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Information Technology's Place in Medical Research

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Abstract-

Medical research will advance as a result of the modernization of our healthcare system using information technology (IT). Medical researchers will be able to assess the efficacy of a certain therapy for a specific demographic or identify the negative side effects of a medicine thanks to health informatics. Despite the fact that part of this research may take place in the private sector, governmental funding in this field will be crucial. According to this study, health in- formatics receives nearly the same share of public funding for medical research in the US and the UK. However, since it has adopted electronic health records among primary care providers far more quickly than the United States, the United Kingdom is in a unique position to gain from developments in health informatics research. A more significant strategic choice was taken by the National Health Service (NHS) to prioritise medical research as one of its primary goals. As a result, the NHS will be able to make technological advancements and policy adjustments to enhance information exchange and its information base for research as it continues to grow its IT infrastructure. The NHS is presently developing the capacity that the US lacks to convert its current or future electronic health information into a searchable database for medical research. The United States should improve the capacity to exchange medical data for permitted research in a timely and effective way if it wants to take full use of health informatics' potential.

I. INTRODUCTION

Many industrialised nations have made plans to invest in health information technology in order to improve their healthcare systems (IT). These programmes aim to employ technology to enhance the healthcare system by lowering costs, enhancing patient safety, and enhancing the standard of treatment. These nations have the same objective of improving healthcare, but the degree to which they have achieved this aim varies greatly [1].

Particularly, the adoption of health IT, such as electronic health records, has lagged behind several European nations in countries like the United States. A contemporary healthcare system must include interoperable electronic health records in order to provide patients and payers with a variety of advantages. For instance, when using a comprehensive and reliable collection of patient data, computerised decision support systems utilised in hospitals are most beneficial to patients. By ensuring that patients and physicians have access to the best available data when deciding on a course of treatment, these platforms may assist assure a return to the fundamental tenet of evidence-based medicine.

The amount of money invested in health IT research has received less attention than the extent to which countries have advanced their use of the technology. But reliable medical research is a prerequisite for evidence-based medicine. Additionally, the quantity of health data that will be made accessible to medical researchers will significantly increase as we move toward a more digital environment. Future medical researchers will have access to vast internet databases containing terabytes of data for their examination, while previous researchers had just a few restricted data points written on paper on which to base their ideas.

The advancements in medical research that will be made possible by upgrading our health care system are anticipated to be some of the biggest advantages. Rapid-learning health networks, for instance, will allow medical researchers to ascertain a treatment's efficacy for a specific demographic or identify a drug's dangerous adverse effects. Public funding in this field will be crucial, even if part of this research will take place in the private sector, for instance via commercial pharmaceutical research.

A number of current initiatives provide a taste of the potential that IT will bring to medical research in the future. But to overcome the upcoming social and technological obstacles, governments will need to exercise significant leadership and effort if they are to realise this objective.The following are a few of the questions this essay will consider: What role does health informatics play in the United States' and the United Kingdom's overall commitment to enhancing healthcare? How much money are these countries spending on the technology that will be the foundation for this study? How have national research institutions approached medical research as an international problem that requires international collaborations rather than just a home one?

This essay will examine the extent to which data-intensive, IT-based medical research is being conducted in the United States and the United Kingdom. The study will examine public initiatives and efforts made in each nation in this area. Additionally, both past and future public expenditure in these initiatives will be quantified in the study. Finally, the study will include a qualitative evaluation of how well each nation's policies and efforts have advanced this kind of research.

BACKGROUND

A. *Informatics in Health Care*

With physicians and researchers producing terabytes of medical data about individuals and their conditions, the area of health care is becoming more and more data-intensive. A medical encounter today may leave a long trail of digital data thanks to the use of high-definition medical imaging and implantable or wearable medical devices like heart monitors, whereas a patient visiting the doctor 20 years ago may have only generated a few data points—basic information such as weight, blood pressure, and symptoms. More significantly, this information is increasingly being gathered and made accessible in an electronic format as hospitals and clinicians move away from paper medical records. The use of informatics to advance medical research and health care is now feasible because to the accessibility of enormous data sets of digital medical information. Informatics, often known as "in silico" research, provides a new route for medical discovery and analysis. The emphasis of informatics is on creating new and improved methods for processing information using technology. Informatics, which has numerous specialities including bioinformatics, medical informatics, and biomedical informatics, is used now at every level of health care, from fundamental research through service delivery.

