The future of healthcare

The cost of healthcare is growing exponentially (Figure 1). Very little of this growth can be ascribed to population, which only grew by about 10% over the same interval (Figure 1). The trend seems clear, regardless of the exact definition of what is included under "healthcare" (according to the ONS, it includes spending by the Department of Health, the armed forces, charities and households) and fluctuations in the value of the currency unit. This trend, which is found in most developing countries, give rise to alarm among treasury ministers; in the UK, it is the second largest item of government expenditure, amounting to almost 20% (exceeded slightly by pensions). According to the Office fédéral de la statistique (OFS) in Neuchâtel, 10–12% (also a growing percentage) of the population spend time in hospital in any one year, another measure of the significance of healthcare.

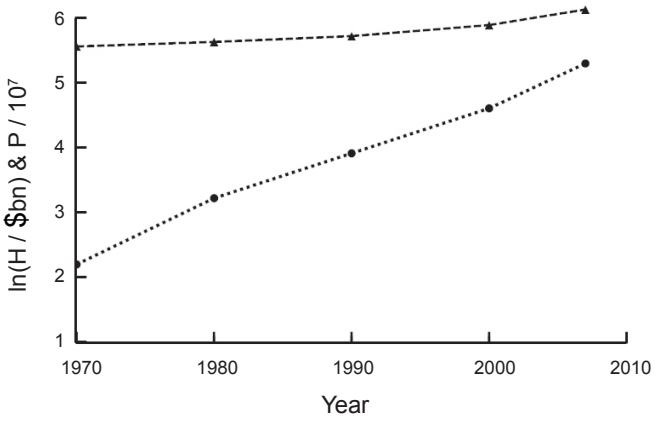

Figure 1. The cost of healthcare in the UK, in (US) billions of (US) dollars, plotted (circles) as its (natural) logarithm from 1970 to 2007 (regression gives the growth rate as $\$9 \times 10^7$ year^{-1}), and (triangles) are the UK population for the same interval in tens of millions. Source: (UK) Office for National Statistics (ONS).

The reasons for this increase are not clear. One would have thought that with ever improving education and nutrition (the latter also, presumably, a result of improving education) the health of the general population would, actually, improve with time; the main architect of the UK's National Health Service (NHS), Nye (Aneurin) Bevan, is indeed often quoted as saying that in time the service would "wither away".[1] Here it should be pointed out that prior to the NHS healthcare was rather patchy; the objectives of the 1946 NHS Act were to promote "the establishment of a *comprehensive* health service designed to secure *improvement* in the *physical and mental health* of the people of England and Wales and the prevention, diagnosis and treatment of illness, and for that purpose to provide or secure the effective provision of services" (emphases added). As measured by life expectancy, health certainly has been improving, but was doing so anyway during most of the 20th century; in fact the rate of improvement markedly slowed down around the time the NHS was founded. This should at least suggest the need for deeper enquiry into the factors underlying the general state of health of the people of a nation.

These factors are of course seemingly numerous. Genetics and environment are very likely to play a rôle, the former, however, likely to compensate for deficiencies in the latter. For example, the further north one lives, the weaker the sunlight to which one is naturally exposed, and which is an important source of vitamin D; this could be compensated by more copies of the relevant enzymes or by a (possibly cultural) predilection for vitamin D-rich foods. Then, medical knowledge has greatly advanced, which should result in more (cost-) effective treatment for disease and the results of accidents. Nevertheless, through a complex process,[2] this knowledge has also resulted in nosocomial ill-health, especially hospital-acquired infections (HAI) [4]. Antimicrobial resistance to antibiotics has become such a problem that the entire Volume 2 of the 2011 Annual Report of the Chief Medical Officer for England was devoted to "Infections and the rise of antimicrobial resistance". As a result of this resistance, new antibiotics have to be developed, which are generally more expensive than the old ones; HAI also imply longer (and hence more costly) hospital stays. And then, as Ivan Illich has pointed out, "Le système médical ... crée sans cesse de nouveaux besoins de soins. Mais plus grande est l'offre se santé, plus les gens répondent qu'ils ont des problèmes, des besoins, des maladies" [5]. Health and medicine occupy a special place in human activities, but Illich's point may reflect of a more general

[1] Sometimes this remark is quoted in the context of private medicine (that is, when the costs of medical care are paid by the patient), which was the main way in which healthcare was provided in the UK prior to 1948, the year in which the NHS was founded, the meaning being that state medicine would become the exclusive way providing healthcare to the entire population. On the other hand the services actually provided by the NHS after its inception focused on relief of sickness, rather than preventive medicine; the latter, surely inevitably increasing with increasing knowledge (e.g., of the toxicity of chemicals to which workers might be occupationally exposed [1]), would itself have been expected to eliminate much sickness.

[2] The results of which were not really predictable (cf. [2]). Well acquainted as we are now with the tenets of natural selection, it would indeed seem obvious that the use of antibiotics would lead to antimicrobial resistance. But this is easy enough to say with hindsight; in reality the matter is really more complex (cf. [3]). The Chief Medical Officer for England, in Volume 2 of her 2011 Annual Report, writes of the "*paradoxical* emergence of new infectious disease threats" (emphasis added) even though this emergence can be well understood within the general framework adumbrated by, e.g., [2].

