



ÓBUDAI EGYETEM

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Terméktervező Intézet

Pill Box Design for Patients with Chronic Disease or for People Taking Occasional Supplement

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1. GATHERING INFORMATION:

1.1. History

17th century - Pillboxes were present almost from the 17th century and served for more than storing pills, but they were considered artifacts also used to display art (*refer to figure 1.1.1 and 1.1.2*). They were made from any material available, from wood to different metals and even bones. In the beginning, they were designed to be placed on the nightstand or table. But then, the need for portability grew; hence the size reduced to fit in a purse. Usually, the boxes were embellished with figurines or painted stories and were sold at auctions for high prices; however, the quality of the paintings and engravings on the pillboxes were declining as they had to become smaller, and so the figures became blurred and undetailed. As the boxes became smaller, they were regarded as jewelry, and Tiffany's had a line of pillboxes designed.^[1] Although the boxes stored the pills, they didn't remind people when to take them, and therefore, the use of just the pillbox declined, and many inventions appeared to reach our modern-day SMTWTFS (Sunday, Monday, Tuesday...) plastic boxes.



Figure 1.1.1: pill box that has a classical scene painted on it. ^[1]



Figure 1.1.2: Vintage Italian Pill Box that features the Romantic Renaissance Courtship scene ^[2]

[1] *The history of pill boxes*. The Hunt Magazine. (2017, December 5). Retrieved December 12, 2021, from <https://thehuntmagazine.com/life-style/pill-boxes/>.

[2] https://www.etsy.com/listing/1021386229/vintage-italian-pill-box-oval-romantic?ga_order=most_relevant&ga_search_type=all&ga_view_type=gallery&ga_search_query=italian+pill+box&ref=sr_gallery-1-3

1929 - Since the 19th Century many methods existed to aid the patients and simplify caregivers' job regarding medication adherence and more inventions were being released. One example is Mary C. Mottayaw's medication tray patented in 1929 ^[3]. (*refer to figure 1.1.3*). The tray takes the shape of a clock allowing the patients or caregivers to lay down the pills at the exact time they should be taken therefore they are able to see when to take the pill and recognize if they missed a pill. The tray has a spot in the middle in which a pocket watch can be placed and therefore the hand of the watch will match the tray and the patient or caregiver can see the time and take the pill that is corresponding to it. ^[4]

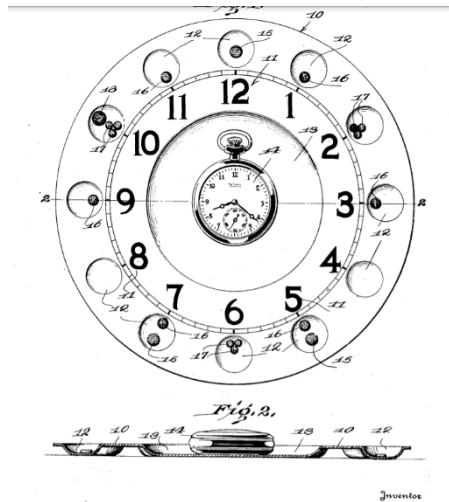


Figure 1.1.3: Mary C. Mottayaw's Tray design patented in June 11, 1929 ^[4]

1954 - During the 1950's the importance of medication compliance was a priority especially that the medical regiments became more complicated with antibiotics released into the market. Medical professionals measured a patient's compliance through blood and urine tests to monitor the concentrations of drugs in them, rather than finding solutions to ensure the patients compliance through memory aid. In 1954 THE Trak-Pak dispenser was released to be sold as an addition with Squibb medication (*refer to figure 1.1.4*). The dispenser did not provide any memory aid to the patients however it was portable and people felt they add value as they pay the same and get something extra. These remained and were again used with other medications and vitamins in 1962. ^[4]

[3] Gossel, P., 2021. Packaging the Pill. [online] Artefactsconsortium.org. Available at:

<<http://www.artefactsconsortium.org/Publications/PDFfiles/Vol1Med/1.05.Medicine-Gossel, PackagingThePillGrBlank3AWEBF.pdf>>

[4] M. C. Mottayaw (1929). US Patent No. 1,717,060. Ohio: United States Patent Office.

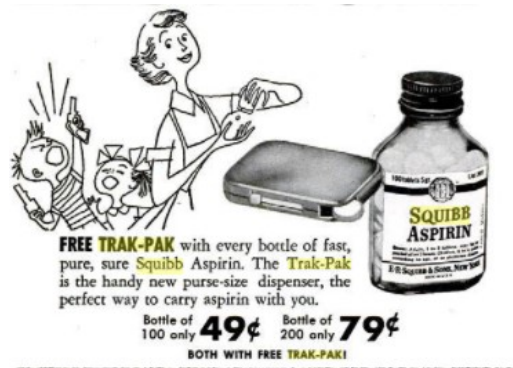


Figure 1.1.4: Trak-Pak pill dispenser used by Squibb medication to promote aspirin [5]

1962 - In 1962 David P. Wagner filed for a patent for what became revolutionary in the pharmaceutical industry. The pill dispenser packaging idea came about due to Wagner's wife always forgetting to take her contraceptive pill as it had a complicated regimen, therefore Wagner being a product engineer decided to find a solution. That is when he came up with pill box packaging that has a memory aid (*refer to figures 1.1.5 (a) and (b)*). He created a model of the pill box using acetate sheets and wood and filed for the patent in 1962. Following that he tried to approach some companies who produced contraceptive pills, but none of them agreed to use his packaging idea. [3]



Figure 1.1.5 (a): Circular pill dispenser Prototype by David P. Wagner [6]

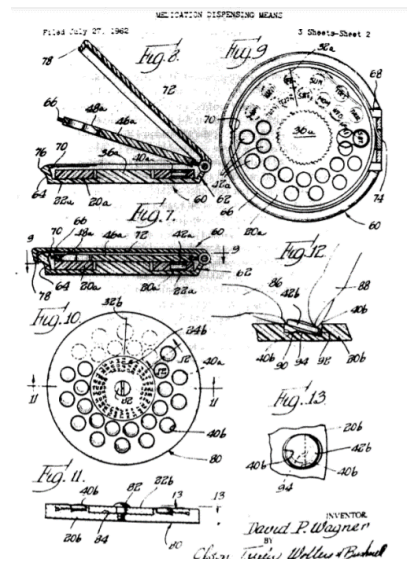


Figure 1.1.5 (b): David P. Wagner pill dispenser illustrations from the patent granted in 1964. [3]

[3] Gossel, P., 2021. Packaging the Pill. [online] Artefactsconsortium.org. Available at: <http://www.artefactsconsortium.org/Publications/PDFfiles/Vol1Med/1.05.Medicine-Gossel,PackagingThePillGrBlank3AWEBF.pdf>

[5] Google Books. 1955. LIFE. [online] Available at:

<<https://books.google.hu/books?id=QIQEAAAAMBAJ&pg=PA41&lpg=PA41&dq=Squibb+%22Trak-pak%22&source=bl&ots=IDGBQyx7ww&sig=ACfU3U12OaPiDOCXNCPOT9z8IYDmahUMuw&hl=en&sa=X&ved=2ahUKEwiv0dyjh0zAhUEs6QKHUNDAIgQ6AF6BAGQEAM#v=onepage&q=Squibb%20%22Trak-pak%22&f=false>> [Accessed 12 December 2021]

[6] Wagner Pill Dispenser Patent Model. (n.d.). National Museum of American History. Retrieved October 10, 2021, from https://americanhistory.si.edu/collections/search/object/nmah_332970

1963 - One of the companies Wagner approached with his model is Ortho Pharmaceutical. Following that, in 1963, Ortho Pharmaceuticals released “DialPak”, the first prescription drug to be compliance packaged (*refer to figure 1.1.6*). Each pill was packaged separately according to the day it must be taken, similar to Wagner’s design. It was marketed as the package that “remembers for her”. Ortho Pharmaceuticals proved that they can produce the pill package from cheap materials as a single-use package. Thereon after, that package could be recognized by anyone, it became famous and many companies started using it, all of which paid Wagner royalties as it was his patented design. ^[3]



Figure 1.1.6: First Ortho DialPak dispenser ^[7]

In the 1960’s it was common that women would hide their contraceptive pills so that people wouldn’t know they were taking it, which created a trend for the aesthetic of pill boxes. It started with Wagner who claimed that his design would fit into women’s purses and will seem compact like other female products. Following that companies were designing compact pill boxes, pastel colored with floral or cameo designs.^[3] (*refer to figures 1.1.7 and 1.1.8*).