In the last ten years, the area of bioinformatics has grown rapidly in order to keep up with developments in the study of molecular biology and genomics. By, for instance, examining DNA sequences or simulating protein structures, researchers might utilise bioinformatics to better comprehend intricate biological processes. The Human Genome Project, which used informatics to accurately analyse and sequence the 3 billion chemical base pairs that make up human DNA, is the most well-known example of this [1]. Advances in information technology, such as the processing power, storage technology, and software algorithms required to acquire,

store, and evaluate the massive data sets involved in genetic research, have enabled significant advances in fundamental research.

System biology has been significantly impacted by informatics as well. Systems biology makes predictions about the behaviour of complex biological systems through computer modelling and mathematical simulations. For instance, scientists have developed models that mimic the formation of tumours. Researchers may acquire a deeper and more thorough grasp of how illnesses influence a whole biological system in addition to their effects on specific components by using computer models [2].

Clinical informatics, often known as medical informatics, is the study of using information processing to enhance the delivery of healthcare. It involves a variety of applications, such as employing information technology for patient care, scheduling patients and resources, and medical billing in a clinical context. The usage of clinical decision support systems (CDSS), which provide feedback and guidance to healthcare professionals at the point of care, is an example of medical informatics. Such a system would, for instance, alert a prescribing physician to possible medication interactions based on the patient's current medical history and known sensitivities. Health care professionals may contribute to the reduction of medical mistakes by combining patient information with clinical recommendations. According to estimates, adverse medication events alone cause 19 percent of injuries in hospitalised patients in the United States and cost hospitals more than $2 billion annually, not including costs for medical malpractice [5].

Medical research, clinical care, and informatics all intersect in the unique topic of biomedical informatics. The main goal of biomedical information science is to create new tools and technologies that will make it easier to gather, display, retrieve, and evaluate biological data. Such study may result in improved knowledge of disorders, novel therapies, diagnostic tools, and customised medicine.

B. *Benefits of Health Informatics*

It may be possible to increase the research capacity of medical professionals and scientists by combining massive data sets of medical information with technologies to analyse this information. This large repository of biological and clinical information may be used by medical researchers to find novel therapies and comprehend diseases. Pharmaceutical firms may utilise biological data to develop medications targeted at certain groups. The information may be used by healthcare professionals to diagnose and treat patients more effectively.

By using informatics in the healthcare industry, "fast learning" health applications may be made possible, assisting with biomedical research, effectiveness research, and medication safety studies [7]. For instance, with this technique, issues with recently discontinued prescription medicine Vioxx may be recognised more immediately and adverse effects from recently released pharmaceuticals can be tracked in real-time. Additionally, studies on the advantages and disadvantages of medications for certain groups might result in more efficient and secure treatment plans for patients.

Rapid learning strategies, as mentioned in Reference [7], have been shown to significantly enhance both the quality and cost of healthcare in addition to patient safety. These quick learning health networks may help clinicians practise evidence-based medicine more effectively by converting all of this raw digital data into knowledge. The adoption of medicines deemed to be the best practise for a particular population based on scientific evidence of projected benefits and dangers is known as evidence-based medicine. As health

care prices continue to climb and populations become older, cost-cutting in the health care industry is becoming a higher concern in both the United States and the United Kingdom. Given a patient's unique medical profile, healthcare professionals may use quick learning networks to determine not just the most successful therapies, but also the most affordable treatments.