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phenomenon common to any kind of insurance (which is what, in effect, the NHS provides), what economists call "moral hazard",[3] and which is succinctly expressed as the old maxim "The way to be safe, is never to be secure".[4] Then there is the fact that the ever increasing use of technology, which inevitably distances man from nature more and more, engenders what Boyden has called "phylogenetic maladjustment" [7]: if the conditions of life of an individual deviate from those which prevailed in the environment in which the species evolved, it is likely that the individual will be less well suited to the actual conditions than to those to which it had become genetically adapted through natural selection. Examples of environmental conditions that might provoke phylogenetic maladjustment include the widespread use of motor vehicles, discouraging exercise; pesticides, traces of which may remain in comestible food; and genetically modified (using modern, molecular biological, genetic engineering techniques) comestible plants. Finally there is the fact that populations, especially in developed countries, are ageing (as shown by the increase of life expectancy already mentioned); although this improvement may be at least partly due to advances in medicine, in general elderly people are more frail and more likely to require medical intervention (e.g., hospitalization to replace broken bones).

The response of those responsible for healthcare systems has not, in general, been to look at fundamental (underlying) possible causes, such as those mentioned in the preceding paragraph, but to seek "fixes" on a higher level.[5] Two such fixes currently appear to be in favour, centralization (concentration) and telemedicine. The argument for the former is that modern, advanced and highly effective equipment and services are intrinsically expensive (the capital cost of the equipment, and sometimes running costs as well) and, furthermore, require *teams* of highly trained specialists to properly use them. It is not, therefore, feasible to widely disperse such equipment and the associated teams among small district general hospitals, a corollary of which is that they become unviable. At first sight this seems like a fairly unexceptionable, if not obvious conclusion but it does bear further scrutiny. One point to make is that "viability" is usually demonstrated by a particular accounting framework, the choice of which is, essentially, arbitrary and usually politically motivated. A good example is the rather specious accounting framework that was used to demonstrate the "unviability" of rural branch lines, when there was underlying political pressure, actually rooted in venality, in the Marples era at the UK Ministry of Transport to run down the railway system and replace it by motorways. The closure of these lines was vehemently opposed by their users, as are proposed closures of small district general hospitals. There is clearly a need for a more objective and overarching method for assessing viability, and this is now available in the form of the J-value [8, 9], alas invented too late to save many branch lines. Regarding the expense of advanced medical technology, too few options appear to have been considered. In 2009 the Royal Academy of Engineering launched an initiative to develop *open source* hardware for medical devices, inspired by the long established and highly effective tradition of open source software, with the aim of designing a medical scanner for primary care procurable at a cost of £1000. Daniel Steenstra was appointed Visiting Professor at Cranfield University to work on the initiative, but apparently it has not as yet resulted in any concrete design. Were such scanners to become available they would, presumably, be very widely disseminated and there would need to be a corresponding increase in the numbers of specialists able to understand and use such devices—a matter of education.

An important point in favour of concentration is that skill in diagnosis and treatment depends heavily on experience. A consultant (the senior rank in the medical profession, achieved after at least 8 or 9 years of training) at a busy specialist hospital in a large metropolis may (in contrast to his or her colleague at a small rural unit) see hundreds of patients suffering from similar ailments each year. The value of the accumulated experience is immense, and often likely to outweigh the advantage of the almost inevitably superior anamnesis available to the person who treats himself, with the assistance of knowledge recorded in books and journal articles or gleaned from the world wide web.

[3] Formally defined as the inducement for one party to undertake a high-risk act with the knowledge that it is protected against the risk and that any cost of protection is borne by another party.

[4] Quoted in [6].

[5] A possible exception is provided by the remark "In short, there are fewer economic incentives to produce new antimicrobial agents then there are other classes of drug—*a market failure*" (emphasis added) in Volume 2 of the 2011 Annual Report of the Chief Medical Officer for England. But this idea is not further developed in the remainder of the report. A thorough analysis of the notion—if it has any meaning—would presumably require the contributions of economists. Nevertheless, the author (the Chief Medical Officer for England) does stress "the *overarching* challenges that we face" (emphasis added) and that the report is aimed at, *inter alia*, politicians, so why not include economists among the contributing experts and, dare one say it, complexity scientists and systems engineers? The authors and editors seem to have been exclusively medical scientists, practitioners and administrators.

Regarding telemedicine, the medical director for NHS England, Sir Bruce Keogh, in a BBC radio broadcast on 11 July 2014 advocated the use of mobile telephones for patient monitoring, and this was echoed even more recently by the chief executive of the same organization, Simon Stevens, in a broadcast on 16 September 2014. On the one hand this implies great centralization—one centre would, presumably, suffice for the entire country, but on the other hand it also implies dispersion, "getting expertise to the person rather than the other way round". Acute care, such as that requiring surgical intervention, would be provided in large regional centres, and other types of care could be remotely provided in the home. This would probably need to be augmented by the availability of personal chemical sensors capable of analysing breath and biofluids—the cellphone has been proposed as a platform, given its ubiquity and considerable computing power. The scientific literature certainly evinces great research activity in the field of such sensors, although the practicability of the proposed devices needs more critical scrutiny.

