Chapter 15

Health and Social Care

Summary

Socio-technical approaches are often applied in the development of healthcare information systems and medical devices. Socio-technical approaches are appropriate because the problems of developing technology for healthcare lie not with the complexity or novelty of the technology itself, but in the complex ways healthcare is practised and organised.

Background

The healthcare domain has proved unexpectedly complex for systems developers. The production of integrated electronic health records was originally seen as straightforward, no more complex than the production of any records system for any organisation. Only after decades of effort and phenomenal cost are we beginning to see these deployed.

There is also a long list of failures in this domain. A particularly notable failure is that of the London Ambulance dispatch system in 1992. This failure was implicated in the deaths of up to 30 people. This was not a technical, but a socio-technical failure; there were technical problems with this system, but it also failed to address and support the established practices of dispatch. It became clear from this disaster that simply procuring the cheapest system was not an appropriate strategy. Development approaches need to be both technically sound and to pay appropriate attention to the support and evolution of work practices.

The Domain

Healthcare and social care are large, overlapping domains encompassing a wide range of organisations and activities. Needless to say, the work in these domains is often life-critical. Health and social care organisations include:

- **Hospitals**: These are usually large, complex organisations. Hospitals within any health system may do similar tasks but often have vastly different cultures, practices and outcomes.
- **General practices/Family Doctors**: These are often small, autonomous practices. They are usually a first point of call for any non-emergency situation, and build long-term relationships with patients.
- **Ambulance Services**: These are not usually operated from a hospital but by an independent organisation.
- **Pharmacies**: These are independent businesses whose work it is to prepare and dispense medications.
- **Social care**: This is a large area, encompassing mental health services, patient rehabilitation, care for elders and so on. Failures of social care can lead to problems that need to be addressed by other services.
- **Public health**: Many governments and charity organisations run public health initiatives with the aim of preventing people from developing health problems in the first place.

Healthcare organisations can vastly improve the outcomes of care when they communicate and coordinate effectively. When someone falls ill, for example, they may interact with several organisations, and be discharged from hospital into social care. So information technology problems do not just fall into each of the areas mentioned above, but they also exist across them.

Complexities in Health and Social Care

Why is developing information technology for health and social care so difficult? Why is this sector such a quagmire for technology with project after project going over budget and failing to deliver what was envisaged? The answers to such questions seem to lie in the complexity of the domain:

1. There is simply a mass of information. Everyone in the developed world will engage with a healthcare provider many times during their lifetime. For each engagement, relevant information from previous ones should be available. Each encounter is also potentially useful in building evidence about the efficacy of services and treatments.

2. Healthcare organisations are extremely large. Organisations such as NHS England, NHS Scotland, and Kaiser Permanente in the USA operate many hospitals and services. Hospitals are themselves large organisations, and often act in a highly autonomous way.

3. Healthcare is highly politicised, with successive governments trying to reform and reshape the sector.

4. Powerful professional groups dominate healthcare. Many of these groups predate the organisations they work within. These groups cannot be managed in the same way as employees of other organisations often can be, health professionals must be persuaded rather than told what to do.

5. Healthcare faces a massive coordination problem, this ranges from co-operation in operating theatres, to shift handovers, to shared care and handover between organisations. The quality of coordination can have a huge impact on the effectiveness of care, for example a fast coordinated response to a stroke and then coordinated, long-term rehabilitation massively increases the chance of a stroke victim fully recovering.

6. Finally, the range and complexity of tasks undertaken in healthcare is huge. These tasks are also highly contingent, particularly where health professionals need to deal with acute situations.

Socio-technical Challenges for Health and Social Care

Here we list four major socio-technical challenges for systems engineering in health and social care.

1. Supporting Practice

It is extremely important that information technology for healthcare is fit for purpose. Hospitals in particular are complex work environments, where health professionals work with multiple technologies, paper, devices, with other people, and not least patients. The preference in systems development is to design

and evaluate a technology under controlled conditions, but this ignores the complexity and dynamic nature of the work and environment. Figure 1 below shows just how many technologies may be in use at any one time. Somewhere beneath all the equipment is a premature baby fighting for survival.

