Technology in healthcare: How can we best meet the population's needs?

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‘It has become appallingly obvious that our technology has exceeded our humanity.' This quote by the brilliant Albert Einstein will form the overriding theme of this essay. As mankind makes quantum leaps in developing technology, it is imperative that we retain and lead with compassion. Empathy, kindness and gratitude are underestimated quality improvement tools.

There are three fundamental terms that need defining before exploring and formulating a response to this question. What do we mean by technology? Which population are we going to focus on? And finally, what are the pertinent needs of aforementioned population?

Definitions

I think the title of the question should be redefined as population's challenges/problems not population's needs. There are varying definition of needs[i] and each have limitations. The definition that is most prevalent is based on consequentialism and focuses on effectiveness: a need can only be defined with reference to a specific objective e.g. A is needed to achieve B. An alternative definition was proposed by Culyer and Wagstaff, ‘the expenditure required to effect the maximum possible health improvement, or equivalently, the expenditure required to reduce the individual’s capacity to benefit to zero.’[ii] Ultimately, this is a question inextricably linked to the basic economic problem of scarcity of resources. The human needs are unlimited because they grow and evolve while the means of fulfilling the needs ... are limited[iii].

It is befitting that the Oxford English Dictionary, as recent as 2009, revised its several definitions of technology controversially and reflects the ever-changing use of ‘healthcare’ in the modern day vernacular. 'The application of such knowledge for practical purposes, esp. in industry, manufacturing, etc.; the sphere of activity concerned with this; the mechanical arts and applied sciences collectively.Freq. with modifying word, as alternative technology, applied technology, food technology, information technology, space technology: see the first element.' For simplicity, the Google definition may be cumbersome; 'the application of scientific knowledge for practical purposes, especially in industry'

As technologies break down borders and for the purposes of this essay, I will make reference to national and international trends as well as particular references to the state of healthcare within the UK.

Challenges, Problems or Needs?

A provisional list of challenges include rising costs; changing demographics; resource gaps; easy access; move from being supply driven towards a demand driven consumer mode; building hospitals without walls; care for patients without borders and patients exercising choice. According to the King's Fund, the three main challenges in the UK include national spending review; integration of health and social care in order to reduce the complexity and inequitable state of the current system and the ensuring the NHS has adequate leadership to deliver a high standard of care with relatively ever-decreasing finite resources[iv].

Brief history of technology in healthcare

It is imperative to look back at history in order to explore the direction of technology in healthcare. It was under 800 years ago that Roger Bacon developed the first magnifying glass in 1250; only 200 years ago since the Rene Laennac invented the stethoscope and surprisingly 46 years since the first commercial CT scanner and this achievement of Sir Godfrey Hounsfield was recognised by sharing the 1979 Nobel Prize for Physiology or Medicine with Allan Cormack. It is important to note that society has made significant sustainable developments only since the beginning of the 20th century and the prospect of the new technologies developing in the forthcoming century is immensely exciting.

Social media and virtual/augmented reality

The rise of social media only within the last decade has catapulted health agenda into people's lives. As Chou[v] suggests, 'new technologies..may be changing the communication pattern'. The quality of this communication remains to be subject to regulation and quality improved. People have the opportunities of being part of communities. The use of popular social media site, Snapchat[vi], by Professor Shafi Ahmed – dubbed 'the Virtual Surgeon' - is ground-breaking. He has also adopted mixed-reality Hololens technology to perform bowel cancer surgery connecting with surgeons across continents[vii]

Virtual reality is usually associated with surgery and particularly training purposes but there are a plethora of other ways it is being utilised. It is being used in conjunction with augmented reality technology for diagnostic purposes. It is also used for pain therapies that supplements current therapies[viii], eating disorders/obesity[ix] and cognitive rehabilitation for patients with stroke, Parkinson's Disease and brain injuries.[x]

Nanotechnology

One of the leading causes of death in men and women is dementia and Alzheimer's disease[xi]. There are huge developments in diagnostic and therapeutic options with nanotechnology. Rivastigmine delivery in conjunction with nanoparticles can cross the blood brain barrier efficiently with comparatively lower side effects[xii]. Nanotechnology is improving the sensitivity and specificity of MRI and PET contrast agents which can detect amyloid plaques and neurofibrillary tangles – the hallmarks of Alzheimer's disease.

