

The Impact of Innovation of Electric Toothbrush

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ABSTRACT

The continuous invention of new technologies enabled by electricity and the Internet has paved the way for innovations for virtually all electrical products. One of the areas that have attracted attention is the invention of electric toothbrushes. The benefits of the electric toothbrush over the conventional toothbrush promise the continued transition of customers to use the device, thus showcasing the future marketing potential of the product. The rising acceptance of electric toothbrushes and their perceived benefits necessitated a study on their impact on the toothbrush sector. The emergence of the electric toothbrush as a high-tech accessory places it above the manual toothbrush in delivering a fresh breath, preventing gum disease and tooth decay, and monitoring oral health. Despite the high price tags attached to these products, they will continue expanding their market share as more individuals become conscious of oral health.

Keywords: toothbrush; technology innovation; smartness; SWOT

1. INTRODUCTION

1.1. Background

The continuous invention of new technologies enabled by electricity and the Internet has paved the way for innovations for virtually all electrical products. The electric toothbrush is no exception. It is no doubt that the invention of this product has been vital following the emergence of oral health as a critical indicator of human health [1]. The consideration of oral health as a human health indicator emanates from the rise of dental caries to the third-largest chronic non-communicable disease after cancer and cardiovascular disease. With prevention being the key emphasis, the notable benefits of the electric toothbrush over the conventional toothbrush promise the continued transition of customers to use the device, thus showcasing the future marketing potential of the product.

Currently, there are many electric toothbrushes on the market designed to have different effects. A majority of toothbrush manufacturers are in China. Besides, the country is the largest consumer of toothbrushes. By 2016, the electric toothbrush market was worth \$2.2 billion, expected to grow to \$3.77 billion by 2023. This would represent a CAGR of 8% between 2017 and 2023 [2]. The role of the product in improving oral health explains why it is expected to record a high CAGR over the period. First, the electric toothbrush is a technological oral product that cleans teeth, tongue, and gums using side-by-side or rotation movements of the head. The side-by-

side or rotation movement of this device makes it effective in removing plaque and minimizing gingivitis. Manufacturers are also incorporating the electric toothbrush with advanced features that improve the brushing experience. Some of these features include brushing modes tailored for people with sensitive teeth. Other features include gum massaging and whitening. The devices could also have pressure sensors to help keep the required pressure on gums and teeth while brushing. The rising acceptance of electric toothbrushes and their perceived benefits necessitated a study on their impact on the toothbrush sector. This study examines the effect of the electric toothbrush on the toothbrush sector with specific regard to innovations, competition, incentives for use by customers, and incentives for entry into the market by competitors.

1.2. Research Areas

It is no doubt that several studies have examined the rising popularity of electric toothbrushes in the market. For instance, Aparna et al. (2018) noted that innovations attributed to electric toothbrushes had heightened the popularity of electric toothbrushes [3]. The innovations include rotation oscillation action (ROA), timer, Bluetooth, and pressure sensors [3]. Ng in 2020 also cited the increasing popularity of powered toothbrushes, particularly among persons targeting to improve their oral health [4]. Despite these studies, no study to our knowledge has explored the impact of innovation of

electric toothbrushes on spurring innovation in the sector, attracting new entrants, and offering additional incentives for people to consider and uphold oral care. This study fills this research gap by examining how these innovations have spurred innovations and increased the popularity of electric toothbrushes, thus expanding their market share.

The smart toothbrush is another innovation enabled by the advent of electric toothbrushes. This study explores how this innovation concurs with the hypothesis that electric toothbrushes have spurred new innovation. Most electric models have an app that monitors the brushing habits of the individual. The app's functions include tracking the brushing time, reminding the person when to change the brush head, and in some instances mapping the areas that the person brushes effectively and those that they do not to improve brushing outcomes. This is an exciting innovation that requires a study to determine its scope and applicability.

