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Master Thesis

Medthings AS – a break-through innovation with the handling of medication

Master's in Applied and Commercial Biotechnology

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Abbreviations

ADC - Automated Dispensing Cabinet

AI – Artificial Intelligence

CE – European Conformity

CSR – Corporate Social Responsibility

3D – 3 Dimensional

DRPs – Drug Related Problems

ECG – Electronic

EES – Electronic Expert System

EU – European Union

FDI – Foreign Direct Investment

GDP – Gross Domestic Product

GPs – General Practitioners

GPRS – General Packet Radio Service

HCP – Health Care Professional

HDI – Human Development Index

HTA – Health Technology Assessment

HIV/AIDS – Human Immuno-Deficiency Virus/ Acquired Immunodeficiency Syndrome

IMI – Innovative Medicine Initiative

IPR – International Property Right

LED – Light Emitting Diode

MDDD - Multi-Dose Drug Dispensing

MDs – Medical Devices

MPA – Medical Product Agency

NFC – Near Field Communication

NHS – National Health Service

OTC – Over the counter

RN – Registered Nurse

PHC – Primary Health Care

R&D – Research and Development

SEK – Swedish Krone

SME – Small and Medium Enterprises

WHO – World Health Organization

Wi-Fi – Wireless Fidelity

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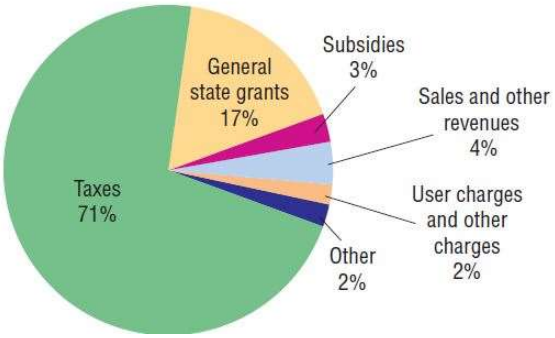


Abstract

Patients depend on medicines to maintain health, prevent illness, manage chronic ailments and treat/improve disease conditions. However, there are growing reports indicating the misuse of medicines (not taken on time, skipped dosage, irregular or improper dosage) causing a great deal of challenge to the health sector. The major challenge lies with the elderly people (above 75 years) who often tends to forget their medications or are not adhered to it. At present, changing demography with a high number of elderly people and providing them quality health services is the biggest challenge. People aged 80 years or over use an average of 5.8 prescription drugs per person. The global spending on medicine reached $1.2 trillion in 2018 and is set to exceed $1.5 trillion by 2023, while the global automatic pill dispenser machine market accounted for $1,755 million in 2016 and is estimated to reach $3,023 million by 2023. Studies suggests that 25% of the emergency rooms are alone filled with patients taking wrong medications making it the cause of majority of the deaths and involving an expenditure of $10.30 billion annually. Several losses of life can be avoided if intake of medicine can be controlled.

In addition, there is a huge medicine wastage due to unused/expired or skipped dosage. In 2019, Swedish pharmacies collected over 1,300 tonnes of medicinal residues (Wallêr, 2019), affecting the economy and well and the nature. Medicine management plays a very vital role in order to ensure the correct intake of medicine. Several approaches, from nurses to automated robots have been sought to ensure the correct use of medicines but none of them have been able to turn out completely effective. The variety of automated pill dispensers in the market with multiple functionality and features lack one thing or the other. Although every dispenser is produced with the aim of dispensing the correct medicine at the correct time with accurate dose, it fails to ensure whether the medicine is actually taken or just thrown away.

This thesis was written with a purpose to investigate the specific needs for medicine management using Mobili[1] and to suggest a market entry strategy for it in the Swedish market. Several articles and literature reviews were considered to gather background knowledge on this issue and some primary data were collected through personal communications with

[1] An innovative and modern pill dispenser system produced by Medthings AS, Norway

concerned persons. Furthermore, business analysis tools were also used to study the market and the target customers and to know about the competitors.

Overall, an image that despite a hefty number of pill dispensers in the market, the exact number of them used at present and their comparison based on the price was not clear. An important finding was that although not quite great, but still there is possibility of entrance and success for Mobili with the target group of people above 75 years with chronic ailment and multi drugs prescriptions, or young age group with daily supplement intake having a busy schedule requiring reminder. Although there was a conflict of thoughts on the benefits and trust-worthiness of the pill dispensers, yet the literature suggested that the elderlies are quite familiar with the technology and the health professionals also praise such automated pill dispensers.

1. Introduction

In this current world scenario, both prescribed and non-prescribed medicines are taken in large quantity irrespective of gender and age group. As reported by ("Medicine use statistics - Statistics Explained," 2021), EU alone forms a large circle of these groups where women take more medicines as compared to men due to uses of contraceptive and other hormonal pills, while the proportion of prescribed medicine intake increases with age reaching a peak with age group above 75. Similarly, the use of non-prescribed medicines is also used to great extent by almost all age group for various reasons. Irrespective of the purpose, it is very important that the medicine intake is appropriate (correct dose and time).

According to the WHO statistic, Nordic countries spend 10.8% of total GDP while the member countries of EU invest 9.5% (both having range of 2.1% - 11.9%) with the highest of 18% in USA. The World Bank reported that in 2018 the total % of GDP spent worldwide was 9.84%. NHS spends £ 11 billion per year on drugs where 85% occurs in general practice (MeiBner, 2020). These investments are very important and crucial in order to maintain the health of the country's population and provide them with proper health facilities. These data supports the statement made by Samadbeik, Ahmadi, Sadoughi, and Garavand (2017) that medicine is a vital part of therapy supported by the government of many nations. The government along with the private sector contributes a lot to make this area as flexible as possible.

Despite all the efforts and investment, it is quite difficult to keep track of every individual's health condition, their history and their lifestyle after disease. The major hurdle lies in taking care of old people or diseased person of any age with several medications in a day. The major challenge faced today is to provide high quality, accessible and affordable care for ageing complex and multimorbid population (van der Kleij et al., 2019). The old aged people (usually above 75 years) need to be reminded every now and then to take the medicines and need a guidance throughout the clock. They not only are physically dependent with poor eyesight, weak limbs to open the medicine blister, but also mentally weak to remember all their medicines name, times and dosage. If not taken care, they are most likely to miss their dose or skip it or even take a wrong medicine. In order to help them take their medications at proper time with correct dose, different formal caregivers (professional/licensed healthcare takers) or informal caregivers (unpaid care providers: family, relatives) are assigned. In Europe, number

of informal care givers[2] outnumbers those of formal caregivers, often playing invisible role in the welfare system. This weight of responsibility often burden them and hence they themselves in long term can require support and care (MeiBner, 2020).

The irregular intake of medicines has created a huge impact on the health care system. 25% of the emergency room in hospitals have patients with wrong medicine intake which involves an expenditure of around $10.30 billion per year. It is also a leading cause of injuries and death worldwide. In 2009, circulatory disease alone accounted for 40% of all deaths, giving second rank to cancer (Annell, GlenngårdcH, & Merkur, 2012). Further, medical wastage results in economic burden on the individual stakeholders as well as the society due to direct cost of unused medication as well as disposal costs and environmental issues (West, Diack, Cordina, & Stewart, 2014). Ekedahl in 2006 performed a cross-sectional study with 1557 patients in 59 random pharmacies of Sweden and reported that the major cause of medicine wastage was passed expiry date followed by death of the patient.

These facts and figures have a negative impact on the services and quality of health care making it necessary to have control on the correct use of medicine and to find a stable and effective solution to it.

People around the world have adapted different solutions for keeping tracks of their medicines or of their loved ones. They have private nurses assigned by the government visiting the elderly to give them medicines, many elderly stays at elderly care or hospitals, they set up alarms or notifications to alert them, write down on a paper, carry medicine with them in a small manual box and so on. But none one of it 100% effective in providing correct dosage at correct times.

[2] The family members taking care of the elderly are often too much burdened: both mentally and physically, and in most of the cases end up having stress.

1.1 Aims and Objective

Medthings AS, a newly established company has developed an automated medicine dispenser, which according to them, is a better and more modern solution to the major issue of medicine intake/management as compared to its competitors. This thesis aims at investigating the specific needs for medicine management and to suggest a market entry strategy for these solutions in Swedish market. More specifically to suggest a suitable beach head market in Sweden.

In order to achieve the aims, the project has focused on:

- providing an outline of the health care system of Sweden, specifically related to medicine dispensers.
- getting insight of the key stakeholders need related to medicine management
-positioning of Mobili against its competitors
-gathering information about the current use and future perspective of automated pill dispensers

2. Background

2.1 Overview of Swedish geographic, demographic and health structure

Located in the Northern Europe in Scandinavia, Sweden is home to around 10.3 million population (where 18% of population are 65 years or older and more than 5% being 85 years or older) with 24,000 islands and half of its land covered with forest. According to the 2013 statistics, more than 1.6 million persons lived on islands corresponding to 17% of its total population[3]. It has an average life expectancy of 81 years, giving it a 5th rank worldwide and comprises of publicly run health centres run by 21 county councils. The 290 municipalities are responsible for the social care (elderly care, home care, handicap care), 21 county councils look after the primary populations, while the central government establishes the principles and guidelines for health and medical care (Figure 1). Westerlund and Marklund (2020) reports that primary care plays an important role in addressing individual's overall health care needs (also including preventive measures) and hence accounts for approximately 20% of all expenditure on health care enrolling 16% of the physicians prioritizing sales and fast dispensing of prescription rather than counselling[4]. About 14.5 million primary care visits spending approx. SEK 28 billion take place annually in Sweden (Ekman, 2018). A total of 11% GDP is invested in health care system equivalent to 3,323 billion$. For every 277 population, one doctor is assigned. As per the report of Workman (2021), Sweden exported drugs and medicines worth $8.2 billion in 2019, while NHS spends £11 billion annually on drugs.

[3]https://www.scb.se/en/finding-statistics/statistics-by-subject-area/environment/land-use/land-use-in-proximity-to-shoreline/pong/statistical-news/coast-shores-and-islands-in-sweden-2013/

[4] Study suggests that counselling has a great impact on medicine adherence

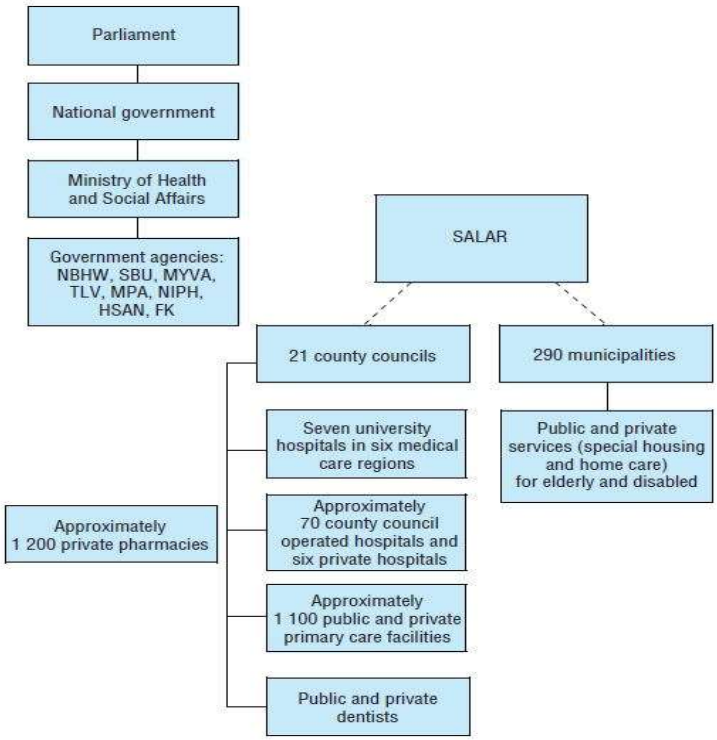


Figure 1: Overview of Swedish Health care system (Source: WHO)

[5]There are 100 hospitals in Sweden, out of which 85 are run by regional government while the rest are private. The outpatient care, for patients coming in hospital for treatment without being admitted or staying there overnight, is organized into primary care district, each with 5,000 to 50,000 inhabitants. Westerlund and Marklund (2020) reported that there are 46,000 registered physicians and 106,000 registered nurses (RNs) with approx. 9,800 registered pharmacies in Sweden. They also stated that the district nurses make home visits especially for elderly and are employed in home care. [6]The National Board of Health and Welfare (Socialstyrelsen) finances the measurement of quality and efficiency of health care in Sweden with target groups as officials, decisions maker, municipalities, regions and politicians.

