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Research Article

Strategy to Develop Knowledge-based Second Opinion Health System

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Abstract: Healthcare expenditures rise day by day. There is a clear disparity among nations to provide global healthcare and equal health facilities among different countries. This research aims to develop a knowledge-based online second opinion health care management system and develop a methodology to receive quality health care advice without traveling abroad. By using a knowledge-based expert opinion system, a subscriber or patient can easily get a second opinion and evaluate a first consultation or opinion provided by the current doctor to any doctor practicing in any distant location and review complete case information. Knowledge-based healthcare system specifically focuses on an online portal designed to provide connectivity between patients and healthcare specialists, clinics, or hospitals. There is an objective of provisioning of expert medical second opinion for patients from registered care consultant or care facility. Patient has the liberty to select one or more than one appropriate consultant(s) on the basis of their profile, ranking, and reviews. Defined set of cost is fixed by the consultant(s) for medical consultation from specialty dashboard with the ability of communicating complete case information, along with first opinion by their primary consultant and level of urgency for getting the opinion back from care consultant.

Keywords: Knowledge base health, universal healthcare, care consultation, second opinion system

1. INTRODUCTION

Healthcare conditions of the peoples around the globe are amazingly different. One part of the world, which is technologically advanced, provides top quality care to its people [1]. On the other hand people living in poor third world countries have no access to better healthcare. They cannot even afford the cost of healthcare services in western developed countries. The cost of care is so high that it is not affordable for masses living in developing or underdeveloped countries [2]. Think tanks, government agencies, organizations, employers and insurance companies all are working on the grave issue to provide better healthcare to all human beings all over the globe to save human lives and build a better world for everyone on the planet [3]. Compared to developed countries in Europe and America, the situation in Africa and certain Asian countries is totally different, i.e., where physician to patient and hospital bed to inpatient ratio is even less than 1 per 1000 patients respectively. Healthcare, care providers and care delivery centers, all are not available to masses [4]. Governments have inadequate funds to spend on healthcare and humans are losing their lives due to unavailability of care and its centers [5].

Countries have two basic models of providing healthcare to their people, where one is private like in countries such as USA and the other is government supported where it is state-funded system and government is responsible to pay the bills, i.e., Canada, UK. Both the models have their

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own advantages and limitations [6]. Care disparity which exists between developed and developing countries has been the issue of research where collaboration of policy makers, researchers, and civil society, controlled by officials, is required with merger of political, academic, and support experience [7]. This approach is do-able but requires lots of collaboration among all players of the healthcare and bureaucratic circles which is not very simple and hence causing not to happen. The new approach is to use internet as a medium to bridge the gap between care quality and cost for developing and developed countries.

2. CARE DISPARITY

Physician services, consultations, and hospitals are the main sources of healthcare spending that rose much faster than the growth rate of medicine spending. In USA, healthcare expenditures rising faster than inflation and wages inspite of several initatives taken to control them [8].

Health care spending in USA increased to 5.3 percent in 2014 in comparison to a growth of 2.9 percent in 2013. Total spending on healthcare in 2014 reached to around $ 3.0 trillion which equals to $ 9,523 per person per year. This expenditure on healthcare contributes to 17.5 percent of GDP which is up from 17.3 percent in 2013 [9]. The same growth is expected in the US healthcare and by end of 2016, it will become almost 18% of the GDP of the country [10]. US healthcare spending when categorized by type of sponsor is mainly contributed by the following top four players where households contributed 28 percent, private business contributes 20%, federal government contributed 28% whereas local and state government fund 17 percent [11]. Experts agree that the increase in expenditure in recent years was primarily due to the Affordable Care Act under which major coverage expansions are planned and promoted, particularly for Medicaid and private health.

