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# Health Information Technology in Developing Countries: A Structured Literature Review with Reference to the Case of Libya

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***Abstract*—**This paper reports a structured literature review of the application of Health Information Technology in developing countries, defined as the World Bank categories Low-income countries, Lower-middle-income, and Upper-middle-income countries. The aim was to identify and classify the various applications of health information technology to assess its current state in developing countries and explore potential areas of research. We offer specific analysis and application of HIT in Libya as one of the developing countries. A structured literature review was conducted using the following online databases: IEEE, Science Direct, PubMed, and Google Scholar. Publication dates were set for 2000-2013. For the PubMed search, publications in English, French, and Arabic were specified. Using a content analysis approach, 159 papers were analyzed and a total number of 26 factors were identified that affect the adoption of health information technology. Of the 2681 retrieved articles, 159 met the inclusion criteria which were carefully analyzed and classified. The implementation of health information technology across developing countries is varied. Whilst it was initially expected financial constraints would have severely limited health information technology implementation, some developing countries like India have nevertheless dominated the literature and taken the lead in conducting scientific research. Comparing the number of studies to the number of countries in each category, we found that Low-income countries and Lower-middle-income had more studies carried out than Upper-middle-income countries. However, whilst IT has been used in various sectors of the economy, the healthcare sector in developing countries is still failing to benefit fully from the potential advantages that IT can offer.

***Keywords*—**Developing Countries, Developed Countries, Factors, Failure, Implementation, Libya, Success.

## I. Introduction

THE increased use of health information technology (HIT) worldwide offers tools to enhance the delivery of effective healthcare services (the term HIT and eHealth are used interchangably through this paper. e-Health is the use of the Internet and other ICTs to support healthcare delivery to the public). e-Health involves the use of diverse tools including Electronic Medical Records (EMRs), mobile health (m-Health) and Decision Support Systems (DSS) [98]. The field of e-Health is one of the vital elements that contribute to the development of a country's economy. In order to achieve economic development we need to have a healthy society [104]-[107]. In most developed countries, the implementation of information and communication technology (ICT) across economic sectors has generally reached a state of maturity. In developing countries however, implementation typically remains firmly in the early stages, with different sectors of the economy at higher levels of maturity than others. In this study, “developing countries” refers to: Low-Income Countries (LICs), Lower-Middle-Income Countries (LMICs) and Upper-Middle-Income Countries (UMICs) as defined by the World Bank [136]. HIT in developing countries is yet to be fully investigated [137]. Even in developed countries, progress in HIT is still varied.

Libya was selected as an illustrative case of a developing country which is rich with natural resources and has a low population, but is yet to benefit from the potential value of HIT to improve healthcare services. The first author of this paper has personal experience of the Libyan healthcare context and accessibility of personal contacts for research purposes.

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## II. Method

### A. Selection of Literature

The guidelines proposed by [144] were used to conduct this literature review. The authors conducted a structured review as suggested by [145] by retrieving and classifying published literature on the different applications of HIT in developing countries over the last 13 years. The techniques for the process, synthesis and participation of the evidence were guided by [147], [148]. Our study seeks to answer the following research questions:

**RQ1.** To what extent has HIT been deployed in developing countries?

**RQ2.** What factors have been reported in the literature that influences the success/failure of the adoption of HIT in developing countries?

### B. Data Sources and Search Strategy

Comprehensive searches were performed on the following on-line databases: IEEE, Science Direct, PubMed, and Google Scholar. Only research which explicitly addresses HIT systems in the context of developing countries was included. Publication dates were limited to 2000-2013 with publication in the English language. For the PubMed search, publications

in French and Arabic were also included. In addition, the results gathered were then "snowball-referenced", a procedure that involves searching the references of each search result for additional relevant articles/publications.

The literature search was carried out in two stages. The first stage used the keywords "Developing Countries, Information and Communications Technologies, Health Information Technology, e-Health and Health Informatics".