[3] Gossel, P., 2021. Packaging the Pill. [online] Artefactsconsortium.org. Available at:

<<http://www.artefactsconsortium.org/Publications/PDFfiles/Vol1Med/1.05.Medicine-Gossel,PackagingThePillGrBlank3AWEBF.pdf>>\

[7] Wendt, Warner, D. W. M. W. (2015, June 19). Packaging the Pill. National Museum of American History. Retrieved October 11, 2021, from <https://americanhistory.si.edu/blog/packaging-pill>



Figure 1.1.7: Enovid-E compact pastel pill box with floral design [8]

The trend of disguising pillboxes remained even in the 1980s, where pillboxes were designed



Figure 1.1.8: Pill box disguised as compact makeup/mirror and advertised as discreet and elegant, by Ortho.^[8]

to look like wallets or credit cards. ^[3]

[3] Gossel, P., 2021. Packaging the Pill. [online] Artefactsconsortium.org. Available at:

<<http://www.artefactsconsortium.org/Publications/PDFfiles/Vol1Med/1.05.Medicine-Gossel,PackagingThePillGrBlank3AWEBF.pdf>>\

[8] CHAN, LUK, ROSMAN, YONG, I. C. A. L. M. R. S. G. (n.d.). Design: Packaging. Tenthingsthepill, Weebly.

<https://tenthingsthepill.weebly.com/design-packaging.html>

1990s - Companies were trying to find new ways to help women remember their pills, to set themselves apart from the competition. Different designs for pillboxes with memory aid were designed and patented, for example, the pillbox with built-in alarm (*refer to figure 1.1.9*). Other companies tried to associate pill-taking with other daily routines such as brushing teeth or washing hands to remind patients to take their pills. For example, organon's "Remember me Compliance Kit" includes a toothbrush, a soap bar, a "Remember me" sticker for the bathroom in addition to the packaged pills. ^[3] (*refer to figure 1.1.10*).

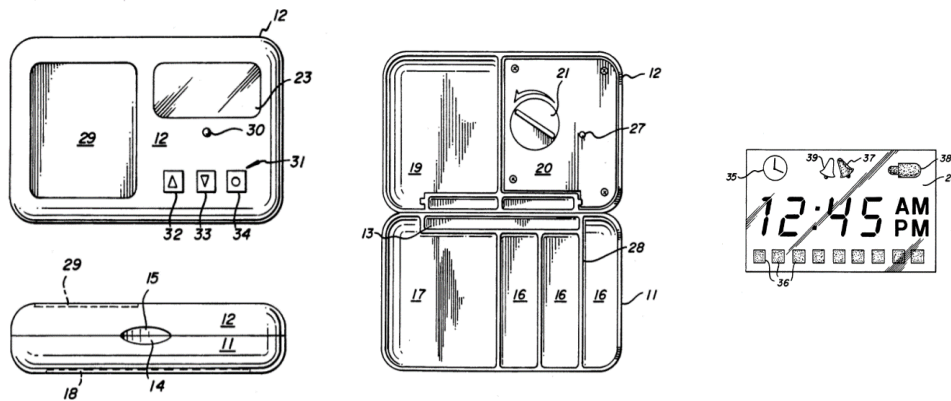


Figure 1.1.9: Alarm Pill box by Malcolm R Raven patented in 1991.^[9]



Figure 1.1.10: "Remember me" compliance kit released in 1993
[10]

[9] Malcolm R. Raven (1991). U.S Patent No. 5,020,037.

[10] Desogen Remember Me Oral Contraceptive Compliance Kit. (n.d.). National Museum of American History. Retrieved October 11, 2021, from https://americanhistory.si.edu/collections/search/object/nmah_1273034

Present - Looking at the history of the pill box, it can be seen that since the beginning, the main goal is finding efficient ways to remind patients of taking their medication consistently. Over the years many ideas came about to solve that issue, and the one used most nowadays is the SMTWTF pill box which has compartments for all the days of the weeks. Some trends from the past remain important in today's pill box for example Portability. It is an important factor in previous and today's pill boxes as it ensures people will take their medication even when they are on the go. Another trend which remains in the present time is people preferring aesthetical boxes in order to hide the fact that they are pill boxes. Some examples include casings with design elements where the pill box can be placed (*refer to figure 1.1.11*).

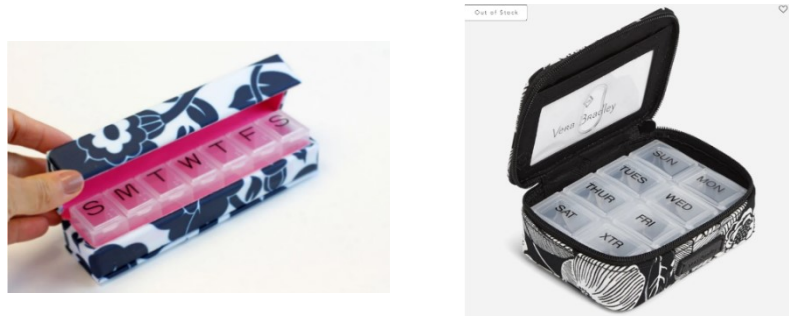


Figure 1.1.11: Floral cases to cover the plastic pill box. ^[11]

A growing trend in today's pill boxes is smart pill boxes. As people's dependency on technology increases smart pill box designs are emerging with higher prices and efficient reminders. Moreover, modern looking boxes are becoming a trend with sleek simple design (*refer to figure 1.1.12*).



Figure 1.1.12: Nordic style pill box design ^[12]

[11] *pretty pill box*. (n.d.). [Photograph]. Latimes. <https://ca-times.brightspotcdn.com/dims4/default/52704c6/2147483647/strip/true/crop/2048x1367+0+0/resize/840x561!/format/webp/quality/90/?url=https%3A%2F%2Fcalifornia-times-brightspot.s3.amazonaws.com%2F73%2F73%2F87fb955c9b46d8d58da910691862%2F1a-trb-gear-a-pretty-pill-case-makes-having-to-001>

[12] *Nordic Style Portable Pill Box*. (n.d.). [Photograph]. Ecommsmartservices. <https://www.ecommsmartservices.com/wp-content/uploads/2020/05/a0pox-k87xb-540x540.jpg>

1.2. Pill Boxes and Medication adherence

People who take multiple medications several times or every day of the week are more susceptible to issues with medication adherence. The main issue is forgetting. Firstly, forgetting which medication should be taken, secondly forgetting at what time each medication should be taken especially if they have complex regimens, and sometimes forgetting to take the medication as there are many boxes each in different place and not close to the patient. All these problems can be reduced by using a pill box as the pills are organized in separate compartments according to the days they are supposed to be taken, thus reducing or completely eliminating the mess of having many boxes and trying to figure out which one should be taken. That's why even health professionals recommend patients to use pill organizers especially for the elderly as with age the number of medications the person has to follow increases.^[13]

Older or younger people who have chronic diseases or take vitamins and supplements daily would need to keep their pills with them so it doesn't hinder their daily activities. A pill box allows that for them and reduces the stress of planning their day according to their medication schedule. This is important especially for older people to keep them active in the community and independent while following their medication regimen.^[14]

Patients are also advised to keep a list of the medication doses and prescription information and side effects in a list to keep track of the important information and not be of a health risk.^[15] On the other hand, health concerns arise from using pill boxes because most medication's effectiveness depends on the timing they are taken and therefore people relying on their memory to take the pills offers a health risk. Moreover, having more than one pill in one compartment poses a serious health risk of taking the wrong pill at the wrong time, as it is not enough to remember the shape of the pill and the color especially that those might change or some pills can look similar but they are extremely different (*examples in figures 1.2.1 and 1.2.2*)

[13] A. (2021, January 27). The Benefits of Using a Pill Box Dispenser. Shantys - Pillmate Pill Box, Nit Comb and Pill Accessories. Retrieved October 11, 2021, from <https://www.shantys.com/2017/11/benefits-using-pill-box-dispenser/>

[14] de BorjaOliveira, C. R. (2013). Analysis of the audit factor structure in . . . - scielo.br. Scielo. Retrieved October 10, 2021, from <https://www.scielo.br/j/rsp/a/wWq6LsHNFnRSD4Snj6WgqSC/?format=pdf&lang=en>

