Perspectives of Future Healthcare IT

KUZUNO Hiroshi, KANAZAWA Masaki, IINO Akemi, ANDOH Masataka, TOKUSHIMA Daisuke

Abstract

In Japan, the increase in the rate of ageing in the population has made the optimization of medical expenditure more necessary than ever. In this situation, NEC has attempted to develop a vision of a society that achieves optimum use of healthcare services. These will include health promotion, disease prevention and medical intervention and life support services. We have also studied healthcare IT solutions that will support this policy. Healthcare IT consists of an information system for providing advanced services that has evolved from the collection, accumulation and utilization of lifelong healthcare information of individuals and from utilizing this information to support scientifically well-founded treatments and prevention methods. This paper introduces the above themes together and discusses issues for their realization.

1. Introduction

In Japan, the increase in the rate of ageing of the population has been continuously increasing the amount of expenditure on medical care. On the other hand, as the decrease in the working population is expected to result in slower economic growth, there is the risk that society may no longer be able to support the increase in state medical expenditure.

It is therefore indicated that optimization of medical expenses will be a critical issue for the future. NEC projects a vision of a desirable society for 2025 based on an assessment of the healthcare services required for medical expenditure optimization. These will include health promotion, disease prevention, medical intervention and life support services. NEC also proposes healthcare IT solutions to support such a vision. Our reason for setting the long-term target for 2025 is because we estimate that a very long period will be required for the evolution of suitable healthcare IT solutions. These will include reparation of the legal system as well as computerization and standardization of the conventional medical information systems.

2. Desirable Vision of Society in the Field of Healthcare in 2025

2.1 Basic Concept

Only half a century ago the major causes of death among Japanese people were infectious diseases that affected the entire population but today more than 60% of deaths are caused by three adult diseases. This trend is similar to that found in other countries. Therefore, in order to prevent medical expenditure from increasing even further, it is important to prevent chronic diseases or, in other words, to extend a healthy lifespan by changing the behavior patterns of individuals.

From the viewpoint of improvements to the quality of life it is also necessary to apply medical intervention that is optimized in consideration of individual differences and which matches the needs of individual patients. This strategy is aimed at reducing the amount of medical intervention that is expected to be ineffective as well lowering the discomfort of patients and the amount of labor employed in caring for them.

To make the above possible, we believe it necessary to prepare the foundations for recording the lifetime healthcare information of each individual (PHR: Personal Health Record for individuals, EHR: Electronic Health Record for medical institutions), the foundations for utilizing information in the scien-

tifically-founded treatment methods (EBM = Evidence Based Medicine) and prevention method (EBH: Evidence Based Healthcare), and suitable environments including advanced medical technologies and medical insurance systems to promote their use. Subsequently, we will be able to build a society that is capable of achieving the following objectives, in accordance with the health condition of each individual (see **Fig. 1**).

　1) In a healthy condition: A society in which every member can stay healthy without suffering disease or injury.
　2) In a diseased or injured condition: A society in which one can receive optimum treatment and rehabilitation anytime and anywhere, and can be speedily returned to a healthy condition.
　3) In a condition needing life support: A society in which one can receive optimum support to enable participation in society and to lead a creative daily life.

The specific description of the social vision in section 2.2 and after presupposes that the following technological issues are solved by 2025.

● Vital sensors with high performance, compact size, non-invasiveness and network connection capability (Blood sugar meter, etc.)
● Elucidation of the relationship between genetic information and disease/drug response
● Enhancement of EBM/EBH
● Electronic archiving of medical intervention information (Dissemination of electronic medical charts)
● Standardization of medical treatment information and intervention techniques
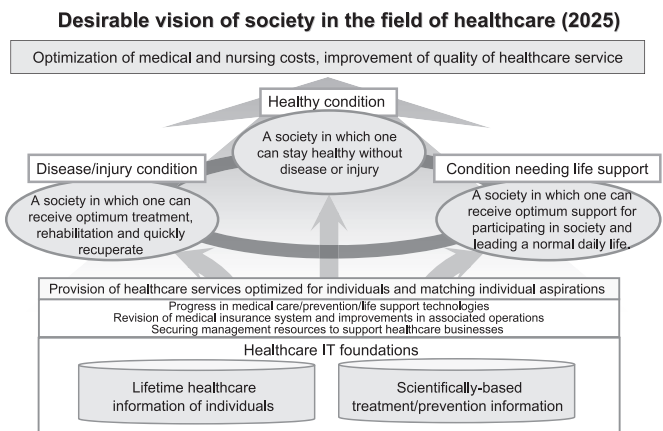● Practical implementation of regenerative medicine, a

power assisting suit, etc.

