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Reducing demand for energy in hospitals: Opportunities for and limits to temporal coordination

Abstract

This chapter describes some of the ways that demand for energy is made in hospitals. It develops an account of energy demand as the outcome of the organisation of connected working practices that constitute the regular provision of healthcare. Drawing on interview data taken from an ethnographic study of institutional rhythms and the organisation of working practices in hospitals, it describes how changes in the material arrangements, professional boundaries, and temporalities that underpin hospital life affect the fixity and flexibility of connections between practices in ways that matter for the potential for large institutions to achieve demand side response and to foster the design of new and less resource-intensive ways of working.

Introduction

This chapter argues that demand for energy in institutions is the outcome of changes in various forms of institutional organisation of working arrangements. Intervening in the organisation and timing of working arrangements is presented as an opportunity for both improving demand response as well as reconstituting working arrangements in such a way that they demand less energy. I argue that opportunities to steer demand in this way, through temporal coordination, depends on there being sufficient flexibility in the various forms of connection between working practices that hold temporal arrangements in place.

To make this argument, I refer to three empirical examples taken from a study of three acute[1] National Health Service (NHS) hospitals. I refer to hospitals as example cases for two reasons. First, the NHS is the largest public sector contributor to climate change in Europe and one of the largest employers in the world. Through the running of its services it is responsible for approximately 25 million tonnes of carbon emissions each year and for the organisation of the working lives of 1.7 million people (see NHS Sustainable Development Unit, 2016). Predictions estimate that even if the NHS successfully delivers all of its currently planned interventions, it will still miss its government set 2050 carbon emissions reduction target by 26%. The NHS represents an example of a large and complex organisation that requires significantly new ways of thinking about and reducing its energy consumption. The second reason for referring to hospitals as example institutions is that the hospital has already been well studied as an institution that makes and shapes patterns of working. In this chapter, I draw on and extend Zerubavel (1979) ethnographic study of hospital life in the U.S. The example cases that I refer to are taken from interviews that were part of my own ethnographic study of institutional rhythms and the organisation of working practices in hospitals. This research was conducted over a six-month period at three sites and included observations of daily working practices and routines in different departments, from auxiliary and background services such as laundry and decontamination departments to frontline clinical services delivered on wards, in operating theatres, and in intensive care units. 27 interviews were held with a range of staff from hospital and estates managers, to nurses and clinicians, and to facilities and operational staff. I use this material to illustrate a way of thinking about how demand is made in institutions. I do not claim that this way of thinking can be inferred by the narratives presented. Rather the example cases help me to show up and describe how healthcare services have changed, are changing, and do not change, and how these changes and obduracies matters for the constitution of demand for energy in hospitals.

From here I go on to say more about the current NHS strategy for reducing carbon emissions, to show how an understanding of how demand for energy is made is missing. In the following section, I

describe how working arrangements in hospitals are organised temporally, and in other ways. I then go on to illustrate, through an example of the changing role of diagnostics in the provision of health care, how the timing of working practices depends on interconnections between temporal and material arrangements. In the final two sections, I show how potential changes to the timing of working arrangements, as a strategy for managing and reducing demand for energy, depends on there being sufficient flexibility across various forms of connection between working practices. I illustrate this with examples referring to the rearrangement of the way that breast cancer services are delivered in the NHS and the limitations on clinical developments in radiology services.

What do hospitals use energy for?

Reductive accounts of consumption, and of energy use, underpin current NHS sustainable development strategies, limiting potential opportunities for managing and reducing demand for energy.[2] Demand for resources like energy as well as the services that those services are for are considered to be made outside of the hospital, to be disconnected from everyday hospital life, and to be something that the hospital has little control over and has to respond to accordingly. The idea that demand is made externally and met through the delivery of services is reflected in the NHS Sustainable Development Unit's strategy for reducing carbon emissions (see NHS Sustainable Development Unit, 2016). On the one hand, the strategy counts on, and expects, the health sector and hospitals to receive carbon savings as a result of changes in national and international government policy, including changes in: "… public spending, increased renewable energy in the UK energy mix, improved carbon efficiency of production and more fuel efficient vehicles." (NHS Sustainable Development Unit, 2016). On the other hand, the actions it proposes that the health sector itself should take to meet demand for resources in a less carbon intensive way, include: adopting more efficient technologies, procuring products made in less carbon-intensive ways, and implementing energy and waste saving programmes that require changing the behaviour of staff. I leave criticisms of this kind of approach to energy 'efficiency' (see for example Wallenborn, 2015), of

the promise of renewable energy sources, and of a dependence on technological innovation for carbon reduction to one side in this paper, and instead highlight that there is no discussion of how the health sector itself is implicated in the making of demand for energy. Energy consumption is instead taken to be steadily increasing and the only question, for those interested in sustainable development within the NHS, is one of how to supply this growth in the least carbon-intensive way. However, consumption is not static, it is not permanently and unilaterally growing, and there are more questions to ask and to answer beyond how to keep up with growing demand. Demand is rather dynamic, changing in different ways all the time. There are a wealth of social scientific ideas that can help to study and understand these dynamics and that can help us to understand possible new opportunities for steering and shaping them.