C. *Building the Digital Platform for Medical Research*

This idea of a smart, interconnected infrastructure for health care research has not yet been achieved. Although a number of pilot programmes have been successful and showed the potential advantages that may result from widespread use of informatics in health research, numerous technical challenges still need to be solved. Making data available, linking already-existing data sources, and developing better tools to evaluate medical data and reach relevant conclusions are some of these challenges.There is a lack of electronic access to a lot of medical research data. For instance, the low rates of adoption of electronic health records among primary care practitioners and in hospitals provide a difficulty for the United States and the United Kingdom. Electronic health records provide a thorough description of a patient's medical history, including all of their diseases, treatments, test findings, drug histories, and known allergies. In the United States, around one-fourth of primary care clinicians utilise an EHR system; in the United Kingdom, 89 percent do. Only approximately 10% or less of hospitals in the US and UK have implemented EHR systems, which indicates that the rate of utilisation is substantially lower in hospitals [19]. A necessity for developing the underlying data sets required for biomedical informatics research is the broad use of electronic health records. Researchers will be able to use informatics to solve a variety of problems, such as clinical trial research, comparative effectiveness studies, and medication safety monitoring, with the aid of access to the electronic health data of large populations.

The initial phase is just gathering medical data in an electronic format. Biomedical research has a substantial problem in terms of interoperability. Researchers are unable to completely exploit the enormous quantity of electronic medical data since it is spread across several databases. Incompatible data formats or data interfaces may make it difficult to analyse data across numerous data sets, even when the organisations that collect and disseminate biomedical data are eager to share their data. Due to the time and money required to manage the differences between various data sets, researchers who seek to utilise numerous data sets are limited in their ability to work with the data [6].

To enhance the use of informatics in healthcare, members of the research community have long advocated for better coordination and interoperability across data repositories. They have put up a number of proposals to deal with interoperability, but none of them have, as of yet, won over everyone [6, 7]. The creation of online communities to exchange computer code to lessen the load of dealing with various data sets has been one intermediate answer. The most noteworthy is Bio*, a group of open-source initiatives in biomedical informatics that provide academics reusable code to utilise to automate routine computer operations. The project, for instance, has modular computer code that can merge data sets from various data sources or alter DNA sequences [6].

IINATIONAL PRIORITIES IN HEALTH INFORMATICS

In health informatics, both the United States and the United Kingdom have made considerable expenditures. Since many types of medical research contain an IT or informatics component, determining the degree of public expenditure in health informatics at the national

level is a difficult science. Additionally, a number of government agencies have contributed to the cost of this study. One trend, however, is evident: an increasing amount of medical research is relying on high-speed computation or mathematical modelling.

This section will list the current investments being made in research to create IT tools for medical research by the national governments of the United States and the United Kingdom. This section makes an attempt to not emphasise investments in medical research that just employs IT, but rather to concentrate on those that depend on IT as the primary technique of study, even if the distinction is not always exact..

A. *United States*

The U.S. Department of Health and Human Services has primarily provided public financing for biomedical in- formatics research in the United States (HHS). The Food and Drug Administration (FDA) as well as the Centers for Disease Control and Prevention (CDC), Agency for Health Research and Quality (AHRQ), and National Institutes of Health (NIH) all provide financing to HHS (FDA). The National Science Foundation may provide some extra funding for biomedical informatics research even if that organization's primary objective is to assist non-medical research in those fields.

Each year, the NIH spends $30.5 billion in medical research. The NIH's rising level of expenditure in grants connected to information technology is a sign of the field's expanding significance. Although not specifically financing for biomedical in- formatics, money for "Network and Information Technology R&D" has increased significantly during the previous five years. The NIH predicts funding to amount to $950 million in FY 2010 as opposed to just $509 million in FY 2005 [11]. Within the Center for Information Technology, the NIH also manages the High Performance Computing and Informatics Office. This office's goal is to provide the NIH scientific community the high performance computing tools and resources it needs to carry out its biological research. The software programmes required by researchers in bioinformatics, structural biology, and proteomics are provided by this office.

The National Center for Biotechnology Information, the National Cancer Institute Center for Bioinformatics, and the National Center for Biomedical Computing are the three main funding sources for NIH's investment in biomedical informatics research (NCBI).

For NIH, the NCBC represents a critical strategic investment. In order to "address research barriers and to improve the way biomedical research is performed by overcoming particular hurdles or filling designated knowledge gaps," the National Institutes of Health (NIH) produced the Roadmap for Medical Research in 2004 [12]. One goal of developing the Roadmap was to guarantee funding for these studies since many of them would otherwise fall beyond the purview of current NIH centres or seem too risky. The Roadmap was previously supported by a 1% contribution from each NIH institution, but since 2006, Congress has been the exclusive source of funding.