On the other side, 182 million population of Nigeria is at risk of Malaria. It is transmitted throughout the country. Malaria accounts for almost 60% of outpatient and 30% of hospitalizations in Nigeria. It is highest cause of mortality of children under five and contributes to about 25% of infant mortality and 11% of maternal mortality. Furthermore, 12 percent of the world's population lives in the African region and has the world lowest life expectancy rate, i.e. 58 in females and 55 in males. Africa also has the highest adult mortality rate of more than 330 per year in 1000 humans [12].

One in every 10 South Africans is HIV-positive out of a total 54.96 million population. The estimated

Fig. 1. WHO, "Core Health workforce and infrastructure (density per 10, 000 population) Health Workforce Density Report," 2015 [14].

Table 1. Physicians available per 10,000 persons and GDP spending.

Region	Physician Density Value (2007-13)	% of GDP Spending (2012)
African Region	2.7	5.6
Region of the Americas	21.5	13.6
South-East Asia Region	5.9	3.7
European Region	32.1	8.9
Eastern Mediterranean Region	12.7	4.6
Western Pacific Region	15.5	6.6

overall HIV occurrence rate is around 11.2% of the total population. In 2015, the estimated population will be 6.19 million living with HIV. Research also reveals that an estimated 16.6% of population is HIV positive among adults aged between 15 to 49 years [13]. Niger has 0.02 Physicians density per 100 population which means there will be only 2 providers/physicians for a population of 0.1 million people. In Fig. 1 the data shows physician density around the world.

In another perspective, with respect to regions, the Physician density per 10,000 humans according to WHO region as well as the percentage of GDP spending across the world is as follows:

One can conclude from the above Fig. 1 and Table 1 that there are two major problems which the world is facing at the moment to increase healthcare services for human beings on Earth and which are as follows:

1. Cost
2. Health infrastructure

a. Physicians are core component of that infrastructure

b. Inpatient facilities

c. Outpatient facilities

Researchers believe that almost 40% of patients take a second opinion after getting primary consultation from a doctor [15]. Introducing cost effective and quality healthcare, might serve the purpose, but the problem for developing countries of the world won't be solved, so that requires developing some methodology which should be able to address this challenge in a more effective and efficient way.

A new approach is proposed to address the problem by creating a unified portal where patients can register to portal free of cost for taking online care from the registered physicians/consultants. Medical professionals and consultants can only register to portal by passing the strict verification process of their diplomas, certificates and professional licenses at zero cost.

3. RESEARCH APPROACH/ METHODOLOGY

Secondary data have been being used to evaluate the potential of existing systems with respect to their functional enrichment to satisfy the user needs along with their usability from end user/patient perspective. Qualitative analysis technique is used to design a new online system to help facilitate the physicians/consultants to provide appropriate care consultation to patients from all around the world by consulting the patient medical records along with diagnostic and/or monitoring orders and extract an expert opinion which will include further treatment suggestions or substitutions and recommendations regarding future wellbeing considerations.

3.1 Review of Existing Work

Usually Specialty Consultations can be initiated by a patient or by a physician. If a patient/subscriber is demanding a healthcare consultation, the patient usually has to involve his or her local treatment provider. Once the patient and the patient's physician agree to follow the consultation route, the physician registers with the available online services. All such existing services usually accept mail history

information of the patients.

The provider, being the technical hand, then completes a patient history and attach the necessary imaging and lab results by post to the consultants address. A specialty consultant reviews the case, as described by the referring physician, within three to four business days. After the primary evaluation has been re-evaluated by the Specialist consultant, a second opinion is generated and sent back to the patient's primary physician. Patients are notified through the email for the completion of opinion process.

We take a two way approach to analyze the existing systems and their functionalities to find out the limitations in their approach relevant to second opinion healthcare service which are as follows:

1. US patents/prior acts
2. Online systems.

3.2 US Patents/Prior Acts

We have studied almost all the patents and patent applications available to date on topics relevant to second opinion healthcare consultation from the USPTO database [16]. The descriptions and details of the patents and patent applications helped us to understand the limitations in the existing approaches as shown in Table 2. Each existing system/patent/ application is evaluated on certain features which are found to be necessary for such systems.

e-Cleveland's "MyConsult" offers an online medical second opinion service that connects the patients to a consultant physician. These special expertise and services are offered to patients when they are facing a serious diagnosis at predefined/ fixed costs. An in-depth review of medical records, patient history, laboratory, and imaging results leads the Cleveland Clinic experts to render an expert second medical opinion which may include treatment choices or substitutes, as well as endorsements regarding future healing considerations [17].

