the IOL “bank” just being used for emergency backup. This would also have the secondary benefit of ensuring that the lenses would be available as required for the list which, even in the best managed IOL banks, does not always happen.

If hospitals communicated their operating list plans and requirements to their major suppliers then consolidated shipments at eco-friendly times could be the result. Consolidation of orders, from hospital to companies, and company deliveries to hospitals i.e. pharmacy and surgical disposable orders combined. For example a common occurrence at present is for the same company to receive a pharmacy generated order for Tuesday followed by a theatre generated order for IOLs for Wednesday, then yet another order for 12 procedure packs for Friday, all delivered separately. Improving the procedure packs would also result in fewer deliveries.

Another more radical suggestion is to have NHS delivery hubs, for consolidation and onward shipment, to individual hospitals along with other items. This is different to the NHS Supply chain model which is purely a logistics hub. Multiple companies could deliver to a convenient regional hub which serves several hospitals, considerably reducing delivery carbon costs.

Procurement decisions within the NHS are not usually made on the grounds of sustainability grounds, but efforts should be made to source products from companies that adhere to all regulations, and comply with sustainable and ethical standards, not just on price alone. In the meantime there are many easy changes that could be made to improve the carbon footprint of procurement in ophthalmology.



9. Education and sustainability from medical school onwards

The issue of climate change and its consequences continues to gain momentum in universities across the country. Many medical schools throughout the UK now have highly active Wilderness and Expedition Medicine Societies with sustainability a key topic discussed at national conferences. The limiting factor in making medical education a sustainable activity is that there is little recognition of its importance within the curriculum.

At present few medical schools have regular teaching on climate change and its impact on healthcare both domestically and on a wider scale. Intercalated degrees in Global Health and similar topics are offered but they only apply to the minority who choose to study such subjects. It is not that education on sustainability matters does not exist; it is that it is not available to the majority of students.

The Sustainable Healthcare Education (SHE) working group have recently drafted twelve 'Priority Learning Outcomes' (Centre for Sustainable Healthcare 2013), a series of recommendations presented to the GMC that aim to make environmental awareness and practical solutions more pertinent in the medical education curriculum. These recommendations are all intrinsically linked to topics in Tomorrow's Doctors (General Medical Council 2009), the GMC's publication that sets outcomes for all British graduates.

Not only does the SHE working group provide recommendations on how to alter the medical education curriculum, it also gives suggestions on how to implement change (General Medical Council 2009). Examples of students that have produced work in the area are also given. All medical schools offer student selected projects as part of the medical education curriculum and it appears this would be a useful way in which to encourage more work to be produced in the topic.



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As climate change and related issues of sustainability becomes more recognised in all aspects of healthcare it is vital that medical education is included too. In order to make students appreciate the importance of sustainable healthcare, medical education should incorporate teaching on the subject that is accessible to all students. Matters of sustainability should be taught at a medical education level so that as healthcare itself becomes more sustainable, the next generation of doctors appreciates its significance.

10. Developing the evidence base: Collecting sustainability data

At present the evidence base regarding sustainability in ophthalmology is poor. If meaningful improvements are to be suggested then a solid evidence base is required to justify any changes and also to monitor progress.

Carbon footprinting

The term 'carbon footprint' has been used ubiquitously in both public debate and the scientific literature. Broadly speaking, it has been used to refer to an assessment of the gaseous emissions resulting from the full life cycle of a product or process, with particular attention given to those emissions considered to be of relevance to climate change. The Kyoto Protocol identifies six gases with global warming potential although only three are commonly reported- carbon dioxide (CO₂), methane, and nitrous oxide (Kyoto protocol 2008). CO₂ is most commonly used as the reference gas, with the emissions of the other gases being expressed in the units of CO₂ equivalents (CO₂eq).

