

7014AAD - DESIGN MANAGEMENT SPECIALISM 2



i - Inhaler

Smart Wearable Device

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I. INTRODUCTION

This proposal presents the design process for a new wearable Smart Inhaler that works as a product of Apple Inc. The device's working title is an I-inhaler which is designed for people who live with asthma.

Apple Inc is a well-known company providing smart products and a range of related software, services, and accessories. Apple is moving into the health care market through several medical products such as the Apple Watch Series 4 or Health App. In the iOS 4 feature review in December 2020, Dr. Cliff Olson stated that iOS 14 will allow the Air Pods Pro to have the ability to amplify sound like hearing aids (CBinsights, 2019). Besides Dr. Abram Bailey also says it will provide some benefits for people with mild-to-moderate hearing loss (Hearing Tracker, 2020). Therefore, the I-inhaler Pendant will capitalize on this healthcare market and be a new smart health device for Apple to target a more specific consumer.

This proposal will provide an overview about the definition of Asthma, what the inhaler and smart inhaler do, and some existing designs and technologies around inhaler products. It will also show some design specifications and concept solutions of the new device. An important part of this project is that it is for a stand alone device and is not reliant on a phone application.

User personas with several methodologies for market research such as the Double Diamond and Ansoff matrix will be evaluated in this project, in order to make the new i-Inhaler pendant achieve the highest quality and efficiency. The project will look at how Porter's five forces of market analysis can be used for this new industry and from that SWOT will show the individual attributes that apply to the company as it looks at this project. RACI matrix will be used for allocating roles and who will be responsible for each task. Gantt Chart will be considered for assisting and scheduling the project.

II. DESIGN PROCESS - THE DOUBLE DIAMOND METHODOLOGY

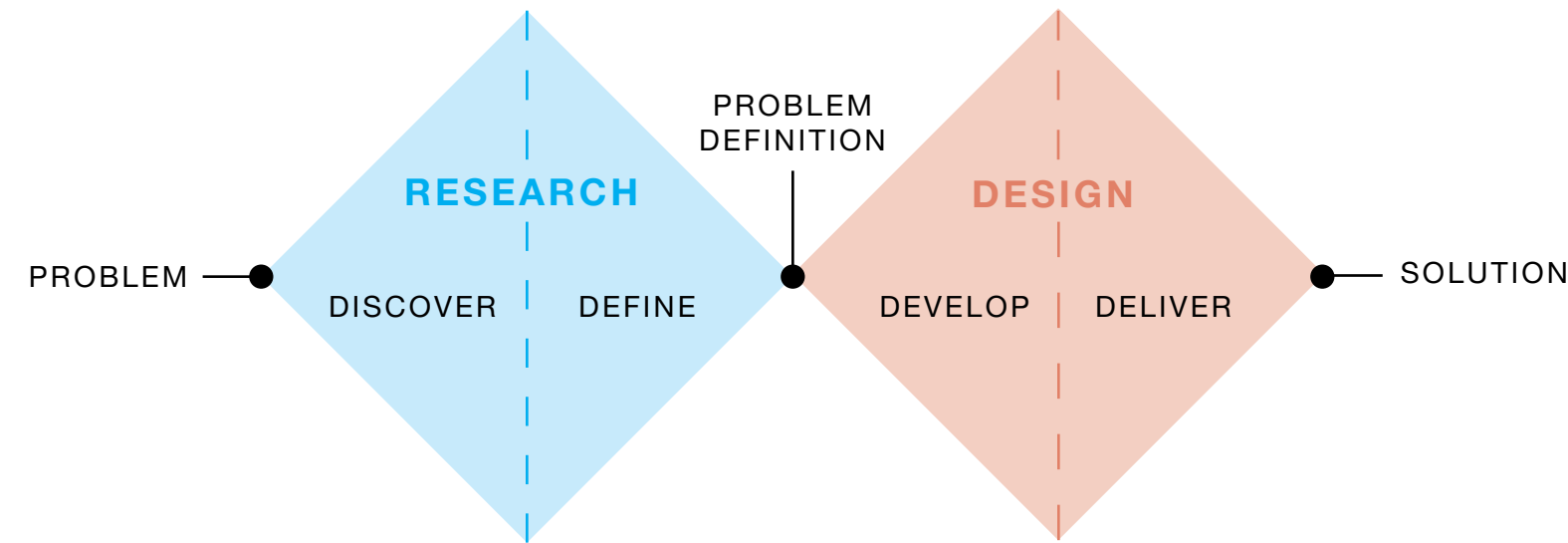


Figure 1: Illustration of the double diamond diagram

Source: Wikipedia, 2021

In 2005, the UK Design Council developed a model called the 'double diamond' diagram as a simple, graphical way to describe the design process (Design Council, 2007).

This model has four main parts across two diamond shapes. They are 'Discover, Define, Develop and Deliver'. The first diamond looks at the specific problem and how to understand it. Each of the four stages is characterised by either interconnected or divergent thinking (Irbite and Strode, 2016).

This report uses the Double Diamond structure. First, to understand customer's problems and identify target markets for the product. After that, to explore creative and innovative ways to satisfy the user's needs.

RESEARCH

DISCOVER — — — — —

In this phase, an idea or a user's needs must be worked out (Gustafsson, 2019). This part represents an opportunity for Apple to research the market for smart inhalers including the customer's problems, needs and the technological requirements. Additionally, this helps Apple identify specific target markets for the smart inhalers.

Roles/ Teams: Design Director, Design Manager, Project Manager, Research Team, Design Team, Engineering Team, Technology Team.

DEFINE — — — — —

In this phase the needs, problems and ideas are focused toward a final solution (Gustafsson, 2019). Observation and analysis information from the Discover phase will be the initial part of this. This will involve some use of methodologies such as Ansoff matrixes to fully consider the market's attractiveness.

Roles/ Teams: Design Director, Design Manager, Project Manager, Design Meam, Research Team, Engineering Team, Technology Team, Program Team and Financial Team.

DESIGN

DELIVER — — — — —

The last quarter represents the delivery output stage, where the final product or service is completed and launched into its market (Design Council, 2007). This phase will utilize analysis through cost estimation. Porter's five forces analysis will need to be considered for managing risks from competitors before launching the products into the target markets. SWOT analysis will also be used to evaluate the products.

Roles/ Teams: Design Director, Design Manager, Project Manager, Design Team, Research Team, Engineering Team, Technology Team, Program Team, Financial Team and Marketing Team.

DEVELOP — — — — —

The third quarter is a phase of development where design-led solutions are further built on, and tested (Design Council, 2007). After developing character profiles of the target markets in the Define part, this phase will develop design specifications and concept solutions for the i-Inhaler. Agile Stage gate Hybrid methodology will be used to create prototypes and test all the design solutions to clarify the best smart inhaler's solutions for the target markets.

Roles/ Teams: Design Director, Design Manager, Project Manager, Design Team, Research Team, Engineering Team, Technology Team, Program Team and Financial Team.

RESEARCH

1. ASTHMA



Asthma is a common long-term condition that causes occasional breathing difficulties for many people. It affects people of all ages, it can also be fatal (NHS, 2021).



300 million
people have asthma
globally in **2017**



This is set to increase
400 million
by **2025**

Figure 2: Asthma is on the rise
Source: Asthma UK, 2017

(Further information about Asthma available in Appendix 1)

According to the Health Survey for England 2018, the highest percentage of adults with asthma were the 21% of people aged 25 to 34. Followed by 19% of 35 to 44 year olds. (National Statistics, 2019).