Within the social sciences, a strong case has been made for treating patterns of consumption (Warde, 2005), and particularly of energy consumption (Shove and Walker, 2010), as outcomes of practices and the ways that practices are arranged. In their article, 'What is energy for?', Shove and Walker (2014) challenge the idea that energy supply and demand is either a cause or a consequence of changing political, economic, and technological systems. Instead, they propose an approach that views energy demand as constituted by practices, or by what people do. In their words:

> *"To persistently ask 'but what is energy for?', and to take that as the central question is to take a different view of the social. It is to see society not as an outcome of intersecting systems, like geological forces pressing this way and that, but as emergent from, and defined by, social practice."*
>
> (Shove and Walker, 2014)

Rather than conceiving of energy use as the result of tectonic shifts in national and international policy, in changing economic strategies, and of technological and scientific progress, these authors call our attention to the practices that energy is for. Instead of focussing on limiting and enabling

social structures that govern the consumption of energy, an approach that focusses on practices draws our attention to the regular and social reproduction of everyday activities at home and at work that constitutes what are seen as normal and acceptable ways of life that are what energy is used for. In the hospital, practices might include the prescribing, distributing, and taking of medicine; diagnosing, testing, and treating patients; as well as eating, washing, and resting. While different theoretical traditions reflect different definitions of a practice (see Schatzki, 2016), what practice theorists have in common is that they argue for the centrality of practices in the analysis of the constitution of social life and how it changes.

Energy demanding practices are not free to be reproduced at any time and in any place. Instead, they are connected in time and across space, and it is this spatiotemporal extension that facilitates their effective and regular reproduction. They can be connected in sequence. For example, diagnosing, prescribing, ordering, receiving and then, administering medicine. They might also be connected in space. For example in hospitals there are a range of activities taking place at any one time: people being treated, having operations, taking bed rest; people serving and drinking coffee in the café; managers having strategic, planning, and investment meetings; staff delivering goods, cleaning up, serving lunch, and so on. The idea that practices connect and that they are interdependent is important for understanding how demand is made. The reproduction of a given practice can require the reproduction or indeed exclusion of another practice, or set of practices. Cancelling a clinic, for example, might mean that a whole range of connected activity including patient travel, follow-up appointments, tests, and admissions do not happen. While admitting a patient requires a whole host of administrative, diagnostic, and treatment practices to be performed. The central challenge of reducing energy demand, for authors such as Shove (2009), Shove, Pantzar and Watson (2012), Southerton, McMeekin and Evans (2011), and Walker (2014), is one of modifying practices and their arrangements so as to disrupt the regular reproduction of practices and reduce consumption associated with practices that might not be enacted.

In this chapter, I work with these ideas to challenge prevailing understandings of how demand for energy is made in institutions like hospitals and more broadly in large organisations like the NHS, by focussing on the practices that hospitals use energy for. Because hospitals use energy in the regular provisioning of healthcare services, and to explain how hospitals make demand, I go on to describe how working practices involved in the delivery of healthcare are organised, shaped, and changed by various forms of emerging connections between practices.

How hospital life is organised (temporally and in other ways)

One way that working practices are connected, and hospital life (and hence energy demand) is organised, is temporal. Although hospitals are often perceived to be highly irregular organisations that respond to emergencies and to changes in patients' health, as well as to changing demographics and diseases, in many ways hospital work is highly responsive and unpredictable. This is because it is underpinned by a socio-temporal structure that shapes 'normal' and acceptable ways of working. In his ethnographic study of *Patterns of Time in Hospital Life* (1979), Zerubavel describes the temporal sequences and socio-temporal cycles that run through and structure the organisation of hospital working arrangements. He argues that sequences of working practices in departments and across the hospital make up socio-temporal cycles that structure the organisation of hospital life. These include the duty period, shift patterns, and staff rotations which intersect with social cycles of the day, the week, and the year, as well as with cycles of career progression and training. The culmination of intersecting sequences and cycles is that working practices in hospitals exhibit a rhythmic temporal pattern. In Zerubavel's words:

> *"[Both]... routine and nonroutine events and activities [are forced] into regular temporal patterns, thus introducing a rhythmic structure into hospital life… even purely medical events and activities are forced into rhythmic patterns which are dictated by nonmedically based schedules."*

(Zerubavel, 1979)

The timing of a given practice is, therefore, a product of its connections to other practices, as well as of the temporal organisation of the hospital as a whole. This holds true of both medical and nonmedical activities. Zerubavel explains, for example, how it is purely a social convention that medicines are distributed and therefore required to be taken every four hours rather than every four hours and eighteen minutes. This timing is a product of medicine rounds close sequencing with meal times (1979).

