

Hochschule Furtwangen University

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M.Sc. International Management

Research Project B:

Frugal Innovation in the Indian Health Care Sector

Comparative case study to identify success factors of frugal innovations and
evaluate the potential of reversed innovation

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Abstract

The notion of frugal innovation or how to do more with less becomes increasingly relevant in a world which faces many severe health care challenges. In general, frugal innovations have the potential to provide low-cost, simple, and valuable solutions to these challenges. Therefore, this research aims to shed light on key success factors and patterns of frugal innovations in the Indian health care sector. For this reason, the research analyzes a sample of nine selected frugal innovations. The frugal innovation examples are examined with respect to their innovation characteristics. Further, the examination of success patterns allows to investigate the potential of reversed innovation in developed countries in order to improve global health. To sum up, the research provides profound insights on the subject of frugal innovations and conclusions on the research questions. Finally, an outlook on future developments in the health care sector and future research are given.

Keywords: *Frugal Innovation, Health Care, India, Case study, Success factors, Reversed Innovation*

Key findings

- With the help of a comparative case study on nine frugal innovation examples in the Indian Health care sector, seven success factors with significant relevance were identified: High quality of care, High asset/resource utilization, High clinical volumes, Clinical efficiency, Patient-centric approach, Accessibility, and Service specialization.
- Based on the seven success factors identified, the question was evaluated which opportunities and threats the frugal innovations face in order to be implemented in developed countries.
- The research paper examined the current status of frugal innovations in the Indian health care system and provides an outlook on future developments concerning reverse innovation potential.

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List of Abbreviations

AECS	Aravind Eye Care System
AI	Artificial Intelligence
AIDS	Acquired Immune Deficiency Syndrome
ANM	Auxiliary Nurse Midwifery
ATNF	Apollo Telemedicine Networking Foundation
BI	Business Intelligence
BMVSS	Bhagwan Mahaveer Viklang Sahayata Samiti
BOP	Bottom of the Pyramid
CRM	Customer Relationship Management
DISHA	Distance Healthcare Advancement
ECG	Electrocardiogram
ERP	Enterprise Resource Planning
FY	Fiscal Year
GDP	Gross Domestic Product
GE	General Electric
GNM	General Nurse Midwifery
HDI	Human Development Index
INR	Indian Rupee
IOL	Intra-Ocular Lenses
LBW	Low Birth Weight
LSH	LifeSpring Hospitals
NH	Narayana Health
MIT	Massachusetts Institute of Technology
PCM	Phase change material
PHR	Personal Health Record
PPP	Purchasing Power Parity
RHA	Rice Husk Ash
R&D	Research and Development

1. Introduction

1.1 Problem definition

The world is facing numerous health challenges and the lacking health care system in India is one example and a huge public challenge. The reasons for that can be found on the demand and supply side. There is a constant population growth accompanied with a rise of non-communicable diseases. The slow development of health care infrastructure and less physicians make the problem on the supply side even worse. Most of the population have simply no access or no money to qualitative health care. Expensive technologies, drugs, and operation costs appear insuperable.¹ Therefore, many diseases cannot be diagnosed or treated due to limited access and limited financial resources.² Further, many deaths, in particular infant deaths, are caused by these problems.³

In order to solve these problems and succeed in this market, companies have to understand the certain needs and requirements of emerging markets. Mainly they must think about offering the right value proposition by addressing lacking or inadequate market segments for the so called "bottom-of-the-pyramid costumers".⁴ Ultimately, market based solutions for the underprivileged are required to address these socio-economic problems.⁵

Concepts and theories like "jugaad", "cost innovation" or "frugal innovation" already exist and aim to solve the above described challenges. All of them explain the phenomena of developing products or processes at minimum cost with the resources available. These concepts directly addressing the specific local needs like affordability or simplicity.^{6,7}

Preliminary work in this field focused primarily on the exploration of similarities and differences compared to other types of innovation (e.g. Brem and Wolfram 2014). Moreover, several researches discussed the relationship between sustainability and frugal innovations (e.g. Pansera and Sarkar 2016).

¹ Cf. Dagar and Dadhich 2016.

² Cf. Villgro 2018.

³ Cf. Walters 2015.

⁴ Cf. Mukerjee 2012.

⁵ Cf. Ramdorai and Herstatt 2015, p. 18.

⁶ Cf. Ramdorai and Herstatt 2015.

⁷ Cf. Agarwal and Brem 2012, p. 2.

However, only a limited number of research has focused on the potential of frugal innovations to solve global health problems (e.g. Ramdorai and Herstatt 2015 or Arshad et al. 2018). Therefore, this study aims to identify success factors of frugal innovations in the Indian health care sector by assessing nine examples of frugal innovations.

1.2 Research questions

This paper focuses on frugal innovations in the Indian health care sector. Further, a comparative case study helps to identify the key success factors of frugal innovation development in India. Moreover, the paper investigates the reverse innovation potential of these frugal innovations in developed countries. In conclusion, the paper aims to examine the following research questions:

- (1) Which factors have allowed selected frugal innovations to be successful in the Indian health care sector?
- (2) What is the potential for replication of those frugal innovations in developed countries?

1.3 Structure of the report

The present paper is divided into ten sections. The first two sections deal with the background and state the theoretical foundations to the research. Further, these sections highlight the relevance of this paper. An overview is given about what exactly is meant by frugal innovation and why it mainly appears in emerging and developing countries. This section also includes an explanation about the bottom of pyramid concept, and subsequently defines the term reverse innovation.

The third chapter highlights the particular need for frugal innovations in remote areas of the world. A general overview about the Indian health care sector and major challenges is given.

Section four focuses on the research methods by describing the descriptive research process, the case study selection, and the case criteria. Further this paper aims to develop a pattern of success factors concerning frugal innovation in the Indian health care sector.

The fifth section contains the examination of nine different frugal innovation examples with regard to specific case criteria.

This is followed by an analysis and comparison of the cases in section six. The seventh chapter investigates the reversed innovation potential of frugal innovations. The concise analysis helps to provide a detailed answer on the research questions.

Section eight provides the overall summary of the report. Finally, limitations of this research and future research is given in section nine followed by the conclusion of the present report in section ten.

2. Theoretical Background

This chapter aims to introduce the concept of Bottom of the Pyramid (BOP). Moreover, a general idea on frugal innovation, its application and practices is given. Finally, the notion of reverse innovation is explained.

2.1 Concept of the Bottom of Pyramid

The distribution of wealth and generation of income in the world can be demonstrated in the form of an economic pyramid. At the top of the pyramid, the wealthy people with high income are located. Nevertheless, more than four billion people live at the BOP on less than \$2 per day.⁸ As the current market typically serves the population with high purchasing power, low-income segments are mostly undiscovered and untouched. This provides firms with the opportunity to serve this untapped, low socio-economic market.⁹

The concept of the BOP arises from a widespread segment of the poorest economy. In general, the market serving the BOP is currently small-scaled and unorganized. However, this will not inevitably stay the same in future. Realization of the potential for a new market segment serving the BOP is increasing. Competition and challenges arose since numerous companies are increasingly interested in penetrating the BOP.¹⁰ In India where the BOP is predominant, growth is being tracked in the bottom part of the pyramid. From 2009 to 2012, rural consumption outpaced urban consumption. In particular, rural consumption grew at 19.2 % while urban consumption grew at 17.2 %.¹¹ This indicates a strong future for the BOP segment.

Besides, it is crucial to understand the BOP before entering and serving this market. BOP can be penetrated typically by offering choices and reassuring self-esteem to the consumers of this segment.¹² In order to understand the hidden market at the BOP, active engagement of private enterprises is vital. This will create attention and give choices for the BOP consumers, as they do not have to solely depend on what is available in their local

⁸ Cf. Prahalad and Fruehauf 2004.

⁹ Cf. Ramdorai and Herstatt 2015.

¹⁰ Cf. Karamchandani et al. 2011, pp. 107–111.

¹¹ Cf. Accenture 2013.

¹² Cf. Prahalad and Fruehauf 2004.

area. To sum up, organizations should not treat BOP as a corporate social responsibility but integrate the consumers' needs into their business model.¹³

2.2 Frugal Innovation

Before discussing frugal innovation, it is important to understand the concept of low-cost innovation. Low-cost innovation provides a rudimentary product to the mass BOP market and emerges out of factors such as low-customer sophistication, constrained resources, and emerging lower- and middle-class consumers.¹⁴ One type of low-cost innovation is frugal innovation.

Frugal innovation can be defined as the redesigning of a product component and processing it to get only the most essential element.¹⁵ A frugal product or process is cost effective as it does not include any extraneous or costly features. Low cost is also achieved through mass production techniques in new areas such as economies of substitution, where technology revives an already existing product. The cost is lower when specific older components are substituted with newer components, rather than rebuilding the entire product. Generally, these streamlined products are created using already existing resources and technologies. Similarly, the price-per-product remains low, as it is targeted to the BOP market. The tools used to shape the frugal innovation are easily available, effective, affordable and simple.¹⁶

In sum, frugal products are less sophisticated than its counterpart products. Therefore, it simply serves its purpose and provides core functionality. The quality-based, flexible, simple, and low-cost creation strategy of frugal innovation, targets the market with limitation to financial, material or institutional resources. Frugal innovations respond to these limitations and turn them into an opportunity.¹⁷ The trend of innovating frugally arises particularly in countries with suitable socio-economic and geographic conditions such as India and China.

¹³ Cf. Prahalad and Fruehauf 2004.

¹⁴ Cf. Agnihotri 2015, pp. 399–400.

¹⁵ Cf. Sammut-Bonnici and McGee 2015.

¹⁶ Cf. Tran and Ravaud 2016.

¹⁷ Cf. Bound and Thornton 2012.

2.3 Reversed Innovation

Although frugal innovation is targeted to the low income setting with limited resources, the relevance is not only restricted to low-income and middle-income countries.¹⁸ For western societies, innovation has predominantly focused on advanced features with high pricing products. However, the current resource constraints and increasing demand has led the economically stable countries to consider adapting frugal solutions from emerging markets.¹⁹ This generates the notion of reverse innovation. Reverse innovation is the exportation of knowledge and innovation into developed markets that have been originally established in emerging markets.²⁰ Generally, it is the replication of ideas that are created and utilized in low- or middle-income economies.²¹

An innovation does not necessarily have to rely on high costs, high pricing, and sophisticated design. It should rather focus on improvisation, ingenuity, and most importantly, on customer needs. However, this is not always substantial due to various reasons. Diffusion of two different economic environments is always a complex process.²² There must be a “need to change” and an availability of volume and resources in the specific market.²³ Furthermore, the misconception regarding that no valuable learnings are coming from low income countries sets a major drawback while considering reverse innovations.^{24 25}

However, if western economies consider reverse innovation, it is crucial to change their general approach to innovation rather than changing the entire production and processing line.²⁶ Companies need to offer an affordable price to their customers. This varies according to the purchasing power of every country. Furthermore, companies need to recognize their target customers’ actual living conditions and the reliability of the product. Lastly, the value chain of the product needs to be re-shaped, keeping the economically disadvantaged consumers equally in mind.²⁷

¹⁸ Cf. Howitt et al. 2012.

¹⁹ Cf. Crisp 2010.

²⁰ Cf. Ostraszewska and Tylec 2015, p. 58.

²¹ Cf. Zedtwitz et al. 2015, pp. 12–28.

