Digitalisation, energy and healthcare

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1. Introduction

Health sector digitalisation has been in the news recently, with the Medical Director of NHS England endorsing a report by the Royal College of Physicians (RCP), which argues that many outpatient appointments are unnecessary and calls for alternatives including remote monitoring and telephone or video-link appointments[1]. Meanwhile, the NHS Long-term Plan, published in January 2019, contains a whole chapter on mainstreaming digital services. Digitalisation has also emerged as a major theme from our fieldwork in the English health sector as part of the Invisible Energy Policy project within the DEMAND centre. However, while digitalisation in general is a hot topic in energy research[2], there is, surprisingly, currently very little evidence on its impacts on energy demand in the health sector.

This paper focuses on acute healthcare in England, because that is the sector where we have conducted fieldwork. However, it is likely that these issues will affect all aspects of healthcare (and also social care) and will be relevant around the world (including in the global South, where mobile health is an especially fast-developing sector, with major impacts in challenging and unconventional healthcare settings (e.g. Latif et al, 2017).

In this working paper, I start by outlining some key facts about energy demand in the health sector, why it is important, and what kinds of interventions are being proposed to reduce it. Then, leaving energy aside, I move to a second starting point; introducing the subject of digitalisation in health. I then bring these two themes together, to ask what we know about the energy impacts of digitalisation in the UK's acute health sector. I finish by reflecting on what this suggests about what matters for energy demand in the health sector, and what it means for energy researchers.

This working paper is not intended as a comprehensive review, but rather as a starting point for discussion with experts inside and outside academia. Feedback is very welcome, and can be addressed to Sarah Royston: s.royston@sussex.ac.uk[3]

2. Energy demand in the UK health sector

2.1 What are the energy and carbon impacts of UK healthcare?

The public sector represents 2% of the UK's carbon emissions (HM Government, 2017: Clean Growth Strategy). Figure 1 shows how energy use is distributed among different parts of the public sector (Source: BEIS, 2018).

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[1] https://www.bbc.co.uk/news/health-46142276

[2] E.g. Digital Society is a theme of the new CREDS centre

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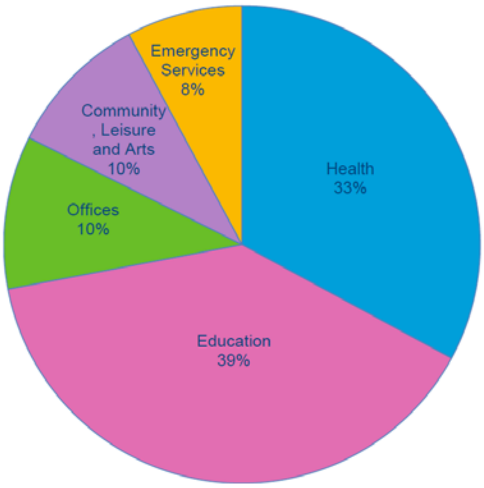
Figure 1: Total UK Wider Public and Higher Education Sectors Energy Consumption by Sub-sector



BEIS has stated that most of the potential for carbon reduction through energy-saving measures can be found in the health and education sectors (BEIS 2018:2).

In 2014-15[4], in England and Wales, it is estimated that:

- The health sector consumed an estimated 17,380 GWh of energy.
- Hospitals were responsible for 91% of this (15,780 GWh) (equating to 4.4MtCO2e).
- Hospitals had the highest energy intensity (per m^2 floor area) in the sector

(BEIS; 2016)