Connections between practices and their interdependencies mean that certain practices occupy central and fixed positions in practice arrangements and therefore in hospital schedules, while others are more flexible and can happen at different times. Meal times on wards, for example, act as a strict temporal anchor around which other practices are arranged, while completing paperwork, writing up patient notes, and performing clinical observations are practices which have more flexible positions in daily schedules. Southerton describes how the temporal organisation of daily life matters for the fixity and flexibility of different practices. He writes that:

> *"The temporal organisation of the day can be characterised as being constituted by practices that have a fixed position within schedules… These are surrounded by interrelated practices that have a more malleable position within sequences, leaving a stock of practices contingent on filling empty slots within the day."*
>
> (Southerton, 2006)

Zerubavel and Southerton help us to see that working practices are connected temporally and that the temporal organisation of hospital life matters for the fixity and flexibility of practices in hospital schedules. These are important observations for understanding how institutions make patterns, profiles, and peaks in demand for energy. If demand is the outcome of the regular reproduction of working practices and practices are organised temporally, then both managing and reducing demand

depends on reconfiguring the temporal organisation of institutions and on the making and breaking connections between practices.

On the one hand shifting the timing of working arrangements is a way of achieving demand side response. Demand side response has gained increased attention from system operators and regulators because of its potential to (1) lessen the effects of high demand on ageing infrastructure; (2) reduce requirements to draw off more carbon intensive supplies and hence reduce costs to consumers; (3) and to better match the timing of demand with the timing of outputs from low carbon generation (wind, solar, etc.). Peaks in energy consumption are also likely to become more problematic in the future as services like heating and mobility move to electrification (Powells et al., 2014). Changing the timing of energy intensive activities so that they take place outside of peak demand is one strategy for reducing energy consumption that requires a careful understanding of the timing of practices and their potential fixity and flexibility in hospital schedules.

However, this uneven distribution of demand is also representative of the temporal patterning of total demand that underpins the range of practices that make up hospital life. While peaks are the outcomes of societal synchronisations, the outcomes of many energy-intensive practices happening at the same times, societal synchronisations are held in place by the same socio-temporal orders and rhythms that Zerubavel describes. Southerton, writes: “Peak loads in energy consumption and transport represent simple empirical observations that reveal such rhythms.” (2013) The temporal order that is revealed by observations of these kinds of societal synchronisations is multi-scalar, produced by the activities that are performed daily, weekly, annually. Walker argues that: “Each of these scales of rhythms in practice - daily, weekly, seasonal - and their interaction, are generative of the rhythmic patterns of energy demand.” (2014) The rhythmic patterns of energy demand are underpinned by the socio-temporal ordering of practices. Torriti follows this line of thinking when he argues that the significance of peak load is that is that it is representative of the way that practices are ordered in time:[3]

> *"Peak energy demand emerges as a phenomena which epitomises the relevance of practices as a unit of analysis in this context. At the heart of the approach which places social practices at the centre of our understanding of the dynamics of energy demand is the position that the timing of energy demand is determined by the way practices are ordered in time."*
>
> (Torriti, 2017)

Shifting the timing of working arrangements, therefore, is not only a strategy for desynchronising energy intensive practices so that peaks are shaved, but it also reconfigures the temporal organisation of working practices, and hence total load. As a result, energy load is not just displaced through the changing timing of working practices; it can also be dissipated as temporal connections are broken, and previously connected practices are no longer reproduced. Following Zerubavel, problematic and unevenly distributed profiles of demand, as well as patterns that represent total demand, can, therefore, be understood as the outcomes of problematic, or conflicting social cycles. Opportunities for resolving these can be found in strategies of temporal coordination, in intervening in and shaping the temporal organisation of the hospital. But opportunities for modifying the temporal organisation of working practices to shift peaks and modify patterns of demand so that they are less resource intensive depends on the flexibility of specific temporal connections and the way that those arrangements are held in place by other forms of connection between working practices.

