## Impact of Medical Technological Advances

### Key Messages

#### IT & Telecommunications
- Significant capacity shortcomings in ICT in Wales have been identified.
- Technological developments are likely to be one of the most important drivers of medical spending.
- ICT will improve links between healthcare providers.
- The focus of care will shift from secondary services.
- Patients will have greater control over their care.
- Telemedicine could improve links between patients and expert opinion.
- Telemedicine can enable self-diagnosis and self-care at home.

#### Genetics
- Genetic screening could identify people at risk of a particular disease and allow appropriate interventions to be introduced before the disease develops.
- The earliest gains are predicted in pharmacogenetics.
- Ethical and financial issues could slow advances.

#### Minimally invasive surgery
- Minimally invasive surgery will reduce hospital stay and promote outpatient operations.

#### Miniaturisation
- Care could be moved from secondary to primary services
- Miniaturisation could potentially enable people with chronic diseases to remain out of hospital.

### Aim:

To provide pointers to the impact of medical technological advances.
Methodology
Because of the timescale available to undertake this piece of work, the author does not claim to provide a definitive list of future medical technological advances and their impact. Instead this paper uses evidence from already known literature and a search of relevant and well respected sites and sources of information, to provide an overview of future medical technological advances.

Main areas of new technological advances
The main areas of technological development likely to affect healthcare towards 2015 have been categorized as:

- IT and telecommunications, including decision support systems.
- advances in molecular genetics;
- developments in biotechnology which will enable advances in genetics to be exploited;
- development of bioengineering to produce artificial body parts and organs;
- further developments in minimal access surgery;
- use of robotics in surgery;
- further developments in transplantation.

IT & Telecommunications

Information Technology in Wales
Significant capacity shortcomings in ICT have been identified in Wales. The Wanless Report recommended an overhaul of information systems in Wales to improve quality, timeliness and coverage and that ICT should be a priority for investment.

Securing Our Future Health found technological developments have been and are likely to be one of the most important drivers of medical spending.

In Wales, Informing Healthcare is one of the key enablers for Designed for Life. It is the programme to develop new methods, tools and information technologies to transform health services for people in Wales.

The programme will be responsible for:

- the creation and development of an individual health record that provides information to the patient and those who look after them when needed;
- the implementation of a number of service improvements which will provide clinicians, carers and patients with the tools, skills and knowledge to adopt best practice;
• the delivery and maintenance of an integrated national technical network which supports patient care delivery by enabling information to be shared irrespective of organisational boundaries.

Key Messages
• Significant capacity shortcomings in ICT in Wales have been identified.
• Technological developments are likely to be one of the most important drivers of medical spending

Information & Communications Technology

Key developments in ICT include:

• Decision support systems;
• Medical record keeping and transfer;
• Aids to rehabilitation and enablement;
• Public access to information.

Wanless identifies a range of new information technologies which could potentially be used in health care:

• The internet is a source of information, which can be used by patients and professionals.
• Digital TV has the potential to provide health information programmes.
• Personal Digital Assistants are small portable computers which could be used by health professionals on the move.
• Wireless Application Protocol (WAP) phones provide mobile internet access for health care professionals at locations which are convenient for the patient.
• Telemedicine has the potential for medical consultations to be carried out remotely via e-technology.

Computers and telecommunications technology will promote and increase

• remote monitoring and diagnosis;
• links between hospitals, between hospitals and general practitioners, between hospitals and clinics;
• the speed of communication;
• the capacity for remote consultation, operations and teaching.
Advances in medical technology will increase the trend to move care away from acute hospitals into primary care, new specialised acute procedures centres, new recovery centres and the home. New technologies mean more diagnosis and treatment can be done in the community or daycare settings. Electronic records will make care faster and safer and allow people to monitor the quality of their own care.

The Department of Health has identified significant opportunities for the use of Information and Communications Technology (ICT) to improve the quality of care and to meet patient expectation, including:

- improving efficiency and streamlining the work of professionals;
- monitoring, performance management (clinical & non-clinical) and clinical governance, dissemination of evidence based best-practice;
- convenience;
- joined-up working through the NHS and social care;
- reduction in human errors.

