

Characterization of Healthcare Mass Customization

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Abstract

The evolution of healthcare delivery systems and changing needs of patients have triggered the need for healthcare mass customization (HMC). Instead of one-size-fits-all and trial-and-error approaches, HMC approach promises patients more-likely-to-work solutions. Mass customization principles and characteristics, leading to healthcare mass customization, are the key factors to optimize healthcare systems in terms of effectiveness, efficiency and economies of scale. This paper represents a design framework for HMC by developing the concept of characterization of HMC, demonstrates a case study example of Narayana Hrudayalaya Heart Hospital in Bangalore, India.

Keywords

Healthcare mass customization, lean concepts of HMC, Types of HMC, Narayana Hrudayalaya Heart Hospital

1. Introduction

The idea of mass customization (MC), in general, targets to satisfy customers' unique needs with the help of manifold advanced technologies such as computer-integrated manufacturing, flexible workforce and information and communication systems (Maital 1991). MC has been widely applied to manufacturing systems to meet customer demand where and when the product is needed and how they need it. In MC, the needs of an individual are translated into design, then produced, and delivered to the customer. Besides the manufacturing systems, service systems have been convenient to apply MC systems to achieve customer satisfaction within higher quality and lower cost aspects.

Healthcare system is one of the most essential and broadest areas, which needs revolution in terms of quality and cost effectiveness. Application of MC to the healthcare, as healthcare is an area with the need of a series of significant innovations, will lead to a new concept, called healthcare mass customization (HMC). Technological advances, social trends, and globalization bring drastic changes to healthcare industry. Thus, most of the patients do not concede traditional methods, including one-size-fits-all and trial-and-error approaches. Patients, from now on, expect medical treatment and services to be tailored to their individual needs at affordable costs. HMC system, with help of lean principles of HMC and types of HMC, can derive some advantages in the healthcare industry explicitly by providing inimitable care delivery that satisfies patient's inimitable needs at an affordable cost. This paper focuses on handling the traditional healthcare system shortages, established upon patient needs, with the implementation of healthcare mass customization concepts.

2. Characteristics of Healthcare Systems

Table 1 illustrates the comparison of healthcare systems between mass healthcare, lean healthcare and mass customized healthcare systems. Mass healthcare represents the standard healthcare services, which is used nowadays. In mass healthcare, care providers practice traditional healthcare methods regardless of individual's unique conditions with the least efficiency and satisfaction. Lean healthcare provides high quality and high efficiency healthcare services that are optimized for different segment of patients in a cost effective manner with some consideration of patient satisfaction. Mass customized healthcare focuses on high quality and highly responsive healthcare services that are individualized for each patient with cost effectiveness and with maximum patient satisfaction. While lean healthcare focuses on the elimination of non-value-added-processes (waste processes), mass customized healthcare aims at the elimination of waste processes by dropping of the unwanted and unneeded practices.

Table 1: Comparison of healthcare systems

Feature	Mass Healthcare	Lean Healthcare	Mass Customized Healthcare
Goal	Standard healthcare service with negligible variety regardless of patient condition	High quality and highly efficient healthcare that is optimized for each segment of patients	High quality and highly responsive healthcare that is individualized for each patient
Process	Providers maintain extra capacity, resources, and supplies	Providers adopt lean practices to offer efficient and cost effective patient care	Providers adopt flexible and responsive processes to offer individualized care
Outcome	Healthcare with no concern for patient satisfaction, cost or efficiency	Cost effective and efficient healthcare with some consideration for patient satisfaction	Cost effective an responsive healthcare with focus on maximum patient satisfaction

Mass healthcare requires care providers to maintain extra effort, capacity, resources, and supplies to cater to patient’s needs, since the traditional healthcare systems are built on standardized care delivery for every patient. Mass customized healthcare promises providers to conduct flexible and responsive processes for individualized care, while lean healthcare only afford lean principles for care providers to offer efficient and cost effective care. To understand the differences among mass healthcare, lean healthcare and ass customized healthcare, Chinnaiiah et al. (1999) stated that the term named as patient sacrifice must be understood. Patient sacrifice is the gap between what each patient genuinely needs and what the healthcare system can provide to him or her. According to Chinnaiiah et al (1999), the relationship between patient needs and healthcare system capabilities can be described as follows:

Let M be a set of all elements representing patient needs:

$$M = \{ x \mid x \text{ is a 'patient need' } \}.$$

Let N be a set of all elements representing healthcare system capabilities:

$$N = \{ y \mid y \text{ is a 'healthcare system capability' } \}.$$

Let R be the intersection of M and N.