Hospital life is not only organised temporally. Practices also connect, and arrangements are underpinned, by other forms of connection that matter for the temporal organisation of hospital life. In previous work (Blue and Spurling, 2016), we suggested that the temporal organisation of the hospital *inter*connects with professional boundaries and material arrangements,[4] as well as with other forms of connection between practices. Professional boundaries, or as we have described

them, jurisdictional connections (the abstract organisation of expertise and division of labour), that matter for who works when, where, and with whom, are reflected in the temporal sequences and cycles in the hospital. Similarly, material connections between practices interconnect with temporal and jurisdictional ones. The physical location of certain departments, for example, embedded in hospital design, permits and limits opportunities for collaboration, working in sequence, sharing equipment, etc. and holds in place (literally) particular ways of working.

Recognising that working practices in the hospital are not only arranged temporally but also by other forms of connection, matters for understanding the fixity and flexibility of working practices and hence for opportunities for temporal coordination to disrupt and reconfigure patterns of consumption, to shift and reduce demand. Instead of seeing fixity or flexibility as a given characteristic of a practice, or a product of its positioning within the intersecting temporal sequences and social cycles, the potential for shifting the timing of working practices rather depends on the historical layering (Blue and Spurling, 2016) of connections between practices and interconnections between various forms. In describing how past practices and their arrangements matter for present and possible future configurations, Schatzki writes:

> *"… the pasts of practices, arrangements, interwoven timespaces, and social phenomena are among the items that circumscribe, induce, and underwrite the public presence of activity - and, thus, their own emergence, persistence, and transformation. The practices, arrangements etc. that arise from human activity in turn contextualize activity. History thus embraces mutually dependent activities, arrangements, practices and social phenomena."*
>
> *(Schatzki, 2010)*

Although Schatzki is working with a specifically developed schema of practice theory here, the argument is that past arrangements of practices, in their temporal, material, jurisdictional and other forms, circumscribe, induce, and underwrite the emergence, persistence, and transformation of

practice arrangements. It follows, therefore that fixity and flexibility of practices are a product of those emerging forms of connection. Opportunities for temporal coordination are dependent on the historical layering and emergence of interconnected forms of material, temporal, and jurisdictional connections.

In the following three sections, I illustrate how the historical layering of interconnections matters for emerging fixities and flexibilities through a description of three examples: emerging interdisciplinary working in breast cancer services in the NHS; fixed temporal working arrangements in radiography; and changing material arrangements in pathology.

Changing material arrangements in pathology

Innovations in technology are not straightforwardly responsible for increasing demand for energy. Neither does innovation in healthcare technology drive the reconfiguration of working practices in the hospital. In some cases configurations of working arrangements can be so strongly embedded that technologies will be rejected should they significantly disrupt the temporal or jurisdictional order. It is instead the historical layering of interconnections which afford flexibilities in types of connections and establishes new limits on possible future ways of working. The role of pathology services in the hospital (referred to sometimes by hospital staff using the umbrella term diagnostics which includes pathology, radiology, and other kinds of testing services) has changed dramatically over the last forty years, in part because of changing technological capabilities. Lawrence, a manager for pathology services, described this change and some of the reasons for it:

> *"Diagnostics thirty to forty years ago was used very much as a confirmation of a diagnosis which they'd [doctors] already arrived at. So they did the physical examination of the patient, took the history of that [patient] and said I think this is what's wrong with you, we'll do the test to confirm. So that's the philosophy. Unfortunately, now it's reversed on its head, diagnostics is being done upfront. So the diagnostic is driving the decision-making process."*

(Lawrence, pathology services manager)[5]

While pathology had previously provided confirmation of diagnoses that consultants and doctors arrived at through other kinds of medical tests, energy intensive services like pathology and radiology now form part of the services provided at the very beginning of many patient pathways.[6] Instead of featuring more sparingly as a confirmation tool, sometimes after treatment had already begun, or even when a patient had left the hospital, diagnostic services are now used to identify specific pathologies and set in motion courses of action to treat the patient. So while resource intensive activity in the lab and in radiology had previously been part of some, but not all patient pathways, it now forms a part of the beginning of a majority of sequences of activity in the hospital.

