

# Barriers to Adoption of Hospital Management Systems : A Study of Punjab Healthcare Industry

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## Abstract

The convergence of information technology in healthcare has the potential to revolutionise this sector. Technology integration in the form of hospital management systems popularly known as hospital information systems (HIS) offers a big opportunity not only to enhance service quality, but also reduce healthcare costs and increase patient satisfaction and care. It facilitates integration of hospital processes and management of medical information to foster a culture of efficiency. Nevertheless, in the Indian healthcare sector, as compared to its peer nations, the state of technology integration is dismal, with sluggish adoption of HIS. The state of Punjab is no exception to this. Interestingly, hospitals in Punjab possess advanced medical technology and health care delivery infrastructure, but still, they are trapped in relentless competition, high healthcare costs, and poor patient satisfaction. Numerous barriers exist that refrain the hospitals from implementing HIS. Punjab health challenges, though unique and complex, offer a remarkable opportunity. Our research aimed at specifically identifying the factors that are responsible for the low rate of adoption of hospital management systems in the hospitals of Punjab. It further proposed a suggestive framework to industry practitioners and policy makers to tackle these barriers so as to enhance HIS integration and change the face of the Punjab healthcare industry.

**Key words :** hospital management systems/hospital information systems, healthcare, technology integration, barriers, Punjab

**JEL Classification :** I15, I18, M15, O32

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Technological innovations have provided new ways to improve service quality, promote patient care, and augment operational efficiency in the healthcare industry. Technology integration in healthcare continues to evolve with paradigm shift from the initial EMR systems to the advanced sophisticated hospital management systems/hospital information systems (HIS). HIS are massive, integrated systems that support the comprehensive information requirements of hospitals, including patient, clinical, ancillary, and financial management. It promotes timely and accurate information for evidence based decisions at all levels to enhance the quality of healthcare (Bihari, 2010). It has been adopted widely by countries across the globe, providing innumerable benefits in terms of better access to information, enhanced quality of service delivery, and improved patient care. Though HIS has proven its metal and is known to foster a culture of accuracy and efficiency in healthcare, yet a developing country like India is still facing many challenges and barriers that are in sharp contrast to those faced by the developed countries (Sood, Nwabueze, Mbarika, Prakash, Chatterjee, Ray, & Mishra, 2008).

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India's competitive advantage in healthcare lies primary in the availability of a large pool of well-trained medical professionals and lower medical cost as compared to its peers in the Asia and West. Surprisingly, the cost of surgery in India is nearly one-tenth of that in U.S. or Western Europe. However, the Indian healthcare sector is indeed a paradox. While there are world-class hospitals with state of the art healthcare, their number is small and inaccessible to suburban and rural India. As per WHO National Health Accounts, India's healthcare spending as a percentage of GDP and its health indicators such as IMR and life expectancy continue to lag behind those of LMIC (lower and middle income countries) average (Source: World Bank Database, World Development Indicators covering 214 countries from 1960-2011 with 331 indicators; Mckinsey Analysis). Nonetheless, Indian health outcomes and the quality of underlying health systems significantly lag than those of peer nations.

As of today, the scenario is changing, and healthcare providers are increasingly focusing on the technological aspect of healthcare so as to standardize the quality of service delivery, control costs, enhance patient engagement, and provide timely information for better informed decisions. The formation of the Telemedicine Society of India, the Medical Informatics Society of India, and launching of Health Management Information System (HMIS) portal by the Government of India to convert local health data into real time useful information are certain steps in this direction. This opens up a large market for hospital information systems and information technology (IT) related applications. However, HIS is still at its nascent stage in Indian healthcare, with the medical professionals and management being hesitant to adopt this system owing to huge investments of funds and time.

The state of health affairs is further complicated by inequity in healthcare across different states and various demographic segments within the population. Our research addresses the problems in implementing HIS in healthcare in the state of Punjab. The grim picture of Punjab health sector is not only because of non-availability of qualified health personnel, but largely due to pressures of globally determined economic policy and a strong resource crunch faced by the state. The state has failed in delivering the necessary health care to its people mainly due to poor governance, dysfunctional role of the state, and lack of strategic vision. Consequently, the challenges in integrating IT into the healthcare systems in the state of Punjab are many. The fear of technology failing (paper systems being considered more reliable), greater infrastructure requirements, and lack of awareness about HIS benefits are the bottlenecks in its adoption. Adding to the woes is the reluctance by the hospital managements and medical staff to deploy HIS.

The studies conducted so far on HIS in India have primarily focused on the extent of usage of HIS in healthcare, but very few have studied the barriers in the adoption of HIS in this sector. Moreover, this is a state specific study on the state of Punjab, which is not being conducted earlier. Our research specifically addresses the following research questions:

**RSQ1 :** What is the degree of adoption of hospital information systems in the hospitals of Punjab?

**RSQ2 :** Which barriers or factors are responsible for the non-adoption of HIS by certain hospitals?

**RSQ3 :** What kind of suggestive framework can be developed for industry practitioners and policy makers to help them boost the implementation of HIS in hospitals?

Our research has sound implications for policy makers as it helps them better understand the barriers to HIS implementation and take necessary actions to remove these. Besides, it may be useful to medical practitioners to understand the value of HIS and redefine their health systems to incorporate HIS.