The Roadmap's three main topics all revolve on the development of new medical research tools that will help researchers better understand illnesses at the cellular level. Having a Bioinformatics and Computational Biology project that will enable researchers to exchange, analyse, integrate, and display enormous data sets is a significant endeavour in this area.

The NCBC is the main undertaking within the Bioinformatics and Computational Biology agenda. In order to establish specialist biomedical computing centres at American educational institutions, NIH established the NCBC via a two-stage financing procedure. The NCBC is

"dedicated to all aspects of biomedical computing, from fundamental computational science research to providing the tools and resources that biomedical and behavioural researchers require to accomplish their job," according to the NIH [12]. The NCBC also acts as a training ground and educational institution for more biomedical information scientists. The National Institutes of Health committed between $14 and $17 million in FY 2004 and $12 to $14 million in FY 2005 to support the NCBC. Seven awards in all have been given to various institutions [12].

NCICB is the NIH's second-largest biomedical informatics initiative. The National Cancer Institute, a department of the NIH, houses NCICB. As a pioneer in the application and advancement of bio-medical informatics infrastructure, tools, and data to enhance medical research, NCICB was founded in 2001. The Center for Biomedical Informatics and Information Technology was established in place of NCICB in 2006. (CBIIT). From $71.7 million in FY 2005 to $101.2 million in FY 2009, representing an increase of over 40% over 4 years, funding for the Center has gradually grown over time [4].

The Cancer Biomedical Informatics Grid (caBIG), an initiative aimed at using bioinformatics to promote cancer research, has received the majority of NCI's financing in this field. CaBIG is a collaborative effort involving more than 80 organisations, although being financed by the NCI. The caBIG initiative, dubbed "an Internet for cancer research," links cancer centres, cancer researchers, and clinical trial participants in order to make the large quantity of medical data created by patients open, accessible, and useable to medical researchers [2].

The caBIG program's director, Dr. Kenneth Beutow, explains the goal of the initiative in Reference [2] as follows: "Personalized medicine is all about information. However, information must be available in order to be helpful. Through interoperability, we are supporting accessibility with caBIG, basically establishing a space where information can be shared, integrated, and used. Additionally, caBIG's initiatives involve creating software tools for managing clinical trials and disseminating research data. Additionally, ca- BIG has worked to create best practises for the use of electronic health records and an uniform terminology for data transmission. The caBIG project has already produced significant results for medical research. The Biological Pathway Exchange, for instance, is a tool created by caBIG that is used to represent the signal transduction routes, or biological pathways, that are utilised for communication between and inside cells. These communication routes influence how cells behave, including whether they survive or die and if they spread to other areas of the body. Because it improves their comprehension of how proteins interact with one another, such research is particularly helpful to researchers investigating proteomics [2]. Due to the caBIG program's success, the BIG Health Consortium was created. This public-private cooperation aims to use the caBIG model to unite hitherto unrelated life sciences and healthcare sectors in order to do customised medicine research. caBIG received $20 million per year in support from NCICB (now CBIIT) between 2004 and 2006 for its pilot phase [3]. The caBIG enterprise phase's financing has expanded since the pilot phase's 2007 conclusion. Funding climbed to $45.8 million for FY 2008, and $43.1 million is anticipated for FY 2009 [4].

The National Cancer Institute's (NCI) 2010 Professional Judgment Budget Request demonstrates the significance that the National Health Institutes put on increased funding in bioinformatics. Describe "what a financial infusion may make feasible and how NCI would spend those money" [2] is the goal of the budget proposal. The NCI has requested an increase in funding of $2.1 billion for 2010, a significant increase above its 2009 budget of over $5.0 billion. A significant chunk of these additional monies, including $40 million for systems biology research, $45 million for improving biomedical computer capabilities, and $100

million for expanding caBIG and supporting the BIG Health Consortium, would be directed by NCI to bioinformatics. NCI also suggested making significant investments in other areas of high priority research that heavily use bioinformatics, such as allocating $200 million to the expansion of The Cancer Genome Atlas (TCGA). The National Human Genome Research Institute and the Cancer Genome Atlas are working together to create the technologies required to sequence and analyse DNA from tumours as well as vast data sets on the genetic makeup of different types of cancer. NCI estimates that it could record the genomes of up to six different tumour types each year with the increased funding.

