Diffusion of Innovation and Viability of Hospitals - An Empirical Study

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Abstract

Though the impact of innovation on firms' performance is a widely studied topic, there is a dearth of research on this topic specific to private hospitals in India. The objectives of this study were to assess the diffusion of innovation among private hospitals, to examine the relationship between innovation adoption and viability of private hospitals and to examine variations in diffusion of innovation across various categories of private hospitals. This was a quantitative study conducted among 154 private hospitals in Kerala in Jan 2021. Responses to 4 statements related to innovation and 3 statements related to viability were captured using a 5 point Likert scale. Bivariate correlation results indicated that there is a positive correlation between adoption of innovative practices by hospitals and their viability. Variations in diffusion of innovation across types of hospitals were examined using independent sample t-test or ANOVA. Hospitals with specialty services, hospitals with inpatient facility, hospitals located in urban areas and newer hospitals were seen to be more open to adopting innovative practices. Findings of the study have significant implications to hospitals. Since innovation is seen to have an impact on viability it is important that hospitals adopt innovative practices in healthcare.

Key words: Diffusion of innovation, Healthcare innovation, Hospitals, Viability.

1.   Introduction

Healthcare innovation is about finding new and more effective ways of solving healthcare problems. The aim of healthcare innovation is to provide accessible, affordable and sustainable healthcare at personal and public level and also to improve quality, safety, effectiveness and efficiency of healthcare solutions. Innovation can be in the area of technology, policies, systems, products, services or ideas. For the many innovations in the healthcare sector to be considered useful, they need to penetrate far enough to reach the end consumers i.e. patients. This can happen only through diffusion of innovation among hospitals. It needs to be noted that while innovations in diagnosis and treatment of diseases is critical for quality, safety and effectiveness of healthcare delivery, it is innovations in management practices, cost control and patient management that ensures accessibility and affordability of healthcare services. Hence adoption of innovative practices by hospitals in all these areas is equally important. It is important to assess diffusion of innovation in our hospitals to understand if patients actually stand to benefit from the many healthcare innovations. Private hospitals in the country operate in a business environment that is characterized by fierce competition that makes their survival challenging. From an organisational point of view, the ultimate test for effectiveness of hospital innovations would be its impact on the viability of hospitals. Examining the relationship between innovation and viability of hospitals can help us appreciate the importance of innovation for healthcare providers.

2.   Review of Literature

Harvard Business Review (2003) defines innovation as the embodiment, combination or synthesis of knowledge in original, relevant and valued new products, processes or services. Schweitzer F et. al. (2015) classify healthcare innovations as social innovations as they aim to solve problems related to health, which is a social issue. According to WHO, health innovation refers to practices that identify better policies, technologies, products, systems and delivery methods to improve health and wellbeing of the population, especially those of vulnerable populations. **Types of hospital innovations:** Innovations in hospitals can be of varying kinds: In their review of literature on hospital innovations Djellal and Gallouj (2007) state that other than technological innovations hospitals can have organisational innovations (e.g. changes in organizational structure to improve healthcare delivery), managerial innovations (e.g. changes in administrative practices or financial management systems), relational or service innovations (e.g. quality of patient facilities, reduction in waiting time), social innovations (e.g. experiments with internal communications) and innovations in external re-

lations (e.g. establishment of specific relations with stakeholders). Herzlinger R.E. (2006) opines that three types of innovation in healthcare are needed to make it better and cheaper: changes in technology, new business models and delivery (the way patients buy and use healthcare services).

Significance of healthcare innovations – from patient perspective: Christensen C (2017) strongly suggests that only disruptive innovations can make healthcare affordable and accessible. Mazumdar (2018) stated that only affordable innovations in healthcare can ensure affordability and accessibility to healthcare on a sustainable basis.