## **Literature Review**

Previous research studies on healthcare have primarily focused on the potentiality of the personal health record (PHR) systems. PHR developers need to consider the impending problems related to designing of security,

confidentiality, and availability of patients' data (Win, Susilo, & Mu, 2006). The management is not always ready to adopt new technology (Tang, Ash, Bates, Overhage, & Sands, 2006). Apart from the management, the paramedical professionals, technicians, lab assistants, and specially the nurses resist the use of technology (Bowies, 1997; Darbyshire, 2000; Mitchell & Sullivan, 2001; Schmitt, Titler, Herr, & Ardery, 2003). Key barriers to electronic medical records were found to be : high initial financial costs, slow and uncertain financial payoffs, and greater physician time. Additional barriers include difficulties with technology, complementary change in support, electronic data exchange, financial incentives, and physician attitudes (Poon, Blumenthal, Jaggi, Honour, Bates, & Kaushal, 2004).

A hospital management faces significant barriers while establishing a hospital and huge investments go into it in terms of infrastructural setup and adoption of integrated information system such as HIS (Wolter & Friedman, 2005). Lack of funds, insufficient resources, and poor infrastructure are proven to be major barriers in the adoption of hospital information systems (Benson & Dha, 2011). Hospitals face cognitive barriers in the form of physical disabilities, insufficient computer skills, non-availability of technical staff, lack of standardization, low rate of computer literacy that should be dealt with before adopting HIS (Archangel, 2007; Hayajneh & Zaghloul, 2012; Ismail, Jamil, Rahman, Abu Bakar, Mohd Saad, & Saadi, 2010; Itumalla, 2012).

Hospitals rely heavily on software vendors for all their IT solutions. The hospital software vendors extend their product range and services to cover the general purpose and the domain specific Open Source Software (OSS) health products (Munoz-Cornejo, 2007). However, the OSS faces challenges such as standardization and integration, human-computer interaction, and the structure of information that hamper adoption of HIS (Hersh, 2004; Ismail et al., 2010; Khalifa, 2014; Wears & Berg, 2005). Ismail et al. (2010) mentioned that raising users' understanding of the system requirements and benefits are important to ensure success. Non-familiarity and uncertainty about the skills related to the use of new applications can affect acceptance of the system (Ash & Bates, 2005; Austin, Pier, Mitchell, Schattner, Wade, Pierce, & Klein, 2006; Karsten & Laine, 2007; Yusof, Papazafeiropoulou, Paul, & Stergioulas, 2008). Interoperability among the various departments within the hospital is also a barrier in the adoption of an information system in a hospital (Jha, DesRoches, Campbell, Donelan, Rao, Ferris, & Blumenthal, 2009). Studies have also highlighted other barriers like lack of clear benefits, insufficient incentives, payer - provider relationships, marketplace competition, and privacy legislation (Kaye, Kokia, Shalev, Idar, Chinitz, 2010; Singh & Muthuswamy, 2013; Sellitto & Carbone, 2007).

Developed countries have adapted new health technologies to a great extent. However, the developing countries are still struggling for it and facing a lot of barriers like inadequate infrastructure, scarcity of resources, absence of skilled workforce, and disinterest of the management to invest in HIS (Anwar & Shamim, 2011). Indian hospitals need to enhance the service quality by using information technology to meet the global competition as well as increasing patient's expectations (Itumalla, 2012). The adoption of HIS incurs heavy investments in terms of installation of technology, escalating the cost of the diagnosis and treatment which acts as a challenge for HIS adoption (Kalpa, 2012). Lack of or shortage of experienced technical staff, poor acceptance of hospital information systems software are major constraints for the adoption of HIS (Khalifa, 2014).

## **Database and Methodology**

All hospitals in and around the peripheral of Punjab comprise the universe of the study covering a broad cross-section of various sizes and age-groups. A sample of 50 hospitals was randomly selected from this universe. For the purpose of the study, primary data was collected using a well-structured questionnaire. The reliability of the questionnaire (internal consistency) was evaluated using Cronbach's alpha (Cronbach, 1984) which is an important reliability index based on the number of the variables of the questionnaire and their correlations. In social sciences research, an alpha value greater than 0.60 is considered quite reliable.

The Table 2(a) reveals that the value of Cronbach's alpha on HIS problems faced by hospitals is 0.714 and this value is high (greater than 0.60), so the scale is quite reliable. The questionnaire so administered was pretested before actual use.

The questionnaire was later mailed to the Senior Consultant Doctors, Proprietors, or Administrators of these hospitals with a request to fill the same and send it back. They were asked to rate their level of agreement with the different barriers in HIS adoption. Full and final responses were received from 31 hospitals constituting a response rate of 62%. The time period of the study is November - December, 2015. Later, charts were used to depict the relation of different hospital related variables, that is, investment, sales revenue, number of employees, and age of hospital (in years) with degree of adoption of HIS.

To identify empirically the factors that hamper the adoption of HIS in hospitals, factor analysis technique was used to reduce the vast number of problems in HIS implementation into a fewer factors/barriers, which explain much of the original data. Kaiser Meyer Olkin (KMO) test shows the suitability of factor analysis. This value varies between 0 and 1. If the value is closer to 1.0, then factor analysis is considered useful. In our study, the KMO measure is 0.512, which confirms the appropriateness of factor analysis (Table 3). Barlett's test of sphericity indicates whether the correlation matrix is an identity matrix. If Barlett's test of sphericity is significant, then it indicates a probably significant relation among variables. In our study, the significance level has a small value, that is, 0.000, which is less than 0.05 (Table 3). Hence, the given variables are highly correlated. The empirical estimates of KMO value and Barlett's test indicate that factor analysis is feasible. Later, principal component analysis was applied to identify the barriers to HIS implementation in hospitals. Varimax rotation was used for factor rotation since it minimizes the correlation across factors and maximizes within the factors.

