An E-Health Model: A Technical and Economic Perspective

Hassan Makhmali, , Simeon Yates, Babak Akhgar , Naser Aniba, Mazen Qeitishat, and Richard Wilson
C3RI, Sheffield Hallam University, Sheffield, United Kingdom

Abstract - E-health in the developed countries has increased significantly in recent years, and yet these healthcare services are rapidly reaching a point of inflection. The rise in health expenditure, the burden of the ageing population, and the growing expectations of citizens are all contributing towards large-scale restructuring in the 'way' that healthcare is provided and supported via use of ICT. Our proposed conceptual economic e-health model focuses not only in technical but also economic areas. Furthermore, we have attempted to show some economic perspectives of e-health, in particular, related to alternative markets. Competition in an ideal and is engaged with many non-markets problems, however, quasi competition market is more efficient than monopolist governments and therefore we think that the main responsibility of government is planning and controlling continuously not engaging directly with e-health deployment scenarios.

Keywords: E-health, Market, Monopolies, Models

1 Introduction

E-health is an extremely broad topic, encompassing the many different domains of information and communication 'technologies' (ICT) responsible for supporting many aspects of healthcare provision. Adoption of such technologies, in the developed countries, has increased significantly in recent years, and yet these healthcare services are rapidly reaching a point of inflection. The rise in health expenditure, the burden of the ageing population, and the growing expectations of citizens are all contributing towards large-scale restructuring in the 'way' that healthcare is provided and supported via use of ICT [1]. Whilst previous adoption of ICT in healthcare has been largely in the implementation of distributed systems, it is now apparent that a more holistic approach to 'e-health strategies' is required (both locally and on national levels) in order to move toward a new successful model of healthcare [2]. Moreover, governments and healthcare providers around the world are considering patient satisfaction and healthcare costs. Arguably, economics within micro and macro environment are controversial in proving or disproving the mechanism to maximising, minimising and optimising healthcare services.

2 Global perspective of e-health

According to the World Health Organisation (WHO), e-health relates to three important functionalities in supporting three main areas of healthcare services. These are digital data transmission, data storage and data retrieval, to support clinical, educational, and administrative purposes [3].

In order to explore the area of e-health fully and to determine how these 'strategies' can be developed, it is essential to understand what exactly e-health is? Why do we need e-health? and what do we hope to achieve by implementing it? In a focused review in 2001, Gunther Eysenbach described the 10 e's of e-Health, which are aimed at providing some resolution to the question 'why do we need e-Health?' In a more focused review, Gunther Eysenbach in 2001 has noted ten of the most important advantages of e's in e-Health in response to the question 'why eHealth?' these are:

1. 'Efficiency';
2. Enhancing quality of care;
3. Evidence based;
4. Empowerment of consumers and patients;
5. Encouragement of a new relationship between the patient and health professional (Information Society);
6. E-Learning;
7. Enabling information exchange and communication in a standardized way between health care establishments;
8. Extending the scope of health care beyond;
9. Ethics; and
10. Equity. [4]

In 2005, the European Commission described e-health as "the use of modern ICT to meet the needs of citizens, patients, healthcare professionals, healthcare providers, as well as policy makers" [5]. At the same time, Bruno Salgues published a paper describing e-health as an umbrella term that encompasses all of the ICT domains, commonly associated with health informatics, and extends these by incorporating modern tele-services, medical virtual learning, and medical science applications [6].

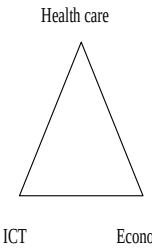

Figure 1- triangle figure as a basic efficient model.

In the context of the multidimensional of e-health, as shown figure 1, it is noted that, that there are three main components. In the proceeding sections, we will explore healthcare services in the context of ICT and economy.

3 ICT Infrastructure related to e-health

Over the past couple of decades using ICT has increased dramatically. Currently, rapid development in several ICT sectors is becoming very notable [7]. Telecommunications,

mobile and wireless service, internet technologies and software developments become more attractive to many governments, investors and customers in developing countries. Therefore, many governments especially in developed countries have used ICT applications to enhance efficiency, decrease cost, prevent time wasting and decentralisation [7]. One of the most important sub-domains of e-government is e-health [8]. Indeed, ICT in this context is divided in to two sectors, hardware and software. Hardware is needed for the development of the infrastructure, initially for connectivity, for remote areas. For example, landline, mobile, computer, installing antenna or satellite and developing communication cable or light fibre to achieve wideband and high speed in the Internet connection. Moreover, in the software sector this could be addressed by using portals and websites. Portals are the main sectors of 'e-paths' or 'Networks' in order to provide services such e-health services in healthcare system. They can enable each user to access initial health information. In addition, websites like portals could be addressed with some services to support patients within internet engine research. Portals and websites can store and share a wide range of information services, through access of health information based on WHO's definition [3]. In addition, some portal's advantages could be offered within research and e-learning facilities, Information society utilities, accessing business offerings and the other individual productivity applications [9].