R represents the degree of intersection between the delivered care defined by the set of patient needs and the set of healthcare system capabilities. R is appropriate to characterize an HMC system and also to distinguish the differences between mass and lean healthcare systems. Representation of the spaces for M, N and R are shown in Venn diagram in Figure 1.

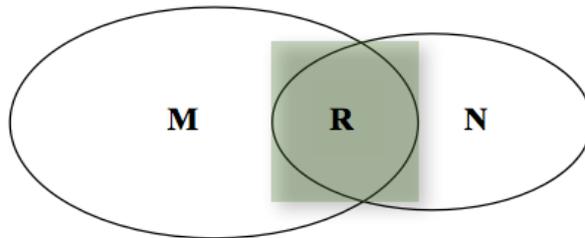


Figure 1: Representation of M, N and R space

3. Definition of Healthcare Mass Customization

Healthcare mass customization (HMC) is a process for aligning a provider’s capabilities with patients’ healthcare needs. Replacing one-size-fits-all approach and trial-and-error approach with individualized care delivery system will lead us to HMC. Therefore, a healthcare mass customization system can individualize medical solutions by incorporating demographics, income, drug history, medical history, genomic information, and lab results. The goal of HMC is to improve patients’ health state, patient satisfaction with efficiency and effectiveness. Kouris et al. (2010) stated that in medical practices, it is usually observed that patients of the same age group, with similar duration and body mass index (BMI) do not respond in the same way to a given treatment, hence the reason for why

same drug has different effects on each patient should be understood. A possible reason is that every patients has different biological or non-biological reasons to respond or not to respond a drug, so that Kouris et al. (2010) explained that one treatment may be effective to cure 100% of patients while other treatment may reach 0% of its effectiveness for a certain patient group (Williard and Ginsburg 2009). As Jethwani et al. (2011) stated, the aim is to have the ability to assess the treatment options and drug dosages for each patient, in which the risk factors are the least significant. In this case, the problem stems from the fact that it is not clear which treatment is likely to be effective for a given patient, so the treatment that works for the most is primarily selected first (Obama 2007). This tactic has caused loss in healthcare quality, since there are groups of patients in which a treatment will not be effective. On the other hand, the mass customized approach in the field of healthcare leads to better and more effective therapies (Williard and Ginsburg 2009) . To reach these goals, some key features will be helpful to determine the best and most suitable therapy. Salvador et al. (2009) argued that solution space development, robust process design, and choice navigation are the key features of HMC and can be defined as follows:

- Solution Space Development: This feature promotes the identification of the patients' needs, which differ widely and frequently from patient to patient.
- Robust Process Design: It helps to ensure that an increased patient variety does not impair performance of the healthcare delivery processes.
- Choice Navigation: Choice navigation provides tools to help patients in identifying and to evaluate their options.

3.1 Six Lean Principles of HMC

Lean principles are based on providing the full value that consumers desire from services, with the greatest efficiency and convenience (Womack and Jones 2005). Since the goal of HMC is to reach higher quality and higher efficiency, HMC operates on six lean principles:

