

ANALYZING THE IMPACT OF DIGITAL TRANSFORMATION AND ARTIFICIAL INTELLIGENCE ON DELIVERY OF HEALTHCARE SERVICES AT PUBLIC AND PRIVATE HOSPITALS IN MULTAN-PAKISTAN

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Abstract:

This research has been conducted to investigate the impact of digital transformation on the delivery pattern of healthcare services in public and private hospitals in Multan, Pakistan. In order to determine causal relationship between artificial intelligence, digital transformation, financial impediments and the delivery of healthcare services primary data was collected from 200 medical professionals and para-medical staff from 12 public and private hospitals through a structured questionnaire. The empirical results reveal a positive and statistically significant association between artificial intelligence, digital transformation, financial barriers and delivery of healthcare services. The study suggests the use of latest artificial intelligence to make the delivery of healthcare services more efficient and effective.

Keywords: Digital transformation; financial Barriers; artificial intelligence;
delivery of healthcare services

Type of study: Original research Article

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1. Introduction

Improvement in health quality of the patients through latest and updated hospital management system has become a prominent policy in less income countries. Using Digital Transformation (DT) is a significant approach to address the demand for health care services in the 21s century. Digital Transformation (DT) in health care may offer services to the people at door steps. It helps to address growing demands, rising prices, restricted resources, manpower shortages and the national and worldwide distribution of best practices. Health services via DT may also assure efficiency and effectiveness in the health management system. The fields of information science, computer science, information technology, and healthcare all are involved in hospital management systems. Researchers [1] explores the resources, technologies, and methodologies needed to streamline the collection, storage, retrieval, and use of health and biomedical information. Information and communication systems, clinical guidelines, accepted medical language, and computers are all included in this. Unfortunately, developing countries cannot provide good health services due to a lack of resources and funding. It was concluded that the implementation of DT in the healthcare sector could significantly improve the overall performance of its services.

Various studies reported that digital transformation enables innovative business, communication and healthcare models that were previously unthinkable. With more direct and faster connections and larger amounts of data, companies can develop new business ideas and products faster and more flexibly. This development has also led to an increase in customer inquiries and a reduction in response times. These studies also support innovative approaches for healthcare organizations. With the innovation of digital

transformation and the development of medical technologies, the quality of medical care provided by various medical institutions has improved significantly. In addition, it poses new challenges for managers and employees in the healthcare system. Healthcare professionals need to understand how to increase the cost-effectiveness and efficiency of healthcare systems.

With more than 240 million population, Pakistan is the sixth most populous country in the world. About 30% population of Pakistan lives below the poverty line. Life expectancy is 60 years for men and 70 years for women. In Pakistan, the public and private health sectors work in parallel. The health sector is managed by the federal government but is ultimately vested in the provinces. This government strategy reinforces the commitments of provincial governments, which, in relation to the population, lack human resources and health infrastructure. Private hospitals are crucial to the delivery of healthcare throughout the nation. The majority of the clinics is found in populated regions and has modern medical equipment. Demand for private healthcare is higher than that for public healthcare. The DT services are now accessible to the Pakistani healthcare industry: patient management information systems (MIS), biometric attendance systems for physicians and other hospital staff, online payment systems for credit card processing, internet, computers, and mobile phones. According to Pakistan Telecommunications Authority (PTA) (2020), Multan District is a developed and densely populated area in southern Punjab, Pakistan where almost all institutions and individuals have access to 3G and 4G internet services. Previous studies recommended that it is needed to conduct fresh research on the specific dimensions of digital transformation in order to improve hospital management system. Further, fewer studies have conducted on digital transformation particularly in block chain technology,

fog computing and cloud computing intelligence based on Artificial Intelligence (AI) in both public and private hospitals in Pakistan. Therefore, this study has been conducted to examine the current health management system in District Multan-Pakistan because still no study has been carried out in this area regarding the digital transformation (DT), financial barriers (FB), artificial intelligence (AI) and delivery of healthcare service (DHS). Further, the related literature shows that majority of previous studies are quantitative in nature, therefore, the researcher will use both quantitative and qualitative methods to get deep insight into the matter. Additionally, this study will target medical Professionals, paramedical staff and hospital management to record their' views regarding actual services provided to them in the selected hospitals. In this study, both types of hospitals (public and private) are selected which will provide a comparative analysis of public and private healthcare services based on digital transformation and official intelligence.