²² Cf. Bhatti et al. 2017, p. 1913.

²³ Cf. Greenhalgh et al. 2004, pp. 581–629.

²⁴ Cf. Hossain 2013.

²⁵ Cf. Harris et al. 2015.

²⁶ Cf. Mukerjee 2012.

²⁷ Cf. Mukerjee 2012.

3. Indian Health care sector

A brief overview of the status quo of the Indian health sector is provided and also the major challenges are identified in this section.

3.1 Status quo

Since the beginning, the Indian health care sector struggled to deliver quality care with regard to affordability, accessibility, availability, and acceptability.²⁸ In general, the health care sector is not able to march in step with the growth in population. In addition, there is a great imbalance between demographic segments and states.²⁹

According to the Human Development Index (HDI) report 2017, India is ranked 130 among 189 countries and thus is located in the lower third. In terms of the health dimension, measured by life expectancy at birth, India remains low with an expected life of 68.8 years.³⁰ Moreover, India's spending on health care in 2015 (percentage of GDP) is 3.90%, which is considerably less than other middle income countries.³¹ Beyond that, almost a quarter of the Indian population lives below the poverty line with less than \$1.90 a day on basis of purchasing power parity (PPP).³² The public share of the total spending amounts to 25.64%, which is one of the lowest in the world. On the other side, the private health expenditure amounts to 73.50% in 2015 and plays an important role.³³ This results in a heavily privatized health care system, which leads to high out of pocket expenditure for patients.³⁴ In conclusion, the health care sector in India is lagging behind to achieve the adequate outcomes.

3.2 Major health care challenges in India

At the present time, India faces several major health care challenges. Firstly, for the more than 70% of India's population living in rural areas, the accessibility for treatment is limited. There is a major deficiency of doctors, nurses and hospital beds in the Indian

²⁸ Cf. Dagar and Dadhich 2016, p. 5.

²⁹ Cf. Dagar and Dadhich 2016, 17.

³⁰ Cf. United Nations Development Programme 2018, pp. 22–25.

³¹ Cf. United Nations Development Programme 2018, pp. 50–53.

³² Cf. United Nations Development Programme 2018, p. 42.

³³ Cf. World Health Organization 2019.

³⁴ Cf. Dagar and Dadhich 2016, pp. 25–26.

health care system. The doctor to population ratio lies at 1:1,700, whereas the WHO suggests a ratio of 1:1,000.³⁵ Further, this ratio can be six times lower in rural areas than in urban areas.³⁶ Additionally, about 60% of all hospitals and 80% of doctors are located in urban or semi-urban areas.³⁷

Moreover, the affordability of health care in India is a severe problem. As mentioned earlier, the privatized system and the absence of health insurances lead to high out of pocket expenditure. In many cases, people have to borrow money to cover their hospital costs and around 39 million³⁸ fall under the poverty line every year because of high health expenses.³⁹

Ultimately, there is a desperate need for affordable and quality health care to serve the poor masses in the rural areas in India.

³⁵ Cf. Dagar and Dadhich 2016, p. 34.

³⁶ Cf. Ramdorai and Herstatt 2015, p. 53.

³⁷ Cf. Dagar and Dadhich 2016, p. 14.

³⁸ Cf. Dagar and Dadhich 2016, p. 14.

³⁹ Cf. Ramdorai and Herstatt 2015, p. 54.

4. Research methods

This section outlines the methodologic approach for this research. The research strategy of the paper is constructed as qualitative research. The investigation of frugal innovations in the Indian health care sector demands an exploratory research design, with the objective to extend understanding and gain insights of the specific research topic.⁴⁰ In particular, the case study collection, case criteria, and data collection are given in the following sections.

4.1 Case study selection

Comparative case study research methodology has been chosen for this research. This allows for an intensive examination of the current setting.⁴¹ The comparative case study approach enables the analysis of similarities, patterns and differences among selected cases. This implies that phenomena can be better understood when directly compared to other meaningful cases or situations.⁴²

In order to examine the success factors of frugal innovations in the Indian health care sector, nine frugal innovations were selected for the study. A purposive sampling strategy was applied to identify frugal innovations, which allows for an actively selection of case studies to help answer the research question.⁴³ These cases are: Aravind Eye Care System, LifeSpring Hospitals, BMVSS - Jaipur Foot, Embrace Infant Warmer, GE Healthcare - MAC 400 ECG System, Biosense Technologies, Narayana Health Limited, Tata Swach, and Apollo Telemedicine Networking Foundation.

4.2 Case criteria

For these nine case studies, data on different frugal innovation characteristics were retrieved according to specific case criteria. Those criteria are listed as follows: Introduction, Success Strategies, Type of Innovation, Financial Sustainability as well as Challenges and Problems. More detailed information on each criteria is given below

⁴⁰ Cf. Saunders et al. 2009, pp. 139–140.

⁴¹ Cf. Bryman 2012, p. 67.

⁴² Cf. Bryman 2012, p. 72.

⁴³ Cf. Marshall 1996.

1.) Introduction

Firstly, the introduction criteria contains general information on the drivers of frugal innovation, the founder, founding date, background, type of organization, and vision/mission of the innovator.

2.) Success Strategies

Secondly, various key success strategies that lead to the success of each frugal innovation are identified, examined, and explained.

3.) Type of Innovation

Thirdly, the type of innovation is examined according to the innovation classifications of the OECD Oslo Manual 2018 (Guidelines for collecting, reporting and using data on innovation), which distinguishes between process, product, marketing, and organizational innovation.⁴⁴ Furthermore, the innovation characteristics are explained and described.

4.) Financial Sustainability

Fourthly, the financial sustainability section includes information on the organizations general financials, pricing model/structure, cost structure, and profitability.

5.) Challenges and Problems

Lastly, current and future challenges and problems of the organization are stated and described.

4.3 Data collection

The secondary and primary data on each criteria was collected through extensive internet research for the frugal innovation, innovator's website, company reports, publications or newspaper articles about the innovation, and previous published case studies. In particular selected information databases such as EBSCO and Google Scholar are used to collect relevant and current data. The overall collection of secondary data is executed with regard to the objective to identify data which is suitable and enables to answer the research questions.⁴⁵ Finally, the criteria among the nine cases were analysed and compared to identify success factors of frugal innovations in the Indian health care sector.

⁴⁴ Cf. Oslo Manual 2018.

⁴⁵ Cf. Saunders et al. 2009, p. 272.

5. Cases

5.1 Aravind Eye Care System

Introduction

Worldwide more than 440 million people are blind or visually impaired. However, 80% of that blindness is avoidable.⁴⁶ Dr. Govindappa Venkataswamy founded Aravind Eye Care System (AECS) in 1976 with the vision to eliminate preventable blindness by providing quality eye care to all people.⁴⁷ Beginning with only 11 beds in a separate room of his private home, Aravind Eye Care System is now considered one of the largest eye-care provider in the world.⁴⁸ Today, AECS consists of a network of 12 hospitals in India with the mission to bring affordable health care to the masses. In the fiscal year (FY) 2017-2018 AECS handled about 4.1 million out-patient visits in total. Moreover, about half of the 478,028 surgeries performed in FY 2017-2018 were free of charge.⁴⁹

Success Strategies

Several employed strategies by Aravind are critical to their success. In particular, five key strategic choices are noteworthy. These are explained in greater detail in the following paragraph.

Focus on cataract treatment

AECS is a multi-faceted clinical organization, which many center of excellence, e.g. retina and vitreous surgery, laser procedures or lacrimal surgery. However, it remains a large scale organization with a narrow clinical focus, emphasizing cataract surgery. In FY 2017-2018, around 62% of all surgeries performed were cataract surgeries.⁵⁰ Especially in India, cataracts are the primary cause of blindness.⁵¹ This narrow clinical focus allows AECS to streamline their operation procedure and allows surgeons to specialize.⁵²

⁴⁶ Cf. World Health Organization 2018.

⁴⁷ Cf. Aravind Eye Care Systems 2018.

⁴⁸ Cf. Ramdorai and Herstatt 2015, p. 54.

⁴⁹ Cf. Aravind Eye Care Systems 2018.

⁵⁰ Cf. Aravind Eye Care Systems 2018.

⁵¹ Cf. Rangan and Thulasiraj 2007, pp. 40–42.

⁵² Cf. Ramdorai and Herstatt 2015, pp. 55–56.

High clinical volumes

In the fiscal year 2017-2018 AECS handled more than four million out-patient visits and performed a total of 478,028 surgeries.⁵³ In order to generate this volume of, AECS pioneered the use of outreach eye screening camps to reach out to the poor. With the help of partner organizations, e.g. Lion's Club and Rotary Club, Aravind is able to screen thousands of patients in camps daily. Selected patients, which require further treatment, are then transported for free by buses to the next AECS hospital.⁵⁴ ⁵⁵ Aravind recognized early on the high importance of tight partnerships with philanthropic organizations and local communities to reach out to the rural poor and gain scale.⁵⁶ In the recent FY 2017-2018, Aravind conducted 2,779 camps and screened 562,853 patients, 94,953 of these received further surgery.⁵⁷

Operational and clinical efficiency

In order to achieve a high operational efficiency, AECS introduced an innovative “assembly line” system for surgery.⁵⁸ Patients are prepared for surgery, including the anesthetizing in groups by trained assistants and nurses, so the surgeon solely concentrates on the surgery itself. When an operation is completed, the treated patient is quickly moved to the recovery room and the next patient is already readied.⁵⁹ Furthermore, each operating room is equipped with two or three beds, which ensures little waiting time between surgeries.⁶⁰ This system ensures high productivity of surgeons and enhances utilization of medical equipment and operation supporting staff. Compared to an average Indian ophthalmologist, an AECS doctor performs five times more surgeries a year. Overall, this process improves the quality of treatment and significantly reduces costs of care. Ultimately, by 2006, performing a cataract surgery costs AECS about \$18 (including intra-ocular lens) compared to \$1,800 (excluding intra-ocular lens) in the United States.⁶¹

⁵³ Cf. Aravind Eye Care Systems 2018.

⁵⁴ Cf. Ramdorai and Herstatt 2015, p. 55.

⁵⁵ Cf. Rangan and Thulasiraj 2007, p. 42

⁵⁶ Cf. Rangan and Thulasiraj 2007 p.42

⁵⁷ Cf. Aravind Eye Care Systems 2018.

⁵⁸ Cf. Rangan and Thulasiraj 2007, p. 43

⁵⁹ Cf. Rangan and Thulasiraj 2007, p. 43.

⁶⁰ Cf. Ramdorai and Herstatt 2015, p. 55.

⁶¹ Cf. Rangan and Thulasiraj 2007, pp. 43–45.