**Table 1. Classification of Hospitals on the Basis of Different Hospital-Related Variables**

| Classification by Amount of Investment |                | Classification by Sales Revenue              |                |
|----------------------------------------|----------------|----------------------------------------------|----------------|
| Investment Amount                      | % of Hospitals | Sales Revenue                                | % of Hospitals |
| <7.5 million                           | 32.25(10)      | < 3 million                                  | 38.70(12)      |
| 7.5 - 15 million                       | 22.5(7)        | 3-6 million                                  | 22.59(7)       |
| >15 million                            | 45.16(14)      | >6 million                                   | 38.71(12)      |
| Total                                  | 100(31)        | Total                                        | 100 (31)       |
| Classification by Number of Employees  |                | Classification by Age of Hospital (in years) |                |
| No. of Employees                       | % of Hospitals | Hospital Age                                 | % of Hospitals |
| <15                                    | 41.93(13)      | < 11 years                                   | 29.03(9)       |
| 15-30                                  | 29.03(9)       | 11-22 years                                  | 45.16(14)      |
| >30                                    | 29.03(9)       | >22 years                                    | 25.80(8)       |
| Total                                  | 100(31)        | Total                                        | 100(31)        |

Note: Figures in parenthesis shows the number of hospitals in each category

**Table 2(a). Cronbach's Alpha on HIS Problems Faced by Hospitals**

| Reliability Statistics |                                              |            |
|------------------------|----------------------------------------------|------------|
| Cronbach's Alpha       | Cronbach's Alpha Based on Standardized Items | N of Items |
| 0.714                  | 0.714                                        | 18         |

**Table 2(b). Level of Agreement to Different HIS Problems Faced by the Hospitals**

| Problems in HIS Implementation |                                                                                                                                    | <i>Strongly Disagree</i> | <i>Disagree</i> | <i>Neither agree nor Disagree</i> | <i>Agree</i> | <i>Strongly Agree</i> |
|--------------------------------|------------------------------------------------------------------------------------------------------------------------------------|--------------------------|-----------------|-----------------------------------|--------------|-----------------------|
| 1                              | Rigorous user training needs.                                                                                                      | 0.00 (0)                 | 3.22 (1)        | 6.45 (2)                          | 48.39 (15)   | 41.94 (13)            |
| 2                              | Anxiety to adopt new technology by medical, paramedical, and other healthcare specialists.                                         | 0.00 (0)                 | 0.00 (0)        | 12.91 (4)                         | 51.61 (16)   | 35.48 (11)            |
| 3                              | Lack of effective planning and strategy by the top management.                                                                     | 0.00 (0)                 | 0.00 (0)        | 16.13 (5)                         | 51.62 (16)   | 32.25 (10)            |
| 4                              | No standardized approach for selection of suitable vendor for HIS.                                                                 | 0.00 (0)                 | 6.45 (2)        | 25.81 (8)                         | 48.39 (15)   | 19.35 (6)             |
| 5                              | No standardized system for assigning/defining authority- responsibility relationships.                                             | 0.00 (0)                 | 16.13 (5)       | 9.67 (3)                          | 45.17 (14)   | 29.03 (9)             |
| 6                              | No security standards to prevent misuse of patient's private data.                                                                 | 0.00 (0)                 | 6.45 (2)        | 12.90 (4)                         | 45.17 (14)   | 35.48 (11)            |
| 7                              | Higher investments leading to greater financial burden on organization.                                                            | 0.00 (0)                 | 0.00 (0)        | 22.58 (7)                         | 29.03 (9)    | 48.39 (15)            |
| 8                              | Greater infrastructural requirements in terms of servers and PCs with good bandwidth network connectivity and clean power supply . | 0.00 (0)                 | 0.00 (0)        | 9.67 (3)                          | 58.07 (18)   | 32.26 (10)            |
| 9                              | Reluctance by the top management to implement HIS.                                                                                 | 0.00 (0)                 | 12.90 (4)       | 19.35 (6)                         | 35.49 (11)   | 32.26 (10)            |
| 10                             | Lack of customization of the software according to the needs and practices of the hospital.                                        | 0.00 (0)                 | 9.67 (3)        | 19.35 (6)                         | 48.39 (15)   | 22.59 (7)             |
| 11                             | Lack of qualified IT specialists to operate HIS.                                                                                   | 0.00 (0)                 | 9.67(3)         | 9.67 (3)                          | 58.07 (18)   | 22.59 (7)             |
| 12                             | No universal standards or Code of Conduct to maintain medical data or records.                                                     | 0.00 (0)                 | 16.13 (5)       | 12.91 (4)                         | 29.03 (9)    | 41.93 (13)            |
| 13                             | Interoperability /Integration issues among different departments.                                                                  | 0.00 (0)                 | 6.45 (2)        | 16.13 (5)                         | 45.17 (14)   | 32.25 (10)            |
| 14                             | Lack of awareness of HIS value and benefits.                                                                                       | 3.22 (1)                 | 6.45 (2)        | 12.91 (4)                         | 61.29 (19)   | 16.13 (5)             |
| 15                             | Poor financial resources of the concerned organization.                                                                            | 0.00 (0)                 | 3.22 (1)        | 6.45 (2)                          | 54.84 (17)   | 35.49 (11)            |
| 16                             | Regional area limitations (inner city or rural location barriers).                                                                 | 3.22 (1)                 | 16.13 (5)       | 22.58 (7)                         | 22.58 (7)    | 35.49 (11)            |
| 17                             | Poor bandwidth network connectivity.                                                                                               | 3.22 (1)                 | 25.81 (8)       | 9.67 (3)                          | 45.17 (14)   | 16.13 (5)             |
| 18                             | Lack of technically trained medical staff to handle HIS.                                                                           | 0.00 (0)                 | 9.67 (3)        | 16.13 (5)                         | 48.39 (15)   | 25.81 (8)             |

Note: Figures in parenthesis represent the number of hospitals in each category.

