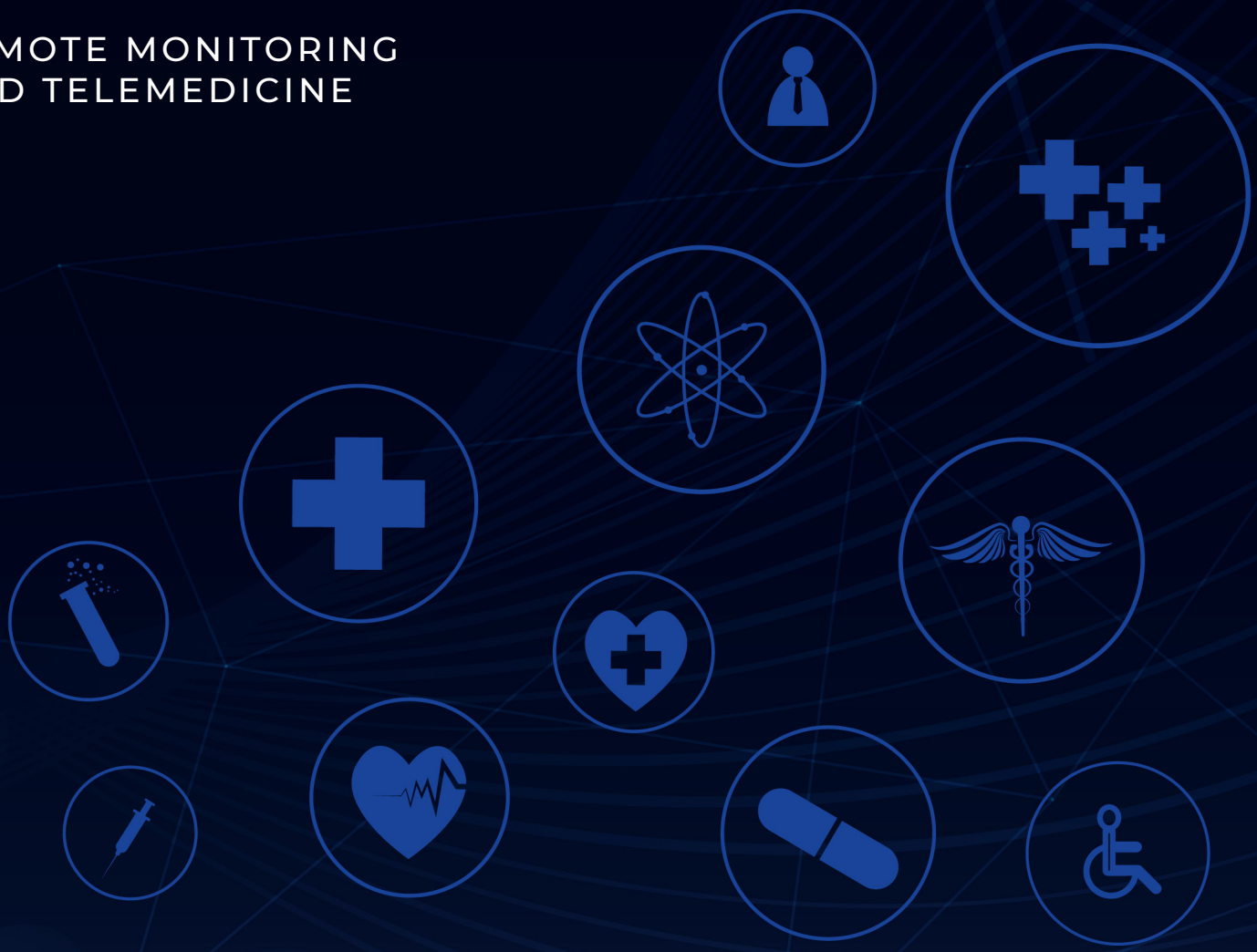
HEALTHCARE REPORT

January 2021

REMOTE MONITORING
AND TELEMEDICINE



GründerAtelier

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Keywords:
Healthcare, Remote Monitoring, Telemedicine, TeleHealth, Challenges, Benefits, Healthcare Trends, Europe, Case Study, Future Outlook

ACRONYMS AND ABBREVIATIONS

Acronyms & Abbreviations	Definition
ICT	Innovation in Information and Communication Technology
mHealth	Mobile Health
EHRs	Electronic Records
RPM	Remote Patient Monitoring
MBO-Ä	Musterberufsordnung der Ärzte *Professional Code for Physicians*
GSAV	Gesetz für mehr Sicherheit in der Arzneimittelversorgung *Law for advanced security in the supply of medicines*
DVG	Digitale-Versorgung-Gesetz *Digital Healthcare Act*
BfArM	Bundesinstitut für Arzneimittel und Medizinprodukte *Federal Institute for Drugs and Medical Devices*
DiGA	Digitale Gesundheitsanwendungen *Digital Health Applications*
PU	Pressure ulcers
SEM	Subepidermal Moisture
COPD	Chronic Obstructive Pulmonary Disease
IHS	Integrated Health Solutions
CLMS	Cath Labs Managed Services

1. AN INTRODUCTION TO REMOTE PATIENT CARE

1.1 Healthcare 2.0: Remote services for an improved care delivery

Innovation in information and communication technology (ICT) has reshaped healthcare[1]. Our society is moving towards a new paradigm of healthcare management. ICT technologies are creating a new ecosystem in which people's well-being is enhanced and cared for by relying on innovative and remote solutions. As a result of this new trend, many european countries are sponsoring programs and creating policies to spread and allow for higher adoption rates over the population of these innovations.