[5] Sweden | Commonwealth Fund

[6] Quality and Efficiency in Swedish Health Care - Regional comparisons 2012 (socialstyrelsen.se)

The health care system is Sweden is quite similar with that of Norway in many perspectives and is largely funded locally. The Health and Medical Service Act of 1982 ensures that everyone living in Sweden has access to good health care.

According to Westerlund and Marklund (2020), the major challenge faced by Swedish health care is caused due to change in demography, resulted by a rapid population growth (by 16% in last 20 years) caused by a large immigration and by an increased population of older people.

2.2 Comparative Scenario of elderly in other EU countries (MeiBner, 2020)

In Germany, 81% of population in need of long-term care are 65 and older.

In Netherlands, over 115,000 mainly very old persons reside in long term care facilities. Half because of psychogeriatric conditions such as dementia. About 455.000 elderly people receive home health aide or nurse care at home care during an average 4.5 month and 5.2 hours a week.

France has around 600,000 people living in 7,500 nursing home and 100,000 in assisted living facilities (residences autonomie).

2.3 Remote healthcare

Remote healthcare is a term used when a patient can get the care and treatment within the sphere and comfort of his home. This system has been seen to be very effective for elderly. Majumder et al. (2017) elaborated that remote healthcare helps to monitor the health status of elderly people continuously in the comfort of their home rather than expensive [7]in-patient care in hospitals and nursing care.

According to WHO, by 2050, elderly population over the age of 65 would outnumber the children under the age of 14. This data indicates that it will be a challenge to provide appropriate care and treatment to the elderly in the near future. In addition, Majumder et al. (2017) reported that 15% of the world's population suffer from various disabilities with 110-

[7] Patients those are admitted in the hospitals overnight or more for treatment

190 million adults having significant functional difficulty. This demands for a more sophisticated, electronic way of monitoring and treatment such and remote healthcare or e-health.

2.4 Remote healthcare in Sweden: then and now

Remote healthcare started in Sweden in 1915 with telemedicine (remote reading of ECG signals across the campus at Lund University), but didn't speed up much. Olsson and Jarlman (2004) stated that e-health including empowerment, prevention, administration, screening, diagnosis, treatment, monitoring, follow-up and rehabilitation came into recent use in Sweden as part of remote healthcare. In 2000, Federation of county council, the Swedish association of Local authorities, the Swedish Pharmacy chain – Apotek AB and the association of Private care provider, together founded a national organization – Carlink, to coordinate and stimulate the use of information technology in Swedish health care system (Olsson & Jarlman, 2004).

Sweden has a centralized architecture and a national electronic prescription database (Samadbeik et al., 2017) which started with 9% of national prescriptions stored electronically, reaching up to 32% in Sep. 2004 (Olsson & Jarlman, 2004). Today, Sweden is one of the leading countries in e-Prescribing with 90% of all it prescriptions stored electronically and is well accepted and appreciated by both the pharmacists and the patients (Hammar, 2014). The financial investment for the electronic prescription is mainly done by the government and public resources, while the cost of system development is paid by service providers and the pharmacies (Samadbeik et al., 2017). The county councils (hospital care, primary health care) and the municipality (elderly care, home-care) covers the services for public and hence has their own political powers to set priorities, launch e-health initiatives, etc (Olsson & Jarlman, 2004).

The pharmacies in Sweden uses an electronic prescription system named Electronic Expert Support (EES) which analyses the prescription stored in Swedish national prescription repository and also identifies potential drug-related problems (DRPs) such as drug interactions, therapy duplications, high doses, potential contradictions, inappropriate drugs and doses for geriatric or paediatric patients (Westerlund & Marklund, 2020). It was reported that approx. 5.2 million EES-warnings were analysed in 2018, cutting off the chances of medication errors, and the potential DRP detected were clinically relevant (Hammar, 2014).

[8]DIGNIO - a value driven software company and a leading Norwegian specialist on remote health care since 2010, has successfully created a great platform for remote healthcare with its products, enabling home-based monitoring and treatment of the patients. Its mobile and cloud-based system has changed the whole medicine management system and provided a large extent of independency. [9]It has not only limited its services to dispensing medicines, rather extended the horizon into telemedicine, remote patient monitoring, medication compliance, self-reporting, self-management and home lab. In addition to pill dispensers, it has products that measure temperature, oxygen saturations, blood sugar, blood pressure, weight, lung function and capacity of the patients and is automatically recorded and transferred via Bluetooth to MyDignio as patients record. [10]It serves its product in several European countries including collaboration with UK (Manchester) and China (Shanghai). For pill dispensing, they have Pilly SMS and Medido.

Figure 2. Pilly SMS with 28 chambers for holding in medicines.

[8]https://dignio.com/en/

[9] https://www.norwayhealthtech.com/member/dignio-as-2/

[10]https://www.news-medical.net/news/20210108/Norwegian-health-tech- company-Dignio-settle-in-Manchester.aspx

2.5 Drug use and its issue

The use of both prescribed and over the counter drugs is widespread with both pros and cons. The major challenges lie in the irregular and inappropriate intake of prescribed drugs. Along with this, drug in-adherence in elderly and chronically ill patient is the major concern. In 2011, a total of 14,166 Swedes died due to ischaemic heart disease (a condition caused by reduced oxygen supply to heart), which according to the International observer, can be included in avoidable mortality indicator (Regions, 2012). This clearly indicated that if the medications are taken on time in appropriate amount as per the prescriptions, the death rates can be controlled to a large extent. Another major challenge is the drug treatment of the elderly and children because of the increased prevalence of morbidity, changes in physiology, pharmacokinetics, pharmacodynamics and large variation in weight and metabolism in addition to lack of knowledge, safety and efficiency issues respectively (Hammar, 2014).

2.6 Multidose drud dispensing (MDDD)

According to Hammar (2014), MDDD (multidose drug dispensing) is a service whereby patients (often old with several diseases and many different medications) receive the medicines machine packed into unit dose bag for each time of administration. But it can be prescribed only by a physician, specifically a general-practitioner, followed by suggestion and recommendation of municipal nurse (Bardage. C, Ekedahl. A, & Ring. L, 2014B).

Majority of the people in their older age are multi drug user, whereby they are prescribed several drugs to be taken in a regular interval of time daily for almost rest of their life. Due to association of large number of co-morbid conditions, reduced renal drug elimination, decreased hepatic drug clearance, reduction of body water content and increment of body fat content, old-aged people are more prone to drug-drug interactions in case of improper administration (Ruiz, 2010). In addition to these, another major issue is the huge amount of medicine wastage occurring as a result of poor compliance of patients, excessive and irritational prescription, lack of control of sales of prescription medication in community pharmacy, patients non-adherence (West et al., 2014).

In Sweden, special units within National Corporation of Swedish Pharmacies perform and administer multi-dose drug dispensing to the patients, among which majority lives in nursing home (Johnell & Fastbom, 2008). This can be a tedious work with several elderly and

chronically ill patients. It requires more labour, accuracy, time and effort in order to pack and administer the drugs. This gave rise to an electronic and automated solution of dispensing medications and e-health.

Traditionally, pharmacies filled up the patient-specific cassettes of unit-dose medications, which were then dispatched to nursing homes or to patients. But now, it has been replaced by Automated Dispensing Cabinet (ADC) (Authority, 2005), where the medicines, as shown in Figure 3 are packed in sachets and delivered to the patients in long strips, which the patient rips open and consume. Bardage, Ekedahl, and Ring (2014) reported that the automated multi-dose drug dispensers replaced the manual packaging of multi-dose medications from the pharmacies of Sweden in 1980s. Johnell and Fastbom (2008) described that the multi-dose amenity acts as an alternative to ordinary prescriptions dispensing for people with regular combined medications focusing to reduce medication errors, regular intake, minimize medicine wastage and assure proper intake. The automated dispensers follow the eHealth function – inform, monitor and track cycle and interaction (van der Kleij et al., 2019). Supporting this, McKinsey reports that around 180 billion Swedish Krona (SEK) (equivalent to approx. US$20 billion) could be saved through implementation of various eHealth solution (Ekman, 2018).

Figure 3. Long strips of sachets containing multi-dose medicines packed by the pharmacy

2.7 Medicine management

According to Prof. Anne Grete, medicine management is a chain of process starting from prescribing, dispensing, procurement (mixing the medicines), administration and analysis. It starts with the first meeting with the GP and follows the steps as shown in the Figure 4 below, whereby the medicine is prescribed, dispensed, administered and evaluated for the effect. The medicines are either dispensed by the community pharmacies and administered at home or nursing home under primary care or by RNs as secondary care. The automated pill dispenser come into play while administration. But unfortunately, it cannot analyse whether the drug has been taken or not, its correct dose, allergic interactions, and so on. Hence, the pharmacists are primarily involved in medication management/analysis during dispensing of medications and are responsible for safe dispensing of prescribed drugs, examining prescription before dispensing (Hammar, 2014).

In Sweden, a patient pays maximum SEK 2200 for reimbursable medicines and the province pays the rest. In addition to this, many Swedish provinces still have the same budgets as they had before the break-up of the pharmacy monopoly which means that the dose dispensing service can be provided for more people at the same price (Kügelgen, 2016).

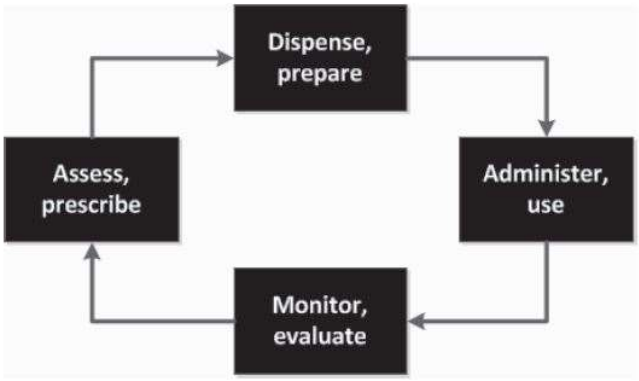


Figure 1. The steps in the medication management process in primary and secondary care. In primary care, prescribed medications are primarily dispensed at community pharmacies and administered either at home or at a nursing home. In secondary care, medications are often dispensed and administered by nurses from a local medical supply.

Figure 4. A flow diagram showing the process of medicine management (Hammar, 2014).

2.8 Prescription drugs and elderly

In Sweden, about 1 in every 5 people is 65 years or older making Sweden having one of the Europe's largest elderly populations. Cost of pharmaceuticals for [11]outpatients is the third largest expense with the health and medical care for elderly and person with disabilities accounting for a quarter of health and medical care system. This has put the Swedish health care system under huge pressure with increasing need for health and care services for ageing population with simultaneous decrease of labour.

2.9 Digitalization in Sweden

Study suggests that majority, i.e., 80% of the population state that they feel included in the digital society with 25% feeling involved fully and 44% feeling involved to a large extent.

KRY telehealth app is an example of Stockholm based digital innovation connecting patients with doctors especially aimed at helping much neglected mental health. People living in sparsely populated municipality in Västerbrotten county in Sweden have limited access to transport resulting in delayed medical visits leading to higher cost of required treatment and in lower quality of patient life.

The National Board of Health and Welfare provides online education in various health and care areas. Swedish Government has taken a decision called ICT for everyone – "A digital agenda for Sweden" in order to meet the challenges existing in both national and international level and to exploit all the possible opportunity of digitalization.

[11] Patients who do not stay overnight in the hospital for treatment

2.10 Market trends and competitors

Medicines are used worldwide irrespective of age, gender, social status and disease of a person. [12]The global spending on medicine reached $1.2 trillion in 2018 and is set to exceed $1.5 trillion by 2023.