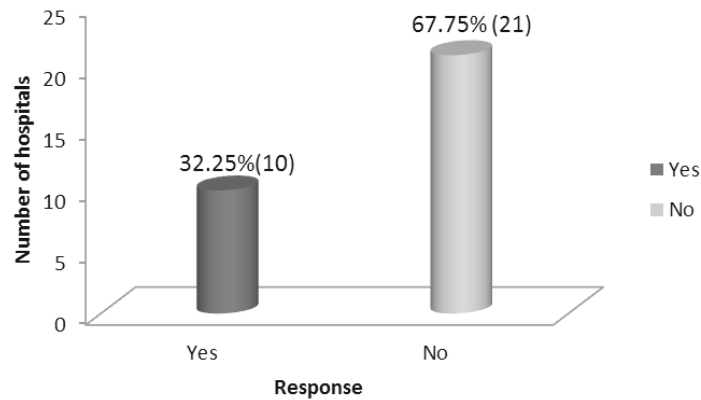
**Table 3. Results of KMO and Bartlett's Test**

|                                                  |                    |         |
|--------------------------------------------------|--------------------|---------|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. |                    | 0.512   |
| Bartlett's Test of Sphericity                    | Approx. Chi-Square | 251.637 |
|                                                  | <i>Df</i>          | 153     |
|                                                  | Sig.               | 0.000   |

## Results and Discussion

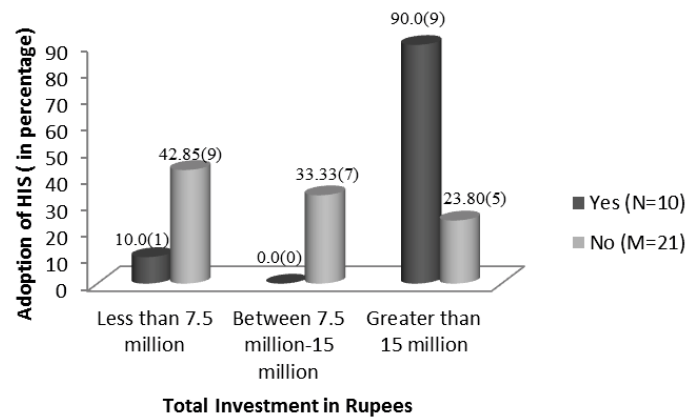
The survey conducted on 31 hospitals in Punjab throws light on some striking observations regarding the current status of technology integration in the Punjab health care industry. It exposes the impending problems and barriers responsible for the low degree of HIS adoption by the hospitals of Punjab. The Table 1 shows the classification of the hospitals on the basis of different hospital related variables, that is, investment, sales revenue, number of employees, and age of the hospitals (in years).

**Figure 1. Adoption of HIS by the Sampled Hospitals in Punjab**



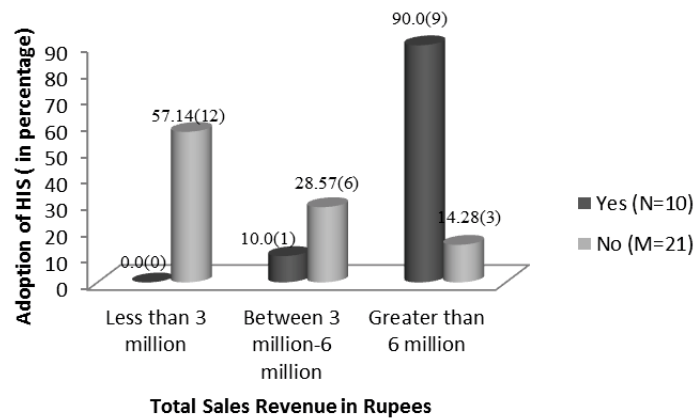
Note: Figures in parenthesis represent the number of hospitals falling into the category

**Figure 2. Adoption of HIS Classified on the Basis of Total Investment**



Note: 1) Figures in parenthesis represent the number of hospitals falling into the category  
2) N = No. of hospitals adopting HIS and M = No. hospitals not adopting HIS. Total hospitals (N+M=31)

**Figure 3. Adoption of HIS Classified on the Basis of Sales Revenue**



Note: 1) Figures in parenthesis represent the number of hospitals falling into the category  
2) N = No. of hospitals adopting HIS and M = No. hospitals not adopting HIS. Total hospitals (N+M=31)

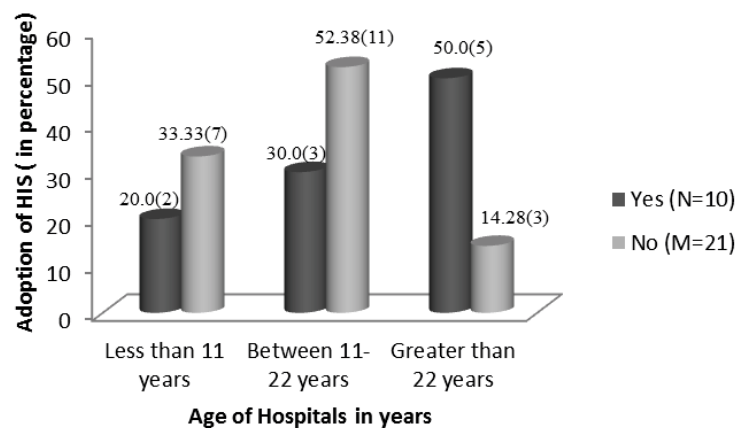


**Figure 4. Adoption of HIS Classified on the Basis of Number of Employees**



Note: 1) Figures in parenthesis represent the number of hospitals falling into the category  
 2) N = No. of hospitals adopting HIS and M = No. hospitals not adopting HIS. Total hospitals (N+M=31)