[15] Vorvick, L. J. V. (2020). Keeping your medicines organized. Medline Plus. Retrieved October 12, 2021, from <https://medlineplus.gov/ency/patientinstructions/000600.htm>



Figure 1.2.1 (a): Panadol (paracetamol); pain killer pill [16]]



Figure 1.2.1 (b): Calcium and vitamin D pill [17]



Figure 1.2.2 (a): vitamin c pills [18]



Figure 1.2.2 (b): Plavix(clopidogrel) medication to prevent heart strokes, blood thinner help with arterial circulation.[19]

Moreover, some pills are packaged in special vials to prevent moisture and light from entering which cannot be ensured when using a pill box. In addition to the mentioned issues, one of the biggest concerns is distributing pills into the pill box. The process of removing pills from their original package and filling them in the right days and times of the pill box, can incur many errors. Therefore it is always advised for a person to recheck the sorting to reduce possible errors. [20]

There are many types of pill boxes; some with bigger compartments, some with 7 compartments for the days of the week, some with built in alarms to remind the patient to take their pill... etc. They could be sold anywhere and are not subject to legal requirements or specific instructions of use. Original packaging of pills ensures the right conditions for the medicine locking out the moisture, light and having a specific temperature, therefore removing it from its original can impose risks on the patient.[21]

[16] <https://shopee.com.my/Panadol-Advance-Panadol-Optizorb-Caplet-500g-i.19172982.2634767159>

[17] Calcium. (n.d.). [Photo]. Nutrstock. <https://149361871.v2.pressablecdn.com/wp-content/uploads/2018/03/5230.jpg>

[18] Jeffcott, N. J. & Stocksy. (n.d.). Vitamin C tablet [Photo]. Everyday Health. <https://images.everydayhealth.com/images/possible-benefits-of-vitamin-c-supplements-1440x810.jpg?w=1110>

[19] [https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.goodrx.com%2Fclopidogrel%2Fwhat-is&psig=AOvVaw3St1TA8cnNETTe25KWiL-](https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.goodrx.com%2Fclopidogrel%2Fwhat-is&psig=AOvVaw3St1TA8cnNETTe25KWiL-N&ust=1632481331194000&source=images&cd=vfe&ved=0CAwQjhxFwoTCNCQy5r5IPMCFQAAAAAdAAAAABAX)

[N&ust=1632481331194000&source=images&cd=vfe&ved=0CAwQjhxFwoTCNCQy5r5IPMCFQAAAAAdAAAAABAX](https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.goodrx.com%2Fclopidogrel%2Fwhat-is&psig=AOvVaw3St1TA8cnNETTe25KWiL-N&ust=1632481331194000&source=images&cd=vfe&ved=0CAwQjhxFwoTCNCQy5r5IPMCFQAAAAAdAAAAABAX)

[20] Basaraba, S. B. (2020, March 21). Are Pillboxes for Multiple Medications Safe? Verywell Health. Retrieved October 11, 2021, from

<https://www.verywellhealth.com/pillboxes-and-drug-safety-2224150>

[21] Borja-Oliveira, C. R. D. (2013, February 1). Organizadores e cortadores de comprimidos: riscos e restrições ao uso. Scielo. Retrieved October 12, 2021, from <https://www.scielo.br/j/rsp/a/wWq6LsHNFnRSD4Snj6WgqSC/?lang=en>

1.3. Analyzing Existing Products

1.3.1. 7-day Organizer



Figure 1.3.1.1: 7-day plastic pill organizer ^[22]

The most basic and the common is the 7-day pill organizer which consists of 7 compartments each labeled according to the day of the week where all Mondays pills will be placed in the Monday compartment and so on.

Pros:

- Organizes the pills a person has to take into their specific days.
- Can show if you took pill or not if there are 3 or less pills in the day
- Light weight and portable.

Cons:

- If the person has to take more than 3 pills a day it can become confusing and mixing of pills might occur, as all pills are in the same compartment.
- No indication which pill should be taken and which time.
- Dependent on persons memory, no reminders to take pills.
- Has to be refilled every week.
- If many pills are placed in one compartment it would be difficult to remember whether the medication was taken or not

[22] APEX 7- DAY PUSH TO OPEN PILL ORGANIZER. (n.d.). [Photo]. Carex.

https://cdn.shopify.com/s/files/1/0240/6504/8681/products/carex-com-pill-organizer-apex-7-day-push-to-open-pill-organizer-28287852937321_1000x.png?v=1621616874

1.3.2. Weekly pill organizer 4 times a day (morning, noon, evening, night)



Figure 1.3.2.1: Multi colored grid weekly organizer ^[23]

A weekly organizer with 3 or 4 compartments for each day of the week indicating the approximate time the medication should be taken morning, evening or night.

Pros:

- Unlike the basic 7 days pill box, there is some indication when to take certain pills.
- If a person takes more than 3 pills they are separated in different compartments and not in one compartment which reduces the likeliness of mixing between pills
- Usually, its modular which means the compartments for 1 day can be separated from the rest so it can be easier to carry.

Cons:

- No reminder to take medication, therefore depending on a person's memory.
- Usually, the compartments are smaller and cannot fit multiple pills or bigger vitamins.

1.3.3. Electronic Pill box

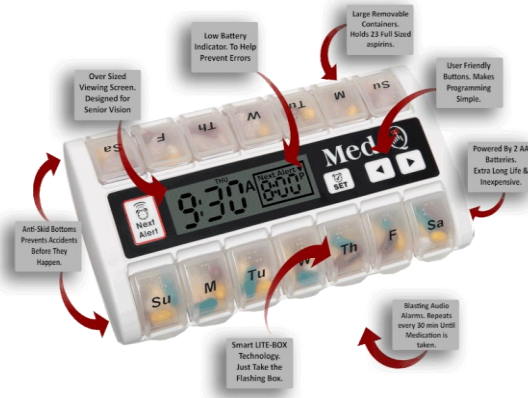


Figure 1.3.3.1: Electronic Pill organizer with built in alarm and light indicator [24]

Electronic pill boxes are a version of the basic 7-day pill box or the weekly 4 times a day pill box but with the addition of light or sound reminders.

Pros:

- They have a reminder mechanism whether an alarm or lights or a combination of both ensuring that a person takes the pill at the right time.
- Organizes the pills a person has to take into their specific days.
- Can show if you took pill or not if there are 3 or less pills in the day

Cons:

- If it was a 7-day pill box with 7 compartments the same disadvantages apply as before. (confusing pills, not knowing which pill to take,)
- Although the size of an electronic pill box can be suitable for carrying however because they have built in alarms, they are not ideal to be taken everywhere due to the noise.
- Pill box will need batteries or to be recharged and if not, it will be a normal pill box without reminders having the same disadvantages as in 1.3.2 and 1.3.2.

[24] electronic pill box. (n.d.). [Gif]. Med Q. <https://i1.wp.com/medqpillbox.com/wp-content/uploads/2019/09/gallery-pic-6.jpeg?fit=1150%2C800&ssl=1>

1.3.4. Smart pill box



Figure 1.3.4.1: Ellie Grid Smart pill box [25]

Smart pill boxes are usually pill boxes that sync to an app and also include light or sound reminders to take pills.

Pros:

- Has reminders – both built in and app reminders
- Has sensors for when a compartment is opened and a pill is taken
- Sleek modern design
- Easy refill

Cons:

- Expensive
- Pill box should be charged and if not, it loses its smart abilities
- As it requires an app some older people might find it complex to use.
- Not suitable for the elderly, difficult to open and take pill especially if they have arthritis
- Reminders are too brief and if not taken quickly the light and reminders turn off.
- Beeping sound and lights make it hard to be portable specially to work or school.