2. Material and Methods

2.1 Research Design

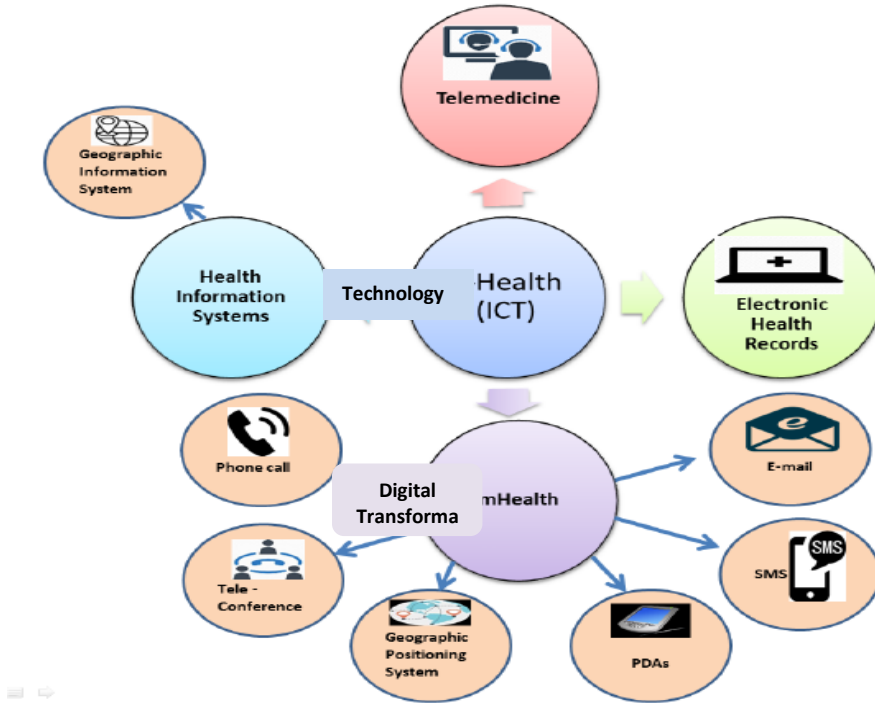
The researcher has employed a descriptive research design as it focuses on observations and perceptions of existing situations, the description and explanation of existing problems, conditions, practices or relationships; Opinions, beliefs and attitudes, ongoing processes and evolution of inclination towards. The survey method is purely quantitative and uses the questionnaire survey method. This research is based on mixed methodology (quantitative and qualitative) in nature; therefore, primary data of healthcare staff (doctors, nurses), patients and management of the selected hospitals as participants will be collected from Public and Private hospitals through quantitative (Close-ended) and qualitative (open-ended) questionnaires which will be analyzed to

find out the answers of this research's questions and also to achieve the research's objectives.

2.2 Theoretical Framework

Technology based e-health/Digital health is defined as “the cost-effective and secure use of technologies in support of health and health related fields, including health care services, health surveillance, health literature and health education knowledge and research”. The delivery of healthcare is being revolutionized by a rising number of technology innovations, according to the World Health Organization. Electronic health records (EHRs), mobile health, telemedicine, and other technology-enabled services are all included under the broad phrase "digital health," which also refers to a variety of related technologies. This theoretical framework has been adopted from the study of Saarikko, Westergren, and Blomquist, (2020) as exhibited in [Figure 1](#)

Fig 1: Theoretical Framework

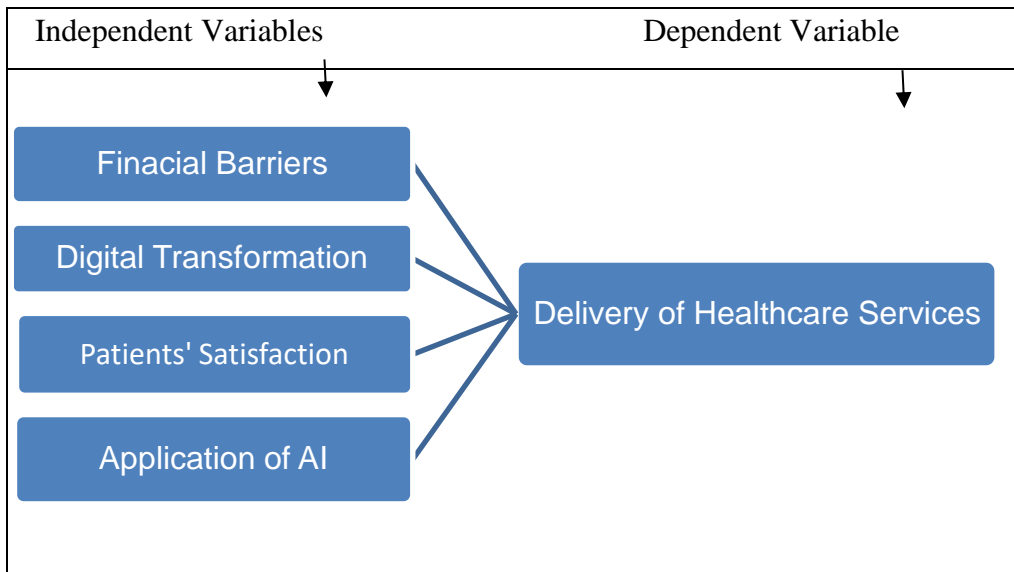


Source: ICT Applications in Health Care, 2020

Telemedicine literally means distance healing. It is defined as “the delivery of healthcare services, where distance is a critical factor, by all healthcare professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for continuing education of healthcare providers, all in the interests of advancing the health of individuals and their communities”. In order to provide healthcare, particularly in isolated rural and remote areas, telemedicine uses computers and telecommunications systems. It assists in cutting costs and travel time to medical facilities while providing specialized healthcare services in emergency situations. Health or mobile health, a component of e-health,

defined as “medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants (PDAs), and other wireless devices,”. The World Health Organization (WHO) is bringing healthcare to remote areas with fanfare. A health information system can be defined as a health data management system. “Health Information System collect data from health sector and other relevant sectors, analyses the data, and ensures their overall quality, relevance and timeliness, and converts data into information for health-related decision making” (World Health Organization 2008). Figure 2 depicts research model of this study.