1.3. Rationale and Purpose of the Study

Undoubtedly, the increasing popularity and market share of electric toothbrushes is attributed to their higher effectiveness at maintaining oral health [5]. While most of the studies covered in this paper have associated improved oral cleanliness with using electric toothbrushes, a cross-sectional study conducted by Petker et al. in 2019 did not observe any notable differences between electric and manual toothbrushes on oral cleanliness among daily users [6]. The method used by this study to examine the impact of electric toothbrushes on spurring innovations, competition, and incentives is the analysis of electric toothbrushes by application, bristles, competitors, innovations, and user feedback. As a result, this study will fill the research gap by examining the latest innovations in electric toothbrushes and their role in improving oral care. Besides, the study examines whether players in the sector have shifted from traditional players to new entrants solely motivated by the product's innovations. Finally, the study examines the factors or uses regarded as incentives by users shifting from manual to electric toothbrushes.

2. LITERATURE REVIEW

2.1. Smart Toothbrush

2.1.1. Characteristics

The smart toothbrush uses electricity and AI technology to improve the brushing experience and oral hygiene outcomes. It is a feature-packed gadget with a wireless connection to a mobile app that can track how long and thoroughly one brushes teeth [7]. People react differently to their experiences while using the smart

toothbrush. Majority claim that it is fun using the gadget because it helps display brushing habits and motivate thorough brushing. The smart toothbrush has, among other features, the aspect where it operates using a timer of two minutes or more. The newest smart toothbrushes focus on removing plaque on the places that people easily skip over. The toothbrushes also have sensors that detect the brush head's position and report to the mobile app in real-time the parts of the mouth that have been brushed [7]. The display of all this information is in the form of animation of the mouth. Using the device provides the best outcomes when one puts the mobile device at the sink side to watch the progress immediately.

2.1.2. The Development Process

The smart toothbrush has a thick handle with a gyroscope to help detect motion. The other essential modules of the device include an accelerometer, a pressure sensor, and a component that detects and monitors scrubbing motions. The head of the smart toothbrush is replaceable because it is the part that gets worn out due to daily wear and tear during scrubbing (Evangelista). The device also uses Bluetooth to sync with either iOS or Android app to provide a real-time three-dimensional map of the user's teeth.

2.1.3. The Difference Between an Ordinary Toothbrush and An Electric Toothbrush

Several differences are noticeable between an ordinary toothbrush and an electric toothbrush. In terms of cost, the price of a smart toothbrush is almost 40 to 50 times that of an ordinary toothbrush. For instance, an ordinary Oral B toothbrush is \$5, while an electric toothbrush from the same company is \$200 [7]. Moreover, recent studies show that electric toothbrushes clean teeth and gums much better than ordinary toothbrushes [8]. The other conspicuous difference is in the additional features found in smart toothbrushes that are not in ordinary toothbrushes.

2.1.4. The relationship between consumers and smart toothbrushes in China

The uptake of electric smart toothbrushes in China has been slower considering the cost and little information regarding its significance vis-à-vis the ordinary toothbrush. The demand for the device has been on the rise as Chinese disposable income increases [9]. The target for most of the companies dealing in smart toothbrushes is the increasingly sophisticated young consumers [9]. The older generation is less receptive to the tech-based toothbrush.

2.2. Technology Innovation

2.2.1. Definition

Technology innovation has been used to create lasting value in many enterprises to address the needs and problems among humans. Technology innovation can be defined as a new or improved product or process that has significantly different features and technological advancements from before [10]. A product is considered an innovation if it delivers or achieves specified advantages for a particular sector. The development of electric toothbrushes is an example of technological innovation because the new product provides a solution to oral hygiene problems that the ordinary toothbrush might not give. The innovation is based on the application of information technology and the Internet of Things.

2.2.2. Main factors

The electric or smart toothbrushes offer nothing new except for the innovative features that support better oral hygiene. The main factor considered in this innovative product is the function rather than the cost. Most of the features have been tailored to help reduce the risk of tooth decay, gum disease, and other dental complications [11]. However, the latest developments have tried to reduce the overall cost of producing smart toothbrushes. Thus, the main factors of technological innovation include functional efficiency and cost to attract a significant portion of the target market.

2.3. Development process and application areas

The development process encompasses a step-by-step formulation that goes into producing smart toothbrushes. The design of the smart toothbrush covers the development of the brush motion monitoring system, the orientation of the grip axis, accelerometer, and the magnetic sensors that evaluate the brushing styles [12]. The process of developing and assembling these parts vary from one company to another.