Big data

Big data is a term to describe the inability for traditional data processing software to deal with large or complex data and is 'high-volume, high-velocity and/or high-variety information assets that demand cost-effective, innovative forms of information processing that enable enhanced insight, decision making, and process automation[xiii]'

The analysis of big data[xiv] has the capacity to change the way clinicians use technologies to develop a deeper understanding and make informed decisions[xv]. Sources of big data include social media and internet browsing data; machine-to-machine data; biometric data and human-generated data such as patient notes. The National Institute of Health and Clinical Excellence (NICE) is a leader in analysing big data in relation to novel therapies and drugs. Although it is exciting to see this being implemented, it is associated with its own challenges such as privacy, security, information governance and continually developing technologies to standardise and streamline data.

Standardisation in the NHS, in my view, will be one of the greatest challenges as the current incorporation of various systems make this an exceptional feat. McKinsey regards big data as a tool to improve efficiency and cut down on waste by focusing on three areas; clinical operations – cost-effective ways of diagnosis and management; research and development – predictive modelling and public health – analysing disease patterns[xvi] In the US, for example, McKinsey estimates it can help save more than $300 billion per year.

Artificial Intelligence

Following on from big data, the natural transition is to focus on artificial intelligence (AI) which aims to mimic human cognitive functions[xvii] Discussions have been fuelled by the prospect of replacing human

doctors with AI doctors but it can be confidently presented that this is not going to happen in the near future. However, AI can assist in providing better clinical decisions in radiology, oncology and cardiology as examples. Somashekhar et al demonstrated that the IBM Watson for oncology would be a reliable AI system for assisting the diagnosis of cancer through a double-blinded validation study[xviii]

There are three main categories found to be useful in healthcare: classical machine learning techniques[xix]; deep learning techniques and natural language processing (NLP) methods. The algorithms and methodology are beyond the scope of this essay. Interestingly, NLP target useful information from narrative texts such as patient notes or discharge summaries to assist clinical decision making.

In respect to specific technologies, IBM Watson system is a world leader. The system incorporates all methods of artificial intelligence, specifically machine learning and NLP. It has made great strides in oncology such as 99% of the treatment recommendations from Watson are concomitant with those of doctors. Recently, the FDA-approved Arterys, a deep learning clinical platform to facilitate cardiologists to diagnose pathologies.[xx]

There are limitations to artificial intelligence in terms of regulation and data exchange. There are issues surrounding the designing of clinical trials and lack of standards governing safety and success . Secondly, there needs to be a continuous supply of data in order for AI systems to work effectively and this data sharing capability is not conducive in the current healthcare environment.

In summary, current challenges include reducing mortality and morbidity in an ageing and increasing population with scarcity of resources. The technologies discussed in this essay can only facilitate addressing resource gaps by cost savings and encouraging a new breed of healthcare professionals to take advantage of cutting-edge technologies with a view to having hospitals and care without borders. The current healthcare system requires government and health leaders to invest in and to pontificate about the benefits of developing these technologies. The recent launch of the NHS Digital Academy is promising in developing Chief Information Officers (CIO) and Chief Clinical Information Officers (CCIO) in light of Professor Robert Watcher's review of IT in hospitals[xxi]. It has been described by Dr Harpreet Sood as 'an informatics leadership course for NHS digital leaders by digital leaders.[xxii]'

Humanity, kindness and caring are epithets which have taken doctors many years to develop. It is encouraging to witness technologies developing at such a rapid pace but ultimately populations, large or small, are made up of individuals who need to be treated with humanity and dignity.

Word count: 1497

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