The National Center for Biotechnology Information is the third important source of funding for bioinformatics at the NIH (NCBI). The National Library of Medicine (NLM), a department of the NIH, houses NCBI. With $73.5 million in the FY 2006 budget, out of a total NLM budget of $329.5 million, NCBI is a substantial programme within NLM. Additionally, NLM's extramural programmes branch promotes biomedical information technology. This section provides funding for conferences, training and education for informaticians, resources for medical libraries, and fundamental and practical research in biomedical informatics. The budget for extramural programming in FY 2006 was $69.2 million.

In order to provide a national repository for data on molecular biology, Congress founded NCBI in 1988. The abundance of genetic data and the growing dependence of medical researchers on bioinformatics have increased the significance of the NCBI mission. By creating and providing assistance for the software programmes and information systems required to store and interpret genetic and molecular biology data, NCBI furthers its objective. GenBank, an announced online database of all publicly accessible DNA sequences, is one of the hallmark initiatives of NCBI. The National Center for Biotechnology Information (NCBI) serves as a central repository for genetic sequence data, exchanging information daily with a number of international partners, gathering sequence data directly from researchers, and receiving information submitted to the U.S. Patent and Trade Office. The NCBI provides integrated search tools including BLAST, which enables researchers to compare nucleotide or protein sequences across sequence databases, and Entrez, which searches the huge collection of biological databases maintained by NCBI. These technologies assist speed up the discovery and study of genes by connecting sequencing information with relevant articles in databases like PubMed.

The American Recovery and Reinvestment Act of 2009 also provided $1.1 billion for comparative effectiveness research in addition to the funding sources previously listed. The Office of the Secretary of HHS has received $400 million of these funding. Comparative effectiveness study has great promise for informatics research and helps provide information on the advantages and disadvantages of various treatment alternatives. As a result, a significant amount of these monies will probably support research in informatics. The Federal Coordinating Council for Comparative Effective Research, which is in charge of recommending how to spend these money, has suggested that data infrastructure be the main area of investment. Data infrastructure might include collaborations with the private sector, the establishment of distributed electronic data networks and patient registries, and combining existing data sources to allow addressing CER questions, as stated in the Council's report to the President [21].

There have been significant efforts made by several other federally supported health care initiatives to collect relevant data sets and evaluate this data to enhance healthcare. To transfer clinical research data across researchers and institutions, the National Institutes of Health (NIH) developed the National Electronic Clinical Trials and Research (NECTAR) network. It will be

easier to discover and use the most efficient treatments if there is less duplication of effort across studies thanks to improved access to clinical trial data. The National Electronic Disease Surveillance System (NEDSS), a programme to monitor public health for outbreaks and trends in diseases, is managed by the CDC. Each state has its own electronic surveillance system for infectious disease surveillance, either utilising NEDSS or its own unique information system, based on public health, laboratory, and clinical data. According to a recent assessment, electronic surveillance systems are operational in 40 states [13]. The CDC also runs BioSense, a platform designed to quickly recognise and track illness and bioterrorist outbreaks. With the intention of creating a system to monitor the safety of medications and other medical items regulated by the FDA, the FDA created the Sentinel Initiative in 2008. The Sentinel Initiative, which is still in its early stages, aims to provide the FDA access to other data bases, including electronic health record systems, insurance databases, and other medical registries, so that possible dangers may be identified more quickly.