At a glance, the e-health domain covers a wide range of applications. For example, some applications include deploying Management Information Systems (MIS) in clinics or hospitals, a national health monitoring system, computerisation by the evidence-based of primary care services. Further application include, the linking of ministry of health and healthcare insurance schemes, issuing smart cards for patients, making electronic appointments and health records, standardisation of health terminology, categorising and codify of diagnoses and accessing mortality databases to determine a cause of death and medical production are considered [10]. Furthermore, some technical facilities are based on remote access such as telemedicine, internet and robotics [11].

In addition to this, developed countries such as North America and Europe are also beginning to develop health information platforms and infrastructures as part of their national strategies (e.g. UK NHS ICT Platforms). Today, their ideas are emerging as a unique approach toward building more efficient and effective healthcare services based on the Internet. Also electronic health records are playing an important role in improving clinical practice, hospitals, research, and policy and service management [12].

One of the most important premises of e-health is forming an information society. Information society could be formed through combination of professional human resources based on ICT infrastructures as technical parts.

4 Economic perspective of e-health

According to Samuelson, economics is "*the study of how individuals and societies choose to employ scarce resources that could have alternative uses in order to produce various commodities and to distribute them for consumption, now or in the future, among various persons and groups in society*"[13]. Briefly, this definition notes that economics is a scientific way of optimising the use of scarce resources..Decreasing the costs in health services, for healthcare providers, and increasing the demand for patients will be considered as an essential value. Indeed, governments should investment in some e-health projects which will have economical evaluation components such as opportunity cost, marginal analysis, time preference and economic efficiency. E-health economic evaluation means the methodical way to assess resources and whether they are used or allocated efficiently within an explicit criterion. At a glance, microeconomic covers firm or organisation's situation and markets, which they involve to give e-health services in order to describe minimising cost or maximising benefits based on market's type. Furthermore, macroeconomics are about government policies with regards to how the government obtains tax and how it will be distributed. This could be distributed as an investment, expenditure or subsidies to increase welfare or reduce poverty [14]. There are two important factors in the e-health economic context these can affect many economic variables such as government and market. Additionally, they have two crucial and famous mechanisms in order to action in the real world such as cost and price factors [15].

In addition, to Williamson (1981), one of the most basic approaches in all organisations is transaction cost. He has noted economising is compatible by allocating transactions to government structures within an internal organisational environment. Moreover, it has needed to divide some application details and recognising government structure. Williamson believes that this approach can determine domains of efficiency from organisation to market and it could be applicable for inside transaction in order to plan employment details [16].Moreover, Mahoney has noted about behavioural approach and he believes "resource learning" theory. In addition, resources are categorised within financial, human, physical, technical and organisational capabilities as a capital [17]. As it can be seen in e-health definitions, it can cover these elements as a multidimensional

5 Theoretical analysis of market mechanism

Modern technology such ICT beside health care services can shift demand and supply's curves upwards because of it can increases efficiency. For the reason, costs of providing e-health services are decreased significantly. It means that customers and suppliers can consume and produce more goods and services in the same price and cost [18]. This figure shows the shifting demand and supply curves of e-health services because of increasing technology as below.

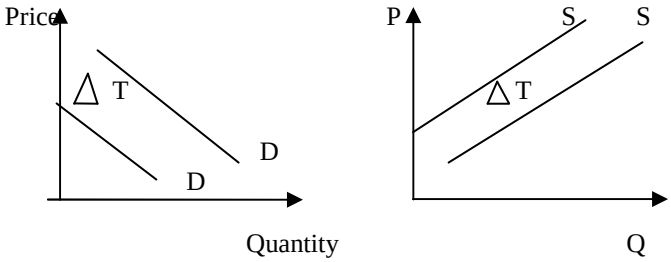

Figure 2 - Increasing Technology and shifting Demand and Supply Curves

However, many governments make huge investments in order to facilitate the move from traditional to modern healthcare (e-health) in non-profit organisations. Nevertheless, this situation looks like a governmental monopoly, and a monopoly in goods and services is not efficient [16]. Since, governments are not efficient in allocating goods and services to people such inefficiencies are the main factors in reducing welfare and satisfying of consumers [19]. Thus, they have to release there duties to private sector within price and market mechanism, although some goods and services are necessary and urgently needed by many people such as food and healthcare services.