This second stage used a list of all the names of the countries in the following three categories: LICs, LMICs, and UMICs. The list was compiled with reference to the World Bank categorization. This stage ensured that all relevant e-Health studies were collected during this further stage. All countries' names were listed in a query, followed by the application of HIT. From the first query, a number of studies related to developing countries appeared which did not appear in the stage 1 search. In most cases, this was because the authors had used the name of the country in the title of the research paper, rather than categorizing it as an LIC, LMIC or UMIC. Further keywords used to specify articles included HIT, developing countries, developed countries, success, exploring, failure, information technology, factors, EMRs, and personal medical records (PMRs).

### *C. Inclusion and Exclusion Criteria*

The criteria for selecting the studies in the retrieval of the literature were as follows: the search was limited to journal articles and conference proceedings, excluding full journal papers which duplicated studies. Studies conducted in developed countries and studies that were solely concerned with technical aspects of HIT were excluded and used as background studies. Duplicate references were also excluded.

### *D. Methods of Analysis*

We followed the same approach used by [144] to select, classify and organize the literature. Content analysis was used in the analysis of the included literature. The following criteria were used to classify the literature:

Research methods and data collection methods: In this study we wish to examine previous research in terms of the methodologies used. We classified the methods as follows: (1) case study; (2) quantitative method; (3) qualitative method; (4) mixed method; (5) observation; (6) experimental study; (7) field study; (8) other methods.

Content analysis of the reviewed studies led us to identify 26 factors that had an impact on the implementation of HIT in developing countries some of these factors can act as enablers and facilitators to implement HIT, and some of them can be considered as barriers that hinder the implementation of HIT (see Table I). We found that the four most common factors were 96 studies out of 159 studies had costs as a factor of success/failure, followed by regulation (54/159) studies, ICT infrastructure (53/159), and internet access (48/159). Whereas, the factors that received the least attention were digital divide 3/159, political instability 2/159, and "brain drain" only one study which addressed this factor.

**Application Type**: The various applications of the HIT were also classified and grouped as follows: (a) computerized physician order entry (CPOE); (b) DSS; (c) EMRs; (d) m-Health; (e) picture archiving and communication system (PACS); (f) personal digital assistant (PDAs); (g) telemedicine.

TABLE I
FACTORS AND THEIR REFERENCES IN THE LITERATURE

| Study | Factor | N of studies |
|---|---|---|
| [1]-[54]. | Regulations | 54 |
| [32], [55]. | Political instability | 2 |
| [9], [12], [13], [18], [22], [25], [36], [40]-[42], [46], [56]-[61]. | Policymakers | 17 |
| [2] , [3], [8], [10]-[12], [14], [15], [17], [19]-[21], [23], [26], [31], [32], [35], [36], [40], [43], [46], [50], [51], [59], [62]-[85]. | Internet access | 48 |
| [5], [11], [14], [24], [34], [39], [43], [51], [54], [60], [66], [69], [71], [76], [85]-[97]. | m-Health | 27 |
| [19], [32], [45], [51], [52], [56], [57], [66], [69], [72], [75], [76], [99]-[103]. | Outage of power | 17 |
| [16], [21], [32], [39], [45], [65], [66], [70], [76], [100]. | Backups | 10 |
| [2]-[7], [9], [11]-[19], [21]-[24], [26]-[29], [32], [35], [37], [40]-[43], [45]-[48], [50]-[53], [55], [58]-[64], [69], [71]-[74], [76], [77], [80], [81], [85], [86], [88]-[95], [99], [101], [108]-[135]. | Costs | 96 |
| [6], [12], [13], [15], [16], [31], [37], [40], [42], [44], [47], [50], [51], [53], [61], [63], [68], [70], [78], [84], [87], [95], [100], [103], [113], [129], [130], [138]-[143]. | Technology acceptance | 33 |
| [15], [37], [41], [42], [146]. | Resistance to change | 5 |
| [21], [24], [31], [34], [45], [51], [52], [70], [75], [85], [101], [113], [126], [141], [149]-[151]. | Open source software | 17 |
| [12], [19], [27], [41], [46], [77], [99]. | Academia | 7 |
| [12], [27], [35], [37], [59], [61], [86], [91], [92], [97], [102], [118], [143], [152]. | Awareness | 14 |
| [1], [12], [14], [15], [37], [42], [43], [46], [52], [53], [55]-[57], [59], [61], [63], [69], [84], [111], [130], [138], [146]. | IT skills | 22 |
| [6], [7], [9], [12], [19], [32], [37], [45], [46], [52], [55], [59], [60], [70], [71], [77], [79], [85], [96], [99], [102], [115], [126], [138]. | Sustainability | 24 |
| [12], [27], [38], [57], [60], [61], [77], [100], [108], [143], [153]. | Organizational factors | 11 |
| [1], [3], [11]-[14], [17]-[19], [22], [23], [26], [27], [29], [32], [37]-[39], [41]-[43], [45], [46], [52], [53], [55]-[57], [60], [63], [65]-[67], [69], [70], [73], [75], [78], [85], [86], [90], [94], [99], [102], [108]-[110], [115], [119], [121], [130], [131], [154]. | ICT infrastructure | 53 |
| [15], [16], [18], [28], [38], [41], [42], [50], [57], [60], [66], [67], [100], [114], [129], [130]. | Cultural and social barriers | 16 |
| [18], [55], [60], [69], [70], [72], [89], [102], [117], [121], [125]. | Other infrastructural factors | 11 |
| [2], [4], [7], [11], [12], [18], [19], [27], [31], [37], [38], [46], [47], [50], [52], [53], [56]-[58], [60], [61], [63], [71], [73], [75], [76], [81], [85], [86], [93], [97], [99], [101]-[103], [113], [126], [131], [156]. | Training | 39 |
| [4]-[6], [12], [21], [23], [33], [37]-[39], [45], [46], [60], [82], [131], [142]. | Interoperability | 16 |
| [38], [52], [86], [150]. | Theoretical frameworks | 4 |
| [21], [46], [59], [75], [85], [95]. | Languages barriers | 6 |
| [67], [90], [114]. | Digital divide | 3 |
| [11], [12], [15], [43], [46], [55], [59], [65], [70], [77], [81], [85], [110], [112], [120], [121], [127], [138]. | Digital divide | 18 |
| [73]. | Brain drain | 1 |