Fig 2. Sketch of Research Model



2.3 Hypothesis

The hypotheses of study are listed below: -

H₀: Digital transformation does not have any significant impact on delivery of healthcare services in public and private hospitals.

H₁: Digital transformation has significant impact on delivery of healthcare

services in public and private hospitals.

H₀: Financial barriers do not have any significant impact on delivery of healthcare services in public and private hospitals.

H₁: Financial barriers have significant impact on delivery of healthcare services in public and private hospitals.

H₀: Artificial intelligence does not have any significant impact on delivery of healthcare services in public and private hospitals.

H₁: Artificial intelligence has significant impact on delivery of healthcare services in public and private hospitals.

2.4 Area of Study

The study has been conducted in district Multan-Pakistan region. The city is located between 34°01' north latitude and 71°35' east longitude. The total area of Multan is 1,258 square kilometers. The total population of Multan District is 2,019,121 people [18]. Multan is a developing city and the economic center of all surrounding regions. It is the most populous city in all of southern Punjab where there are several public and private hospitals. Nisthar Hospital is the largest public hospital in Multan which also serves entire population of Southern Punjab while the selected City hospital, Bakhtawar Amin hospital and Ibn-e-Seena Hospital are also large and developed private hospitals in Multan city.

2.5 Population and sample of study

The population for the study comprised of all registered health practitioners in public and private hospitals located in District Multan-Pakistan. The target population of this study is the entire health practitioners working in public and private hospitals.

2.6 Sample size and Sampling Technique

The Sample size of this study is 200 participants selected from emergency wards, clinical labs and gynecology wards of the both type (public and private) selected hospitals. It comprises of the 100 medical professionals and 100 paramedical staff and managerial staff selected by using convenient sampling technique.

2.7 Data Reliability and Validity

The items of questionnaires were based on the scales of Hospital Management System (5-items), Digital Transformation (10-items), Artificial Intelligence (5-items), Quality of Healthcare Service (4-items) and Patient Satisfaction (7-items). All scales were measured through 5-point Likert scale (SA=Strongly Agree, A=Agree, N=Neutral, D=Disagree, DA=Strongly Disagree) while patient satisfaction was measured through 3-point Likert scale and Cronbach Alpha Responses of participants against each item were encoded and entered into SPSS software (V.20) wherein data reliability of these 5-scales was analyzed. Values of Cronbach's Alpha were found between 0.85, 0.79, 0.81, 0.77, 0.76 against HMS, DT, AI, and QHS respectively which means scales of this study are valid and reliable.

2.8 Selected Variables

According to the study design and objectives, demographic variables include participants' gender, hospital category and respondents' education while statistical variables include Digital Transformation (DT), Financial Barriers (FB), Patient Satisfaction (PS) and Artificial Intelligence (AI) and Delivery of Healthcare Service (DHS) was considered as dependent variable. Scales of Financial Barriers, Digital Transformation, and Delivery of Healthcare Service were adopted from the previous studies of Malik M. et al.,

(2008).

3. Results

3.1 Descriptive Analysis

In descriptive analysis, demographic characteristics and responses of participants were analyzed through SPSS v.20. Therefore, for interpreting mean scores against the responses of 5-likert scale, the ranges of mean scores are explained as; a). Mean Score 1.00-2.99 is considered equal to Disagree (Negative); b). Mean Score 3.00-4.00 is considered equal to Agree (Positive).

Table 1 contains demographic characteristics of participants.

Table 1.:

Demographic Characteristics of Respondents

Category-wise	Frequency	Percent
Medical Staff	100	50%
Patients	100	50%
Gender-wise		
Male	182	91.0%
Female	18	9.0%
Type-wise		
Public	6	50%
Private	6	50%
Qualification-wise		
Metric	32	16.0%
Intermediate	62	31.0%
Graduation	23	11.5%
Master or above	83	41.5%

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Total	200	100.0%
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Out of total 200 participants, 100 respondents belong to medical staff and 100 respondents belong to patients equally while majority of the participants (182, 91.0%) of this study were males while females were (18, 9.0%). Further, total 12 hospitals were selected from district Multan after the participants were equal participated. Majority of participants (83, 41.5%) Master or above degree holders while 32 (16.0%), 62 (31.0%) and 23 (11.5%) metric, intermediate and graduate degrees holders respectively.

3.2 Analysis of statements.

3.2.1 Financial barriers

The responses of participants about financial barriers and their impact are presented in [table 2](#).