**Figure 5. Adoption of HIS Classified on the Basis of Hospital Age**



Note: 1) Figures in parenthesis represent the number of hospitals falling into the category  
 2) N = No. of hospitals adopting HIS and M = No. hospitals not adopting HIS. Total hospitals (N+M=31)

**(1) Degree of Usage of HIS in Punjab Based Hospitals :** It is quite discouraging to discover that a meagre 32.25 % of the surveyed hospitals of Punjab (10 out of 31 hospitals) had adopted HIS ; whereas, a huge majority of 67.75 % of the hospitals (21 hospitals) had not adopted HIS at all (Figure 1).

Our survey reports that as the size of investment increases, the degree of HIS adoption also showed an increase (Figure 2). Nine out of ten hospitals adopting HIS had an investment greater than 15 million. In contrast, only one of these hospitals had an investment of less than 7.5 million, and none of the hospitals with an investment of 7.5-15 million had adopted HIS. The most prominent reason for this is that hospitals with greater investment size are in a better position to meet infrastructural, financial, and manpower requirements of HIS. Noticeably, higher is the level of hospital sales, the greater is the adoption of HIS. None of the hospitals adopting HIS had sales revenue less than 3 million and a meagre 10 % (one hospital) of those adopting (10 hospitals) had sales revenue between 3 million to 6 million (Figure 3). Surprisingly, nine hospitals adopting HIS had sales revenue greater than 6 million.

The results affirm that as the number of employees increases, greater is the likelihood of the hospital to adopt HIS. Nine out of 10 hospitals using HIS had more than 30 employees (Figure 4). On the contrary, a scanty 10 % (one hospital) of these hospitals had less than 15 employees (Figure 4). Strikingly, a meagre percentage (4%) of the hospitals adopting HIS had more than 30 employees. With an increase in hospital staff, issues of maintenance, departmental integration, and data handling become even more intricate and cumbersome. Consequently, hospitals are more likely to adopt HIS to enhance and improve manageability of hospitals with a greater staff.

Furthermore, the adoption rate was higher among the older hospitals as compared to their younger counterparts (Figure 5). While 20% (two hospitals) of the hospitals adopting HIS (10 hospitals) are the younger hospitals (with age less than 11 years), nearly 50% (five hospitals) of the hospitals using it were the older ones (with age greater than 22 years). In fact, well established hospitals with greater experience in healthcare are more receptive to adoption of HIS systems. These hospitals feel the need to incorporate latest technologies in routine hospital activities to enhance patient credibility and boost market reputation.

**(2) Problems/Barriers in HIS Implementation :** We surveyed 31 sample hospitals to determine their level of agreement to the various problems in adoption of HIS systems on a 5-point Likert scale. Survey results indicate that 'rigorous user training needs,' 'greater infrastructural requirements,' and 'poor financial resources' emerged as the prominent obstacles in HIS implementation, as quoted by a vast majority (90%) of the sampled hospitals (Table 2 (b)). These results are consistent with the findings of Anwar and Shamim (2011), who found similar barriers. An equally overwhelming majority (80-86%) agreed that 'Anxiety to adopt new technology,' 'Lack of

**Table 4. Principal Component Analysis - Total Variance Explained**

| Component | Total Variance Explained |                     |                    |                                     |                     |                    |                                   |                     |                    |
|-----------|--------------------------|---------------------|--------------------|-------------------------------------|---------------------|--------------------|-----------------------------------|---------------------|--------------------|
|           | Initial Eigen Values     |                     |                    | Extraction Sums of Squared Loadings |                     |                    | Rotation Sums of Squared Loadings |                     |                    |
|           | Total                    | Percent of Variance | Cumulative percent | Total                               | Percent of Variance | Cumulative percent | Total                             | Percent of Variance | Cumulative percent |
| 1         | 3.919                    | 21.774              | 21.774             | 3.919                               | 21.774              | 21.774             | 3.143                             | 17.459              | 17.459             |
| 2         | 2.955                    | 16.417              | 38.191             | 2.955                               | 16.417              | 38.191             | 2.542                             | 14.122              | 31.581             |
| 3         | 2.001                    | 11.117              | 49.308             | 2.001                               | 11.117              | 49.308             | 2.141                             | 11.893              | 43.474             |
| 4         | 1.885                    | 10.473              | 59.781             | 1.885                               | 10.473              | 59.781             | 2.107                             | 11.708              | 55.182             |
| 5         | 1.481                    | 8.228               | 68.009             | 1.481                               | 8.228               | 68.009             | 2                                 | 11.110              | 66.292             |
| 6         | 1.169                    | 6.495               | 74.504             | 1.169                               | 6.495               | 74.504             | 1.478                             | 8.211               | 74.504             |
| 7         | 0.967                    | 5.374               | 79.878             |                                     |                     |                    |                                   |                     |                    |
| 8         | 0.844                    | 4.689               | 84.567             |                                     |                     |                    |                                   |                     |                    |
| 9         | 0.574                    | 3.189               | 87.756             |                                     |                     |                    |                                   |                     |                    |
| 10        | 0.503                    | 2.793               | 90.549             |                                     |                     |                    |                                   |                     |                    |
| 11        | 0.422                    | 2.343               | 92.892             |                                     |                     |                    |                                   |                     |                    |
| 12        | 0.309                    | 1.714               | 94.606             |                                     |                     |                    |                                   |                     |                    |
| 13        | 0.271                    | 1.505               | 96.111             |                                     |                     |                    |                                   |                     |                    |
| 14        | 0.222                    | 1.232               | 97.344             |                                     |                     |                    |                                   |                     |                    |
| 15        | 0.191                    | 1.06                | 98.403             |                                     |                     |                    |                                   |                     |                    |
| 16        | 0.142                    | 0.788               | 99.191             |                                     |                     |                    |                                   |                     |                    |
| 17        | 0.088                    | 0.486               | 99.677             |                                     |                     |                    |                                   |                     |                    |
| 18        | 0.058                    | 0.323               | 100                |                                     |                     |                    |                                   |                     |                    |