Quality assurance of surgery

Another factor of high importance is that AECS is not compromising on quality while offering low-cost treatment. By constantly achieving top-notch treatment quality, Aravind has earned a good reputation for clinical excellence. One measurement of treatment quality is infection rate after completed surgery. Studies have shown, that in comparison with Western hospitals, Aravind is not only on par with the United States, but even surpassed the United Kingdom. In addition, AECS closely monitors quality to create a continuous improvement process.⁶²

Vertical integration

As already mentioned, AECS leverages the time of a surgeon to ensure high-productivity. However, this process requires the hiring and training of many clinical ophthalmic assistants in order to achieve clinical efficiency. As the required pool of nurses was not existing at first place, Aravind decided to create its own supply. Each year, AECS selected approximately 300 young women (18-23 years old) from the nearby area of the hospitals to provide them a two year training free of charge. Afterwards, they receive a full-time job offer to work in one of Aravind's hospitals. These women make up about 60% of Aravind's total workforce.⁶³ The emphasis of the training lies on the development of ophthalmic techniques and delivering patient-centric treatment. Ultimately, the people are the backbone of Aravind success and bring the vision to eliminate needless blindness into reality.⁶⁴

Type of Innovation

Process Innovation

The process innovation in the context of ACES is mainly due to the introduction of the "assembly-line" procedures during the surgery. With this, Aravind is able to achieve a high operational and clinical efficiency in their operation process, as explained above.

Product Innovation

Aurolab, an internal manufacturing capacity within AECS, was founded in the early 1990s with the objective of producing low-cost Intra-Ocular Lenses (IOL). Beforehand, AECS was dependent on IOL donations from manufacturers in the United States or Europe, as the

⁶² Cf. Burns 2014, p. 296.

⁶³ Cf. Krishnan 2015.

⁶⁴ Cf. Rangan and Thulasiraj 2007, pp. 45–47.

important price accumulated to about \$150 per lens⁶⁵. Based on the need for cheaper IOLs, AECS began to invest into production facilities and technology to produce IOLs at a fraction of the previous price. Today, Aurolab is one of the largest ophthalmological equipment suppliers in India. Furthermore, they export IOLs to 120 countries and possess a worldwide market share of about 10%.⁶⁶ Moreover, AECS encountered the problem of fungal eye infections in some areas and the absence of appropriate medication in rural areas. For this reason, Aurolab developed eye drops (Vozole) for treating serious fungal infections.⁶⁷

Forus Health is a medical technology company based in Bangalore. Together with AECS, they developed 3nethra, an ophthalmology pre-screening device. It is designed to be portable, compact and easy to operate, which allows for usage in remote areas (eye screening camps). The devices are considerably cheaper than existing technology in the market, which increases affordability. To sum up, 3nethra assists clinicians in the evaluation, diagnosis, and documentation of visual health.⁶⁸

Marketing Innovation

As explained in earlier, AECS leverages economies of scale to lower costs of treatments and therefore are able to serve the poor profitably. With the help of their innovative outreach camps in collaboration with partner organizations, they can attract the large number of patients required. This innovative new model to attract patients is one key to their success.⁶⁹

Financial Sustainability

AECS is a family owned organization managed by Govel Trust and mostly run by Dr. Venkataswamy's family members who serve as hospital directors. It has never relied on funds or government grants. Nevertheless, in their early days the organization had difficulties to receive bank loans. In order to acquire start-up capital, the founder Dr. Venkataswamy mortgaged his home to raise \$55,000.⁷⁰ From the beginning, he was aspired to be self-reliant and sustain profitable growth from operating surpluses.⁷¹

⁶⁵ Cf. Rangan and Thulasiraj 2007, p. 46.

⁶⁶ Cf. Ramdorai and Herstatt 2015, p. 57.

⁶⁷ Cf. Ramdorai and Herstatt 2015, p. 58.

⁶⁸ Cf. Ramdorai and Herstatt 2015, p. 58.

⁶⁹ Cf. Ramdorai and Herstatt 2015, pp. 56–57.

⁷⁰ Cf. Burns 2014, pp. 293–295.

⁷¹ Cf. Leah Davidson 2015, p. 18.

Aravind achieved their financial sustainability through the implementation of a cross-subsidization system. The 45-50% of paying patients are subsidizing the 50-55% of non-paying patients, while quality of treatment stays the same.⁷² According to the book *Infinite Vision* published by Mehta et al, AECS generated about \$28 million in revenue and achieved \$13 million in operating profit in the FY 2009-2010.⁷³ In conclusion, AECS managed to develop a unique and innovative system that allowed for cheap, high-quality treatment in a financially sustainable manner.

Challenges and Problems

Despite, their phenomenal success in recent history, AECS also faces challenges going forward in the future. The success has been mainly due to their cost-effectiveness, clinical volumes and operational efficiency. However, there is also a challenge in attracting and dealing with the high volume of patients. This requires continuous innovation to overcome those constraints.

5.2 LifeSpring Hospitals

Introduction

LifeSpring Hospitals (LSH) is a growing chain of maternity hospitals in India. LSH was founded in 2005 by Anant Kumar with support by HLL Lifecare Ltd (government of India enterprise) with the mission to offer affordable and high-quality maternal health-care to women with low-income across India.⁷⁴ Maternal and infant mortality is a serious problem in India. The maternal mortality rate (number of maternal deaths per 100,000 births) is 167 in 2013, according to UNICEF India. Many women living in rural poor areas cannot afford private hospitals and have a higher chance of dying during delivery.⁷⁵ LifeSpring identified this opportunity and tackled the challenge to provide an innovative business model to offer high-quality, affordable health-care solutions for women in India.⁷⁶

The first hospital opened its doors in Moula Ali, Hyderabad (Capital of Andhra Pradesh, India). Later, Acumen Fund (US-based non-profit global venture fund) invested into LSH

⁷² Cf. Burns 2014, pp. 293–295.

⁷³ Cf. Mehta and Shenoy 2011.

⁷⁴ Cf. Krishnadas 2011, p. 1.

⁷⁵ Cf. UNICEF India n.d.

⁷⁶ Cf. Krishnadas 2011, p. 1.

and transformed it into a joint venture (50:50) with HLL Lifecare Ltd. At the same time, LifeSpring was incorporated into a private limited company in 2008.⁷⁷ Today, LSH operates a network of 12 small hospitals with 20-25 beds in India and performed a total of 35,000 deliveries since its foundation.⁷⁸

Success Strategies

Several employed strategies by LifeSpring Hospitals are critical to their success. In particular, four key strategic choices are noteworthy. These are explained in greater detail in the following paragraph.

Service specialization

LifeSpring Hospital is pursuing a niche strategy and entirely focuses on maternal care. This narrow specialization is one crucial factor for the success of LifeSpring. Their services include prenatal care, deliveries, postnatal care, paediatric care, etc.⁷⁹ The clear focus on in-patient maternal care allowed LSH to standardize their processes to achieve lower costs and increase productivity. The standardization includes standardized kits for surgery or clinical protocols. Moreover, it allowed LSH to employ less qualified Auxiliary Nurse Midwifery nurses (ANM) instead of more expensive General Nurse Midwifery nurses (GNM). ANM nurses are less qualified and are therefore less costly than GNM nurses.⁸⁰

High throughput

By using different approaches, LSH generates high clinical volumes. Firstly, they choose hospital location very carefully. The hospitals are located in high population density areas to reach their target customers. The proximity and accessibility to hospitals is a key criteria as it reduces costs of transportation for customers.⁸¹ Secondly, LSH uses a unique marketing approach to increase throughput. It consists of voucher distribution programs, outreach staff and community initiatives. For example, the outreach staff gathers information on family and medical history to customize their message to the specific situation of the patient.⁸²

⁷⁷ Cf. Krishnadas 2011, p. 5.

⁷⁸ Cf. LifeSprings Hospital n.d.

⁷⁹ Cf. Krishnadas 2011, p. 3.

⁸⁰ Cf. Karamchandani et al. 2009, p. 50.

⁸¹ Cf. Krishnadas 2011, p. 8.

⁸² Cf. Karamchandani et al. 2009, p. 49.

High asset utilization

With their narrow focus on a limited array of maternal services and high clinical volumes, LSH is able to enhance optimal asset utilization of key assets in their hospitals. They cut down costs by using simple equipment and employing of specialized doctors.⁸³ In conclusion, according to (Karamchandani et al. 2009), LifeSpring asset utilization is more than five times higher than comparable private hospitals.⁸⁴ Ultimately, this results in lower per unit costs of key assets for LSH.

High quality maternal health care

Another element of their success is the high quality of the offered maternal health care. The quality is kept at a high level to offer patients a greater surplus compared to other options.⁸⁵ By focusing on a niche segment of the market and high standardization, LSH achieves high quality.⁸⁶

Type of Innovation

Organizational Innovation

With their innovative market based strategy, LifeSpring has demonstrated how to provide high-quality and affordable maternal care to people at the BOP. Their business model, characterized by service specialization, no frill, high throughput and high asset utilization, is more productive than their peers.⁸⁷ LifeSpring identified the opportunity and created an innovative, simple and sustainable business model to achieve their mission.⁸⁸

Financial Sustainability

LSH has proven to be a profitable business by achieving cash profit at corporate level according to internal sources. Moreover, 10 of 12 LifeSpring Hospitals remain profitable.⁸⁹ LSH employed several financial strategies in order to stay financially sustainable. Firstly, the strategy to focus on a particular niche (maternal care) allowed LSH to standardize procedures and hence reduce costs immensely.⁹⁰ Secondly, LSH mostly leased their hospitals (usually 15-20 years) to save on high land costs.⁹¹ Moreover,

⁸³ Cf. Krishnadas 2011, p. 1.

⁸⁴ Cf. Karamchandani et al. 2009, p. 50.

⁸⁵ Cf. Karamchandani et al. 2009, p. 47.

⁸⁶ Cf. Krishnadas 2011, p. 7.

⁸⁷ Cf. Karamchandani et al. 2009, p. 49.

⁸⁸ Cf. Krishnadas 2011, p. 11.

⁸⁹ Cf. LifeSprings Hospital n.d.

⁹⁰ Cf. Krishnadas 2011, p. 1.

⁹¹ Cf. Krishnadas 2011, p. 2.

LSH have a strict no frill policy to cut costs, e.g. outsourced pharmacy and laboratory service, no canteens, basic furnishing, no air-conditioning, etc.⁹² Finally, their cross-subsidization pricing model, which allows women to choose between three types of wards: general ward, semi-private room and private room.⁹³ Generally LSH charge prices 30-50% below average market prices in the private sector. For instance, the price for a normal delivery in a general ward amounts to Indian Rupee (INR.) 1,499 (\$35) compared to average market price of INR 5,450 (\$120).⁹⁴ In the conclusion, LifeSpring has managed to create an innovative and financially self-sustaining business model.

Challenges and Problems

With their mission to offer affordable and high-quality maternal health-care to women with low-income, LSH has contributed to reduce maternal mortality in India. Nevertheless, LifeSpring faces challenges in the future. One challenge is to serve the poorest of the poorest of the poor, who even cannot afford the price of a normal delivery (INR 1,499). Hence, the corporation has to expand their services to serve this customer group, while maintaining the same high-quality standard. Another challenge is to sustain the same level of customer service quality across all hospitals of the LifeSpring network.⁹⁵

5.3 BMVSS - Jaipur Foot

Introduction

Bhagwan Mahaveer Viklang Sahayata Samiti (BMVSS) was established in 1975 at Jaipur (capital and largest city of the Indian state of Rajasthan) by Dr. Mehta. The vision of BMVSS is to ensure rehabilitation of disabled people by providing them with prosthetics or artificial limbs, calipers and other mobility-assisting appliances, free of charge. Since its foundation, BMVSS helped over 1.7 million people⁹⁶ to regain their mobility, dignity and livelihood.⁹⁷ The foundation of BMVSS is very closely linked to the invention of the Jaipur Foot (prosthesis for below and above-the-knee amputees) in 1968, which is explained later. Nowadays, BMVSS is considered the largest limb-fitting organization worldwide.

