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A Review of HIIPS: Healthcare Information Infrastructures among Public Hospitals (Case Study Sudan)

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ABSTRACT
Most of the countries in the world share a common goal, namely, to enhance the health of their populations and to improve the quality healthcare. In addition, countries have concerns to make the patient care better. With the introduction of ICT these countries make large investments in the healthcare sector, hence these countries need to assure and measure the value of their investments, and wisely allocate the healthcare resources. It is important to provide good information for decision making [1]. The concept (HIIPS) is a proposed healthcare information infrastructure research project that will be set in the Republic of Sudan especially in the Federal Ministry of Health and Ahfad University for Women Healthcare Center (AUW-HC) initially. After that it will be generalized to cover the whole Sudanese public hospital and link them together with the ministry of Healthcare in the Republic of Sudan, to make the information about the Sudanese citizens' (patients) available and timely accessible, the idea is to enable Electronic Exchange of Electronic Patient Record (EPR) among public Sudanese hospitals in order to enhance the quality of work and help the medical staff in the decision making process. .

Keywords:- Healthcare, Electronic Health Record HER, CSCW, coordination,HIE, Patients record.

I. BACKGROUND AND SOCIETAL RELEVANCE

In Sudan, the healthcare sector is divided into three healthcare providers which are: Public Organizations, private organizations and Non-Governmental Organizations NGOs. All those organizations are potential beneficiaries' and vital for use our (HIIPS) system, there is a need for (HIIPS) in Sudan; with the total number of Sudanese citizens approximately 33,419,625 persons beneficiary from the Sudanese public hospitals facilities which they are work manually. It's clear that the manual systems of public hospitals in Sudan do not satisfy the reporting needs of beneficiaries (patients and Doctors). This kind of inefficiency and problem created by such systems includes:

- Poor admin for clinical data.
- Poor doctor patient communication.
- Poor communication between medical staff.
- Unavailability of information about the patients timely.
- queuing.
- Time consuming.
- Slow retrieval of data.
- Paper wastage.
- Poor data storage.
- And the loss of information.

An effective Information System should be capable of maintaining an institutional memory, where the information about beneficiary (patients) or (populations) is easy to access. A computerize system such as Electronic Exchange of Healthcare Information(EEHI) among public Sudanese hospitals can address such problems and provide advanced services for ordering and reporting of Hospital Information Systems (HIS).

II. THE STUDY QUESTIONS AND ACADEMIC STATE-OF-THE-ART

This study revolves around two main questions: 1) what are the current practices of information exchange among hospitals in Sudan? And 2) how may these practices be improved with new healthcare information infrastructure?

WHAT IS INFORMATION INFRASTRUCTURE?

The term Information Infrastructure in the field of Computer Support Cooperative Work (CSCW) refers to the digital facilities and services that work within digital environment and connected to the internet that provides computational services, consist of help desk and data repositories'.

WHAT IS CYBER-INFRASTRUCTURE?

Cyber-infrastructure integrates hardware for computing, data and networks, digitally enabled sensors, observatories and experimental facilities, and an interoperable suite of software and middleware services and tools. However, (Atkins et al. 2003) defining Cyber-infrastructure as those layers that sit between base technology (a computer science concern) and discipline-specific science. According to the Atkins report, Cyber-Infrastructure consists of "hardware, software, personnel, services and organizations" [2]. Another definition from [3] Cyber-Infrastructure consists of computational systems, data and information management, advanced instruments, visualization environments and people, all linked together by software and advanced networks to improve scholarly productivity and enable knowledge breakthroughs and discoveries not otherwise possible.