2.2 Vision for People in a Healthy Condition (2025)

We believe that measures in the following four areas are required in support of healthy individuals (see **Fig. 2**).

(1) Prevention According to Individual Disease Affinity
The first step consists of measures to deal with inherited genetic risks. In this step, gene diagnosis is performed according to a request from an individual or his/her family and appropriate lifestyle guidance is given based on the EBM/EBH information.

(2) Health Promotion and Prevention According to Individual Condition and Lifestyle
The second step consists of measures with respect to the health condition varying on a daily basis and to the treatments that are specific to individuals. In this step, vital data is identified in real time and the information on the PHR and EBM/EBH as well as an action schedule is utilized to prevent emergencies and injuries, for example, by providing advice on the degree of exertion for each kind of exercise etc. Also, evidence-based advice is provided with regard to various aspects of life, such as driving a vehicle and in support of leading a comfortable daily life.

(3) Appropriate Prevention Based on Early Detection of Symptoms
The third step consists of measures to be taken when an individual begins to deviate from a normal condition, although not yet in the disease condition. In this step, the health condition and the PHR and EBM/EBH information are utilized in the same way as in step (2) in order to prevent disease

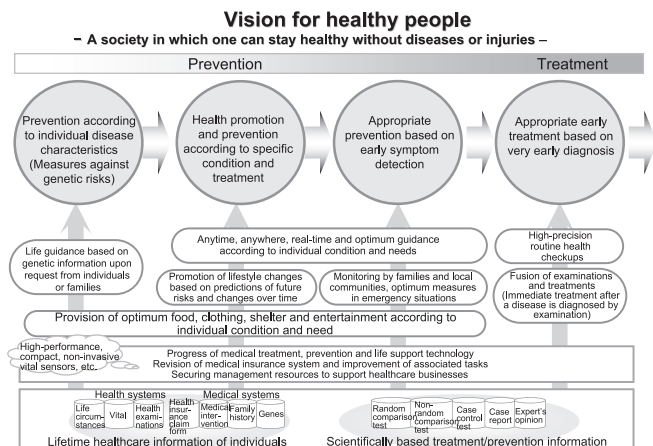Fig. 1   Desirable vision of society in the field of healthcare.

Fig. 2   Vision for healthy people (2025).

by giving advice on the disease risks expected from condition changes and on the countermeasures to be adopted.

(4) Appropriate Early Treatment Based on Very Early Diagnoses

The fourth step consists of measures at the very early stage of the onset of the disease. In this step, highly accurate physical checkups are performed in order to discover very early symptoms. Appropriate early treatment (treatment at the same time as examination, etc.) is then prescribed to promote an early cure and prevention of aggravation.

2.3 Vision for People in Disease/Injury Condition (2025)

When an individual succumbs to the disease or injury condition, measures will be required in the following four steps (see **Fig. 3**).

(1) Prompt Application of Treatment That Is Optimum for the Individual and That can Persuade the Patient after Onset

The first step consists of countermeasures to be applied at the onset of the disease. In this step, the family doctor collaborates with the specialist as necessary in order to apply appropriate initial treatment in consideration of the specific condition in order to enable an early cure and to prevent aggravation. In all of the steps, treatment should be given that is acceptable to the patients (and their families) by giving them an easy-to-understand account of the course of treatment and its scientific basis.

(2) Smooth Transfer to a Specialized Treatment Institution, Quick Start of Treatment
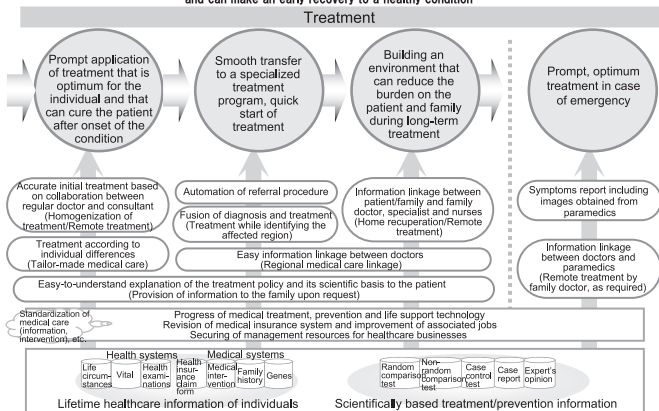
The second step consists of the measures to be taken when treatment in a specialized medical institution is required in order to obtain the use of advanced medical devices, etc. In this step, the referral procedure is automated and the required information is transmitted between doctors by means of EHR so that treatment at the transfer destination can be started quickly.

