IMPLEMENTING EHEALTH THROUGH NETWORKING: THERE IS MORE OF 'E' IN EHEALTH BEYOND NETWORK IMPLEMENTATION

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ABSTRACT

The growth of Information and Communications Technology has brought a significant change in the means and mechanisms of handling issues and challenges of health services. The injection of Information and Communications Technology has changed the concept of health and associated services sector by coining a new term eHealth. eHealth deals with the process of providing best class services to various nodes in the health care environment. This is possible due to linkages and inter-connectivity of various siloed works which ensure that patient, as well as stakeholders, are able to access the best class service. However, implementing eHealth through networking is challenging as there is more of 'e' in eHealth than is anticipated. This paper takes into consideration the 'e' parameters of eHealth which need to be taken into account while designing and implementing eHealth network. The paper discusses the practical implementation of several components of 'e'. The future scope results in the inclusion of more and more of eHealth network components and accordingly draft out those 'e'components which are applicable in the practical scenario for a well-developed eHealth network system.

KEYWORDS: *'e', eHealth, Node*

INTRODUCTION

The word *eHealth* is ubiquitous and is closely associated with the field of Information and communications technology (ICT). According to [1], "*eHealth*" is a generic term which is broad and is construed to mean the usage of information and communications technologies in healthcare services. However, researchers differ on the nature, scope and the dimensional components of eHealth. World health organization (WHO) contends that eHealth refers to the process of cost-effective and secure usage of information and communication technologies to support various applications of health care services and its associated components such as health surveillance and education, research and generation of new avenues for improvising health services [2] While the European Commission advocates eHealth as the usage of modern information and communication technologies and thus meet the needs and requirements of various strata of the society such as senior citizens, patients, and research organizations and the like [1]. On the other hand, [4] looks at eHealth as an emerging field comprising of medical informatics, public health and business-related processes wherein health services and information pertaining to healthcare services are delivered or enhanced by means of internet and other related technologies. In the same context [4] corroborates that eHealth is characterized technical development as well as the depiction of mindset which is targeted to improve the healthcare and its associated services by the application and usage of information and communication technology.

Digital health is closely related to eHealth [5][3]. Digital health takes into consideration the various tools and services of information and communication technologies which are aimed towards prevention, diagnosis, treatment and the overall focus to improve the efficiency of health sector **Figure 1**. According to [5] eHealth takes into consideration the issues which deals on the supply side, quality related aspects of health program and the overall application of information and communications technologies to improve the efficiency and efficacy of the health initiatives. In other words, eHealth systems utilize their time by juggling through limited resources around competing priorities. Digital health, [5] on the other hand, makes use of ICT to gather a large amount of data which can be real time and which can be subjected to various functions such as data analytics so as to enable healthcare practitioners to arrive at the decisions based on facts. This interdependency between eHealth and Digital health necessitates the need to rethinking on the implementation side of eHealth through networking. In other words, there is more of 'e' in eHealth when an implementation is the focus.

Figure 1

Source: https://innovatemedtec.com/digital-health
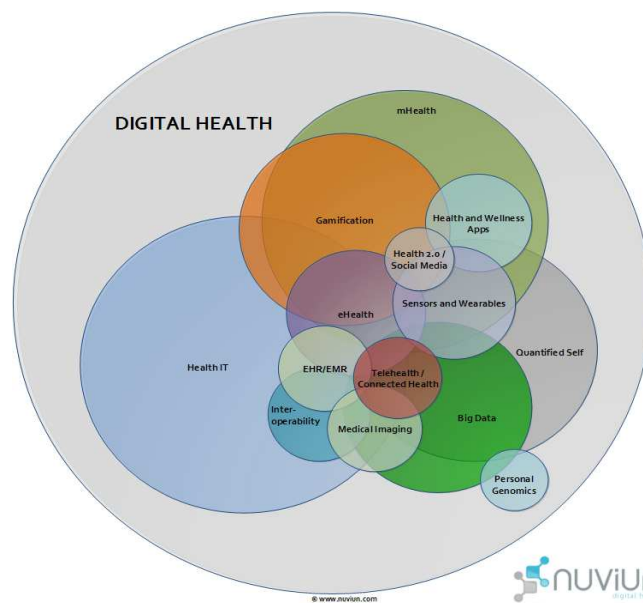
Related Work and the Emergence of 'E' and Beyond Network Implementation