[25] Ellie Grid. (n.d.). Elliegrid Smart Pill Box [Photo]. Ellie Grid.

https://cdn.shopify.com/s/files/1/3102/2852/products/JPEGimage2_1_900x.jpg?v=1625605884

Disadvantages of smart pill boxes were deduced from user reviews of the product which can be seen in the screenshots below. (Refer to figure 1.3.4.1)

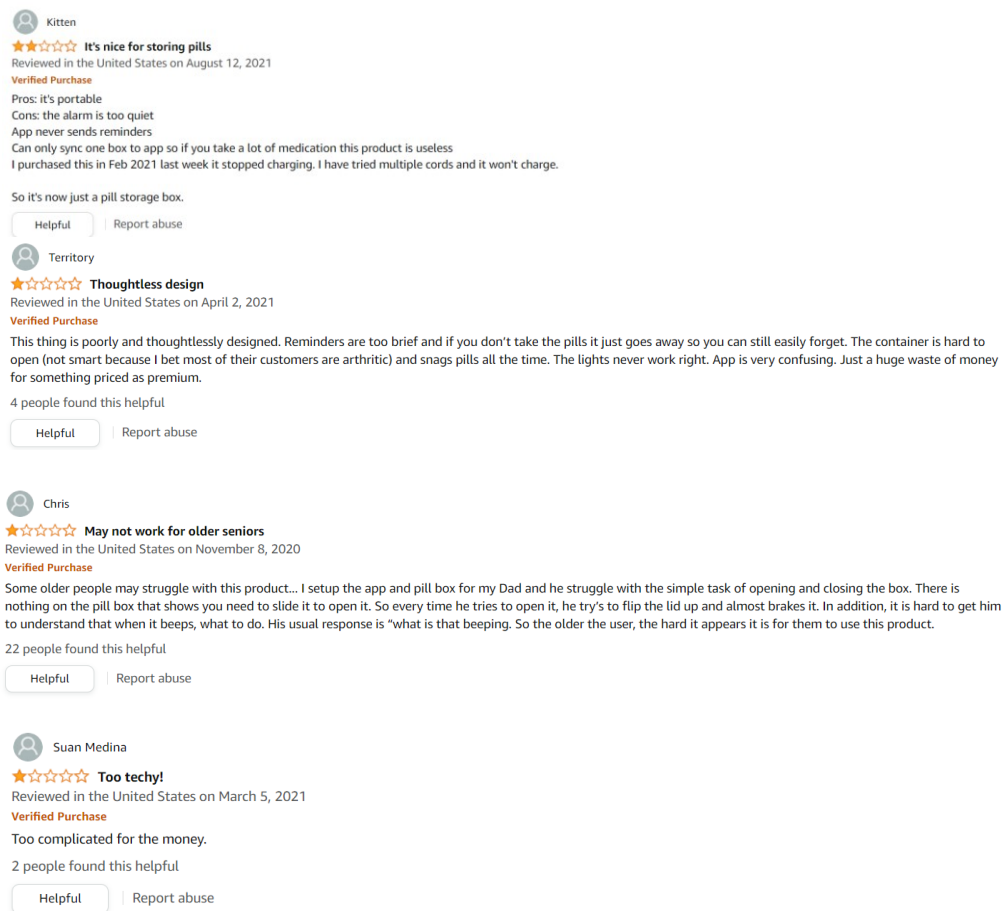


Figure1.3.4.2: Screenshot of amazon reviews to assess product usability

1.3.5. Home medical system:

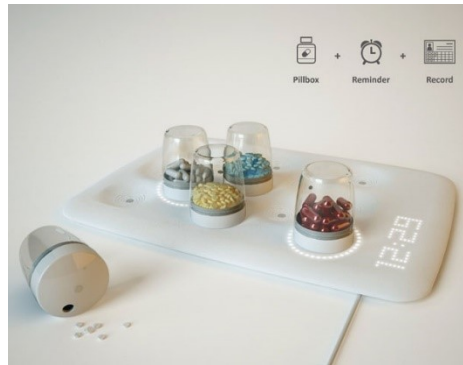


Figure 1.3.5.1: Easy Pill medical System directed towards the elderly ^[26]

Pros:

- Has auditory and visual reminders which are important especially for the elderly
- Syncs to an app creating a health record for caregivers to monitor.
- Each different medication is in a compartment of its own eliminating risk of taking the wrong pill
- Modern sleek design

Cons:

- Not portable-does not suit occasional users or give the elderly independence
- Expensive

1.4. Presentation of Precedents

Being surrounded by older family members, with chronic illnesses or members who abide by a strict vitamins and supplements regime a common issue was noticed; taking pills is a complicated task that hinders daily activities even with the use of a pill box.

Therefore, it was clear that a pill box redesign was needed.

Referring to the positives of the existing most used pill box (*SMTWTFS*, refer to section 1.3.1) it was apparent that some features still work and can remain in the new design, these include:

1. Separate compartment for each day
2. Portability

However, the other parts could be improved to simplify taking medications.

Firstly, the closure. According to scientists, pills can be affected negatively by light, moisture, heat and air therefore storage information are important to be read and also removing the pill from its original package can damage it as the primary package ensures the safety of the pills.^[27] Therefore, as an inspiration for the pill box design, research was conducted to understand the closing mechanism of airtight food containers/pantry storage.



Figure 1.4.1: Pantry storage airtight containers with silicon edge.^{[28][29]}

[27] Vorvick, L. J. V. (2020b, January 23). Storing your medicines. Medline Plus. Retrieved October 15, 2021, from <https://medlineplus.gov/ency/patientinstructions/000534.htm>

[28] OXO POP 2.7qt Airtight Food Storage Container. (n.d.). [Photo]. Target. <https://www.target.com/p/oxo-pop-2-7qt-airtight-food-storage-container/-/A-15672341#>

[29] TASTY+ square storage jar 1.6 L. (n.d.). [Photo]. Nordic Nest. https://www.nordicnest.com/assets/blobs/brabantia-tasty-square-storage-jar-16-l-dark-grey-storage-jars/505728-01_1_ProductImageMain-f90363ec99.jpg?preset=medium

Second part is portability. Although the existing plastic pill boxes are portable yet portability can still be improved. Having a flat object to pack is easier than a bulkier, or thicker item as it takes less space and fits in today's laptop bags, handbags, ...etc.



Figure 1.4.2: Non flat object in bag VS. Flat object. (author's own image)

Third part is ease of taking pill and least amount of handling of pills. Normal pill cases have smaller yet deeper compartments for pills which might fit 10 pills but usually over each other which means a person who takes many pills has to remove all the pills from the compartment in order to reach the desired pill. This could be solved with a flat box that has rounded edges where pills can slide easily to be taken by the user.

1.5. Market Research

1.5.1. User Experience Survey

As part of market research, an online survey was conducted targeting pill box users, health care professionals and caregivers whether professional, volunteers or caring for family member, to identify the issues with existing products and ensure that there is a market for the product which will be designed.

Questions of the survey:

(Note that the person who needs care is referred to as client)

1. What is your age?
 - a. Under 18
 - b. 18-24
 - c. 25-34
 - d. 35-44
 - e. 45-54
 - f. 55-64
 - g. 65+

2. Which of the following best describes you?
 - a. I own and use a pill organizer
 - b. I am a caregiver and I am responsible of keeping track of my client's medication schedule (either professionally or of a family member)
 - c. I am a health care professional/ I have experience in using pill boxes
 - d. Other

3. Which of the following best describes you?
 - a. Occasional Pill box user (I use it to organize my vitamins and supplements)
 - b. Regular pill box user (I have chronic health conditions and use the box daily)
 - c. Other

4. How many different medications (of which are pills) do you / your client(s) take?
 - a. Less than 3
 - b. 3
 - c. 4-5
 - d. 6-7
 - e. Other (10+)

5. How many pills do you/your client(s) take in a day? (average)
 - a. 1-2
 - b. 3-5
 - c. 6+
 - d. Other
 - e.

6. What type of pill box do you / your client(s) use?

(Refer to section 1.3 for figures)

- a. 7 days plastic pill box *(refer to figure 1.3.1)*
- b. Weekly pill organizer with 3-4 compartments for each day (morning, noon, evening), night). *(Refer to figure 1.3.2)*
- c. Electronic pill box. *(Refer to figure 1.3.3)*
- d. Smart pill box. *(Refer to figure 1.3.4)*
- e. Pill organizing home system. *(Refer to figure 1.3.5)*
- f. Other

7. Do you carry your pill box with you when you go out?

- a. Yes- always
- b. Yes-sometimes
- c. No
- d. Does not apply to me, I am a caregiver.