III. PART ONE: THE STRUCTURE AND CONTENT OF INFORMATION INFRASTRUCTURES IN HEALTH CARE (INCLUDING EXCHANGE, EHR, EPR):

Healthcare Information Infrastructures for Public Hospitals in Sudan is a necessary step for improving health in our nation. It well requires a collaborative work and efforts by public and private health sectors organizations, and for sure by the government of Republic of Sudan especially the ministry of health. Better health is what we need for our population, our family, our neighbors, our friends and nation and for all people over the world. It's become matter of life for the people in the developing countries, especially in Africa. However, it's not matter of quality of life for our nation in Sudan. It's a matter of stability and happiness within our communities, better health may result improved and increased the productivity of industry and the satisfaction of the healthcare workers. The call for action was headed by the researchers who began to study information infrastructure for health care sector, For example, [1] argued in his article(Building the national health information infrastructure for personal health, health care services, public health, and research) that improving health in our nation requires strengthens four major domains for healthcare systems; which are: managing the personal health , delivery of the care, public healthcare and related research in health. [1] Stated many barriers results in poor quality, including the difficulties of accessing the data, information and knowledge. All those barriers and shortcoming can be excluded by the implementing of a National Health Information Infrastructure (NHII) because its offers the connectivity and knowledge management facilities. NHII is defined as "An information and communications infrastructure exists to connect users to each other, to information, and to analytical tools and to enable management and generation of knowledge" [1] It is a means to computerize all the manual work and move from paper based system to computerize assisted integrated system, which can improve the quality of health data, information and knowledge. Why should Sudan build (HIIPS)? Information infrastructure is a base tool for any information intensive industry especially heath care industry, an integrated infrastructure allow the beneficiaries' to share and exchange the information about the patients between hospitals. (HIIPS) should be built through collaborative efforts between public and private health organizations and investment. [1] argued that, the key enablers for information infrastructure are: incentives, standards, privacy and security framework, and funding. Now is the time for the republic of Sudan to take the opportunity of the introduction of ICT and the internet facilitation. And start building the healthcare information infrastructure for public hospital in Sudan i.e. (HIIPS). Many researchers around the world put the spot light on Electronic Health Record EHR or EPR because their importance as a major elements in the process of exchange between hospitals. For example [4] presented a reviews paper in the literature of electronic health record area, included several questions as follows: 1) how electronic health records are defined? According to the international organization for standardization (ISO) the EHR is defined as:" a repository of patient data in digital form, stored and exchanged securely, and accessible by multiple authorized users. It contains retrospective, concurrent, and prospective information and its primary purpose is to support continuing, efficient and quality integrated health care" [4]. 2) How the structure of these records is described? The structure and content of EHR is categorized into three type's time oriented electronic medical record the data is presented according to ordering time, problem oriented electronic medical record notes are taken according to the problem, and source oriented record the content of the record depends on the method example X-ray. 3) In what contexts EHR are used? It's used in primary secondary and tertiary hospitals. 4) Who has access to EHR? The EHR is accessed by number of users in the healthcare professionals like doctors, laboratory technician, nurses, administration staff, and patients 5) which data components of the EHR are used and studied? There is number of data component recorded in the EHR system where used and studied in this review paper includes referral, present complaint past medical history, life style, physical examination, diagnoses, tests e.g. laboratory and radiology, procedures, treatment, medication and discharge. 6) What is the purpose of research in this field? the purpose of this studies reviewed is to identify the success factors of implementing information system according to [5] there is six success factors are information quality, system quality, information use, user satisfaction, individual impact and organizational impact. This study has added to our knowledge: an overview of the types of information included in the HER, an overview of the content of HER. Also, the role of nurse's information system and data produced by patients has not been taking into account and this need more study. In the 21th century many developed courtiers started to build their own information infrastructures system in the healthcare sector, For example, [6] used a combination of literature review and interview with experts from seven industrial countries to