Carbon footprinting studies with varying methodological approaches and complexity are now being reported within the medical literature but few in ophthalmology (Morris et al in press). However there is a need to make a number of informed assumptions within any carbon footprinting methodology. The context of those assumptions and the sources of data and emission factors must always be made clear. Another source of error in carbon footprinting is not setting clear boundaries of where the



study ends. New studies need to be conducted to provide the evidence and a baseline for change.

11. Current sustainability initiatives in ophthalmology

Current initiatives:

- **Network** - Within ophthalmology, eye care professionals have already begun to collaborate with public health professionals, pharmaceutical representatives and academics to explore the opportunities within sustainability accelerate transformational change in eye services.
- **Research** - Existing literature on sustainable eye care has helped to analyse the environmental impact of current ophthalmic practices. Future publications which aim to map out the carbon footprint of various eye care services including cataract surgery and glaucoma community care will further guide the sustainability movement and potentially lead to major improvements in eye care delivery in the hospital and community.

Future Initiatives:

- **Sustainability Fellowship** - The Centre for Sustainable Health care, in collaboration with the University of Warwick is currently in the process of creating a sustainability fellowship. This one year opportunity would be open to ophthalmology trainees with an interest in sustainable health care and service development. This fellowship will provide candidates with the opportunity to build a sustainability movement within the eye care community; undertake quantitative analysis of environmental impacts; and catalyse exploration of transformative innovations in care.



- **Commissioning** - A sustainable commissioning working group comprising of multidisciplinary professionals will be essential in providing strategic input on how to integrate sustainability into NHS commissioning for eye care. This group will inform stakeholders including The Royal College of Ophthalmologists, UK Vision Strategy and regional clinical commissioning groups (CCGs) on evidence based strategies for delivering high value sustainable eye care.

12. Raising Awareness and Changing Behaviour: Local Sustainability Champions.

Sustainability is an evolving dimension of the provision of healthcare. As such, an opportunity exists to implement lessons already learnt elsewhere. For example, a clear parallel exists between sustainability and another clinical systems improvement programme - the relatively recent drive towards improved patient safety.

In common with its approach to sustainability, the NHS was also a 'late adopter' of the principles of safety engineering. High hazard industries such as aviation, rail transport and nuclear energy have invested considerable resources in the monitoring and improving of safety for some time now.

Whilst their safety measures have historically been based on retrospective data, the recent understanding that organisational and human factors make a greater contribution to rate of accidents than do simple technical failures is reflected in a shift in the focus of these industries towards predictive measures of safety. One such focus has been the evaluation of a 'safety culture', such as management behaviours, safety systems and employee perceptions of safety. The healthcare industry is now in the process of engendering a safety culture. An early lesson for the implementation of sustainability is clear; in order to effectively introduce green initiatives as clinical systems improvement projects within a specialty, a 'sustainability culture' must be created in the background to support these projects.



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Perhaps the safety discipline can also teach us how best to develop this culture? Programmes to promote local fellows in patient safety are already proving to be successful (<http://www.institute.nhs.uk/>, <http://www.scottishpatientsafetyprogramme.scot.nhs.uk/programme>). The creation of Local Representative posts has proven to be effective within the Green Nephrology Programme (Mortimer et al 2011).

Although no robust empirical evidence exists to suggest that good leadership improves healthcare (Ovretveit et al 2008), this is perhaps due to the inherent difficulties of studying the notion of leadership and aligning it with outcomes, and intuition and history suggest that effective leadership is important to guide change. Local sustainability champions will therefore be required to provide leadership.

Is it simply leadership that is important - or does the form of this leadership also matter? Sustainability projects are, in essence, clinical systems improvement projects. The factors underpinning the failure of particular clinical systems improvement projects to meet their objectives have been investigated previously. In one study, 33% of clinical systems improvement project failures were attributable to unsupportive management behaviours, whilst a further 39% of failures were attributable to resistance to change amongst employees (Ogbonna et al 2000). Therefore, a cultural change will be necessary to effect sustainability projects and it might be anticipated that transformational leadership may be the most appropriate form of leadership.