Table 1

Financial Barriers

Item	Statement		SA	A	UN	D	SD	Total	Mean	SD
1	Funds are not sufficient to adopt and implement digital transformation in our hospital	Count	27	66	7	73	27	200	3.88	1.163
		%	13.5	33.0	3.5%	36.5	13.5	100.0		
		%	%	%	%	%	%			
2	Healthcare services are provided on cheap prices in our hospital	Count	31	126	8	8	27	200	3.25	.565
		%	15.5	63.0	4.0%	4.0%	13.5	100.0		
		%	%	%	%	%	%			
3	Digital	Count	6	64	31	62	37	200	2.56	.881

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	transformation has reduced Healthcare costs in our hospital	%	3.0%	32.0	15.5	31.0	18.5	100.0		
				%	%	%	%	%		
4	Healthcare services are costly due to emerging technologies i.e. AI, Big Data, Virtual consultation	Count	11	32	20	83	54	200	3.32	.933
		%	5.5%	16.0	10.0	41.5	27.0	100.0		
				%	%	%	%	%		
5	Technological devices are available due to sufficient of funds.	Count	32	53	3	82	30	200	2.14	1.218
		%	16.0	26.5	1.5%	41.0	15.0	100.0		
			%	%		%	%	%		

The above results indicate that only three statements show positive mean score (3.88, 3.25, 3.32 > 3.0) which means majority of respondents were agreed that Funds are not sufficient to adopt and implement digital transformation in public hospitals, healthcare services are provided on less cost in the hospital and healthcare services are costly due to emerging technologies i.e., AI, Big Data, Virtual consultation. Responses under two statements show negative mean score (2.56, 2.14 < 3.0) which means majority of respondents are disagreed that Digital transformation has reduced Healthcare costs in private hospitals and Technological devices are available due to sufficient funds.

3.2.2 Digital transformation

The views of participants about digital transformation in the selected hospitals are given in table 3.

Table 2

Digital Transformation

Item	Statement		SA	A	UN	D	SD	Total	Mean	SD
1	Digital technologies make hospital management system more affective and result-oriented	Count	50	10	1	41	200	98	2.35	.720
		%	25.0%	5.0%	0.5%	20.5%	100.0%	49.0%		
2	Process of diagnoses and treatment would speed up with digital technologies	Count	28	62	56	49	200	5	3.23	.759
		%	14.0%	31.0%	28.0%	24.5%	100.0%	2.5%		
3	Digital transformation makes interaction easy and flexible among patients, medical staff and hospital management system.	Count	37	24	67	49	200	23	1.31	.462
		%	18.5%	12.0%	33.5%	24.5%	100.0%	11.5%		
	Digital	Count	103	24	13	29	200	31	3.07	

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4	transformation ensures the accountability and efficiency of medical staff regarding health services.	%	51.5%	12.0%	6.5%	14.5%	100.0%	15.5%		1.108
5	Digital transformation improves transparency in Hospitals management system	Count	74	59	61	27	10	231	3.10	.642
		%	12.5%	10.0%	10.3%	4.6%	1.7%	39.0%		
6	Through digital transformation, hospital management system can solve patients and improve their system.	Count	50	10	1	41	200	98	2.35	.720
		%	25.0%	5.0%	0.5%	20.5%	100.0%	49.0%		
7	The hospitals must have an effective system for employees to make suggestions for management how to improve quality of services.	Count	28	62	56	49	200	5	3.23	.759
		%	14.0%	31.0%	28.0%	24.5%	100.0%	2.5%		
	Hospital staff must	Count	37	24	67	49	200	23	1.31	

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8	be trained to diagnose quickly to treat patients	%	18.5%	12.0%	33.5%	24.5%	100.0%	11.5%		.462
9	Staff must be rewarded and recognized (financially/officially) for improving quality and efficiency	Count	103	24	13	29	200	31	3.07	1.108
		%	51.5%	12.0%	6.5%	14.5%	100.0%	15.5%		
10	The hospitals must have effective policies to improve the quality of healthcare services.	Count	74	59	61	27	10	231	3.10	.642
		%	12.5%	10.0%	10.3%	4.6%	1.7%	39.0%		

The Responses of participants about digital transformation are shown in table 3 which suggest that six statement show positive mean score (3.23, 3.07, 3.10, 3.23, 3.07, 3.10 > 3.0) which means majority of respondents were agreed that first; process of diagnoses and treatment would speed up with digital technologies, second; digital transformation ensures the accountability and efficiency of medical staff regarding health services, third; digital transformation improves transparency in hospitals management system, fourthly; the hospitals must have an effective system for employees to make suggestions for management how to improve quality of services, fifth; staff must be rewarded and recognized (financially/officially) for improving quality and efficiency and sixth; the hospitals must have effective policies to improve the quality of healthcare services. Responses under four statements show negative mean scores (2.35, 1.31, 2.35, 1.31 < 3.0) which means majority of

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respondents are disagree that digital technologies make hospital management system more effective and result-oriented, digital transformation makes interaction easy and flexible among patients, medical staff and hospital management system, through digital transformation, hospital management system can solve patients and improve their system and hospital staff must be trained to diagnose quickly to treat patients.

3.2.3 Artificial intelligence

The views of the participants about the application of artificial intelligence tools in the selected public and private hospitals are presented in the [table 4](#).