assess the state of health information technology and determine the key factors for adoption of health information exchange HIE in seven countries: the United States (U.S.), Canada, United Kingdom (UK), Germany, Netherlands, Australia and New Zealand (NZ). In this study they defined HIE as" the exchange of clinical data such as problem lists, clinicians' notes, or other critical medical information from one provider organization to another". According to this definition they started collecting the relevant data by searching the literature by using terms such as "computerized records", "electronic health records" , "electronic medical records" and "health information exchange" also they searched Google, Google Scholar and other search engines, and also they contact experts in HIE in each of the seven nations. They were able to contact leading government experts overseeing the adoption of HIE. The result showed that, implementing HIE between the seven industrial nation is not complete yet (the UK, Netherlands, Australia and NZ) had nearly universal use of EHR among general practitioners (each >90%) and Germany was far along (40–80%). They found that evaluation of the HER in hospitals in the seven nations is not high-quality and the data in EHR is not reliable in acute care settings. They also found that exchange health information or clinical information is remains low in each country. In conclusion health information technology has the ability to improve the health service quality and efficiency. The cross country health clinical information is not currently available. The insight gained from this study is that: most countries are in the beginning of implementing of heath information exchange or health information technology, examining different countries' HIE approaches can provide valuable insight. Some counties are achieved success with HIE in ambulatory sector, but there is steel lack in hospitals sectors, Health information exchange between countries will prove very useful to continued progress for all countries. Many countries have started to use information technology to assure and improve the the patient safety, and to improve the quality of health care services. Canada one of those countries, [7] conducted a qualitative study to identify the success of different side of the Canadian plan and ways to enhance the adoption of electronic health records. In 2001 Canada Health Infoway detected a plan to carry out a national system of electronic exchange of health record between regional, the Infoway is government-funded corporation that come in with a novel model for interprovincial collaboration to establish core aspects of a national framework. They assess ten years history of Canada's e-health plan by using case study to assess the E-health in Canada and to evaluate its effectiveness and efficiency and to identify the ways to increase the adoption of electronic health record in Canada. In this study they used a case study approach, and structured interviews as methods. Also, they reviewed the national report and documents and also conducted structured interview and they identified 32 potential candidates that they represent the national organization. The potential candidate was contacted using phone call and Email. Also, they used questionnaire to collect the relevant data and to analyze this data they used the grounded-theory approach which is a technique used in similar studies for analyzing qualitative data. The result showed that the stakeholder's participant in the study (questionnaire) they identified national standard funding for implementing E-health in Canada. Also, the study found that the patient registration and digital imaging as a significant achievement of health plan. The study provides a recommendation for the future work, however, this recommendation may not represent all the stakeholders in this study, and the researchers were not able to assess either the participants view varied across provinces or stakeholder's groups, such a difference may be relevant to understanding why some provinces were successful to adoption and implementing health information technology. In my conclusions, I think Canada has implement a national plan to electronically exchange of health care record by establishing a model for successful exchange health information between provinces to allow collaboration work between hospitals and making national framework, in the future Canada looking for establishing E-health policy to guide the implementation of health information technology. To address the major strategic priority of health care reform and to make improvement in the patient safety, managing the chronic disease, sustainability of health care system and to promote for electronic exchange of electronic health records and clinical data to address these challenges, the polices are needed to: (a) Facilitate sharing the clinical information between hospitals and clinical centers timely and health providers. (b) To make personal health records accessible. Many countries have started electronic patient record to assure and improve the the patient safety, to improve the quality of health care services and to reduce the readmission to the hospitals. This may result in reduces the cost of treatment for the patient and the healthcare providers. United state of America one of those countries, for example, [8] they argued that the readmission to the hospitals is common and costly in the united state of America. the cost of readmission about $17 billion each year; in addition there is a lack of information exchange between the hospitals about the patient decease, also the patients think that their healthcare provider have a little information about them. To solve these problems the authors utilize health information exchange systems HIE as a solution for readmission by facilitates the access to the patient clinical data and improve communication. The method were used in this study was conducted retrospective cohort study of hospital readmissions among adult patients in the Rochester, New-York area 2009-2010. The study conducted covers 38 healthcare organization in the New-York County and region. The data were collected via Rochester Regional Health Information Organization (RHIO) and exchanged via web based technology. "We analyzed claims files from two health plans that insure more than 60% of the area population. Claims data provided all patient demographics, diagnoses, and encounter information" (Joshua R Vest). The study showed that the readmission after discharge is for the same cause within 30 days. And to measure the outcome of this experiment they use HIE usage as