**Table 5. Varimax Rotated Component Matrix**

|    |                                                                                                                    | Component |       |       |       |       |   |
|----|--------------------------------------------------------------------------------------------------------------------|-----------|-------|-------|-------|-------|---|
|    |                                                                                                                    | 1         | 2     | 3     | 4     | 5     | 6 |
| 1  | Rigorous user training needs.                                                                                      |           |       | 0.895 |       |       |   |
| 2  | Anxiety to adopt new technology by medical, paramedical, and other healthcare specialists.                         |           |       | 0.623 |       |       |   |
| 3  | Lack of effective planning and strategy by the top management.                                                     |           |       |       |       | 0.842 |   |
| 4  | No standardized approach for selection of suitable vendor for HIS.                                                 |           | 0.647 |       |       |       |   |
| 5  | No standardized system for assigning /defining authority - responsibility relationships.                           |           | 0.816 |       |       |       |   |
| 6  | No security standards to prevent misuse of patient's private data.                                                 |           | 0.896 |       |       |       |   |
| 7  | Higher investments leading to greater financial burden on the organization.                                        |           |       |       | 0.762 |       |   |
| 8  | Greater infrastructural requirements in terms of servers and PCs with network connectivity and clean power supply. |           |       |       | 0.815 |       |   |
| 9  | Reluctance by the top management to implement HIS.                                                                 |           |       |       |       | 0.753 |   |
| 10 | Lack of customization of HIS software according to the needs and practices of the hospital.                        |           |       | 0.651 |       |       |   |
| 11 | No universal standards or Code of Conduct to maintain medical data or records.                                     |           | 0.493 |       |       |       |   |
| 12 | Interoperability /Integration issues among different departments.                                                  | 0.802     |       |       |       |       |   |
| 13 | Lack of awareness of HIS value and benefits.                                                                       | 0.855     |       |       |       |       |   |
| 14 | Poor financial resources of the concerned organization.                                                            | 0.764     |       |       |       |       |   |
| 15 | Regional area limitations (inner city or rural location barriers).                                                 | 0.643     |       |       |       |       |   |
| 16 | Poor bandwidth network connectivity .                                                                              | 0.448     |       |       |       |       |   |
| 17 | Lack of technically trained medical staff to handle HIS.                                                           |           |       |       |       | 0.655 |   |
| 18 | Lack of qualified IT specialists to operate HIS.                                                                   |           |       |       |       | 0.836 |   |

effective strategy by top management,' 'Lack of security standards,' and 'Lack of qualified IT specialists' are major deterrents to HIS implementation. These results are consistent with the findings of Munoz-Cornejo (2007), Archangel (2007), Miller and Sim (2004), and Poon et al. (2004). 'No well defined authority-responsibility relationships,' 'Higher investments,' 'Interoperability issues,' and 'Lack of awareness of HIS value' are other prominent barriers as quoted by 75-79% hospitals. Hsiao, Chen, and Hwang (2008) ; Kaye et al. (2010) ; Kalpa (2012) ; and Khalifa (2014) also highlighted these barriers. Further, 70-75% of the sampled hospitals agreed that 'Lack of customized software,' 'No universal standards for medical records,' and 'Lack of trained medical staff' are other barriers that hinder HIS adoption in hospitals. Munoz-Cornejo (2007) reported 'Vendor selection' as a barrier to the adoption of HIS. 'No standardized approach for vendor selection,' 'Reluctance by top management to implement HIS,' 'Regional area limitations,' and 'Poor network connectivity' were agreed to as problems by a comparatively lesser number of the sampled hospitals.