2.4. The relationship between technology innovation and consumers

Technological innovation is only valid when it gets accepted, and the uptake continues to grow among consumers. It is commonly known that the fierce competition in the market drives firms to put continual effort into introducing products with a higher degree of novelty to consumers [13]. Technology innovation requires the direct involvement of the consumers to determine the efficacy of the resultant product in the market. Regarding smart toothbrushes, firms have been working closely with their target markets to determine their experiences and ways to enhance the uptake of the

new product. The involvement of the consumers has also helped integrate the specific cultural aspects into the anesthetic and functional components of the smart toothbrush.

3. METHOD-SWOT ANALYSIS

3.1. Strengths

Innovation is one of the notable strengths of electric toothbrushes. There is no doubt that innovative features such as smart connectivity, applications, and Bluetooth connectivity have opened new opportunities for toothbrushes users, thus creating a significant difference between electric toothbrushes and manual toothbrushes [3]. With new innovative features motivating users to acquire electric toothbrushes, it is apparent that companies which stayed ahead of competition on innovation will have a competitive edge over their rivals. Besides innovation, the clear positioning of electric toothbrushes as being tailor-made for users intending to improve their oral care implies that users that can afford the product will purchase them rather than considering them as a mere alternative to manual toothbrushes. This is a strength to guarantee the continued growth of the product in the market. The continuous introduction of new products is another strength associated with electric toothbrushes since players are continually innovating new products in the segment to satisfy customers that continually crave for new products with improved features to replace existing ones.

3.2. Weaknesses

Despite the strengths of electric toothbrushes mentioned above, these products also face several weaknesses. One of their weaknesses is low penetration [14]. Despite the extensive distribution network of existing players like Oral-B and Colgate, they have been unable to avail their electric toothbrushes to their customers extensively as is the case with manual toothbrushes. While a customer can purchase a manual toothbrush at any retail outlet, this is not the case with electric toothbrushes since they are only available in specific outlets. Besides low penetration, electric toothbrushes also face a low awareness level among the public, with the highest degrees of unawareness being in the developing and low-income countries. Undoubtedly, increasing their awareness of these products, particularly benefits of tracking and improving oral health, will significantly increase toothbrushes' market share. Finally, electric toothbrushes target a specific niche of customers: users with oral health issues, including sensitivity and plaque. While these products are also suitable for users without oral health issues, a significant majority of users that purchase them present oral health issues. Thus, the fame of curing oral health issues has

been emerging as a notable weakness to their continuous expansion into the market.

3.3. Opportunities

There is no argument against unexplored markets as an opportunity that electric toothbrush manufacturers can leverage. The steady growth of demand for personal care products implies that electric toothbrush manufacturers should anticipate a continuous rise in the demand for their products. Besides targeting on users with oral health issues, manufacturers should also develop cheaper alternatives for individuals without oral health issues and kids. This strategic move could dissuade them to shift from manual toothbrushes to electric toothbrushes. Besides exploring new markets and customer segments, manufacturers of electric toothbrushes can also innovate new products and introduce new features to attract more customers to purchase their products.

3.4. Threatens

The key threats facing electric toothbrushes are competitions from manual toothbrushes and cost consciousness. Competition is normally internal as main players such as Oral-B and Colgate also manufacture manual toothbrushes, which are also up to the task, especially for individuals without any oral health issues. Cost-consciousness poses a significant threat to the future of electric toothbrushes because users, particularly price-sensitive customers would opt for manual toothbrushes due to their comparatively lower prices. While it is impossible for players to lower the prices of electric toothbrushes to be almost equal to that of manual toothbrushes because of the additional features that they contain, they should attach competitive price tags to these products to convince customers to acquire them.

4. RESULTS

It is evident that electric toothbrushes offer a better cleaning experience than manual toothbrushes. This is particularly beneficial since proper cleaning is vital for keeping gums and teeth healthy. The better cleaning experience offered by electric toothbrushes arises from the fact that their manufacturers design bristles to remove plaque effectively by reaching difficult to places like the back molars. This advantage explains why electric toothbrushes can significantly reduce tooth decay and gum disease. The less work that electric toothbrushes leave for the user is their other advantage. Using an electric toothbrush is easy since the device does most of the difficult work for the user. Thirdly, the electric toothbrush is also more effective than a manual toothbrush at getting rid of bad breath. Bad breath is usually associated with poor dental hygiene, especially when a person using a manual toothbrush is unable to remove the food particles that get stuck between teeth.