a primary independent variable. In conclusion, this study takes a sample of 6807 discharged patients the financial saving after using HIE in US approximately about $605 472 annually accounting to an estimated 48 potentially avoided readmissions each year. The use of an electronic record exchange through an HIE it reduces the readmission to the hospital and can save the financial cost. The use of HIE system make the information about the patients available, complete in time and complete medication lists. Diagnoses made in the hospital recent laboratory, radiology results, laboratory and radiology tests still pending at the time of discharge that required ambulatory follow-up. We think this study is relevant to our PhD research because it's applied in the hospital as our study and used HIE as a solution for their problem and it's showed that using the HIE is very useful in the problem solving. Until now in Sudan there is no computerize system to manage the public hospitals services and there is no link between Sudanese hospitals. These studies showed that implementing HIE in hospitals can save a lot of money and life's. Also, accessing the patient's information from outside hospitals result on improving the care of patients in the emergency department, For example, [9] argued that in the fragmented healthcare system the medical staff struggle to access the patient information from outside organizations in the emergency department, that was treated in another hospital timely and retrieve the relevant information about the patient. The main objective of this study is to assess whether the use of electronic exchange of healthcare information HIE have a positive impact on the emergency department ED. By improving the ED process and its ability to facilitate more clinician timely access and viewing the patient information from outside organizations. They used data from large academic medical center to achieve their objective and to access the detailed information about patient they were used HIE if the outside organization is implemented Epic, if it's not they were used the Fax. By 2014 they activated HIE module called Care Every-where. The results showed that there is no direct association between the data retrieved from HIE to ED, but using HIE is faster to access the patient information from outside organization. [10] was conducted study in Northern California comprises eleven hospitals that use common electronic health record vender (Epic Systems, USA) and It's associated HIE platform (Care Every-where). They focused on clinical summary exchange in the period of time from (2013 to 2015) to examine the relationship between electronically exchange of patient health information across health-organizations and hospitals. They concentrated on two keys decision, the first one is whether automatically search the patient information from other organizations without patient consent and the second one is to require the health information exchange HIE specific patient consent. The eleven hospitals involve in this study were used the same systems which are Epic and (Care Every-where) platform which is a standards-based network providing peer-to-peer patient matching and query-based HIE between organizations. They collected the relevant data from two sources; the first source is Self-reported data that was collected from chief medical information officers and other leaders and the second source from eleven collaborative organizations. The result showed that nine of the eleven organization enabled patient health information exchange between hospitals during the period of study (2013-2015) without patient consent and these organizations experienced a greater increase in volume of exchange over time by 1349%. In conclusion the use of auto-querying without patient consent in HIE can have a significant impact on the heath information exchange by increasing the exchange volume. [11] Argued that there is abroad agreement that health information exchange HIE is intended to transferring electronically the patent health information across organizations to enable better and more efficient care. This study used the national data of the US hospitals to evaluate how market dominance by EHR vendors was related to hospitals' engagement in HIE in the period of time 2012 and 2013. They used national data of the US which consist of information from all hospitals in the US plus data from Colombia district. They emerged data from two sources, the first one is American Hospital Association (AHA) and the second source is Annual Survey Health Information Technology. In conclusion: the study showed that there is a relationship between EHR and HIE, also there is a great agreement that EHR is fundamental component for HIE. So the results came as concerns of policy maker about the relationship of EHR vendor's dominant and their ability to facilitate or impede the diffusion of HIE. Also, the results showed that the hospitals that used system of dominant vendors (Epic) engaged more in HIE, conversely the hospitals that doesn't use the dominants vendor's system are less engaged in the HIE. However, their study focused on the EPR vendor's dominance in hospital's engagement in the HIE and ignored other engagement factors like information come from outside hospitals and ambulatory providers. [12] argued that Electronic exchange of healthcare information across organizations is expected to enhance and improve the quality of care and reduce the related cost. The important element to achieve this is interoperability. Interoperability is defined as the ability of healthcare organizations to exchange the heath information electronically between them. The National Coordinator for Health Information Technology in the US confirmed that, but the sustained use of HIE between providers has been difficult to achieve. A number of factors play role on that including concerns about security of exchanged information. The tension between expected benefits of interoperability of health information and breaching of the patient health information, the study proposed an information security control theory to explain this tension. There were a previous study investigated the problem between sharing and protecting the health data it was exploratory studies. They used qualitative research approach as method. Also, they arranged meetings with the coordinated through the HIE's executive director to collect the relevant data for their study. Semi-structured interviews were conducted personally or over phone the interviews exceeded four months and were