B. United Kingdom

The National Institute for Health Research (NIHR) and the Medical Research Council (MRC) have traditionally provided the majority of national funding for fundamental medical research in the United Kingdom (NIHR). The Office for Strategic Coordination of Health Research was established by the British government in 2006 in response to a study by Sir David Cooksey, which led to the decision to reevaluate expenditure on medical research (OSCHR). To increase the efficiency of medical research, optimise the therapeutic advantages for patients, and make better use of the limited resources available, OSCHR was established. The spending plans of both departments were consolidated into a single research fund as a result of the 2007 Comprehensive Spending Review. When Scotland and Wales each made the decision to completely contribute their own financial resources to the research fund in 2008, it marked the end of the consolidation process. The entire financing for research will reach around £1.7 billion annually by 2010.

The research potential of big electronic patient record databases, in particular, has been recognised by the OSCHR Board as a key opportunity for UK biomedical science, patient safety, and public health [15], according to the October 2008 OSCHR report. OSCHR has committed a substantial sum of money to health informatics in its anticipated budget for 2010–2011, which is the time frame following the conclusion of the current three-year Comprehensive Spending Review. The MRC and NIHR will both provide funding for this study. The Connecting for Health in England's Research Capabilities Programme will receive £18 million from the NIHR budget. The MRC's budget allocates £0.6 million to collaborative initiatives that will examine ways to utilise electronic data sets to enhance medical research [15].

The National Health Service (NHS), a publicly financed healthcare system that provides treatment to all British citizens, includes the Research Capability Programme. The Department of Health established the national NHS Connecting for Health programme in 1998 with the goal of using IT to update its healthcare system. One of NHS Connecting for Health's initiatives is the Research Capability Program. The objective of the programme, which was first conceived in 2005 as a project to collect population data for epidemiological and comparative effectiveness studies, has expanded into a wide endeavour to change the NHS such that health care research is a primary area of concentration. The goal is to make use of the large potential supply of NHS data in order to enhance patient safety and quality of treatment via better medical research.

The UK Clinical Research Collaboration's (UKCRC) Advisory Group released a report in 2007, which prompted the development of the Research Capability Programme. Six specific suggestions were made in the UKCRC report for the UK to enhance its research capacity. These suggestions included requiring the use of a unique identifier in all patient records, making research a primary goal of the NHS Care Records Service, making databases of comprehensive, longitudinal medical records that cover the entire population available, improving data completeness and quality, addressing regulatory and governance issues regarding the use of data, and collaborating with all relevant stakeholders [18]. The Research Capabilities Programme is at present creating the technological architecture, functional requirements, data standards, information governance, infrastructure, and stakeholder engagement necessary to enhance the UK's clinical research capabilities in direct response to the UKCRC report.

The UK has seven research councils that provide funding for research in a variety of sectors, in addition to the NHS. The UK e-Science Programme, a concerted effort to provide academics across all areas access to the massive data sets, computer resources, and software tools needed to exploit informatics research, has included all of the research councils since it was launched in 2001. The project got £118 million in initial financing when it was launched as a collaborative operation between the research councils and the now-defunct Department of Trade and Industry. It has had some remarkable results, such as employing grid computing to pinpoint three medications that can be used to treat bacterial infections that are resistant to antibiotics. Can-cerGrid, an attempt to provide software tools to lower the cost of clinical research and improve data exchange, was also supported by funding for the e- Science Programme. While the MRC provides funding for the majority of health informatics research, it also collaborates on some of this work with the Engineering and Physical Sciences Research Council (EPSRC), the Economic and Social Research Council, and the Biotechnology and Biological Sciences Research Council (BBSRC) (ESRC). For instance, the BBSRC launched a £6.5 million bioinformatics and biological resources fund in 2008 to support health informatics research. The BBSRC has an annual budget of over £450 million.

Prior MRC activities demonstrated its dedication to health informatics research by its financing and strategic choices. The MRC boosted its funding for informatics fellowships from £0.9 to £1.4 million between 2005 and 2006. The MRC gave the National Cancer Research Institute's bioinformatics project £1.1 million in 2006. The MRC awarded grants totalling £2.2 million in 2007 to assist the growth of the bioinformatics workforce. The MRC set aside £1.5 million in 2008 to provide grants that would encourage the use of electronic databases in medical research. This study received additional money from the EPSRC, ESRC, and the Wellcome Trust for a total financing of $10 million. The MRC and EPSRC collaborated to sponsor a £2.3 million project to research the use of information technology to promote higher quality medical diagnosis and care [17]. A new strategy plan for the MRC has been released for the years 2009 through 2014 and maintains the focus on health informatics research. This plan has four strategic goals, one of which is to fully utilise the potential advantages of population-based data. To do this, tools to use current data sets, sharing and linking of future data sets, and the creation of a national framework to support this kind of research are all goals in this plan.

