

Development of An Improved Pillbox Design
&
How Has Human Desire for Convenience Shaped Medical Treatment?

Undergraduate Thesis Prospectus

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Bachelor of Science, School of Engineering

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On my honor as a student of the University, I have neither given nor received unauthorized aid on this prospectus as defined by the Honor Guidelines for Thesis-Related Assignments.



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Introduction

Medication nonadherence, the act of not following medication as prescribed or not continuing to take a prescribed medication (Ho P. Michael, Bryson Chris L., & Rumsfeld John S., 2009), is an immense issue facing the United States today, costing the American healthcare system almost \$300 billion annually (“Medication Adherence,” 2017). Studies show that 20-30% of medications are never filled, and 50% of medications for chronic disease are not taken as prescribed (Viswanathan et al., 2012). A variety of factors contribute to this lack of medication adherence, notably forgetfulness, lack of a convenient method to take medication, self-consciousness, and expensive costs of prescriptions. The technical side of this prospectus aims to address the first four factors, while the STS side of the prospectus discusses the impact of convenience on medical treatment.

The primary mission of the technical project is to create a novel pillbox design that can fit inside a wallet. After a design has been constructed, the design team will meet with and survey healthcare professionals and patients to make sure the prototype meets consumer needs. Finally, a patent will be written and submitted to take the device to market.

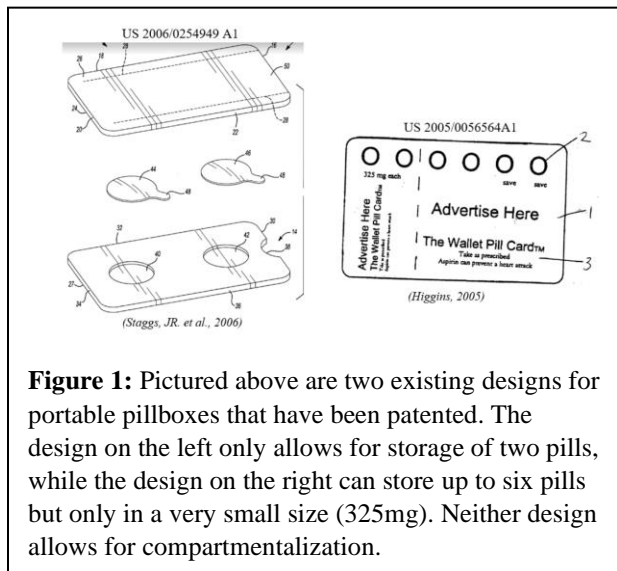
The STS portion of the prospectus will analyze how and why the demand for convenience has become a top priority among consumers, and in turn how convenience has affected medication adherence. This can be analyzed through the STS framework of social construction of technology (SCOT). SCOT argues that successful innovations cannot be assumed to “work better” than failed innovations, but rather it must be analyzed if the relevant social context promotes or hinders the adoption of an innovation. In the context of this project, use of the SCOT framework will allow for an effective analysis on how the value of convenience has shaped both the healthcare system and individuals’ adherence to medication.

Technical Project: Development of Improved Pillbox Design

The objective of this project is to create a pillbox design that is more convenient and effective than existing models in order to improve medication adherence. This device will be constructed on the following five criteria: low cost, inconspicuous design, compartmentalization, maximized pill capacity, and durability.

Prior Art

There are a variety of products on the market that provide a way for patients to organize their prescription medication. Blister packages and rectangular boxes allow people to compartmentalize medication by day for dosage organization and can be a daily reminder for patients to take their medicine. However, these pill containers are more commonly used at home because of their lack of portability. This can be problematic for individuals that are often away from home and need medication throughout the day. Attempts to create portable pillboxes have often been characterized by bulky design, lack of compartmentalization, and low pill capacity (as visualized in Figure 1).



Design Criteria

Creation of a more effective portable pillbox will require balancing a larger pill capacity while minimizing the thickness of the pillbox. A relatively large pillbox capacity is a vital aspect of design criteria with the growing number of medications being taken on a daily basis by the

American population. Nearly 3 in 5 American adults take at least one prescribed medication per day, and the number of patients taking at least five prescriptions in a day has doubled from 2000 to 2012(“Medication Adherence,” 2017). There is also a need for storage of non-prescription medication, such as ibuprofens and cold medicine, where multiple pills are often taken over the course of a day. However, the design must also be relatively inconspicuous for two primary reasons. In order to fit inside a wallet, the pillbox must be close to the size of a credit card or make use of empty space in a wallet so as to not add significant bulk. In addition, there is a social stigma around taking pills in public which could disincentivize medication adherence. An inconspicuous pillbox design could help individuals feel more privacy around taking their medication.

Compartmentalization, low cost, and durability are also key features that will be considered in the creation of a portable pillbox design. As mentioned above, one popular pillbox allows for separation of pills into 7 smaller compartments, one for each day of the week.

Incorporating compartments into a portable design will allow for greater flexibility among users

<p style="text-align: center;">Design Criteria</p> <ol style="list-style-type: none">1. Large pill capacity2. Thin design3. Compartmentalization4. Low cost5. Durability <p>Figure 2: The five design criteria listed above will guide development of the pillbox design in the technical project.</p>	<p>to separate pills by pill type, pills to be taken together at one time, or another method. The design must also be low cost, as most plastic pillboxes can be bought for under ten dollars(“Amazon.com,” n.d.). Finally, the novel pillbox must be durable and protective to prevent damage to stored pills during compression and impact.</p>
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If the design criteria are met, the created pillbox will aim to improve medication adherence among users. Patients will be able to transport needed medication in a portable, discreet manner throughout the day instead of having to carry around a bulkier option. Filling a

portable pillbox in the mornings can create habitual action that can act as a reminder system, promoting better medication adherence (Donna M. Sudak, 2017). This will hopefully have a profound effect on the health of the American population, as studies have shown that approximately 125,000 deaths and 10% of hospitalizations have been caused by a lack of medication adherence (Viswanathan et al., 2012).