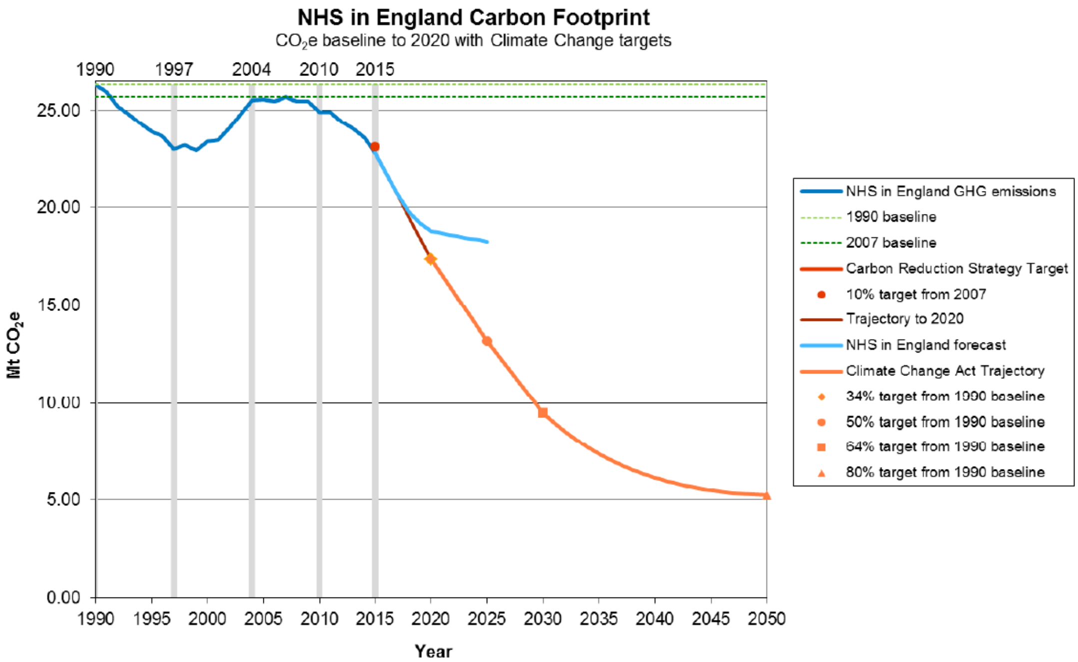
Pollard et al. (2014) and Connor et al (2010) estimate the carbon footprint per hospital bed day to be in the region of 12kgCO2e for electricity, hot water and heating. If factors such as travel and procurement are included, the estimated figure is substantially higher: 80 kg CO2e (Reynolds, 2012) or 91kg (SDU, 2012) per bed day. (For comparison, 91kg is the carbon equivalent of travelling about 460 miles in a typical new car[5]).

On any one day NHS-related traffic accounts for 5% of road traffic in England alone[6]. Patient and staff travel accounts for 18–28% of the NHS carbon footprint in each of the UK nations (Isherwood et al, 2018).

2.2 Reducing energy and carbon impacts of UK healthcare

The official advisory body on sustainability for the NHS in England, the Sustainable Development Unit (SDU), has adopted the Climate Change Act targets of a 34% reduction in carbon emissions by 2020, and 80% by 2050. This is equivalent to reducing the NHS footprint by 86% by 2050, relative to 2007 (2007 being the baseline year used in the NHS). The SDU published a Carbon Reduction Strategy for NHS England in 2009 (updated in 2010) and set the NHS an additional target of reducing its 2007 carbon footprint[7] by 10% by 2015, which was met.

[4] A detailed study of sectoral energy use was carried out in 2014-15; no similarly comprehensive data is available for more recent years.
[5] The average carbon dioxide emissions of cars registered for the first time in 2017 was 122 grams of carbon dioxide per kilometer.
[6] www.sduhealth.org.uk/areas-of-focus/carbon-hotspots/travel.aspx
[7] All scopes of emissions - direct and indirect



Source: SDU (2015).

However, official forecasts in 2016 stated that "...*if we continue to cut emissions at the same rate the sector will reach 30% reduction by 2050 compared with Climate Change Act target of 80%"* (SDU, 2016[8]). Only 39% of English NHS providers now report that they are on track to meet the 34% carbon reduction target by 2020 (SDU, 2018).

Overall energy use by English NHS Trusts is close to its level in 2001-02, and electricity use (especially relevant when we consider digitalisation) has increased by around 10% in this time[9].

To reduce energy use in health-related organisations, typical strategies include improvements to the efficiency of the building fabric and technologies (walls, lighting, BMS etc) or awareness programmes focusing on promoting energy-saving behaviour. However, there are many other ways that energy demand can be reduced. Although we often don't think of it as an "energy intervention", the best way to cut the energy use of the health sector is to ***keep people out of hospital*** (and other services), ideally through prevention, in other words, keeping them healthy. This cuts "bed day energy" from the buildings, procurement etc, as well as the fuel used for travel. Linking up A&E with psychiatric services to reduce rates of readmission is one strategy identified by the SDU to reduce the overall need for healthcare and prevent readmissions.