**Key Messages**
- **ICT will improve links between healthcare providers.**
- **The focus of care will shift from secondary services.**
- **Patients will have greater control over their care.**

**Telemedicine**

Telemedicine is an umbrella term that encompasses any medical activity involving an element of distance.

Telemedicine methods will allow patients to have the expert opinions that they may not have otherwise had.

Telemedicine will have a role in linking populations in remote geographical areas with their required level of expertise.

 Appropriately developed telemedicine facilities will reduce the need for buildings, facilities and personnel. Diagnostic specialists will be concentrated in fewer locations with information transmitted from community settings by non-medical staff.

Telemedicine will provide a mechanism for linking different specialist interests with each other and with general care in the community.
Telecommunications will allow links to small local centres where common conditions can be diagnosed and treated, to self-diagnosis and self-care at home, with the help of developments in instrumentation such as blood glucose monitors.

The Department of Health has stated that telecare and related technologies can allow:

- Avoidance of unnecessary hospital admission and timely discharges;
- Falls prevention strategies;
- Saving lives through more reliable fire/smoke detection for older people;
- Timely information to inform people’s care package reviews;
- Improving quality of life and reducing care costs for people with long term conditions and with strokes;
- Better monitoring of people with chronic obstructive pulmonary disease and diabetes which can alert to changes in condition and significantly reduce out-patient attendances.

**Key Messages**
- Telemedicine could improve links between patients and expert opinion.
- Telemedicine can enable self-diagnosis and self-care at home.

**Genetics**
Advances in genetics are anticipated to support four areas of healthcare:

- Prevention & diagnosis, including screening
- Therapy
- Enhancement
- Reproduction

Early diagnosis is predicted to improve the management of disease, and in the case of carriers, inform reproduction choices. Genetic screening could identify people at risk of a particular disease and allow appropriate interventions to be introduced before the disease develops. As a result, the role of medicine could shift from treating the symptoms of disease to eliminating its cause.

Therapeutic and preventative benefits arising from the discovery of genes could lag 20 to 50 years behind the diagnosis. Some question the appropriateness of screening and diagnosis if there are no treatments available. This could have the following impact:

- Demands on the healthcare workforce to educate and counsel;
- Increased monitoring;
- Increase reassurance.
Ultimately gene therapy will mean the replacement or deletion of the defective gene to eliminate the associated illness; this is unlikely to begin to have a profound effect on UK health in 2020.

The earliest gains are predicted to come from the use of genetic information to predict the effectiveness and side effects of drug therapies. Many believe that pharmacogenetics could have an impact on the care of more that 15% of patients by 2018.

Morris & Detmer argue that the development of pharmacogenetics will be disruptive to healthcare; genetics has the potential to redefine ‘disease’, ‘treatment’ and ‘patients’ and demand new relationships with ‘patients’.

Although the opportunities of advances in genetics are recognised, some issues have been identified:

- Genetic services are likely to be integrated within primary care, with implications for training, workload and resourcing. GPs may be unwilling to raise the issue of genetic risk with patients in the absence of effective screening technologies and therapies to reduce the risk or prevent disease and patients may be unwilling to make lifestyle changes in the context of genetic determinism.
- Genetic screening and selection within reproductive technology potentially allows parents to specify their child’s characteristics, raising difficult ethical issues about the value of life.
- The development and implementation of new technologies will be affected by the extent to which they are seen to be safe and ethically acceptable.
- Financial factors.

### Key messages
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### Tissue Engineering / development of bioengineering to produce artificial body parts and organs

Tissue engineering involves combining human cells with synthetic biomaterials to produce products such as skin, cartilage, bones and organs. It is an area of huge potential given the needs of an ageing population.
One condition tissue engineering could impact is heart disease. People with heart disease may have the option of cardiac vessel regenerative tissue implants, thereby avoiding the need for bypass surgery or angioplasty.

The development of bioengineering to produce artificial body parts and organs is predicted to replace transplantation within the next three decades, alleviating the problem of the shortage of donors for transplantation.

This area is very much in the development phase; some progress is predicted by 2020.

Ethical concerns may affect progress in this field.