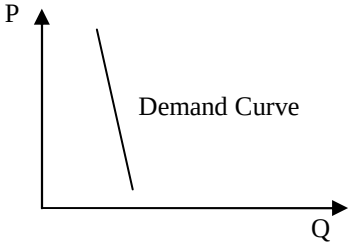

Figure 3 - inelastic demand for necessity goods and services

The figure above shows, that in the context of health services, increasing the demand for a health service adds to the price of that healthcare service. Adam Smith believes an "Invisible Hand" is in the market in order to equal demand and supply automatically [20]. Moreover, it seems that this amazing hand should be in ideal market within an automatic mechanism is well suited in perfect competition market. According to economics theory, a perfect competition market has some classic assumptions that can be efficient in minimising price for consumers. These assumptions are; "the agents have no market power, they are price takers, competition market will drive the market price down to the competitive level (equal to the marginal costs) and consumer's welfare.

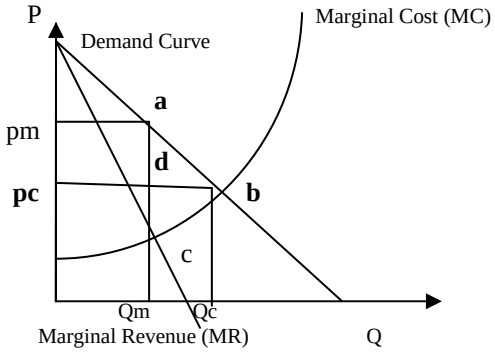

Figure 4 - presenting extreme price in perfect competition and perfect monopoly market

The figure above shows, perfect competition price is taken from cross marginal cost and demand curve and it is lower than a perfect monopoly. Meanwhile, monopolist determine price from cross marginal revenue and marginal cost. Therefore, high pricing in a monopoly market is decreased social welfare exponentially. The determine area under the demand curve in figure 4, above (A,B,C,D), states the deadweight, social gain and proves inefficiency in a perfect monopoly market [21][22].

6 Conceptual designing for private e-health model

According to the three sides of the triangle literature review, as introduced above, it is understood that e-health services could be given on the internet. Moreover, modern facility such as ICT is well-suited platform to support e-health advantages within strategic planning. In addition, economic knowledge was addressed new technology and price mechanism through competition market could be provided more satisfying for consumers or patients. Healthcare and medication are essential for patients and they do not have any considerable substitute goods and services. Therefore, we providing the following comments to design an e-health private model:

- Advantages of e-health in private section within competition market
  - High market efficiency to decrease price and cost.
  - Lower price than monopoly as it is mentioned in figure 4.
  - Queue less and saving time because patient satisfaction will be increased.
  - More social benefit than social cost due to the reductions in price for patients.
  - Increased patient satisfaction brought about by low prices and improvement in services.
  - High Quality because of changing technology and the re-distribution of e-health.
- Disadvantages of privatise e-health within ICT companies

- Concerns for the security of patients records
- Centralised companies and inequity. Many people do not have computer and internet and they are unable to gain access to computers.
- Office corruptions, which is conterevertial between public and private sections.
- Weakness in government control as they remain responsible for them.
- Creating trust

➢ Clearing some contexts for e-health services based on ICT Companies

- Making e-health consulting centres, some places that professionals can give consulting to patients.
- Building e-health database centres these could store health information in order to share and retrieve between stakeholders.
- E-learning centres regarding e-health, virtual centres can improve health based knowledge repositories.
- E-doctor centres, health services within intelligence algorithm.
- Invites to SMEs (Small and Medium Enterprise) to carryout e-health projects
- Encouraging Public Private Partnership as successful way to accept heavy government responsibilities.
- Supporting co-operative company as a kind of private organisation to do some of the activities.
- Supporting NGOs (Non Government Organisation), as a charity, in providing e-health services.