The Table 3, 4, 5, and 6 show the results of the factor analysis. As discussed earlier, the empirical estimates of Barlett's test and KMO's value indicate that factor analysis is feasible. After application of principal component analysis along with Varimax rotation method, certain factors were extracted. Six factors were retained on the basis of Eigen values (values that represent the total variance explained by each factor) and variance explained. The standard practice normally used is that all the factors with an Eigen value of one or more should be extracted. Clearly, there are six factors having an Eigen value of more than 1 (Table 4). Our research extracted six critical factors/barriers (which cumulatively explained 74.504% of the total variance) that are deterrents to the adoption

**Table 6. Factors Hampering/Barriers in HIS Adoption**

| <b>Factors</b>                                           | <b>Statements</b>                                                                                               | <b>Factor loading</b> |
|----------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|-----------------------|
| <b>Factor 1 : Organizational Barriers</b>                | Interoperability /Integration issues among different departments.                                               | 0.802                 |
|                                                          | Lack of awareness of HIS value and benefits in the organization.                                                | 0.855                 |
|                                                          | Poor financial resources of the concerned organization.                                                         | 0.764                 |
|                                                          | Regional area limitations (inner city or rural location barriers).                                              | 0.643                 |
|                                                          | Poor bandwidth network connectivity in the hospitals.                                                           | 0.448                 |
| <b>Factor 2 : Lack of Universal Standards</b>            | No standardized approach for selection of suitable vendor for HIS.                                              | 0.647                 |
|                                                          | No standardized system for assigning /defining authority - responsibility relationships.                        | 0.816                 |
|                                                          | No security standards to prevent misuse of patient's private data.                                              | 0.896                 |
|                                                          | No universal standards or Code of Conduct to maintain medical data or records.                                  | 0.493                 |
| <b>Factor 3 : Technical Barriers</b>                     | Rigorous user training needs.                                                                                   | 0.895                 |
|                                                          | Anxiety to adopt new technology by medical, paramedical, and other healthcare specialists.                      | 0.623                 |
|                                                          | Lack of customization of HIS software according to the needs and practices of the hospital.                     | 0.651                 |
| <b>Factor-4 : Financial and Infrastructural Barriers</b> | Higher investments leading to greater financial burden on the organization.                                     | 0.762                 |
|                                                          | Greater infrastructural requirements in terms of servers and PCs, network connectivity, and clean power supply. | 0.815                 |
| <b>Factor-5 : Managerial Resistance/Barriers</b>         | Lack of effective planning and strategy by the top management.                                                  | 0.842                 |
|                                                          | Reluctance by the top management to implement HIS.                                                              | 0.753                 |
| <b>Factor-6 : Human Capacity Barriers</b>                | Lack of technically trained medical staff to handle HIS.                                                        | 0.655                 |
|                                                          | Lack of qualified IT specialists to operate HIS.                                                                | 0.836                 |

of HIS in hospitals of Punjab. All the variables/statements with factor loadings greater than 0.40 were considered in the relevant factor (Table 5). After the number of extracted factors was decided, the factors were interpreted and named. The rotated factor matrix is used for this purpose. The name of the factors, variable labels, and factor loadings are summarized in the Table 6.

Factor 1 : Internal Organizational Barriers ; Factor 2 : Lack of Universal Standards and Regulations ; Factor 3 : Technical Barriers ; Factor 4 : Financial and Infrastructural Barriers ; Factor 5 : Managerial Resistance ; and Factor 6 : Human Capacity Barriers emerged as the six barriers to HIS adoption.

On the basis of our study, Internal Organizational Barriers emerged as the most prominent barrier to HIS adoption which explains 21.7% of the total variance. Our results are consistent with those of Hsiao et al. (2008), Ismail et al. (2010), Benson and Dha (2011), Kalpa (2012), and Khalifa (2014), who identified similar organizational factors affecting HIS adoption.

The second major barrier is found to be Lack of Universal Standards and Regulations, which explains 16.4% of the variance. This is consistent with the findings of Fitzgerald and Kenny (2004) ; Poon et al. (2004) ; Munoz-Cornejo, (2007) ; Sellitto and Carbone (2007) ; Hung, Hung, Tsai, and Jiang, (2010) ; and Khalifa (2014).

Technical Barriers explain 11.1% of the variance. Similar challenges were reported by Thiri (2006), Hung et al. (2010), Hayajneh and Zaghloul (2012), Singh and Muthuswamy (2013), and Khalifa (2014).

Financial and Infrastructural Barriers is another important barrier revealed by our study explaining 10.4% of the total variance. This is in line with the findings by Kaye (2010), Benson and Dha (2011), Kalpa (2012), and Khalifa (2014) who also identified financial and infrastructure barriers as a major factor that hampered HIS implementation.

Managerial Resistance emerged as an important barrier that explains 8.2% of the variance. Evidently, the top

management is not always supportive of a change in the conventional style of a hospital's functioning. Studies by Miller and Sim (2004), Poon et al. (2004), Munoz-Cornejo (2007), Archangel (2007), Hsiao et al. (2008), Kaye et al. (2010), Kalpa (2012), and Khalifa (2014) have also highlighted the same. Human Capacity Barriers referring to the shortage of the technically trained medical staff and qualified IT specialists to operate the systems also deter HIS adoption, explaining 6.4% of the variation. Poon et al. (2004), Archangel (2007), Munoz-Cornejo (2007), Hsiao et al. (2008), Miller and Sim (2004), and Kalpa (2012) also mentioned this barrier in their research.

**(3) Suggestive Framework for Enhancing HIS Adoption :** Over the past years, Indian hospitals have overlooked and neglected hospital management systems despite its proven effectiveness in healthcare. This situation is particularly dismal in Punjab, with a sluggish adoption of HIS by the hospitals in the state, as evidenced by our research. Our survey identified the barriers/factors in HIS adoption. This forms the basis for the development of a suggestive framework for enhancing HIS adoption in the hospitals. The framework aims at removing the bottlenecks in traditional hospital systems to foster the implementation of HIS in hospitals of various states of India. It intends to facilitate the health policymakers and practitioners to evaluate, adopt, and procure services in ways that realistically recognize and encourage truly valuable healthcare innovation such as HIS. The framework aims at the following:

**(i) Universal Standards to Maintain Patient Data :** The substantial expansion of healthcare industry in India and the entry of major private players necessitates a strong regulatory system and universal standards to supervise the quality of services delivered and safeguard people against unethical practices. Standard guidelines for HIS and standard operating and audit processes should form the basis of clinical care across public and private sectors, with adequate monitoring by the regulatory bodies. The formation of Telemedicine Society of India and HMIS (Health Management Information System) portal by the Government of India are steps in this direction.