Providing care in or near home is often the next best thing to prevention. For example, if people have long-term conditions, a nurse might visit them instead of them coming into hospital; or some services can be shifted to local clinics. This obviously shifts the "building-related" energy demand from hospitals into homes or other sites, but arguably, for some conditions, might reduce it overall, because hospitals are so energy-

[8] https://www.england.nhs.uk/2016/01/climate-change/
[9] Source: ERIC, 2001 - 2017. Currently available at http://hefs.hscic.gov.uk/ERIC.asp, but this site will close in February 2019.

intensive. For example, frail older people kept unnecessarily in hospital beds might be using less energy if they were cared for at home or in social care.

Care near home obviously reduces fuel used in transporting patients – though there is likely to be more fuel used by staff (so there are issues about what is reported and by whom). For example, the University Hospitals Plymouth NHS Trust has implemented self-administration of immunoglobulin at home for many patients with antibody deficiency. By avoiding patient travel, it has saved a total of over 31 tonnes of CO2e per annum (not accounting for carbon from deliveries to homes; and not accounting for carbon saved by the reduction in service use) (Isherwood and Porter, 2018).

The Sustainable Development Unit has done some work looking at ways of cutting carbon in the NHS. They produced this table of proposed interventions.

Rank £/tCO2e	Name	£ / tCO2e	tCO2e saved in 2020	£000s saved in 2020
1	Theatre kits in hospitals - reducing packaging	-31,600	329	11,500
2	Sugar reduction in soft drinks	-7,380	1,420	0 (saving in 2026: 32,200)*
3	Combined Heat and Power (CHP)†	-6,340	3,750	26,400
4	Reducing medicine waste	-4,430	7,030	37,500
5	Active staff travel	-3,790	4,180	0 (saving in 2026: 19,500)*
6	Psychiatric liaison	-2,000	84,500	259,000
7	Biomass boilers	-1,870	28,400	4,690
8	Effective use of long-acting injections	-1,620	166	297
9	Driver training for fuel efficiency and safety	-1,570	3,960	1,480
10	Reducing social isolation in older people	-1,320	62	0 (saving in 2026: 421)*
11	Teleconferencing	-981	4,100	5,020
12	Furniture reuse scheme	-527	175,000	425
13	Telehealth/Telecare for long term conditions	-341	6,740	2,550
14	Solar - photovoltaic	-261	2,690	1,030
15	Variable speed drives	-231	10,300	3,930
16	Staff energy awareness & behaviour change	-210	75,100	21,500
17	Lighting - controls	-167	2,250	863
18	Building Management System (BMS) - optimisation of existing systems	-153	14,100	3,440
19	Lighting - high efficiency	-141	18,800	7,190
20	Optimising office electrical equipment	-125	11,100	4,250
21	Temperature set points - '1 degree C'	-111	46,200	6,260
22	Building Management Systems (BMS) - new systems	-93	29,200	4,440
23	Heating upgrade	-91	18,200	2,470
24	Decentralisation of hot water boilers	-87	18,000	2,430
25	Boiler plant optimisation	-76	2,050	278
26	Dry recycling of general waste	-45	1,240	387
27	Building fabric - glazing, insulation & draft proofing	-24	11,400	1,540
28	Reducing waste anaesthetic gases	-15	11,900	201
29	District heating	-15	27,900	3,780
30	Boiler replacement	-3	6,160	834
31	Smoking cessation	-1	42,200	0 (saving in 2026: 248)*
32	Solar - thermal	0	2,350	319
33	Prescribing non-propellant inhalers for asthma	0	341,000	0
34	Travel planning	1	48,900	23
35	Reducing fuel poverty through referrals for home insulation	1,480	17,400	0 (saving in 2026: 171,800)*