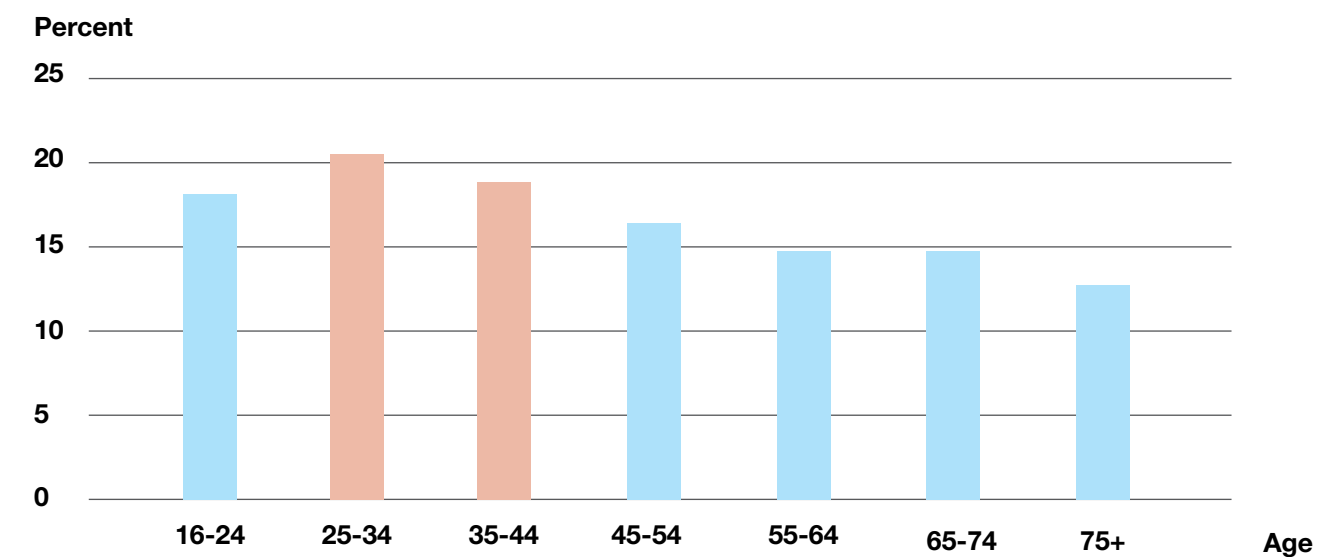


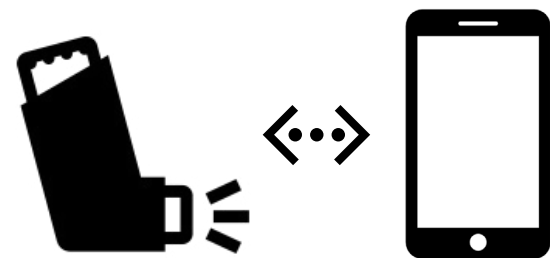
Figure 3: Amount of diagnosed asthma among adults aged 16 and over
Source: National Statistics, 2019

2. INHALER AND SMART INHALER

There is currently no real cure for asthma, but there are simple treatments such as using inhalers that can relieve the symptoms (NHS, 2021).



An inhaler is a small device containing active medication that allows for a dose of medication to be inhaled into the lungs of a user (NHS, 2021).



A medical inhaler that connects with a mobile app is termed a smart inhaler. These devices are made with technology that gathers information and helps record data about the time and date of each use, the location where used and the frequency of use (Dr. Thomas, 2021).

3. COMMON ASTHMA INHALER MISTAKES

- Forget to shake the inhaler before each use (Web MD, 2020).
- Inhalation at the wrong time and therefore do not inhale some or any of the medication (Web MD, 2020).
- Use of an exhausted or empty inhaler, that may contain some propellant but no active medication (Web MD, 2020).
- Over under dosing by immediate repeated inhaler use. Patients thinking their inhaler is jammed so press several times (Web MD, 2020).
- Use of an unclean inhaler can blow dust into a user's lungs (Web MD, 2020).
- Breathing the medication out too quickly before its been absorbed in the lungs (Web MD, 2020).
- No air check before use especially with new inhalers which means a miss firing of medication (Web MD, 2020).
- Failing to breath out and empty lungs bore use. Patients can blow medication away rather than breathe it in (Web MD, 2020).
- Incorrect frequency of use from not following their practitioner's guidelines or reding the inhaler's instructions (Web MD, 2020).
- Forgetting to carry their inhalers (Condon, 2014).

4. MARKET ANALYSIS - SMART INHALERS

The global market for smart inhalers is surprisingly large and is showing strong growth trends. In 2017, the global market had reached around \$930 million, with the latest forecasts pointing to potential sales of \$8 billion by 2027 (Statista, 2019).

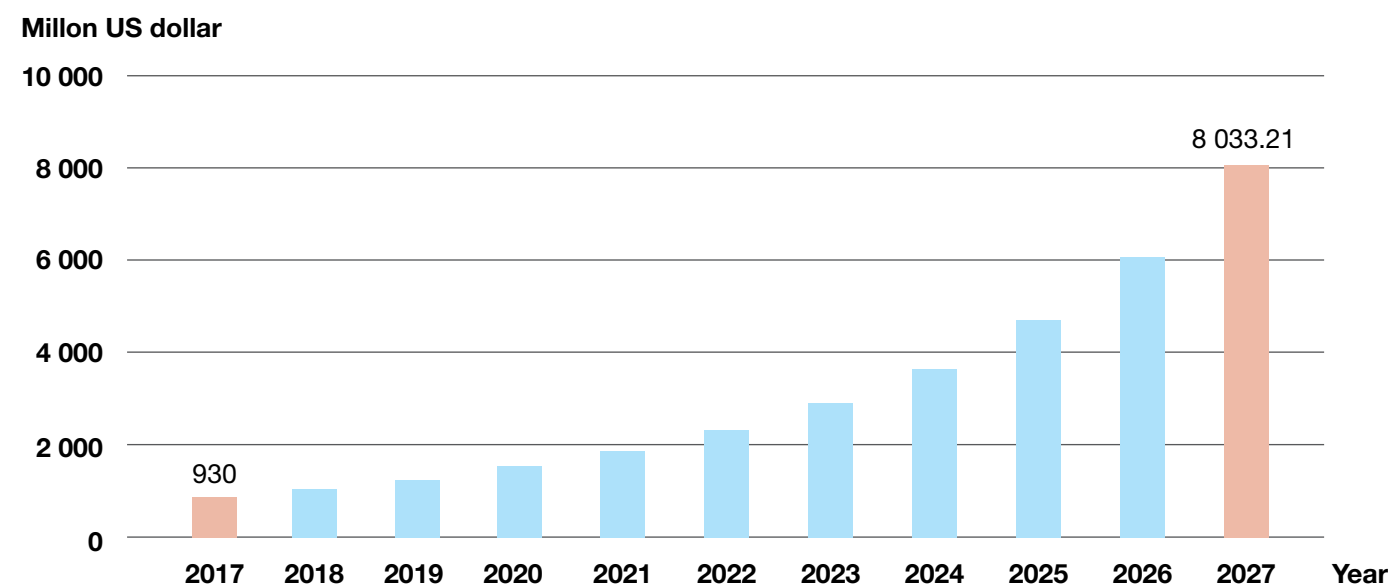


Figure 4: Smart inhaler global sales in \$US 2017-2027

Source: Statista, 2019

Research shows emergency hospital admissions for asthma incidents fell by more than half, from 11.6 to 5.4, when electronic medication monitors were used. (Inhalation Technology Supplement, 2019).

Clinical studies show that there is 80% adherence to preventative medication observed among asthma patients using smart inhalers (Persistence Market Research, 2019).

Security topped the list of concerns for many patients about using smart inhalers, fearful that their treatment could be compromised. 59% suggest that a fear of data hacking has spread over from other industries (Bespak, 2018).

Existing Smart Inhalers



The Propeller sensor automatically records each puff and gathers data about patient's asthma. It provides reminders and personal support. It can forecast usage around air quality and weather. Another feature of this app is it can track a lost inhaler and make it produce a ring tone (Propeller Health, 2021).

Battery Life: 12 - 18 months.



Adherium's Hailie® sensor attaches to a patient's inhaler to monitor dose compliance and promote a high level of adherence (Patient knows best, 2019). It provides real-time information on user's inhaler use through the Hailie® app (Adherium, 2021).

Battery Life: 2 - 3 months.



The Propeller sensor automatically records each puff and gathers data about patient's asthma. It provides reminders and personal support. It can forecast usage around air quality and weather. Another feature of this app is it can track a lost inhaler and make it produce a ring tone (Propeller Health, 2021).

Battery Life: 12 months.



Evaluating Existing Smart Inhalers

Technology

All three devices work through Bluetooth and all record patient data. The Propeller and Adherium's Hailie® products are sensors that attach to traditional inhalers. The 3M device is stand alone as a smart inhaler.

- Gathering research data: All three devices, can help improve treatment schedules, dosage reminders, and track use. The propeller product can even track air pollution.
- Device tracking: The Propeller inhaler has feature so it can be found if patients forget to carry or lose their devices.
- Alert patients: All three can help patients with missed or replicated doses and can give use reminders.
- Track symptoms: The Propeller device can record and note, where and when symptoms worsen, and monitor use of reliever inhalers.

Cost

- Traditional inhalers retail at around \$25 whereas the new generation of smart inhalers retail at around \$99. There is some price variance based on the inhalers different features provided.
- The price of the Propeller smart sensor is around \$300, this is justified by its advanced functionality.

Design

- All the latest smart inhalers appear quite clinical and seem to lack modern tech design, and as such there are not very appealing to fashion conscious consumers.
- All three products look like toys. Adherium's Hailie® sensor inhaler is somewhat boxy in appearance and a little awkward looking. It does not have smooth lines.
- All three tend to be quite plastic. They do not use modern alloys as such they do not match with consumers idea of tech.
- Only the 3M product has a patient screen on the inhaler. The other two rely on apps for reading of information.
- The 3M design is bright but lacks a modern high-tech appearance.
- None of the existing products look like they are in the same design family as smart phones, watches, tablets, and headphones.

Battery Life

- The propeller inhaler has a very long battery life of 12 - 18 months. But these can all be charged with existing USB chargers.