⁹² Cf. Karamchandani et al. 2009, p. 49.

⁹³ Cf. Karamchandani et al. 2009, pp. 48–49.

⁹⁴ Cf. Krishnadas 2011, p. 8.

⁹⁵ Cf. Krishnadas 2011, pp. 12–13.

⁹⁶ Cf. Bhagwan Mahaveer Viklang Sahayata Samiti n.d.

⁹⁷ Cf. Datar and Chaturvedi 2013, p. 1.

Success Strategies

Several employed strategies by BMVSS are crucial to their success. In particular, three key strategic choices are noteworthy. These are explained in greater detail in the following paragraph.

Patient-centric approach

The invention of the Jaipur Foot itself was based on observation and interaction with amputees. This patient-centric approach is strongly embedded in the organization until today. Further, the model of BMVSS involves the open-door policy and the treatment of poor people, even without appointment or registration and completely free of charge. Furthermore, the organization is constantly seeking for feedback to incorporate it into the improvement process of their products.⁹⁸

Lean organization structure

Their lean organization structure and assembly-line process allows BMVSS to perform averagely 40 to 50 fittings daily. This structure entails the rapid fitment of limbs in only three hours. Every step in the process, from measuring, fabrication, fitting and training resembles an assembly-line process. Moreover, fitments are adjusted until the patient is completely satisfied. This allows for high process efficiency to treat a large number of patients in a short timeframe without compromising on quality.⁹⁹

Close collaboration with technology partners

BMVSS has established collaborations with several technology institutions to continuously work on improving and technologically upgrading their products. These partnerships are key to the success of their products. The research partner include Stanford University, Massachusetts Institute of Technology (MIT), the Dow Chemical Company, Indian Space Research Organization, etc.¹⁰⁰

Type of Innovation

Product Innovation

The Jaipur Foot (Appendix 1) was developed at the Sawai Man Singh (SMS) Hospital in 1968 by a group of orthopedic surgeons and innovative craftsmen. They observed that only few patients received artificial limbs after accidents, mainly because imported limbs

⁹⁸ Cf. Datar and Chaturvedi 2013, 3-4.

⁹⁹ Cf. Datar and Chaturvedi 2013, p. 5.

¹⁰⁰ Cf. Datar and Chaturvedi 2013, p. 9.

were highly expensive and the fitting process was skill- and time-intensive. Moreover, these limbs were inappropriate for the needs in India, as amputees had to walk barefoot in rugged terrain, sit cross-legged, etc. Hence, there was a strong need for a low-cost prosthesis, which requires only short fitting. The solution was the Jaipur Foot, which imitates the functions of a human foot. In particular, the lightweight and the mobility are remarkable characteristics. The foot can be fitted to the patients limb with a shank (Appendix 2), developed and produced by BMVSS, to serve both below-knee and above-knee amputees. The prosthesis allows patients to run, ride bicycles and climb trees. By 2013, BMVSS fitted on average 22,000 limbs per year.¹⁰¹

The Stanford-Jaipur Knee (Appendix 3) was invented and designed by the Stanford University in collaboration with BMVSS. The project was to develop an innovative, cheap knee-joint that could be produced locally for around \$35.¹⁰² This involved a simple production process and the use of locally obtainable materials.¹⁰³ Confronted with these challenges, the team at Stanford developed the Stanford-Jaipur Knee. The innovative design is characterized by its simplicity (only five plastic pieces), performance (stability and 165-degree motion), durability (three to five year lifespan), comfort (1.5 pounds) and cost of production (\$20).¹⁰⁴ Moreover, it has been named as one of the 50 best innovations of the world in 2009 by Time Magazine.¹⁰⁵ A comparable knee joint could cost up to \$10,000. By 2013, BMVSS had already fitted 5,000 Stanford-Jaipur Knees.¹⁰⁶

Financial Sustainability

BMVSS relies on several sources of income. Mostly, they are funded by government grants, donations and interest from corpus.¹⁰⁷ In general, donations accounts for the majority of income. In 2011-2012, major donations accumulated to around \$1.3 million. Further, around one-third of the income comes from government grants. The remaining share is attributable to their own income on the corpus. In 2012, the corpus of BMVSS was at \$6.1 million, which guarantees a yearly interest of \$600,000.¹⁰⁸

¹⁰¹ Cf. Datar and Chaturvedi 2013, pp. 1–7.

¹⁰² Cf. Zenios and Denend 2012, p. 2.

¹⁰³ Cf. Datar and Chaturvedi 2013, p. 8.

¹⁰⁴ Cf. Zenios and Denend 2012, p. 2.

¹⁰⁵ Cf. Rahim Kanani 2011.

¹⁰⁶ Cf. Datar and Chaturvedi 2013, p. 8.

¹⁰⁷ Cf. Rahim Kanani 2011.

¹⁰⁸ Cf. Datar and Chaturvedi 2013, p. 6.

In order to ensure the best utilization of funds, BMVSS applies strict expenditure policies and evaluate every dollar spend. For this reason, only 4% of total expenditure refer to administrative and overhead costs, compared to the average at 20% for the non-profit industry.¹⁰⁹ However, with their free for all model, funding remains a critical challenge for BMVSS.

Challenges and Problems

BMVSS faces several challenges and problems. Firstly, there is a problem of the unreached patients. Although, BMVSS performs approximately 22,000 limb fitments annually, there is still a large number of unserved amputees in India and the need to scale up the business.¹¹⁰ Secondly, additional investments in R&D are necessary to continuously improve their products and develop new innovations (e.g. Jaipur Hand). This problem is related to the question about the free-for-all model as the company faces financial problems. In order to become a financially sustainable company, some argue that they have to change this model. Thirdly, there are issues about the product quality, for instance the longevity. The Jaipur Foot has a lifespan of around three years, which is only half the lifespan of equivalent prostheses.¹¹¹

5.4 Embrace Infant Warmer

Introduction

Each year more than 20 million babies are born at low birth weight. According to the World Health Organization, this is one of the main reasons for the high mortality rate of newborns.¹¹² About 3 million of these newborns die in the developing world and usually within their first month of life.¹¹³ LBW can cause many complications like hypothermia, a status where the baby's temperature drops down dramatically. Finally, this status leads to death. The best way to prevent hypothermia is to place the newborns in an incubator until they can regulate their own body temperature without external help after gaining enough weight. But the use of the incubators is very costly (around \$20,000 per unit) and requires a constant supply of electricity. Both aspects are quite problematic in emerging

¹⁰⁹ Cf. Datar and Chaturvedi 2013, p. 7.

¹¹⁰ Cf. Datar and Chaturvedi 2013, p. 10.

¹¹¹ Cf. Prince Mathews Thomas 2013.

¹¹² Cf. Denend et al. 2013.

¹¹³ Cf. Walters 2015.

and developing countries.¹¹⁴ People are simply not able to spend this huge amount of money and have no constant access to qualitative health care or to the electric grid.

Success Strategies

The story of Embrace began 2007 with the vision of four entrepreneurs from Stanford University. The aim of Jane Chen, Rahul Panicker, Naganand Murty, and Linus Liang was to prevent the infant death rate problem in emerging and developing countries caused by LBW.¹¹⁵ The main success strategy of the product resulted in the simple, cheap and affordable material and therefore in cutting down costs by using adequate equipment.

Optimal resource utilization

The so called "Embrace Infant Warmer" (Appendix 4) offers a low-cost solution and can be used perfectly in rural areas of the world. It looks like a miniature sleeping bag with a heater inside that keeps low birth weight babies warm.¹¹⁶ The sleeping bag is small, safe, reliable and very easy to use. It consists of reusable pouch of phase change material (PCM) and costs only a fraction of a standard incubator.¹¹⁷ The separate heater or pouch can be heated by using for example hot water and will be placed inside the sleeping bag. This makes it affordable and accessible for people living in remote areas.¹¹⁸ The sleeping bag absorbs or releases heat in accordance with the baby's needs while the heater can retain the heat level for up to several hours.¹¹⁹

Type of Innovation

Product Innovation

The problem of babies facing hypothermia occurs primarily in developing and emerging countries. People living in remote areas have often no access to qualitative health care, medical devices or even electricity. Low-birth-weight and premature babies have no chance to survive. Those that do survive often face lifelong problems like heart diseases or brain disorders.¹²⁰ The Embrace Infant Warmer tries to solve this product by offering a product innovation which is cheap, affordable and easy to use even without electricity. Walters (2015) stated: "What we needed was not just a lower-cost version of what exists

¹¹⁴ Cf. Denend et al. 2013.

¹¹⁵ Cf. Walters 2015.

¹¹⁶ Cf. Technology Exchange Lab 2018.

¹¹⁷ Cf. Denend et al. 2013.

¹¹⁸ Cf. Technology Exchange Lab 2018.

¹¹⁹ Cf. Denend et al. 2013.

¹²⁰ Cf. Technology Exchange Lab 2018.

today. We needed something that could function without a constant supply of electricity; something that was easy enough for a mother, a midwife, a health care worker to use. Something that would stay at a hospital but also a village clinic”.¹²¹

Financial Sustainability

The mission of Embrace is to grow and expand quickly by offering their products to emerging and developing countries. The core idea is to make the product available for as many people as possible. Therefore, Embrace has split itself into two entities. The non-profit entity and the for-profit entity. The first one owns the intellectual property and donates the products to populations that needed them the most. Also, they provide training and education in maternal care. On the other hand, there is the for-profit entity licensing the intellectual property for supporting education and research and development. Consequently, it sells products to paying entities like to hospitals or to the government.¹²²

Challenges and Problems

The team of Embrace first decided to go for a non-profit entity. Later Embrace realized all the difficulties associated with such a model. The costs of management, marketing, distribution and production were simply underestimated. But there was still the anxiety about external reactions. Embrace mostly reliant on donations and partnerships with non-governmental organizations feared that some cooperation would be cancelled in case of switching to a for-profit model. Therefore, Embrace decided to build a hybrid structure that comes with of many difficulties, as Denend et al. (2013) state: “It’s difficult enough to operate one organization [...]. With two entities, we have to be sure we have the manpower and processes in place to keep them as seamlessly integrated as possible, while at the same time having an onsite agreement to make sure there isn’t a conflict of interest. There are a lot of issues to figure out”.¹²³

¹²¹ Walters 2015.

¹²² Cf. Walters 2015.

¹²³ Denend et al. 2013.

5.5 GE Healthcare - MAC 400 ECG System

Introduction

Over 17 million deaths are caused by cardiovascular diseases, representing 30 percent of all deaths globally. This development is primarily affecting low-income countries like India where annually two million people are dying due to heart-related problems because people cannot afford treatments or have no access to them. Singh (2011) writes: "India was expected to soon be host to more than half of all worlds' heart patients, making ECG testing of tremendous value in early detection".¹²⁴ Besides this, the world population is rising especially in developing and emerging countries. Consequently, the need for basic health care become even more important.¹²⁵

Success Strategies

General Electric announced in 2009 the plan of creating at least 100 health-care innovations over the next few years by focusing mainly on aspects like better access, lower costs and improved quality. Two products were originally developed for markets in emerging countries: A handheld electrocardiogram (ECG) device for India and a portable ultrasound machine for China.¹²⁶

Cost savings, high accessibility without compromising on quality

The ECG simplifies the first step of diagnosing a heart disease or a heart problem by measuring the electrical activity of the heart. The Mac 400 ECG system (Appendix 5) make this procedure cheap, easy and accessible for physicians using it in rural areas of the world.¹²⁷

Patient-centric approach and local production

The Mac 400 ECG system was designed in 2008 at the John F. Welch Technology Centre in Bangalore, India after carefully analysing customer requirements.¹²⁸ Using local R&D has also offered many other advantages like a faster process, lower costs or a better knowledge about available components and costumers.¹²⁹

¹²⁴ Singh 2011, p. 3.