Source: SDU, 2016:11

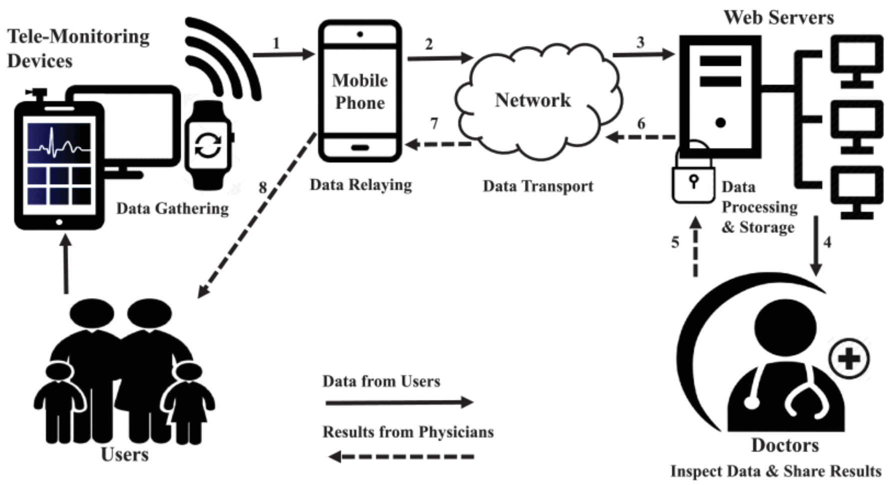
As the table shows, by far the biggest saving is from changing the type of inhalers prescribed. The key point here is that reducing energy use in health is not just about the usual technical energy efficiency measures (the blue rows), but about all kinds of interventions, including prevention of the need for healthcare (green rows) and changing models and locations of clinical care (pink rows).

Digitalisation is implicated in many types of intervention. It contributes directly to reducing staff travel - e.g. through teleconferencing, as in the table - but is also tied into prevention (e.g. through mobile health apps) and especially into remote care, through tele-consultations, remote monitoring etc. But before digging deeper into its energy implications, it is helpful to take an overview of digitalisation in health.

3. Digitalisation in health: The "digital health revolution"

Digital health, or e-health, is a broad term that encompasses many different technologies and innovations (often interconnected), including:

- mobile health apps (m-health), which can support and monitor healthy behaviours
- connected biometric sensors and devices (such as continuous glucose monitoring, or pacemakers with automated wi-fi check-ins);
- consultations via video link or phone (also known as "telemedicine")
- electronic personal health records
- decision support systems that mine clinical datasets (Duggal et al, 2018).



Source: Latif et al, 2017, p11543.

In what has been called a digital health revolution, globally, at least 153 000 mobile health apps have been released since 2015, bringing the total to around 320 000. There is now an official NHS Apps Library. In 2017 the digital health industry was worth £19bn globally (Duggal et al, 2018).

In the NHS, responsibility for digital services lies with NHS Digital, created in 2016 (having previously been known as the Health and Social Care Information Centre since 2005). NHS Digital have stated that they aim to use technology and data to:

• *reconcile the growing demand for health and care services with reducing resources*
• *focus on prevention, self-management and well-being in addition to treating ill-health*
• *increase the personalisation of care and support services to empower the citizen*
• *accelerate and extend the integration and devolution of services* (in the "Fit for 2020 - Report from the

NHS Digital Capability Review" (2017)[10]).

Other digital policy documents (such as the 2014 National Information Board's Personalised Health and Care 2020 report[11]) also stress cost-saving, efficiency and patient empowerment. These top-level goals have translated into a range of programmes. For example, NHS Digital has 3 programmes within its Urgent and Emergency Care domain (among many other programmes):

- *Clinical Triage Project: A programme of transformation to improve the precision, access, and utility of patient triage in the urgent care system. It will be faster than the existing system, enabling secure and easy access to patient records for a more personalised service.*
- *NHS 111 Online: Developing a digital service for the public to enter their symptoms online via computers and mobile devices, quickly and easily connecting them directly to their local NHS 111 urgent care services.*
- *Access to Service Information: Developing an open platform that holds accurate, up-to-date information about urgent and emergency care services. Clinicians will be able to access real time, up-to-date information about available services in order to successfully manage demand on urgent care[12].*

The main point here is the sheer **scale and extent** of the digital transformation that is happening in health. So what might these kinds of developments mean for energy use?

4. Digitalisation and energy use in health

This is obviously a complex subject, not least because of the range of technologies that fall within "digitalisation" and because they keep changing. I'll therefore focus on areas where there is some (albeit very limited) existing evidence. These are often specific schemes based on remote care and monitoring (often called telehealth / telemedicine / telecare). Things like mobile health apps, or overarching system upgrades, do not tend to be assessed, probably because the methodologies would be more challenging.

4.1 Energy and carbon benefits of digitalisation: Reduced service use and transport

In the existing literature, the energy and carbon benefits of these digitalisation interventions are seen as deriving from two types of scheme impact: i) reductions in service use (e.g. in estimates of "avoided"[13] bed days or energy used in hospital buildings, procurement etc); and ii) reductions in transport - usually for patients and occasionally staff.