8. If your answer was "No" to the previous question please answer why.

- a. My medication Schedule does not overlap working hours or going out.
- b. I am in a care home
- c. I have multiple pillboxes that I keep at places I'm frequently at
- d. Other

9. What are some problems with the pill box/ organizer?

(Multiple answers could be checked)

- a. Forgetting to take pills (no reminder)
- b. Forgetting if I took pill or not
- c. Taking pills at inconsistent times
- d. Confusing pills/ mixing up pills
- e. Compartments are too small to fit my vitamins/supplements or all my meds
- f. My pill organizer is not portable (too bulky, heavy, or insufficient closure)
- g. Time wasted refilling pills
- h. High cost for smart pill box
- i. Losing the prescription information due to separation from original package
- j. Bad quality box (wears easily)
- k. Box is not modern/aesthetical
- l. No problems with my box, its perfect
- m. Other

10. How do you remember to take your pill on time? (if applicable)

- a. I remember by myself due to routine
- b. Someone (caregiver) reminds me to take my pills
- c. I have reminders on my smartphone, tablet, smart watch...
- d. I have an alarm clock / reminder gadget

11. How do you ensure that the client takes their medication on the right time? (if you are a caregiver)
- a. By following a printed schedule and filling the information manually
 - b. Through reminding devices
 - c. Through a system that stores client's information and medication schedule.
 - d. Other
12. Have you or the person you take care of ever had a medical issue/complication, or treatment-resistance due to bad medication adherence (forgetting to take pill, taking the wrong pill, taking medication at inconsistent times)?
- a. Yes
 - b. No

The purpose of the survey was to evaluate the existing problems with pill boxes among different age groups and to identify potential design improvements tailored for the audience which are occasional and regular pill box users. The results for 75 people were collected and analyzed in order to come up with a functional efficient design.

1.6. Statistics

People are becoming more aware about their health and therefore the market for vitamins and supplements is growing and self-medication from over-the-counter pills is increasing in Europe (*refer to figure 1.6.1*). This provides an opportunity for a pill box design that not only serves people with severe illnesses but also occasional pill takers who want to organize their supplements and vitamins.

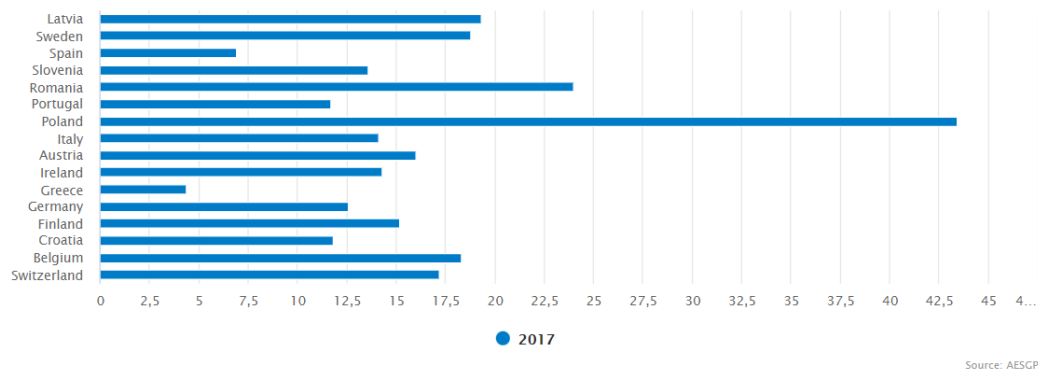


Figure 1.6.1: Non-prescription share of pharmaceutical market in European countries ^[30]

[30] Ecovia Intelligence. (2020, December 30). *Which trends offer opportunities or pose threats on the European natural ingredients for health products market?* | CBI. CBI Ministry of Foreign Affairs. Retrieved October 15, 2021, from <https://www.cbi.eu/market-information/natural-ingredients-health-products/trends#increase-in-over-the-counter-medicines-and-self-care-products-in-europe>

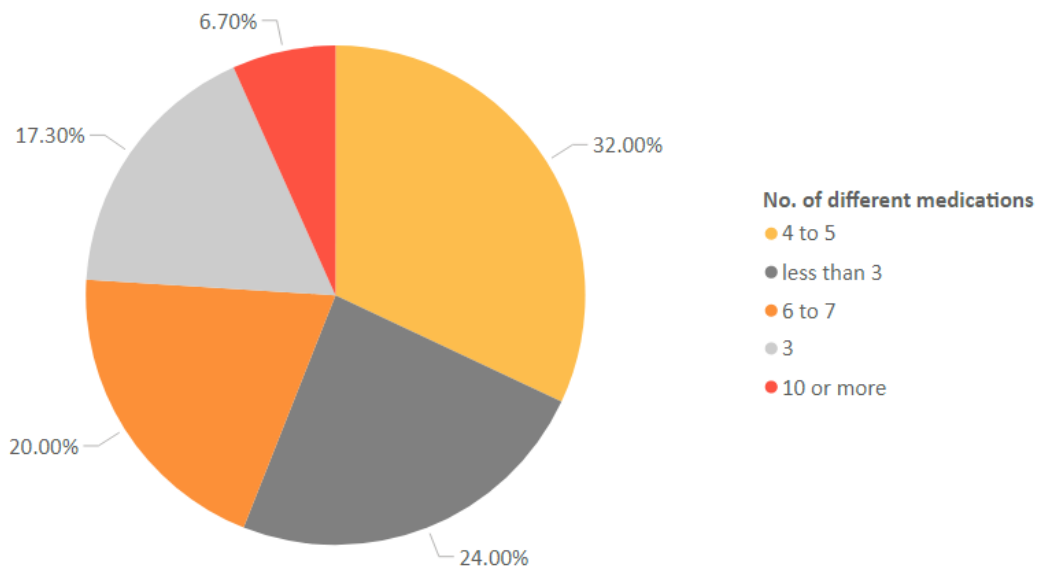
2. ANALYSIS

2.1. Results of the User experience Survey

Looking at the results of the questionnaire, many conclusions can be drawn.

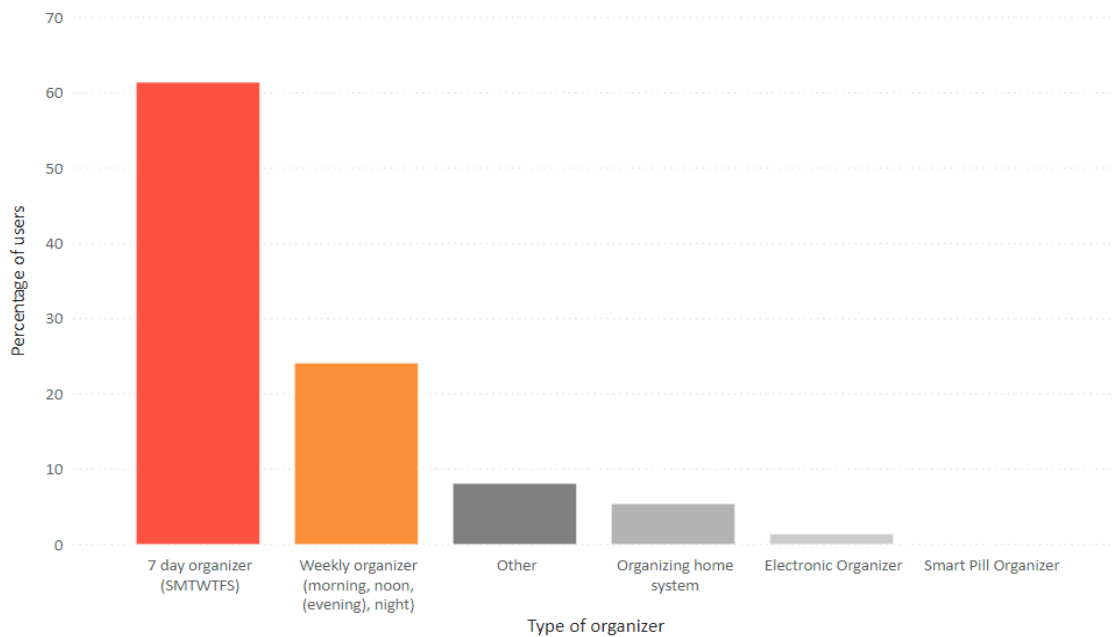
Firstly, almost 59% of the primary audience takes 4 or more different types of medication, with 6.70% taking 10 or more different pills, which shows that more than half are susceptible to confusing or forgetting pills. Moreover, it shows the need to have a pill box with big enough compartments to fit the pills and reduce the confusion between pills.

