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LOW POWER DESIGN OF THE MEDICAL DEVICE AMONG GENERAL PHYSICIANS AND SPECIALISTS- A STUDY IN CONTEXT TO INDIAN HEALTHCARE SCENARIO

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ABSTRACT

India is a country that has power shortage. Power losses in transmission and distribution across India average around 25 percent, and in some areas they can reach 50 percent. That means that half of the electricity being generated either never reaches an end user or is used but never paid for. Power losses in the developed world seldom reach 10 percent. The power shortage can affect healthcare services. It is important that the medical devices are not power hungry. This paper presents a case study of evaluating low power design needs of a medical device among general physicians and specialists.

KEYWORDS: Medical Device, Low Power Design, Usability Engineering

INTRODUCTION

Considering the vast Indian population, the disease patterns, ageing population, growing economy, emergence of technologies point to a need of custom specific design as well as services to create a healthcare platform which is hitherto unrealized.

Medical technology plays a vital role in the delivery of healthcare services in a country. When it is the question of India, the world's most populous democracy, which is fast becoming the hub for medical device design and medical tourism where people from other countries flock to get good quality, affordable medical treatment, medical technology is in a nascent state. However, the opportunities for innovation-led growth are immense. Medical professionals rely on medical technology for tests and investigations to aid their clinical decision-making. Innovation in medical technology can therefore be crucial for the Indian healthcare system to improve access, enhance quality and reduce costs.

The sector however does face significant challenges. Mahatma Gandhi had a dream that India would be a land of self-sustaining villages. 'The true India is to be found not in its few cities, but in its seven hundred thousand villages. If the villages perish, India will perish too', said Mahatma Gandhi. But here are some of the stark realities about the lives of Indian rural population:

- 50% of all villagers have no access to healthcare providers.
- 37% are chronically starved
- 10% of all babies die before their first birthday
- 50% of all babies are likely to be permanently stunted due to lack of proper nutrition
- 33% people have no access to toilets, while 50% defecate in the open

- A mother dies every ten minutes in India
- Over 1.25 million children die annually in India.
- 48% of all children have stunted growth due to malnutrition.

One of the earliest and most critical steps early in the design process is to differentiate between the "customers" and "intended users." Clearly, balancing the needs and desires of both can be challenging, but it is a critical delineation to encourage the safest, most usable design. Considering the Indian scenario this is a vital point.

Review of Literature

Vijay Govindarajan, GE's chief innovation consultant, described in his GE reports- **Localized breakthroughs go global** the rise of emerging markets such as India and China mark a new phase of globalization. In similar lines is **a study by Dr. Anurag Srivastava**, Chief Technology Officer, Wipro which proclaims that emerging market constitutes 80% of global population which is young (50% less than 25 years) and largely rural (65%) but has high mobile adoption and thus poses great opportunities. This is an important point and it emphasizes the point why a medical device company must focus in emerging market. According to an important study by **Cegedim** five years ago, emerging markets were responsible for just5% of pharmaceutical companies' profits; today, they make up 20–30% of profits. They have a great suggestion that to protect and grow company's investments in BRIC markets, know what brought you there and where you're headed. As mentioned in **WTO study** innovation in medical technologies requires a complex mix of private and public sector inputs; it differs from innovation in general due to the ethical dimension of medical research, rigorous regulatory framework, liability questions, and the high cost and high risk of failure.

The **Economics Times report** says that the healthcare sector in India will grow to $158.2 billion in 2017 from $78.6 billion in 2012. The healthcare sector is growing at a 15% CAGR and jumped from $45 billion in 2008 to $78.6 billion in 2012 and expected to touch $158.2 billion by 2017. The factors behind the growth is rising incomes, easier access to high-quality healthcare facilities and greater awareness of personal health and hygiene, the report said. According to **Frost & Sullivan report** mature economies across the globe grapple with reducing cost, towering budget deficits, and anemic growth, the BRICs are expanding rapidly and driving the global economy. According to the **Stanford India Biodesign** program analysis, the average life expectancy of Indians at birth only reached 65 years in 2009, compared to the global average of 68 years. India also has some of the highest infant mortality and maternal mortality rates in the world, 44 per 1,000 births and two per 1,000 births respectively in 2012. India's disease profile is traditionally associated with communicable diseases, such as malaria and tuberculosis, or tropical diseases, such as Japanese encephalitis and dengue fever. However, coronary heart disease, diabetes, asthma, and other chronic non-communicable diseases are on the uptick. Analysts predict some 60 percent of the world's heart patients will live in India by 2020.