- Principle one: Solve the patient's problem completely by insuring that the treatment plans work effectively and together. Most of the time, what patients really want is that the services to work together reliably and seamlessly with minimal drain on their time and emotions.
- Principle two: Do not waste the patient's time. This principle can be considered as the reconfiguration of the system to eliminate each instance in which the patient is forced to expend time for no return in value.
- Principle three: Provide exactly what is needed for treating or caring for the patient. That principle covers the elimination of trial-and-error approach in the traditional healthcare system.
- Principle four: Provide what is needed exactly where it needed. The opportunity for this principle is to ready the wide variety of services to offer a complete range of care services to serve every patient's need.
- Principle five: Provide what is needed where it is needed exactly when it is needed. A major challenge to "when it is needed" principle is that in such a complex system as healthcare, the interests of the patient, and the care provider must be aligned in a timely manner.
- Principle six: Continually aggregate solutions to reduce the patient's time and hassle. The provider can perform the required healthcare services, with no hassle for the patient. Also, they can be able to solve bigger problems on a continuing basis.

4. Classification of Healthcare Mass Customization

HMC allows both care providers and patients to adjust suitable and appropriate therapy, drug or treatment method to meet their individual healthcare needs. The adjustment of the healthcare services can be done for several types depending on the customization level. This part extends these customization levels, according to Chinnaiah et al. (1999)'s previous study, to classify HMC systems into five types and explains each type of HMC.

- Type 1 : Make to stock HMC
- Type 2 : Assemble to order HMC
- Type 3 : Make to order HMC
- Type 4 : Engineer to order HMC
- Type 5 : Develop to order HMC

4.1 Type 1: Make to stock HMC

Type 1 HMC is the class, which has the least customization level with minimum patient involvement. It includes standardized drugs, healthcare instruments or services, which have a provision for easy customization. This type of healthcare mass customization caters to a large number of patients by offering standard plans, which can be customized by patients themselves. Dental guards, which are used to protect teeth from injury, grinding and

clenching, and air casts, an instrument that holds a broken bone in place to help it heal, are two good examples of Type 1 HMC.

4.2 Type 2: Assemble to order HMC

In this type, devices, drugs or healthcare plans are created by putting together preexisting components or ingredients as per the patient's needs. Type 2 requires customization to be done after determining which therapy is the most convenient for a patient. The example that fits best to this type is that cholesterol patients are usually given a combination of medications depending on their health conditions. For example, a patient may be given a combination of Statin, Zocor, Zetia, Niacin and Niaspan with the adequate amounts from each.

4.3 Type 3: Make to order HMC

In this class of HMC, devices, drugs or plans are fabricated or created after the patient's needs are precisely determined. Type 3 requires more customization compared to Type 1 and Type 2, and patient involvement starts in earlier stages in Type 3 than in Type 1 and 2. One example to Type 3 is contact lenses as they are made after the patient's eyesight is checked and correction numbers are determined. Eye-care specialists can precisely diagnose the degree of nearsightedness or farsightedness and identify corrective measures tailored specifically to the patient's individual needs (Sandmann and Boutros 2012). Another example is dentures, since they are made after taking the impression of patient's jaws in the mouth.

4.4 Type 4: Engineer to order HMC

In this type of HMC, healthcare instruments, drugs or plans are designed from scratch and delivered to the patient according to patient's specifications and requirements. Care providers and patients collaboratively design and produce devices, medicine or plans that precisely meet patient's needs. Artificial limbs and cosmetic surgery are the two examples to Type 4 HMC. Artificial limbs, which are the prosthesis that substitute a missing limb such as arm or leg, are started to be produced within the true measurement of the specific limb for each patient. For cosmetic surgery, apparently, care providers and the patient collaboratively plan for the surgery.

4.5 Type 5: Develop to order HMC

This type has the highest level of customization. In a **develop** to order HMC system, care providers conduct research, synthesize solutions, and produce devices. Drugs or plans to address the patient's unique medical or physiological conditions. The patient may specify the functions or features expected from the therapy, then intense research and development is carried out. Artificial bones, which includes creating a facsimile of a bone that can be used to replace the damaged bone, and special liver surgery, which requires development of a special procedure for liver transplant surgery that is unique for each patient, are two examples for Type 5 HMC. There are some indices changing accordingly while practicing along these five classifications of HMC. These indices can be named as nature healthcare solutions, number of patients served, increasing value to patient and increasing profitability to provider which help us to create matrix of HMC (see Figure 2) (Spencer and Cox 1995). Nature healthcare solutions will change from repetitive actions to unique actions as we move from Type 1 to Type 5. Number of patients served will increase from low to high level as we move from Type 5 to Type 1. Type 5 HMC promises highest value to patients while Type 1 promises highest profitability to the care providers.