Table 3:

Artificial Intelligence

Item	Statement		SA	A	UN	D	SD	Total	Mean	SD
1	Technology is emerged into the Hospital management system to identify patients-health specific issues and their remedies.	Count	19	46	6	101	28	200	2.23	1.100
		%	9.5%	23.0%	3.0%	50.5%	14.0%	100.0%		
2	The use of AI reduces financial costs and treatment duration of patients	Count	16	53	3	92	36	200	3.20	1.098
		%	8.0%	26.5%	1.5%	46.0%	18.0%	100.0%		
3	Smart healthcare system is used for disease surveillance and tracking in our hospital	Count	34	34	42	42	48	200	3.39	.580
		%	17.0%	17.0%	21.0%	21.0%	24.0%	100.0%		

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4	Artificial Intelligence is emerged in hospital management system to manage big data of patients	Count	34	104	11	21	30	200	1.92	.538
		%	17.0	52.0	5.5%	10.5	15.0	100.0		
			%	%		%	%	%		
5	The correlation between the patients' medical data and their age, gender, and environment can be easily detected through emerging technologies.	Count	14	57	12	92	25	200	3.14	1.055

Under the Artificial Intelligence, 5-statements were asked to get participants' opinion. Responses are shown in table 4.7 which indicates that only three statement show positive mean score (3.20, 3.39, 3.14 > 3.0) which means majority of respondents were agreed with the statements that the use of AI reduces financial costs and treatment duration of patients, smart healthcare system is used for disease surveillance and tracking in our hospital and the correlation between the patients' medical data and their age, gender, and environment can be easily detected through emerging technologies. Responses under two statements show negative mean score (2.23, 1.92 < 3.0) which means majority of respondents are disagreed with the statements that the Technology is emerged into the Hospital management system to identify patients-health specific issues and their remedies and the correlation between the patients' medical data and their age, gender, and environment can be easily

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detected through emerging technologies. [Table 5](#) shows delivery of healthcare services.

3.2.4 Delivery of Healthcare Services

The responses of participants about delivery of healthcare services in the selected hospitals are summarized in [table 5](#).

Table 4

Delivery of Healthcare Services

Item	Statement		SA	A	UN	D	SD	Total	Mean	SD
1	Quality of current healthcare services in public hospitals is	Coun	77	80	5	19	19	200	1.72	.829
		%	38.5%	40.0%	2.5%	9.5%	9.5%	100.0%		
2	Speed of patients' recovery from disease in public hospitals is	Coun	29	121	15	13	22	200	3.27	.605
		%	14.5%	60.5%	7.5%	6.5%	11.0%	100.0%		
3	Staff of public hospitals is curious to treat patients	Coun	35	38	25	84	18	200	2.02	1.222
		%	17.5%	19.0%	12.5%	42.0%	9.0%	100.0%		
4	Majority of patients chooset	Coun	33	58	16	69	24	200	3.38	1.163

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	public hospitals for their treatment on the basis of zero cost health services.	%	16.5%	29.0%	8.0%	34.5%	12.0%	100.0%		
5	Medical staff of public hospitals is more qualified than private hospitals.	Counst	31	111	9	9	40	200	3.45	.565
		%	15.5%	55.5%	4.5%	4.5%	20.0%	100.0%		

Under the Delivery of Healthcare Services, 5- statements were asked to get participants' opinion. Responses are shown in table 4.8 which indicates that three statement show positive mean score (3.27, 3.38, 3.45 > 3.0) which means majority of respondents were agreed that Speed of patients' recovery from disease in public hospitals is, Majority of patients choose public hospitals for their treatment on the basis of zero cost health services and medical staff of public hospitals is more qualified than private hospitals. Responses under two statements show negative mean score (1.72, 2.02 < 3.0) which means majority of respondents are disagreed that Quality of current healthcare services in public hospitals is and Staff of public hospitals is curious to treat patients

3.3 Comparison of Means

In order to compare the latest status of public and private hospitals regarding the digital transformation in delivery of healthcare services, analysis of compare means among this study's variables according to their categories and names was considered. Results of mean comparison among hospital categories and names are presented in [Table 6.-](#)

Table 6

Hospitals' Category-wise Comparison

Hospital Category		Digital Transformation	Financial Barriers	Artificial Intelligence	Delivery of Healthcare Services	Patient Satisfaction
Public	N	231	231	231	231	231
	Mean	10.63	11.66	10.44	10.99	11.91
	S.D	3.71	3.82	3.65	3.88	3.75
Private	N	361	361	361	361	361
	Mean	10.86	11.56	10.79	11.26	12.20
	S.D	3.60	3.41	3.33	3.32	4.16
Total	N	592	592	592	592	592
	Mean	10.72	11.62	10.57	11.15	12.09
	S.D	3.67	3.57	3.53	3.55	4.01

Highest total mean score 12.09 reveals that the private hospitals got high patient satisfaction rate while overall mean scores 10.86, 10.79, 11.26 and 12.20 has been chased by private hospitals in the use of digital transformation, artificial intelligence, deliver of hospital services and patient satisfaction respectively as compared to public hospitals. The comparison of hospitals' services is shown in [Table 7](#).