At present, the market is full of look-alike products with a wide range of prices and features.

“Carousel: Designed and made in Sweden” was one of the first automated pill dispensers made and designed in Sweden and used all over Europe since 2002, was awarded the prize of “Excellent Swedish Design” and was presented the Sweden’s most prestigious “construction and Design” (2nd prize) by the King. Its main users were with poor memory: Alzheimer, Dementia, Parkinson’s mental health issues, visually impaired.

Beside this, there are several other automated pill dispensers in the market at present: Evondos, Dosell, Pharmacell, etc, to name a few. [13]Schine Pill Box, started in 1980 is a manual pill storage box, with a Swedish clever patent and an ambition to make it easy to handle and dispense medication/tablets. It has been highly praised by Swedish Rheumatism Association and is sold in Nordic countries, UK, Netherland and Germany.

Evondos emerged as a prototype in 2012, which later in 2014 gained its CE mark and reached its customers. Mika Apell, the founder of Evondos stated that the main aim behind the creation of Evondos was to promote well-being in society through a service which can allow the caretakers to focus on the quality of care rather than just on the arrangement of medicines. He initiated this project in order to solve the problem of pharmacotherapy for her granny, so as to provide her with proper care and affection she deserved ("Story of Evondos," 2021).

The dose dispensing pharmacies (3 in 2019) in Sweden served around 230,000 people with dose dispensed medicine (Wallêr, 2019).

[12]https://www.iqvia.com/insights/the-iqvia-institute/reports/the-global-use-of-medicine-in-2019-and-outlook-to-2023

[13] https://en.wikipedia.org/wiki/Management contract

Bjorkman (2019), reported that establishing a local presence, be it local agents, distributors or sales subsidiaries can pave roads for successful entry to Swedish market. The product must have a CE mark with all the instructions manual and labelling in Swedish and the product will be subjected to 25% value added tax (VAT). It should also comply with the requirement in the Medical device act, supervised by Medical product agency (MPA) (Bardage et al., 2014).

Since 2018 September, 35 medicine dispensing robots (Figure 5) are being used in ordinary homes at Umeå municipality of Sweden in order to provide users greater independence with their medications (*Medication Dispensing robots*).

Figure 5. Health care workers using medicine dispensing robots in Umeå municipality

The users are notified by audio and light signals when it's time for medicine, and is transferred to a locked container simultaneously with an alarm sent to the staff in case of missed dose. In addition to enable users to be responsible for their medications and increased compliance, it has benefitted by reducing the work journey/ home visits for staffs (*Medication Dispensing robots*).

PILLOXA is a patient-centric platform allowing to easily track the medicine intake where they receive a smart pillbox using sensors detecting missed doses (MeiBner, 2020).

Evondos (Figure 6) is highly used in Finland and Norway which is regarded as safe, correct and reliable medicine dispensing robot used by most home care or residential care clients and pharmacies respectively. It allows any of the multidose sachets in Nordic market to be

controlled remotely preventing sachets reading errors ensuring correct medicine intake 99% of the times (MeiBner, 2020).

Figure 6. Evondos E300 – Medicine dispensing robot with multidose sachets.

MEDIPAC (Figure 7Figure 7) the connected pill organizer from Medissimo, used in France won an award at CES in 2014. It lit up the LEDs to alert the users which box to open and comes with a smart phone app reminding the users to take the medicine and also alerts the loved ones about missed dose. It costs € 250 and requires a weekly subscription of € 2. It is prepared/filled in the form of blisters in pharmacies using Siapda application and is intended for use by chronic patients with or without involving nursing staffs to take medications. Study suggested an increase in compliance to 98% from 77% (MeiBner, 2020).

Figure 7. MEDIPAC pill dispenser with pre-filled multi drugs blisters.

In the Netherlands, MEDIDO (Figure 8), a smart pill dispenser by Innospense is used especially for older people living at home with multi drugs doses tending to forget to take them. It reduces

the multiple visits daily by the caretakes or the nurses for giving the medicines and is currently used by approx. 4000 users. It uses GPRS and is fully autonomous. The medicines are supplied by the pharmacy while it is filled on weekly basis by a home care worker (MeiBner, 2020).

Figure 8. MEDIDO with pre-filled sachets of medicine

Home healthcare – equipment and supplies have one of the best sales potentials in addition to non-invasive surgical equipment, orthopedic and prosthetic equipment, e-health and other areas of healthcare.

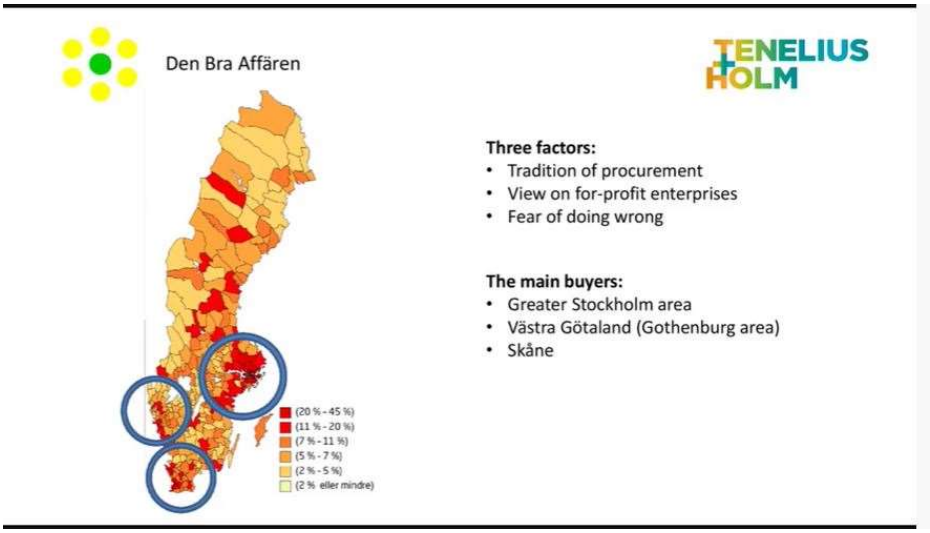


Figure 9: Factors influencing the Swedish market and the main buyers

2.10.1 Public Procurement

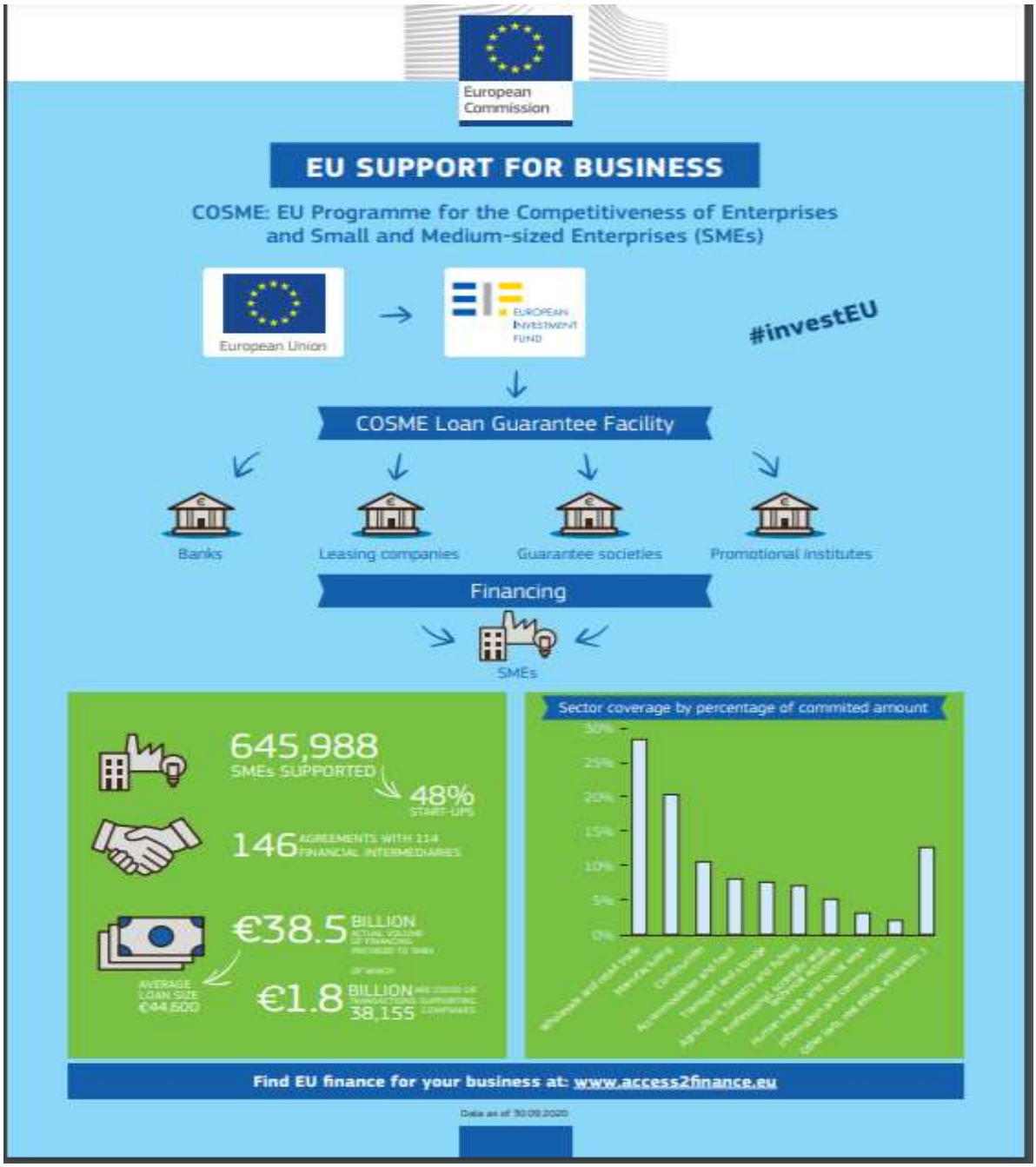
Public Procurement refers to the process through which public authorities (government or local authorities) purchase goods or service from companies. Public authorities are the local buyers in health care sector. EU directives on public procurement cover tenders. EU financing programmes are generally not provided as direct funding rather uses following financial instruments such as:

- loans and guarantees
- venture capital
- business angels
- growth stocks markets
- crowd funding
- fintech/blockchain

2.10.2 Swedish Public Procurement

- 18500 published procurements with yearly purchase of approx. 70 billion Euro
- 70% published procurement stands for Municipals, 959 procurements in medical equipment, pharmaceuticals and hygiene products
- 60% of tenders from Micro or SME enterprises, 40% tenders lead to contract in general – 65% in your industry
- 45% of all contracts were awarded based on lowest price
- 37% of public procurements was framework agreements

[14]COSME: EU programme for the Competitiveness of Enterprises and SMEs, has a budget of over €1.4 billion to fund to facilitate the loans and equity finance for SMEs with market gap. Around 3% of this is allocated for health sectors as shown in Figure 10.



[14]Figure 10. Illustration of the EU programme for financial aid for SMEs.

[14] https://ec.europa.eu/docsroom/documents/44571

2.11 Market Entry Strategy

We can have a variety of entry mode for international market depending on some internal factors (within the company) and some external factors (situations related to the target company.

Following is some of the entry modes with its pros and cons

2.11.1 Export mode

It is one of the best-known, cost-effective method with lowest risk involving direct sales of your product (produced in your country) in another country. The only cost or investment associated is the transport and marketing[15]. It is typically used in initial entry and gradually extends towards foreign-based operations. There are three types of export modes –

- Direct export: It involves the agents or brokers in the foreign market with all the activities directly supervised by the manufacturing company. The producing firm is directly involved in exporting activity and is in direct contact with the first intermediatory in foreign market. They make use of Distributors and Agents.

- Cooperative export mode: Here the export of the product is performed under a collaborative agreement with other companies/firm, where the export takes place with a local representative.