Implementing an eHealth network brings in several issues and challenges. Some of these issues and challenges include the complexity of large demographic customer data set, fragmented and distributed cultural issues and above all the customer's unwillingness to accept and embrace the benefits of the eHealth program. On the other hand, an insufficient number of primary healthcare professionals, especially in rural India, live in a utopia like the situation in the belief that they are not required to update the medical knowledge which they are practicing among the rural folks[6] [7]. On the other hand, medical health care practitioners in urban areas have their own set of issues and challenges. For example, non-standardization of medical records, doubting the integrity of the treatment being imparted to the patients by other network components such as private hospitals versus government hospitals and the like. Things are bound to change as the government is ardently pushing Digital India at the national level for example, the eHealth India portal.

Digital technologies have the advantage of providing access to vital knowledge, data and information which is readily available in a transparent manner and at the same time, simplification of complex problems through networking

becomes the norm [8]. In the same context [9] states that rural India has the greatest potential of eHealth network implementation program. For example, in rural dispensary, a nurse conducts a physical examination and consults the doctor using video or audio feed thus seeks the opinion from others in case more information is required. The greatest challenge [9] remains in the form of changing the behavior of the patient to embrace the institutional eHealth care program instead of going to village quacks.

However, the implementation of the eHealth program will fail to provide the sustainability to the initiative. An extant review of the related work has generated the following concept of 'e' beyond the eHealth network implementation program

[10]. They are

- **E**fficiency – This is the component of the eHealth network implementation program wherein the focus is on decreasing the cost of operations. This is achieved by developing a network system of various components which will utilize improved and enhanced communication technologies and thereby establishes close linkages between the health care nodesand patient-centric nodes in a network

- **E**nhancing quality – This is the component which takes into consideration the quality related issues of eHealth network. For example, the implementation of this will enable the customers to compare and contrast the various health-related services required during the process of treatment and then to prompt action.

- **E**vidence -based – This is another component of the eHealth network implementation program where the data speaks for itself.

- **E**mpowerment – This is the component of the eHealth network implementation program wherein the customers and patients are empowered to make their own decisions through an informed decision-making process.

- **E**ncouragement – This component ensures that eHealth must be encouraged at various levels so that the patients, as well as customers, are able to understand the resultant benefits and thus embrace the eHealth program.

- **E**ducation- This component deals with the issues pertaining to the education of the patients as well as the customers about the various issues and challenges and other things which are to be kept in mind while availing the service of eHealth network

- **E**nabling- This component provides the exchange of information in a standardized manner between several components of the eHealth care verticals

- **E**xtending – This component deals with the issues of extending the domain of eHealth beyond the physical and geographical boundaries of the eHealth network program.

- **E**thics – This component of e-health deals with the ethical issues, professional conducts and other core parameters between health care professionals, patients, and customers.

- **E**quity – This is the component of eHealth which is responsible for bringing eHealth to every stratum of the society.

The E health Network Design and Implementation Process: A Practical Approach.

Based on the industry experience of the author, the approach adopted for design and implementing the eHealth network implementation process follows a two-layered approach

- Strategic and functional requirements wherein 'e' is the target

- Technical Requirements which are too covered under the targeted 'e'

Strategic Functional Requirements

The strategic functional requirements take into consideration the issues pertaining to

- Defining the scope of the eHealth network implementation program. The scope in the context of eHealth network includes aspects such as what is to be included in the network and what is required to be excluded from the network-based on the dynamics. For example, should teleconference with the expert clinicians be included from the rural sector or be confined to urban areas due to connectivity issues it the rural locations. Other aspects to be considered include should medical stores be covered by the network? Should private doctors, private nursing homes be covered in the network and the other aspects and the like. This is the essential and the most important aspect of eHealth implementation program. Unless and until the inclusion and exclusion of the network components are identified and frozen the implementation is bound to fail.