Table.7

Comparison of Hospitals' services

Institute Name		Digital Transformation	Financial Barriers	Artificial Intelligence	Services Delivery of Healthcare	Patient Satisfaction
Nishtar Hospital, Multan	N	17	17	17	17	17
	Mean	11.56	13.15	8.84	10.08	12.35
	S.D	2.87	4.55	4.29	4.42	6.30
Govt. Civil Hospital, Multan	N	16	16	16	16	16
	Mean	7.98	10.97	10.57	10.53	12.40
	S.D	3.49	3.64	3.30	3.17	4.38
Fatima Jinnah Hospital, Multan	N	17	17	17	17	17
	Mean	10.23	12.35	9.98	11.13	11.82
	S.D	3.12	3.23	3.51	3.12	3.50
CPIH Hospital, Multan	N	16	16	16	16	16
	Mean	10.92	11.48	9.69	12.25	12.16
	S. D	2.72	3.02	3.23	4.73	3.32
Nawaz Sharif Hospital, Multan	N	17	17	17	17	17
	Mean	12.54	13.05	11.28	9.08	11.67
	S. D	4.22	3.38	2.97	3.30	2.90
City Hospital, Multan	N	16	16	16	16	16
	Mean	12.97	9.27	12.80	12.33	13.08
	S. D	3.61	2.52	2.64	3.59	3.10
Khawaja Farid Hospital, Multan	N	17	17	17	17	17
	Mean	11.10	12.56	10.80	11.56	12.89
	S. D	3.13	2.92	3.92	2.59	4.30
Mukhar A Sheikk	N	16	16	16	16	16

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Hospital, Multan	Mean	10.92	10.97	10.57	10.53	12.40
	S. D	3.49	3.64	3.30	3.17	4.38
Fatima Hospital Multan	N	17	17	17	17	17
	Mean	10.23	12.35	9.98	11.13	11.82
	S. D	3.12	3.23	3.51	3.12	3.50
Ibn-e-Sina Hospital, Multan	N	17	17	17	17	17
	Mean	7.98	9.27	9.69	12.25	12.16
	S. D	2.72	3.02	3.23	4.73	3.32
Bakhtawar Amin Hospital, Multan	N	16	16	16	16	16
	Mean	12.54	13.05	11.28	11.22	11.67
	S. D	4.22	3.38	2.97	3.30	2.90
Buch Villas Hospital, Multan	N	17	17	17	17	17
	Mean	11.56	11.48	9.34	11.93	12.35
	S. D	3.61	2.52	2.64	3.59	3.10

Highest mean scores 12.97, 12.80, 12.33 and 12.33 by City Hospital Multan in digital transformation, artificial intelligence, delivery of healthcare services and patient satisfaction while Nishtar Hospital got lowest mean score (8.84) in use of Artificial Intelligence and highest mean score (13.15) in financial barriers. Similarly, City Hospital, Multan got lowest score (9.27) in financial barriers while Nawaz Sharif Hospital got lowest mean score (9.08) and (11.67) in Delivery of Healthcare Services and Patient Satisfaction respectively.

3.4 Empirical analysis

The empirical analysis was carried out by using different statistical tools. The estimated results are shown in the following tables.

3.4.1 Reliability and validity of data

The results of reliability and validity tests are presented in [Table 8](#).

Table 8

Data Validity & Reliability

Variables	Scale Mean if item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Financial Barriers	77.2250	136.698	.792	.868
Digital Transformation	79.3200	171.073	.441	.905
Artificial Intelligence	76.8050	132.731	.788	.869
Delivery of Healthcare Service	79.7400	143.108	.781	.869
Patient Satisfaction	78.4050	165.478	.657	.887

The questionnaire used in this study was updated and modified in the light of experts' opinion and the observations of author during pilot study; therefore, the validity of data collection tool was confirmed while the data reliability was also confirmed through statistical tool SPSS v.20 wherein Cronbach's Alpha values of all scales met the minimum required values (>0.7).

3.4.2 One sample T-test

The results of t-test are shown in [Table 9](#).

Table 9:

Results of Sample T-Test

Variables	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Financial Barriers	67.662	199	.000	14.04000	13.6308	14.4492
Digital Transformation	80.497	199	.000	11.94500	11.6524	12.2376
Artificial Intelligence	65.066	199	.000	14.46000	14.0218	14.8982
Delivery of Healthcare Service	61.496	199	.000	11.52500	11.1554	11.8946

Significant differences among variables are determined through t-test as well as to know the strongest predictor on the dependent variable. In the above table 3.10, t values and total mean score against each variable show the differences among variables. The highest mean score 14.72000 and t-statistic value 99.557 show that the Delivery of Healthcare services has the strongest impact on Patient Satisfaction.

3.4.3 Correlation Matrix

Table 10 contains results of Correlation Matrix, indicating strength of correlation between variables.

