



Discontinuous Innovations Framework: A Review of Automatic External Defibrillators in the Healthcare Industry

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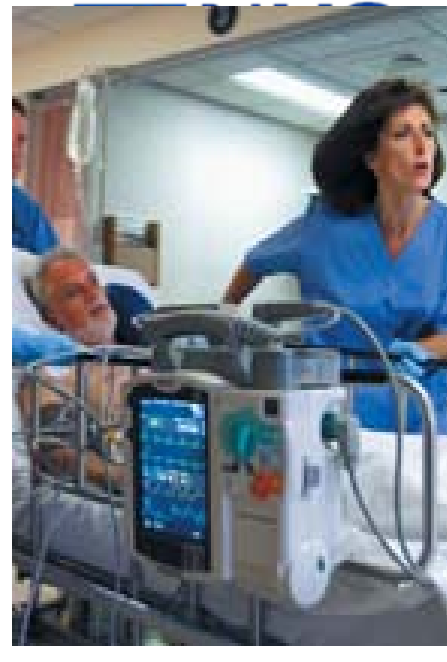
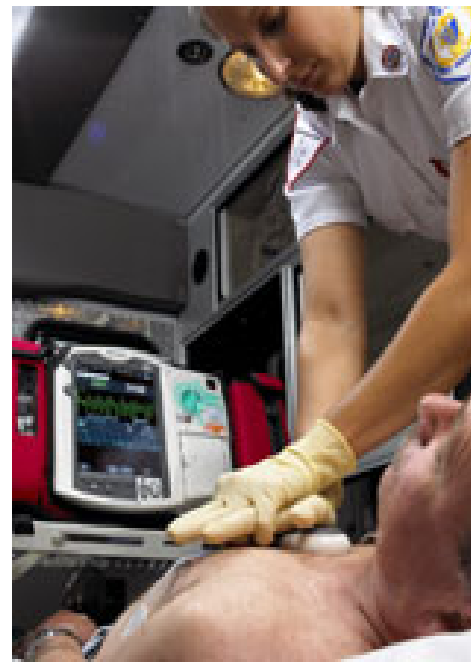
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Agenda

- **INTRODUCTION**
- **THE AED MARKET**
- **SUPERIOR TECHNOLOGY RESHAPED TO SUFFICIENT TECHNOLOGY**
- **CATEGORIZATION OF THE DISCONTINUOUS INNOVATIONS OF AED**
- **SUMMARY**

Introduction

- Manual defibrillators require users to have extensive medical knowledge to operate it.
- Discontinuity - introduction of Automated External Defibrillators (AED)
- An interesting phenomenon – AED had initially stayed at the high-end sector until further innovation occurred to reduce its price to an affordable level for the mainstream market.
- Phenomenon does not fit clearly under conventional classification of discontinuous innovations:
 - Radical innovation
 - Disruptive innovation



- **Radical Innovation**
 - Direct entry to mainstream market:
 - Superior performance at reasonable cost or Substantial cost reduction at reasonable performance
 - Much R&D needed
- **Disruptive Innovation**
 - Enter the market through addressing the low-end or niches and moves up to the mainstream market through a bottom-up disruption
 - Incumbents not interested
- Phenomenon of “sufficient” performance entering mainstream market
 - Cases of discontinuous innovations that **enter mainstream markets**
 - Performances are neither superior to mainstream technologies or much inferior to existing technologies.
 - Could be attractive to incumbents as a new market creation.

THE AED MARKET

- Sudden Cardiac Arrest (SCA) is one of the leading causes of death
- Early defibrillation is the single most important factor in reviving patients in cardiac arrest.
- Two main types of defibrillators are:
 - **Manual External Defibrillators (MED)**
 - Full function defibrillators that support multi-functional operations
 - Only suitable for highly-skilled medical personnel who have received training in advanced cardiac life support and rhythm recognition.
 - Devices are used primarily in hospitals, paramedic units and clinics.
 - **Automatic External Defibrillators (AED)**
 - Basic portable defibrillators
 - Designed for minimally-trained or untrained non-medical personnel such as basic life-savers (BLS) personnel including the lay public to deliver defibrillation.
 - A microprocessor inside the defibrillator automatically analyzes the patient's heart rhythm and advises the operator whether a shock is needed.
 - Audible and/or visual prompts will guide the user through the process.

Emerging Needs

- Likelihood of successful resuscitation during SCA was found to decrease by approximately 7 to 10% with each minute following the SCA.
- After 10 minutes, very few resuscitation attempts are successful
- The key to survival from SCA becomes the key performance factor - **response time to defibrillation.**
- Important to reduce **response time to less than 4 minutes**
- Emerging Market Need - a defibrillator that is so simple to use that anybody could operate a defibrillator and save someone's life.