This requirement for leadership does not demand seniority within the local Trust as a characteristic of a successful Local Champion. However, support from senior figures is undoubtedly of benefit. Furthermore, in the Green Nephrology Programme, the endorsement from respected figures within the specialty has proven crucial to the programme's visibility, public-standing and success at a local level. This engagement of strategic partners was achieved and maintained through the development of a Programme Board and annual multi-stakeholder Summits. The Summit Meetings



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offer Local Champions the opportunity to meet, develop a sense of community and share ideas. Within the Green Nephrology Programme, communication across the community of Local Champions is facilitated by an online network. This model allows for the sharing of tools to raise awareness and implement projects locally.

13. Summary and Vision for the future

One consultant ophthalmologist recently commented ... “...we all know about global warming and society is doing things about it, so it will happen naturally without us having to focus on it specifically in eye health”. However, given this is the single biggest global public health challenge we collectively face, we all share the responsibility for AND the opportunity of moving towards more financial/carbon sustainable Eye Health Services. We can all exert influence at many different levels, from top down to bottom up and within each step of our eye health pathways, to effect the shift towards such.

Leadership has always been in our College’s portfolio, our Consultant job descriptions, and is now in the Royal College of Ophthalmologists Ophthalmic Specialist Training (OST) Curriculum. We need to be proactively sustaining processes toward determining best practice and integrating these into our service redesign. New and particularly non-traditional clinical areas e.g. Carbon, require Advocacy (advising/influencing) to change Consciousness (often in the face of adversity) in our daily planning, delivery and service evaluation. We only know and think about climate change, global warming and carbon consumption because individuals and thus organisations took on the early responsibility for being leaders and developing the Advocacy Tools (e.g. evidence, communication strategy, business case, College good practice guidelines) to raise its profile.

We need to develop our carbon sustainability leadership/advocacy strategy through our interactions with the Department of Health, Commissioners, Professional Organisations (e.g. Faculty of Public Health), Vision 2020UK and Voluntary Sector.



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Given that that the single largest component of eye health carbon footprint is “Procurement” of our medicines/technology, we need to work in close partnership with the pharmaceutical/technology industry which is already familiar with the carbon conversation. The “Oil lobby” were perhaps understandably slow to develop alternative technologies but now car manufacturers are racing competitively towards alternative fuel/power sources to compete for the business of the “modern” car. We need to inspire a similar race toward more carbon neutral surgical equipment, technologies, eye care pathways which of course need to be in line with our core contemporary UK and NHS drivers of; increased efficiency; increased effectiveness; reduced waste; reduced costs; and above all improved quality and value in patient and provider experience.

Engaging with the public and service users Public and Patient Involvement (PPI) is mandatory within the NHS and is an important advocacy tool. Because of increasing awareness of climate change (if only through recent experience!) and carbon footprint determinants, community perspectives resulting from PPI are likely to support the shift toward more carbon neutral service redesign and we need PPI evidence that this is what our leadership/advocacy should be supporting.

Independent providers will also be keen to tailor their services to “customer/market drivers”. Interaction between the Department of Health and NHS in recent years has led to the “Care Closer to Home” agenda of decentralising services into community settings, largely for service user convenience and their reduced need for transport. This intuitively seems to reduce carbon consumption but we need to be clear that the resultant loss of “economy of scale” is not increasing costs and the carbon footprint even though this might be a price society it currently thinks it can afford to pay.

Whilst it is reasonable to progress in the short term with contemporary generic ‘carbon opinions’, we need to invest to develop the scientific evidence for sustainable carbon eye health (e.g. disposable/re-usable and centralised vs community). In the future, with enough evidence, we might be able to accept epidemiological carbon modelling for service/technology redesign using generically accepted scientific



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equations and algorithms but right currently there is little published evidence of how we might reduce the eye health carbon footprint and carefully weigh up impacts on quality of care.