- Upon the decision of inclusion and exclusion of network components, the next step is deciding on the issue of what component of 'e' is to be included or excluded for each of the identified network components. Since some of the 'e's may not be applicable to identified and included components of the network. For example, the 'e' component pertaining to Enhancing quality may not be applicable to areas where there are connectivity issues due to geographic locations or otherwise.

- Upon the identification of applicable 'e' components the next task to identify the measurable parameters which must be developed so as to manage the component of 'e'. All these inputs form the design and development phase of the eHealth network implementation program. For example, the measurable parameters for pathological labs may be defined in terms of SLA's for the simple blood test report to be uploaded in the software.

- Other strategic aspects of the network implementation program cover the issues such as the inclusion of new network nodes which operate in a dynamic environment. For example, wearable devices such as Fitbit, connectivity of smartphones with the eHealth network and other advancements in the medical, information and communications technology.

- The functional requirements for the eHealth network implementation program seek to provide the answer to the question as to whether the particular node is executing its intended function that is performing the task for which he is included as a network component. For example, the lab report generated has included the findings prescribed by the doctor or it has generated only partial findings or incomplete findings. Alternatively, the medicines stores are delivering the medicines of the same brand or company, as prescribed, or is resorting to pushing the medicines of other company.

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TECHNICAL REQUIREMENTS

Once the strategic and functional requirements of 'e' are accounted for the technical requirements come into the picture. It is through these technical requirements that the 'e's identified during the strategic and functional phase, as above, are actually implemented and *validated*. However, in order to implement the technical requirements, consideration is made to the following

- The design of the network

- The integration of the network components

The Design of the Network

The design of the network is the crucial aspect as any improper design or the failure to overlook and important aspect of the design process directly impacts the 'e'. For, not accounting for memory considerations of the core table will reduce the efficiency when the eHealth network goes into production or not taking into consideration the fast and slow bandwidth issues will impact the 'enhancing quality' component of 'e'.

The following points of consideration take care of 'e' issues.

- The issue pertaining to security. This is the most important technical issue which directly impacts the ethical component of 'e'. Any aspect of security being overlooked or is not properly verified and validated will enable the users to resort to unethical practices. For example, providing access to the network node to a user without verification may prompt the user to see the health records of the patients.

- The issue pertaining to the education of eHealth technical practitioner. This is another important issue which needs to be taken care of during the design and implementation of the eHealth network system. Failure to address this most important and crucial aspect will prove to be disastrous for many of the 'e's. for example, not documenting the design or the changes in the network components or documenting the configuration of network nodes is a definite step towards failure. Also, every technical eHealth professional must be educated about this network configuration, network design and the like so that during the crisis he is in a position to refer to these structures and perform the required task In a similar manner, other issues pertaining to the implementation of 'e' components are taken care off.

The Integration of the Network Components

Once the above-identified issues are taken care off, the next step is the deals with the integration of the eHealth network components. The integration generates its own set of problems and issues and thereby directly or indirectly impacts the 'e'

- The migration of electronic data from one network to another network. This is a crucial step and needs to be accounted for during the design, development, implementation and testing phase. Any neglect at this stage will lead to disaster. For example, migration or uploading of patient data such as X-Ray from a remote node (i.e. remote place) to a private doctor in an urban city will be a failure if eHealth system fails to address the 'e' component of quality, ethics, education, and others. The patient's X-ray lands to an unintended doctor or wrong X-Ray is passed

to the intended doctor or the quality of X-ray picture is very low and nothing can be made out of it. All these incidents are related to 'e' components of education, ethics, quality and the like

- The problem of standardization of the data. This is another important aspect of 'e'. The data which moves around the network must be standardized. Hence, while designing the system, standardization of data must be taken care off. For example, one set of doctors in a hospital take the reading of BP as 80/120 as normal while the other takes the normal parameters of BP as 90/130. This induces ambiguity and impacts the 'e'components.