➢ Offering some solutions for promoting ICT companies by government

- Tax exemption, which is an economic policy to support e-health providers.
- Buying guaranteed services which promote a way to create a secure path by predicting techniques.
- Anti-Trust law against monopoly events as a non-market.
- Inviting from NGOs to control failing market and support some disabled people.
- Changing culture by advertising, as an effective tool to state new technology and a way to deal with e-health services.
- Giving speed memory by ministry of ICT as a platform to improve e-health companies.
- *Supporting by free domain, it could be helpful beside speed memory.*
- *Training human resources, which is first player in this case.*
- *Giving speed process by multi-computers for assessing some projects which is needed for processing.*

7 Conclusion

This paper stated there are other important factors to performance e-health planning that governments should be considering seriously. It means that e-health is not only a fixed and linear model but also has a complex various and multidimensional based on real world. This conceptual economic e-health model is focused on two important efficiencies in technical and economic areas. Furthermore, we have attempted to show some economic perspectives of e-health, in particular, related to alternative markets. Because the competition market is an Ideal market and is engaged with many non-markets problems. Although, quasi competition market is more efficient than monopolist governments but the main responsibility of government is planning and controlling continuously not engaging directly with e-health deployment scenarios.

8 References

[1] *Car, J., Black, A., Anandan,C., Cresswell, K. (2008),The Impact of eHealth on the Quality &Safety of Healthcare, A Systematic Overview & Synthesis of the Literature, Report for the NHS Connecting for Health Evaluation Programme, Imperial College London, p.9-10*

[2] Pagliari, C., Sloan,D., Gregor, P., Sullivan, F., Detmer, D., Kahan, J.P., Oortwijn, W. and MacGillivray, S. *(2005), What Is eHealth (*4):A Scoping Exercise to Map The Field, Journal Medical Internet Research, 7(1):e9

[3] WHO Regional Office for the Eastern Mediterranean, authors (2005) E-Health in the Eastern Mediterranean. Eysenbach, G. (2001), What is eHealth? Med Internet Res, 3(2):e20

[4] Eysenbach, G. (2001), What is eHealth? Med Internet Res, 3(2):e20 Available at: http://ec.europa.eu/information_society/activities/health/whatis_ehealth/index_en.htm Last accessed [15th April 2010]

[5] Salgues, B., (2005) E-health, Integrated systems versus incompatible data stock, Proceedings of the 9th Congresso Mudial de Informacao em Saude e Bibliotecas, Salvador – Bahia, Brazil.

[6] Nazi, K.M. (2002), "The journey to e-health: VA healthcare network upstateNew York", Journal of Medical Systems, Vol. 27 No.1, pp.35-45.
[7] eGovernment and eHealth in Cyprus, (2009)
[8] Ridley, G. and Young, J. (2006), Towards Evaluating Health Information Portals: A Tasmania E-health Case Study . University of Tasmania
[9] Kokkinaki, Angelika I., Socrates Mylonas, Stalo Mina, (2005), E-GOVERNMENT INITIATIVES IN CYPRUS, *e*Government Workshop '05 (*e*GOV05), September 13 2005
[10] CHRISTODOULOU, E. (2008), The Development of eServices in an Enlarged EU
[11] Pagliari, C., et al (2005), Risk A. *What is e-health? Email sent to the SIM mailing list.* 2001. [2004 Jul 13]
[12] MACHLUP, Fritz (1964). Professor samuelson on theory and realism. *American economic review*, 54 (5), 733.
[13] KALTER, Robert J. and STEVENS, Thomas H. (1971). Resource investments, impact distribution, and evaluation concepts. *American journal of agricultural economics*, **53** (2), 206.
[14] ROBINS, James A. (1992). Organizational considerations in the evaluation of capital assets: Toward a resource-based view of strategic investment by firms. *Organization science*, **3** (4), 522-536.
[15] Williamson, O.E., (1981), The Economics of Organization: The Transaction Cost Approach, The American Journal of Sociology, Vol.87, No. 3, P. 548, 577
[16] MAHONEY, Joseph T. (1995). The management of resources and the resource of management. *Journal of business research*, **33** (2), 91-101.
[17] Bolton, D. J. (1937), M.Sc, Member. ELECTRICITY DEMAND AND PRICE
[18] Hunt,S.D. and Morgan, R.M., (1995), Resource-Advantage Theory, Jornal of Marketing, Vol. 61, P.77
[19] Mankiw, N.G., (2003), Principles of Economics. Mechanical Industry Press, 2003.8:172
[20] Gottinger H. W. (2003), Economise of Network Industries Network economics, Democracy and Efficiency in the Economic Enterprise, P. (1)
[21] Walker, M. (2000),Competition Law, Anti-Competitive Behaviour, and Merger Analysis: Economic Foundations