The SDU's 2016 report (mentioned above) includes an intervention called "Tele-healthcare for people with

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[10] https://digital.nhs.uk/about-nhs-digital/our-work/transforming-health-and-care-through-technology/fit-for-2020-report-from-the-nhs-digital-capability-review

[11] www.digitalhealth.net/includes/images/news0254/PDF/0172_NHS_England_NIB_Report_WITH_ADDITIONAL_MATERIAL_S8.pdf

[12] https://digital.nhs.uk/about-nhs-digital/our-work/transforming-health-and-care-through-technology/urgent-and-emergency-care-domain-b

[13] The concept of "avoided" demand is deeply problematic, as Shove (2017) has shown. However, here my aim here is to review existing literature and so I will merely refer readers to Shove's comprehensive critique (https://www.tandfonline.com/doi/abs/10.1080/09613218.2017.1361746). None of these studies appear to consider the energy used in homes. Or indeed the (obviously controversial) impact of the increased life-years they are reporting.

long term health conditions in the community". This represents, at present, the only attempt to provide a national-scale estimate of the carbon impact of a telehealth programme (i.e. an estimate of what would happen if an existing pilot was scaled up nationwide). This is based on analysis by NEF, that is itself based on research in The British Medical Journal (BMJ) on the cost effectiveness of tele-health for patients with certain long term conditions. The research included the reductions in the use of services such as in patient and outpatient attendances, A&E visits, and medical visits to homes. NEF's analysis extrapolated these benefits based on the number of people with similar conditions in the UK. The reduction in service use is considered to save carbon emissions. NEF and the SDU conclude that telehealth for these long term conditions could save 6,740t CO2e per year in 2020, if scaled up across the country. (That is the equivalent annual saving of about 3400 households switching to an electric car[14]). However, the analysis ignores carbon emissions resulting from the telehealthcare service itself "*as this is expected to be very low carbon intensity*" (or any energy used in patients' homes) according to NEF's (2015) report on methods for the SDU.

Very recently the evidence base was significantly increased by an RCP report on new models of outpatient care (Isherwood et al., 2018), including a series of case studies on the environmental impacts of innovations, including several based on digital technologies (Isherwood and Porter, 2018). For example:

> The Lancashire and South Cumbria Long Term Ventilation Service invested in a ventilator remote monitoring system in 2017[15]. This allows the team to troubleshoot ventilator problems or make adjustments to settings as clinically indicated. It reduced the carbon footprint of the service by on average 12.4kg CO2e per patient through reduction in clinic attendances. Also, avoiding patient return journeys saved 0.55 tonnes of CO2e per year.
> (There is also other literature on remote monitoring of equipment such as pacemakers that mentions reduced hospital visits (e.g. Harri and Senouf, 2009)).
>
> East Surrey Hospital redesigned their inflammatory bowel disease service using a web portal for patients to log their own symptoms. It saves around 650 patient hospital attendances per annum, a carbon saving of at least 60 tonnes CO2e through reduced service use, as well as the carbon saved through avoided patient journeys.

There have also been many analyses that include transport impacts of telehealth initiatives as part of wider evaluations focused on patient experience and cost. One specifically discusses carbon: this study found that a telemedicine network in the Grampian region (used primarily to facilitate hospital-to-hospital interactions) saves about 59 tonnes CO2 per year through reduced travel, by avoiding 2000 patient journeys, or 260 000km per year (Wooton et al, 2001).

Others mention transport, but not carbon. A study of neurosurgery in the New Mexico area evaluated a program whereby referring hospitals could upload digital neurological images for review by a neurosurgeon

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[14] Based on an estimated 2 tonnes per year saving if a household switches to an EV (estimate from the Committee on Climate Change website)

[15] Home mechanical ventilation is the treatment of patients with chronic respiratory failure or insufficiency by means of a mechanical ventilator at a patient's home. Typically a patient is issued with a home ventilator and attends regular hospital clinic appointments to assess the effectiveness of ventilation. Clinical tests are performed on the patient and ventilator use is assessed by downloading data from the ventilator (Isherwood and Porter, 2018: 4)

to help them decide if a patient transfer was needed. After viewing the images, 44% of the potential transfers were avoided (Moya et al., 2010). Hickey et al (2017) found telehealth was effective in providing follow-up care to burns victims in the US. The average travel distance saved was 188 miles per patient. Ellis et al (2013) also make a case for telehealth by assessing the carbon cost of health-related transport (but do not actually measure telehealth's impacts on carbon).