## III. Results

The life cycle of the literature review is depicted in Fig. 1 Stage 1 of the research yielded 1,319 articles. Of these, 1,287 articles were excluded based on title and abstract screening: 33 studies met the inclusion criteria. Stage 2 returned a total number of 1,362 studies. 700 articles were excluded based on title screening, leaving 662 articles. From these, 408 were excluded after reading abstracts, leaving 253 remaining that met the inclusion criteria. The total number of articles which were considered to be directly relevant from both searches was 159, and these articles are the ones included in this research. A further 128 studies were also considered useful background as they were conducted in developing countries, and were linked to technical aspects of HIT and addressing HIT in general.

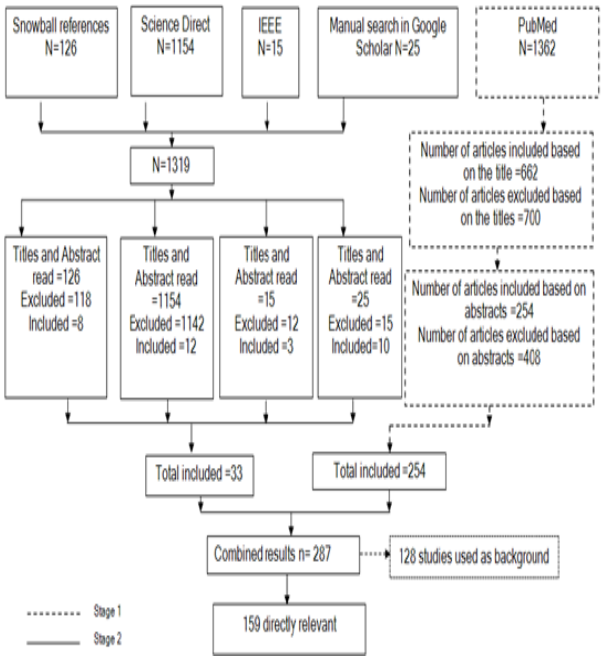


Fig. 1 Process of the structured literature review and the sources of the literature

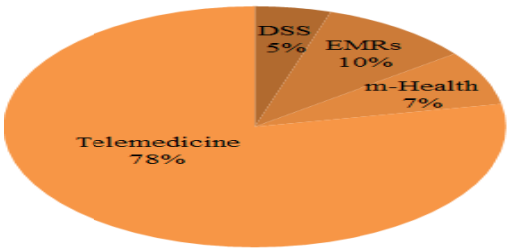


Fig. 2 The various applications of HIT in India

## IV. Findings

### A. Overview of the Papers

Table II lists the 42 countries reported in the literature as having evidence of the deployment of HIT, together with the number of studies relating to that country.

