Advances in Health & Medical Science & Technology

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Revolution in Health & Medical Science

- Shift from focus on acute to chronic disease
- Escalating health care costs
- Torrent of biological data
- Development of advanced high-throughput technologies
- Able to identify individuals at risk
- Intervene before disease strikes

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Historical Perspective

- Past – diagnosed using our five senses
- Macroscopic to microscopic perspective
- Therapy was discontinuous, based on empiric, trial-and-error model of care
- Discovery of DNA, transition occurred
- 10 years ago – molecular perspective
- Develop concept of disease modulation
- Result is a major metamorphosis

Advances in Knowledge Technologies to Transform Healthcare

- Convergence of information technology with advances in molecular biology
- Advances in data management tools for biomedical information purposes
- Better user interfaces will engage scientists and patients at a global level

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Examples

- Enhanced capability of personal computers for use by genomics and related sciences
- Computer chips combined with advances in MEMS to allow monitoring of physical health
- Grid computing advances allow optimum power to analysis vast amounts of biomedical data

Advances in Knowledge Technologies

- Data mining more advanced to allow access to “deep web” repositories
- Advances in natural language processing
- Effect will be to “democratise” health and medical information and knowledge

Advances in Knowledge of Health & Disease

- Convergence of technologies & disciplines
- Shift in perception of health & disease
- Integrate “soft” factors (ie, lifestyle, environment, mental states)
- Expansion of disease sub-categories

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Examples

- Medical imaging advances (CT, PET, MRI)
- By 2020 – real time MRI scans on moving patients
- Molecular Imaging allows non-invasive visualisation in space at a molecular or genetic level
- MI can be used therapeutically

Example

- Until recently, assumed humans born with all the neurons they were every going to have
- Concentrations of neural stem cells in the hippocampus and ventricles of adults that the body uses for neurogenesis
- Development of techniques to manipulate neurogenesis relevant to diseases such as stroke, Parkinson's, Alzheimer's, and Huntington's Disease

The Rise of -omics

- Study of genes & other molecules using high throughput screening and advanced software for analysis of massive amounts of data
- Genomics – study of genes and role in health
- Human Genome Project- 5 years following identify increased complexity
- Therapeutic advances, links to nutrition, health and environmental factors

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Biomonitors

- Smaller, faster processes and wireless broadband will make monitoring health at home cheaper and easier
- Advances in micro-electromechanical systems, nanotechnology and network connectivity will create the network-centric physiological monitors that can measure body temperature, hydration levels, chemical toxicity and other biomarkers

Stem Cells

- Penicillin of the 21st century
- Exceptional potential
- Adult stem cells cannot turn into as many types of cells as embryonic stem cells
- May be useable in the regeneration process across an array of organs
- Obtaining and preserving adult stem cells in large numbers could be a major stumbling block

Embryonic Stem Cells

- Remain the most promising
- Able to differentiate into a large number of different cell types for use in cell therapies
- Political opposition has limited research funding and progress
- Large private companies and a number of countries are pursuing this technology with vigour

Advances and Ethics

- Advances in science and technology bring new ethical challenges
- Ethics and risk assessment
- Funding implications for health care
- Global ethical conduct and equity

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Risk & Responsibility

- Last 50 years – ethical debate has focused on what role society should play in financing and delivery of health care
- Canada & Europe – single payer system to spread health care insurance risk
- USA – health insurance industry – to manage risk at a corporate level

Future Ethical Agreements

- Ethical agreement between the individual the social unit
- For health risks within individual's control over (eg, lifestyle), they will have a positive moral obligation to maintain their own health and prevent disease
- For health risks beyond individual's control (eg, genetics), the social unit will have moral obligation to provide care

Development of Global Ethics

- Ethical positions reflect different stages of development and different contextual circumstances
- Wealthy and progressive societies will progress technologies
- Some societies will delay or derail
- Cycle of time from technology to dissemination is faster than ever before
- Global communication and perceived benefits will make it difficult to contain advances

Evolution of Global Health Care Ethics

- Evolution of health care, politics, and economics based on global concerns
- Global responses to climate change, infectious diseases security and natural disasters suggest that a new level of cooperation may be possible
- Short-term – self-interest may prevail
- Long-term – interconnection of economic and political systems in a transparent environment of knowledge exchange will encourage a global ethic of care

Future Challenges & Choices

- Healthy future societies will be those that offer equitable access to the resources that promote health
- Recognise the growing gulf between rich and poor and the ongoing need for low tech, public health approaches
- Healthy societies will depend on governments losing their fear of tackling difficult issues now, rather than passing them on to the next generation, next round of government or next meeting

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Critical Horizons

"Doing the hardest things will be the most important things for societies to tackle if we are to be healthy future societies" and ethical global citizens.

- (Dr Donald Bone, Corporate Director for Science & Technology, Johnson & Johnson)

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