(Refer to visualization 2.1.1)



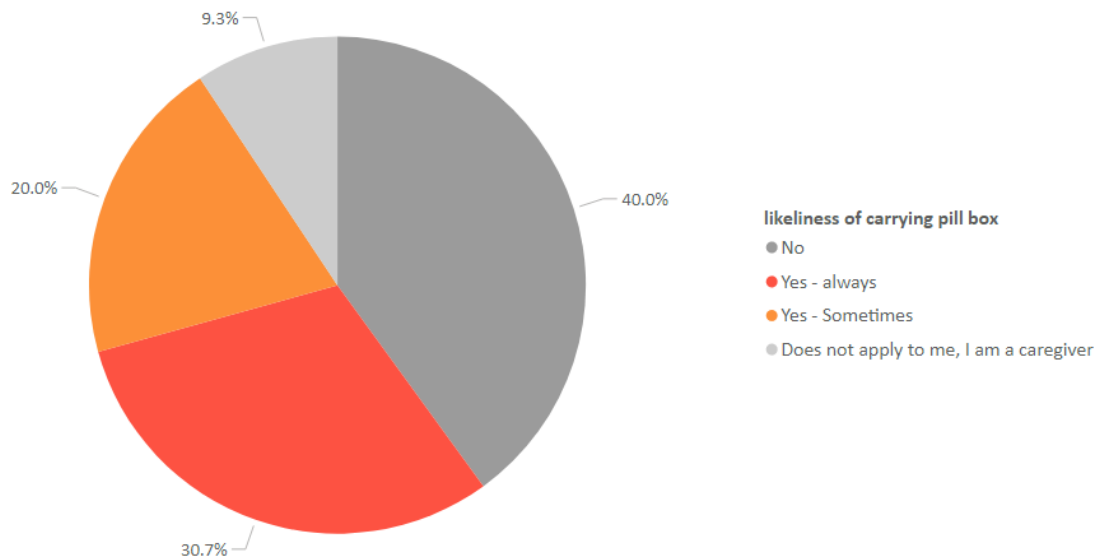
Visualization 2.1.1: Pie chart showing that more than half of the target audience takes 4 or more pills and hence are more susceptible to medication errors. (Made by Author)

According to the questionnaire the most used pill box is the 7-day organizer with 60% users and following that with 24% using the weekly organizer with morning, evening, and night compartments, and 0% using smart pill boxes. This shows that people prefer simpler more cheaper methods rather than complex high maintenance pill boxes even though they include better reminders. *(Refer to visualization 2.1.2).*



Visualization 2.1.2: This chart shows that the most used pill organizer is the simple 7day organizer followed by the weekly organizer with 3-4 compartments a day. (Made by Author)

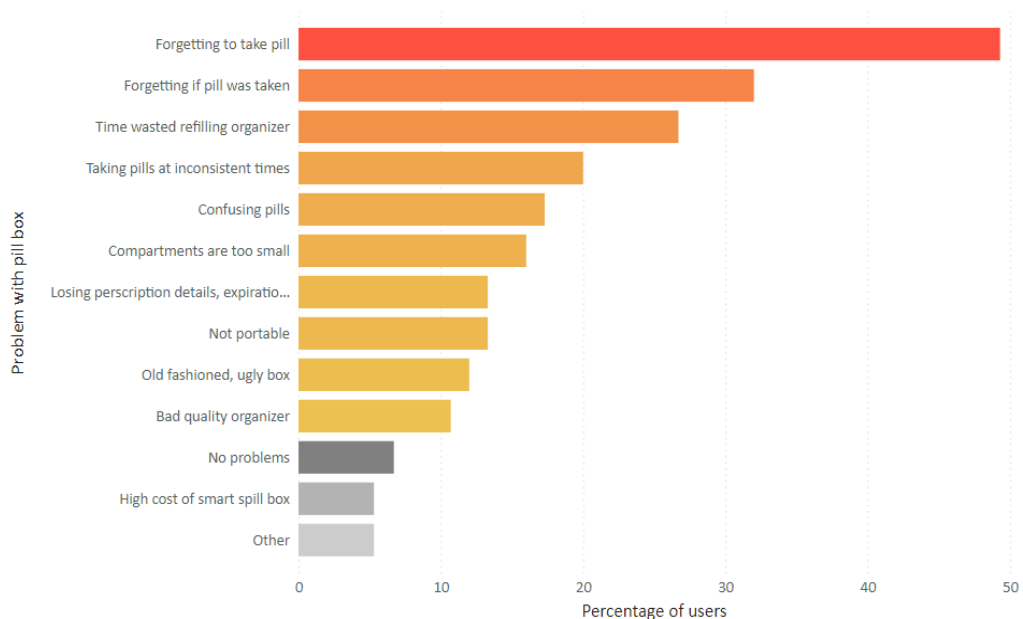
As for the importance of portability, almost 47% of the users said they carried their pill box with them either regularly or occasionally which proves that the designed pill box should have the features to be portable to suit the lifestyle of a working person or an elderly who is not in a care home. *(Refer to visualization 2.1.3)*



Visualization 2.1.3: This pie chart shows the response of users when asked if they carry their pill box with them when they leave the house (Made by Author)

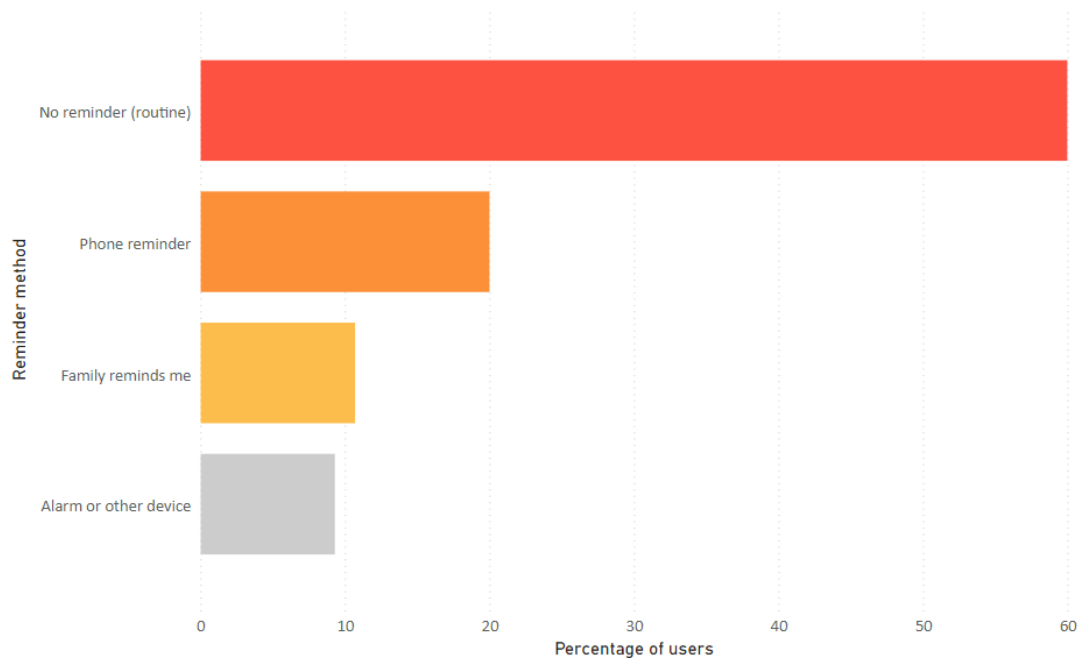
The number one problem with pill boxes according to the users is forgetting to take pills, followed by forgetting whether they took the pill or not. This presents an opportunity for a new pill box redesign that solves these issues by providing a memory aid. Other problems include taking pills at inconsistent times and confusing pills, which are also memory problems of when to take pills and how the pills look like as they are not in their original package.