**(ii) Standard IT Training Modules in Medical Informatics :** Standard IT training modules in medical informatics and HIS should be incorporated as a course in the medical education curriculum. Furthermore, courses for improving healthcare should be introduced and continuous medical education programs should be developed. These programs should be implemented by the Ministry of Health and its formal channels.

**(iii) Managing Resistance to HIS Implementation :** Implementation of HIS is often considered to be a threat by the working staff and they resist this change. Identification of the sources and reasons of resistance to adoption of HIS and efforts by the administrator to manage these issues of change would ensure success of the venture. It is the responsibility of the administrator in charge of HIS to plan and involve everyone to enhance its acceptability.

**(iv) Overcoming Technical Barriers :** Technology barriers are the roadblocks relating to infrastructure, technology, and skilled professionals. Most of the HIS systems fail because of the technical issues plaguing them. Hardware maintenance and technical support is essential for HIS to enhance efficiency. Hospitals must ensure that network devices and communication network are in proper working condition. HIS requirement analysis should be performed thoroughly before the design phase and much before the implementation phase.

**(v) Motivating the Support Staff to Use HIS :** Motivating the staff and support staff is an integral part of operating HIS in hospitals. Fostering teamwork among the staff encourages their involvement in maintaining the system. In-house hospital orientation and training programs for newly appointed staff is imperative to overcome the negative beliefs about HIS. A bonus and incentive system may be introduced for those hospital sections who have successfully implemented HIS.

**(vi) Establishing Requisite Infrastructure :** Hospitals need state-of-the-art information technology infrastructure supporting the automation of essential functions and operational workflow of the hospital. The infrastructure should be responsible for integration, synthesis, and information exchange among departments. Adequate infrastructure should be developed ranging from medical machinery to robust privacy and security protections required for HIS implementation.

**(vii) Customized HIS According to Hospital Specific Needs:** HIS system (software) should be customized as per the needs of the hospital and user requirements. The customized HIS should incorporate modules covering billing and administration, electronic medical records, clinical systems, supply chain modules, and business intelligence. Modular approach would improve productivity and the intelligence tools would enable management to take real-time decisions.

**(viii) Fixing Responsibility and Ownership :** Individuals who are a part of HIS implementation should be made responsible for specific tasks. The person in charge of the implementation team should have the discretion to select individuals in his/her team, but he/she himself should be made fully accountable for HIS execution. This is so because unless there is a single person who takes responsibility of the entire process and is accountable for its failure or success, the implementation is likely to falter.

## Research Implications

The present study makes a valuable contribution to the existing body of knowledge in the area of HIS adoption by the Indian healthcare sector. The findings provide a useful platform for hospitals to rethink on the issue of HIS adoption by removing the barriers and also to HIS vendors to develop HIS softwares customized according to the needs of hospitals. We further propose a suggestive framework to industry practitioners and policy makers to tackle these barriers so as to enhance HIS integration and change the face of the Indian healthcare industry. Though HIS is at its nascent stage with many teething problems and tough barriers, it still holds the potential to revolutionize Indian healthcare and foster a culture of quality, accuracy, and efficiency in hospital management. The suggestive framework for healthcare proposed in our study, if initiated and adopted, will provide an impetus to the adoption of hospital management systems/HIS not only in Punjab, but in different states of India. India has embarked upon a journey of healthcare system transformation and reforms. The journey, though challenging and strenuous, offers promising and inspiring possibilities.

## Conclusion

It is disheartening to discover that among the 31 sampled hospitals, the HIS adoption rate was barely 32.25% (10 hospitals) ; whereas, a vast majority (67.75% ; 21 hospitals) of the hospitals had not implemented HIS systems. It is notable that older hospitals and those with larger size in terms of higher investment, higher sales, and greater number of employees had adopted HIS to a greater extent as compared to their younger counterparts with lesser investment, sales, and employee number. Our survey exposes numerous obstacles/problems which hinder HIS adoption by hospitals in Punjab, that is, rigorous user training needs, greater infrastructural requirements, poor financial resources of the concerned organization, apprehensive to adopt new technology, lack of effective planning and strategy by the top management, inadequacy of security standards, and scarcity of qualified IT specialists being the most prominent ones.

To specifically identify the barriers to HIS adoption, principal component analysis along with Varimax rotation method was used for extracting the prime factors/barriers that hamper HIS implementation across Indian

hospitals. The six major factors extracted by our study are identified as : Organisational Barriers, Lack of Universal Standards, Technical Barriers, Financial and Infrastructural Barriers, Managerial Resistance, and Human Capacity Barriers.

## Limitations of the Study and Scope for Future Research

Our study is an area-specific study limiting itself to one-time period only. The scope is restricted to the hospitals of Punjab and hence uncovers the status of the Punjab health care industry as far as HIS implementation is concerned. The present research makes no attempt to analyze the HIS adoption across other states in India.

Hence, there is ample scope of future research that could explore the status of HIS implementation within different states of India. This would provide a deeper insight into the status of technology integration in the Indian health care industry as a whole. Additionally, future researchers could compare the Indian HIS adoption rate with those of other countries to present a true picture of where exactly India stands in the global healthcare industry.

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