TABLE II
List of Countries Reported in the Literature

| Country name | Number of studies | Country name | Number of studies |
|---|---|---|---|
| Bangladesh | 3 | Mali | 1 |
| Bhutan | 1 | Mongolia | 1 |
| Brazil | 9 | Morocco | 1 |
| Cambodia | 5 | Mexico | 2 |
| Cameron | 1 | Nigeria | 3 |
| China | 10 | Pakistan | 2 |
| Colombia | 1 | Papua New Guinea | 2 |
| Croatia | 7 | Peru | 3 |
| Ecuador | 1 | Romania | 3 |
| Egypt | 1 | Rwanda | 4 |
| Ethiopia | 2 | Slovenia | 1 |
| Ghana | 2 | Somalia | 1 |
| Haiti | 4 | South Africa | 5 |
| Honduras | 1 | Tanzania | 1 |
| Hong Kong | 3 | Thailand | 1 |
| India | 41 | Tunisia | 1 |
| Indonesia | 1 | Turkey | 4 |
| Iran | 1 | Uganda | 4 |
| Kenya | 14 | Uzbekistan | 1 |
| Malawi | 5 | Vietnam | 1 |
| Malaysia | 3 | Zambia | 2 |
| | | **Total number of studies** | **159** |

Table III shows the number of studies broken down by development category. The number of countries designated by the World Bank as being in that category is also provided for reference.

TABLE III
Number of Studies in Each Category

| Category | Number of studies | Number of countries |
|---|---|---|
| LICs | 46 | 36 |
| LMICs | 68 | 48 |
| UMICs | 45 | 55 |
| **Total** | **159** | **139** |

Fig. 2 shows that most of the studies identified in this work were addressing HIT in the Indian context. A total of 41 studies were found. Further, Fig. 2 shows the breakdown of these studies into the different categories of HIT. There are 97 countries where no studies have been conducted. From this we can see that telemedicine has gained the greatest number of studies.

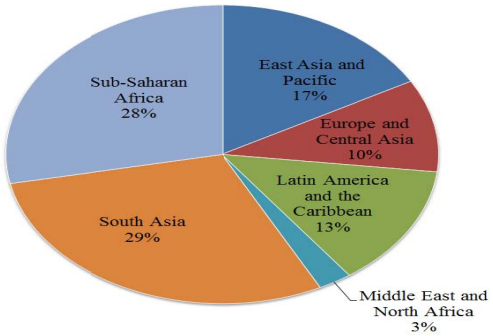


Fig. 3 The distribution of the studies in each region

The findings of this literature review indicate a notable lack of empirical studies that illustrate the current status of HIT in developing countries. This lack is most pronounced in the Middle East and North Africa (see Fig. 3).

Fig. 4 shows the publications of literature in developing countries over the survey period (2000-2012) and shows a rising trend of publications about HIT.

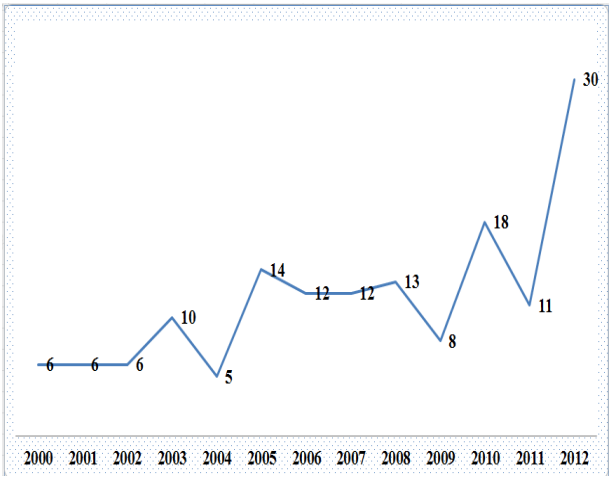


Fig. 4 Number of studies addressing the application of HITs in developing countries from 2000 – 2012