Timeline

The fall semester will primarily consist of developing a physical prototype of an improved pillbox design. Doctors and healthcare professionals will be surveyed to receive input on which of the five established criteria will likely be most important to the end user in order to guide the design process. A computer-aided design (CAD) model will be created as the pillbox shape is developed, and then various materials will be tested for performance to arrive at a working physical model.

The spring semester will consist of both surveying and patent development. After a physical model has been created, healthcare professionals and patients will again be surveyed and given products to perform trial runs. The design can then be adjusted if needed based on consumer feedback. A patent will then be created and submitted to the United States Patent and Trademark Office to officially bring the new product to market.

STS Project: How has human desire for convenience affected medical treatment?

Lack of convenience is one of the largest factors inhibiting medication adherence in the United States. This trend is not only seen in medication adherence, but in many aspects of society. Newfound desire for convenience among consumers has had a profound effect on

technology, as businesses and organizations have responded to satisfy a demand for ease of use, utility, and simplicity (“Six Factors Driving Consumers’ Quest for Convenience,” 2018).

SCOT Framework

The framework Social construction of technology (SCOT) is an STS theory that analyzes the social context surrounding technological innovation. SCOT argues that there are a number of “relevant social groups [...] competing to control a design” (“Social construction of technology (SCOT)—Stswiki,” 2018). Different social groups believe problems in society are best solved in different ways, and therefore favor different technological designs. When one social group prevails over the others, the technological design that is supported by that group wins out over the others in a process called stabilization. SCOT sees technological innovation as a “co-construction in which technology and society [...] negotiate the meaning of new technological artifacts, alter technology through resistance, and construct social and technological frames-of thought, practices, and action” (“Social construction of technology (SCOT)—Stswiki,” 2018). The SCOT framework can be used to study how the relevant social group that prefers convenience over other features (which will now be referred to as the “social group for convenience”) has emerged as the dominant social group in society, shaping which innovations and businesses will be successful in meeting public demand. Furthermore, it can be used to study how the social group for convenience has affected medical treatment and technology.

Driving Forces Behind New Demand for Convenience

The demand for convenience across industries can be attributed to two main factors: consumers’ changing lifestyles and the growth of the Internet. Trends of urbanization, longer

commutes, and greater traffic congestion point to busier, more connected, and more “on-the-go” lifestyles for the average individual. This has led to greater levels of stress, anxiety, and fatigue among the general population, giving rise to a demand for convenience in other aspects of life. Thirty-nine percent of global consumers admit to eating out weekly, and 53% of responders wish there were more products that made their lifestyle easier or products that were more convenient to use (“Six Factors Driving Consumers’ Quest for Convenience,” 2018). Through the lens of the SCOT framework, it is seen how the social group for convenience has impacted the restaurant industry and is creating demand for new products that make the lives of consumers easier.

The Internet has also played a major role in the increased demand for convenience. In a study done by Arvato, a German global services company involved in information technology, convenience was found to be the most important factor for U.S. shoppers when choosing to shop online. Through the lens of the SCOT framework, this shows how after stabilization the social group for convenience has prevailed over other relevant social groups in the grocery shopping industry. Surveyed shoppers believed online shopping allowed for easier price comparison, more product choices, and easier evaluation of stock availability (Arvato, 2017). More broadly, the Internet provides more information to consumers at a faster rate and in a more centralized location, creating greater expectations among consumers for instantaneous information. This point is further described by Ev Williams, the co-founder of Twitter, saying “The internet makes human desires more attainable. In other words, it offers convenience[...]by making things fast and not making people think” (Jaconi, 2014).

Effects of New Demand for Convenience

Consumer demand for convenience has led to a shift in the way businesses operate and how technology develops. For example, online food ordering and grocery shopping has led to the

emergence of companies like Grubhub, Instacart, and UberEats. In a poll of 250 grocery shoppers, the overwhelming factor that led customers to try online grocery shopping was the convenience of deliveries (Jaconi, 2014). In the medical industry, high rates of adherence among senior citizens were found when patients were supplied a 90-day supply of medications and when patients used mail order pharmacy services (Administrator, 2015). In order to be successful, companies have had to adapt by offering services that provide a convenient customer experience. This represents how the social group for convenience has led to changes in business practices and a new direction for product and service development. An analysis of this trend yields observation of SCOT's co-construction of society and technology in technological innovation.

Applying Demand for Convenience to Future Medical Treatment

When examining current approaches to improve medication adherence, improving the convenience of taking medication must be prioritized. As previously mentioned, mailing prescriptions to senior citizens in bulk was shown to correlate with high rates of medication adherence. Further research must be done on how convenience can be increased in taking prescription medication to improve medication adherence. Healthcare professionals must find a way to deliver new medication in a convenient way to patients to maximize the impact of new medical technology on society.

This thesis will examine how medical treatment has shifted to be more convenient for patients, and how further steps can be taken to continue to improve convenience in medication. Interviews can be conducted with healthcare professionals and medical company representatives to examine current approaches to prioritize convenience for consumers. Patient motives can also be explored to understand aspects of healthcare that pose an inconvenience to disincentivize adherence to prescriptions.

Conclusion

As analyzed through the SCOT framework, convenience is a major influencer of consumer behavior. A new pillbox must improve the convenience of taking medication for consumers. While the design of the device takes into account the five established criteria listed above, the most important goal of the project is to create a device that makes taking medicine more convenient. Increasing medication adherence will help save lives, reduce healthcare expenses for consumers and hospitals, and put less strain on the American healthcare system.

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