The ability of the electric toothbrush to remove such particles guarantees a fresh breath to the user. Also, an electric toothbrush prevents the user from brushing too hard, thereby avoiding injury to the gums. If someone brushes too hard against their gums as is the case when using manual toothbrushes improperly, they can cause the gums to recede and bleed and also remove enamel when the brushing is too hard. Finally, electric toothbrushes last longer than manual toothbrushes. Their longevity can extend one year with the user only having to replace the brush head once after every three months.

Higher cost and higher risk of damage are the main disadvantages of electric toothbrushes. It is obvious that the cost of battery-powered toothbrushes is higher than that of manual toothbrushes because of their additional features and options. Besides the high cost of acquiring an electric toothbrush, users of these devices also have to contend with the costly maintenance costs of the device, as they have to replace the brush heads after a specified duration, mostly three months. The higher risk of damage associated with electric toothbrushes arises from the fact that these devices come with charging systems. As a result, the user should be careful to avoid overcharging them. Besides, dropping the electric toothbrush could mean the end for the device and a costly acquisition of a new device. However, this is not the case with manual toothbrushes. In essence, using an electric toothbrush takes significantly more attention and care from the user than a manual toothbrush.

5. DISCUSSION

In regard to the research question that examined the impact of innovation of electric toothbrush on the toothbrush sector, it is evident that the electric toothbrush and innovations associated with the product have significantly affected the toothbrush sector. As pointed out by Aparna et al. in 2018, the key innovations attributed to electric toothbrushes are pressure sensors, Bluetooth connectivity, and smart connectivity [3]. These innovations have revolutionized the working of toothbrushes by transforming them from a boring device that a user would only brush on their teeth to clean them to a smart device that can effectively clean teeth, remove all plaque, prevent gum disease and tooth decay, and provide a fresh breath. These features and benefits are primarily responsible for the significant impact that electric toothbrushes have had on the toothbrush sector. As early as 2000, when baby boomers started to age, electric toothbrushes were already recording strong sales with no advertisements [15]. There is no doubt that the emergence of the electric toothbrush as a high-tech accessory has also contributed to its significant impact on the toothbrush sector. Besides improving oral hygiene, users of electric toothbrushes also fancy their accessories.

Although the current paper is similar with previous papers on the subject, it differs greatly on the scope. For

instance, Aparna et al. in 2018 identified the innovative features of electric toothbrushes [3]. However, the author did not examine the impact of these features on increasing the preference for electric toothbrushes, thus increasing their demand and market share. Also, Ng in 2020 noted the rising popularity of powered toothbrushes [4]. While this study also acknowledges the increased popularity of powered toothbrushes, it also examines the role of the specific innovations in spurring further innovations on the product, thus posing it as a continuously evolving high-tech accessory. However, the methodology of the paper is lacking on the empirical statistics about the effect of the electric toothbrush innovations on the toothbrush sector. Instead, the study only identifies the impacts of the innovations as a whole. If possible, future research could target on the specific innovations that characterize the electric toothbrush.

6. CONCLUSION

One of the areas that have attracted attention is the invention of electric toothbrushes. The rising acceptance of electric toothbrushes and their perceived benefits have necessitated further research to determine market penetration in different parts of the world. The emergence of the electric toothbrush as a high-tech accessory place it above the manual toothbrush in delivering a fresh breath, preventing gum disease and tooth decay, and monitoring oral health. Examining the effects of the electric toothbrush on the toothbrush sector with specific regard to innovations, competition, incentives for use by customers, and incentives for entry into the market by competitors provide insights on the future of this product in the market.