Table 10 Results of Correlation Matrix

		DHS	DTS	AI	FB	PS
DHS	Pearson Correlation	1	.252**	.709**	.720**	.843**
	Sig. (2-tailed)		.000	.000	.000	.000
	N	200	200	200	200	200

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DTS	Pearson Correlation	.252**	1	.280**	.290**	.452**
	Sig. (2-tailed)	.000		.000	.000	.000
	N	200	200	200	200	200
AI	Pearson Correlation	.709**	.280**	1	.691**	.450**
	Sig. (2-tailed)	.000	.000		.000	.000
	N	200	200	200	200	200
FB	Pearson Correlation	.720**	.290**	.691**	1	.483**
	Sig. (2-tailed)	.000	.000	.000		.000
	N	200	200	200	200	200
	N	200	200	200	200	200

** . Correlation is significant at the 0.01 level (2-tailed).

Table 10 shows the 2-tailed significant correlations among variables of this study. Results show that all variables have significant and positive relationship with each other. In order to test hypothesis of this study, correlations among study variables were examined through Pearson correlation test. The correlations values among FB, DTS, AI, DHS and PS are shown in table 4.14 which reveal that there is significant and positive ($p > .05$) relationship among below variables of this study, therefore, the following hypotheses of this study are supported;

4. Discussion

The key findings of this study are elaborated as under: -

4.1 Demographic characteristics of Participants

Out of total 200 participants, majority of participants were doctors (83, 41.5%) while paramedical (62, 31%), pharmacist (23, 11.5%), and admin (32, 16%) respectively while majority of the participants (182, 91.0%) of this study

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are males while females are (18, 9.0%). Further, total 12 hospitals (6-Public and 6-Private) were selected in district Multan from which the participants were equally distributed. Similarly, majority of participants (83, 41.5%) Master or above degree holders while 32, 16.0%, 62, 31.0% and 23, 11.5% metric, intermediate and Graduation degrees holders respectively.

4.2 Findings about Financial Barriers

Three statements under Financial Barriers show positive mean score (3.88, 3.25, 3.32 > 3.0) which means majority of respondents were agreed that funds are not sufficient to adopt and implement digital transformation in our hospital, Healthcare services are provided on cheap prices in our hospital and Healthcare services are costly due to emerging technologies i.e. AI, Big Data, Virtual consultation. Responses under two statements show negative mean score (2.56, 2.14 < 3.0) which means majority of respondents are disagreed that Digital transformation has reduced Healthcare costs in their hospitals and Technological devices are available due to sufficient funds.

Information technology and other enabling technologies are significantly more expensive than traditional approaches and do not correspond directly to sources of investment. Governments in developing countries cannot afford these technologies without help.

4.3 Findings about Digital Transformation

Responses indicate that six statement show positive mean score (3.23, 3.07, 3.10, 3.23, 3.07, 3.10 > 3.0) which means majority of respondents were agreed that firstly; process of diagnoses and treatment would speed up with digital technologies, secondly; digital transformation ensures the accountability and efficiency of medical staff regarding health services, thirdly; digital transformation improves transparency in hospitals management system,

fourthly; the hospitals must have an effective system for employees to make suggestions for management how to improve quality of services, fifthly; staff must be rewarded and recognized (financially/officially) for improving quality and efficiency and sixthly; the hospitals must have effective policies to improve the quality of healthcare services. Responses under four statements show negative mean scores (2.35, 1.31, 2.35, 1.31 < 3.0) which means majority of respondents are disagreed that digital technologies make hospital management system more affective and result-oriented, digital transformation makes interaction easy and flexible among patients, medical staff and hospital management system, through digital transformation, hospital management system can solve patients and improve their system and hospital staff must be trained to diagnose quickly to treat patients.

4.4. Findings about Application of Artificial Intelligence

Majority of respondents were agreed that the use of AI reduces financial costs and treatment duration of patients, smart healthcare system is used for disease surveillance and tracking in our hospital and the correlation between the patients' medical data and their age, gender, and environment can be easily detected through emerging technologies. Responses under two statements show negative mean score (2.23, 1.92 < 3.0) which means majority of respondents are disagreed that the Technology is emerged into the Hospital management system to identify patients-health specific issues and their remedies and the correlation between the patients' medical data and their age, gender, and environment can be easily detected through emerging technologies. There is a great need to develop quantitative and statistical tools to enable robust and robust data analysis. Decision support systems are needed to support doctors in their decision making.

4.5. Findings about delivery of healthcare services

Responses indicate that three statements show positive mean scores (3.27, 3.38, 3.45 > 3.0) which means majority of respondents were agreed that Speed of patients' recovery from disease in public hospitals is, Majority of patients choose public hospitals for their treatment on the basis of zero cost health services and medical staff of public hospitals is more qualified than private hospitals. Responses under two statements show negative mean scores (1.72, 2.02 < 3.0) which means majority of respondents are disagreed that quality of current healthcare services in public hospitals is and Staff of public hospitals is curious to treat patients.

5. Conclusions and policy implications

The findings of this study underscore the significant impact of digital transformation on healthcare delivery in both public and private hospitals in the Multan-Pakistan region. While there have been positive changes in the effectiveness and efficiency of healthcare management due to the adoption of modern technologies, several challenges are still looming to face.