5. MARKET ANALYSIS - APPLE INC.

Marketing Strategy

- Apple has traditionally removed the need for mass advertising, avoiding price wars with competitor products by emphasizing unique value through differentiation (Shankalia and Ramu, 2018).
- Apple have always sold products at premium prices which is a part of its marketing strategy as it ensures consumers accept that the high price reflects the value of its premium products (Shankalia and Ramu, 2018).

Target Market

- The main target market of Apple is middle to upper income people who usually have the financial means to pay the high prices usually commanded by Apple products (Aljafari, 2016).
- Apple customers are primarily between 35 and 44 years old. Besides, a quarter of 18 to 34 year olds say they plan to purchase an Apple product within the next 6 months (Aljafari, 2016).

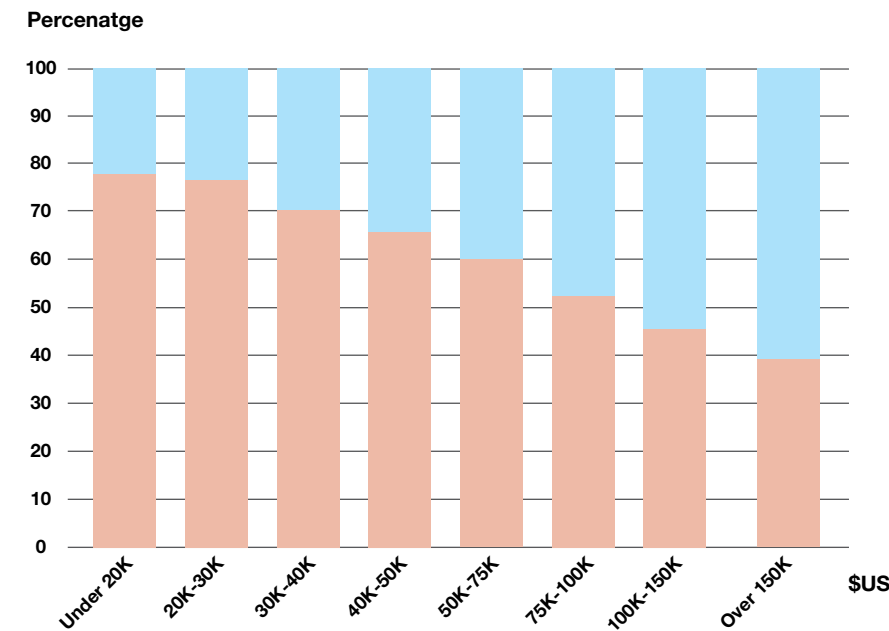


Figure 5: Apple Ownership by Income

Source: CBinsights, 2019

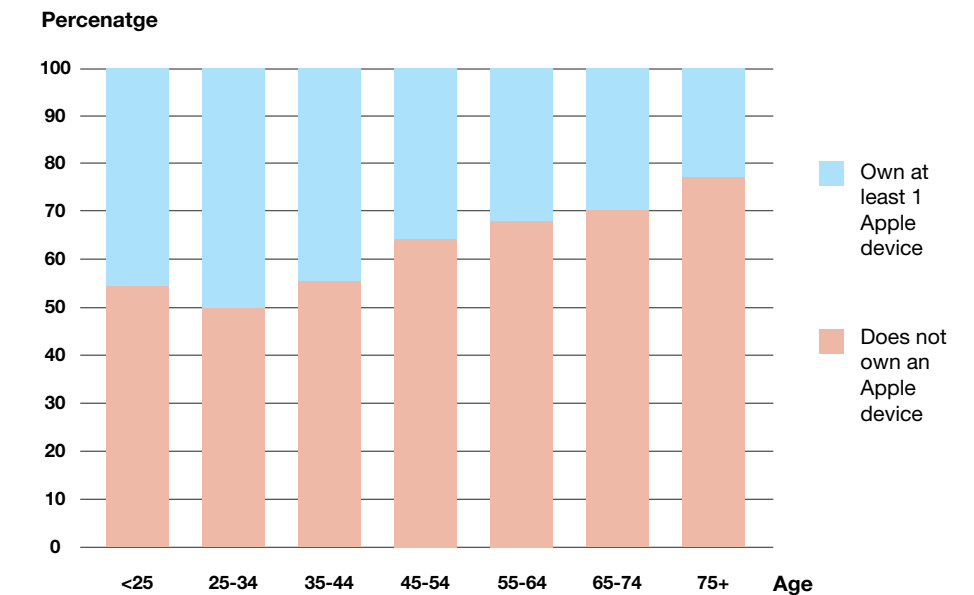


Figure 6: Apple Ownership by Age

Source: CBinsights, 2019

Healthcare Industry - Potential Market

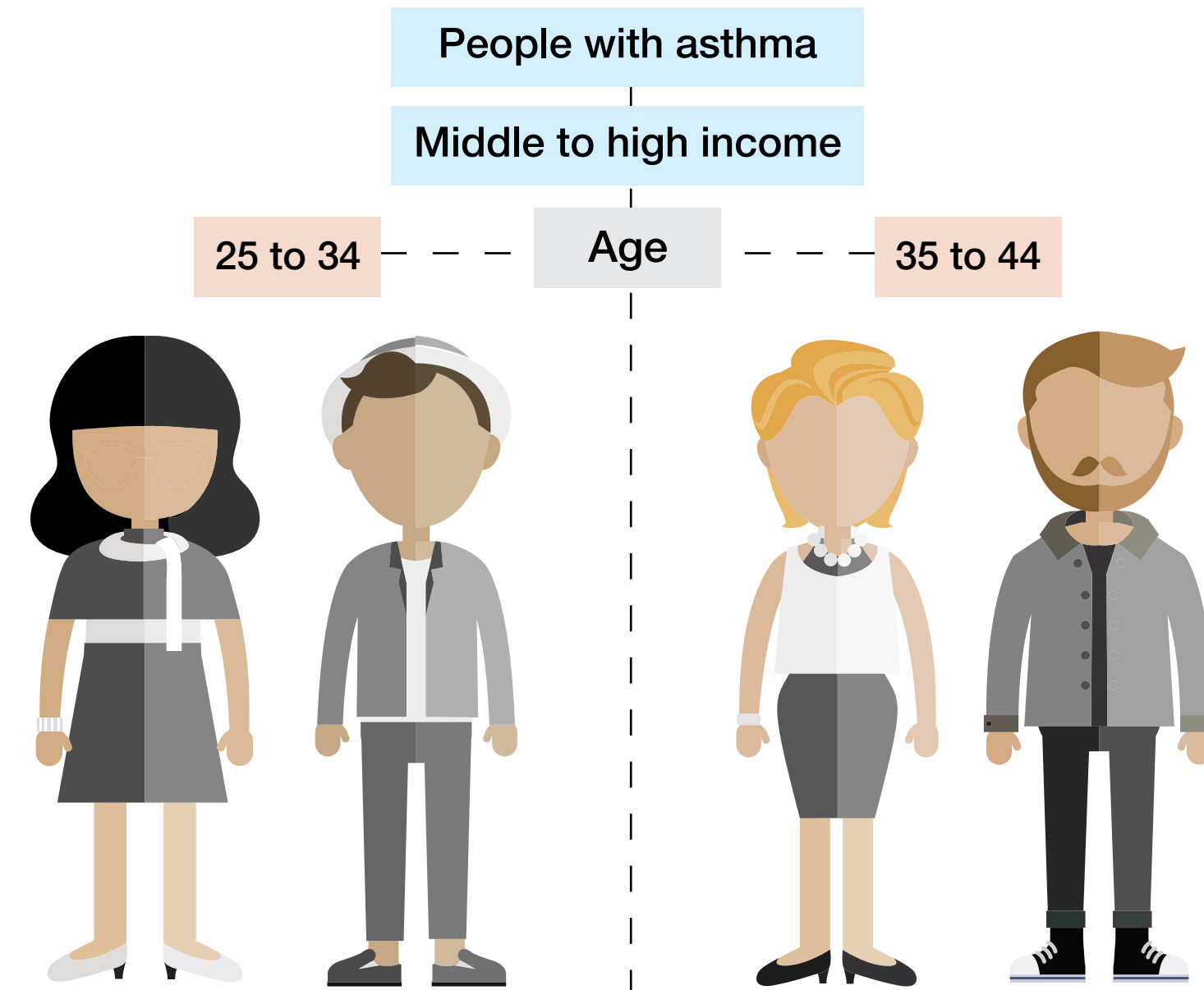
- There is potential for Apple to exploit the healthcare market. Morgan Stanley's report says, "At the mid-point, Apple's health efforts could result in ~\$90B of annual revenue by 2027, roughly ~35% of its current revenue base," (CNBC, 2019).
- Healthcare though can help Apple Inc. differentiate its products more and give the company further reach while maintaining its core business (CBinsights, 2019).
- Apple has several strategic advantages, as it looks to move into the medical market and attack the \$3.5 trillion health-care industry.
- Privacy is an important benefit. For instance, in the Apple Watch heart health study with Stanford University, it was found that people are more willing to share their medical information with Apple than with other less well-known brands (CNBC, 2019).
- Apple makes an enormous amount of non-healthcare revenue, which means it doesn't need to worry about traditional ways to recover costs or have a need to generate a large margin on its healthcare products. If the company wants to dive deeper into the healthcare space, it has the resources to do so and can absorb long timelines associated with healthcare thanks to its large and diversified revenue streams (CBinsights, 2019).