*B. Overview of Methods / Data Collection Tolls Reported in the Literature*

Table IV reports the number of studies adopting each of our methodology categories. Case study is the most common research method, followed by observation. One of the findings of this paper is that a significant number of papers (47) have not explicitly identified the research method and data collection method they used. More studies preferred a quantitative approach rather than a qualitative approach, while 12 studies out of 159 used a mixed methods approach.

TABLE IV
RESEARCH METHODS AND DATA COLLECTION TOOLS

| Research method/Data collection tool | Number |
|---|---|
| Case study | 32 |
| Quantitative | 45 |
| Qualitative | 16 |
| Mixed method | 12 |
| Observation | 4 |
| Experimental | 2 |
| Field study | 1 |
| Other methods | 47 |
| | Total 159 |

## V. DISCUSSION

Overall, the results of this study revealed that HIT is being implemented in developing countries to varying degrees over the last few years. HIT is an issue which is under-researched in some developing, countries, this include countries in the Middle East and North African.

We can see from the literature one of the factors that has been ignored in the HIT literature is organizational memory, and specifically the impact the loss of organizational memory may have on the success or failure of HIT projects. Only [155] addresses this factor in their study. To our knowledge even in IT projects in general, only two studies raised this concern [157], [158].

*A. HIT Promises and Challenges*

We can identify some themes in the literature, one of which is the promise of HIT, and the challenges it brings. HIT has the potential to improve the quality of healthcare and reduce costs [159]-[162]. This can include:

- Helping to manage chronic diseases
- Decision Support Systems helping to provide advice and guidance
- Alerts for abnormal results
- Supporting clinical research

But HIT is a multi-disciplinary field [163] and its evaluation can be complex [164], [165]. Developing countries need to learn lessons from implementing HIT in developed countries. Many academics recognize that HITs have not always succeeded in both developed countries and developing countries [166]-[168] because of its complex nature.

In developing countries, it is to be expected that the failure rate is more pronounced, as developing countries face challenges which be different from those found in developed countries [169], [170]. These challenges may involve political instability, democracy, technical infrastructure, and other factors (see Table I). The range of our study is considered to be wider than recent studies conducted in the field [159]. We have looked at 159 studies addressing HIT in the context of developing countries; our study addresses one of the key limitations of [159] which was the limited choice of keywords used. We employed the strategy of searching for all individual countries' followed by the application of HIT. This yielded a much higher number of studies.

The evidence in this review suggests that the financial factors do not impact the implementation of HIT; however, additional research would need to be conducted to investigate this furtherer. For instance, if we compare Libya (UMIC) and India (LMIC), we found no research has been conducted which address the Libyan context, while at least 41 studies addresses the Indian context. This might be due to various reasons: (1) the population density, whereby most of the population of Libya live in rural areas, (2) the majority of poor countries receive funds from international bodies designed to combat pandemics and diseases; hence policymakers are encouraged by the donors to invest this money in the healthcare sector.

Very little was found in the literature about the use of HIT in certain countries and certain regions. The focus of our future research will be on the countries situated in North Africa, particularly Libya.

It is very clear from Fig. 5 that telemedicine had the highest number of studies, whereas we can only find one study on each of CPOE, PACS and PDAs in the UMICs. For some

application types no studies have been found at all. We need to investigate further whether this is due to these types of systems not being implemented in developing countries, or whether they are implemented but simply not written about in sources accessible to us.