Review of AED product values: Performance

Table 1: Comparison of Performance between MED and AED

	MED	AED	Performance Measurement
VF Detection Capability	Depends on Human interpretation	Automatic <ul style="list-style-type: none"> • Accuracy between 76% and 96% • Specificity was almost 100% 	Inferior to MED *Assumption that human interpretation has no error
Time to Defibrillate	Up to 200 Joules •5 seconds	Up to 150 Joules (Inclusive of VF detection) <ul style="list-style-type: none"> • 15 to 30 seconds 	Inferior to MED
Therapies offered	Shock delivery at variable energy levels of 1-10, 15, 20, 30, 50, 70, 100, 120, 150,170, up to a maximum of 200 Joules	Shock delivery at a preset of 150 Joules of non-escalating energy level for adults and 50 joules for children	Inferior to MED

Review of AED product values: Features

Table 2: List of AED Features

Description of Features	Remarks
Automatic detection of ventricular fibrillation to determine if a shock is needed	Once 3 abnormal complexes are detected, the AED will automatically prime to deliver a shock. This allows the user to be non-medically trained. Users do not need to understand how to read ECG results.
Voice prompts and visual icons	This guides the user through the rescue operation. Hence, the lifesaver could be anybody who gets there first.
Dimensions (70mm x 190mm x 210mm) Weight (about 1.5 kg)	This makes the AED very portable and much less cumbersome than a MED. This enhances its suitability for installation in public places.
Battery – Operated	This is one essential feature to ensure portability. This eliminates the need to find a power source before operating the device.

Review of AED product values: Features

- Key Feature: simplicity to enable the AED to be used by anyone with minimal or no training.
- A different set of performance measurements is possible and shown in Table 3 below.

Table 3: New performance measurement of AED specific to the Public Access Market Segment

	MED	AED	Performance Measurement
Time to Defibrillate – Hospital	Ability to monitor and provide shock in 5 seconds. Treating various cardiac arrests.	Only able to treat VF, system is automatic, taking 15 to 30 seconds between shocks. Accuracy at 76 to 96%	Inferior to MED
Time to Defibrillate – Public	12 minutes	4 minutes	Superior to MED- increases survival rate by 49%

Review of AED product values: Price

- Based off an existing matured technology with no additional frills
- Keeping the entrant price of the AED low (relative to the MED).
- In 1999 (entrant of AED)
 - Low-range MED : between \$4,000 and \$6,000;
 - Mid-range MED was between \$6,500 and \$13,000
 - High-end MED was between \$12,500 and \$23,000.
- AED
 - Between \$2,000 and \$3,000, with an average of \$2,710,
 - Half the unit cost of a low-range MED

Superior Technology Reshaped to SUFFICIENT Technology

- The AED is nowhere near the sophistication of a MED.
 - MED has monitoring parameters and diagnostic capabilities like non-invasive blood pressure measurement, pulse oximeter, capnography and 12-lead electrocardiogram
- Classification of AED's technology and performance was
 - Not HIGH
(Adapted from the established technology of the existing defibrillators)
 - Not LOW
(the AED is a FDA Class III Medical device 23, indicating the need for **pre-market approval** and a scientific review to ensure the device's safety and effectiveness before being made available for commercial use - defines AED had to meet a good standard of performance)
- As such, the AED's technology performance is between 'Superior' and 'Inferior', falling under a classification – 'Sufficient' enabling it to be ADEQUATE for its purpose.
- Suitable for an Incumbent which has R&D resource, brand name and other complementary assets.