Significance of healthcare innovations – from the perspective of hospitals: Health economics holds hospital as a firm like any other and Phelps (2017) goes even further, with his concept of 'physician-firm'. Innovations are important for firms of any kind. Studying the impact of innovation on performance of Vietnamese firms from 2005–2015, Mai A.N. et. al. (2019) concluded that innovators achieve higher profit in comparison with non-innovating firms. Innovation begins with creative ideas. Minor B et. al. (2017) conducted a study to explore the relation between ideation rate (number of ideas per one thousand employees) and productivity of 28 public companies between 2014 and 2016 and found a significant correlation between the ideation rate and growth in profit or net income. Similar pattern was observed across different industries including health care companies. In fact highest ideation rate was observed in a large health care company whose net profit grew 6% over the two years of study. Analysing medicare data of 2.8 million patients from 1986 to 2004 in the US, Skinner and Staiger (2015) noticed that small differences in the adoption of effective technology lead to big differences in productivity across hospitals. Salge and Vera (2009) studied 173 hospitals in the National Health Service network in England and found higher levels of science and practice based innovativeness to be associated with better quality of healthcare delivery. However such an association of innovativeness was not noticed in the case of financial performance or administrative performance of hospitals.

Factors that influence diffusion of innovation in hospitals: Several factors influence adoption of innovation by hospitals. Blank and Valdmanis (2003) studied innovation diffusion in 60 Dutch hospitals and concluded that size of the hospitals, competition and commitment of the hospital to innovation were positively correlated to diffusion of hospital innovations. Relationship between organizational size and innovation was further confirmed by Neystrom et. al. (2002) who studied 70 hospitals to explore the influence of organizational climate on innovativeness and concluded that organizational size is positively related with innovativeness. Studying the diffusion of breast conserving surgery in medical communities, Jerome-D'Emilia and Begun (2005) stated that variations exist across types

of hospitals – it was highest in academic teaching hospitals and lowest in community hospitals in the US. The authors assert that social and cultural norms strongly influence diffusions of innovation. Influence of cultural attitudes in diffusion of innovation was also highlighted by Hashimoto et. al. (2006) in their study where they compared diffusion of stenting technology usage in a teaching hospital in the U.S. with a similar hospital in Japan. Adoption of innovation can even be triggered by association with prominent doctors. Examining association of stent technology adoption by 'non star' doctors to the number of 'star' doctors in their peer group, Burke and Prasad observed that the diffusion of stent by non-stars depends positively on the number of stars practicing at the same hospitals (star is defined as a doctor who completed residency at a top-ranked hospital). Collaboration among hospitals can enhance diffusion of innovation among hospitals. Goes and Park (1997) studied 400 hospitals in California for over 10 years and found out that structural, institutional and resource based associations among hospitals enhance adoption of innovation in hospital services and technologies. Herzlinger RE (2006) states that the factors that affect diffusion of innovation in healthcare include stakeholders and their interests, government policies and regulations, availability of funding, cost of innovation and competition.

Viability of healthcare organizations: Sergio et. al. (2014) proposed Viable Systems Approach (VSA) as a model to study viability and sustainability of healthcare organizations. In the Viability Systems Approach (VSA) systems are said to be viable when they are oriented towards the final goal of survival (Beer S, 1984, 1985).

3. Research Gap

Though the impact of innovation on a firms' performance is a widely studied topic, there is a dearth of research on this topic specific to allopathic private hospitals in India. Studies on impact of innovation on hospital performance focus either on one or a combination of performance parameters as hospital productivity, quality of healthcare delivery, administrative productivity, financial performance, cost of healthcare delivery etc. The impact on all these in their totality viz. 'viability' of hospitals has not been studied as yet. Numerous studies have established differentiated diffusion based on type of innovation but these variations across types of hospitals have not been studied in the Indian context. This paper attempts to cover these research gaps.