recorded. Documentations are also collected including various version of the security policy. After that they analyzed the collected data and recorded interviews. By the end of this process they identified the factors that impose tension between sharing and protecting the data that HIE has addressed through the development and implementation of HIE. The result showed that the proposed theory offers a useful framework through which to realize the information security policy. In conclusion interoperability of the health-care information between organization and vendors becoming critical to improve the quality of the care and also to reduce the relevant cost. However, the secure of health information is vital to successful of HIE and will increase the participation of organizations and the patients. Like many other people based professions communications skills are essential to medical practice staff also. For example, [13] spots the light on the new interaction modes and software that capable of interpreting and recognize the face expression, emotion and voice to be use in soft skills training in the medicine field, in order to make better doctor patient communication. This is crucial for the cure process and to better treatment, so more subtle social skills are needed. The primary focus of this study is to use E-simulation to develop social skills in the medical context. However, according to the recent study undertaken by European consortia to inclusion media supported social skills in the medical care this require both theoretical and case study framework to assist their development [13]. Soft skills are to enhance communication exchange between medical staff and patient by using learning devices to train soft skill. The planned Marina and top-staff projects were used affective computing. [14] has defined affective computing as the types of computer applications that deal with emotion.(Picard) raised the awareness that emotion can interfere with mental performance and learning. There is strong need for the communicative mode from the point of view of practical and scientific to increase the effectiveness and communication between medical staff and patient, to have positive impact between patient health and recovery, to help the patient to get realistic about what will happen to them in the future and to the reduce cost of medical instruction. According to top-staff project there is challenges of communicative between the medical staff and the patients' interaction, such as clinical protocol need to be appropriate managed, the time span on communication is unpredictable and also there are a number of pedagogical issues. The overall objective of E-simulation development is to provide software or learning system for training soft skills focusing in the healthcare context [13]. In conclusion soft skills training is strongly recommended for the physician and nurse practitioner with particular focusing on communication and emotion management skills because it's vital to cure process and patient satisfaction. The use of computing in order to train people in the management of emotions in interpersonal communication through interactive simulations in a collaborative environment is an important development [13].

IV. PART TWO: CHALLENGES OF INFORMATION INFRASTRUCTURES IN RELATION TO DESIGN, IMPLEMENTATION AND USE

Information Infrastructure has been recognized as a potential problem in the workplace that deserves serious attention. As far back as [15], have argued that healthcare is making huge investment in information system and IT like Picture Archiving Communication Systems (PACS) and Radiological Information Systems (RIS). In-fact, to implementing such systems in hospitals has been problematic and where the hospital information systems are in use the benefits gained from them are low and far below what has been expected. They identify a number of challenges and problems related to hospital information systems and to deal with those problems they consider it as "work oriented infrastructures" (EPR) has been since the sixties, but are still not working well even in the developed countries, especially in the large hospitals due to the problems of standardisation because the standard is much needed. For both work oriented and the kind of infrastructure. The aim of this study is to get better understanding of the design challenges that associated with implementing (PACS) and (RIS) systems. Bearing in mind that, the complexity of interdependency between the technology and medical practice in increase by existence of new medical technology and new illness. To reach their aims they used ethnography studies which has becoming widely used in the information system (IS) and Computer Support Cooperative work (CSCW) fields. When using this research approach the focus is on investigations and understandings of actual work practice in their particular contexts. Several research methods used also on this study for data collection including, workplace video recording, interviews, unstructured interviews, observations and an integration, social interaction, more than 40 hours of video documentation, 45 hours of observations and 22 interviews of 1 1/2 hour each were conducted, some participants were interviewed several times. [15] found that there are a major challenges for design of information infrastructure including the following: 1) Standards: The standard means that, in the network that linked to other network the operation must operate smoothly and in convergent and aligned way, and share the same communication protocol. This means that the designing infrastructure required defining standards protocol including communication protocol and coordination artefacts'. 2) Momentum and Irreversibility: The larger number of actors in the workplace within the larger number of components is more important for standard, in other hand when implementing standard in larger networks makes it harder to change the networks, because the networks are linked with the same sharing standards. 3) Installed base cultivation and gateways: An approach to manage the change of large networks must take the existing network and the installed base as its starting point [15]. According to [15] the design of hospital