Categorization of the Discontinuous Innovations OF AED

Table 4: Summary of AED’s overall Product Value

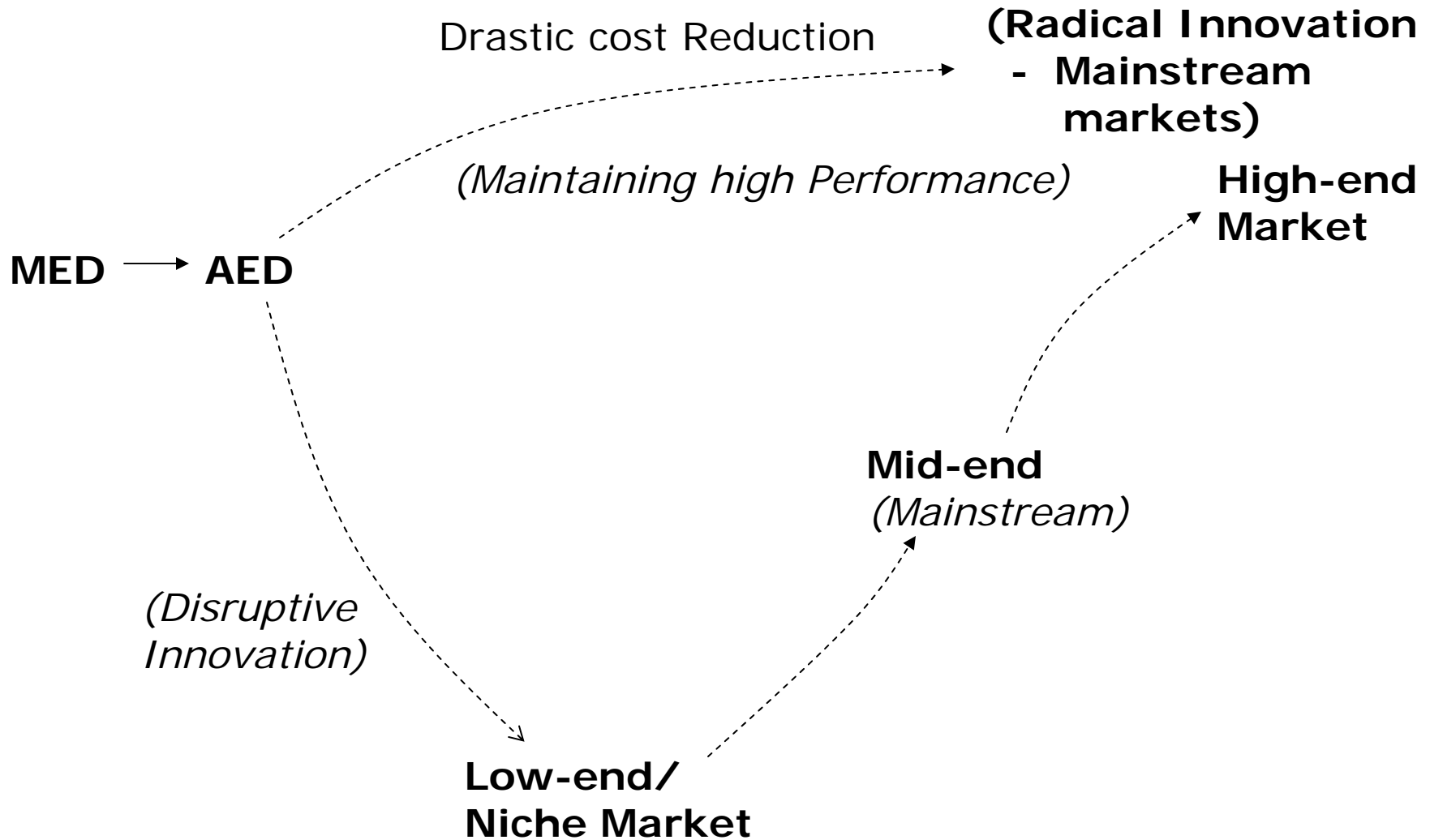
<u>Features</u>	<u>Value</u>
Voice and Audio prompts	High
Automatic VF detection	
Light and portable	
<u>Technology Performance</u>	<u>Value</u>
Non-escalating electric shock	Sufficient
Sensitivity in detecting VF was between 76% & 96%	
<u>Price</u>	<u>Value</u>
Average unit cost \$2710	This is considered much lower compared to what the market is familiar with (price of a full featured MED is about triple the cost). And naturally, the lower the price, the lower the barrier to enter a new market. However, as this was a new market creation, there could be no comparison to a value beyond which customers will not buy.