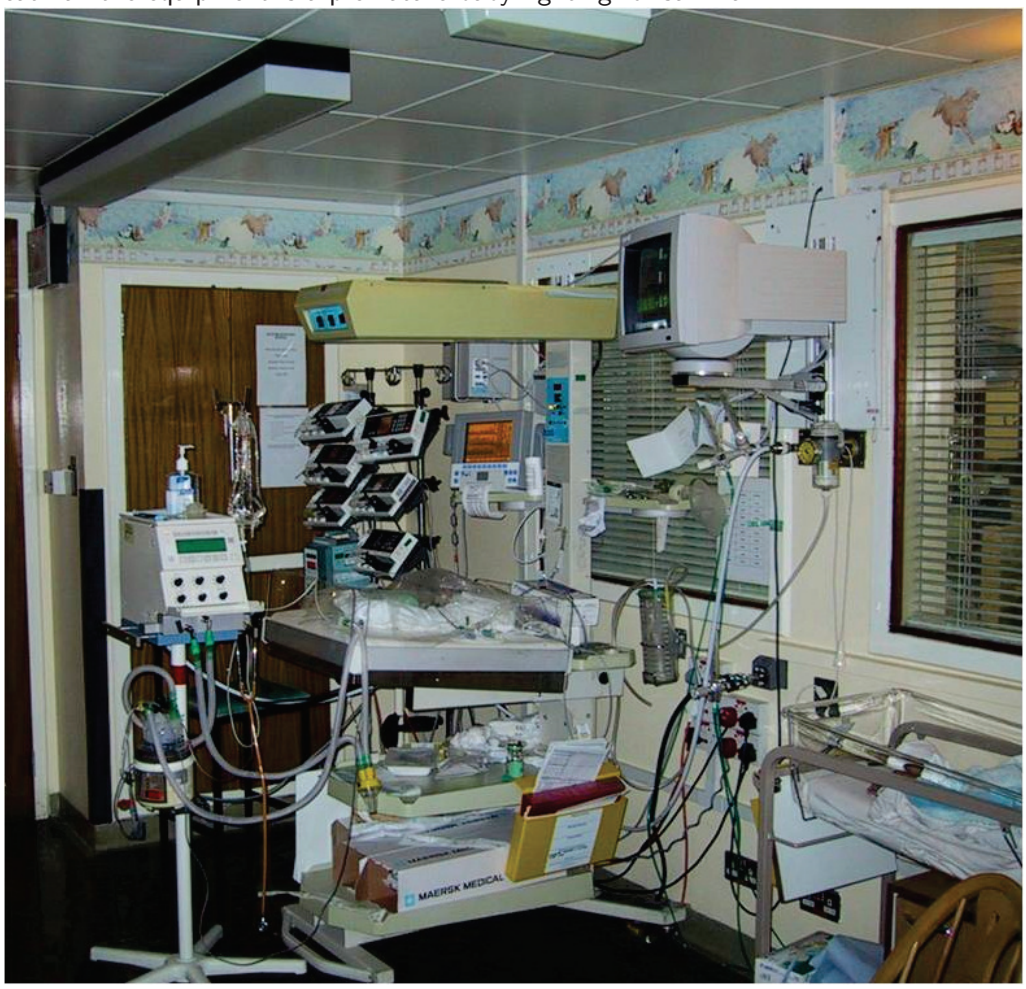

Figure 1: A Neo-natal Intensive Care Unit

2. The Paperless Hospital

One of the key challenges in healthcare is to produce an integrated electronic record. This has been a long-term aspiration, proving surprisingly difficult. Only recently have electronic records been coming into widespread use, and still there are many problems in ensuring the correct people have access to

these, that they are used in uniform ways, and that the information in them is correct and meaningful. Summary records to be shared between providers are still "just around the corner"(as they have been for a long time). One of the key problems of computerisation has been that a medical record is not a thing, but a collection. Medical records are collections of results, summaries, letters and so on. Another problem has been that paper is very convenient for care providers to use. Health professionals do not sit at computers all day but face patients and work with others. Having a piece of paper on a clipboard is extremely convenient. Thirdly, the record has historically been, not simply information about a patient, but notes written to be used among small, richly connected groups. Figure 2 is used to illustrate this point.

FINDINGS: There are aneurysms arising from both intracavernous internal carotid arteries. On the left, the immediate pre-cavernous and intracavernous portions of the internal carotid artery are dysplastic with a fusiform aneurysm. This has a maximum dimension of approximately 1cm. On the right, there is a larger more saccular aneurysm with a maximum dimension of 2cm. This also arises from a dysplastic intracavernous internal carotid artery. The source data images from the angiography and axial GRASE images demonstrate these aneurysms nicely lying within the cavernous sinuses. In addition, there are changes of small vessel cerebrovascular disease in the brain with small lacunar infarcts involving the right gangliocapsular region.