- Indirect export mode: There is no involvement of the manufacturing company, all the exporting activities are taken care by another domestic/local company: export house, distributors. There are five main entry modes -
export buying agent
broker
export management company/export house
trading company
piggyback – usually for inexperienced SME, where they deal with larger company operating in foreign market getting commission paid by the manufacturer.

[15] https://www.workspace.co.uk/content-hub/growth-and-strategy/how-to-enter-a-foreign-market

2.11.2 Intermediate entry mode

This mode involves only the transfer of knowledge and skills with no full ownership by the manufacturing company. It may also have some export opportunities (Tas, 2009).

– Joint venture/Strategic Alliance: Here, two companies own and control the business jointly working in two different countries, where one is local and the other international/foreign. Although beneficial in terms of foreign market knowledge, it can be troublesome while deciding the one who should invest and while splitting profits.

- Licensing: In this mode, a company from the target country pays you a fee and hence use your trademarks, production techniques or patents. This mode requires very less investment while has a high revenue with all the manufacturing and marketing cost covered by the licensee (the company that rents your property).

- Franchising: It is quite similar to licensing, with the difference that the intellectual property rights here are sold rather with a royalty rather than rented.

- Foreign Direct Investment: Also known as FDI, requires a lot of capital costs which you invest directly in facilities such as premises, technology and staffs in a foreign market, either by establishing a new venture or acquiring an existing company.

2.11.3 Hierarchical mode

Tas (2009) restated that with this type of entry mode, the company can fully own and control the foreign market activities. It is also known as Investment mode.

- Merger/Acquisition: In this mode of entry, the company merges itself with the foreign company to enter the market providing immediate access to international manufacturing facilities and marketing network.

- Green field strategy: This is the process of expanding operations in foreign market from the scratch (Tas, 2009), and requires purchase of local property and manpower.

Table 1. Advantages and disadvantages of export modes for the manufacturer ("Chapter 10 - Export modes,").

Export mode	Advantages	Disadvantages
Indirect exporting (e.g. export buying agent, broker or export management company)	Limited commitment and investment required. High degree of market diversification is possible as the firm utilizes the internationalization of an experienced exporter. Minimal risk (market and political). No export experience required.	No control over marketing mix elements other than the product. An additional domestic member in the distribution chain may add costs, leaving smaller profit to the producer. Lack of contact with the market (no market knowledge acquired). Limited product experience (based on commercial selling).
Direct exporting (e.g. distributor or agent)	Access to local market experience and contacts with potential customers. Shorter distribution chain (compared to indirect exporting). Market knowledge acquired. More control over marketing mix (especially with agents). Local selling support and services available.	Little control over market price because of tariffs and lack of distribution control (especially with distributors). Some investment in sales organization required (contact from home base with distributors or agents). Cultural differences, providing communication problems and information filtering (transaction costs occur). Possible trade restrictions.
Export marketing groups	Shared costs and risks of internationalization. Provide a complete product line or system sales to the customer.	Risk of unbalanced relationships (different objectives). Participating firms are reluctant to give up their complete independence.

3. Methods

In order to collect the data and information, we used all the possible sources (primary, secondary, tertiary and grey) that were accessible.

Primary source was vital as it is the first-hand data, reliable and accurate. Secondary sources helped in getting the background and in-depth knowledge about the topic. It also gave us some statistics from the author's research. The tertiary data helped us know about different company's aspects, market trends, governmental factors and the national/international health figures and trends.

3.1 Data collection

3.1.1 Primary data:

The first-hand data were collected by conducting interviews with people having knowledge and ideas about the health sector and its market. On our list, we had 6 people for interview

- Anne Grete Granås (Professor in Pharmacy, University of Oslo)
- Eivind Bjørnstad (In charge of development for elderly home services and former nurse)

Since they both have experience and knowledge in the health care system and medicine delivery, they were able to answer our queries regarding the scope, benefits and drawbacks of multidose dispensers and insight for its market.

- Geir Ove Berg (Welfare coordinator at Kongsvinger commune)
- Börje Bjelke (Swedish Professor and medical doctor with PhD in geriatric care)
- Faizan Iqbal (Pharmacist at Apotek 1, Åndalsnes)
- Fahad Ahmed (Pharmacist and manager at Apotek 1, Blasfjord)

3.1.2 Secondary data

These were the pre-collected data gained from the published research articles, review articles, company and government websites etc. Literature database (PubMed, Google scholar, Oria, Science Direct, etc) were used to download relevant literature with keywords such as elderly care, automated pill dispensers, remote health care system, market for pill dispensers, multidosing system and health care, pharmacy view on multidosing, public procurement for

health market, etc. Google search engine was used to go through all other websites of related company and government (Sweden/Norway).

3.1.3 Grey literature

This included basically the multidose dispenser company annual reports, governmental reports and statistics on figures on health care system of Sweden. These helped us get ideas about the competitors, their product details, government acts, strategy.

3.2 Data analysis

All the collected data were analysed externally and internally with reference to the company using different tools such as PESTLE, Competitor analysis, PORTER's 5 forces, SWOT analysis, Stakeholder's map, Market segmentation. These analyses provide us macro-environment information (knowledge about traits and state of foreign market) and micro-environment information (details about firm's internal capabilities and limitations) which are very crucial for preparing market entry strategy and to analyse the competitors and customers.

3.2.1 PESTEL analysis

PESTEL is the acronym for Political, Environmental, Social, Technological and Legal factors. It is the management framework and diagnostic tool that helps us get knowledge of macroeconomic factors external to the company or industry that affects the company in one way. It is taken into consideration while launching a new product or expanding into a new market with existing companies. These factors have a massive impact but only one way.

Political: This includes the governmental policies, political in/stability, taxations, industry regulations, global trade regulations and restrictions, corruptions, business policies etc. It is very important to be aware of the policies as it can have impact on the manufacturing and marketing of the product.

Economic: Exchange rates, globalization, inflation, economic growth, interest rates, labour cost, employment rate. This factor has a direct and indirect effect as it affects the purchasing power of the customers and change the demand of product affecting the pricing.

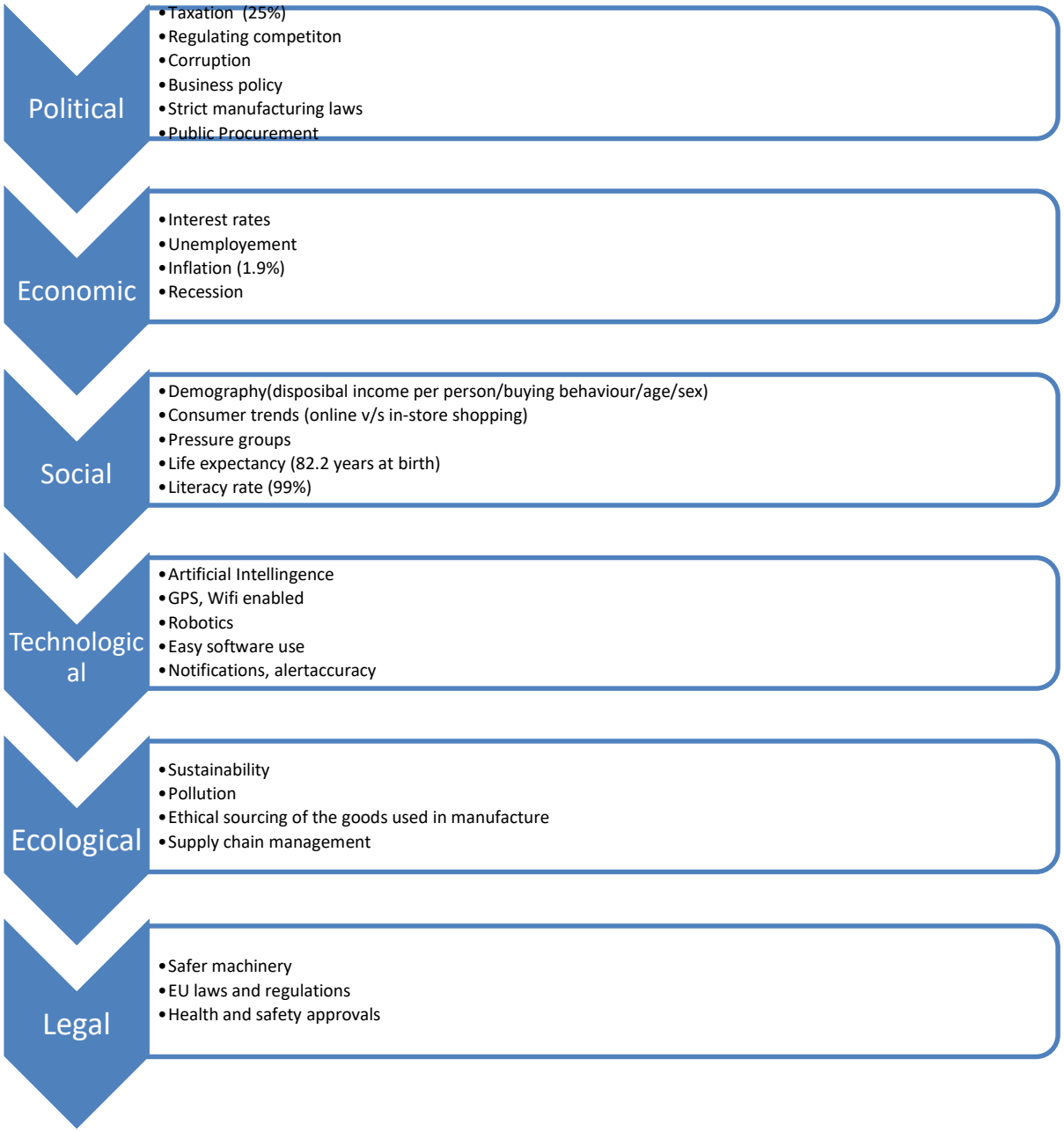


Figure 11. PESTLE Analysis

Social: Factors like demographic growth, age, lifestyle, health, literacy rates consumers trends (online shopping, in-store shopping), culture barriers, falls into this category and is important while targeting certain groups of customers.

Technology: It consists of aspects related to innovation and technology, how our product responds to current technical world, data storage, security, automation, robotics. It also deals with R&D, AI (Artificial Intelligence) and technical awareness the market possesses as it has a huge impact on whether to enter the specific market or not, launch or not launch the product or outsource abroad.

Ecological: This focuses on the environmental issues associated with the risks of the company. Elements like sustainability, recycling of products, natural or local raw materials, pollutions, are focused. There are several political sanctions which the product must comply with. Due to high environmental damages caused by companies, many companies have involved in CSR (Corporate Social Responsibility) and ethical sourcing which has a direct impact on procurement and supply chain management. Carbon footprint targets also needs to be taken into consideration.

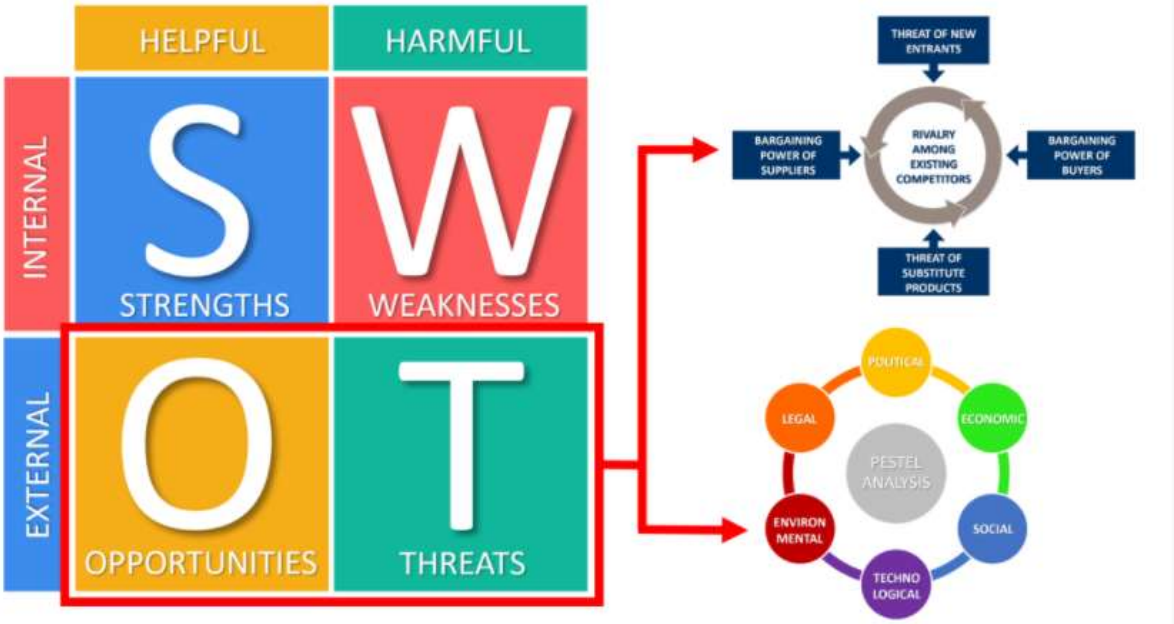
Legal: This factor may overlap with some factors of political aspects but mainly has laws such as employment law, discrimination law, anti-trust law, consumer protection law, Copyright/Patent laws. Employment labour law, health and safety legislations. These legislations keep on changing constantly and are different for different countries. It is very important to be aware of the changes, especially wile entering a new country. Above all, having a legal advisor can help a lot.