Lawrence provided various explanations for this reversal, for the changing role of diagnostics, for the expansion of its services, and its increasing forms of dependence and connections to a wide range of clinical services. One explanation was that services in pathology had to respond to increasing demand made externally by shifting economic, political, and technological landscapes. He suggested that pathology services had developed in line with medical and technological advances. As medicine has been able to specify in more detail exact cancer sub-types, diagnostic services have had to keep up. In Lawrence's words:

> *"[I]n certain areas the work and the complexity of the work that we're doing is very much been driven by… for example in histopathology… we are needing to type the tumour in more detail… because of designer drugs, designer cancer drugs. [C]ertain cancer drugs are [now] being designed [to a] very… specific tumour subtype. In order to subtype that tumour you need to do a significant amount of work. So a lot of that sort of diagnostic work is now being done upfront…"*
>
> (Lawrence, pathology services manager)

Lawrence partly puts this shift in demand for testing down to external advances in medical research and technology, following a prevailing narrative and one that is followed by various organisations including the NHS Sustainable Development Unit. However, he went on to describe other aspects to this growth in demand for pathology services, which were about connecting pathology with different services across the hospital. As pathology services became more developed, they have forged dependencies with different clinical services, and become intimately integrated with new forms of treatment and care.

> *"The other element of it is very much around therapy and management of the patient. A lot of the new therapeutic agents, in particular, chemotherapy… require certain tests to be done… to demonstrate that the patient is responding to that treatment, but some of those drugs are quite toxic in their own right [so] it is to also monitor the side effects. To make sure that [the side effects are] within acceptable limits and… not… causing an issue for the patient. So there is that element of it."*
>
> (Lawrence, pathology services manager)

Lawrence complicates the narrative that medical and technological advances directly relate to demand for pathology services, and hence to the demand for energy and other kinds of resources. The delivery of new treatments and services are partly enabled by changes in the roles, remit, and capacities of diagnostic services. The development of new chemotherapy treatments does not develop independently from changes in diagnostics, but emerges symbiotically. As Lawrence himself reflects: "[It] is… an extremely interrelated, multi-factorial impact in terms of what's actually… driving the demand [for pathology services]."

The changing role and remit of pathology services have of course been part of improving patient treatments and overall population health. It has also impacted demand for energy across the healthcare service. The availability of a wider range and more detailed forms of testing has increased

the number of tests being performed and increased electricity consumption as well as fuel required to transport samples (often individually) for testing. Pathology services are usually at their busiest in the late afternoon and evening peak period. This is because those services receive the bulk of samples in the late afternoon following the accumulation of sample and specimens that have been drawn from clinics during the day and newly implemented turnaround times. In this way, material arrangements connect practices in ways that matter for and at the same time have to fit into the temporal organisation of the hospital.

Advances in the technological capabilities of diagnostic services modify the sequence of practices of diagnosing, treating and testing. But this modification also has significant implications for the temporal configuration of practices and the potential organisation of working arrangements. Changes in this sequence of activities have resulted in increased testing and a fixing of times when pathology services operate (in sequence and coordinated with a wide range of clinical activities). And at the same time this modification in sequence, facilitated by new material forms of connection has afforded pathology services the opportunities to connect with, integrate with, and underpin all kinds of services. The ability to test at faster rates, more accurately, and for a broader range of diseases has enabled a culture of testing and a dependency on pathology services. It has provided the ground for the emergence of new clinical practices that themselves require more testing, and it embeds testing in existing clinical procedures. Perpetuating this demand for testing and dependence on services in pathology has immediate energy consequences, but it also has broader implications for length of stay and 'bed flow' while patients wait for test results, as well as for the increased demand for energy and other resources that accompany patient stay.

The example of changing material arrangements in pathology services illustrates that demand for a range of healthcare services and related energy is not straightforwardly an outcome of the adoption of and integration of new technology, but rather the outcome of changing interconnections between material and temporal connections between practices. New material arrangements allow faster

provision of testing and allow pathology to be connected in different ways to clinical practices and embedded in new kinds of practices. There are also other forms of connection beyond the material and the temporal that matter for the organisation of hospital life and hence how the hospital makes demand for energy.

Flexible professional boundaries in breast cancer services

Material arrangements are not only interconnected to the temporal organisation of the hospital, but also to professional boundaries that shape ways of working. The capacity for temporal coordination then is tied to both to the flexibility of material, jurisdictional, and other forms of connection. One example that well shows up the importance of this historical layering of interconnections between practices that circumscribes, induces, and matters for the fixity and flexibility of practices in arrangements and hence temporal coordination and peaks and patterns of energy demand, is the rearrangement of the way that breast cancer services are delivered in the NHS.

NHS hospitals now run what is known as a one-stop breast clinic for patients referred by their GP for breast cancer symptoms. Before these clinics were established, patients with such symptoms were required to have a series of appointments in different departments across the hospital (and sometimes in different hospitals), with potentially long waiting times in between, before they could get a diagnosis. Now patients receive all of this care in a one-stop clinic, on the same day, and in the same session. Requirements were introduced by the Department of Health in 2010 that all breast patients are required to be seen by a consultant with all accompanying test results within two weeks of referral. This policy and set of temporal targets is stringently adhered to by NHS hospitals and is enforced through the use of financial penalties when targets are 'breached'. This policy, however, did not impose a fundamental rearrangement of hospital services, rather working practices had been developing in this way for some time, and government policy rather codified and standardised already emerging ways of delivering breast cancer services.