14. Authors

Daniel S Morris¹, Aditi Das², Andrew Connor³, Frances Mortimer⁴, John EA Somner⁵, Gokulan Ratnarajan⁶, Thomas Wright⁷, Matthew Cooke⁸, Merav Kliner⁹, Rupert RA Bourne¹⁰, Ian Makepeace¹¹, Ruth Passman¹², Muir Gray¹³, Andrew Cassels-Brown¹⁴

1. Department of Ophthalmology, University Hospital of Wales, Cardiff.
2. Department of Ophthalmology, York District Hospital.
3. Department of Renal Medicine, Derriford Hospital, Devon.
4. Centre for Sustainable Healthcare
5. Vision and Eye Research Unit, Anglia Ruskin University, Cambridge, UK.
6. Vision and Eye Research Unit, Anglia Ruskin University, Cambridge and University College of London Institute of Ophthalmology.
7. Musgrove Park Hospital, Taunton.
8. Warwick Medical School and Heart of England NHS Foundation Trust
9. NHS Bradford and Airedale, Bradford, UK.
10. Hinchingsbrooke Hospital, Huntingdon and Vision and Eye Research Unit, Anglia Ruskin University, Cambridge, UK.
11. Optic (UK) Ltd.
12. Department of Health North West, Manchester.
13. Centre for Sustainable Healthcare
14. Leeds Teaching Hospitals Trust and Nuffield Institute for International Health, Leeds Institute for Health Sciences, University of Leeds



15. References

- Au A, Gupta O. The economics of telemedicine for vitreoretinal diseases. *Current opinion in ophthalmology*. 2011; 22(3): 194–8.
- Bourne RRA, French KA, Chang L, Borman AD, Hingorani M, Newsom WD. Can a community optometrist-based referral refinement scheme reduce false-positive glaucoma hospital referrals without compromising quality of care? The Community and hospital allied network glaucoma evaluation scheme (CHANGES). *Eye* 2010; 24: 881-887.
- Cameron JR, Ahmed S, Curry P, Forrest G, Sanders R. Impact of direct electronic optometric referral with ocular imaging to a hospital eye service. *Eye (London, England)*. 2009; 23(5): 1134–1140.
- Centre for Sustainable Healthcare . Draft learning outcomes for sustainability teaching in medical education, Sustainable Healthcare Education | Centre for Sustainable Healthcare [Internet]. [cited 2013 Jan 15]. Available from: <http://sustainablehealthcare.org.uk/sustainable-healthcare-education>
- Centre for Sustainable Healthcare Resources, Sustainable Healthcare Education | Centre for Sustainable Healthcare [Internet]. [cited 2013 Jan 15]. Available from: <http://sustainablehealthcare.org.uk/sustainable-healthcare-education>
- Connor A, Lillywhite R, Cooke MW. The carbon footprint of a renal service in the United Kingdom. *QJM*. 2010 Dec;103(12):965-75. doi: 10.1093/qjmed/hcq150. Epub 2010 Aug 18.
- Connor A, Lillywhite R, Cooke MW. The carbon footprints of home and in-center maintenance hemodialysis in the United Kingdom. *Hemodial Int*. 2011 Jan 14. doi: 10.1111/j.1542-4758.2010.00523.x. [Epub ahead of print]
- Costello A, Abbas M, Allen A, et al. Managing the health effects of climate change: Lancet and University College London Institute for Global Health Commission. *Lancet*, 373(9676):1693-1733, 2009.
- Day F, Buchan JC, Cassells-Brown A, Fear J, Dixon R, Wood F. A glaucoma equity profile: correlating disease distribution with service provision and uptake in a population in Northern England, UK. *Eye (Lond)*. 2010 Sep;24(9):1478-85.
- Embi PJ, Jain A, Clark J, Bizjack S, Hornung R, Harris CM. Effect of a clinical trial alert system on physician participation in trial recruitment. *Archives of Internal Medicine*. 2005; 165(19): 2272.
- Fraser S, Bunce C, Wormald R, Brunner E. Deprivation and late presentation of glaucoma: case-control study. *BMJ* 2001; 322: 639-43.