(3) Building an Environment That can Reduce the Burden on the Patient and Family During a Long-Term Program of Treatment

The third step consists of measures adopted if long-term treatment is required. The basis of treatment in this step is recuperation at home. The condition of a patient at home (images, vital data, etc.), the operational status of medical devices and the records of treatments by the consultant and family doctor are stored in PHR (EHR). The information of parties concerned are linked closely in order to reduce the burden on the patient and family by the need to visit hospitals, as well as by the insecurity related to measures in case of emergency.

(4) Prompt, Optimum Treatment in Case of Emergency

The fourth step is not the continuation of the third step but consists of countermeasures taken in cases of sudden onsets or accidents in any scene of life. In this step, the personal ID information of the patient is checked, the doctor at the patient transport destination and the paramedics collaborate based on the PHR and the paramedic's symptom report including images in order to apply accurate first-aid and intervention to promote an early cure or aggravation prevention. If the patient has a special condition or there is another special cause such as a rare disease, the family doctor will also collaborate in the treatment and perform remote treatment as required.

2.4 Vision for People in Need of Life Support (2025)

When an individual is in a condition with a need of constant life support, measures will be required in the following four steps (see **Fig. 4**).

(1) Accurate Judgment of Persons in Need of Support for the Smooth Support Services

The first step consists of the measures to be adopted in case constant support becomes necessary. In this step, the businesses concerned (medical care, support service and qualification approval institutions, etc.) link information efficiently using PHR (EHR) before the start of service so that judgment regarding the need for support and the various

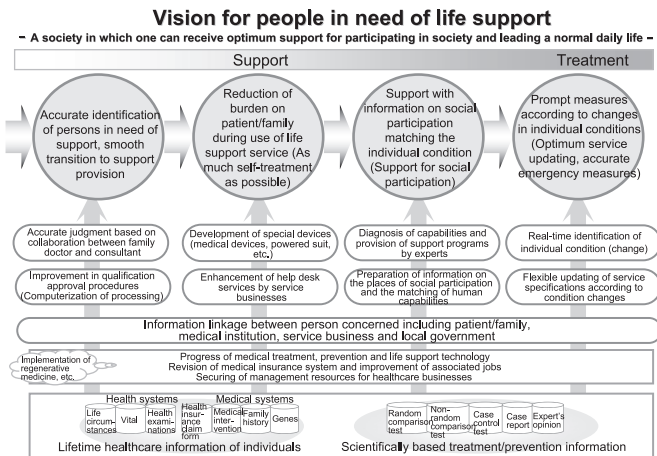Fig. 3   Vision for people in disease/injury condition (2025).

Fig. 4   Vision for people in need of life support (2025).

procedures and preparation of support services may be performed more quickly.

(2) Reduction of the Burden on Patient/Family During Use of Life Support Services

The second step consists of the measures to be taken after the start of constant life support services. In this step, the devices are advanced, the help desk is enhanced and the legal system is prepared so that the service can be used unaided by the patient alone and the burden on the patient/family relationship can be eased.

(3) Support with Information on Social Participation Matching the Individual Condition

The third step consists of the measures for assisting individuals receiving life support services to regain normal social participation. In this step, information regarding individually developed activities according to life support conditions and consultation and advice are given to support participation, even after an individual has regained participation in society.

(4) Prompt Measures According to Changes in Individual Conditions

The fourth step consists of measures taken when the condition of an individual changes gradually. In this step, the condition is monitored continuously to promptly identify changes and the specifications of services are updated flexibly according to the changes in order to maintain the level of comfort achieved by the services used.

3. Healthcare IT Supporting the Desirable Vision of Society (2025)

The healthcare IT supports the desirable vision of society in the field of healthcare in 2025, and is roughly composed of the following five functions (see **Fig. 5**).

(1) Mechanism of Compilation, Collection and Storage of PHR Information

PHR is classified into the health system (life data on exercise and foods, vital data) and the medical system (medical records, etc.).

The health system requires terminals with which individuals can easily compile information and send it to the PHR. Next, the medical system requires the function allowing the medical institution to compile information on an individual and send it to the PHR upon his or her consent. In addition, it is also required to prepare a function that allows the related information to be stored throughout the life of an individual, an alias to be used when the information is referenced, the information disclosure destination (family, doctor, etc.) to be set freely and the individual to verify the access history.