In an interview with Elliot, a surgeon and clinical lead for breast services, we discussed the historical developments and transformations that led to closer and new kinds of working arrangements between the services involved in diagnosing and treating breast cancer. This discussion shows up the historical layering of material and jurisdictional connections between practices that matter for the temporal organisation of these services and the possibility of the two-week target. Elliot described some of the changes that allowed breast cancer services to be delivered in the fashion of a one-stop clinic for patients. She first explains that the integration of new technology reduced the duration of time that it took to test for cancers and that this allowed services to come together on a single day. In Elliot's words:

> Elliot:*"[I]t was the introduction of fine needle cytology. So you had the opportunity to be able to provide a pathology result on the day of the clinic appointment. So the patient could have the, we call it a triple examination that people get in breast clinic, a clinical examination, the radiology, and the pathology. And when these one-stop breast clinics first started people were getting the examination, the imaging and… the cytology [in one day]."*
>
> Interviewer: *"So the availability of that new technology is what allowed those services to be able to come together?"*
>
> Elliot: *"Yes and that's going back about 30 years I think… people were doing cytology then and setting up one-stop breast clinics. And they just became the norm; breast clinics were just done that way."*
>
> (Elliot, breast cancer services manager)

This new and 'normalised' arrangement represents a shift in the temporal organisation of working practices. Patients no longer have to come to the hospital three times, but only once to receive the same diagnosis that they would have thirty years ago. The departments involved no longer run

independently, but have to provide working arrangements and patient pathways that can cater for the one-stop clinic. As a result, timings for diagnostic test turnarounds, patient waiting times and, bed flow, are reconfigured. The frequency of patient visits, the effect on patient flow, and the increased dependence on more sophisticated diagnostic methods, all impact the demand for hospital resources as well as the timings of when energy-intensive activities occur.

In bringing these services together, the one-stop clinic has advanced the ways in which breast cancer is diagnosed and treated. Closer working between radiographers, pathologists, and clinicians has enabled interdisciplinary approaches, research, and treatment and has led to the emergence of new kinds of tests and treatments. Elliot described the impact of bringing these services together:

> *"What's then happened is that the way we diagnose breast cancer has evolved from just having a cytology result into having actually a bit of tissue to report on… That then obviously takes a few days to process because it has to be fixed and blocked and looked at by the pathologist. So that's where you get into the situation where people are coming back in a weeks' time… Because [with] the cytology all you get is a cell and you can tell whether it's benign or malignant, but you can't do any other tests on it. When you get a little slither of tissue, the pathologist can then tell you what type of breast cancer it is, what grade it is, so that's how aggressive it is. And they can start to do the tests that tell you how it's going to respond to treatment as well. And all of those things have gradually become the norm, and the benchmark has moved to treating breast cancer."*
>
> (Elliot, breast cancer services manager)

The close and integrated ways of working in breast cancer services have shaped the development of both the disciplines involved and the ways that they work together, and hence the opportunities and requirements for new material and temporal configurations between the working practices involved. It is only through this kind of close interdisciplinary working that requirements for more detailed

sub-typing and grading of cancers have emerged and in this case, this is what has resulted in further pressure on those services, now working to a two-week target from referral to consultation.

Jurisdictional forms of connections, like material and temporal connections, can also spread across practices organisations, where the temporal and material connections that underpin them are flexible enough to accommodate this. Elliot notes that the way that breast cancer services have been rearranged have become a model for bringing together other services in hospitals to meet similar temporal and financial targets:

> *"We all work much more closely in teams, and that's what's evolved through this close working I think, the multidisciplinary team working on cancer. And I think it's probably fair to say that what we've done in breast surgery or what people did in breast surgery has then spread out into other specialities and the multidisciplinary team working has become standard in all branches of cancer."*
>
> (Elliot, breast cancer services manager)

Interdisciplinary ways of working that bring together specialists, knowledges, and equipment from different fields have become the standard for hospital work around cancer more broadly, and appear to be being taken up in other specialities as well. Emerging interdisciplinary ways of working have implications for demand for services. In this case, bringing pathologists, radiologists, and clinicians together has shifted the temporal sequence and timings of working arrangements from separated services and long waiting times to a one-stop clinic, and finally to a one week wait for cancer subtyping. It is clear that this changing timing matters for the number of clinics, for the number of hospital visits, and for the related resources and patient transport required. The spread of interdisciplinary working could, therefore, lead to greater temporal coordination, fewer patient visits, and a reduction in resources consumed during hospital stays, waits, and visits.

