Royal Society report on developments in information and communication technology (ICT) relating to health

Specific questions

Identifying relevant future technological developments

1. What relevant technology trends are likely to impact on health and healthcare in the next ten to fifteen years?	• Machine learning and data analysis • More data sources: novel sensor technologies; molecular imaging; new imaging modalities and lower cost technologies; lab-on-a-chip; novel instrumentation • Effective and reliable telecommunication (e.g. desktop or PDA based teleconferencing) • Grid computing • Wireless networks and pervasive computing (including wearable monitoring, activity and location monitoring) • Data fusion and contextual interpretation • Linkages of patient information systems • Pervasive decision support (e.g. relevant expertise available to professionals in community or any other healthcare provision setting) • Micro- and pervasive monitoring and device instrumentation technologies (e.g. monitoring built into devices such as heart valves and orthopaedic implants) • Effective MEMS and biochemical power sources • New paradigms for Trust, Security and Quality of Service: establishing trusted international standards • Effective information capture: natural language, multi-lingual, experiential • Visualisation technologies (e.g. allowing the comprehension of complex multi-dimensional information

Assessing the potential positive and negative impacts of relevant future technological developments

2. What areas in the provision of health and healthcare could be positively or negatively affected by these developments?	• Diagnostics
	  o Imaging: new modalities; lower size and cost; better usability by non-expert staff;
	  o Wireless assessment of patients' conditions
	  o Delivery of genomics information on patients and its use in supporting differential diagnosis
	  o On-line 'Meta-database' support for diagnostic decisions
	• Therapy
	  o Supports the provision of personalised healthcare
	  o Cost effective telecare provision for chronic disease and elderly at risk population

	o Surgical robotics o Early warning of failure in therapy performance and outcomes • Public Health o Genomic population studies o Epidemiological data mining • Healthcare Delivery o Effectively linked patient records o Telemedicine (linking medical professionals) o Assembling and using the evidence base: medical decisions; technology implementation decisions; policy decisions o Supporting community based care o Development of healthcare ICT Service providers (who can deliver developments at the super-system level)
3. What actions should be undertaken now to maximise positive impacts, or to prevent or minimise adverse effects?	• Initiating and supporting a well-informed public debate on the benefits of openness in use of personal medical information, and the risks involved • Development of policies and standards of trust and security to maximise benefits at acceptable risks to population and patients • Encouraging use of open standards for healthcare data, communications and service protocols which recognise the highly dynamic nature of the underpinning information and communications technologies

Evaluating the wider implications of relevant future technological developments

4. Do you have any concerns associated with the generation, release and subsequent use of personal data?	• Development of an uncontrolled [black] market in confidential medical information on individuals • Lack of recognition by government of the inability of private organisations (pension funds, health insurers) in a health data rich environment to pool risks in a conventional way which has been axiomatic to traditional private health and pension provision (i.e. Inevitability of population based risk pooling systems – through statutory contributory systems or through tax)
5. What medico-legal and ethical issues merit consideration when introducing new technologies, such as the responsibilities, processes and liabilities for decision making?	• Need for capacity to communicate effectively the information coming from new technologies, and the potential impact on patients • Understanding by all participants of the risk and reliability of the several sources of information
6. What regulations or other mechanisms (including standards) would facilitate the responsible development of relevant technologies?	• Development of trusted international standards addressing: o Data protocols, addressing quality of service, reliability of data and other essential quality related parameters o Standards for the development and reliable delivery of trust and security policies in autonomous information systems
7. What infrastructure would be required to	• Some form of auditable compliance monitoring system for all those holding relevant data. Such

allow any new technologies to be used effectively?	systems must not incur unsupportable cost overheads which would make provision of shared data services uneconomic
8. What are the most likely promoters and barriers to the take up of new ICT devices and systems?	• Promoters o Promoters of public health (DH, NHS) o Patients and related pressure groups who recognise the value of better use of information to solving major health problems o Healthcare research community (including pharmaceutical and academic medical institutions) • Barriers o Medical Professional resistance o Media scare stories
9. What education and training would need to accompany the introduction of any technologies, and who would need to be involved?	• This will depend to some extent on the ability of the Visualisation and Data capture technologies to move as fast as the technologies which are generating new information • Training technologies will be required to make all ICTs accessible to the full range of their potential users
10. How are professional roles and responsibilities likely to be affected by the increasing use of ICT?	• It is to be hoped that medical professional will be able to free more of their time by making better diagnostic and therapy decisions earlier, allowing them more time to support and manage patients • Routine tasks (e.g. immunisation) should be devolved to appropriately skilled support staff who are able to de-risk such services by appropriate use of ICTs.
11. How can the development of technologies that meet patients' and informal carers' needs and are practically useable be best facilitated?	• Effective free markets (regulated through the mechanism of reasonable standards – see 6 above) • A business and regulatory environment which motivates producers to respond rapidly to improve their products • **NOT** centralised design authorities or purchasing bodies or controls
12. What are the potential impacts of the costs of any of these new technologies?	• Costs of improving ICTs should be beneficial (or neutral at worst) when assessed across the broad view of health costs (including individual costs and social costs as well as direct NHS and social care costs)
13. What are the implications of the international use of future technological developments, such as global use of health data, variability of ICT-enabled support, and interoperability?	• Improved epidemiological evidence base • Higher volume/lower cost for effective ICT based technologies (e.g. for widespread deployment of telecare etc) • Better and more consistent care from mobile populations

Are there any other important issues that have not been addressed by the questions above and that you think the working group should address?

14. ICTs related to health may well be taken up to a large extent by individuals on a private basis: means to assure users of the quality of content may be as important as technical quality to ensure that the potential value of ICTs at large are realised.

15. Pseudo validity of data, especially historical information: e.g. problems of cures stimulating related diagnoses; systematisation of wrong diagnoses in meta databases. There will be an increasing need to develop systems which revisit initial data based on later outcomes or findings.