(2) Mechanism for the Compilation, Development and Storage of Regionally Collaborated EHR Information

The EHR requires a function that stores information on an individual compiled by multiple businesses including medical and welfare organizations, such as records of treatments etc. Authenticity should be secured by allowing only those persons specifically obtaining the consent of the
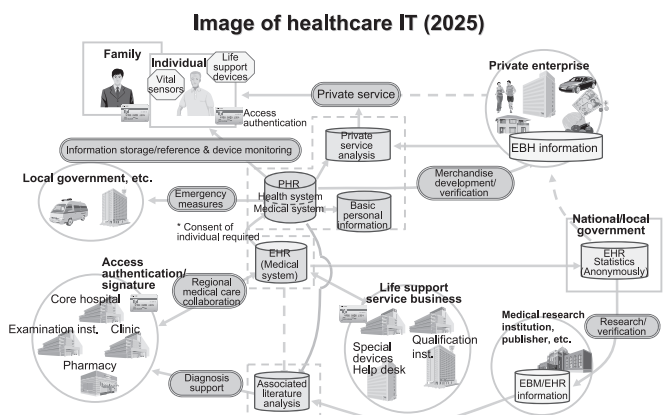

Fig. 5   Image of healthcare IT (2025).

patient to reference such information. It is also required that the EHR is capable of sending information to the PHR upon consent of the individual himself or herself.

(3) Mechanism for the Development and Verification of Evidence of the EBM/EBH

In order to set a hypothesis of treatment/prevention methods based on analysis of information on the progress of the health conditions and to verify such a hypothesis using test subjects, it is required to prepare a mechanism for collecting information on multiple individuals in an anonymous form from the PHR (EHR) upon consent of the individuals. In addition, it is also required to identify the information on the same individual from anonymous information that is continually generated from a variety of institutions and to delete such information regarding an individual if this person withdraws consent after the information is collected.

(4) Mechanism of Utilization of EBM/EBH Information

Services utilizing the EBM/EBH information can be classified into those for individuals and those for businesses.

With regard to the services for individuals, it is required to prepare a mechanism with which the PHR business can analyze the PHR information and the EBH information possessed by various other businesses upon consent of the individual, select the services and information suitable for the individual and give guidance on it.

With the services for businesses, it is required to prepare a mechanism for analyzing the PHR information and the EBM/EBH information possessed by public institutions, etc., and to provide the doctors and health consulting business promptly with the information on the latest treatment applicable to the symptoms of an individual, on the side-effects of drugs and on currently prevalent diseases.

(5) Mechanisms for Security Required for Distribution and Access of Information

It is required to prepare the network/information access management (authentication, history management, etc.), encryption, electronic signature and operation monitoring systems that will not hinder the convenience and efficiency of individuals and medical staff while preventing illegal use or destruction of the PHR/EHR information without the consent of the individual in question.

4. Process of Implementation of Healthcare IT, Essential Issues

Considering the circumstances of computerization of the in-

formation, we believe that the course of preparation of healthcare IT will generally take the following order.

1) Network and security mechanisms required in the following phases.
2) Health PHR
3) Regional collaboration EHR
4) Medical PHR
5) Mechanism for development and verification of the EBM/EBH evidence
6) Mechanism for active utilization of the EBM/EBH information.

There are a large number of issues that are required to be resolved before implementation, including the preparation of laws, standardization, arrangement of organizations carrying PHR, etc. (national government, local government or private businesses, etc.). In the following, we will consider implementation from the viewpoint of user merits.

Healthcare IT can offer high added value via useful services utilizing the PHR and EBM/EBH information. However, development of EBM/EBH necessitates collection and storage of PHR (EHR) information on many people, framing a hypothesis on EBM/EBH and verifying it over a long period of time. In other words, collection and storage of PHR (EHR) are required in the stage prior to provision of useful services based on utilization of the EBM/EBH information.

It is therefore necessary to allow the users including individuals and doctors to compile and register information positively and to provide them with attractive applications for which they would not mind paying the costs. We believe that these are the essential issues for enabling implementation of healthcare IT.

5. Conclusion

In this paper, we introduce a desirable vision for society in the field of healthcare in 2025, the healthcare IT for its support and the essential issues regarding its implementation. In the future, we will verify the appropriateness of the content of the present paper; develop measures for resolving the related issues and endeavor to achieve its practical implementation. In this context we will consider national policy trends; specifically, health examination/healthcare guidelines, dealing with online requests, electronic PO boxes and social security card systems, etc., as well as assessing the implications of actual field conditions.

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Authors' Profiles

KUZUNO Hiroshi
Senior Manager,
New National IT Strategy Business Promotion Division,
Government and Public Solutions Operations Unit,
NEC Corporation

KANAZAWA Masaki
Manager,
New National IT Strategy Business Promotion Division,
Government and Public Solutions Operations Unit,
NEC Corporation

IINO Akemi
Manager,
New National IT Strategy Business Promotion Division,
Government and Public Solutions Operations Unit,
NEC Corporation

ANDOH Masataka
Assistant Manager,
New National IT Strategy Business Promotion Division,
Government and Public Solutions Operations Unit,
NEC Corporation

TOKUSHIMA Daisuke
Assistant Manager,
New National IT Strategy Business Promotion Division,
Government and Public Solutions Operations Unit,
NEC Corporation