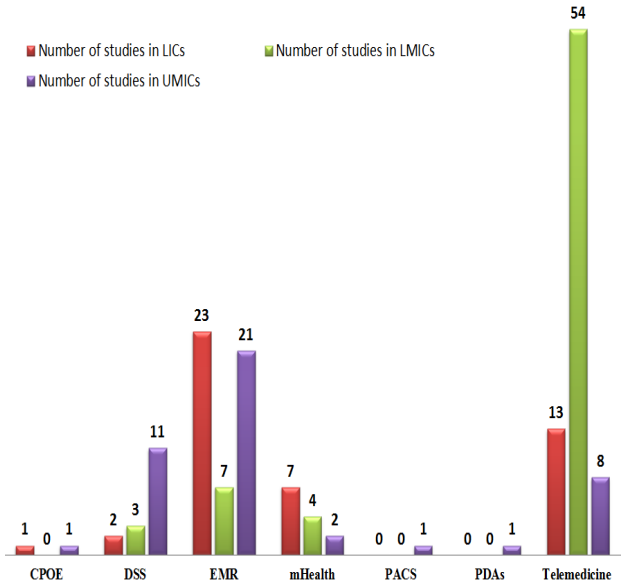


Fig. 5 The various application of HIT in developing countries

### *B. Issues Affecting HIT Implementation in Developing Countries*

Our assumption is that the two main barriers that hinder the implementation of such technologies are (i) awareness of HITs and (ii) limited infrastructure. For instance, some of these systems require a local area network to be used in healthcare centers and this could be considered as a prerequisite. Most developing countries encounter difficulties offering these fundamental requirements.

Our literature review revealed various factors that have an effect on the implementation of HIT. Previous authors have noted that the successful implementation of IT depends upon factors that need to be identified for each country's own requirements [169], [170]. Despite the fact that developing countries share many challenges and factors, each country has its own characteristics, which make the implementation in each country unique.

## VI. HIT and the Missing Evidence

Anecdotal evidence suggests that IT is used in more healthcare organizations in developing countries than those for which studies have been published (and found). Any documentation on these "missing" projects remains unknown and/or ignored. Hence, if the IT solution failed, the organization may attempt it again and previous research shows that organizational memories of that failure are usually not retained, leading to a vicious cycle of failure [157]. Furthermore, where academic literature does exist, it is sometimes of low quality and submitted for research counting exercises rather than to disseminate and share knowledge [171].

Our literature search did not retrieve any literature pertinent to HIT in Libya, so we decided to conduct a manual search in the same databases to find the prevalence of Information Technology in other sectors of the economy (e.g. energy, education and banking). We used a combination of the following keywords in the search: e-Learning, e-Banking, IT - ICT adoption. This search yielded seven studies. It is interesting to note that six of these studies concerned the use of IT in the educational sector, including one study that spanned education, banking and oil. This does not mean that IT has not been used in other sectors of the economy in Libya, but there is none available to us. For all we know, there is a filing cabinet somewhere in Libya full of evidence.

### *A. HIT and National Context*

It might be argued that developing countries may not need to reinvent the wheel to implement HIT solutions and could export HIT programs from developed countries [172]. Reference [160] suggest that any country wishing to implement HIT should follow four steps:

1. Craft ICT architecture and infrastructure;
2. Craft standardization policies, protocols and procedures;
3. Institute user access and accessibility policies and infrastructure; and
4. Institute governmental regulation and control.

Investigating the effect of these steps will be the objective of subsequent stages of this research.

It is crucial for Libya to consider possible barriers and take the necessary precautions before attempting to implement any HIT solutions. It is argued that sustainable HIT can only be maintained if any barriers are successfully considered before any implementation. For instance, potential barriers for successful and suitable HIT are derived from literature: i.e. technical factors, context factors, socio-technical factors, financial factors and academic factors (see Table I). Similar challenges to HIT initiatives are found both in developing countries and developed countries, but there are unique demands for the developing countries which need to be addressed differently along with the factors (see Table I). Moreover, each country requires specialization of its implementations of HIT to cope with the local requirements. Each country has its own particular political, economic and social dimensions (drivers or constraints) that might influence the development of good practice of HIT initiatives.

### *B. Study Limitations*

We have conducted a rigorous review with transparent techniques and strategies. Some limitations need to be addressed.

Firstly, because of the complex and the broad nature of the literature, some subjective judgment inevitably occurs during classification of the studies. Because the coding of the all the papers was done by a single author for all the papers under study.

Secondly, although we have tried to include most of the relevant studies in the review, some might possibly were omitted, particularly those which were not indexed in the searched databases, this may have caused some bias.