Apple's Healthcare Products

Apple already have advanced into healthcare through its iWatch and they can use some features that they have with the i-Inhaler.

- Apple have fall detection technology that will notify if a user falls over and remains motionless (Apple, 2021), this feature can fit easily into its smart inhaler.
- The company also has an emergency SOS that calls emergency services and shares the location (Apple, 2021). From a technological point Apple have features that can easily be developed into the smart inhaler.
- Apple have the find my feature that fits with all Apple devices (Apple, 2021), this removes the need to develop a tracker as the company already has a successful and trusted tracker.
- The users do not have to have their phone with the iWatch (Apple, 2021), and this too can be a feature that can be replicated with the i-Inhaler.

6. I-INHALER TARGET MARKET



7. ANSOFF MATRIX

The Ansoff matrix is a research method that is used by companies in the analysis of products and markets. It is a tool that is applied to strategic management decision making (Yin, 2016). The matrix analysis is composed of four strategies (Smart Insight, 2020):

- Market Penetration is the extent to which a company can exploit its existing customer base and sell more products to them.
- Market Development is how a company may decide to develop its business by entering new markets.
- Product Development is how a company develops its existing products or services.
- Diversification is how a company can move into new markets with new products or services, increase sales with existing customers or by acquisition.

The Ansoff model is theoretical and does not take into account the activities of competitors. So accurate predictions can be difficult in an uncertain world. The role of this matrix is to an outline strategy to achieve growth (Munro, 2014).

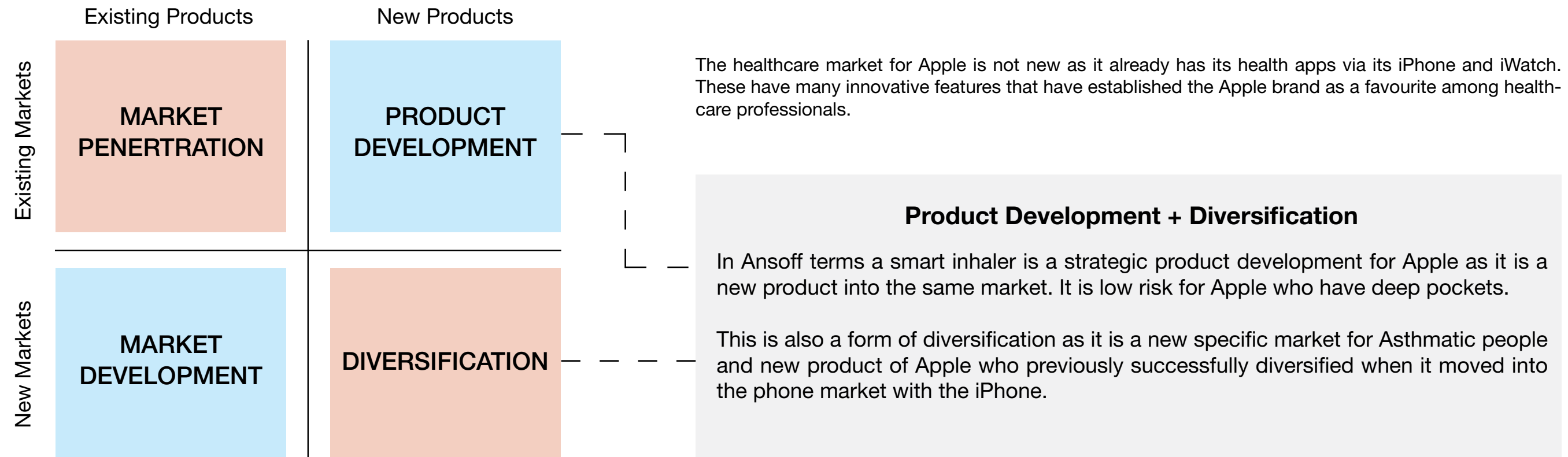


Figure 7: Asoff Matrix

Source: Smart Insight, 2020

8. USER PERSONAS

Sara Kane



"Health is too valuable to be cheap"

AGE 25

OCCUPATION PROFESSIONAL
YOUTUBER

FAMILY SINGLE

LOCATION BIRMINGHAM,
UK

INCOME MIDDLE

DYNAMIC

EXTROVERTED

FRIENDLY

CONFIDENT

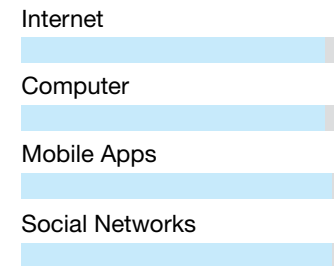
BIO

Sara works is a professional Youtuber. She is physically active and is tech savvy. She wants to remain on top of her asthma, She lives in an urban area and is concerned about air pollution.

GOALS

- Track her inhaler use.
- She is fashion concious and wants her device to 'look good'.
- Measure all aspects of her asthma conditions especially in relation to air quality.

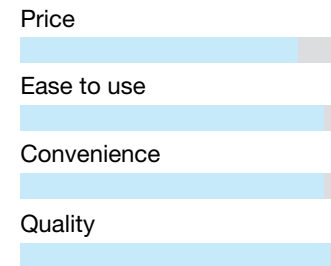
TECHNOLOGY



FAVOURITE BRANDS



MOTIVATIONS



FRUSTRATIONS

- Often forgets her inhaler.
- Embarrassed by the design of traditional inhalers.
- Can't give her medical professionals accurate up to date data.

Robert Dawson



"I want to breath in the air of life forever"

AGE 38

OCCUPATION JOURNALIST
FAMILY MARRIED & 1
CHILD

LOCATION COLUMBUS,
USA

INCOME HIGH

INTELLIGENT

CHARISMATIC

PRODUCTIVE

ANALYTICAL

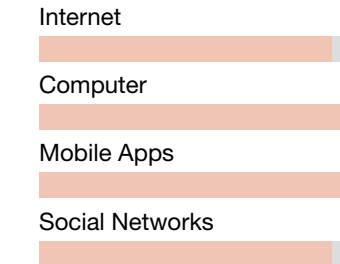
BIO

He works as TV jorunalist in news and sport for a local TV station. He is very knowledgeable about technology. He is fairly sedentary and knows he must be careful about his health especially his asthma. He likes to own the most up to date technology.

GOALS

- To have an easy to carry inhaler.
- Reduce his dependance on his reliever inhaler.
- Give his doctor all the data he can provide about his condition.

TECHNOLOGY



FAVOURITE BRANDS



MOTIVATIONS



FRUSTRATIONS

- Inhalers often run out.
- Usually takes quite a long time to find his inhaler.
- Often forgets his inhaler or doesn't properly reattach the lid after use.

III. DESIGN

1. DESIGN SPECIFICATIONS

There will be 2 versions for this i-Inhaler: one is standard and the other one is premium which named i-Inhaler Pro.

i-Inhaler Specification	Profile								
Environment	i-Inhaler will be environmentally friendly. It will not utilise any materials that are harmful to the environment								
Aesthetic	Not look like a traditional inhaler, Pendant or Key chain to make it easy to carry								
Material	<p>■ i-Inhaler: recycled plastic, LCD touch screen, magnetic charger</p> <p>■ i-Inhaler Pro: recycled aluminium, OLED touch screen, magnetic charger</p>								
Colour	<p>■ i-Inhaler: Black, White, Red, Green, Blue</p> <p>■ i-Inhaler Pro: Space Gray, Silver, Gold</p>								
Function & Technology	<table border="0"> <tr> <td>Sensor</td> <td>Tracker with a flashing LED, vibration and ring tone (to find a lost inhaler),</td> </tr> <tr> <td>Reminder (when to use the device)</td> <td>Alert (to warn of danger from air pollution)</td> </tr> <tr> <td>Data storage (memory as backup)</td> <td>Detect and Record product activity (for patients and doctors)</td> </tr> <tr> <td>Device connection (Bluetooth to iPhone or iWatch)</td> <td></td> </tr> </table> <p style="text-align: center;">Can be used without an app as the iWatch</p>	Sensor	Tracker with a flashing LED, vibration and ring tone (to find a lost inhaler),	Reminder (when to use the device)	Alert (to warn of danger from air pollution)	Data storage (memory as backup)	Detect and Record product activity (for patients and doctors)	Device connection (Bluetooth to iPhone or iWatch)	
Sensor	Tracker with a flashing LED, vibration and ring tone (to find a lost inhaler),								
Reminder (when to use the device)	Alert (to warn of danger from air pollution)								
Data storage (memory as backup)	Detect and Record product activity (for patients and doctors)								
Device connection (Bluetooth to iPhone or iWatch)									
Battery Life	4 - 6 weeks but still depends on patient's activities								