Ophthalmic Services Guidance

- General Medical Council, Tomorrow's Doctors. London 2009.
- Kelly SP, Wallwork I, Haider D, Qureshi K. Teleophthalmology with optical coherence tomography imaging in community optometry. Evaluation of a quality improvement for macular patients. *Clinical ophthalmology* (Auckland, N.Z.). 2011; 5: 1673–8.
- Kyoto Protocol Reference Manual on Accounting of Emissions and Assigned Amount. United Nations Framework Convention on Climate Change. Kyoto Protocol; 2008.
- Limb M. NHS will be paperless by 2015, says commissioning board. *BMJ* (Clinical research ed.). 2012; 345: e6888. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/23065189> [Accessed November 13, 2012].
- Morris DS, Wright T, Somner JEA, Connor A. The carbon footprint of cataract surgery. *Eye*. In press.
- Mortimer F, Collidge T, Connor A. Green Nephrology: A Model for Clinical Leadership. Presented in poster form. BRS/RA meeting, Birmingham, 2011.
- NHS Sustainable Development Unit, 2009. Saving carbon, improving health. London, NHS Sustainable Development Unit, 2009.
- Ogbonna E, Harris LC. (2000) Leadership Style, organizational culture and performance: empirical evidence from UK companies. *The International Journal of Human Resource Management*. Routledge.
- Ovretveit J. (2008) Leading Improvement Effectively. A review of research and policy issues, London: Health Foundation/Krolinska Institutet, MMC, Stockholm
- T Potamitis, P B Chell, H S Jones, P I Murray. Non-attendance at ophthalmology outpatient clinics. *Journal of the Royal Society of Medicine*. 1994; 87(10): 591 – 3.
- Rathod D, Pickering S, Austin MW. Virtual assessment and glaucoma shared care. *Eye* (London, England). 2010; 24(6): 1121.
- Ratnarajan G, Newsom W, French K, Kean J, Chang L, Parker M et al. The effect of changes in referral behaviour following NICE Guideline publication on agreement of examination findings between professionals in an established glaucoma referral refinement pathway. The Health Innovation & Education Cluster (HIEC) Glaucoma Pathways project. *Br J Ophthalmol* 2013;97:210–214.



Ophthalmic Services Guidance

- Ratnarajan G, Newsom W, French K, Kean J, Chang L, Parker M et al. The impact of glaucoma referral refinement criteria on referral to, and first-visit discharge rates from, the Hospital Eye Service: The Health Innovation & Education Cluster (HIEC) Glaucoma Pathways project. *Ophthalmic Physiol Opt* 2013 (Accepted for publication)
- Somner JEA, Scott K, Morris D, Gaskell A, Shepherd I. Ophthalmology carbon footprint: something to be considered? *J Cataract Refract Surg*. 2009 Jan;35(1):202-3.
- Somner JEA, Stone N, Koukkoulli A, Scott KM, Field AR, Zygmunt J. Surgical scrubbing: can we clean up our carbon footprints by washing our hands? *J Hosp Infect*. 2008 Nov;70(3):212-5.
- Sustainable Development Commission, 2008. NHS England Carbon Emissions: Carbon Footprinting Study. London: Sustainable Development Commission; 2008.
- Tavaré a. Where are we with transparency over performance of doctors and institutions? *Bmj*. 2012; 345(jul03 1): e4464–e4464.
- Turley M, Porter C, Garrido T, Gerwig K, Young S, Radler L, et al. Use Of Electronic Health Records Can Improve The Health Care Industry's Environmental Footprint. *Health affairs*. 2011; 30(5): 938–946.
- United Nations. Reference: United Nations General Assembly, 1987. Report of the World Commission on Environment and Development: Our Common Future. Transmitted to the General Assembly as an Annex to document A/42/427 - Development and International Co-operation: Environment, 1987. Available at: <http://www.un-documents.net/ocf-02.htm> (last accessed 18th November, 2011).
- Wennberg JE. Time to tackle unwarranted variations in practice. *BMJ*. 2011; 342.