Within the European Union (EU) as a whole, official thinking appears to have a low regard for the ability of members of the public to look after themselves, despite the principle of subsidiarity being enshrined within the Treaty on European Union,[6] and this strongly retards the development of individual responsibility for healthcare, which is surely the only way to make it sustainable.[7] Yoshida Kenko, a scholar who lived 1283–1350, wrote that "A knowledge of Letters, Arms and Medicine cannot in truth be done without; and a man who will learn these cannot be said to be an idle person" and "Without medicine, a man cannot care for his own body, nor help others, nor perform his duties to parents and his lord" [11]. Yet there has been no shortage of expenditure on education in recent years; since 1970 expenditure on education has grown exponentially with a rate of $\$7.5 \times 10^7$ year^{-1} (UK). Paradoxically, this does not appear to have led to any economies in healthcare, as shown by Figure 2, although caring for oneself is surely cheaper than requiring professional attention. It could be, of course, that this increasing (expenditure on) education leads to more highly qualified engineers developing ever more advanced (and expensive) medical devices. At any rate, the precise proportionality between expenditure on health and on education deserves further attention, along with consideration of what level of health is actually achievable.

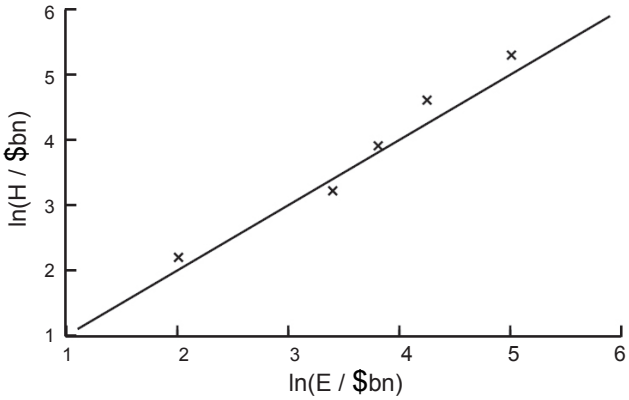

Figure 2. The cost of healthcare in the UK, in (US) billions of (US) dollars from 1970 to 2007, plotted against expenditure on education. Source: (UK) Office for National Statistics (ONS). The straight line has a slope of unity.

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References

1. Teleky, L. Pflanzenschutzmittel und Arbeitsschutz. *Arch. Gewerbepath. Gewerbehyg.* **13** (1954) 313–341.
2. Allen, P.M. and Strathern, M. Complexity, stability and crises. In: *Complexity and Security* (eds J.J. Ramsden & P.J. Kervalishvili), pp. 71–92. Amsterdam: IOS Press (2008).
3. Kepler, T.B. and Perelson, A.S. Drug concentration heterogeneity facilitates the evolution of drug resistance. *Proc. Natl. Acad. Sci. USA* **95** (1998) 11514–11519.
4. Plowman, R. et al. The rate and cost of hospital-acquired infections occurring in patients admitted to selected specialities of a district general hospital in England and the national burden imposed. *J. Hospital Infection* **47** (2001) 198–209.
5. Illich, I. L'obsession de la santé parfaite. *Le Monde diplomatique* (March 1999) p. 280.
6. Ramsden, J.J. Defining security. In: *Complexity and Security* (eds J.J. Ramsden & P.J. Kervalishvili), pp. 9–11. Amsterdam: IOS Press (2008).
7. Boyden, S. Evolution and health. *The Ecologist* **3** (1973) 304–309.
8. Thomas, P.J., Stupples, D.W. and Alghaffar, M.A. The extent of regulatory consensus on health and safety expenditure. Part 1: Development of the J-value technique and evaluation of regulators' recommendations. *Trans. IChemE B* **84** (2006) 329–336.
9. Thomas, P.J., Stupples, D.W. and Alghaffar, M.A. The extent of regulatory consensus on health and safety expenditure. Part 2: Applying the J-value technique to case studies across industries. *Trans. IChemE B* **84** (2006) 337–343.
10. Murray, A. The principle of subsidiarity and the church. *Australasian Catholic Record* **72** (1995) 163–172.
11. Singer, K. *The Life of Ancient Japan*, p. 175. Richmond: Japan Library (2002).

[6] Article 5. Subsidiarity is considered to be fundamental to the functioning of the EU. Actually the idea appears to have been already enunciated by Pope Pius XI in 1931 in his *Quadragesimo Anno* [10].

[7] It is worth noting that this simple and basic principle does not appear to be part of the thinking of the various groups now in existence to address problems in healthcare, such as the European Health Futures Forum (EHFF), the European Connected Health Alliance and the European Society for Quality in Health Care (ESQH).