Life Expectancy	Usually 5 to 8 years but still depends on the individual patient's activities
Size & Weight	Smaller than other smart inhalers in the market and light weight
Reliable: Durable	<p>Water Resitance IP68: up to a maximum 1.5 meter underwater, up to 30 minutes</p> <p>Temperature Resitance: -10 °C to 55 °C</p> <p>Impact Resitance: Stand impact force < 300 Newton</p>
Packaging	The packaging will use widely recyclable materials
Ergonomic	Easy to hold and use, without any sharp edges
Target Product Cost	<p>■ i-Inhaler: slightly more expensive than a normal inhaler because it is a smart one, but much cheaper than the Pro which is a premium version</p> <p>■ i-Inhaler Pro: the entry price will be slightly higher than the existing premium smart inhalers in the market such as Propeller</p>
Market	Asthma patients worldwide
Patents	To be checked
Company Restriction	Create and install all the functions and technologies into a small inhaler
Market Restriction	Healthcare product regulation in different markets and need to link to health care systems such as in the UK. Also need to get approval from governments.

2. AGILE STAGE GATE HYBRID METHODOLOGY

Agile-Stage-Gate is a hybrid product development model that brings together parts of both Agile and Stage-Gate to help companies realise the benefits of both (Edward, 2019).

The strength of this model is that it provides a faster response to changing consumer needs, improved team communications, greater development productivity, and getting products to market more quickly (Cooper & Sommer, 2016).

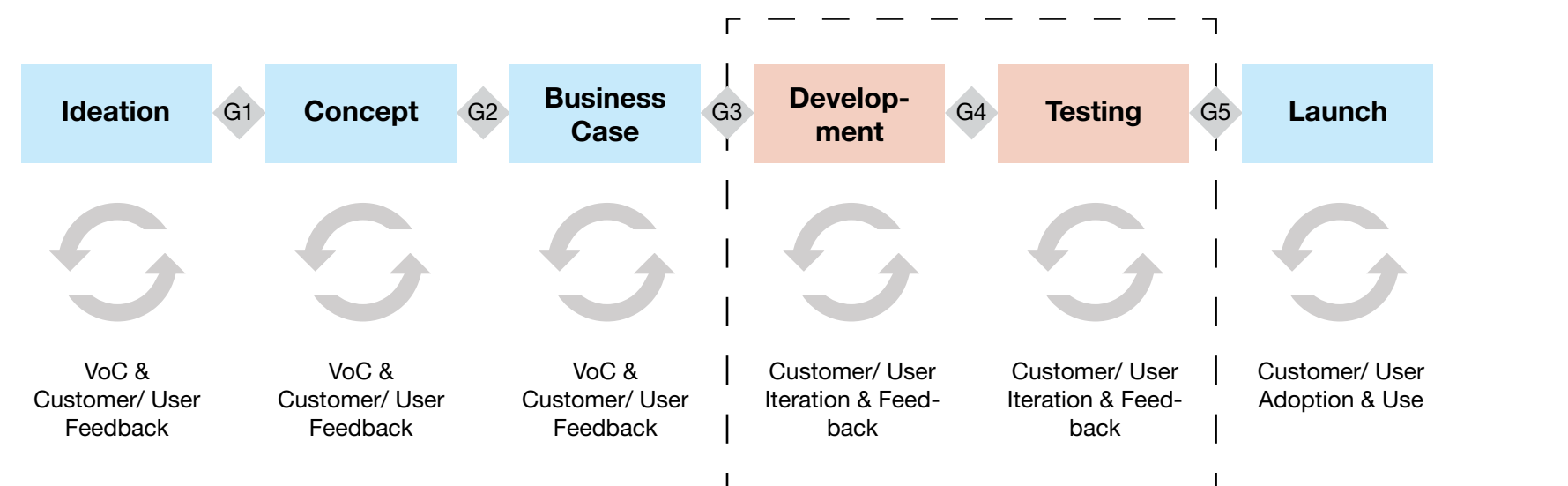


Figure 8: Agile Stage-Gate Hybrid Model

Source: Cooper, 2020

The smart inhaler’s market is growing rapidly, so using a hybrid model in the development of a new innovative i-Inhaler will help Apple reduce testing time but still ensure the product is of a sufficiently high quality to catch up and pass competitive products in the market.

This method will start with a sprint planning meeting to organise sprint goals then identify tasks for the rest of the sprint including 15-minute daily scrum meetings, visual scrum board and sprint review meetings. Each sprint will last between 1 and 4 weeks and gather feedback from the customers (Cooper, 2020).

In this case, the Apple development teams will get feedback from 2 focus groups:

- Asthma patients aged 25 to 44 with middle and high incomes.
- Professionals including doctors and nurses.

The i-inhaler is a physical product so a “done sprint” can be termed a “protocept” (Cooper, 2020) which will use 3D printing. Daily scrum meetings will involve all team leaders and managers in the development part, mentioned in the Double Diamond methodology.

Apple already have some features that can be used to the i-Inhalers including tracking. However, there are some priority features such as asthma personal forecasting which Apple will need to create and test for their new health device.

3. CONCEPT SOLUTIONS

This i-Inhaler is designed to appear like a pendant, it is created to disguise that it is a medical device. It is easy to carry but it's not obvious that it is an inhaler.