- Despite the strides made in digital healthcare, there are disparities in the availability of qualified staff and patient awareness between public and private hospitals. This inhibits the full utilization of e-health services and undermines the potential benefits of digital transformation.
- The quality of electronic medical service delivery equipment provided by public hospitals is often subpar, limiting the effectiveness of eHealth services. Moreover, inadequate government budget allocations and a lack of central oversight further impede the delivery of quality healthcare services in public administrations.
- The study also highlights the vast potential for improvement in healthcare

systems, particularly through the collaboration of government and private sectors. Leveraging Pakistan's robust IT and medical human resources can lead to transformative changes in healthcare delivery, benefiting patients, physicians, staff, and other stakeholders.

The findings of this study hold significant policy implications for healthcare stakeholders and policymakers in Pakistan.

Firstly, investment in human resources emerges as a critical priority. Both government and private sectors should allocate resources towards training healthcare staff in the effective utilization of digital healthcare technologies. This includes providing continuous education and skill development programs to equip healthcare professionals with the necessary expertise to leverage digital tools for improved patient care and management efficiency.

Secondly, infrastructure development plays a pivotal role in enhancing the delivery of eHealth services. Public hospitals, in particular, require substantial investment in upgrading their electronic medical service delivery equipment. By ensuring the availability of quality equipment and technological infrastructure, policymakers can enable healthcare facilities to deliver reliable and efficient digital healthcare services to patients across the region. Third, awareness campaigns are essential to promote the adoption of e-health services among the general population. Government initiatives should focus on raising awareness about the benefits and accessibility of digital healthcare technologies. Clear guidelines and instructions for accessing e-health services should be disseminated to patients, fostering greater engagement and utilization of these services for improved health outcomes.

Fourth, budget allocations for eHealth initiatives also warrant attention from policymakers. Adequate funding is necessary to sustain and scale-up digital

healthcare programs effectively. Governments at both federal and provincial levels should prioritize budget allocations towards eHealth initiatives, ensuring the sustainability and equitable distribution of resources to support healthcare transformation across the region.

Fifth, fostering public-private partnerships (PPPs) can drive innovation and enhance healthcare delivery in the region. Collaboration between the government and private sectors can leverage the strengths and expertise of both entities to address healthcare challenges more effectively. By fostering PPPs, policymakers can facilitate the development and implementation of innovative digital healthcare solutions that cater to the diverse needs of patients and healthcare providers. In short, addressing the policy implications outlined above requires concerted efforts from all stakeholders, including government agencies, healthcare providers, technology firms, and civil society organizations.

6.1 Theoretical contribution

This study supports to those theories which advocate for the right to healthcare, aligning with principles of the Social Determinants of Health theory (Marmot, 2005), which stresses on the need equal access to quality healthcare services for all citizens, promoting the idea that healthcare is a fundamental right. The findings of this study contribute to the Technology Acceptance Model suggested Davis, in (1989) which exhibits positive changes in the digital transformation of healthcare. This model suggests that effectiveness of management in the delivery of healthcare services highlight the fact that the patients are accepting and adapting to digital technologies in health sector. Moreover, the findings of this study also align with Innovation Diffusion Theory proposed by Rogers in 1962. This theory demonstrates that

adoption of digital healthcare solutions bring positive change in public and private hospital and in this case digital technology has led to improved healthcare services. This study also resonates with the Information Systems Success Model (DeLone & McLean, 1992) which suggests that the use of modern devices contributes to the success of information systems in healthcare and it enhance monitoring systems in the hospitals. The results of this study are consistent with the Patient-Centered Care model (Kitson et al., 2013) that focuses on patient-centric approach by applying modern technology in healthcare delivery. It also aligns with model's core principles of providing close care to the patients in respectful and responsive way. This study addresses the core principle of the Digital Divide Theory (Van Dijk, 2005) by demonstrating disparities in the adoption and utilization of e-health services. The unavailability of skilled and qualified paramedical staff in private hospitals and lack of digital services at public hospitals reflects clear digital divide which affects the equitable provision of digital healthcare services and benefits among patients. The insufficient budgetary allocation and of effective digital services in the public hospital aligns with the Policy Implementation Theory (Pressman & Wildavsky, 1973), which urges to implement policies effectively in order to provide healthcare services to the patients at nominal cost and without any discrimination and difficulties. The study also supports to the Institutional Theory proposed by (DiMaggio & Powell, 1983) and this theory pinpoints the institutional factors that influence the adoption and digital healthcare system. The digital divide between public and private hospitals and ineffective government policies emphasizes on the need of strengthening institutions by shaping digital healthcare practices. In the context of these theoretical perspectives, this study provides a valuable insight about the digital

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transformation of healthcare sector by integrating technology, healthcare management and public policy.

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The ethical approval sought from the concerned authorities and participants. The consent of participants was also obtained. All authors read final manuscript of the paper and were agreed to submit it for publishing.

Data Statement

The data that supports the findings of this study will be made available by corresponding author on strong request.

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