5. Case Study for Healthcare Mass Customization

Narayana Hrudayalaya (NH) Heart Hospital in Bangalore, India provides affordable cardiac care, by following a hybrid strategy. It focuses on lowering its costs of operation wherever possible, also keeping its reputation within high quality. Khanna et al. (2005) stated that hospital tends to provide healthcare at an affordable cost, the operations endeavored to keep unit costs lower through a high-level of capacity utilization and productivity by decreasing the unit cost of surgery by the high volume of procedures completed. Dr. Shetty, the medical superintendent who headed the hospital's administrative affairs, calls his strategy as "the Wal-Martization of healthcare". Hospital follows a robust process to handle verity. Dr. Shetty explained: "Compared to hospitals in the West which spend up to 60% of their revenues on staff salaries, the comparable percentage for salaries at NH is only 22%. Our doctors work much longer hours and perform more procedures." Doctors at NH work an average of 12-16 hours a day and perform two or three procedures a day. Dr Shetty also explained: " While other hospitals may run two blood tests on a machine each day, we run 500 tests a day - so our unit cost for each test is lower." NH performs twice as many surgeries per year as the biggest cardiac hospitals in the U.S. while maintaining lower estimated risk-adjusted mortality rates. Khanna et al. (2005) discussed that NH performs surgeries at a 1.27% mortality rate and 1% infection rate in coronary artery bypass graft procedures, compare to the rates of 1.2% and 1%

respectively in the USA. Moreover, NH charges \$2,000 per open-heart surgery on average compare to \$20,000-\$100,000 in the U.S.

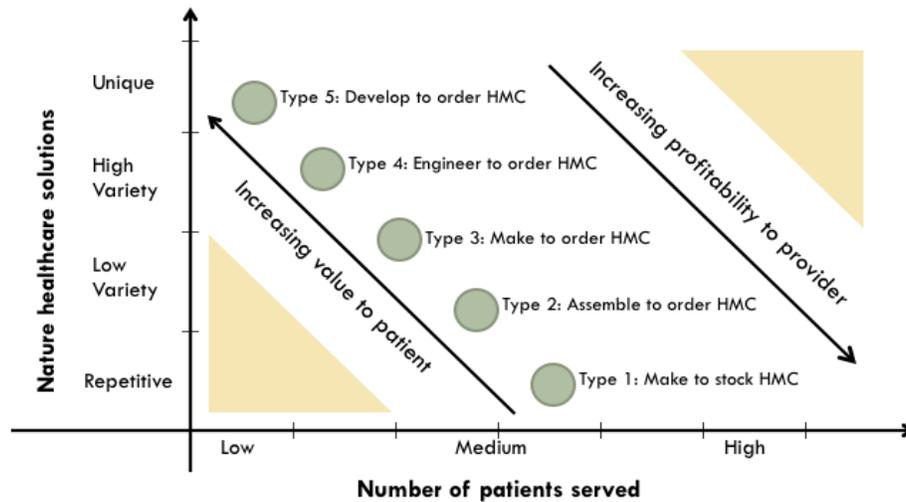


Figure 2: Matrix of healthcare mass customization

6. Conclusion and Future Work

This paper has presented the characterization of Healthcare Mass Customization to go beyond the traditional one-size-fits-all and trial-and-error healthcare system in the western world. Types of HMC has been explained to determine the customization level required for each patient to meet their specific and unique needs with the help of lean principles of HMC. The authors have presented a framework to implement their vision. Future work includes developing flexible healthcare processes to support HMC, and developing data mining methods to discover the healthcare features, which offer significant value to patients with customized healthcare delivery systems. In the future, authors are planning to develop network models to study the dynamics of HMC and to develop operations research (OR) methods to make optimal decisions and policies for HMC.

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