It is clear from this example that changes in one form of connection (jurisdictional) matter for

changes in others (material, temporal) and hence the organisation of working practices in the hospital. The question of which changes in one form of connection will shape others, or be accommodated by or able to shape the complex of practices that makes up hospital life is an empirical question that depends on uncovering the historical layering of connections and the fixities and flexibilities that layering and interconnection affords. It is not always the case, as so far has been described, that technological innovation and potential new material connections will be integrated into current ways of working. Particular temporal connections, for example, can be so tightly interconnected that working practices cannot be shifted to accommodate new clinical processes.

Fixed temporal arrangements in radiology

Temporal connections between practices can be so embedded, so dense, that practices and the temporal arrangements that they make can resist changes in material or jurisdictional forms of connection. The examples described until now have demonstrated how the historical layering of forms of connections between practices and their interconnections matter for the ways that hospital life is arranged. Changes in material arrangements bring practices together, shifting professional boundaries and therefore the potential for new connections between practices. For example, it was fine needle cytology which helped to establish interdisciplinary ways of working in breast cancer services. Material forms of connection also shape temporal configurations of working arrangements. It was new material arrangements in pathology that enabled new connections and new practices to emerge.

However, the following example from radiology shows that the potential flexibility of connections between practices and hence ways of working is first a product of the historical layering of connections and second that it is relative. Complexes of practices or different forms of connection within a given complex are never in a state of fixity of flexibility, but their fixity and flexibility are relative to the kind of change in one form of connection and its impact on other types of connection. Anna, a service manager in radiology, described the various ways that the temporal organisation of

working arrangements in radiology was able to accommodate certain technological changes. For example, Anna described how increased magnification of CT scanners had resulted in multiple periodic appointments and follow-ups for patients.

> *"… CT scanners have gone from providing a slice through you from 10mm to sub 5 mm. What that means is the spatial resolution is increased, and we can see things that we could never see previously. So what we are finding is a lot of nodules in chests, so some people would be walking around with nodules that they don't know they've got… So we'll bring them back at six months, and we'll rescan them... And they're followed up for two years… So the equipment and the ability to see things has changed how we then follow up patients. So clearly we've found a whole load of patients that we never used to see and massively impacted on our demand yet again."*
>
> (Anna, radiology services manager)

In this instance, some of the patients who were already being scanned, as a result of this increased resolution were now being asked to return for follow-up scans at six months and two years from the original appointment. In this case, increased capacity in resolution has increased the frequency of appointments impacting on demand for services, the total number of scans, and the energy required to deliver this service.

Yet Anna described that it is not always the case that working arrangements in the department are modified to incorporate additional, and arguably, lifesaving services. While the frequency of repeating this particular scan could be accommodated by extending hours, running additional clinics at the weekend, not all new services made possible through new technologies were able to be incorporated into existing ways of working. In particular, incorporating services that involved new technology and that required significant temporal reconfiguration often met with most resistance, not least because temporal boundaries were held in place by increased costs associated with

weekend working and unsociable hours.

> *"… cryoablations are targeted killing of liver tumours, renal tumours, and we do it by laying a patient on a CT scanner, finding the area we're interested in and then sticking needles in and ablating it, either using radio waves, microwaves, [or] cryo freezing ... But it takes a long time, and for every hour that that patient is on a CT scanner, we could have done four outpatients. And then you start to think well if that surgeon or radiologist who does that procedure is only doing it on a Tuesday afternoon we're going to have to displace that work that would have been there and put it on a weekend. You then run into the concerns that well actually that's going to cost us more money to deliver that because at the moment weekend working is, has some enhancements on it. So there does come a point where we say we're not going to do any more of those because actually it's too expensive."*
>
> (Anna, radiology services manager)

The flexibility of temporal arrangements and the possibility of temporal coordination depend on the historical layering of interconnections. In this case, temporal arrangements in radiology appear to be flexible in certain areas but not in others. It is possible to add in additional work of the same kind, but reconfiguring entire schedules is impossible, not least because of the financial limitations that accompany broader socio-temporal rhythms of the working day and week, but also because these schedules are held in place by jurisdictional boundaries. The shift patterns, working hours, and rotations of surgeons, radiologists, and teams of staff in radiology is not sufficiently arranged to deliver this service. Reconfiguring the timing of radiology services to incorporate this new service would require too great a shift in established ways of working.