¹²⁵ Cf. GE Healthcare n.d. b.

¹²⁶ Cf. Immelt et al. 2009, p. 3.

¹²⁷ Cf. GE Healthcare n.d. b.

¹²⁸ Cf. GE Healthcare n.d. b.

¹²⁹ Cf. Singh 2011.

Type of Innovation

Organizational Innovation

With the plan to invest more than \$3 billion in health-care innovations, GE build an innovative market-based strategy to enter emerging countries. The company identified the opportunity and created an innovative, simple and sustainable business model to achieve their mission.¹³⁰

Product Innovation

The MAC 400 ECG System is a product innovation designed to meet local requirements in India and to simplify the work of physicians in remote areas. The compact electrocardiograph is accurate, reliable and meet the same quality standards as high-priced full-scale ECG devices. The MAC 400 is very easy to use and minimizes training needs.¹³¹ To describe it in other words, it is a low-price solution, which perfectly targets local requirements.¹³² It is a portable device weighting only 1.3kg. Equipped with a long-lasting Lithium battery it can be recharged in less than three hours. This makes the analysis and printing of ECG's fast and cheap and therefore affordable and accessible for people and clinics in isolated areas without loss of quality.¹³³

Financial Sustainability

Like already shortly mentioned, the Mac 400 is directly designed in India using local R&D which offers many benefits and creates financial sustainability in the long-run: The development process is faster and costs are much lower in comparison to other countries like the United States. To go more into detail, the MAC 400 was developed in only 22 months for about \$500,000. This is in comparison to similar products only a fraction of time and money. The second huge benefit is the better overview of available local and cheap components and third the team has a better knowledge about local costumer needs. This all resulted in a widespread adoption because of huge cost reductions and savings. Another major aspect of financial independence is that GE Healthcare is a division of General Electric and has access to accumulated resources like money or market knowledge. Furthermore, GE Healthcare tried to form partnerships with pharmaceutical and surgical companies or even Banks to make it easier for potential costumers

¹³⁰ Cf. Immelt et al. 2009, p. 3.

¹³¹ Cf. GE Healthcare n.d. a.

¹³² Cf. Immelt et al. 2009.

¹³³ Cf. GE Healthcare n.d. b.

overcoming constraints.¹³⁴ To generate sales not only in India the product originally developed for emerging markets was also being sold in other countries like the United States. This strategy is called “reversed Innovation” and is seen as a huge success and prerequisite for continued vitality in developed countries.¹³⁵

Challenges and Problems

One of the main challenges for GE was the barrier to enter the mass market. Actual sales ended up being within the traditional customer segment. To expand the business GE needed a breakthrough by generating new sales, distribution and service networks. Furthermore, the organizational design worked in favor for this development. The employees were rewarded based on revenues and profit. BOP products like the MAC 400 were much cheaper and had lower margins. Consequently, incentives were limited, and motivation decreased dramatically. Therefore, GE was forced to react and change the existing organizational structure. To solve the issue of entering the mass market by developing different series of the MAC 400 like the MAC 400i with further features for a lower price.¹³⁶

5.6 Biosense Technologies

Introduction

Health care in poor and remote areas of the world is a huge challenge. Many diseases cannot be diagnosed at an early state due to limited access and limited financial resources.¹³⁷ "When it comes to economics of health care, a lot of uncertainty is encountered as majority expenditure is still handled in an out-of-pocket fashion in private centers as opposed to insurance which is more popular in the western world."¹³⁸ The vision of Biosense Technologies, a company started as a college project is to democratise health care in India. Every person should have access to health care and medical devices whenever it is needed without compromising on quality.¹³⁹ Rapid and early diagnosis of many diseases can ease further steps or even save lives.¹⁴⁰ Biosense Technologies was founded by Myshkin Ingawale, Abhisek Sen, Yogesh Patil and Aman

¹³⁴ Cf. Singh 2011.

¹³⁵ Cf. Immelt et al. 2009, p. 3.

¹³⁶ Cf. Singh 2011.

¹³⁷ Cf. Villgro 2018.

¹³⁸ Biosense Technologies n.d.

¹³⁹ Cf. Rajappa 2018.

¹⁴⁰ Cf. Biosense Technologies n.d.

Midha. The company started in 2008 to launch cost efficient devices for early detection of chronic diseases in India.¹⁴¹

Success Strategies

The main objective of Biosense Technologies is to improve lives of people by offering them better access to health care. The company wants to extend creative and alternative solutions by using simple and affordable devices.¹⁴² The success strategy of the company lies in the transformation of easily accessible lifestyle gadgets into devices that can help to detect a range of chronic diseases.¹⁴³ In the following three different gadgets are introduced to help detecting diabetes, anaemia or malnutrition.¹⁴⁴

Cost savings, high accessibility and quality by optimal resource utilization

The TouchHb (Appendix 6) is a non-invasive anaemia screener. It consists of a hand-held needle free battery and simplifies regular monitoring.¹⁴⁵ The product is very easy to use, reliable and painless.¹⁴⁶

The uChek (Appendix 7) is a smartphone-based urine analysis system to diagnosis diabetes beside other diseases.¹⁴⁷ It detects colour changes in urine strips and only costs a fraction of compared devices. Also, it is easy to use and displays results in less than a few seconds. The device is portable and small and does not need electricity.¹⁴⁸ The UChek also operates together with an app. The user can take a picture of the urine stripe and the app analyses what it sees. The result can be directly transmitted to a physician.¹⁴⁹

The Remote diagnostic Kit (Appendix 8) comes together with the TouchHb, the UChek and other useful devices like a blood pressure machine or a temperature probe. It is a very helpful tool to detect quickly pregnancy, malnutrition or other serious diseases in remote areas. This could be for example malaria or typhoid. The kit is portable, easy to use with minimal training and simplifies screening and monitoring.¹⁵⁰

¹⁴¹ Cf. Rajappa 2018.

¹⁴² Cf. Biosense Technologies n.d.

¹⁴³ Cf. Abrar 2013.

¹⁴⁴ Cf. Biosense Technologies n.d.

¹⁴⁵ Cf. Villgro 2018.

¹⁴⁶ Cf. Biosense Technologies n.d.

¹⁴⁷ Cf. Rajappa 2018.

¹⁴⁸ Cf. Biosense Technologies n.d.

¹⁴⁹ Cf. Abrar 2013.

¹⁵⁰ Cf. Biosense Technologies n.d.

Type of Innovation

Product Innovation

Biosense Technologies was founded in December 2008. The company started as a device manufacturer by offering product innovations and transformed into a solution provider for chronic diseases in India by creating innovative processes for the population.¹⁵¹ The devices developed by the company offer huge cost and time savings by simultaneously offering better access and affordability for patients and physicians. The products perfectly meet local requirements and simplify the early detection of many different diseases.¹⁵² "Though problems like anaemia and malnutrition lead to range of other health complications like stunted growth, a sense of urgency with which they are either detected or treated is missing in India"¹⁵³

Financial Sustainability

Before Biosense Technologies registered as a company it mostly functioned as a college project from 2008 till 2013. The company received a lot of support from different organisations like the Centre for Innovation, Incubation & Entrepreneurship (CIIE) or Villgro-Menterra, a private investment venture which supported a college project for the first time.¹⁵⁴ The rise of untreated chronic diseases in rural areas of the world is a huge problem. Consequently, the offered solutions by Biosense Technologies have aroused great interest among public, investors and organizations. Abrar (2013) stated: "The demand for affordable diagnostic health care devices which can be used at home is growing very fast globally".¹⁵⁵ Biosense Technologies has nowadays many different supporters and mainly build on partnerships or investments from private or social organizations.¹⁵⁶

Challenges and Problems

There were also some challenges during the long journey of Biosense Technologies becoming a company. Apart from funding problems the company also faces challenges concerning distribution: "Having just capital is not enough. Once we finish designing a product, getting it out successfully is rather difficult considering the distribution sector

¹⁵¹ Cf. Rajappa 2018.

¹⁵² Cf. Abrar 2013.

¹⁵³ Rajappa 2018.

¹⁵⁴ Cf. Rajappa 2018.

¹⁵⁵ Abrar 2013.

¹⁵⁶ Cf. Biosense Technologies n.d.

for medical consumables is highly fragmented." But the company is keen to improve their distribution channel and supply chain by expansion into new markets and investing in R&D.¹⁵⁷

5.7 Narayana Health Limited

Introduction

Narayana Health (NH) is a private hospital chain founded by Dr. Devi Shetty in 2000. It provides quality healthcare at an affordable price and is considered a social business for profit. It serves over 80,000 patients yearly and employs over 16,000 workers.¹⁵⁸ NH operates on the mission to serve the population who cannot afford medical service without compromising in quality. To support this mission, NH has established a business model with the principal of presenting high-quality service to attract full-price paying patients. The paying patients would then subsidize the specific treatments and surgeries for the ones who cannot afford it.¹⁵⁹ Initially, Narayana health started as one single hospital in India with 225 beds. It has now become one of the most renowned hospital chains due to its efficient business model, skilled doctors, sustainable vision, utilization of resources and leverage to the economies of scale.¹⁶⁰ NH now operates in 30 specialties which includes departments such as Cardiology and Cardiac Surgery, Cancer Care, Neurology, Orthopedics, and Gastroenterology. NH has an international geographical reach as it has now established a hospital in Cayman Islands.¹⁶¹

Success Strategies

The core values for NH are represented by the acronym "iCare": "Innovation and efficiency, Compassionate care, Accountability, Respect for all, and Excellence as a culture."¹⁶² Along with these values and their philanthropic ideology, NH pursued success in the health care through high volumes, clinical potency, sustainable financing and with the utilization of artificial intelligence.

¹⁵⁷ Cf. Rajappa 2018.

¹⁵⁸ Cf. Dr. Raghuvanshi n.d.

¹⁵⁹ Cf. Kothandaraman and Mookerjee 2007, p. 5.

¹⁶⁰ Cf. Narayana Health 2013.

¹⁶¹ Cf. Narayana Hrudayala Limited n.d.

¹⁶² Narayana Hrudayala Limited n.d.

High Volume Efficiency

One of the reasons NH is successful is because of its placement advantage. India produces one of the largest number of doctors, nurses and medical technicians in the world. They are also able to produce in extremely high volumes, thus being able to cross subsidize the costs of their patients.¹⁶³ NH focuses on cardiac care and connects to patients through telemedicine facilities. This increases surgeon productivity and brings the cost down per-patient. There is also a proper utilization of capital equipment as the infrastructures and machines are employed to the maximum.¹⁶⁴

Clinical Quality

The hospital does not compromise on quality of the surgeries and treatments offered. NH hospitals have an average quality compared to the United States average quality.¹⁶⁵ Moreover, NH performed better surgeries than the average of high industrialized country hospitals.¹⁶⁶ The high quality approach in health care with low pricing is a successful strategy adopted by NH. This led to the continuous growth of NH in the past years. NH has globally benchmarked its quality-driven health care services model.¹⁶⁷

Artificial Intelligence (AI)

Narayana Health makes use of AI and uses it to provide high efficiency and advanced analytics in its lab results, forecasting and various other sectors. This is relatively a new form of data storage and communication in the health care sector; especially in India. Ari Altstedter (2019) states that NH employs about 70 programmers and product specialists who intend to handle everything that happens at Narayana hospitals. They help with admission forms, payments, scheduling, pharmacy dispensations, and document the usage of a hospital supplies. The system will record it, along with data on outcomes and complications which is altered endlessly combined through the numbers for unnecessary costs, devising ways to stamp them out.¹⁶⁸

¹⁶³ Cf. Narayana Health 2013.