Key ideas in this literature seem to be that telehealth might have the biggest effects on transport (and carbon) in rural areas where patients are travelling long distances by car (not cities with good public transport), and especially for long term conditions where there may be many appointments that are largely routine or repetitive in nature[16]. It is notable that these studies are each based on a single, localised scheme, with only one study attempting to estimate potential impacts on a wider scale. It is also worth noting in passing that virtually all of these studies report major co-benefits (or rather, core benefits, since they are the main motivations for the schemes) such as patient satisfaction and cost-saving.

4.3 Energy costs of digitalisation

These schemes obviously involve sourcing and using new kinds of equipment. Going back to the RCP case studies:

> Telemedicine clinics were set up to give frail and older patients access to specialist geriatric services closer to home in rural north Wales. New equipment included: a high-definition monitor with a video conference (VC) system and camera, all Wi-Fi enabled, a VC-enabled laptop, digital stethoscopes and digital spirometry devices. Additional bandwidth and wireless router upgrades were required to support the new ways of working. The size of the VC screen was increased following patient suggestions (Isherwood and Porter, 2018).

This is just a small illustration of how the use of technologies is changing through one local scheme, but it is worth bearing in mind the scale of the sector, and the "mainstreaming" of digital care within a "*wholesale transformation of the NHS*" that is promised in the NHS Long Term Plan[17]. I have not yet found any analysis of the energy costs of this kind of intervention. As noted above, the SDU analysis specifically excluded the energy costs associated with ICT that might be increased by telehealth initiatives.

When we are talking about digitalisation and the energy used in buildings, we need to think not only about hospitals and surgeries, but also some other (often remote and largely invisible) sites: data centres. There is not scope here to go into all the literature on data centre energy use, but for a few headlines:

The Information and Communication Technology (ICT) sector including data centres generates up to 2% of the global CO2 emissions, a number on par to the aviation sector contribution, and data centres are estimated to have the fastest growing carbon footprint from across the whole ICT sector, mainly due to technological advances such as the cloud computing and the rapid growth of the use of Internet services. (Bertoldi et al, 2017:2).

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[16] This is not an exhaustive literature review. Other work still to be examined in detail includes (non-academic) work on wifi-enabled pacemakers.

[17] https://www.longtermplan.nhs.uk/online-version/chapter-5-digitally-enabled-care-will-go-mainstream-across-the-nhs/

In the UK in 2016, major commercial data centre sites used 0.76% of the total electricity supply generated in the UK[18]. But increasingly, data is being stored offshore - earlier this year the NHS approved cloud storage of patient data. (For discussion of the energy impacts of data and digitalisation across sectors, please see Morley et al. 2018).

We know very little about the contribution of the health sector to the energy demand arising from data. I have not found a single peer-reviewed reference on the energy implications of health-related data, and there is no published information on how much data is stored and shared in the NHS, and how that is changing. There seems to be a major gap in knowledge here. However, several health sector professionals I've spoken to are concerned about the energy impacts of the increasing amounts of data they believe are being stored and transferred in the NHS, for example, patient x-rays - especially in the context of new Information Governance rules about how long such content must be stored for.

As an illustration of how apparently small demands can escalate within a large system, the head of the SDU has estimated the carbon impact of the incident in November 2016 when an IT technician accidentally sent an email to all NHS email accounts, triggering an avalanche of "reply alls" and bounce messages. He wrote: "*It is possible that by the end of today, the sending of a single email, copied to all, will have resulted in the release of over 1,500 tonnes of CO2, the equivalent of the annual emissions of a small NHS trust.*"[19]

There are some ongoing efforts to promote "green ICT" in the health sector, but experts I have spoken to have suggested that the official guidance is dated and there is not much commitment from Trusts - especially because any efforts are entirely voluntary. The sector struggles to keep its IT systems functional, secure and within budget[20], meaning energy and carbon are often a low priority.