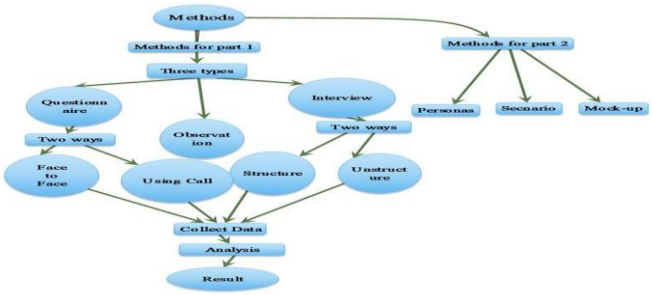
information system has lot to learn from development of classical infrastructure. They are also argued that defining shared standard for exchange the medical information is strategy for building work oriented infrastructures that has proved to be very problematic. As we pointed above there is challenges related to design of information infrastructure. [16] had studied the coordination and cooperative and they pointed challenges of designing related to collaborative work by discussing the relationship between information and representation using Ethnographic study as a method. One of the authors conducted ethnographic fieldwork at the ward over a period of two months, 28 days of five to six hours of fieldwork observation was carried out. Notes were taken by hand and written out in prose interviews lasting 1 hour each with nurses (8), and physicians (2) were made. And from their analysis of the hospital wards found that there is a number of design issue this issues includes: decoupling information and representation, linking and blending the digital and physical world Linkage, bringing the 'Object of Work' back to the real world and privacy issues [16] access and sharing data is issue across various technical platforms, institutions, disciplines and across long periods of time. [17] Explored another barriers related to the system design included the complexity of using the system. They conducted a systematic review of the literature to identify and assess interventions of information and communication technology on the processes of communication and associated patient outcomes within hospital settings. They reviewed the types of interventions that been implemented in hospitals settings to improve clinical communication. They found 18 studies that examined several types of interventions including alphanumeric paging systems, hands free communication devices, mobile phones, Smartphone's, task management systems and display-based systems. They found some evidence that users perceive improvements with communication interventions, given the critical nature of communication. They advocate further evaluation of information and communications technology designed to improve communication between clinician's outcome measures should include measures of patient-oriented outcomes and efficiency for clinicians. In conclusion they used comprehensive methods such as reviewing references lists and searching for related articles to ensure articles were included in their research. Yet, the rapid developments and adoption of new information and communications technology could result in time lag or delay in the Implementation, evaluation and publication of relevant studies as well. There may be publication bias as they restricted to peer-reviewed articles. However, given that their findings showed a general lack of high quality evidence it is unlikely that unpublished or non-peer reviewed articles would change these findings. [18] They spot the light on the persistent challenges and new strategies for health information exchange in United State of America such challenges include; patient safety and quality issues when the patient is handoff among the health providers that they are failed to share the patient information. The policy makers, researchers and industry professional identify that information exchange (HIE) as solution to this problems. The authors addressed history problems and their subsequent lessons of (HIE) for increasing the probability of successful meaningful (HIE).

1. Community Health Management Information Systems History: The Hartford Foundation initiated community health management information systems (CHMISs) through grants to seven states and cities in 1990. However, CHMISs had two problems the primary one is that the lack of affordable and effective technology, CHMISs occurred before the advent of new and cheap reliable high speed internet technology, also CHMISs had a security problem and privacy concerns. The second problem is that the integration between hospitals was never achieved, the lesson learned from this problems is that the need for a clearly defined purpose and effective political support. 2. Regional Health Information Organization History: RHIO is facilitates information exchange between providers within a geographical area to achieve more effective and efficient healthcare services. The problem of RHIOs is that the main barrier to increasing the number of HIE and RHIOs is the lack of a sustainable business model despite of the new technology the RHIOs steel need for data integration, strong security, data storage, database for administration and provide technical support. RHIOs may require upwards of $12 Million for development and $2 to $3 Million in annual operating costs. The lesson learned from these problems is that the technology progress doesn't solve the problem of sharing the information automatically. 3. Strategies: Obama administration office has envisions making the healthcare services in lower price and high quality they discuss the concept of Personal health records PHR and they considered the PHR has appeal as eliminates the cooperative work and because its handoff valuable information for educational directly to the patients. If the PHR application is hosted by RHIOs then there will be no doubt that all the barriers will disappear and complete vender's will participate even if the PHR is maintained by third party such as Google or Microsoft. Another strategy is to consider the PHR as public goods. In conclusion they suggest the following strategies for continues development of HIE in US health services, First adopt and improve business model and keep those that are primarily focused on incremental cost savings to providers. Second do not separate the public health benefits from healthcare benefits, third insure that HIE used the best and secured technology for the information exchange and Fourth with federal government cooperation and support encourage states to be the fundamental geographical unit for HIE activities. The call for action was headed by the researchers who began to study the issues and barriers that impede the progressing of information infrastructure in healthcare. For example, [2] argued that the infrastructures phenomena has been explored by the field of science and technology studies(STS) [2] the infrastructure exists in the background it's invisible. In addition, the large-scale information infrastructure projects or the Cyber-Infrastructure aims at supporting the community digital services but this type of projects has two main