4. Statement of Problem

Innovations in healthcare are meant to improve its quality, affordability and accessibility. To assess if these innovations are reaching the end consumers, diffusion of innovation among hospitals need to be examined as hospital is

the channel through which these innovations would reach the patients. Variations across different categories of hospitals that target different segments of people need to be examined to understand if the distribution of advancements in the sector is equitable among patients. From a hospital perspective it needs to be examined to what extent adoption of innovation contributes to its viability. This paper attempts to address these research issues.

5. Research Objectives

The objectives of the study are:
- To assess the diffusion of innovation among private hospitals.
- To examine the relationship between innovation adoption and viability of private hospitals.
- To examine variations in diffusion of innovation across various categories of private hospitals.

6. Hypotheses

In the context of a hospital, the four main areas for innovation are diagnosis and treatment, patient management, cost control and administration. The impact of adoption of innovative practices in each of these on the viability of hospitals needs to be examined as this would help in getting a comprehensive picture of the relationship between innovation and viability. Hence the following hypotheses are proposed:

Hypothesis 1: Innovation in diagnosis and treatment has no correlation with viability of hospitals.
Hypothesis 2: Innovation in management of patients has no correlation with viability of hospitals.
Hypothesis 3: Innovation in cost control has no correlation with viability of hospitals.
Hypothesis 4: Innovation in administration, marketing and other areas of management has no correlation with viability of hospitals.
Hypothesis 5: Adoption of innovative practices in general has no correlation with viability of hospitals.

7. Research Methodology

This was a quantitative study that was conducted using survey method. Target respondents were doctors who were either consulting doctors in hospitals or proprietors of clinics or hospitals. Sampling frame was a list of all doctors who were registered with I Safe program of IMA, Kerala branch. This numbered to 935 hospitals. All the doctors in the sampling frame were contacted with a request to participate in the survey. 154 doctors chose to participate. Regional distribution of these hospitals is as follows: North Kerala: 53, Central Kerala: 52, South Kerala: 47, Total: 154 (region was not mentioned in 2

cases). Questionnaire was made in Google form and pilot tested among 10 respondents to check for ease of administration and comprehensibility of scale items. The questionnaire was then shared in the social media platform of doctors in the sampling frame. A few face to face interviews were conducted wherever possible, though the number of such interviews was limited due to the COVID19 pandemic situation.

Analysis: Bivariate correlation was used to assess correlation between innovation and viability. To examine the correlation between innovation and viability, an 'innovation score' and a 'viability score' were calculated for each hospital.

Calculation of 'innovation score': Four statements were used to assess adoption of innovative practices by hospitals. These statements were:
1. My hospital adopt innovative practices in diagnosis and treatment.
2. My hospital adopt innovative practices in management of patients.
3. My hospital adopt innovative practices in cost control.
4. My hospital adopt innovative practices in administration, marketing and other areas.

A five point Likert scale was used to assess the extent to which doctors agreed with the above statements. A score of '5' was given for 'strongly agree', '4' for 'agree', '3' for 'neither agree nor disagree', '2' for 'disagree' and '1' for 'strongly disagree'. Based on the responses to each of the above statements related to innovation, an average 'innovation score' was calculated for each hospital.

Calculation of 'Viability Score': Viability of hospitals was assessed on the basis of doctors' responses to three statements related to viability. The statements were:
1. I consider my hospital to be viable (has enough income to cover operating costs and debts and sustain / grow business)
2. I am confident of running this hospital profitably as long as I wish to
3. I am confident of facing competition (from other hospitals, big and small) at present and in future.

A 5 point agree-disagree Likert scale was used in this case also and an average viability score was calculated for each hospital based on the responses for the three statements listed above.

Variation in adoption of innovative practices across different categories of hospitals was assessed using independent sample t-test or ANOVA depending on the number of levels of independent variables.