Partners Online Specialty Consultations is a service for patients to get second opinion where patients and consultants, referring providers can register online to the system. It requires patients to send their pathology and radiology reports by paper submission through post [18]. A Gynecologist's Second Opinion Online is an online second opinion/consultation book which is highly focused on gynecology specialty [19]. Another study proves that patient is more satisfied once second opinion is sought with some other consultant but this study is more focused on cancer patients. Ultimate beneficiaries of the service are patients but the service and request can only be triggered by providers [20].

4 PROPOSED FRAMWORK FOR ONLINE SYSTEM

The Institute of Medicine stated "the free flow of information" and "the patient as the source of control" as key features of patient-centered care [21]. Preceding studies have stated that 90 percent of the patients would prefer to communicate via email with their treating providers or primary care physicians. 56 percent of the patients specify that it may affect their choice of treating doctor [22].

Most of the studies revealed that the availability and utilization of second opinion services are always cost effective along with a considerable clinical impact [23, 24].

A more user friendly system will be designed by keeping the focus on enhancing patient care options through enabling new ways of access between patients and healthcare providers/consultants from any part of the world. The knowledge base online second opinion medical consultation service will enable patients and its users to stay at home country and get access to the world's best specialists to provide the best skilled care assistance and advice for patient's current problem to bridge the gap of expertise needed for the delivery of top class care.

The abstract system model presented below illustrates the steps involved in the implementation of system for a more robust and user friendly system to facilitate the second opinion process. However, it should be clearly understood that the workflows discussed and designed only present the preferred embodiment of the system for the purpose of design and that the numerous modifications, enhancements can be made to them keeping the core concept intact.

The core focus of the new system should be on the following main areas to overcome the current

limitations in the available systems:

1. Usability.
2. Ease of use and user friendliness.
3. Patients should have a choice of consultants to take opinion from for their care.
4. Patients can rank a consultant's advice.
5. Patient can view the consultant's:
   a. professional background
   b. qualifications
   c. affiliations
   d. attachments
6. Patients and consultants must have an easy to use messaging system.
7. Messaging alerts generation for the interactivity among the system users should be a must.
8. Consultants must have a choice to update their cost of consultation on the basis of their ranking by the patients.
9. System should provide a universal accessibility to the users and at any time.
10. System should also provide universal subscription of patients at any time from any where.
11. System should also provide universal subscription of consultants at any time from any where.
12. Patients should be able to post their comments/ reviews on consultant's consultation/opinion.
13. System should provide a specialty dashboard to patients from where they should easily select the specialty relevant to their case.
14. Specialty dashboard should provide the lists and details of all the hospitals, clinics, consultants available/registered for that specialty so that patient can select the best for his case to have opinion from.
15. Patients should have an easy to use mechanism for the uploading of their pathology and radiological reports.
16. Patients should have an easy to use mechanism to state their stories for the consultants in their words.

Fig. 2 illustrates system workflow and details are discussed below.

Fig. 2 is an abstract system component diagram which shows interactivity at a very high level. The system is composed of 3 main access blocks, on the basis of type of member accessing the system:

a. Member-patient block;

b. Common knowledge based second opinion block; and

c. Member-Consultant block.

1.1 Member-patient block comprises of entities that will help member type patients to use the system to get the required consultation from consultants and is further subdivided into the following five modules:

1.1.1 Member-patient registration

1.1.2 Member-patient specialty dashboard

1.1.3 Member-patient case management

1.1.4 Member-patient communication

1.1.5 Member-patient reviews

1.2 Member-consultant block comprises of entities that will help member type consultants to use the system to provide their advice to patients who assigns their cases to them and is further subdivided into four basic modules.