**Minimally invasive surgery**

Minimally invasive surgery has already transformed many surgical procedures, including cardiac surgery. The same technology is being applied in other surgical procedures; high tech surgery will therefore become the norm for many operations, this will impact on staff, space and equipment requirements.

**Radiosurgery**

The least invasive of all minimally invasive surgical technologies is radiosurgery. The used of radiosurgery has developed and is now being used to treat many brain tumours and cerebral vascular malformations as well as Parkinson’s disease and epilepsy. Radiosurgery has replaced conventional neurosurgical procedures for all these conditions.

The increased use of radiosurgery could mean more patients being treated in a special facility in the department of radiation, moving the point of treatment to a different site in the hospital and reducing the length of stay for patients.

Minimally invasive surgery is forecast to account for half of all surgical interventions within 10 to 15 years.

Minimally invasive surgery will reduce the prevalence of traditional hospitals.

The need for lengthy post-operative stays will be reduced using minimally invasive surgical techniques.

**Key message**

Minimally invasive surgery will reduce hospital stay and promote outpatient operations.

**Robots**

The use of robots in surgery is predicted to develop by 2015.
The use of robots in surgery will increase accuracy and consistency.

The use of robots is also predicted to increase in rehabilitation (REF: BMA).

Robots are also expected to be used in hospitals for running central supply services, filling requests and orders in the pharmacy, as well as a range of other tasks.

**Miniaturisation**
Increasing the use of miniaturisation is likely to increase the scope for diagnosis and treatment at home and in primary care.

Some argue a shift of functions from secondary to primary care will come from miniaturisation and increasing ease of use is anticipated to lower screening costs; improve outcomes; and lower use of secondary care. This will result in greater patient satisfaction and greater access to these services as unit costs drop.

Screening is beneficial to health service costs because it reduces treatment costs in the longer term. There is evidence that good management of chronic conditions such as diabetes can significantly reduce costs by avoiding early development of expensive complications. Others however question whether improved diagnosis will actually increase the demand for secondary care.

Implantable devices are also predicted to impact on diagnostics and early delivery of therapy. The development of implantable devices with telemedicine can be used for the management of chronic conditions, enabling people with a chronic disease to remain out of hospital, which will benefit the individual and potentially reduce hospital costs.

**Key messages**
- Care could be moved from secondary to primary services
- Miniaturisation could potentially enable people with chronic diseases to remain out of hospital.

**Effect of new technologies on the healthcare workforce**

Developments in new technologies will potentially result in substantial changes in the skill mix of staff, and have major training implications for medical, nursing and technical staff.

Developments in technology have already led to changing professional roles and boundaries both within the medical profession and between health professionals, especially between doctors and nurses. Towle argues that minimally invasive techniques could lead to surgery
disappearing as a speciality and gradually being merged with internal medicine so that specialists deal with organ systems.

Trends in developing technologies could lead to a largely technical role for doctors confined to the ‘high tech’ end of healthcare with other functions being performed by non-medical staff. Patients could be predominantly with non-medical personnel with tele-linkages to the specialist. This would lead to doctors becoming remote from their patients.

In 1999 the Department of Health launched a strategy to ensure that doctors and nurses have the skills they need to use make best use of new technology introduced into the NHS. The strategy Working Together with Health Information provides the framework for ensuring that NHS professionals have the skills and knowledge to use information and new technology.

As well as changing roles of professionals, new occupations resulting from new technologies in healthcare have also been identified, for example, telemedicine practitioners, presenters and consultants.

Limitations of technology
Although technological advances are predicted to improve healthcare and service delivery, some limitations of these developments have been identified:

- New technologies can be expensive;
- Installing equipment outside the clinical environment, for example patients’ homes, can be problematic;
- Patients can find it difficult to use the technology;
- Reduced contact for patients;
- Potentially increase the burden of responsibility on carers.
- Technological advances may be less useful because of problems with implementation. The development of telemedicine has been restricted by medicolegal and ethical concerns about security, confidentiality and integrity of information.
- As technology is refined, it can be applied to more vulnerable and older groups, and thus also contribute to higher costs given the capacity of these groups to attract costs.

The WHO warns that concentrating on technological development could reinforce or even widen health inequalities and highlight the need to guard against the dominance of expensive high technology therapies which only benefit relatively few people.
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