What this example shows up is that temporal coordination as a strategy for shifting the timing of working arrangements and as a way of managing and reducing energy demand depends on the fixities and flexibilities of certain connections between practices which are afforded by the historical

layering of interconnections. Understanding that changing the timing of working arrangements is limited by, for example, professional boundaries, or even further that changing material and jurisdictional forms of connection between practices has the potential to reconfigure temporal arrangements, presents new opportunities for steering and reducing demand for energy.

Conclusion

I have tried to show some of the ways that demand for energy is made in large institutions, like hospitals. I argued that hospitals do not only respond to externally made demand for services and energy but that demand is an outcome of working practices which are organised in time. I claimed that it is this temporal organisation that underpins patterns, peaks, and profiles of demand and therefore, that steering demand depends on intervening in or shifting the timing of working practices to achieve what Zerubavel calls temporal coordination. However, I argued that working practices in hospitals are not only organised temporally, but also through material and jurisdictional forms of connection, and that these forms of connection interconnect in shaping and holding together practice arrangements and potential opportunities for future connections. Achieving temporal coordination as a way of steering demand, therefore, depends on the relative fixities and flexibilities of interconnections.

The implication of this way of thinking about both demand side response and total demand reduction is that institutions should turn their attention from external shifts in political, economic, and technological regimes, towards the ways that their own working practices are arranged. Of course, this is not to discount these kinds of systemic changes, but to understand how they are manifest in the organisation of the delivery of healthcare services. Rather than being concerned with (and depending on) advancements in renewable supply, electric cars, less carbon intensive forms of production, and changes in public spending, organisations with a remit for reducing carbon emissions in institutions like the NHS, would do well to turn their attention to the healthcare services that energy is for, and to understanding their histories and the ways that they are

developing. We need to know more about how different services are changing and shaping each other, and more about where they are in decline or static and contributing to or holding in place problematic profiles. Strategies for intervention, to close the projected 26% gap in carbon savings required to meet government set targets for the NHS by 2050, that follow from this approach might include: promoting interdisciplinary working and developing services to achieve greater integration, temporal coordination, and increased sharing of resources. They might include a re-skilling and reconstruction of doctors' diagnoses in such a way that it does not depend on testing in pathology, and it might include carbon measurements of potential and emerging services. Equally, such organisations would be interested in achieving more even distributions of energy (for the reasons set out above). At a minimum this would involve a systematic review of the potential for shifting auxiliary and clinical services out of problematic peak times, and what other forms of connections (material, jurisdictional, financial) need to be rearranged to achieve this kind of temporal reconfiguration. At the most, achieving a more evenly distribution of demand would be tied to the project of reassessing and redesigning the organisation of a less resource intensive healthcare service.

On the one hand, it seems counterintuitive to suggest that medical services and healthcare provision should be designed and debated with energy demand, carbon emissions, and sustainability at the forefront of the agenda. Patient care is and must always be the priority for any healthcare institution. On the other hand, in this chapter, I have tried to challenge the view that medical and technological advancement happens beyond the hospital and that it is straightforwardly shaped by processes and practices in the hospital. I have shown that the provision of healthcare services is rather shaped by the flexibilities and fixities afforded by the historical layering of *inter*connections in the arrangements of working practices that makes up hospital life. Moreover, given the considerable contribution that NHS services make to total UK carbon emissions, and the rising numbers of UK hospital admissions that are attributed to air pollution and increasing extreme temperatures resulting from climate change, it is more pertinent than ever to understand more about how

institutions like hospitals make demand for energy and other carbon-intensive resources and about opportunities for steering that demand through temporal coordination of services and reconfiguring practice arrangements.

The suggestion to focus on how institutions shape working arrangements is not only to be applied to hospitals but could well be developed with a broader range of institutions and large organisations in mind. Each will have its own history, its own forms of connections, and its own possibilities for reconfigurations. Research could further be applied in schools, universities, prisons, and other kinds of large organisations to identify significant forms of connection between practices that matter for the temporal organisation and hence energy demand of the institution, and to identify other historically made opportunities for reconfiguring patterns of work and hence for steering energy demand.

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End Notes

[1] Acute care is a level of health care in which a patient is treated for a brief but severe episode of illness, for conditions that are the result of disease or trauma, and during recovery from surgery.

[2] According to the NHS Sustainable Development Unit. 2013. Carbon Footprint Update for NHS in England, buildings energy use makes up approximately 17% of NHS carbon emissions, while transport makes up another 13% and procurement another 61%.

[3] Peaks can, of course, be problematic in their own right, as I write above.

[4] In that article we referred to these as jurisdictional and material-spatial connections.

[5] Pseudonyms and generalised job titles are used throughout to preserve the anonymity of participants.

[6] A typical or planned journey through the healthcare system, from first contact to completion of treatment.