4. Drivers of digitalisation in health

These developments can be seen as the outcome of technological change, but they are also bound up with policies. There are explicit policies promoting and steering NHS digitalisation, such as the strategies of NHS

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[18] DUKES 2017: https://www.gov.uk/Government/uploads/system/uploads/attachment_data/file/637823/DUKES_2017.pdf

[19] Baddley states that:

Industry research has suggested that each spam email has a carbon footprint in the region of 0.3g, non-spam email, without an attachment 1-5g ....The original email went to in the region of 500k staff. @1-5g per email that means IRO 500-2,500kg CO2 straight away... So far I note around 200 'replies to all'. I would be surprised if the level didn't top out at well over 500 by the end of the incident. Each reply goes to 500k people. That is 500x500,000 emails= 250,000,000. If estimating the Out Of Office responses at 10% and delivery receipts at a further 10% we may generate a further 50,000,000 emails that way. 300 Million emails could result in 300-1,500 tonnes of CO2 emitted from this one incident. Not just a major business continuity issue, but a major environmental incident. 1,500 tonnes is the annual carbon footprint of a small NHS provider trust.

[20] As suggested by recent headlines regarding the "absurd" prevalence of fax machines in the NHS (https://www.bbc.co.uk/news/uk-46497526)

Digital. Meanwhile, regulation (internationally) is scrambling to keep up with the pace of innovation. But there are also wider policies that matter, notably cost-saving.

The Carter Review (2016) was a major review that has impacted many healthcare practices. It compared the performance of different Trusts and highlighted "unwarranted variations", in other words, bad practice in spending too much on "non-core" activities such as administration (and energy management, but that is another story). The Carter Review proposed solutions to promote efficiency, and many of these, across the different areas studied, came down to digitalisation:

> *"We were struck by the immaturity of trusts' use of such technology from e-Rostering systems, e-Prescribing and basic electronic catalogues for procurement, so we recommend NHS Improvement needs to incentivise trusts to fully utilise their existing digital systems, and where necessary, enable them to access some of the Spending Review commitment to invest in digital technologies"* (p8)
>
> *"At the very least we think trusts should have the key systems for e-rostering, e-prescribing, patient-level costing and accounting, e-catalogue and inventory management, RFID [Radio-Frequency Identification] systems where appropriate, and electronic health records, and that these systems should be integrated" (p63)*

Hospitals are being very strongly encouraged to become digitally "mature", turning into "smart hospitals".

Another concern is patient experience – a massive overarching agenda, manifested through the Care Quality Commission rating system – the ultimate judgment on whether a Trust is doing well or badly, with huge effects on staff morale and indeed the longer term survival of the institution (poor performers can be taken over by other Trusts). Many digital innovations are presented as improving patient experience. It is even connected up with the single room (dignity and infection prevention) agenda, because single room layouts end up demanding various forms of digital technology – staff tags, patient information screens, smart TVs for entertainment, medical sensors, and so on.

In interviews, hospital professionals told me that having hi-tech equipment was good for attracting the best staff. (Though staff have mixed feelings about some innovations affecting their practice). Another related agenda is the 24/7 NHS – telehealth might offer opportunities to have appointments over a more extended period, and apps are always available. Also relevant are changing data storage (Information Governance) policies, as mentioned above.

Digitalisation is fundamentally intertwined with every aspect of acute health practice, and therefore it is being steered by many different types of policy.

5. Final reflections

Digitalisation is a good example of how the policies affecting energy use are NOT policies about carbon or energy (which are largely voluntary in health, as in other sectors) but rather, policies about things like economic efficiency, patient experience, and “models of care”.

This is just a brief sketch of the issues, and we are, of course, not suggesting attempting to stop health sector digitalisation in its tracks. But we think it is important, as a first step, simply to recognise that this could be a huge influence on energy and carbon in the health sector. Because of the scale of the systems involved, relatively minor changes, for example to rules on patient data storage, could have significant impacts on energy use. Currently a lot of time and money is going into things like LED lighting - so maybe we need to ask questions about whether there are alternative or additional approaches that are valuable.

This review also shows up problems in a binary conceptualisation of building energy and transport energy - which are obviously interconnected once we start thinking about how digitalisation reconfigures healthcare (or other practices), and about where data centres, and procurement, fit into this analysis. Crucially, we know almost nothing about the energy impacts of digitalisation in health – so this represents a big challenge - and opportunity- for energy researchers. Not least, we face the challenge of determining what methods, data and counterfactuals might be used to assess the energy impacts of digitalisation in health.

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