All these factors help us keep up with the current trends and rules in the market and facilitates us to align our product with them. It saves us money as well as time.

3.2.2 SWOT analysis

This is the key part in any strategic planning, where SWOT stands for strength, weakness, opportunities and threats for a company. Christodoulou and Cullinane (2019) stated that SWOT was first used in 1960s and since then widely recognized as an important tool for designing future procedures necessary for thinking in strategic way. This tool helps us know about both the internal and external factors affecting our company and product. Highlighting the positive and negative factors, SWOT helps us decide how to move further. Based on this table, there is room for improvement.

(Figure 12)Figure 12 illustrates the components of SWOT, where a company's strength are its characteristics or valuable company resources such as patents, strong brand reputation, a new innovative product, talented team, strong financial resources, that gives an advantage over other competitors. On the other hand, weakness are the factors in contrast to the strength (bad leadership, small uncompetitive workforce, small capital, that can be a disadvantage for the company. These two are the internal factors of the company and can be controlled to a large extent.



[16]*Figure 12. Table showing the components of SWOT, where strength and weakness are the internal factors while the opportunities and threats are the external factors which are accessed by PESTLE and Porter's 5 forces.*

Opportunities and threats are the external factors that may affect the company's performance in a positive way and could cause trouble in the future respectively. A PESTLE analysis or Porter's five forces are usually the best way to look through the external factors that can favour us and be an advantage for us or could harm us and be a disadvantage.

SWOT/PESTEL is a combined analysis of both internal and external factors, where the latter is more difficult to identify and beyond the control of the organization.

3.2.3 Stakeholder's map

This tool brings together all the stakeholders that are interested and have potential influence in our product. They can be individual people, organizations, aspects, factors, company, platforms, etc. It's advantages are –

- Zoom in: focus and evaluate competitors, external stakeholders that influence our business
- Zoom out: figure out who should we include in our business plan, what opportunities or risks

[16] https://www.business-to-you.com/swot-analysis/

have we overlooked.
- Helps us design resilient system, product or services
- Help us communicate with the essential stakeholders

The axis of Interest as shown in (Figure 14**Error! Reference source not found.**) denotes how engaged the stakeholders are with the outcome of our product while the Influence reflects the level of influence they have in our funding, legal process, etc.

Here, (Figure 14**Error! Reference source not found.**) the first group – Keep informed have high interest low influence where they care about outcome but have no influence.

The second group – Manage closely have both high interest and influence and have the power to break or make our product. So, it is very important to give then regular updates.

Next group – Monitor have low interest and low influence for which we just need to send them updates and monitor them.

The last group – Keep satisfied has low interest high influence as they have large implication for our product and hence their preferences should be read quite early on the process. Majority may not care about regular updates.

3.2.4 Porter's 5 forces

This framework was coined by Harvard Business School Professor – Michael Porter in 1980 in his publication "Competitive Strategy" (Dobbs, 2012) who defines competition not as a tug of war based on the size but on profitability. These 5 forces competitive analysis model illustrates how these forces can be used to explain low profitability and viable entries to industry. It also helps to access the balance of power in business, understand the strength of current competition and understand the potential of the future situation. The strength of forces is inversely proportional to the price and profit (Indiasty, Nwangi, Mandere, Bicharga, & George, 2014).

All the 5 forces as shown in (Table showing the components of SWOT, where strength and weakness are the internal factors while the opportunities and threats are the external factors which are accessed by PESTLE and Porter's 5 forces. (Figure 13), i.e., Threats of entrants, Bargaining power of suppliers, Bargaining power of the customer, Threat of substitute and the rivalry among the customer should be low in order to attain profit. It also reflects that the

competition does not always comes with competitors but rather there can be other factors involved as well.

Figure 13. Porter's 5 forces with their elements listed[17]

Threat of new entrant: Porter's state that new entrant brings new capacity, and desires to gain market shares. He also added that the threat of entrant largely depends on the extent of entry barriers such as economies of scale, customer loyalty, capital requirement (investment in marketing and R&D), cumulative experience, government policies, access to distribution channel (Porter, 1979). The higher these barriers are, lower is the threat for the existing players.

Bargaining power of suppliers: Suppliers have a high power of bargain. They can either raise the price of the raw materials or reduce the quality in order to achieve profit, which can be very dangerous for the company, especially if they are dependent on single suppliers.

[17] https://www.business-to-you.com/porters-five-forces/

Bargaining power of customers: Customers are very powerful if they have several companies offering the same product. Porter described this power as market of output whereby the customers can put the company under pressure and affect the pricing strategy.

Threats of substitute: This force is guided by the chances or risks of being replaced by similar service providing products. Porter stated that one should not only take into account similar looking products but also other things that can offer the same service. The company must be able to upgrade its product if needed or differentiate it products among others in order to avoid suffering in earning and possible growth (Porter, 1979).

Rivalry among the competitors: This last force analyses the intensity among the existing companies in the market depending on their number, size and power. Higher the number of competitors, more difficult it is to survive and prosper. In order to have a strong grip on the market, a company should focus on its product differentiation, market size, industry growth, unique selling portfolio and switching cost.

3.2.5 Market segmentation

Market segmentation is the most fundamental and crucial marketing strategy (Tynan, 1987), which helps to divide the market into different customer groups and identify the buyers among them. Further, once the segment or group of customers have been identified, it helps to develop the product or services according to their needs (Tynan, 1987).

The most common ways to segment a consumer market is the following four groups (Tynan, 1987):

- Geographical: based on the geographic location.
- Demographic: based on age, sex, gender, education status, income, family size, socio-economic group etc.
-Psychographic: based on lifestyle, interests, needs, values.
- Behavioural: based on brand loyalty, usage rate, price priority etc.

Each group has buyers who share similar characteristics and hence ease the selection process. Tynan (1987) mentioned that it helps us solve marketing problems such as defining market, rationalize policies for existing brands and products, position ranges of brands and products varieties, to identify gaps in market offering new product opportunities.

4. Results and Discussion

Every new innovation is a result of a solution to an existing or upcoming problem. The issue of overdose, incorrect medication, missing of the doses, chances of mixing of look-alike medicine has always been a topic of discussion. Several methods have been applied as a part of solution, but not all have been successful. Automated pill dispensers were also introduced in order to optimize the use of medications and to reduce the errors associated with it. It was also possible to reduce the medicine wastage to some extents with its use.

4.1 Business tool analysis

4.1.1 PESTEL

It helped us to analyse the external factors influencing the company and to develop a product in accordance to it.

- Political: There is a lot of political influence in the market of medical devices (MDs) which is controlled by the community, local authorities. The local authorities have the power to accept or reject any device at local level. MDs require to pay 25% tax and undergo through several public procurements and tenders.
- Economical: As per 2020, unemployment rate in Sweden was 8.3% with an inflation rate of 0.7%. It had a score of 8.40 out of 10 in business ranking (market opportunities, foreign trade and exchange control, financing, labour market and infrastructure). HDI (world rank) – 14/188, pointing out that Sweden has a good economic condition and is capable of purchasing the pill dispensers for target groups (ref. Sweden has a public healthcare system)
- Social: rapidly increasing elderly population (about 1 in every 5 people are above 65 or older)
- Technological: Increased digitalization in Sweden with every person having access to internet, mobile phone, electricity. Swedish government has launched several programmes to provide technical education to enable them to use the technology effectively.
- Legal: Should have CE mark, approved by HTA, comply with European MDs standards, ensure human right.
- Environment: Recyclable plastic cassette, sustainable, local raw materials used, no emission of carbon footprints.

4.1.2 SWOT analysis

The below given table enumerates the strength, weakness, opportunities and the threats for Mobili which should be considered before launching the product.

Table 2. SWOT Analysis for Mobili

STRENGTH	WEAKNESS
✓ Innovative and attractive design (by Bård Eker) and easy technology ✓ Reusable plastic (environment friendly) ✓ Local raw materials used ✓ In-built NFC chip allowing the short-range communication between the cassette and the device to ensure identity ✓ Freedom to operate (IPR) ✓ Safety assured as medicines are packed by the pharmacist ✓ Founder very well experienced in industrial design and home care product, with sufficient knowledge of software, legal and financial agendas	✓ Small market size (quite new product) ✓ Market adaptation and acceptance by the users ✓ IPR – expensive and difficult ✓ Some limitations (liquid medications, inhalers cannot be filled in) ✓ Lack of system confirming the intake of medicine ✓ Start-up with limited funds
OPPORTUNITY	**THREATS**
✓ Patent on cassette design ✓ Possibility of adding features according to customer's need ✓ Multiple uses (chronic diseases as well) ✓ Wide market range (from young age to old aged) ✓ Increasing number of old aged people ✓ Hospitals and government being interested gradually ✓ Innovation funding ✓ Rapid digitalization ✓ HTA	✓ High competition (especially nurses) ✓ Government policies and approval ✓ Tenders ✓ Conservative pharmacy and difficult to obtain agreement on filling ✓ Product differentiation is difficult ✓ Slow pace of digitalization in medicine ✓ Lack of long-run financing ✓ Increasing complexity, time and costs of trials. ✓ Changes in the EU directives for MDs.

4.1.3 Stakeholder's map

As shown in (**Error! Reference source not found.**4) we need to focus on the group entitled as "Keep informed" and "Manage closely" as they have a high influence in the product. They can play a big role in promoting or demoting the product and hence is very important to have good terms with these stakeholders.

On the other hand, the stakeholders under the title "Monitor" and "Keep satisfied" who will be directly linked with the launch and use of the product respectively and hence should also be taken good care of by sharing all the updates and features of the products.