Thirdly, there is a paucity of published literature about HIT in Libya. Peer-reviewed literature appears non-existent and even governmental reports are not publicly available and not subject to independent review or regulator bodies. And even writing something which might criticize the government performance can be a risky task especially where corruption is normal practice in many developing countries [173].

Finally, the classification of the factors in Table I do not show where these factors acted as enabler/barrier at each study. For example, if take the case of the regulations, they can be one of the hindrances, when it comes to sharing the patient information with different healthcare providers across the country. Others might see regulations as enabler which helps to protect the patient privacy.

## VII. Further Research

Numerous studies have been conducted in relation to the impact of HIT across developing countries. Research in North Africa is limited, and none at all has been found relating to Libya. Further work will focus on conducting empirical studies in the Libyan context to shed light on the application of HIT in its healthcare institutions.

Sequential Mixed Methods approach will be used to collect data directly from different stakeholders (e.g. IT providers, healthcare professionals, policymakers, the general public).

Our next steps will focus on how to access government reports about the implementation of IT projects in the Libyan healthcare sector.

Although there are numerous applications of HIT, two applications will be the main focus of our future research, namely m-Health and EMRs. Firstly m-Health, because the use of mobile technology has increased dramatically in Libya and almost everyone has a mobile phone. Secondly, EMRs are considered to be the core part of HIT. They provide electronic records which can be inputs to other HIT services. Hence, the main focus of the future research as part of ongoing study will be on the aforementioned applications, with reference to the other applications of HIT.

## VIII. Conclusions

We have summarized and classified the factors that might enable/hinder the implementation of HIT in developing countries (see Table I). The structured review of literature showed that there are numerous factors that could influence the adoption of Health Information Systems in developing countries. The effect of cost on the adoption of HIT in developing countries was the focus of most studies as shown by 96 articles in this review. They tried to identify the cost implications and the likelihood of a good return on investment of HIT in developing countries. 54 articles reviewed various forms of regulations such as standards and the implications of both international and local laws in the adoption of HIT. ICT infrastructure and internet access were reported by 48 and 53 articles respectively. However, only one article reported brain drain as one of the factors affecting HIT adoption. Perhaps this may be as a result of the variation in definition given to it. Brain drain as defined in this study, refers to the migration of people mostly believed searching of better standard of living.

These factors vary by individual country and the literature contains various inconsistent definitions of terms used. We hypothesize that the role of organizational memory merits further investigation as a success factor in successful implementation of HIT in developing countries. We propose to explore whether this can illuminate the likelihood of failure before investing in such technology.

On one hand, the literature suggests that HIT has the potential to enhance the delivery of healthcare services. On the other hand, it has proven to be quite challenging to implement services in developing countries and developed countries alike. This is due to the complex nature of the healthcare process. For instance, there are numerous stakeholders and there are different expectations from the different users of such systems. We propose to develop a multi-stakeholder framework for eHealth success factors in developing countries.

Technology on its own cannot solve all the problems, particularly in a multidisciplinary area like HIT when there are different stakeholders involved in the process. Sociotechnical factors, organizations structure and financial capital need to be taken into consideration.

The findings of the literature review indicate a lack of empirical evidence in North Africa. IT is being used in the various sections of the economy, but that the healthcare sector is still failing to benefit fully from the advantages that IT can offer.

Finally, since the adoption of HIT in healthcare organizations in Libya has not been explored, this research will we hope provide a starting point and open the door for the research community in Libya to conduct further research, for example on the efficacy of healthcare services, disease prevention, reducing mortality and morbidity.

The literature showed that the main causal factors of HIT failure are often human-related rather than always solely technology-related (see Table I). Whilst IT has been used in various sectors of the economy most developing countries, the healthcare sector is still failing to benefit fully from the potential advantages IT can offer. Developing countries do not need to reinvent the wheel to implement HIT solutions; some lessons can be learned from the developed countries taking into account local context. In addition, developing country like Libya, policymakers might need to identify the barriers that could hinder implementing HIT and suggest some strategies for overcoming these barriers. In turn, this might help to ensuring when the government invests implement HIT systems are managed and completed on schedule, sustained, and without deteriorating into partial or complete failure.

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