In addition to memory related problems, other issues related to the container itself were agreed upon such as, small compartments, ugly design, bad quality and other issues that create an opportunity for a new design. (*Refer to figure 2.1.4*)



Visualization 2.1.4: This chart shows the problems with existing pill boxes according to the users, with the top issues being related to memory. (Made by author)

Another important conclusion after looking at the questionnaire is that most people depended on their memory rather than reminders of any sort to take their pills which is not reliable and can pose serious medical issues especially in the case of caregivers as they are responsible for someone's life therefore relying on memory is not a preferred method. The second most used method is phone reminders with 20% and after that is depending on a family member 11%. All of this information provides a market for a pill box with an easy phone app reminder to ensure adherence and safety while being the least complex and also keeping the family informed if needed. *(Refer to visualization 2.1.5)*



Visualization 2.1.5: This chart shows that the majority of the users depend on their own memory to take their medication. (made by author)

Lastly, 33% of the total people said that they/the person they take care of have faced medical complications or treatment resistance due to bad medication adherence, although that is less than half, it is still a big percentage and shows the importance of a better pill box design that ensures adherence, and consistency. *(Refer to visualization 2.1.6)*

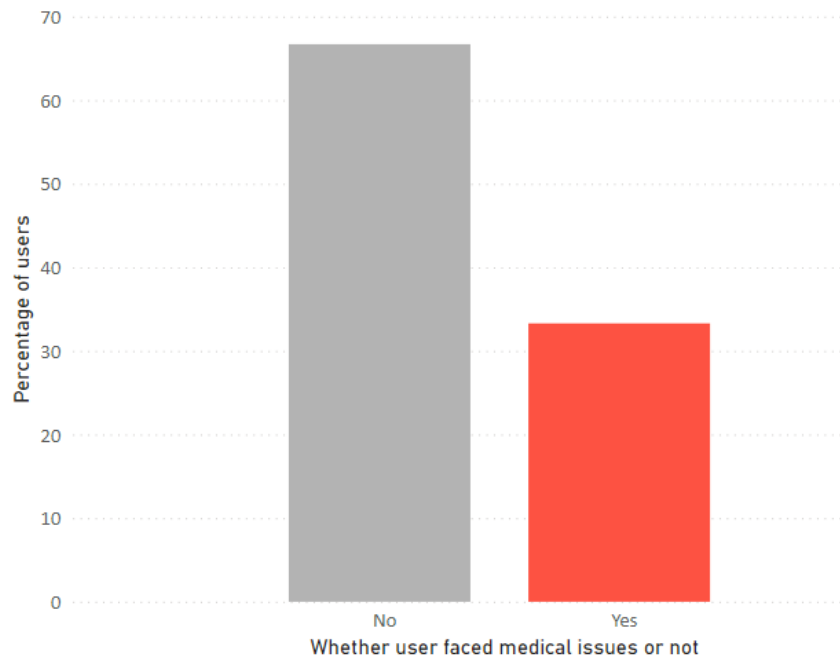


Figure 2.1.6: Shows the percentage of users that faced a complication or medication resistance due to bad medication adherence. (Made by Author)

2.2. Target Group

The main target group of the pill box are occasional pill takers who take some pill and or supplements and vitamins, and regular pill takers who have chronic illnesses and need to rely on a pill box every day to ensure a proper medication schedule. Care givers are also a huge part of the target group as they can rely on a pill box and reminder system to care for their client and therefore considered a customer and huge influence on the user.

2.3. Requirements

The designed pill box should simplify a complicated medication regime in order to ensure the effectiveness of the prescribed medication and reduce the risk of any complications due to missing pills or taking wrong pills.

Therefore, the pill box should:

1. Have an effective closure to ensuring the right environment of pills. Blocking out moisture, light and air.
2. Have big enough compartments to fit vitamins and supplements or as many pills as the user takes.
3. Simplify taking pills out of the compartments, with least handling of pills.
4. Have a sleek modern design to fit into the everyday user's lifestyle.
5. Reduce persons contact with pills/handling of pills (touching the pills with hands) in order to avoid moisture and bacteria affecting the pills. Especially with pills that can dissolve easily.

And the Application should:

1. Remind the user to take their pills at consistent times every day.
2. Remind the user that they already took their pill.
3. Remind the user to take the pill box when needed.
4. Remind the user to refill pill box.
5. Show the user a picture of the pill to avoid pill confusion.
6. Provide important basic information such as side effects, expiration date...etc. as pills are removed from their primary package.

3. CONCEPT GENERATION

3.1. Plan Variations

3.1.1. Design Plan 1

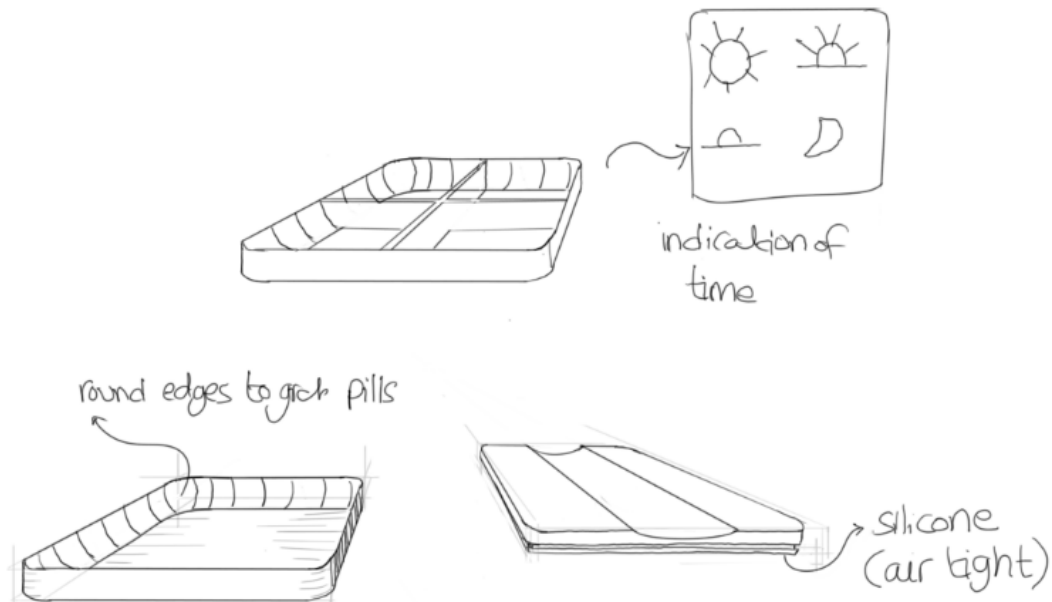


Figure 3.1.1.1: Design sketch 1: Flat pill box (Made by author)

3.1.2. Design Plan 2

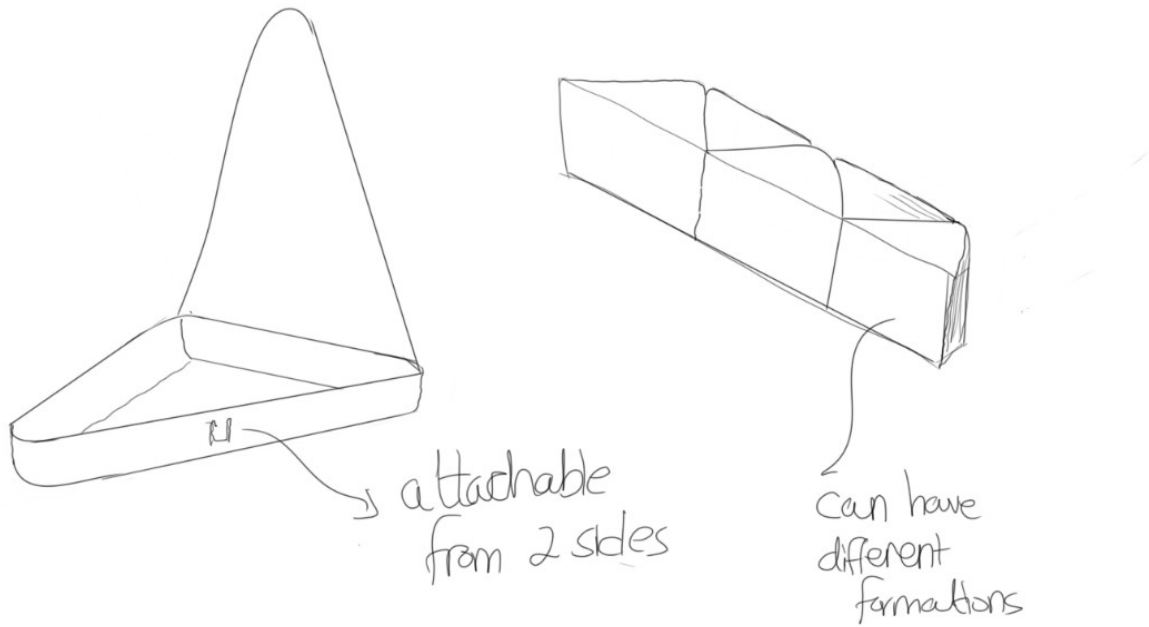


Figure 3.1.2.1: Design Sketch 2: Modular design (Made by Author)