1.2.1 Member-consultant registration

1.2.2 Member-consultant patients

1.2.2.1 Member-consultant patients provides access to patients who have assigned any cases to the logged in consultant and is subdivided into two sub modules

1.2.2.1.1 Member-consultant-patient communication module

1.2.2.1.2 Member-consultant-patient case management module

1.2.3 Member-consultant account management

1.2.4 Member-consultant reviews

1.3 Common is the common area in Fig. 2 which is the core of the whole system and provides a mechanism to consultants to provide their advice/opinion on the basis of medical

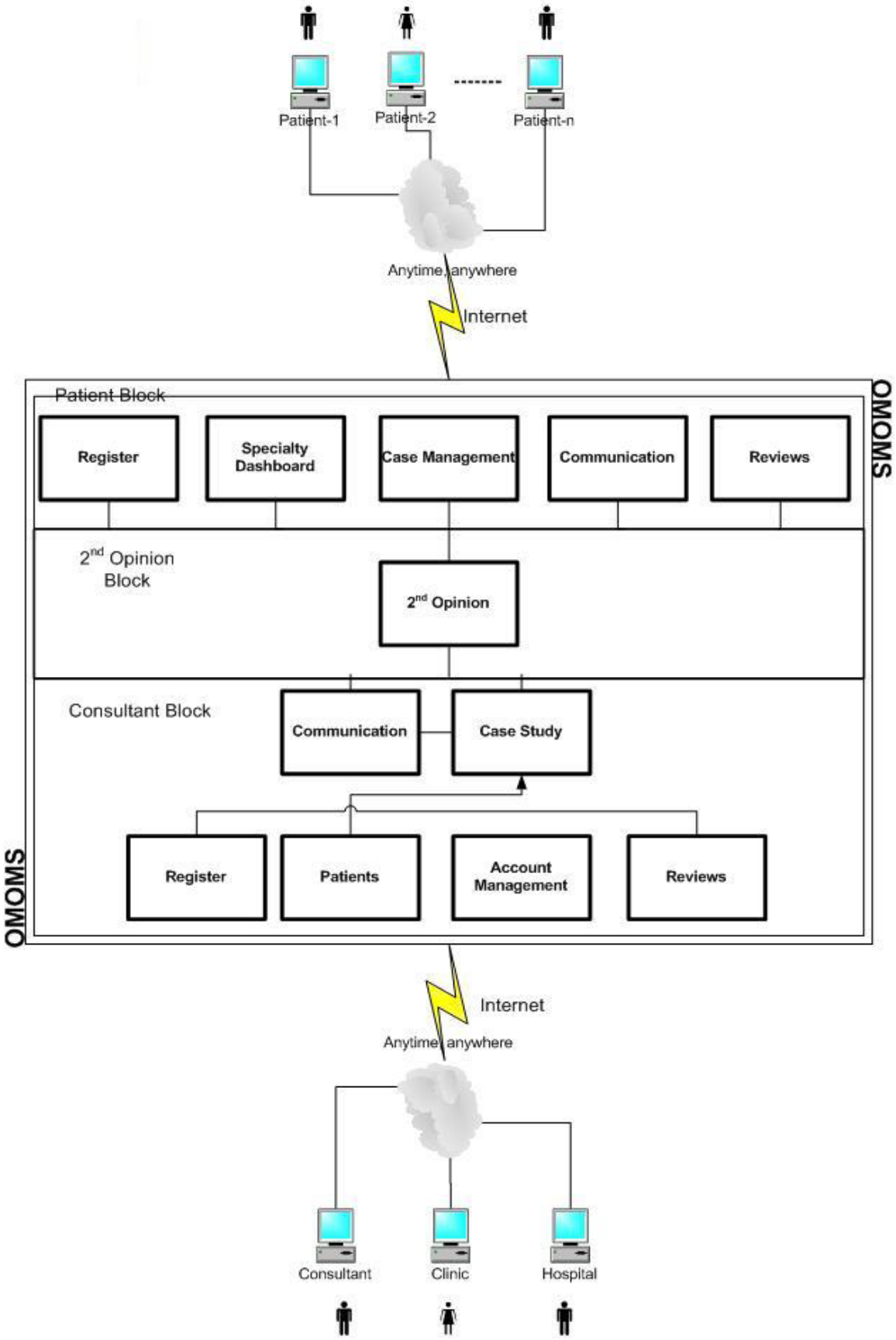

Fig. 2. Proposed mechanism for online healthcare management system.

information provided by the patients. Patients can access the respective opinion/ advice from the assignee consultant from their member functionality area after logging into the system.

1.4 Fig. 2 also provides internet as the medium to access and use the system functionality for the member types i.e. patients, consultants

1.5 Fig. 2 also provides a clue that n-patients can access the system at anytime from anywhere through the internet.

1.6 Fig. 2 also provides some clue for member-consultants as they can be the part of system as individual or be as clinic or hospital to serve the patient requirements.

1.7 Fig. 2 does not provide any details of the administrator's access mechanism and their respective functionality blocks which will be used to manage the knowledge based second opinion health management system.

The research not only took into account the modeling of the system but also considered making the system feasible for patients and physicians and its sustainability from operational perspective.

4.1 Patients Access

According to UN Broadband Commission, 57 percent of the world's population remains offline and is not able to take benefits of the huge economic and social advantages of the Internet [25]. The usual Internet adoption rate in poor countries lies below 10% in 2013, which is less than 1/4 of the espousal rate in developing countries and 1/8 of that in developed countries [26].In developing countries where the system will get implemented and facilitate the patients the access to internet is made available by internet cafes. Internet cafes are usually available to people in low income areas of the society where they can access the internet on a per hour rate. Similarly the mobile internet is also becoming very cheap now a days, so a mobile version of the application will also become helpful for the users of developing countries to cheaply access the application.

4.2 Physicians Access

