Delivering the healthcare we deserve

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The grand challenge we propose is: To integrate the vast pool of medical information relevant to the care of any specific patient and deliver it in an effective and coordinated manner at the point of care, allowing us to approach the levels of quality in patient care that are theoretically possible given the current state of medical knowledge.

The Societal Need

It is widely accepted that there is a serious gap between the medical care patients should receive and that which they actually receive, leading to the observation that the "application of what is known already will have a greater impact on health and disease than any single drug or technology likely to be introduced in the next decade"[1]. The scale and complexity of modern healthcare systems is increasing relentlessly. The sheer quantity of medical information, even within a single specialty, is already beyond the power of one person to comprehend[2]. Evidence is accumulating that failing to provide standard treatment is a problem of epidemic proportions[3]. In one study[4] over 10% of patients admitted to NHS hospitals experienced an adverse event; around half of these events were judged preventable with ordinary standards of care. A third of adverse events led to moderate disability or death.

Many observers in many countries have recognised that ever increasing resources for health services do not and cannot guarantee uniformly high standards of care. Errors by individuals and failures at organisational level are extremely difficult to eradicate. Individuals and organisations simply do not have the capacity to cope with the flood of information, new medical knowledge and constant changes in policies and procedures that we see today. This problem can only get worse as research and new medical knowledge drive changes in clinical practice.

Many kinds of clinical decision have been shown in systematic reviews to be very significantly improved by computer decision support. The grand challenge we are proposing is not, therefore, simply to develop new or better systems for determining the "best" clinical decision in a particular situation – such systems exist. The problem is that despite decades of research, development and investment, computer support for clinical decision making is still experimental, piecemeal and rarely used in routine practice.

The Grand Challenge

Routinely achieving the best care for every patient that could be expected given the resources available and current medical knowledge represents a deep challenge in several areas. We see at least three major issues which must be addressed simultaneously:

1. Integration of information

(a) How to locate, filter and collect all the relevant information, and use it to frame and to inform clinical decisions. Information important to the care of a patient includes but is not limited to:

- Medical knowledge, research and clinical trial results (often contradictory, often incomplete, often only partially relevant to the case in hand).
- Policy guidelines (international, national and local), including regulatory and compliance issues.
- Patient data and clinical records.
- The context of treatment – what else is the patient being treated for at the same time, how do treatments and conditions interact?
- The professional knowledge, opinions and instincts of clinicians.

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1 Sir Muir Gray, Director of Clinical Knowledge, Process and Safety at *NHS Connecting for Health.*

2 Fox J and Das S *Safe and Sound: Artificial Intelligence in Hazardous Applications*, MIT and AAAI Press, 2000; Bates DW, Gawande AA. "Improving safety with information technology". *N Engl J Med.* 2003;348:2526–3.

3 McGlynn EA, Asch SM, Adams J, et al. "The quality of health care delivered to adults in the United States". *N Engl J Med.* 2003;348:2635-2645.

4 Vincent, C, Neale G, Woloshynowych A. "Adverse events in British hospitals: preliminary retrospective record review" *British Medical Journal* 2001;322:517-519. These results have been extensively cited and discussed, see http://www.bmj.com/cgi/content/abstract/322/7285/517

- Patient preferences, values and wishes.

(b) How to integrate these disparate and often incompatible types of information to give a single overall recommendation.

(c) How to guarantee security, privacy and where necessary anonymity of information in a large-scale system where the individual participants may not be under strict centralised control.

2. Co-ordination

(a) How to co-ordinate the various people, processes and resources involved in the care of a patient: ensuring everyone is aware of what is going on, that information and resources are available and correct where and when they are needed, and that care is scheduled as efficiently as possible.

(b) How to co-ordinate the various services and resources required for effective decision making. The information needed is increasingly distributed over a wide variety of sources: a vast and growing medical literature; patient records and notes; databases local to different clinical services, and countless medical systems and devices with their own specialized data management functions. This specialisation, the particular local needs and circumstances of each clinical unit and the sheer scale of modern healthcare, make it increasingly unlikely that complete centralisation of information systems will be helpful, practical or even possible. We will need more agile styles of integration that accept that the people best placed to curate information are individuals working at a small scale in local clinical units.

3. Effective delivery of information; effective integration into clinical culture.

Perhaps the biggest challenge is to provide intelligent computer support that clinicians *want to use* in their work, that assists rather than getting in the way. Clinical computing systems, even those which show strong results in evaluation studies, have a sad history of disuse, rejection, resentment and even mutiny among users when attempts are made to deploy them in routine clinical use. Many studies have highlighted the poor fit between clinician's needs and work patterns and the mode of use forced on them by computer systems, as well as the professional, social and political issues which often cloud clinical IT deployment.

(a) How can information be rapidly and effectively communicated to exactly the people who need to know it, when they need it? How can computer systems anticipate information needs, be aware of the evolving state of patient and workplace, and summarise all the relevant information succinctly and usefully?

(b) How can decision support be delivered in a form that clinical decision makers find useful, accessible and compatible with their existing work patterns? How can information systems fit within the culture of a high-pressure and already overstretched workplace? What can be done to ease the inevitable cultural impact?

Timeliness and Appropriateness of the Challenge

There are several reasons why this challenge is particularly timely. First, the scale of the problem is becoming more acutely evident. Second, it is becoming ever clearer that the problem cannot be solved simply by standardising and centralising all healthcare computing. Besides the usual difficulties of introducing large-scale computer systems, the history of medicine as a profession led by its own skilled practitioners makes it more resistant to standardised working practices than industries with traditionally central management. Third, emerging theories and technologies may provide a new perspective on the problem. We propose that in response to the disappointing record of attempts to centralise and standardise healthcare computing we as a community should explore ways to re-formulate the problem as one of coordination of distributed and partially incompatible knowledge and services. We believe this would ease the problems in all three of the areas identified above. Maturing computer science theories in areas such as knowledge representation, decision theory, distributed coordination of knowledge and process, service-based and agent-based computing, planning and workflow management, could all support such a reformulation.

A key feature of a “Grand” challenge, in our opinion, is that the destination is precise but the vehicle for reaching it pulls a very large amount of science and engineering in its wake. The destination point for our challenge is easily stated: Each patient in routine medical treatment should receive the best care theoretically possible given the state of medical knowledge and the resources available. Even the grossest statistics confirm that we are not achieving this by a wide margin at present. Statistics for medical error and adverse incidents, and studies of care actually received vs. accepted “best practice”, can give a strong indication of progress towards the goal. As indicated, we believe a large amount of computer science and engineering would be required to achieve the challenge. Moreover, the challenge has a strong moral imperative – it is surely indefensible that we should, as a society, routinely fall below this high standard today.