In the UK, a number of nonprofit groups that operate, at least in part, with public support, are also focused on health informatics. For instance, one of the key locations for biomedical informatics research in the United Kingdom is the European Bioinformatics Institute (EBI) in Cambridge. EBI is one of the five institutes that make up the European Molecular Biology Laboratory (EMBL), a significant fundamental research organisation that receives funding from 20 different European countries. EBI conducts bioinformatics research, trains scientists

and students in bioinformatics, and gives free public access to online biological data- bases. With a budget of around €43.2 million in 2008, EBI operated with funding from EMBL accounting for about 45 percent of the budget. EBI also receives financing from a number of other organisations, including the NIH in the United States, which provides over €3 million, and the MRC and BBSRC in the United Kingdom, which provide a combined sum of money in the same range. The Wellcome Trust and the European Commission each provide €7.5 million and €8.8 million of the remaining money for EBI. The Wellcome Trust is the biggest charity in the UK, investing over £600 million yearly in both domestic and international research. The National Cancer Study Institute is another significant nonprofit that supports this research (NCRI). An organisation called NCRI was created as a public-private collaboration to assist cancer research in the United Kingdom. With the aim of enhancing the effect of cancer research via the use of informatics, NCRI launched the Informatics Initiative in 2003. By creating globally recognised data standards, databases, and data tools, it has concentrated on enhancing data sharing within the cancer research community. The NCRI Oncology Information Exchange serves as the main interface to this data (ONIX). Researchers may access a variety of data sources via ONIX, which also offers them specific tools for searching biological databases. Promoting data sharing of all publically funded research via the development of technological standards and the implementation of cultural change within the research community is one of NCRI's major successes. With the establishment of a data sharing initiative in 2001, the MRC has been one of the key participants in this endeavour. Other organisations involved in cancer research, such as the Wellcome Trust, BBSRC, and Cancer Research UK, have followed suit and implemented their own data sharing policies. For instance, the BBSRC created a new data sharing policy in April 2007 that says the organisation would support initiatives to make data as freely accessible as possible for use by its researchers in future scientific study.

1.RECOMMENDATIONS AND CONCLUSIONS

There are considerable expenditures in medical research made by both the US and the UK. Therefore, it comes as no surprise that both countries have invested in informatics research given how crucial it is to medical research. The United States has made a far larger overall public investment in health informatics than the United Kingdom. However, both nations provide nearly the same proportion of all public funding for medical research to health informatics. It is impossible to determine whether nation has more technical capability for biomedical informatics research from this study since it only examined publicly-funded research.

There are qualitative disparities between these two countries' approaches to health informatics. The development of the Research Capability Programme has been significant for the United Kingdom. Because it has adopted electronic health records among primary care providers far more quickly than the United States, the United Kingdom is well positioned to gain from breakthroughs in health informatics research. What's more, the NHS has made a crucial strategic choice to prioritise medical research as a primary endeavour that it must fund. As a result, the NHS will be able to make technological advancements to boost information exchange and its information base for research as it continues to grow its IT infrastructure. Additionally, because to its special position, the NHS may more directly influence matters that are important to researchers, such enhancing data quality, via its own policy directives.

With initiatives like UK Biobank, researchers in the UK may benefit from the country's electronic health record system. A large-scale medical research effort called UK Biobank aims to understand how a person's lifestyle, environment, and genes impact their health. With the

help of both public and commercial funding, the initiative aims to sign up 500,000 volunteers in the UK who will take part in an initial health assessment, supply medical samples, and provide permission for researchers to continuously monitor their medical data. The NHS's data-sharing capabilities have made this initiative viable and will enable researchers to monitor participants' health over the next years. The research needed NHS data only to get started since it was necessary to identify prospective participants and ask them to participate in the study using their medical records [20].