Physicians as the integral component of the system will also be needed to join the portal to provide their valuable consulting services. Physicians will be able to sell their consulting services on the portal and patients will rank them by the value of their consultation. More the number of patients, more will be the physicians available to provide their service. An automatic provider evaluation system will be added in the application that will rank providers from 1-10 on the basis of their qualification, satisfied patients population and their professional associations.

4.3 System Support

The application will require lots of storage space to host the patients' health related information which will not only include their history but will also include imaging results. The system will get benefited by charging a small portion of physician fee that will not be more than 2%. System is designed with a noble cause and it will only require sustainability for its operations. Online help will be made available to patients and providers through frequently asked questions and via send an email function.

5 CONCLUSIONS

The provision of knowledge-based decisions support second opinion consultation while evaluating first consultation report along with the capability of allowing consultants direct registration and their ranking mechanism by the patients who have taken any kind of second opinion, is the need of the time.

Furthermore, the aforementioned analysis concludes that the availability of such system will help achieve cost effectiveness which results in lowering the healthcare budgets which is the biggest challenge to the growing economies of the world. We need to market the use of such system so that maximum people should make use of such systems to avoid un-necessary treatments or surgical procedures that will result from highly expert opinion.

The availability of a universal portal where patients from all over the world can register along with the registration of consultants from reputable institutes/clinic/hospitals, is the need of the time and will bring effective care to the patients residing in

such areas of the world where care expertise is not available.

In theory, a new idea has been surfaced through the current research by building a universal portal over the internet to be accessed by the patients around the world to get benefited from the expert's opinion. The current research will open a new era for researchers to think and work in a direction to improve ways of care coordination between patients and physicians. Improved, easily accessible, fast and cost effective ways of care coordination should be the next areas of research.

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