associated issues the first one: sharing the information in the sense of public good this might lead to breaching the privacy [16];[2]. The second issues are the idea of sustainability of supporting research over the long time. Although heterophony in Cyber-infrastructure development is major issue related to the system access, information exchange, redesign, update and maintenance of the system. Another issue rose by [2]and they considered as design problem is that how to build ontology (build ontology means gathering the domain knowledge and translate this knowledge to machine knowledge) and how to describe data with metadata. By the existence of the internet new issues of information infrastructure become visible noticeable issues include: issue of data and resource sharing, issues of database query, community standards and data spaces, domain knowledge repository and ontology's [2]. Since 1960 the healthcare field and its organizations has been seeking for establishment of integration information infrastructure with multiple objectives and aims. For instance, to reduces the redundant of data, seamless integration of artefacts' to increase the efficiency and effectiveness of care. [19] They analyzed the infrastructure in healthcare using ethnography studies and combined methods by including observation, semi structured interview, and documents as a methods to generate the study data. They described the challenges evolving information infrastructure and found that standardization and integration is the major and central challenges. Also they found new form of errors emerge by Appling Electronic Medication Module EMM including transmission errors, and sometimes clinician uses each other's login ([16]; 20] argued that it's very hard to implementing a new technology in the healthcare settings diverse and locally located. They point to the several ways in which new technology results in purposed and unintended organizational consequences. In short designing implementing and using technology involves complex socio-technical challenges and the CSCW field has made a contribution in mapping out the complexities of coordinating daily activities and documentation practices among health-care staff. However, the healthcare encompasses many of professional groups and services this added complexity to the coordination. However, [21] argued that the starting point for this special issue on CSCW and dependable healthcare systems is the recognition of 'dependability. The authors of this study have two main goals First, they present an overview of the development of health-related research in CSCW distinguish the major themes and approaches, and summarizing insights from this research about the practical work of healthcare, health ICT Policies and agendas, and technology support for collaborative care work. Second they step back to critically reflect on the practical effects of the research for real systems. In conclusion they found that most of contributions could be categorized as workplace studies and that the majority of design prototypes are focused on smaller scale interactions, though most studies do offer implications for design. However, despite significant investments and efforts getting this right has proved to be a challenging task. The causes for the problems are complex and varied. Although many software products have been built and acquired from heterogeneous sources during a long period of time and the systems have differences in implementation technologies and architectures. Generally, CSCW has strongly focused on the intertwined agendas of understanding cooperative work and designing tools to support that work. The value of CSCW in healthcare studies is that they contribute a rich understanding of the subtle situated practices in the delivery of healthcare. However, these studies resulted respectively in the design and deployment of a new planning system. They argued that moving to electronic patient record (EPR) in hospitals settings is one of the reported advantages of the (EPR) is the opportunity to capture data in more structured formats and to support standardized clinical workflows. However, there is a problem of the information that doesn't fit in the formal electronic record. They argued that one of the key contributions of CSCW research into healthcare is the attention drawn. Expanding contexts of healthcare work poses challenges for integration and standardization and larger-scale vendor driven initiatives. Care is also expanding out of clinical settings into people's homes, bringing yet further challenges. However, expanding contexts can also refer to the expanding scale of ICT implementations. They argued that workplace studies have made a major contribution to the field of CSCW, drawing attention to subtle practices that enable effective collaboration CSCW problem. Self-evidently, society's dependence on computer-based systems continues to increase while the systems themselves embracing humans, computers and engineered systems become ever more complex. Workplace studies typically focus on a single setting making it difficult to assess the generalizability of the finding. "The lesson of all these studies is that organizations are (in part) information processors. People, routines, forms, and classification systems are as integral to information handling as computers, Ethernet cables, and web protocols."[2]

IV. ANALYTICAL AND METHODOLOGICAL APPROACHES

Methods for part (1): Ethnography: interviews and observations, surveys. We did an observation study and we did an interview with the relevant actors that will be involving in our future study and we observed the emergency response in Republic of Sudan in order to get an idea of the present state of emergency response to implementing electronic exchange of healthcare information among public Sudanese hospitals. Methods for part (2): having did that we formulate a thesis of key challenges. And we did personas concerning those involved in the emergency response professional as well, as doctors and registration employees and laboratory technician. Then we did scenario for the new map of (HIIPS) and we did a mock-up for the screen of the Electronic Exchange of Healthcare Information EEHI among Hospitals.