8. Scope of the Study

Geographically the study was limited to Kerala, the state that is consistently ranked highest in health index among all states in the country by NITI Aayog. Taking Kerala as an exemplary state in health achievements, diffusion of innovation in hospitals in Kerala was studied. The study was confined to modern medicine hospitals in the private sector as this form the major chunk of healthcare delivery system in the country. Hospitals covered in the study mostly provided primary and secondary care.

9. Findings

Adoption of innovative practices by hospitals is captured in the following descriptive statistical data.

Table 1. Adoption of Innovative Practices by Private Hospitals

Adopt innovative practices in:		Frequency	Percent	Mean Score
Diagnosis and treatment	Strongly Disagree	5	3.3	3.7
	Disagree	9	5.9	
	Neither agree nor disagree	30	19.7	
	Agree	85	55.9	
	Strongly agree	23	15.1	
	Total	152	100.0	
Patient Management	Strongly Disagree	5	3.3	3.6
	Disagree	13	8.6	
	Neither agree nor disagree	37	24.3	
	Agree	79	52.0	
	Strongly agree	18	11.8	
	Total	152	100.0	

Cost Control	Strongly Disagree	9	6.0	3.6
	Disagree	8	5.3	
	Neither agree nor disagree	35	23.3	
	Agree	78	52.0	
	Strongly agree	20	13.3	
	Total	150	100.0	
Administration and Marketing	Strongly Disagree	17	11.3	3.2
	Disagree	16	10.7	
	Neither agree nor disagree	55	36.7	
	Agree	47	31.3	
	Strongly agree	15	10.0	
	Total	150	100.0	

As indicated by the mean scores, innovative practices are most adopted for diagnosis and treatment of diseases. Hospitals adopt innovation to the same extent for cost control and patient management. However, in comparison, innovation is adopted to a lesser extent in administration and marketing.

9.1 Testing of Hypotheses

For testing the hypotheses, viability score of the hospital was taken as the dependent variable in all cases. Statistical tool used was bivariate correlation.

Table 2. Correlation between Viability and Innovation Scores

	Viability Score	Innovation in Diagnosis and Treatment
Pearson Correlation	1	.283**
Sig. (2-tailed)		.000
N	154	152
		Innovation in Patient Management
Pearson Correlation	1	.328**
Sig. (2-tailed)		.000
N	154	152
		Innovation in Cost Control
Pearson Correlation	1	.258**
Sig. (2-tailed)		.001
N	154	150
		Innovation in Administration and Marketing
Pearson Correlation	1	.142
Sig. (2-tailed)		.083
N	154	150
		Innovation Score
Pearson Correlation	1	.280**
Sig. (2-tailed)		.000
N	154	152

Hypothesis 1: Innovation in diagnosis and treatment has no correlation with viability of hospitals.

Independent variable: Rating for the statement 'My hospital adopt innovative practices in diagnosis and treatment'.

p value is 0.000 (< 0.05). Null hypothesis is rejected. Innovation in diagnosis and treatment has correlation with viability of hospitals. Pearson correlation coefficient of .283 indicates a small correlation with viability.

Hypothesis 2: Innovation in management of patients has no correlation with viability of hospitals.

Independent variable: Rating for the statement 'My hospital adopt innovative practices in management of patients'.

p value is 0.000 (< 0.05). Null hypothesis is rejected. Innovation in management of patients has correlation with viability of hospitals. Pearson correlation coefficient of .328 indicates moderate correlation with viability.

Hypothesis 3: Innovation in cost control has no correlation with viability of hospitals.

Independent variable: Rating for the statement 'My hospital adopt innovative practices in cost control'.

p value is 0.001 (< 0.05). Null hypothesis is rejected. Innovation in cost control has correlation with viability of hospitals. Pearson correlation coefficient of .258 indicates a small correlation with viability.

Hypothesis 4: Innovation in administration, marketing and other areas of management has no correlation with viability of hospitals.