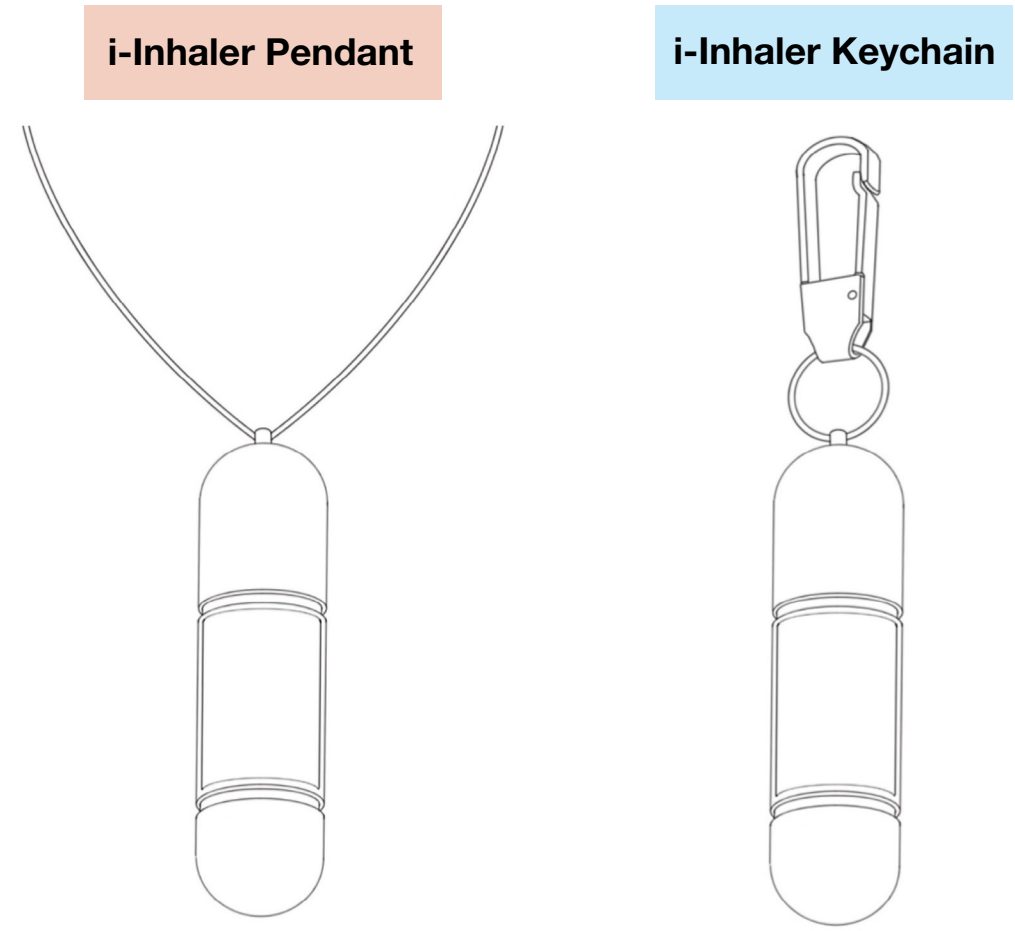


Figure 9: i-Inhaler Pendant and Keychain

i-Inhaler

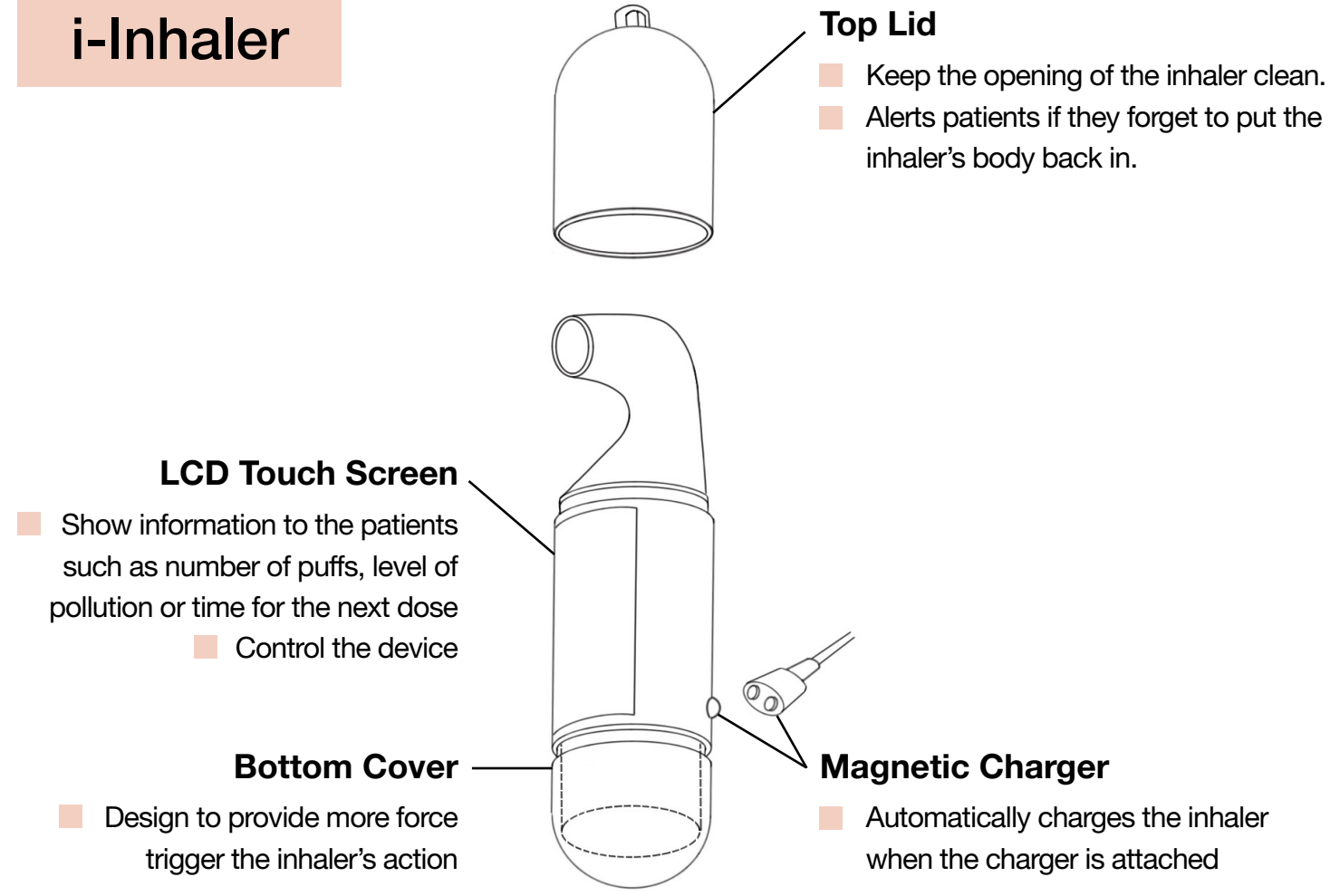


Figure 10: i-Inhaler Design

i-Inhaler Pro

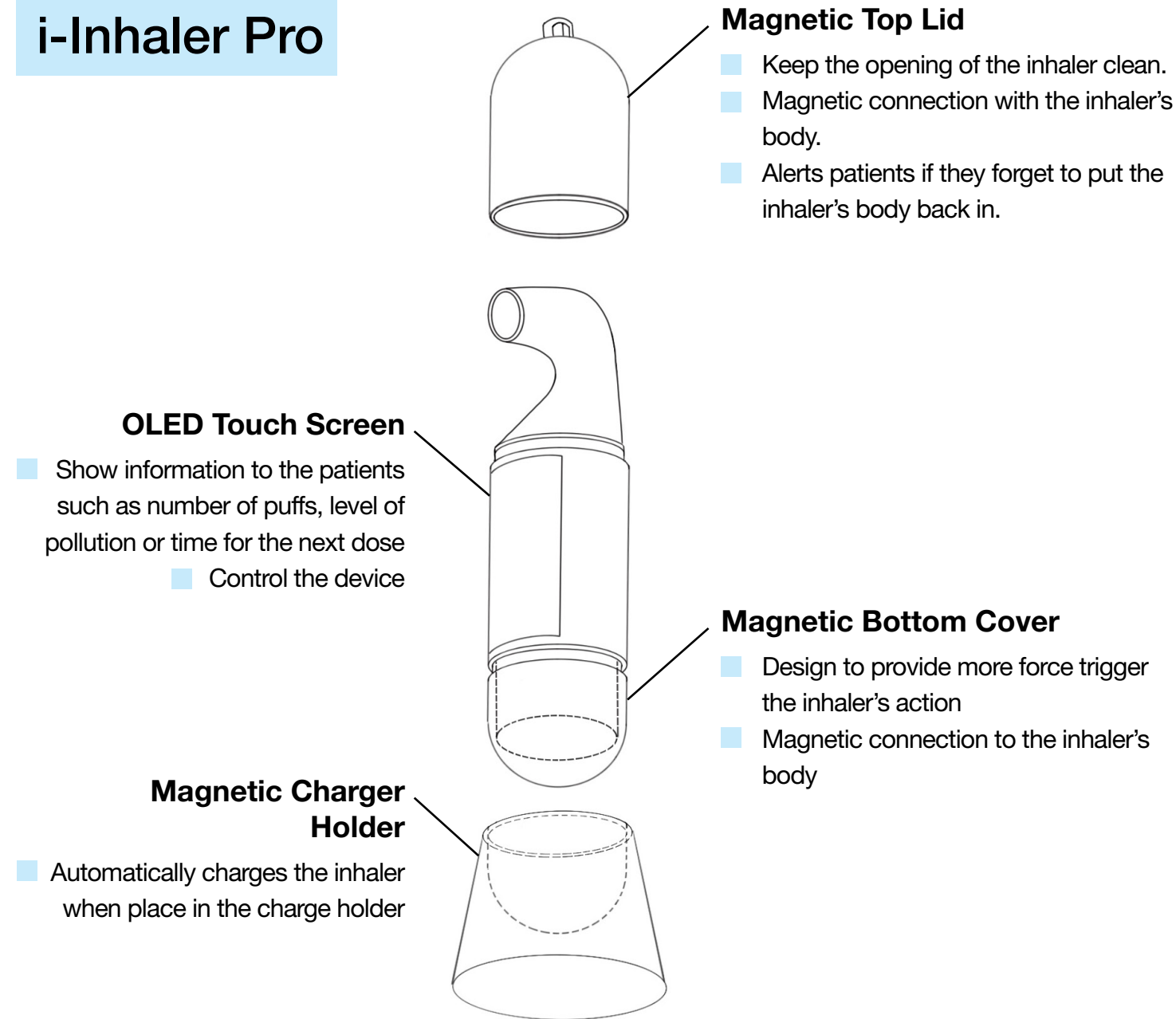


Figure 11: i-Inhaler Pro Design

4. HOW I-INHALER CONCEPT FITS THE USER PERSONAS?

- The users Sara and Robert both admit to regularly forgetting their inhalers. The built in tracking function will obviously be attractive to them both. Additionally, as a pendant or key chained design, the i-Inhaler is easy to carry and hold for them both.
- The i-Inhaler top lid has a function that alerts the user to its incorrect attachment after use so it will protect our two personalities from inhaling lint and contaminants when using their inhalers.
- The touch screens on the device mean they are not dependant on an app, they can rely on the i-Inhaler to give them up to date data about useage.
- Sara is also fashion consious and the appearance of the new i-Inhaler will be more appealing to her than traditional inhalers.
- Sara will be pleased that the i-Inhaler has a built in air quality warning system that can allert her to the need to increase her doses if required.
- Robert is a journalist who spends a lot of time in different weather conditions, so the new inhaler being water resistant and robust will be attractive to him too.
- Robert is analytical and wants to have data for himself and for his doctor so the i-Inhaler will be invaluable to him.

5. PORTER'S FIVE FORCES ANALYSIS

Porter's five forces framework is based on the idea that a strategic decision should take into account the external opportunities and threats to an organisation (Bruijl, 2018).