From the analysis, the notable impact of electric toothbrushes on the toothbrush sector is incontestable. The emergence of the electric toothbrush as a high-tech accessory places it above the manual toothbrush in delivering a fresh breath, preventing gum disease and tooth decay, and monitoring oral health. Despite the high price tags attached to these products, they will continue expanding their market share as more individuals become conscious to oral health. Subsequently, manufacturers of electric toothbrushes should continue innovating new features and applications to enhance the brushing experience and lure users of manual toothbrushes to electric toothbrushes. Besides, the analysis also reveals the need to improve the lifespan of the brush heads to reduce the burden of replacing the heads after every months. This could be made possible by researching on softer and stronger materials for making the bristles to increase their lifespan. Furthermore, manufacturers of electric toothbrushes should offer competitive prices to attract price-sensitive customers to the product.

REFERENCES

- [1] P. E. Petersen, et al., Oral health information systems-towards measuring progress in oral health promotion and disease prevention, *Bulletin of the World Health Organization* 83 (2005): 686-693.
- [2] Y. Doshi, and G. J. Sha, *Electric Toothbrush Market Size, Share & GROWTH: Industry Report 2023*, Allied Market Research, Allied Market Research, (Mar. 2018), www.alliedmarketresearch.com/electric-toothbrush-market.
- [3] K. S. Aparna, M. P. Puranik, and K. R. Sowmya, Powered toothbrush-A review, *Int J Health Sci Res* 8.5 (2018) 299-306.
- [4] C. Ng, et al., Safety and design aspects of powered toothbrush—A narrative review, *Dentistry journal* 8.1 (2020): 15.
- [5] V. Humm, et al., Treatment Success and User-Friendliness of An Electric Toothbrush App: A Pilot Study, *Dentistry Journal* 8.3 (2020): 97.
- [6] W. Petker, et al., Oral cleanliness in daily users of powered vs. manual toothbrushes—a cross-sectional study, *BMC oral health* 19.1 (2019): 1-9.
- [7] T. Vence, Why We Don't Recommend Smart Toothbrushes, *Wirecutter*, 25 September 2020, <https://www.nytimes.com/wirecutter/blog/smart-toothbrushes-dont-recommend/>. Accessed 13 September 2021.
- [8] Oral Health Foundation, Electric Toothbrushes win the Head-to-Head against Manual in Record-Breaking New Study, <https://www.dentalhealth.org/news/electric-toothbrushes-win-the-head-to-head-against-manual-in-record-breaking-new-study>, accessed 13 September 2021.
- [9] R. Liao, Xiaomi-Backed Electric Toothbrush Soocas Raises \$30 Million Series C, *TechCrunch*, 11 February 2019, <https://techcrunch.com/>, Accessed 13 September 2021.
- [10] Tilastokeskus, Technological Innovation, https://www.stat.fi/meta/kas/tekn_innovaatio_en.html. Accessed 13 September 2020.
- [11] A. Capritto, 3 Smart Toothbrushes from CES 2020 You'll Want This Year, *CNET*, 10 January 2020, <https://www.cnet.com/health/personal-care/smart-toothbrushes-from-ces-2020-youll-want-this-year/>. Accessed 13 September 2021.
- [12] H. Lee, et al, The Effect of Technology – Exploration on Product Innovation: An Analysis Based on Korean manufacturing SMEs,

- International Journal of Quality Innovation, 2 (2016), 1, <https://jqualityinnovation.springeropen.com/articles/10.1186/s40887-016-0009-y>. Accessed 13 September 2021.
- [13] J. W. Lee, et al., Development of Smart Toothbrush Monitoring System for Ubiquitous Healthcare, Conference Proceedings Annual International Conference of the IEEE Engineering in Medicine and Biology, February 2006, https://www.researchgate.net/publication/5899629_Development_of_Smart_Toothbrush_Monitoring_System_for_Ubiquitous_Healthcare. Accessed 13 September 2021.
- [14] R. Al-Kattan, and N. Al-Shibani, Knowledge and Attitude Toward Electric Toothbrush Use Among Dental Professionals in Saudi Arabia, *Journal of Advanced Oral Research* 10.1 (2019): 34-39.
- [15] G. Winter, "No Ads, but Strong Sales for Electric Toothbrushes," *The New York Times*, *The New York Times*, 13 Dec. 2000, www.nytimes.com/2000/12/13/business/no-ads-but-strong-sales-for-electric-toothbrushes.html?auth=login-google1tap&login=google1tap.