¹⁶⁴ Cf. Ramdorai and Herstatt 2015, p. 55.

¹⁶⁵ Cf. Govindarajan and Trimble 2012.

¹⁶⁶ Cf. Kothandaraman and Mookerjee 2007.

¹⁶⁷ Cf. Narayana Hrudayala Limited n.d.

¹⁶⁸ Cf. Altstedter 2019.

Type of Innovation

Process Innovation

Following an optimized internal process innovation, Narayana Health proceeds on a factory style approach to health care. The lean manufacturing process helps the hospital chain to produce in bulk, thus avoiding construction cost.¹⁶⁹ Dr. Shetty utilizes simple economies of scale to offer quality healthcare at affordable prices. Technological assistance such as the use of broadband enables remote diagnosis and teleconsultations, real-time access to medical data across the group, and optimization of management efficiency thanks to a cloud-based enterprise resource planning (ERP) system.¹⁷⁰ NH offers a micro insurance scheme in partnership with the state government with a new model innovation process. This covers the surgeries performed in the hospitals of Karnataka, India.¹⁷¹

Financial Sustainability

NH revenues come mainly from its health care operations, with cash-paying patients accounting for 40 percent, patients registered under government/ micro-insurance schemes 30 percent, privately-insured patient 30 percent, and services to hospitals outside the network less than one percent.¹⁷² NH offers a broad range of quality health care at low cost. They cross subsidize the cost of their patients. Medical treatment and surgeries are available at different price levels. In addition, NH remains financially stable through utilizing technology innovation. NH has partnered with TriMedx, who service equipment beyond its usual lifespan. This helps in reduction of long-term capital expenses.¹⁷³

Challenges and Problems

NH has a strong purchasing power for medical supplies due to its massive patient volumes. Nevertheless, there might be other hospitals and clinics following Narayana's business model in the near future. Thus, they need to continuously innovate in their processing as it is the major core of their business model. A major challenge for NH for is

¹⁶⁹ Cf. Dr. Raghuvanshi n.d.

¹⁷⁰ Cf. Dr. Raghuvanshi n.d.

¹⁷¹ Cf. Ramdorai and Herstatt 2015, p. 73

¹⁷² Cf. Dr. Raghuvanshi n.d.

¹⁷³ Cf. Narayana Health 2013, p. 6

to bring down the cost as it can predict many competitors arising in the health care industry.

5.8 Tata Swach

Introduction

Tata Swach was launched by one of India's multinational conglomerate holding company; the Tata Group, in collaboration with Tata Chemicals Innovation Centre and the Tata Research Development and Design Centre.¹⁷⁴ The low cost, low maintenance and user-friendly water purifier was introduced in 2009. Today it is considered as one of the world's most cost-effective water purifier. The product is targeted towards the Indian population who do not have the basic access to clean drinking water. Thus, Tata Swach was introduced with the mission to reduce water-borne diseases by making safe drinking water accessible to all.¹⁷⁵ The purifier uses natural materials like rice husk and a cutting-edge nanotechnology which eliminates water borne diseases.¹⁷⁶

Success Strategies

In a country such as India, where water borne diseases cause frequent fatalities, most water purifiers were too expensive for the low-income population to afford. This created a market potential for the BOP. Tata Swach took advantage of this opportunity and introduced their product Tata Swach (Appendix 9). The advantages of the product are that no water boiling is required, no use of harmful chemicals, and zero water wastage.¹⁷⁷

Optimal resource utilization

The water purifier is targeted for the local households that does not have access to clean drinking water and cannot afford a purifier or afford to boil the water. Thus, a simple model based on natural materials and cutting-edge nanotechnology was introduced by Tata.¹⁷⁸ The infused rice husk ash with the coating of silver nanotechnology eliminates 90 per cent of the bacteria that causes serious diseases.¹⁷⁹ Tata Swach does not use any

¹⁷⁴ Cf. Tata Swach 2017.

¹⁷⁵ Cf. Tata Chemicals Ltd 2010.

¹⁷⁶ Cf. Ahlstrom 2010, pp. 11–24.

¹⁷⁷ Cf. Tata Swach 2017.

¹⁷⁸ Cf. Ahlstrom 2010.

¹⁷⁹ Cf. Singh et al. 2011, pp. 77–86.

harmful chemicals in its purifier.¹⁸⁰ The resource utilization make its cost effective and user friendly.

Type of Innovation

Product Innovation

Tata realized the need of a low cost, user friendly water purifier in the Indian water purifying market. With the resources available, Tata Swach positioned itself as a low-priced product, which is easy to operate and easily available.

Impressed by the Sujal Rice Husk Ash (RHA), which was already existing in the market, Tata Group revived the project to develop a low-cost water purifier that would also meet international standards of purity.¹⁸¹ The use of rice husk ash and silver nanotechnology for purification was a disruptive innovation in the Indian market. A unique product design through an automatic defect proofing mechanism in the product was also introduced.¹⁸²

Financial Sustainability

Tata Swach provides safe drinking water at Re. 0.10 per liter¹⁸³, which amounts to approximately \$0.002 (\$1=INR 50).¹⁸⁴ It is specifically made not for profit model but rather for serving in the BOP market and sustaining in it against the competitors. As the product is owned by the Tata Group and is a non-profit product, it can be carried out sustainably in the market for water purifies.

Challenges and Problems

In terms of the product itself, complaints regarding the bulb-filter problems have been arising in the product reviews. Thus, Tata Swach needs to customize its technology and revise its product quality. The purifier it does not yet fully satisfy the health requirements set by World Health Organization.¹⁸⁵

¹⁸⁰ Cf. Tata Chemicals Ltd 2010.

¹⁸¹ Cf. Charles Dhanaraj 2011.

¹⁸² Cf. Shambhu Kumar 2014.

¹⁸³ Cf. Tata Chemicals Ltd 2010.

¹⁸⁴ Cf. Tiwari and Herstatt 2012.

¹⁸⁵ Cf. Ahlstrom 2010.

5.9 Apollo Telemedicine Networking Foundation

Introduction

Telemedicine is regarded as an information communication technology platform in health care services, as it gives a wide access to health care facilities.¹⁸⁶ It provides services to rural areas by utilizing different technologies to uplift educational and administrative activities.¹⁸⁷ Rural Indian areas only have access to primary health center with basic facilities, sometimes managed by only one registered medical practitioner. Therefore, Apollo Hospitals established an institution in the name of Apollo Telemedicine Networking Foundation (ATNF) in 2009. It specializes in consulting the patients who cannot personally attend the doctor due to distance restrictions and high costs. Apollo first started their work in Aragonda, where tele camps would help specialists to see several patients one after another.¹⁸⁸

Success Strategies

Apollo Telemedicine Networking Foundation quickly realized the opportunity gap of information technology in the Indian health care sector and developed platforms and solutions to achieve the efficiency and uniformity through Telemedicine.

Company Collaboration

Initiating with the pilot project, “The Aragonda Hospital Project”, ATNF slowly started spreading its work to other states of India and gradually to the world. They have collaborated with robust companies such as the Government of Gujarat and Aditya Birla Group. Other projects such as Kudankulam Nuclear Power Project (KKNPP), Distance Healthcare Advancement Project (DISHA), Telemedicine for Hospital-on-Wheels and Home Tele-care & Tele Nursing are also coordinated by ATNF.¹⁸⁹

Market Implementation

ANTF successfully implemented its idea in the telemedicine sector in India. ATNF offered its consultancy services all over India and abroad to hospitals wanting to replicate this project.¹⁹⁰ According to the findings in the case study conducted by Sridevi and Alagarsamy (2015), “Apollo hospitals were able to promote telemedicine and distant

¹⁸⁶ Cf. B. Bowonder et al. 2005, p. 2.

¹⁸⁷ Cf. Bollineni 2011.

¹⁸⁸ Cf. Bollineni 2011.

¹⁸⁹ Cf. Bollineni 2011.

¹⁹⁰ Cf. Bollineni 2011.

medical facilities to 40% remote areas and to provide communication amongst medical community by dissemination of specialized medical knowledge through a technologically advanced network.”¹⁹¹ Following their innovation strategy, they have collaborated with Indian and Foreign universities and research organizations, and other Foundations in telemedicine areas. They also provide scholarships, stipends, awards and rewards for persons engaged in research in the field of Telemedicine.¹⁹²

Type of Innovation

Process Innovation

Apollo Hospital realized that innovation on health care information technology can help them achieve the objective of deficit of doctors in rural areas of India. At ATNF, the mode of operation is truly telecommunication. Introducing a discrete business model, ATNF uses cloud platform and has Web-based software which is used to transmit electrocardiograms, images CT scans, ultrasound pictures, MRI and other reports. The videoconferencing camera is focused on illuminated x-ray lobby. The images are viewed by the consultant at the tertiary center. Using computer aided transmission of audiovisual data, a doctor can diagnose the case of a patient in a distant location using an identified specialist from any location.¹⁹³ ANTF uses various platforms to operate its telecommunication such as the Apollo Personal Health Record (PHR).

The PHR helps its patients to receive, store and access their health information online. The streamlined process allows doctors to access patient data at all times, which results in time savings. Another service provided by ANFT was the online booking system. This service gave patients an opportunity to book a doctor’s consultation online. Other areas such as patient management, virtual consultation, Customer Relationship Management (CRM), Business Intelligence (BI) are also available, which helps to connect the patient to their tertiary service providers.

Financial Sustainability

ANFT focuses on enabling access to specialist care with the help of telemedicine faculties such as tele-cardiology or tele-radiology. Cost of consultation for primary care in Common Service Centers (CSC) is INR 100. However, the specialist consultation costs are higher, ranging between INR 1,000 to INR 2,000. ANFT is in collaboration and paid partnership

¹⁹¹ Sridevi and Alagarsamy 2015, p. 27.

¹⁹² Cf. Sridevi and Alagarsamy 2015.

¹⁹³ Cf. Sridevi and Alagarsamy 2015, p. 25.

with the state government. They have also partnered with CSCs to provide tele-consultation.¹⁹⁴

Challenges and Problems

Telemedicine has high potential in the future, nevertheless the challenges are demanding. Hence, Apollo faces various challenges concerning its growth. The doctors are not willing to travel to the rural areas due to lack of transportation, distance and low salary. Patients are sometimes not used to telecommunication, let alone telemedicine.