Figure 2: A Neuroradiology Report

Figure 2 shows a section from a neuroradiology report. It holds a great deal of technical language, but is not simply a 'container of facts'. Consider the part of the findings section that states "the angiography and axial GRASE images demonstrate these aneurysms nicely lying within the cavernous sinuses". Why would an aneurysm ever be described as "nicely lying" anywhere in someone's body? The answer, of course, is that this report is oriented to the medical procedures that are to follow. Despite its formal nature, this report is more like a letter written to a person the author knows well, and is relevant to what the author thinks that person needs to know. Computer scientists often approach medial information as if it is a series of facts, but in reality it is highly bound up among people and practices.

3. Large Scale Information Systems

The scale of healthcare means that the information systems that support it can be very large scale. In practice there are many independently produced and managed systems that are expected to be interoperable.

In England, the National Programme for IT (NPfIT) was established in 2002

to see the development of a number of technologies for the NHS including integrated electronic records, electronic prescribing and networking infrastructure. It was originally intended as a three-year project costing 2.3 billion pounds. However this spiralled to 12.4 billion over 10 years. Some elements of the programme have been very successful (if over time and over budget). Other health services, for example the NHS in Scotland, have sought to undertake more bottom-up driven programmes, with technologies being developed at a local level and the being scaled up to national level if they are successful. Both bottom-up and top-down strategies run into problems, and it is not clear which is really the better approach. Large programmes such as NPfIT can serve to highlight the cost and difficulty of producing health technologies, but this does not mean other approaches aren't wasteful. Denmark has been widely credited as having the most effective healthcare information technology in the world. In Denmark, there has been a centralised programme of IT governance, but no fixed initiatives. Digitization has been incremental and technologies allowed to evolve. Denmark is of a similar size to Scotland, but it is not clear whether its approaches to healthcare can scale to the larger health systems in England, the USA, etc.

In addition to clinical information, health organisations also produce and manage a great deal of service data. This includes information about demographics, outcomes, medications, care pathways, incidents, episodes of care, and so on. These are large-scale non-trivial data sets that are essential to evaluating, planning and costing services. Handling and making sense of this "big data" is one of the coming major challenges for systems engineering. It is a socio-technical challenge because attention needs to be paid to the ways it is collected, and inevitable problems and inconsistencies in the quality of the data mean that support needs to be provided for how it can be legitimately interpreted.

4. Patient Safety

Another key challenge of developing medical technologies is to improve and support patient safety. Medical error is a leading cause of death and injury. In the USA, more people die every year from medical error than they do road accidents. In England up to 5% of hospital admissions suffer a preventable error and 0.3% of admissions die from these. Such preventable errors are unacceptable, and the cost of litigation against healthcare providers is actually far higher than the costs of implementing safety precautions. Information technology cannot be used to solve all types of preventable accident (for example patient falls, or hospital acquired infections) but it is relevant to many diagnostic and treatment

errors.

A major effort has been made to address medication safety. Medication error is a major source of harm, and a great deal of attention has been paid here to how information can be clearly recorded and presented, checks made and problems tracked. The switch to computerised order entry has been one of the most effective means of reducing medication error. Computerised entry resolves problems with the legibility of handwriting, missing fields, inappropriate values entered and so on. A more complicated challenge is support for flagging potential adverse drug interactions where more than one medication is prescribed for a patient. Another challenge is the linking of prescribing systems to patient records.

The large-scale collection and examination of incident reports has also been a key way in which information technology can be used to improve safety. Incident reporting was brought to healthcare after its success in the aviation industry. Anaesthesiology was the first profession to adopt this on a broad scale, but now incident reporting systems are usually organisation wide. Incident reports are used to report incidents of harm or where there was potential for harm. Reporting these enables health providers to learn from problems and mistakes and put corrective measures in place. It is important to learn about small problems, and incidents where there was no actual harm. Major accidents often share causes with smaller incidents. Major accidents are rarely completely novel events, but result from unfortunate combinations of factors that have previously caused no harm.

Retrospective

Socio-technical work has repeatedly stressed the importance of understanding local, practical issues in the design, configuration and deployment of healthcare technologies. Technologies continue to fail because they do not suit the complexities of practice and/or because they are unacceptable to those who must use them. This has never been to deny that generic technologies are inappropriate for care, but is to say deployment is dependent upon local factors.

Over the next decade, socio-technical systems engineering for health and social care will increasingly face challenges associated with large-scale systems engineering. How can coordination be supported across systems and between organisations? How can large-scale networks and datasets be managed? And how can internet based services be better used by the public for gathering information and storing health related data (for example from digital devices)?