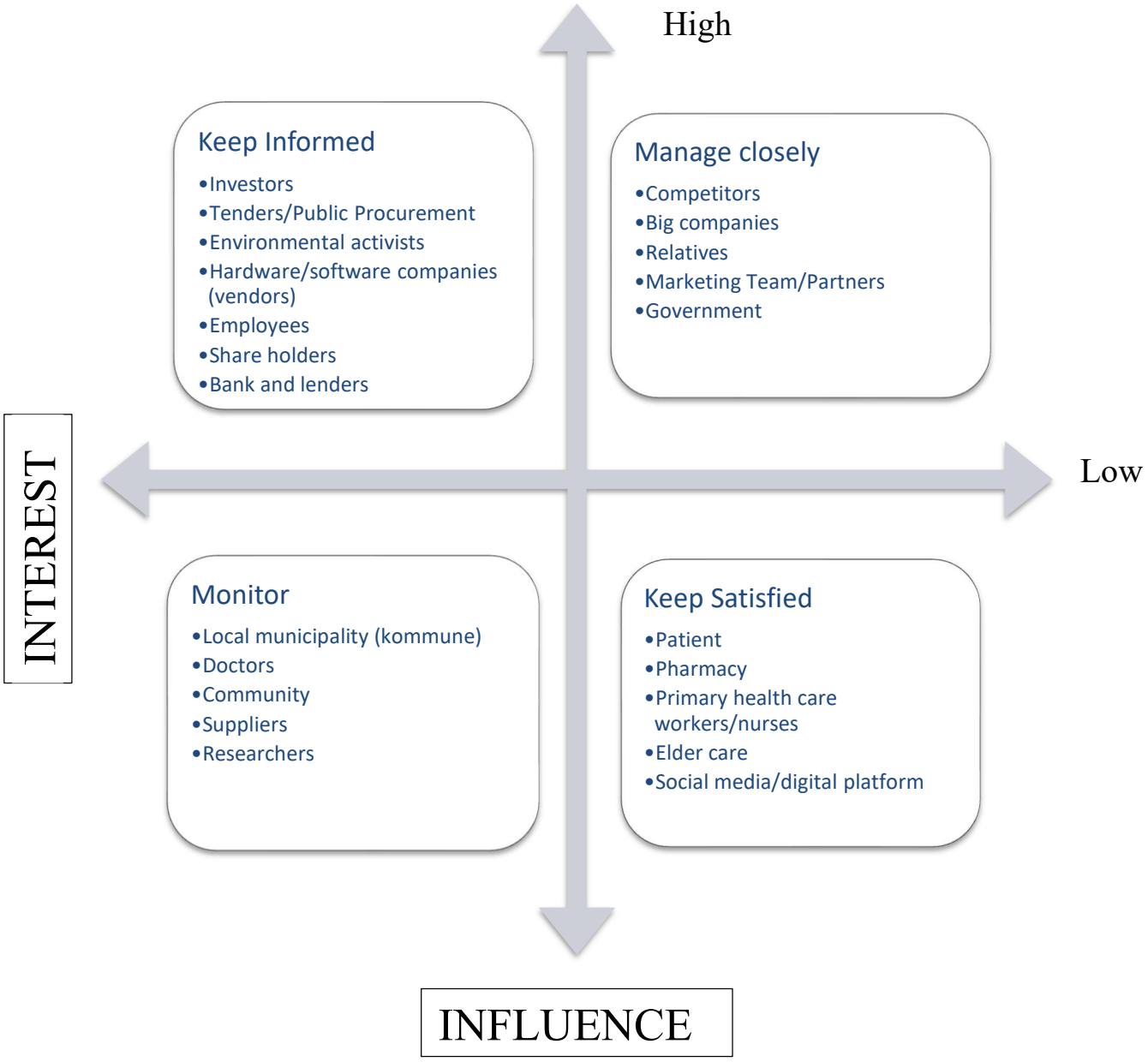


Figure 14. Stakeholder's map

4.1.4 Porter's 5 forces

These 5 forces affect the company externally.

Threat to new entrant: We should always keep track of new competitors as we already have many in the market. Since the cost of entry of a new competitor is somewhat difficult but an existing company can scale up and start this product. In addition, since Mobili still don't have a customer base, it can be very easy to lose opportunities to other company who can offer even a small extra value in addition to Mobili. But as it has patent on its design, it will be difficult for others to imitate it.

Bargaining power of suppliers: We need the raw material to make our product which we buy locally. Since Mobili has two suppliers for each unit, we can say it is on safer side if one of them fails to deliver supplies as demanded. So, it has low supply risk.

Bargaining power of the customer: Customers can have a very high power of bargain. Mobili can provide high value to the customers for their satisfaction ensuring that they don't see it as expensive.

Threat of substitute: Although Mobili has a unique portfolio with unique features, yet we have high chances of cheaper alternatives of same sort in the market. There is also a possible threat of new services or innovation and government policies for medicine dispensers that can disrupt the whole market.

Rivalry among competitors: This is quite high as Mobili has a lot of competitors in the market with a varied price strategy. The product differentiation is also very low unless monitored closely.

4.1.5 Market Segmentation

The market for Mobili can be segmented under the following titles:

- Geographic: city areas, not surrounded by islands as it is difficult to reach
  easily accessible places with good transportation services
- Demographic: geriatric population above 70 years
  people with chronic diseases such as dementia, cognitive issues
  multi drugs users

young people with alcohol/drugs issue or mental health issue
women with daily hormonal pills intake
well educated people with knowledge of using digital platforms
above average income

- Psychographic: busy lifestyle who needs reminder for taking their medicine (vitamin supplement or hormones)
long term drug users with chronic ailments (cancer, diabetes, pressure, HIV/AIDS)
- Behavioural: punctuality, people who wants everything in order
high living standards
people who like fancy devices/gadgets

Study also revealed that Swedes are an increasingly digitized people, even in the oldest group, 76 years and up, with more than half being internet users. Beckman, Parker, and Thorslund (2005) reports that majority of the elderly population (aged 77+) in Sweden has physical, visual or cognitive limitations which is directly related to ability to manage medicines.

Personal conversations with healthy people have revealed that they are very much concerned for their parents who are not extremely old but yet need assistance with medications due to poor eyesight or weakness. Mobili can be a good choice for the active old people who are physically active but need reminder and easy dispatching of their daily medicines.

4.2 Market scenario

4.2.1 Market entry mode

The entry mode decision is connected to the internationalization process and the adaptation. We must decide among internalization (hierarchical mode) or externalization (export mode) to determine the mode of entry. Here we will discuss 2 major modes – Sales and production subsidiary or direct export (local Swedish agent).

- Sales and Production subsidiary

Internationalization - High cost
- High Risk
- Low flexibility
- High control

Internal factors - Company size (small)
- International experience (?)
- Product complexity (high)
- Product differential advantage (high)

Direct export

Externalization - Low cost
- Low risk
- High flexibility
- Low control

External Factors - Socio cultural distance (low)
- Demand uncertainty (?)
- Market size and growth (medium)
- Trade barrier (low)
- Intensity of competition (high)
- Number of relevant intermediaries (high)

These factors point towards externalization as having a local agent as an intermediate can help us bridge up the gap and create a user-friendly market for Swedish population. Moreover, there is low risk and set up cost with high flexibility of pulling out the string if the business does not work well which is not possible in Internalization.

4.2.2 Market trend and competition

Although there are several automated pill dispensers in the market, but their growth rate seems to be quite slow. (personal communication) made a comment that the pace of development of automated pill dispensers in Sweden in quite slow. He also added that most of the pills are dispensed in the bags/sachets instead of automated one. Anne Gerd elaborated that at present we have manual dispensers with 28 compartments filled and dispensed manually with hands for maximum a month and semi-automated dispensers which is filled manually and dispensed automatically. She also added that the manual boxes are far way cheaper and easier to carry although it has some drawbacks as well.

Evondos has assisted to dispense over 8 million accurate medicine doses with a turn-over of 11 million Euro (2020) and a +60% turn over growth, and at present is available in more than

150 local authority districts in Nordic countries including Oslo, Stockholm and Helsinki ("Story of Evondos," 2021). Geir Ove mentioned that the cost of leasing one single Evondos costs 215kr/month.

Geir Ove presented the data whereby 2556 sachets of multidose were dispensed to the patients in the month of March with a compliance of 99.2% (0.8% of unused medicines). He added that although the patients are very much satisfied with the service from Evondos in Kongsvinger, yet the first impression of Evondos is not so alluring to them due to its big size. The patients cannot travel with it as it is huge but it has an option of "Travel mode" whereby it dispenses out medication early for the travel duration. From the political perspective he stated that every commune has a fixed budget that can be used for technology and health services, which unfortunately is very low. Once the budget is used, not a single patient more can be offered the service, irrespective of the extent of demand. Moreover, it is very difficult to convince the politicians and to make them ready to allocate some extra budgets. This is the same scenario with Sweden whereby the county council employ physicians who must be very cost aware while offering MDD (Bardage et al., 2014). It is also a challenge to obtain long-run financing of health due to the rapid change in the demography with increasing number of elderly patients (Anell, Glenngård, & Merkur, 2012).

Bjørnstad, in the personal communication stated that in 2007, Philips's pill dispensers were used in USA, but it did not have market in Europe back then as the market was not ready 10 years ago. From his perspective, Evondos is not quite appropriate due to its huge size. He also commented that there are about 150 drugs that can't be dispensed into the sachets used today for dispensing because of contamination issue or fragility, due to which generic substitutes are used. This may affect the multi-dosing causing drug-drug interactions. In Sweden, 15% of the physicians and 1/3rd of nurses and assistant nurses reported that generic substitutions makes it more difficulty for patients to identify various medicines available in the sachets (Bardage et al., 2014).

Nomeco, a Phoenix company, SeniorSam, Mediq, MEDIFON, ONEMED, SUNNFJORD APOTEK, Danish CARE Supple are some of the chains where the pill dispensers are sold in Sweden.

Geir Ove commented that in Norway, they have a collaborative program for medical dispensers named Nedre Toten, whereby they choose among different pill dispensers.

Currently in Kongsvinger, they are using Evondos E300 (37), Medido (5) and Pilli (3) excluding Evondos mini and Dosell from the list. He also mentioned that Kongsvinger commune is most satisfied with Evondos, as a result of which, they delivered 2556 sachets in the month of March alone.

The five main suppliers – Cerner, Evry, Cambio, CombuGroup, and Norbotten. County Council have a 97% share of all users that dominate the e-health sector. Although the state is responsible for the health policy, yet, 17 county councils and 4 regions are responsible for the funding and provisions of health care services(Anell et al., 2012) Domestic production is quite strong for medical equipment while medical device sector is one of the leading export sectors in Sweden. GE Healthcare, Baxter, Fresenius, Philips, Abbott, Thermo Fisher, Johnson & Johnson, Siemens, and Nobel Biocare are some of the major global companies to mention with a strong influence in Sweden. Tamro and Oriola-KD are the main wholesalers of logistic service providers negotiating directly with the manufactures rather than traditional wholesalers. They are allowed to deliver to pharmacies, primary care centres and hospitals but not directly to the patients (Ponten, 2017). 200,000 customers use automated dose dispensing in Sweden as per 2016 (Kügelgen, 2016). According to the Stefan Krisch (managing director Svensk Dos), Sweden can have private customers in future.

4.2.3 Market access strategy

European market consists of 27 countries with more than 27 different Health care (HC) systems. In order to make a successful entry to a market it is very important to define global strategy and adapt locally. Following points are very important:

- CE Mark
- HTA and Data requirement
- Budget and financing system
- Procurement and tenders

Following are the common issues while entering a market that should be taken into consideration early:

- HC cost pressure
- increased use of HTA for decision making on the admission of innovative technology
- Cross Border Directive provides an incentive on HTA
- use of tendering for MDs considered as commodities
- cost management measures

- moving from clinical to financial decision making
- device reimbursement complexity

Innovative Medicine Initiative (IMI) [18]

In addition to these, Innovative Medicine Initiative (IMI) is world's biggest public-private partnership (PPP), a partnership between the EU and the European pharmaceutical industry. It works to improve health by facilitating collaboration between key players in healthcare research including

- universities
- research centres
- pharmaceutical and other industries
- SMEs
- patient organizations
- medicine regulators

A budget of € 3.3 billion budget was allocated through IMI programme for the period of 2014 - 2020

4.2.4 Pharmacies and prescribed medicines (Wallêr, 2019)

In 2019, 86 million prescriptions were dispensed from the pharmacies where 230,000 customers were provided with dose dispensed medicines indicating a huge opportunity for Mobili. The majority of the pharmacy sales, i.e., 74% includes prescribed medicine, which are packed by a special form of pharmacy called dose dispensing pharmacies having a community pharmacy permit. This service of automated pill dispensing is procured by regional authorities and at present there is only one dose dispensing pharmacy in the market. In addition, online sales in pharmacies have raised to SEK 500 million monthly in Jan 2020 from SEK 120 million with a largest segment of prescribed drugs. This has also benefitted the rural areas and small towns in receiving the medicines.