Independent variable: Rating for the statement 'My hospital adopt innovative practices in administration, marketing and other areas'.

p value is 0.083 (> 0.05). Null hypothesis is not rejected. Innovation in administration, marketing and other areas of management has no correlation with viability of hospitals.

Hypothesis 5: Adoption of innovative practices in general has no correlation with viability of hospitals.

Independent variable: Innovation score

p value is 0.00 (< 0.05). Null hypothesis is rejected. Adoption of innovative practices in general has correlation with viability of hospitals. Pearson correlation of 0.280 indicates a small correlation with viability.

9.2 Variations in Diffusion of Innovation across Hospital Categories

It is established that adoption of innovative practices is important in ensuring viability of hospitals. This made it necessary to examine the adoption of innovation across various categories of hospitals. For this, innovation

score of the hospital was taken as the dependent variable (DV). Depending on the levels of the independent variables (IV) either ANOVA or independent sample t-test was used to understand the variations in innovation across different categories of hospitals.

Innovation Score: Variation between Hospitals with In-patient Facility and Hospitals without In-patient Facility

Table 3. Innovation Scores: Hospitals with and without Inpatient Facility

	N	Mean	Std. Deviation	Std. Error Mean
Hospitals with in patient facility	64	3.7	1.005	.126
Hospitals with only outpatient facility	88	3.4	.741	.079

Innovation score of hospitals with inpatient facility is higher.

Table 4. Variations in Innovation Scores: Hospitals with and without In-patient Facility

	Levene's Test for Equality of Variances		t-test for Equality of Means				
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Equal variances assumed	4.127	.044	1.874	150	.063	.265	.142
Equal variances not assumed			1.788	110.215	.077	.265	.148

Levene's Test for Equality of Variances: Sig. 0.044 (< 0.05). Null hypothesis is rejected. There is significant difference in innovation scores of hospitals with inpatient facility and hospitals with only outpatient facility.

Innovation Score: Variations across Types of Hospitals

Table 5. Innovation Score: Hospitals with Specialty and General Medical Services

	N	Mean	Std. Deviation	Std. Error
General medical service only	52	3.284	0.828	0.115
Specialty medical service only	43	3.797	0.570	0.087
Offers both general and specialty services	57	3.575	1.026	0.136
Total	152	3.538	0.869	0.070

Mean innovation score is highest for hospitals with only specialty service. Hospitals with specialty service, even if it is along with general medical service are seen to be more innovative (as indicated by the mean of their innovation scores) than hospitals with only general service.

Table 6. Analysis of Variance of Innovation Scores: Hospitals with Specialty and General Medical Services

ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	6.314	2	3.157	4.369	.014
Within Groups	107.656	149	.723		
Total	113.970	151			

p value is 0.014 (<0.05). There is significant difference in innovation scores across different types of hospitals.

Innovation Score: Regional Variations (Hospitals Located in South, Central and North Regions of Kerala)

Table 7. Innovation Scores: Hospitals in South, Central and North Kerala

	N	Mean	Std. Deviation	Std. Error
South	47	3.676	0.895	0.131
Central	50	3.450	0.773	0.109
North	53	3.472	0.934	0.128
Total	150	3.528	0.871	0.071

Mean innovation score for South is highest. Though North Kerala is considered slightly backward in comparison to other parts of the state, it is interesting to note that mean innovation score for hospitals in North Kerala score is marginally higher than that of Central Kerala (where 'progressive' districts as Ernakulam and Kottayam are located).

Table 8. Analysis of Variance of Innovation Scores: Hospitals in South, Central and North Kerala

ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.495	2	.748	.986	.375
Within Groups	111.447	147	.758		
Total	112.942	149			

Analysis of variance shows that the difference in innovation scores across the three regions – southern, central and northern parts of the state – is not very significant.