While these trends pose challenges for the country's healthcare system, they also present significant opportunities for medical device companies. It is estimated that by 2020 cardiovascular disease will be the cause of over 40 per cent deaths in India as compared to 24 per cent in 1990. Globally, it causes 17.3 million deaths annually. With over 3 million deaths owing to cardiovascular diseases every year, India is set to be the 'heart disease capital of the world' in few years, said doctors on the eve of World Heart Day (September 29).

Indian coronary artery disease is very peculiar as compared to the west; the disease follows an accelerated course and affects mostly the entire length of the artery (diffuse disease). This coupled with the fact that 40 per cent of these patients are diabetic makes it deadly. The detection rate of cardiovascular diseases has also increased in the country with more diagnostic labs coming up in the rural areas. The prevalence of coronary artery disease in rural India is estimated to be up to 7 per cent as compared to the urban areas where the incidence is up to 12 per cent. The main reasons for this epidemic is lifestyle changes such as sedentary jobs, improvement in socioeconomic status leading to unhealthy diets rich in fats, high stress jobs and the addictions like smoking and tobacco chewing.

A study by **International Diabetes foundation IDF**20-79 age group is the reference since it is the age group covered by most studies. For most countries there is little or no prevalence information about people with diabetes below 20 or above 80 years. The latest global figures on diabetes, released by the International Diabetes Federation (IDF), has raised a serious alarm for India by saying that nearly 52% of Indians aren't aware that they are suffering from high blood sugar. India is presently home to 62 million diabetics — an increase of nearly 2 million in just one year. India is second only to China which is home to 92.3 million diabetics. By 2030, India's diabetes numbers are expected to cross the 100 million mark. India is also way ahead when it comes to number of diabetics when compared to its immediate neighbors. Bangladesh has the second highest number of diabetics after India but the number stands at just 5.5 million. Sri Lanka has 1.1 million diabetics, Nepal 5.06 lakh, Mauritius 1.4 lakh, Bhutan 22,362 and Maldives 15,908. Over 30 million have now been diagnosed with diabetes in India. The CPR (Crude prevalence rate) in the urban areas of India is thought to be 9 per cent.

It’s compounded by the fact that so many of India’s citizens aren’t on the grid at all (no count is precise, but the number is probably somewhere between 300 million and 400 million). Not only do power lines fail to reach many rural areas, but many of those living in city slums are also without utility services (often they simply cannot afford the estimated $105 it takes to connect to the grid, even if such connections are available). The Power Grid Corporation of India operates more than 70,000 miles of transmission lines that stretch across most of the subcontinent. What had been five regional grids have been united into a single national system that reaches to within a few miles of most of the population, a process completed in 2013. The grid’s transmission connections between regions remain inadequate, however—this was the primary cause of the 2012 blackout—and India’s switching and control technology has been little upgraded in the last two decades.

Based on the literature review the following hypotheses were formed

Null ($H_{O\ -1}$): There is no significant difference for low power design medical device among general physicians and specialists

Alternate ($H_{1\ -1}$): There is a significant difference for low power design of the medical device among general physicians and specialists

RESEARCH METHODOLOGY AND DESIGN

This section details out the research methodology for the present study. It explains the research objectives and a suitable methodology to achieve those objectives. The objectives of this study were to identify medical device market drivers for emerging markets in context to Indian Market.

Locale of the Study

This study is focusing on Indian market which is a microcosm of the emerging market. The present study was conducted in Indian medical device markets. For convenience, efficacy I have divide the regions in 5 different zones namely:

East (Kolkota)

West (Mumbai, Pune)

North (Dehradun)

South (Chennai, Bangalore)

NCT (Delhi, Gurgaon)

From each zone, equal numbers of samples were taken by collecting the list of doctors from the particular city and then selected the doctors based on their specialty.

Sample and its Selection

The total sample consisted of 300.

- 60 Cardiologists
- 60 Critical care
- 60 Diabetes specialists
- 60 general physicians

Research tool

Keeping in mind the purpose of the study, types of sample and their specialties were decided to use questionnaires, schedule, interview, observation and case study method.

Based on the literature survey a questionnaire of 30 questions was made which was sent to a group of 10 doctors.