Porter's five forces model helps us understand the forces that affect profitability in a specific industry these helps form business decision making (Beattie, 2019).

A drawback is that it is largely backward looking and can place a company in one industry when actually they straddle several different industries (Beattie, 2019). This is certainly the case with Apple who are amongst others, active in the music industry, the telecoms industry and the medical industry.

Another basic problem associated with this analysis is that it is often wrongly used as a company model and not used as intended as an industry model. The value is in looking at the industry which may not be of use to a company which will have its own specific issues which are better analysed through SWOT than by this model (Beattie, 2019).

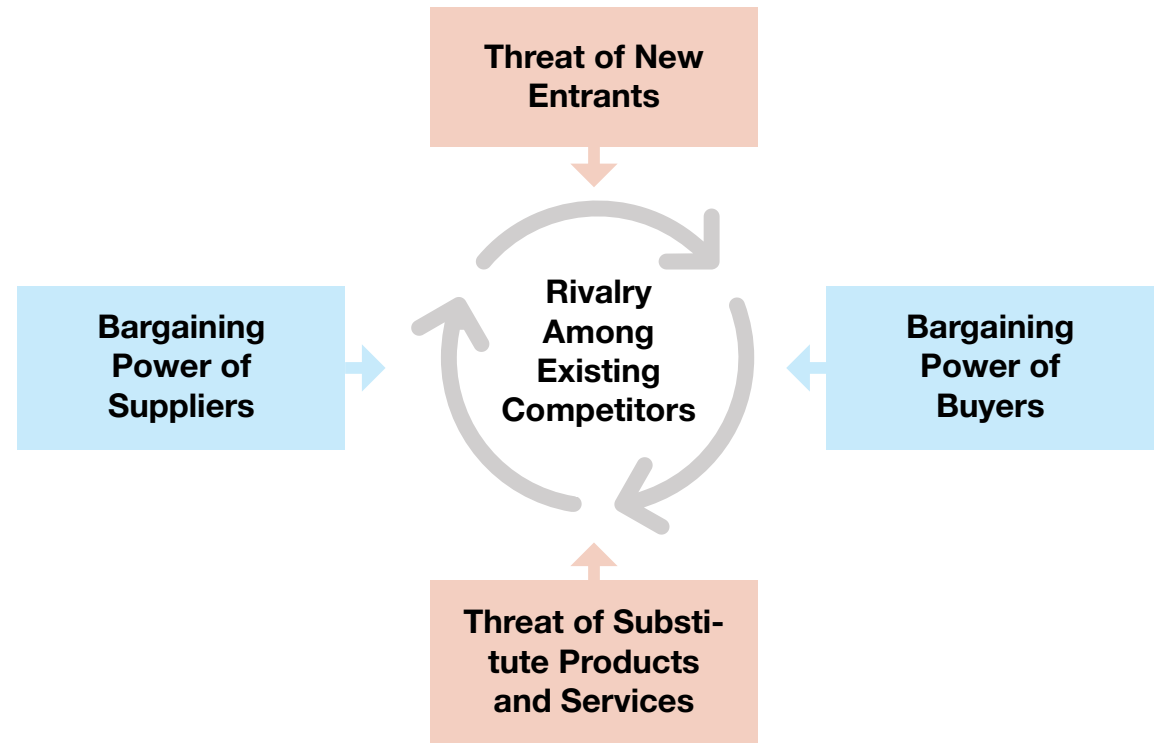


Figure 12: Porter's Five Forces Analysis

Source: Bruijl, 2018

Rivalry Among Existing Competitors

Apple is a very well-known and prestigious brand within the technology industry, but the threat of Apple from existing competitors is clearly high.

Threat of New Entrants

In any new and growing market new entrants will emerge. Apple have a brand advantage, but new companies entering a market can establish significant market share quite quickly.

Threat of Substitute Products and Services

the only real threat to consider is existing inhalers. These may fall in price and therefore may become more desirable within existing markets and thus crowd out the new i-Inhaler. There is also the treat faced by new inhalers entering the smart inhaler market.

Bargaining Power of Suppliers

This is the case with scarce resources. Generally speaking, the technology suppliers are already supplying Apple. Indeed, Apple are often known to buy companies to ensure supply and restrict supply of possible to competitors. The medication used in inhalers such as salbutamol are relatively easy to produce and are fairly cheap as such Apple should not worry too much about supplier bargaining power.

Bargaining Power of Buyers

This varies according to markets. For example, the UK has a National health service that is a major buyer and thus has the power to force prices down. However, it will be medical professionals and end users who will ultimately be the major decision makers in the smart inhaler market, as a dominant brand Apple are in a good position to negotiate from a position of size that competitors may lack.

6. SWOT ANALYSIS

SWOT Analysis is a significant tool for strategic decision making that helps identify organisational and environmental factors that a company needs when looking at new products (Gürel, 2017).

It is always useful for a company to look at itself. A company can improve its efficiency by a ruthless inventory of its practices. SWOT will allow for a company to understand key issues that affect its performance. However, it must be remembered that SWOT will not offer solutions (Queensland Government, 2017).

- **BENEFITS:** A benefit to SWOT is its relatively low costs although this is not particularly important to a mammoth company such as Apple. It will allow for any company to address its weaknesses. It can also be a deterrent to external threats as it challenges competitors. A company may also be able to ruthlessly capitalise on its strengths (Queensland Government, 2017).
- **DISADVANTAGES:** Although there are great benefits that come from this analytic tool it also has limitations. As mentioned, before it does not provide solutions. It also does not provide a to do list, a company will have various things that it needs to address. It can feasible provide too many ideas and a company can be distracted (Queensland Government, 2017).

STRENGTH

- It has an aesthetic quality and doesn't look like a traditional inhaler, but it also has high functionality.
- The new design will help patients gain easy access to vital information and help them avoid the problem of forgetting the product.
- Another advantage is that the company can use various choices for customers from materials to colours depending on their interests and money.

OPPORTUNITY

- This venture opens a further path for Apple to the health care market. They have made tentative steps in that direction with its iWatch.

WEAKNESS

- This is a new product for Apple. They are known as a tech company but are customers ready to see them as a medical device provider?
- Apple's do not have medical distribution channels.

THREAD

- The obvious threat to Apple is from the big pharmaceutical providers. There are some prestigious smart Inhaler companies in the market already.
- Other technology companies could be tempted into this market too. A crowded marketplace may lead to customer confusion.
- Government regulation can be a problem as this can be notoriously slow.

7. COST ESTIMATION

Cost estimation is the process of calculating all the costs associated with a project within a given time (Stobierski, 2019).

Expenses	Description	Unit	Cost (\$)
Labour			
Design Director	Hours of time		
Design Manager	Hours of time		
Product Manager	Hours of time		
Researchers	Hours of time		
Designers	Hours of time		
Engineers	Hours of time		
Programmers	Hours of time		
Other Staff	Hours of time		
Material			
Product production	Quantity		
Prototype	Quantity		
Packaging	Quantity		
Travel			
Accommodations	Per person		
Travel tickets	Per ticket		
Fuel & Oil	Per person		

Expenses	Description	Unit	Cost (\$)
Hardware			
Equipment	Quantity		
Software			
Development	Hour of time		
Licenses/ Patents	Per licenses/ patents		
Marketing/ Communication			
Graphic design	Hours of time		
Printing	Quantity		
Telephone	Per person		
Insurance			
Electricity			
Other supplies			
Total expenses			
Income			
Equipment	Quantity		
Net Income			

8. RACI MATRIX

The RACI model is a methodology that can be applied to an organisation's management structure. It is a way to divide the workload and responsibilities among a team in relation to key functions of an organisation (Well Grounded, 2019).

Responsible

This is the person/people who actually has/have overall authority over a task.

Accountable

This is the person is ultimately in charge of a task, who is liable for it being carried out.

Consulted

This is the resource person/people who may have important and useful information to help achieve the desired task.

Informed

This is the person/people who should be updated regularly as the task progresses, the task being of importance to their responsibilities in the organisation.