4.2.5 Multi drug dose dispensing and the perspectives

Several studies have been carried around different parts of the world to check its efficiency and efficacy along with its drawbacks which gives room for improvements. It had been

[18] https://ec.europa.eu/health/md_topics-interest/overview_en

reported by Bardage et al. (2014), that in 2011 alone, approx. 180,000 individuals (80% 60years or older) received their prescribed medicines via automated MDD from the pharmacies. Among these, 40% lived in ordinary home and 60% in elderly care home, with majority of them having assistance in both places. The statement made by West et al. (2014) supported the use of MDD stating that community pharmacy viewed the instalment of dispensing as a potential solution to reduce medication wastage. In addition, the survey conducted by Bardage et al. (2014) concluded that majority of the health care professionals, nurses and nursing assistants had a positive attitude towards automated MDD and suggested to increase its use among patients with memory deficiencies, patients on stable or several medications, poor adherence to prescribed medicines, patients with motor deficiencies, as they believe it contributes to correct dosage, helps patients take their medication in correct time, reduce confusion among patients and facilitates the handling of medicines.

The major difference is the advanced health services in Sweden than in Norway which is more individual focused as said by Professor Bjelke. He mentioned that Sweden has an autonomous speciality for last 30 years now. He also added that Swedish health care encourages the people to stay in home rather than a home care or hospital which is not the best thing as the elderly are isolated and cannot socialize due to lack of communication and contact with other people.

Elderly people after 90s need special help to take their medications, and are mostly found sharing/borrowing medicines from the neighbours or friends which is a great threat and concern (Bjørnstad). Pill dispensers can be a great help for them, but the major problem is making the elderly acquainted with the technology. On the contrary, Authority (2005) argued that such automated systems of dispensing drugs cannot assure patient safety unless cabinet design and use are carefully planned and implemented to eliminate wrong drug selection and dosing error. Bjørnstad suggested that according to the municipalities in Norway, only 10% of the elderly aged between 70-75 years need assistance whereas a vast majority of elderly aged above 90years need full assistance and care. He also mentioned that traditional pill boxes are still very much in use as compared to any other device.

On the contrary, Professor Bjelke pictures multidosing as a mess and dangerous and hence suggested that it should be super controlled system. According to him, the major weakness with the MDD is that these are not biologically controlled or correct. These are just autonomous systems working continuously, with no feedback on the status of the patient or the intake of medicine. He commented that these systems may work perfectly for prophylactic

treatment for active people with high risk in treatment of acute diseases. In order to make it more effective, it is best if controlled by a nurse or care taker to ensure that the medicine is taken. WHO has several literatures citing that most of the pills are not taken from the pill dispensers, either thrown away, missed or neglected. He does not see much scope for it.

Anne Grete commented that Sweden and Norway have quite similar system of national database repository, where all medical records of the patient can be retrieved by any pharmacy, although several hospitals, nurses, veteran do not have access to it yet. Anne Grete mentioned that according to the literatures, there is a 10% chance of error when the medicine is dispensed by a nurse at home, while the error rate with automated pill dispenser is very low (1 in 100,000 doses).

Another point to be taken into consideration as mentioned by Fahad (in personal communication) is the expiry date of the medicines after being filled in the machine. He also added that since the medicines inside the blister package are packed under optimum conditions (temperature, humidity, etc), it can be dangerous once they are open and exposed to environment. So, the dispensers should be created so as not to cause any reactions after being removed from the blister.

Faizan mentioned that one plus point which he sees with the multi-dosing dispensers compared to the dosete is the reduced burden on the environment as the sachets in which the medicines are packed are thrown away carelessly polluting the environment while the cassette of the dispensers is reusable and environment friendly. As a pharmacist, he believes that the new technologies do not give optimal result and hence they are more reluctant towards it.

4.2.6 Challenges with digitalization (MeiBner, 2020)

many technologies are start-up innovation counting on funding from health care and social welfare organizations

- the coverage of cost of certain technology on care is an individual decision depending on economic status of patient and health insurance
- research and development projects are strongly concentrated towards technical achievements rather than focusing on the actual need of elderly in need and their care takers
- lack of assurity for human right and dignity of elder people
- introducing new technology in elderly care consist of more than technical issues including variety of authorities and responsibility making it more difficult

- innovative programmes in health care are initiated without overview of priorities and strategies on social changes
lack of clear view of legal and operational framework
- lack of clear link between digital strategies, ageing and care framework

4.2.7 Mobili and the struggle

Medthings AS came up with a smart, portable, easy to use, user friendly, personalized automated pill dispenser – Mobili, that assures safety, efficiency and efficacy to the patients. It is built considering the issue of big sized dispensers (Evondos), difficulty in operating and filing (Hero), safety concerns. It comes with an in-built NFC chip, which is personalized for a patient, and aligns only with the one present in the cassette of medicines for that particular patient avoiding any mixing or wrong delivery of the medicine to the patient. It is composed of a reusable, eco-friendly plastic, that will not affect the environment and can be reused multiple times. The cassettes are sealed preventing the misuse or mixing of the tablets.it is designed with simplicity and with the goal of not compelling the users to change their habits or daily routine. Mobili adapts with the patient's daily life, making it easier and convenient or the elderly, who are not much interested in technical gadgets.

Although Mobili has focused the user's comfort during its development, yet there are some factors it may need to focus on. According to the comment from Anne Grete, all the multidose dispensers are local solutions, only effective for tablets or capsules, but not for fluids, powder or inhalations. In addition to this, she also added that there is no solution for the dosage involving splitting of tablets, neither can all the tablets be split due to entero-coated nature. In Sweden, prescriptions involving splitting of tablet was common and constituted 10% of prescription for tablet formulation (Berg & Ekedahl, 2010). These critical dosage medicines can in future give rise to 3D printing. Furthermore, she elaborated that the drug dispensing depends on the type of patient and medicine, being more effective for chronic ailments or prescribed antibiotics, taking into consideration drug-drug interaction and correct dosage. Since at present, majority of multi-dosing is in the form of sachets filled with medicines, she believes that the people with dementia, rheumatic diseases, arthritis having problem in opening the sachets can be very much benefitted with a device like Mobili due to its disable-friendly features. From a pharmacist's perspectives, she believes that it is very important to know the capacity of the patients, support they get from the home, who is responsible to fill up the

dispenser and how often. She also thinks that home filling can cause errors due to the confusion arising from the similar colour, shape and size of the medicine.

5. Conclusion

The views and statements with respect to the use of automated dose dispensing varies to a great extent. It has both the positive and negative comments. Despite of widespread use of multidose dispensing system, Wallerstedt et al. (2013), cited that according to polypharmacy indicator, the odds for potentially harmful drug treatment was 3.58 times (≥10 drugs) to 5.48 times (≥3 psychotropics) greater for patients aged ≥65 years with Swedish MDD. In addition, the chances for a drug to stay unchanged during a six months period were higher if prescribed via MDD system than via ordinary prescription. Thus, these statistics shows that there are more things to be considered besides just dispensing the medicines.

[19]Moreover, statistics revealed that the larger cities of Sweden such as Södermalm in Stockholm and Hisingen in Gothenburg have densely populated island. Meanwhile, all of Södertörn and parts of Nacka are also considered islands, resulting in more than half of the population of Stockholm county living in islands. Transportation of the dispensers or filling of the medicines, or visits for maintenance and service can be very challenging as majority of the people live on islands. In addition to geographical challenges, business angel communities are fragmented in Sweden resulting in obstacles in supply and demand chain ("Final report 2019,")

For a small company like Medthings, it is very important to know the issues related to the MDD, which are not solved by the existing dispensers in the market. It is also equally important to perform enough trials, form strong connections with the local authorities, county councils and to evaluate the experience of the users from previous device.

All the pill dispensers present in the market today lack one feature or the other. While comparing the 2 robotic pill dispensers – Hero and MedaCube, Hero does not have features like recording messages, barcode scanner for easy data entering, battery backup and is not suitable for people with Dementia. On the other hand, MedaCube is far way expensive than Hero. So far Philips Medicine Dispenser was reported to be the standard dispenser, especially designed for the one with cognition challenges, although the filling part is a bit tough. Livi

[19]https://www.scb.se/en/finding-statistics/statistics-by-subject-area/environment/land-use/land-use-in-proximity-to-shoreline/pong/statistical-news/coast-shores-and-islands-in-sweden-2013/

requires a significant level of technical ability and training, making it more prone to errors (Caro, 2020).

It was also noted that the main problem lies in making people acquainted with the new technology. Launching the product alone is not sufficient. The user needs to be well informed and taught about the use and features of the product. Ekman (2018) stated that the major setback in adapting e-health is the poor design of innovation, weak uptake of technology and expensive technology in terms of purchase and maintenance.

The filling can be either done by the machine or by the pharmacists or by the users/family members. In all these cases, ensuring that the correct dose with correct amount is filled is very important. The major challenge while filled by the pharmacist is the timely delivery of the medicines to the patients, while the main benefit is the cross checking of the medicine for DDR or allergic reactions.

Mobili, in addition to all its features, should have a system whereby it can monitor the status of the patient. It should be able to track whether the patient has taken the pill or just thrown it away after being dispensed out of the machine. Workman (2021) mentioned that the main concern of the health professionals was to ensure safe medication practices and good care arrangements for service users who valued their independence when having a digital medication dispenser. Sweden developed 4 new dispensing systems after re-regulations of pharmacy market in 2009, but soon discovered weakness related to reliability, functionality and usability which could affect patient safety. Since feature of reliability (if the medicine is taken or not) is missing in almost all the dispensers present at the market, it could be an opportunity for Mobili to have such a system integrated in it. Mobili should focus to be user-friendly rather than being government-friendly. The most important point is adherence and compliance and the need of the user.

Mobili must undergo CE mark approval, HTA and Data requirement, budget and financing system and procurement and tenders in order to enter the Swedish market. In order to adapt locally, it is very important to collaborate clinical, regulatory and market access strategy. Although launching a medical product seems a straight forward process, but it involves coordination among different professions. The major hurdles toward the market entry can be the increased use of HTA for decision making on the admission of innovative technology, health care cost pressure, cost management pressure, and use of tenders. Moreover, it has been

noted that finding a private market can also be an option for Mobili as the approvals and budgets from the county council is a major hurdle and it can take a long time for government to put medicine dispensers in their system.

Technological innovations are not widely or consistently used in ageing and care at present in several countries suggesting a fundamentally different approach. It is also concluded that there can be a varying group of users, beside elderly. People of age group 18-90 years can be a market for Mobili. People with daily supplement intake, or long-term medications can also be a target group for us. The elegant and portable feature of Mobili can attract people of young age or modern old aged people who take supplements like vitamins, iron, protein capsules etc. It can also be used for small kids taking in calcium or other daily supplements or children suffering from conditions which require medication. These groups can provide us with private market. Although elderly people are the main focus group, but they may not be the first paying customers as they rely totally on government for the health services. Our first paying customers can be people with more than average range of income, and who tend to forget their medications due to busy life styles.

Hence, for a start-up company like Medthings, it is very important to test several times the efficiency and safety of Mobili, before stepping into the market. Choosing a private market collaborating with local agents (Tamro and Oriola – KD) and then gradually making its way towards the public market would be a better idea. If possible, Mobili should also be incorporated with ability to hold medicines in the form of gummy, jelly, suspensions, etc. This will give us a wider range of customers and a competitive advantage.

6. Limitation

Although the target market was Sweden, this paper does not contain a full overview of it. Due to lack of primary data, (unable to contact people from Sweden directly for interview), this paper had to rely majorly on the literature or make a comparison from Norway. Since the health care system in Sweden and Norway is quite similar, many facts were considered to be common in the paper above. Meanwhile, many of the journals and annual reports of Sweden health care system were available only in Swedish language, making it difficult to translate accurately. The competitive analysis was also performed for overall USA, Scandinavia and UK instead of only Sweden. Furthermore, information on the new technology is difficult to verify as the indicators like number of users and prices are confidential. The published material also lacked the exact number of active users making it highly challenging to evaluate the impact of the system.