A presentation of eHealth implementation

Table 1 below depicts the practical implementation of 'e' in the eHealth network. For the purpose of the paper, the author has covered only 4 'e's of the eHealth network nodes. In a similar manner, others can be developed.

Table 1: Target 'e': Parameters

Originator Network Node	Impacted Network Nodes	Output Generated /Delivered/ Information Sought	'e' Parameter Targeted	Measureable Parameter
Doctor	Patient	Electronic Health Record	Efficiency Education	Number of patients consulted per day; educated patients on new medications; new research findings; change in lifestyle
Doctor	Research Organization	Symptoms uploaded for more information	Education Encouragement Enhancing quality Empowerment	Increase in knowledge; quality of treatment provided to patients; Education new interns about findings and symptoms in patients
Dietician	Patient; student; housewife; Working executives and others; Research organization	Electronic prescription	Education; Ethics Empowerment Evidence-based Encouragement	Individual applies the knowledge imparted by the counselor with demonstrable improvements such as weight reduction;
Medical equipment supplier	Hospital; nursing homes; clinics	Electronic record for the supply of medical equipment's	Education; Ethics Evidence based Encouragement	Equipment's supplied as per specifications; no compromise on quality and cost
Medical Store	Doctor; Research Organization; patients; Dieticians; and many others	Side effect if any of new medicine; precautions for taking new medicine; response of new medicine floated in the market after research; medicines short of supply; companies manufacturing particular medicines	Education; ethics; empowerment; evidence based; encouragement; equity; enabling	Market trend so new research medicines; number of customers buying new medicines; market potential;

Table 1 provides the implementation of targeted 'e' parameters by taking into account the originating node, the impacting node that is the node which is directly or indirectly interacts with the originating node. For example, the node doctor interacts directly with the patient. On examination and interaction with the patient, the doctor generates an electronic health record. This electronic health record is available to the other nodes in the eHealth network such as medical stores, research organizations, dieticians and the like. However, these nodes will be able to view the records only when the relevant access rights are granted to them. For example, in the eHealth records, only when the doctor indicates that the services of the dietician are warranted then and only then the eHealth record is displayed to the dietician. In case, this is not so than the 'e' component of ethics is compromised which must be taken care off during technical designing aspects of eHealth system implementation. The last column of the table deals with the measurable parameters. This is the crucial aspect as this helps the executive management in improving the eHealth network system.

In a similar manner, other network components such as data analysts, research organization, medical educational institutions, specific research centers such as cancer institutes and de-addiction camps can be brought under the ambit of eHealth network.

Future Scope and Limitations.

eHealth is a dynamic and ever-evolving field. Due to frequent changes, the identified 'e' to is required to be tuned so to as to accommodate the new changes in the eHealth network. Further, these new parameters need to be evaluated in a holistic manner and the impact it will have other nodes of the eHealth network. This is the future scope which can be taken care off.

The limitation that is observed during the development of the paper is the fact that enhanced and new 'e' could have been incorporated in the paper but the constraints on the limit and the page size prevented the author from including more of the parameters of 'e'.

CONCLUSIONS

The research paper has provided a practical approach to the process of incorporating 'e' in the development of eHealth network. These 'e' are vital components without which the eHealth network loses its value. This paper is able to fill in the need in a detailed manner by linking he theoretical perspectives of 'e' in eHealth with the practical aspect of implementation by incorporating the mathematical equations, identified nodes, and other aspects into a well-developed eHealth network system.

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