The NHS is developing the capability that will allow the United States to convert its present or future electronic health information into an useable database for medical research. Given the decentralised nature of the present initiatives to boost the usage of electronic health record systems, this is not entirely unexpected. The HMO research network, a coalition of 16 health maintenance organisations (HMO) in the United States that gives researchers access to health data for a significant population, is the closest option to the information base the NHS is constructing in the United States.

Future American initiatives to accelerate the adoption of electronic health record systems should include functional specifications that permit the secondary use of medical data for research in order to remedy this shortcoming. For instance, while developing interoperability specifications and other standards for its growing definition of "meaningful use," which will decide how monies from the 2009 stimulus package are spent, HHS should take the significance of secondary usage of medical data into account. Instead of building fragmented, project-specific research data bases, the objective should be to construct a nationwide data-sharing infrastructure to enable health informatics research. Instead of simply making all patient data available for research, many existing or prospective programmes concentrate on introducing a second layer of reporting requirements to health care providers to acquire access to crucial patient data. For instance, the "America's Affordable Health Choices Act of 2009" (H.R. 3200), recently introduced by Rep. Dingell (D-MI), included a requirement that all healthcare facilities receiving federal funding from the Medicare or Medicaid programmes report hospital-acquired infections to the CDC's National Healthcare Safety Network [10].

Both countries continue to have difficulties, particularly with respect to data exchange. The technological infrastructure and data standards required to enhance data exchange across current systems must be developed with ongoing investment. Additionally, a mechanism is required to enable the timely and effective sharing of pertinent medical data for permitted medical research. Patients' privacy must be protected, but these specific safeguards must be weighed against the potential advantages of study. Regulations pertaining to privacy may significantly affect the spread of technology, as Reference [9] has shown. As a consequence, politicians should exercise caution when enacting privacy laws that restrict the use of technology in the healthcare industry since they might have a major negative effect on the standard of treatment and medical research.The UK seems better equipped to handle these difficulties. The Research Capabilities Program has created work materials that address many of these challenges around data sharing as part of its Information Governance and Threat Assessment agenda. In order to establish a pseudonymization service for the de-identification of patient data, for instance, it has identified choices and subsequent procedures. It has also examined the legal ambiguities that must be resolved in the United Kingdom in order to utilise patient data for research. Before broad usage of data from electronic health records for medical research, problems including patient permission must be handled. The use of patient medical data directly in research studies or the identification of patients for potential participation in research studies may both need the patient's agreement.

The United States should likewise create a thorough analysis of these problems with data sharing. Consider the existing legal framework for exchanging scientific data, for instance. The NIH has a similar commitment to open data sharing as the MRC. Since October 2003, the National Institutes of Health (NIH) has mandated that all grant applicants requesting funding of $500,000 or more include a data sharing strategy in their submission or provide justification for why data sharing is not feasible. The HIPAA Privacy Rule and other federal and state rules, including those, have been identified by NIH as having the potential to obstruct data exchange [16].Finally, both countries must make sure that their research communities are robust. In addition to the technological infrastructure needed for advanced biomedical informatics research, a competent pool of researchers with training in biomedical informatics and allied subjects will also be needed. The MRC has provided funding for fellowships and workforce training in the UK. The NCBC has been utilised in the US to increase the number of qualified researchers in computational biology, bioinformatics, and biomedical informatics [14]. The necessity for collaboration on this research and partnerships with the commercial sector is also acknowledged by the United States and the United Kingdom. As was previously said, the research communities in both nations have established cooperative relationships, as seen by the cooperation between the NCI and the NCRI.At the local, national, and international levels, there is a need to pursue informatics in healthcare. The World Health Organization adopted Resolution WHA58.28 in 2005 to create an eHealth Strategy, noting the "potential impact that advances in information and communication technologies" could have on medical research. The resolution also urged member states to implement "national electronic public-health information systems and to improve, by means of in- formation, the capacity for surveillance of, and rapid response to, disease and public-health emergencies" [8]. In response to this demand, the United States and the United Kingdom both pledged to significantly increase the use of IT in medical research during the next years.

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