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Appendix I

Table 3. Trends in Swedish Public Procurement

Public and total expenditure on health by service programme, 2009

	Public expenditure on health		Total expenditure on health	
	SEK millions	%	SEK millions	%
Health administration and insurance	4 173	1.7	4 173	1.3
Public health and prevention	8 836	3.5	11 265	3.6
Prescribed drugs	21 601	8.6	27 956	9.0
Medical services				
inpatient care	83 017	32.9	84 288	27.2
outpatient/ambulatory physician services	72 316	28.7	85 344	27.6
outpatient/ambulatory dental services	9 843	3.9	24 284	7.8
ancillary services	13 107	5.2	13 203	4.3
home or domicilary health services	21 870	8.7	22 857	7.4
Capital formation of health care provider institutions	11 034	4.4	13 298	4.3
Not specified/other	6 051	2.4	22 897	7.4
Total expenditures on health	252 150	100.0	309 421	100.0

Table 4: Public and total expenditure of Swedish health care programmes

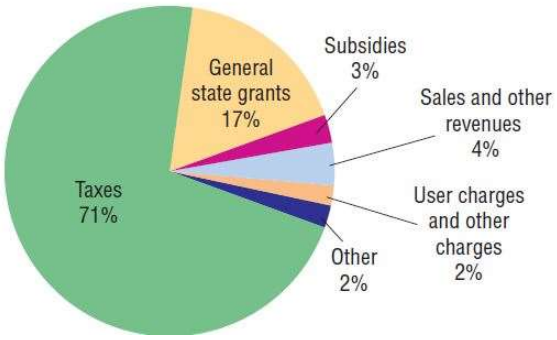

Figure 15: Sources of total revenue (Source: WHO 2019)

Table 5: Trends in health care expenditure

Trends in health care expenditure, 1995–2009

	1995	2000	2005	2008	2009
GDP, US$ per capita	28 755	27 686	40 551	51 937	42 965
GDP, PPP US$ per capita	21 911	27 726	32 298	37 424	–
Total health expenditure PPP US$ per capita	1 739	2 284	2 952	3 622	3 690
Total health expenditure as % of GDP	8.0	8.2	9.1	9.2	9.9
Public expenditure on health as % of total expenditure on health	86.6	84.9	78.8	78.3	78.6
Private expenditure on health as % of total expenditure on health	13.4	15.1	17.4	16.8	16.6
Government health spending as % of total government spending	10.6	12.6	13.1	13.8	13.8
OOP payments as % of private expenditures on health	99.9	91.1	93.5	92.8	92.8
VHI as % of private expenditure on health	0.1	1.2	0.8	1.2	1.2

6.

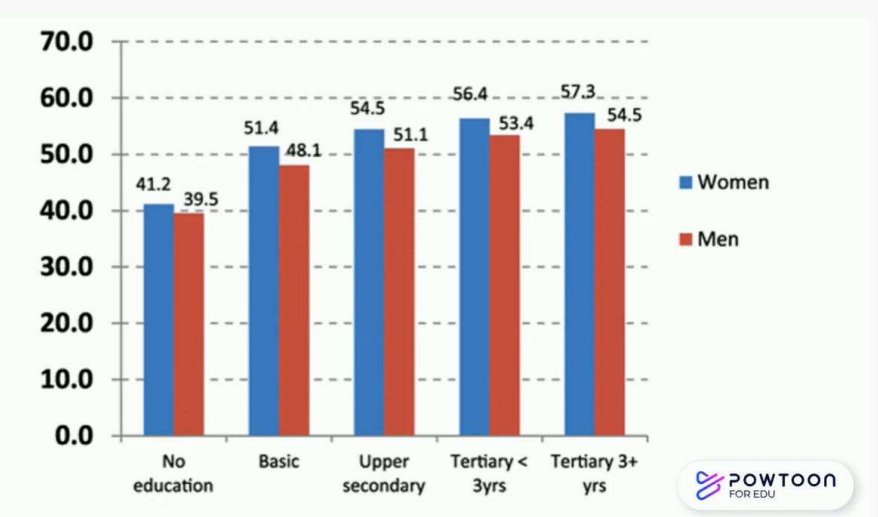

Figure 16: Life expectancy of men and women compared to their educational status

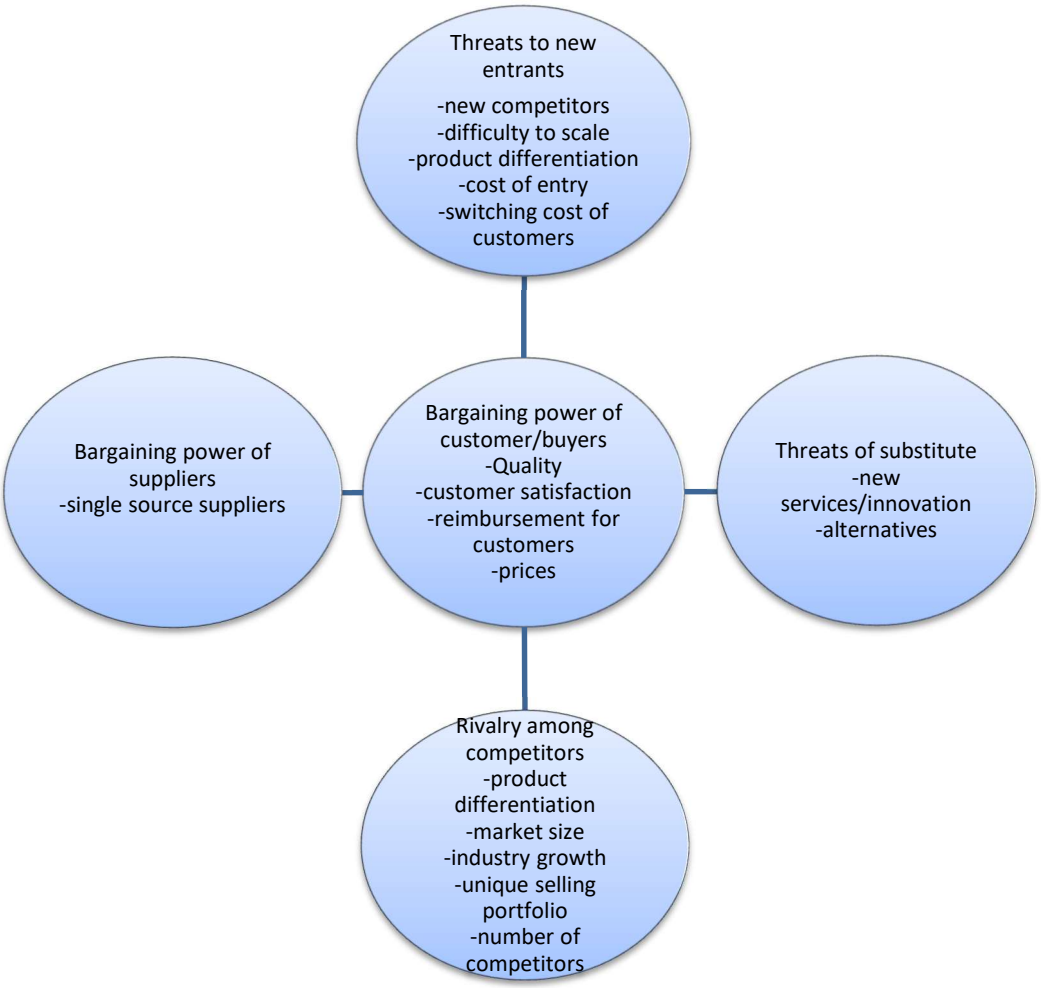

Figure 17. Porter's 5 forces

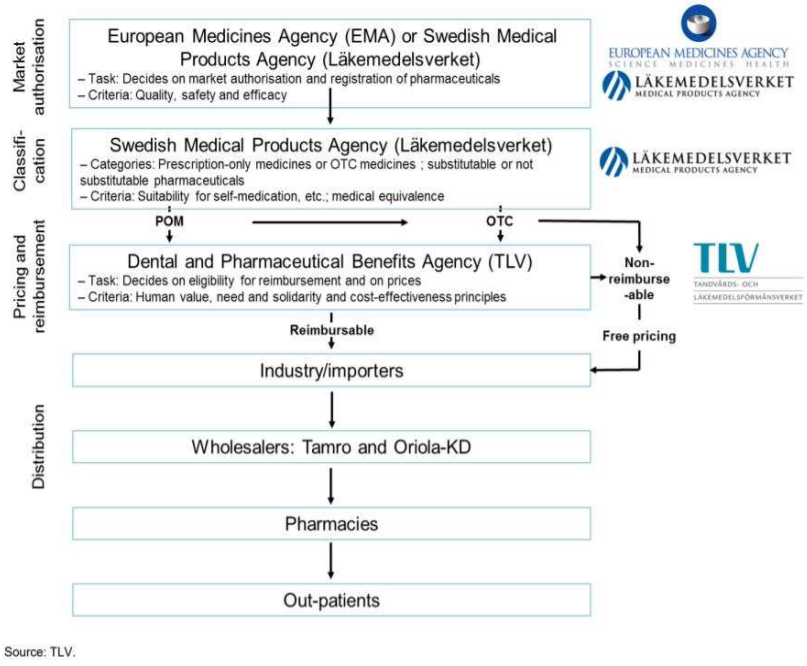

Figure 18. Flowchart showing the pharmacy system in Sweden

Pricing*

Product	Up front fee	Monthly Fee	Two year Cost	
MedaCube	$1499		$1,499	
Livi	$49	$99	$2,425	
Hero	$100	$30	$820	
MedMinder Maya	$0	$40	$960	
Philips	$0	$60	$1440	
*Pria***	$700	$10	$880	
*TabSafe***	$1200		$1200	
CompuMed	$790		$790	
GMS (no WiFi)	$80		$80	
MedReady (no WiFi)	$159		$159	
GMS (WiFi)	$200		$200	
MedReady (cellular)	$307	$16	$691	

*Current as of Jan 2020. | ** also available as refurbished or rental. | ***Upfront fee includes first 6 months of subscription.

Table 6. List of some major pill dispensers in market and their price(Caro, 2020)

Appendix II

Questions asked to Fahad and Iqbal

-As a pharmacist, which method is highly followed for medicine administration by you?

- As a pharmacist, which pill dispensers have you come across and how often do you use it?

- What are the main types of disease/medicines for which the pill dispensers are used mostly by you?

- How do you view the benefits and drawbacks of automated pill dispensers from a health professional's point of view? Are there any major weaknesses in the systems that are available on the market today?

- How do you see the association between multidose dispensers and the risk of incorrect medication? Are there other negative or positive impacts that a pill dispenser can have on the medical professionals (pharmacists/nurses/care takers)?

- What is the status for using automated medicine dispensers for elderly patients?

Questiones asked to Geir Ove

-How does the government/municipalities in Norway view the multidose dispensing system?

- How supportive are they when it comes to these dispensing systems, do they still go with the traditional way or are there some changes?

- As you work with Evondos, what do you think is the major hurdle for pill dispensers and how difficult is it to make its' way to the market? How is it for Evondos?

- Among the pill dispensers that you have come across, which one has the most striking features that makes it stand out and satisfies the demands of customers?

- What are the challenges faced by government while introducing new ideas or technology in health and medical system? Why do you think the growth of pill dispenser in Norway is slow?

- Do you think the government would be interested in introducing pill dispenser in their health and medical system or is there still a long way to go for these pill dispensers?

- What sort of advancement do you predict in the coming years for the medication system particularly pill dispensers?

- In your opinion, how should a new company like Medthings approach the market? Who do you think will be the first paying customers?

Questions asked to Prof. Bjölke

- Can you briefly describe elderly care in Sweden and/if how it is different from Norway (particularly when it comes to administration of medicines for elderly patients?)
- As an expert in geriatric medicine, what do you think is the overall best way to administer medication for elderly patients living at home? Take into consideration the cost/benefit for patients, healthcare system, relatives etc.
- How do you view the benefits and drawbacks of automated pill dispensers from a health professional's point of view? Are there any major weaknesses in the systems that are available on the market today?
- How do you see the association between multidose dispensers and the risk of incorrect medication? Are there other negative or positive impacts that a pill dispenser can have on the medical professionals (pharmacists/nurses/care takers)?
- What is the status for using automated medicine dispensers for elderly patients in Sweden?
- How do you vision medicine management after the 10 years?