3.1.3. Design Plan 3

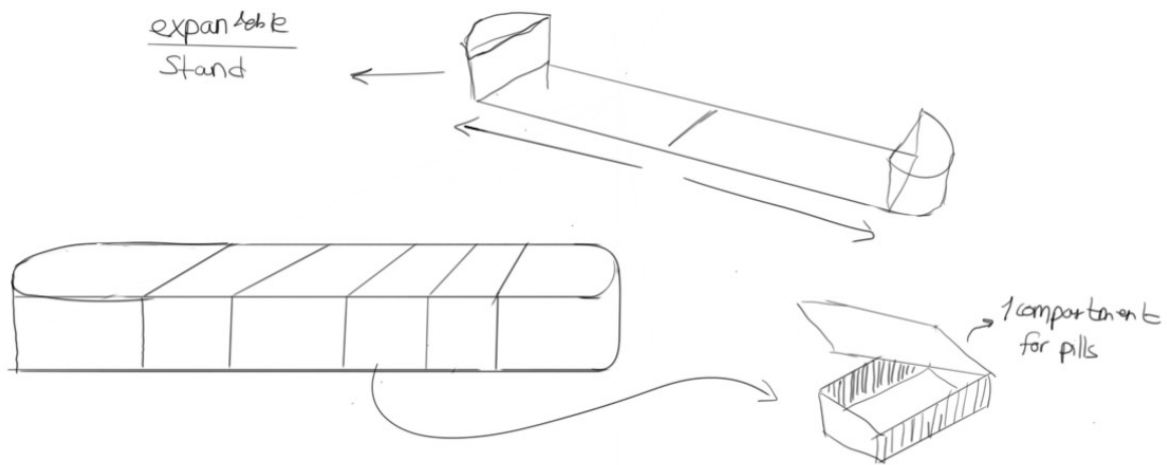


Figure 3.1.3.1: Design Sketch 3: Expandable Stand (Made by Author)

3.2. Analysis of Design Ideas

3.2.1. Design Idea 1: Flat Box

The design tackles the problems of portability, confusing pills, handling pills, and complicated pill regimes.

Features:

1. Flat shape

This feature allows the design to be easily portable and placed in any bag pocket without being bulky and taking up space. Most of today's bags include spots for laptops, tablets, phones all of which are flat design and therefore the pill box fits into that lifestyle. Moreover, the flat design ensures that the pills stay aligned side by side instead of on top of each other unlike the existing 7-day and weekly pill boxes, which means the user can see all the pills and access the pill they have to take without removing all the pills from the compartment. *(Refer to requirements in section 2.3.)*

2. Rounded Inner Edges:

This feature allows the user to take out pills easier by sliding them up the round edge without the need to flip the box and take out the necessary pills. This reduces pill handling and reduces the time in which a person takes their pill.

3. Air tight closure:

The primary packaging of pills in which we buy them in whether bottled or blister packs, is designed so that the pills can have the right environment, therefore when removed from their original package the same safe environment should be kept constant. Therefore, an air tight seal ensures that the pills are not exposed to air and moisture.

4. Opaque Plastic:

This feature is also important to protect the pills, as it does not allow the light to enter.

5. Rounded outer edges:

Looking at design trends in 2021, rounded sleek and smooth forms are being more used. In a study, it was proven that the human brain conditions sharp edges with harm, although the pill box cannot be harmful if not rounded the rounded edges create a more modern and friendly feel. Moreover, rounded edges are visually appealing and therefore this feature solves the issue of unattractive pill organizers.

3.2.2. Design Idea 2:

This design focuses on the idea of catering for different users both occasional and regular users.

Design features:

1. Modular design

The detachable and attachable compartments allow the users to decide how many compartments do they need according to their medication schedule. Furthermore, it allows the person to control the number of times they want to refill, for example if someone takes pills every day of the week and purchases 14 different compartments they can refill once every two weeks rather than every week or every day.

The detachable feature also allows for easier portability as the user can grab the compartment that is needed for the day and not carry all the other compartments that are meant for other days.

2. Triangle shape:

this feature allows the compartments to be organized in different formations according to the users' preferences and place they are storing their compartments (*refer to figure 3.2.2.1*). The triangles are flat at least on two sides therefore the user can place them flat on a surface or standing up.

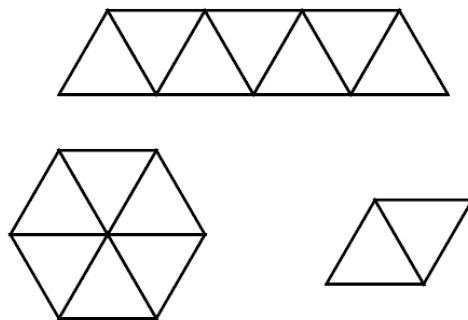


Figure 3.2.2.1: different formations of triangle pill box compartments (Made by Author)

3.2.3. Design Idea 3:

This design presents a creative way for having different number of compartments as the stand length adjusts according to the number of compartments present.

Design features:

1. Expandable stand

This allows the user to purchase the stand as as many compartments needed for their medication regime, and also add compartments if needed in the future. (the stand can fit up to 8 compartments)

2. Pill Shaped form:

An extra visual element where the form of the pill compartments and the stand form a pill shape no matter how many compartments are added on the stand.

3.3. Final Plan

After analyzing the design variations, the chosen design is design number 1 due to its simplicity and range to suit both occasional and regular users.

3.3.1. Analysis of design 1:

The first design offers a great solution especially for users who take many pills (7+) as they could see all their pills and easily reach and grab the required pill at the required time. The 4 sections of morning, noon, evening and night accompanied by the application provide a good solution for not confusing similar looking pills and thus reducing the risk of complications. Yet, this design can suit regular pill users who many pills in a day however might be too big or unnecessary for people who take less pills (3 or less) a day or occasionally (few days a week). Therefore design 2 can be utilized.

3.3.2. Analysis of design 2:

Having detachable compartments, that can be sold separately suits the occasional user's lifestyle. If a person takes a small number of pills each or only on certain days of the week, they would benefit from having less compartments, or smaller compartments as the pills wont stack since there are not many. The compartments can also be carried easily and separately which also caters for the occasional users need and does not force them to carry a whole week's number of pills for one day out. Accordingly, this design can be the missing part of the first design.

For that reason, the decision of having a product family to suit all pill takers lifestyles and medication habits, was made.

3.3.3. Analysis of design 3:

The compartments in this design would have to be deeper but smaller, similar to the existing pill box designs, which means the pills would be stacked on top of each other and have to be removed in order to reach the desired pill. Moreover, extra handling of the pills will occur which might pose the risk of dissolving of pill or bacteria surrounding the pill. Small compartments were also an issue for users especially occasional users as some vitamins and supplements won't fit since they are bigger than other pills. In addition to that, the idea of an expandable stand seems complex for a pill box and might not suit the user, a simpler solution is preferred which can be seen from their choice of using the 7- day plastic pill box

3.4. 3d Visualization



Figure 2: Flat box design (Made by Author)

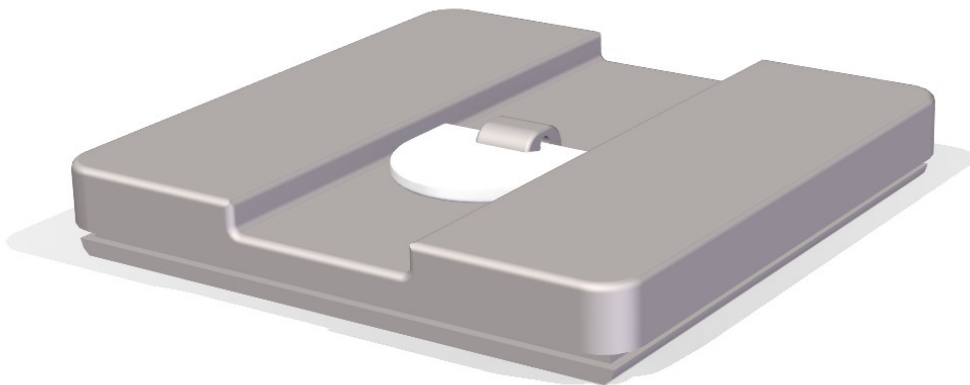


Figure 3.4.2: Flat design lid (Made by Author)

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