More governmental support could also motivate the medical sector to come up with more innovations.¹⁹⁵ Although, Indian Space Research Organization has expanded the number of hospitals with satellite connections for telemedicine to over 100 institutions, large rural areas are still not connected to major cities. This is due to the fact that these connections are expensive, and hospitals do not have a strong broadband network.¹⁹⁶ Short-term courses to train the trainers and the users are also necessary. Making the scheme attractive by providing reimbursement to teleconsultants is also important. Furthermore, partnerships and grants are considered of importance for the future of ANFT.¹⁹⁷

¹⁹⁴ Cf. Singh 2017, p. 17

¹⁹⁵ Cf. Sridevi and Alagarsamy 2015.

¹⁹⁶ Cf. Sridevi and Alagarsamy 2015.

¹⁹⁷ Cf. Ganapathy and Ravindra 2009, p. 854.

6. Analysis of cases & Discussion of results

In order to analyze the cases, the following Table 1 illustrates an overview of selected key characteristics of each case.

Organization	Founder	Founding Date	Financial Sustainability	Type of Innovation	Success Strategies
Aravind Eye Care System	Dr. Govindappa Venkataswamy	1976	<ul style="list-style-type: none"> Private non-profit Cross-subsidization pricing model 	(1) Process Innovation (2) Product Innovation (3) Marketing Innovation	(1) Focus on cataract treatment (2) High clinical volumes (3) Operational and clinical efficiency (4) Quality assurance of surgery (5) Vertical integration
LifeSpring Hospitals	Anant Kumar with support by HLL Lifecare Ltd	2005	<ul style="list-style-type: none"> Private for-profit Cross-subsidization pricing model 	(1) Organizational Innovation	(1) Service specialization (2) High throughput (3) High asset utilization (4) High quality maternal health care
BMVSS - Jaipur Foot	Dr. Mehta	1975	<ul style="list-style-type: none"> Private non-profit Free-for-all pricing model Reliant on government grants & donations 	(1) Product Innovation	(1) Patient-centric approach (2) Lean organization structure (3) Close collaboration with technology partners
Embrace Infant Warmer	Jane Chen, Rahul Panicker, Naganand Murty and Linus Liang	2007	<ul style="list-style-type: none"> Two entity system: Non-profit and for-profit Private organization 	(1) Product Innovation	(1) Optimal resource utilization
GE Healthcare - MAC 400 ECG System	General Electric (GE)	2009	<ul style="list-style-type: none"> Private for-profit 	(1) Product Innovation (2) Organizational Innovation	(1) Cost savings (2) High accessibility (3) High quality

					(4) Patient-centric approach (5) Local production
Biosense Technologies	Myshkin Ingawale, Abhisek Sen, Yogesh Patil and Aman Midha	2008	<ul style="list-style-type: none"> Private for-profit 	(1) Product Innovation	(1) Cost savings (2) High accessibility (3) High quality (4) Optimal resource utilization
Narayana Health Limited	Dr. Devi Shetty	2000	<ul style="list-style-type: none"> Private for-profit Cross-subsidization pricing model 	(1) Process Innovation	(1) High Volume Efficiency (2) Clinical Quality (3) Artificial Intelligence
Tata Swach	Tata Chemicals Limited & Tata Consultancy Services	2009	<ul style="list-style-type: none"> Private non-profit 	(1) Product Innovation	(1) Optimal resource utilization
Apollo Telemedicine Networking Foundation	Dr Prathap C Reddy	1999	<ul style="list-style-type: none"> Private non-profit 	(1) Process Innovation	(1) Company Collaboration (2) Market implementation

Table 1: Overview of cases

In general, the sample of nine case studies revealed several findings concerning frugal innovations in the Indian health care sector.

Firstly, the analysis reveals that half of the frugal innovations are provided by non-profit organizations, which do not seek for profit maximization. In contrast, the other half are for-profit organizations. Interestingly, all organizations are considered private organizations. That results in an exclusion of governmental cases from this research. Another finding is the pricing model of frugal innovations. One third of the cases deploy a cross-subsidization pricing model, namely AECS, LSH, and NH. As mentioned in earlier sections, this allows for subsidization of non-paying patients. Surprisingly, one organization (BMVSS) applies a free-for-all pricing model. Concerning the financial sustainability, the analysis shows that the majority are self-sustainable and only the minority is reliant on government grants and donations. Particularly noteworthy is Embrace, which applies as only organizations a two entity system consisting of a non-profit and for-profit entity.

Secondly, the comparison showcased the type of innovation. Six out of nine cases in our sample developed some form of product innovation. Examples are the Jaipur Foot, Embrace Infant Warmer or Tata Swach. Hence, the predominant focus in our sample are product innovations. Four out of nine frugal innovations introduced process innovations. The minority of frugal innovations are organizational and marketing innovations.

Finally, the success factors were analyzed and compared. In this context, the analysis indicates that the quality of care is shared by most of the frugal innovations (55%). These companies, namely AECS, Biosense Technologies, LSH, NH, etc., do not compromise on quality while offering low-cost treatment. In particular, AECS and NH earned respectable reputation for clinical excellence, which approaches western standards. For most of these firms, high quality is achieved through narrow clinical focus. Furthermore, high or optimal asset/resource utilization is another key success factor applied by four out of nine organizations. This allows organizations to lower production cost and enhance optimal utilization of key assets. In the case of LifeSpring Hospitals, asset utilization exceeds comparable private hospitals in India by five times. Another crucial success factor is the high clinical volumes, assignable to one third of selected frugal innovations in the sample. The high number of patients treated enable organizations to lower the cost per patient and increases productivity drastically. In particular, Aravind Eye Care System and Narayana Health Limited are outstanding examples of organizations scaling up their number of patients treated. In order to attract the large volumes of patients required to leverage economies of scale, both organizations apply innovative patient acquisition through outreach camps. Moreover, both organizations also share the factor of high clinical efficiency due to an assembly-line system for surgery. This lean system allows the reduction of surgery time, high productivity of surgeons, and enhances utilization of medical equipment to ultimately lower treatment costs per patient. For instance, a surgeon at AECS performs five times more operations a year than the average Indian ophthalmologist. The embedment of patient-centric approach and management is regarded as another success factor identified in 22% of all cases. Especially, BMVSS - Jaipur Foot and GE Healthcare adopt this approach and carefully analyze patients' needs and requirements to offer optimal medical products and services. Further, these organizations are characterized by a culture of continuous improvement. Other mentionable factors are service specialization and accessibility of care, both found in two frugal innovations. In those cases namely LSH and AECS, the service specialization in

pursuing a niche strategy and narrowing the clinical focus acts as an enabler for other key success strategies.

To sum up, seven success factors with high importance were detected according to the analysis of the nine selected frugal innovation cases. In descending order of importance, these success factors are listed as follows: High quality of care; High asset/resource utilization; High clinical volumes; Clinical efficiency; Patient-centric approach; Accessibility; Service specialization.

These findings highlight the key success factors identified of frugal innovations in the Indian health care sector. Further, the findings disclose considerable insights and act as a starting point to assess the reversed innovation potential of the selected frugal innovation examples.

7. Reversed innovation potential

This chapter aims to identify the reverse innovation potential of the previously described frugal innovation cases. A closer look on existing literature about reverse innovation strategies helps to develop several assumptions concerning a successful adaptation in developed countries. Possible opportunities and threats will be explained. This is followed by an analysis of the key success factors of frugal innovations concerning the health care sector to give meaningful statements about the potential transformation into high-income settings.

The term “frugal innovation” describes a process of creating a product or service solution mainly for emerging and developing economies. Spreading these innovations globally is described by the term “reverse innovation”.¹⁹⁸ Although the definitions sound clear, the implementation can be difficult. Adopting products, processes or services in a poor country before implementing them in rich countries contains a lot of opportunities and threats.¹⁹⁹

The opportunities are obvious and have been recognized by many companies. There is a huge potential in implementing innovations from low- and middle- income countries to high-income countries.²⁰⁰ Emerging markets are expanding three to four times faster than Europe or the US. This reason makes it attractive for many firms to increase their market share in these economies before competing in developed ones.²⁰¹ Reverse innovation is described as "prerequisite for continued vitality" and defence mechanism against competitors. This means that many companies depend on this kind of approach. Otherwise, competing firms will take advantage of it.²⁰² Although many successful reverse innovations were adopted by low and mid-end markets in the own home country, experts expect a growth towards western markets.²⁰³ One example is the electrocardiogram series MAC of GE which were originally developed for low-income countries like India. The portable low-cost device is nowadays very popular among physicians and sold all around the world.²⁰⁴ The main reason for the broad acceptance of

¹⁹⁸ Cf. Immelt et al. 2009.

¹⁹⁹ Cf. Corsi and Zedtwitz 2016, p. 73.

²⁰⁰ Cf. Bhattacharyya et al. 2017.

²⁰¹ Cf. Corsi and Zedtwitz 2016, p. 73.

²⁰² Cf. Immelt et al. 2009.

²⁰³ Cf. Corsi and Zedtwitz 2016, p. 74.

²⁰⁴ Cf. Immelt et al. 2009.

this innovative device is the increase of life quality for everyone. Therefore, it does not matter from where the innovations originates.²⁰⁵

Having the general opportunities of reverse innovation in mind, the next step is to have a closer look at the potential of entering the global health care sector. This step is divided into two parts. Firstly, the reverse innovation potential is examined in relation to four success strategies identified. Secondly, the other four success strategies are examined.

(1) High quality of care, Patient-centric approach, Accessibility, and Service specialization

In particular, there are four success factors of Indian frugal innovations that can be highlighted. High quality of care, patient-centric approach, accessibility and service specialization are factors with a huge potential to penetrate the health care system in the developed world.

A comparison between ten developed countries reveals that the United States for example is ranked last when it comes to health care efficiency, equity, and healthy lives. This indicates that a higher health care spending per-person in developed nations does not directly equate with high quality health care.²⁰⁶ Therefore, the aspect of high-quality health care that can be offered by many frugal innovations can be seen as a precondition for acceptance. Patient-centric approaches, accessibility for everyone, and service specialization are interesting factors concerning future developments. The world population and life expectancy continue to rise. This implies that the world is facing a higher number of people in total and growing population of elderly in the future. The need for tailored, accessible healthcare is rising dramatically. Reverse innovations offer a chance to solve these issues by addressing future developments and needs.²⁰⁷ ²⁰⁸ Although, communicable diseases like Acquired Immune Deficiency Syndrome (AIDS) continue to decrease, non-communicable diseases like cancer, heart diseases or diabetes continue to rise dramatically. Main reasons for this development are changing lifestyles and diets, obesity, and urbanization. This is closely related to deaths caused by ambient pollution which are also expected to rise.²⁰⁹ With regard to success factors like high

²⁰⁵ Cf. Corsi and Zedtwitz 2016.

²⁰⁶ Cf. Deloitte 2019.

²⁰⁷ Cf. GE Healthcare n.d. b.

²⁰⁸ Cf. Deloitte 2019.

²⁰⁹ Cf. Deloitte 2019.

quality of care, patient centric approaches, accessibility, and specialization, reverse innovation originally coming from emerging health care sectors have great potential to enter developed countries.