Activities	Roles/ Teams	CEO	COMPANY OWNERS	PROJECT MANAGER	RESEARCH TEAM	DESIGN DIRECTOR	DESIGN MANAGER	DESIGN TEAM	TECHNOLOGY TEAM	PROGRAM TEAM	ENGINEER TEAM	BUSINESS MANAGERS	MARKETING TEAM	FINANCE TEAM
Research user's problems & identify design solutions		R/A/I	C/I	C/I	R/C/I	C/I	C/I	I	I	I	C/I	R/I	C/I	C/I
Research & review existing technology for smart inhaler		C/I	I	R/A/C/I	C/I	R/C/I	R/C/I	C/I	R/C/I	C/I	C/I	C/I	I	I
Review design solutions to company owners		C/I	I	R/A/C/I	C/I	R/C/I	R/C/I	C/I	C/I	C/I	C/I	C/I	I	I
Review cost estimation for the project & target cost for the products		C/I	C/I	R/A/C/I	C/I	R/C/I	R/C/I	I	I	I	I	I	I	R/C/I
Develop & review design solutions (hardware & software)		C/I	I	R/A/C/I	R/C/I	R/C/I	R/C/I	R/C/I	R/C/I	R/C/I	R/C/I	C/I	I	I
Test & review design solutions (hardware & software)		I	I	R/A/C/I	R/C/I	R/C/I	R/C/I	R/C/I	R/C/I	R/C/I	R/C/I	I	I	I
Fix design problems		I	I	R/A/C/I	C/I	I	I	R/C/I	R/C/I	R/C/I	R/C/I	I	I	I
Final testing		A/C/I	I	R/C/I	C/I	I	I	R/C/I	R/C/I	R/C/I	R/C/I	I	I	I
Review final products		A/C/I	C/I	R/C/I	C/I	C/I	C/I	C/I	C/I	C/I	C/I	C/I	I	I
Final approval from company owners		A/C/I	C/I	R/C/I	C/I	C/I	C/I	C/I	C/I	C/I	C/I	C/I	I	I
Start production & launch		C/I	I	R/A/C/I	I	C/I	C/I	C/I	C/I	C/I	C/I	C/I	R/C/I	R/C/I
Support & improvement		C/I	C/I	R/A/C/I	C/I	I	I	I	I	I	I	I	I	I

9. GANTT CHART

A Gantt chart is a chart that sets out a time scale for a project in which the length of a bar representing a certain activity is proportional to the duration of that activity. Gantt charts have gained wide acceptance and popularity due to their simplicity and ease of production and interpretation. However, Gantt charts may not be particularly useful for projects with a significant number of activities (Mubarak, 2010).

This i-Inhaler project is estimated to last 6 months from the initial research to final launch. This time frame is due to careful consideration of the existing smart inhalers and give enough time for regulatory aspects of the project

Activities	Weeks	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Research user's problems & identify design solutions		█	█	█																							
Research & review existing technology for smart inhaler			█	█	█																						
Review design solutions to company owners					█	█	█																				
Review cost estimation for the project & target cost for the products							█	█																			
Develop & review design solutions (hardware & software)								█	█	█	█	█															
Test & review design solutions (hardware & software)											█	█	█	█	█	█	█										
Fix design problems												█	█		█	█		█	█								
Final testing																			█	█	█	█					
Review final products																					█	█	█				
Final approval from company owners																						█	█				
Start production & launch																							█	█	█		
Support & improvement																									█	█	

V. CONCLUSION & LIMITATIONS

Through a design process, this I-inhaler project has shown how a new healthcare product can be effectively designed and delivered to the market by Apple inc.

The i-Inhaler is a revolutionary new product that has the potential to save lives. It is forward thinking and represents a new opportunity for Apple.

The process of design from initial idea to final product can be delivered through careful use of design management tools as shown throughout the project.

There are limitations in healthcare regulations that will need to be addressed by a company hitherto unknown in the medical pharmaceutical industry. Overall though these limitations can be overcome with time, but will require good negotiations and sound legal advice.

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VII. APPENDIX

1. ASTHMA

The most common symptoms of asthma are wheezing, a tightness in the chest, gasping for air. Indeed, some sufferers may also cough. The severity of symptoms can vary widely from mild to severe. In the worst cases a full-blown asthma attack can be fatal if not treated promptly (NHS, 2021).

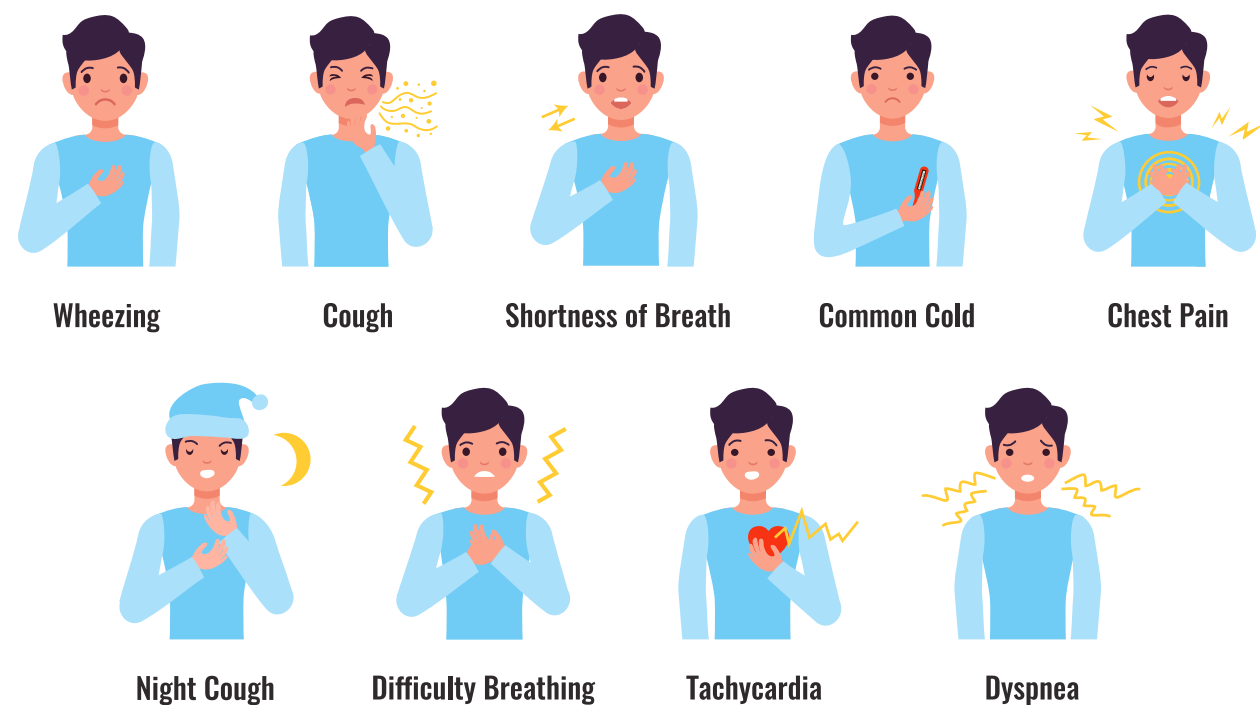


Figure 13: Asthma symptoms

Source: Freepik, 2020

The UK has a particularly high rate of people dying from asthma which is one of the worst death rates in Europe. It has increased by more than 20% in the five years to 2015. Asthma attacks were fatal for 1,434 people in that same year in the UK (PNSC, 2018). Also, more than 12,700 people have died from asthma in England and Wales in the past decade which is a similar number to road death fatalities. Asthma deaths increased by 33% in the years 2008-18 (Iacobucci Gareth, 2019).

Figure 14 shows that women are more likely suffer from asthma than men, at 11% to 9% respectively in the UK. A higher number of women reported asthma symptoms being controlled by using medication than men at 4% to 3% (National Statistics, 2019).

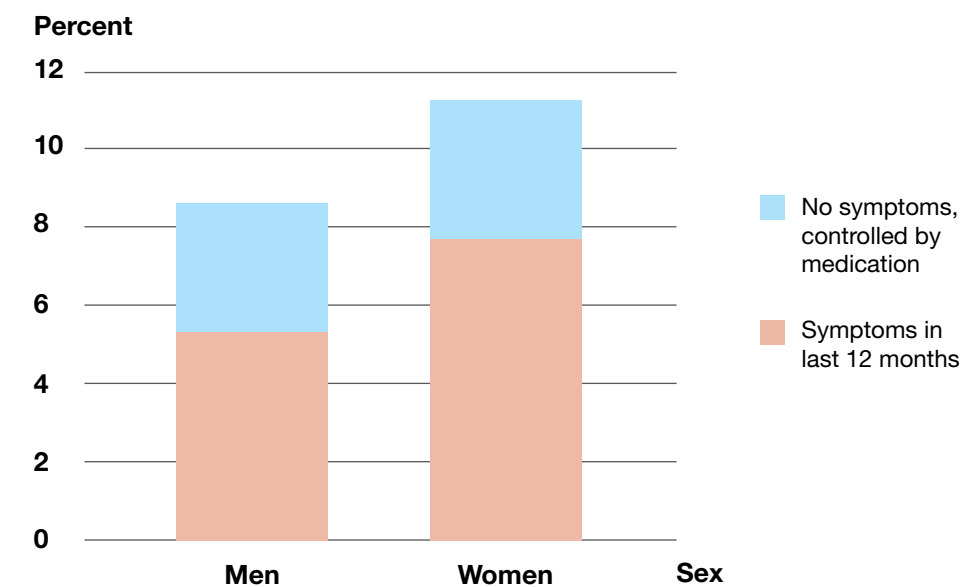


Figure 14: Asthma rates among adults aged 16 and over, by sex

Source: National Statistics, 2019