V. ACCESS TO THE FIELDWORK SETTING

In term of access the fieldworks setting, we contacted relevant actors in the field of healthcare and Ministry of Health in Republic of Sudan. Some of actors' are hospital managers, doctors, nurses and finally technician, all those actors are aware of our intention and are currently awaiting more information for further scheduling.

VI. ETHICAL CONSIDERATIONS

All ethical considerations will be in accordance with the existing guidelines of the Sudan University of Science and Technology. This includes ensuring the quality and integrity of our study in seeking informed consent and respecting the confidentiality and anonymity among our interlocutors.

VII. FINDINGS AND DISCUSSIONS

The previous researches say that; (HIE) can increase the effectiveness, efficiency and quality of the healthcare services. And it can provide help for the medical staff and improve the medical process. Now a day's the adoption of (HIE) is increasing and (HIE) is diffusion around the world. However, the previous studies say that the implementation of (HIE) is not complete yet in any country in the world. However, there are a number of countries they have started the adoption of (HIE) compared to the situation in the republic of Sudan which is an African country and its classified in the area of developing country, the work of implementing (HIE) has not started before this study. The purpose of this study is to fill the gap in the literature of (HIE) in the republic of Sudan and to design a plan or "frame work" for the adoption and implementation electronic exchange of healthcare information among public Sudanese hospitals EEHI.

- CHALLENGES:

The study found that one of the Challenges that will face the adoption of HIIPS in republic of Sudan is that: some people think sharing the patient information between hospitals it will leads to privacy breaching of the patient's information. But in other hand it's necessary to share the patient information between hospitals because it cans safe patient's lives.

The ethnography study through observation in Republic of Sudan showed that the medical staff are agreed it's difficult to find the patient's medical record for two reasons: the first one is that it's difficult to search about patient in the manual system and the second reasons is that: some patient doesn't have patient record at all and this is an opportunity for our new proposed project HIIPS. Because it's main purpose is to make the patient information timely accessed, available and secured.

Bearing in mind that the loss of medical records leads to medical errors in other hand HIIPS will make it easiest for the medical staff to retrieving the information about the patient from computerize database quicker. The challenges will be how to convince the Sudanese government to support and adopting HIIPS to improve the healthcare services and increase its efficiency and effectiveness and also reduce the cognitive load from medical staff.

VIII. CONCLUSION

In our conclusion, computer-based patient records and the systems in which they function are becoming an essential technology for healthcare because the information management challenges faced by healthcare professionals are increasing daily. It is important to understand the potential influence that Healthcare Information Infrastructure for Public Sudanese Hospitals (HIIPS) can have on medical staff daily activities and work. Many studies indicates that the quality of of healthcare information exchange HIE systems including attributes such as effectiveness and control and reliability provide complete and accurate information about patients for medical staff. It seems that using (HIE) helped administrators, doctor and laboratory technician to identify and eliminate ineffective activities involved in the patient process and supported medical staff' daily practice, by providing complete essential data to support optimal patient care. Unfortunately in our country Republic of Sudan we do not have an Information System to mange and store the populations' information. As we mentioned this study aims to build Healthcare Information Infrastructure for Public hospitals in Sudan HIIPS. For this reasons we made a systematic review in the literature using key words for search like "healthcare information infrastructure", "electronic patient record", "electronic health record" and "healthcare information exchange" to find answer for our research questions. Also, we will use ethnographic study in two parts, for part-one we used questionnaire, interview, observations, and investigations, note-taking and recording interview. On part-two we used the design methods (e.g. personas/scenarios and Mock-up) Also, we well use ethnographic studies in the future work as a main method to achieve the study goals.

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