A final questionnaire consisting 25 questions open and closed (refer annexure 1 for details) was made based of the feedback from the above mentioned group of doctors.

Procedures of Data Collection

The study aimed to understand medical device market drivers for emerging markets in its total perspective with special focus and context to Indian market. For the data collection 300 samples were selected from the 5 zones:

- East (Kolkota)
- West (Mumbai, Pune)
- North (Dehradun)
- South (Chennai, Bangalore)
- NCT (Delhi, Gurgaon)

Each 60 of Cardio, diabetes, and critical care specialists were randomly selected from these cities. A total of 600 questionnaires were send by post, email, online survey and face to face interview.

Some of the respondents were very helpful while for many others emails and telephone were used extensively to make them understand the purpose of the research and assure them that the data provided will be used only for academic research and their identity will never be revealed.

Data was gathered through questionnaires and telephonic interviews were conducted to substantiate the integrity of the data received.

Only 340 filled questionnaires were received out of which 300 were found to be fully filled. The rest 40 were discarded since they were incomplete. Thus with the unconditional assistance of various associated. data was collected comfortably from the respondents within the scheduled time interval.

Hypothesis Test

The followings tests are conducted on the hypothesis for elicitation the relation. When we found correlation between Usability and Low power design according to responses of my all respondents, general group, specialists group, all male respondents and all female respondents. Below table indicates correlation between Usability and Low power design according to responses of my all respondents. Studies show that there is a correlation between Usability and Low power design, it means if low power consumption in devices then usability is better. We use this test for comparing the means of two samples, even if they have different numbers of replicate. In our study we use group t test.

Table 1: T Test between Groups

	Group2	N	Mean	Std. Deviation	Std. Error Mean
Low_power_design	**Specialists**	180	4.64	.493	.037
	General	120	4.78	.414	.038

	T	df	Sig.	Decision
Low_power_design	2.647	298	t is significant at the 0.01 level.	$H_{0\text{-}3}$ Null is Rejected at 10% confidence level

In above table through t-test I checked different opinion of specialists and general groups about usability, telemedicine and low power design. I found about to usability specialists mean opinion is 18.28 and general people's 18.09,so opinion is same and t is not significant. About to telemedicine specialists mean opinion is 5.02 and general people's 5.12,so opinion is same and t is not significant but when i checked Low power designs specialists mean opinion is 4.64 and general people's 4.78,so opinion is not same and t is significant at the 0.01 level.

Hypothesis Tests ANOVA

By ANOVA test we will calculate difference of opinion of Cardiac Physicians, Critical Care Specialists, Diabetes Specialists and general group about usability, low power design and Telemedicine.

ANOVA (Analysis of Variance)

It is a statistical test of the difference of means for two or more groups

Table 2: ANOVA-1

ANOVA							
		Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**	**Decision**
Low_power_design	**Between Groups**	1.980	3	.660	3.081	.028 *	H0-6Null is rejected at 10% significance level
	Within Groups	63.417	296	.214			
	Total	65.397	299				

** Significant at the 0.01 level.
* Significant at the 0.05 level.

Null ($H_{0\ -6}$): There is no significance for low power design of the medical device among cardiac, critical care and diabetes specialists

Alternate ($H_{1\ -6}$): There is a significant difference for low power design of the medical device among cardiac, critical care and diabetes specialists

Alternate Accepted

In above table through ANOVA I calculate common views of groups-specialists and general group about to usability. cardiac physician's view is 17.98,critical care specialists view is 18.05, Diabetes specialist's view 18.82 and general group mean is 18.09. It shows all four group have different opinion about it. Its F value 4.356 shows significance level is 0.01. Means all four group have different view on the matter of usability. About to telemedicine cardiac physician's view is 4.93, critical care specialists view is 5.12, Diabetes specialist's view 5.00 and general group mean is 5.12. its F value is 2.053 shows that there is no difference on the matter of telemedicine, and on low power design cardiac physician's view is 4.68,critical care specialists view is 4.57, Diabetes specialist's view 4.67 and general group mean is 4.78., the F value 3.081 shows Significant at the 0.05 level.

CONCLUSIONS

This is an interesting point to note that There is a significant difference for low power design of the medical device among cardiac, critical care and diabetes specialists. This is crucial since specialists use the device for design longer time and hence it is important that the backup time is more. If it has to be more then it has to be a low power design.

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