Innovation Score: Regional Variations (Hospitals Located in Urban, Semi urban and Rural Regions of Kerala)

Table 9. Innovation Scores: Hospitals in Urban, Semi urban and Rural Areas

	N	Mean	Std. Deviation	Std. Error
Urban	38	3.921	0.590	0.096
Semi urban	56	3.455	0.991	0.132
Rural	58	3.366	0.831	0.109
Total	152	3.538	0.869	0.070

As expected, mean innovation score was highest for hospitals in urban areas followed by semi urban areas and rural areas.

Table 10 Analysis of Variance of Innovation Scores: Hospitals in Urban, Semi urban and Rural Areas

ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	7.666	2	3.833	5.373	.006
Within Groups	106.303	149	.713		
Total	113.970	151			

p value of 0.006 (<0.05) indicate that variation in innovation score is significant between hospitals in urban, semi urban and rural areas.

Innovation Score: Variations across Newer and Older Hospitals

Table 11. Innovation Scores: Newer and Older Hospitals

	N	Mean	Std. Deviation	Std. Error
1 to 10 years	59	3.729	0.772	0.100
11 to 20 years	29	3.586	0.676	0.125
More than 20 years	64	3.340	0.991	0.124
Total	152	3.538	0.869	0.070

As expected, newer hospitals score better in innovation score than the older ones. Hospitals that were 1 to 10 years old had a mean innovation score of 3.729, those that were 11 to 20 years old had a mean score of 3.586 and even older hospitals had a mean score of 3.34.

Table 12. Analysis of Variance of Innovation Scores: Newer and Older Hospitals

ANOVA				
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4.729	2	2.364	3.225	.043
Within Groups	109.241	149	.733		
Total	113.970	151			

P = 0.043 < 0.05. There is significant difference in innovation scores across hospitals of different age categories.

10 Discussion

An 'innovation score' (that was reflective of diffusion of innovation in the hospital) and a 'viability score' (that was indicative of the perceived ability of the hospital to stay viable or survive) was calculated for each hospital to examine the correlation between innovation and viability. Adoption of innovative practices in general has a direct correlation with viability of hospitals. Coming to the specifics, while innovations in diagnosis and treatment, management of patients and cost control have direct correlation to viability of hospitals, innovation in administration, marketing and other areas of management was found to have no correlation to viability of hospitals. Hospitals with specialty service, even if it is along with general medical service are seen to be more innovative (as indicated by the mean of their innovation scores) than hospitals with only general service. Coming to regional variations in diffusion of innovation, hospitals in South Kerala scored highest, though the difference was not significant compared to the center and north. As was expected, adoption of innovation by hospitals in urban areas was more compared to semi urban and rural areas and the difference was significant. Newer hospitals were faster to adopt innovation compared to older hospitals. There was significant difference in innovation scores of hospitals with inpatient facility and hospitals with only outpatient facility.

11 Managerial Implications

Findings of the study have significant implications to hospitals. Since innovation is seen to have an impact on viability it is imperative that hospitals adopt innovative practices. Surprisingly, adoption of innovative practices in patient management was seen to have more correlation to viability than use of innovation in diagnosis and treatment. This could probably be because the hospitals that were covered in the study mostly offered primary and secondary medical care. It follows that such hospitals need to focus on improving patient experience. Innovative ways can be adopted to reduce waiting time, easy retrieval of patient data, remote monitoring of patients, ease of taking appointments and making payments and so on. Adopting innovative practices in cost control has an impact on viability and if hospitals practice this and pass the cost savings onto the patients it can go a long way in making healthcare more affordable.

12 Limitations and Future Scope

Ideally financial measure of viability should have been considered in the study, but financial records of hospitals are not easily available, hence non-financial measure of viability had to be considered. The study revealed that adopting innovative practices in diagnosis and treatment, management of patients and cost control have a direct impact on viability of hospitals. An explanatory qualitative research to identify specific innovative practices adopted by hospitals in each of these areas can take this research further. Impact of organisational innovations, relational innovations, social innovations and innovations in external relations on hospital viability can also be explored.

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