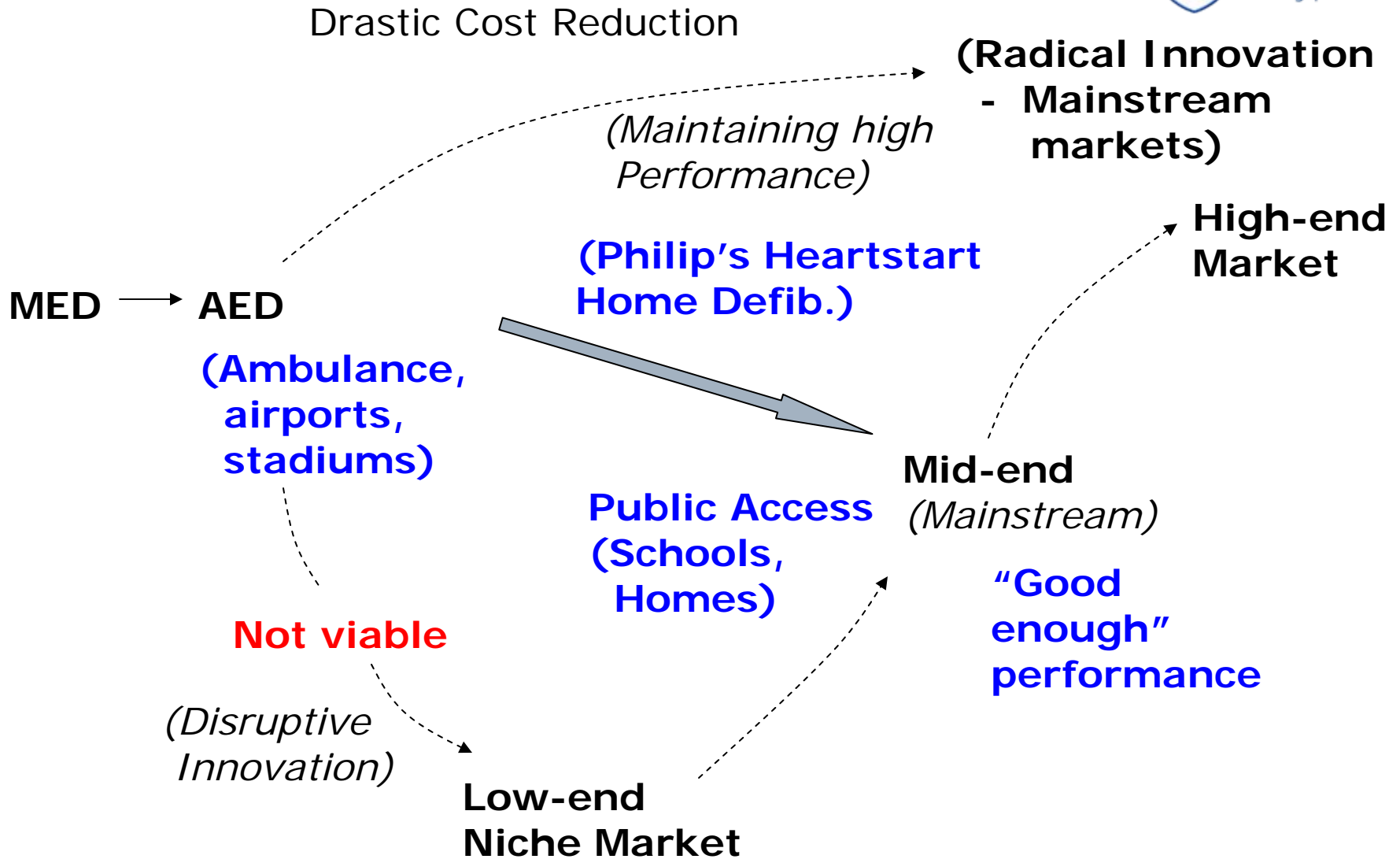
Review of the AED Market segmentation

- **Hospital Market segment** has three sub-segments:
 - Acute Care
 - Non-acute Care
 - Non-treatment
- **Pre-Hospital Market**
- **Public Access Market**
 - Home
- **Alternate Care Market**

AED Market Growth & Revenue

- in 1999, manufacturers' revenues from sales of external defibrillators (AED and MED) in the US market grossed \$314 million.
 - MED units totaled \$206.8 million and accounted for 65.9% of the total defibrillator sales.
 - AED units totaled at \$107.2 million and accounted for 34.1% of the total defibrillator sales.
 - At market entry already captured 34.1% of the market revenue.
- In 2002, under the **Hospital** segment,
 - Total market revenue was at \$146.3 million
 - 91.6% were MED units and only 8.4% of the sales came from AED devices.
 - Hospital Segment is the mainstream market for MED.
- In 2002, under the **Public Access** segment,
 - Total market revenue was at \$107.8 million
 - 94% belongs to AEDs and MEDs account only for the remaining 6%.
 - Public Access is the **mainstream market** for AEDs.
- AED and MED are targeting at different sub-segments.
- AED has created a new market segment and sub-segments for itself





SUMMARY

- An example of the AED Industry was illustrated. AED's features, price and performance were discussed and analyzed to be sufficient to bring about an increase in value received by the users.
- Innovation behind the AEDs' success does not fall neatly into current definitions of radical or disruptive innovations.
- AED industry also shows that a new product need not always be technologically superior (**Radical**) or technologically inferior initially (**Disruptive**) – it can also emerge when a **superior technology is reshaped to the level sufficient** to satisfy the new market needs.