Beside many opportunities, reverse innovation also implies some risks. Emerging economies show a greater willingness to adopt frugal innovations than western economies. This is kind of obvious because of tailored local requirements. This includes limited financial resources, less accessibility, and a lack of products or services which are self-evident for western countries like infrastructure, energy or communication.²¹⁰ The strategy of implementing innovations in low-cost countries is totally different to the strategy of implementing these innovations in high-income countries. Concerning the health care sector, there exists a huge gap in emerging countries and therefore an urgency for solving this problem immediately. High-income countries are not facing this kind of problem.²¹¹ Consequently, a product or service that has been proven to be successful in emerging countries does not automatically mean it will be successful in developed economies. There is a need for certain transformations to make it globally acceptable. Successful innovations in emerging markets are often not good enough to compete in developed ones. Therefore, there is a need for pioneering new applications or lower price points in order to cannibalize existing higher-margin products.²¹² This makes the process of reverse innovation very risky, difficult, and cost intensive. Overall, there is a necessity for a superior understanding about combining local resources with global expectations. A well informed, international outlook on business activities is a precondition for the reverse innovation process.²¹³

(2) High quality of care, High asset/resource utilization, High clinical volumes, and Clinical efficiency

Concerning the success factors of frugal innovations in the Indian health care sector there are also some remarks. As already mentioned, developed markets have a completely different understanding about quality issues. Therefore, one potential threat concerning the acceptance of reverse innovations in developed countries could be the quality. Western economies are used to deal with high quality products and services. Gaining trust

²¹⁰ Cf. Immelt et al. 2009.

²¹¹ Cf. Bhattacharyya et al. 2017.

²¹² Cf. Immelt et al. 2009.

²¹³ Cf. Corsi and Zedtwitz 2016.

of western costumers could be challenging by introducing low-cost and good-enough solutions.²¹⁴

The high asset/resource utilization is a huge benefit of frugal innovations in emerging markets. People living in remote areas of the world must deal with limited resources and options. There is an urgent need for low-cost solutions by making use of local resources.²¹⁵ Usually developed economies dispose of a variety of options and not facing this kind of problems. Cost savings and optimal resource allocations are obvious benefits but often not strictly necessarily. Consequently, reverse innovations coming from emerging countries are often not an option to consider and not seen as a threat by many western companies.²¹⁶ High clinical volumes and clinical efficiency are further success factors of frugal innovation in the Indian health care sector. Many innovations are based on this cost-saving approach that helps to lower the cost per patient and increases productivity drastically. Scaling effects can be exploited easily. The reasons for this are the large market size, the growing demand, and the rising population of emerging economies.²¹⁷ It remains questionable if developed countries can benefit from these methods.

²¹⁴ Cf. Corsi and Zedtwitz 2016.

²¹⁵ Cf. Walters 2015.

²¹⁶ Cf. Corsi and Zedtwitz 2016.

²¹⁷ Cf. Agarwal and Brem 2012, p. 1.

8. Summary

In this paper the researchers have investigated frugal innovations in the Indian health care sector. The aim was to gain a more in-depth view on the subject of frugal innovations with regard to the health care sector. Firstly, the theoretical background including the Bottom of the pyramid, frugal innovation, and reversed innovation concept was described. Further, the need for frugal innovations to solve major health care challenges in India and also worldwide was outlined. The desperate need for affordable, accessible and quality health care underlined the relevance of this research to identify success strategies of frugal innovations.

The exploratory research design consisted of a comparative case study to extend understanding and gain insights of the specific research topic. A purposive sampling strategy helped to select to nine frugal innovation examples. The selected frugal innovations using a purposive sampling strategy are as follows: Aravind Eye Care System, LifeSpring Hospitals, BMVSS - Jaipur Foot, Embrace Infant Warmer, GE Healthcare - MAC 400 ECG System, Biosense Technologies, Narayana Health Limited, Tata Swach, and Apollo Telemedicine Networking Foundation.

For each frugal innovation example, data on different frugal innovation characteristics were retrieved according to five specific case criteria. Those criteria are listed as follows: Introduction (e.g. Drivers of frugal innovations, founder, founding date, vision/mission, etc.), Success Strategies, Type of Innovation (Process, product, marketing or organizational innovation), Financial Sustainability (e.g. general financials, pricing model, profitability, etc.) as well as Challenges and Problems (e.g. current and future challenges). The secondary and primary data on each criteria was collected through diligent internet and literature research for the frugal innovation, innovator's website, company reports, publications or newspaper articles about the innovation, and previous published case studies.

Furthermore, the frugal innovation examples were analysed and compared with regard to selected case criteria. The obtained findings comprise seven success factors with high importance. Those success factors are listed as follows: High quality of care, High asset/resource utilization, High clinical volumes, Clinical efficiency, Patient-centric approach, Accessibility, and Service specialization.

Finally, based on the identified success factors, the reverse innovation potential (employment in high-income settings) of those frugal innovations in the Indian health care sector was analysed. Further, possible opportunities and threats were identified. This section of the research was divided into two parts. Firstly, the reverse innovation potential was examined in relation to four success factors (High quality of care, Patient-centric approach, Accessibility, and Service specialization) identified. Secondly, the other four success factors (High quality of care, High asset/resource utilization, High clinical volumes, and Clinical efficiency) were examined. To sum up, several threats and factors were identified which highly affect the potential of reversed innovation in developed countries. Ultimately, the obtained findings were critically evaluated and possible limitations were outlined. Further, possible future research paths were suggested.

9. Limitations

The authors are aware that the research may have some limitations. The first limitation is the fact that only nine case studies were examined in this research, which clearly results in insufficient information to draw a precise conclusion. This might create a bias while answering the research questions and could have influenced the obtained findings.

Another cause of possible error was the difficulty of finding and collecting sufficient information regarding some of the cases. This is due to the absence of empirical literature on several frugal innovations. This lack of information might alter the results obtained from the cases.

Another cause of possible error was the difficulty of finding and collecting enough information regarding some cases. This is due to the absence of empirical literature on frugal innovations. It caused difficulty in finding appropriate information on some of the organizations. The concept of for-profit and non-profit organizations was not introduced in the research. This is mainly due to the lack of official information by the Indian government on selected frugal innovation cases. Generally, a for-profit provider has been defined as an organization with a primary goal of making profit. This profit can further be distributed towards company expansion, dividend payment, research and development, product extension or investment on subsidiary companies. On the contrary, a non-profit organization focuses on helping the community. Nevertheless, the researchers have identified for-profit and non-profit organizations and their financial sustainability based purely on literature available.

An additional possible source of limitation is the sample population. The case studies were primarily extracted from the Indian healthcare sector. Product and processes from other frugally innovative economy, such as Brazil or China were not considered. This is due to the objective of the research to focus solely on the Indian health care sector. Nevertheless, this might create a prejudice when it comes to the topic of worldwide frugal innovations.

Given the fact that the frugal innovations were analysed regarding several case criteria such as Introduction, Success Strategies, Type of Innovation, Financial Sustainability, and Challenges and Problems, there was a lack of precise quantitative aspects to measure the factors that allowed frugal innovations to be successful in the Indian health care sector.

In conclusion, these limitations reveal the difficulty in the data collection and inadequate information distribution and could have influenced the results obtained.

10. Conclusion

This paper has underlined the importance of frugal innovations and provided profound insights into the world of frugal health care innovations. Certain needs and requirements of the “bottom-of-the-pyramid market” are addressed by adequate value propositions of frugal innovations. The findings compromised seven success factors of these innovations which provide considerable insights. High quality of care, high asset/resource utilization, high clinical volumes, clinical efficiency, Patient-centric approach, accessibility and service specialization were used to analyze the replication potential of frugal innovations in developed countries in the health care sector.

Concluding, the reverse innovation potential can be seen positively and negatively. The process of developing innovations in emerging countries and selling them globally contains several opportunities and threats. Therefore, it is difficult to provide a clear statement about this concept.

To start with the potential threats, it can be emphasized that four success factors out of seven do not have great potential to stimulate the existing situation of the global health care sector in a positive way. Currently, the world population does not face the challenges of the emerging and developing countries of the world especially when it comes to health care issues. There is no urgent need for low-cost and easily accessible solutions. Moreover, concerning market size and demand, there are no huge benefits to exploit frugal innovations in the developed world. Success factors like high asset/resource utilization, high clinical volumes or clinical efficiency are seen in a critical light. Although emerging markets highly benefits from these factors due to their limited amount of resources or remoteness, the developed world does not face these kinds of problems. Furthermore, cost saving approaches by scaling effects cannot be easily exploited in developed countries. Many developed countries simply do not have the opportunities to benefit from this due to legal and hygienic restrictions and lower population. Also, the success factor of high quality care must be regarded critically and reviewed in more detail when considering the reverse innovation potential. Although many frugal innovations promise the same quality as comparable western products, low-cost and good enough solutions often cannot compete with very high-quality standards of developed economies. To summarize, the success factors high quality of care, high asset/resource utilization, high clinical volumes and clinical efficiency are not yet applicable for developed countries.

Apart from these aspects, the future perspective concerning global health care is more pessimistic and therefore changes the previous assumptions. The global world is changing and simultaneously also the way of making use of health care services. There will be a growing number of challenges in the future such as the increase of the world population, demographic changes, pollution, the growing number of elderly people, and non-communicable diseases. Reverse innovations have the potential to react on this development. Consequently, success factors like patient-centric approach, accessibility, and service specialization are gaining interest and importance, especially in the future. The need for tailored, simple, and easily accessible healthcare will rise drastically. The factor of high quality care, already offered by some frugal innovations has also potential to get improved over the next years. It can be assumed that as soon as the need for healthcare is rising, restrictions and expectations will simultaneously decrease. From this point of view, there are many reasons to consider reverse innovation potential of frugal innovation in the health care sector especially concerning the future developments.

The research paper examined the current status of frugal innovations in the Indian health care system by giving an overview about the Indian health care sector and the major challenges. Nine different frugal innovation stories were analyzed to figure out main success factors which helped to provide an outlook on future developments concerning reverse innovation potential. Consequently, the first research question about factors which have allowed selected frugal innovation to be successful in the Indian health care sector was answered. Although the research could not reach a single conclusion concerning the reverse innovation potential, the second research question was still answered transparently by the help of comprehensible statements.

This paper acts as a basis for further studies and cannot present general valid statements due to several limitations and bias that were presented in the previous chapter. Future studies on the current topic are recommended to extend knowledge caused by the difficulty to find enough insights about the case studies. Further, the findings of this paper should be validated by a larger sample size which implies a higher number of cases in total and the extension of possible success factors. The examination of more frugal innovations in different countries is also recommendable. To sum up, in order to gain deeper insights about frugal and reverse innovations further research should be undertaken.

11. Appendix

Appendix 1: Jaipur Foot



Source: http://jaipurfoot.org/pop_images/Jaipurfoot.jpg

Appendix 2: Below-knee shank



Source: jaipurfoot.org/pop_images/BelowKnee.jpg

Appendix 3: Stanford Jaipur Knee



Source: http://jaipurfoot.org/pop_images/StanfordJaipur.jpg

Appendix 4: Embrace Infant Warmer



Source: <https://www.embraceinnovations.com/#products>

Appendix 5: The MAC 400 ECG System



Source: <http://www3.gehealthcare.in/en/products/categories/diagnostic-ecg/resting/mac-i>

Appendix 6: Biosense TouchB



Source: <https://www.biosense.in/touchb.php>

Appendix 7: Biosense uChek



Source: <https://www.biosense.in/ucheck.php>

Appendix 8: Biosense Remote Diagnostic Kit



Source: <https://www.biosense.in/anmol-arogya.php>

Appendix 9: Tata Swach Smart + (Non-Electric 15-Litre Water Purifier)



Source: <https://tataswach.com/products/tata-swach-smart-plus>

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