Digital application for mobile devices (mHealth), electronic health records (EHRs), support systems for diagnostic, cloud database for health monitoring and many other innovations are disrupting the Healthcare market. We have many examples of this disruption happening across the world. The NICTIZ project in the Netherlands or the NHS program in the United Kingdom. All these new programs are relying on the possibility of using data storage, process and exchange to allow for big data to improve patient outcomes.

The concept of storing data and processing them without the needs of the active presence of the patient can be synthesized with the idea of Remote patient monitoring (RPM) which describes the usage of specific technologies to facilitate interaction between patients at home and clinicians[2]. It enables patients caring and monitoring not to be limited to clinics or similar facilities but allows the patients to achieve a satisfactory level of care from home or in remote locations.

Subjective data are collected per patient by using devices which store the information at data centers or healthcare facility data storages. These data are later on analysed by specialists or by complex algorithms to determine the most appropriate cure, to review the progress of a patient's health improvement or to check whether the condition of a patient is stable or needs rapid intervention. These devices are used to control the condition of patients affected by different diseases. The most common cases are for dementia and falls, diabetes, congestive heart failure, infertility among others.

There is also an increasing number of telemedicine applications that merge consumer electronics and online features to create a new system of communication between patients and care providers, leading to new care models.

All these innovations allow patients to stay home and enjoy routine care services by just having a device or sensor attached or close to them. All these data on physical and psychological states of the patient can be stored or even transmitted in real time to care providers for review. RPM systems are generally based on devices such as glucose meter, blood pressure meter, weighing scale which are connected to a central medical hub that manages the inflow and outflow of data and information. Hospitals and other facilities are also part of

this loop in case they use EHRs or PHR systems.

Moreover, the innovations are also spreading on the portable devices such as smartphones and tablets removing the need to set up another device with the patient. This trend is usually referred to as mobile Health (mHealth) and allows for healthcare information to be available under multiple aspects and also accessible in different ways. Fungibility of controlling tools and measurement methodologies allow for Information technologies to adapt to the patient increasing the likelihood of retention of these technologies by the patient.

This whole new ecosystem assists the decision-making process of numerous healthcare providers. These new technologies not only allow professionals to provide care services to a broader audience but also to rely on data analytics and real time monitoring to increase the efficiency of treatments and follow-ups.

1.2 The Pressing Need for RPM in COVID-19 Pandemic

Remote monitoring has never been as valuable as it has been over the last year. Restrictions, lockdowns and contagion risks have limited the possibility to provide in-person care to patients and elderly in need. Since telemedicine can be a light-asset activity and built on applications that can be downloaded by anyone in possession of a device with internet connection, it is a highly scalable solution to solve an urgent problem. Moreover, telemedicine can also be developed on a platform-basis where patients can interact and receive the advice needed[3].

COVID-19 outbreak created a new set of conditions that affect everyone's daily life. Work, family, leisure time, social activities and healthcare are few of the many areas that have been affected by it.

While certain sectors have suffered financially such as the travel and automotive ones, the healthcare sector was forced to face its own inability to manage its services in an efficient manner. Beside the lack of preparation to face a pandemic, the healthcare ecosystem witnessed huge bottlenecks that today's systems possess. The healthcare system has been pushed by the need and the urgency of the matter to consider more seriously a possibility that has been present in the industry for quite some time. Remote monitoring has emerged as the new solution to address all the challenges that ongoing patient care, chronic diseases and social distancing policies are pouring onto our society.

1.3 Remote services: Development over recent years in Europe

As the need for remote monitoring and digital healthcare has soared in recent years, laws regulating the video consultation and telemedicine have been drafted.

Paragraph 4 under section 7 of the German Medical Association's Professional Code of Conduct ("Musterberufsordnung für die in Deutschland tätigen Ärzte" - MBO-Ä), allows remote treatment for physicians since 2018.

In August 2019, the German Parliament passed the Law *‚Gesetz für mehr Si-*

cherheit in der Arzneimittelversorgung (GSAV)', which introduced electronic prescriptions.

In January 2020 the Digitale-Versorgung-Gesetz (DVG) came into force. This new act changed the digital health scene in several ways: (i) Decreased implementation time of medical apps by patients, since doctors will be able to add these apps in their prescriptions. Moreover, patients will be able to be proportionally reimbursed by statutory health insurance for a duration of one year once the app has gone through the numerous testing by the BfArM (Bundesinstitut für Arzneimittel und Medizinprodukte) to ensure its safety; (ii) Construction of a obligatory digital network for the health sector is underway, pharmacies and hospitals are obliged to get connected to the Telematics Infrastructure by end of September 2020 and 1st January 2021 and midwives, physiotherapists, along with long-term care and rehabilitation facilities can optionally connect while the cost will be reimbursed and (iii) implementation of electronic patient documentation[4].

The goal of Digital Healthcare Act (DVG) is to increase the utilization of these new applications for care. This is why the investment is extended to €200 million per year in the innovation fund until 2024. And successful approaches will be ensured to be integrated into the healthcare system in a fast and efficient manner. The purpose of this new program is to push health insurance funds to sponsor digital healthcare in a patient-oriented manner by meeting all their needs by providing funding to innovative healthcare entrepreneurs . The Digital Healthcare Act brings in digital innovation that can be used for diagnosis, prevention, treatment or alleviation of the condition and monitoring. In the future, this act will also enhance the connectivity of the healthcare system since the friction for information exchange between various healthcare providers and the insured patient will be gradually reduced. The digital health applications (DiGA – in German: *"Digitale Gesundheitsanwendungen"*) could open a new chapter for digital healthcare in Germany. This arising topic will be covered in our next report where we delve into DiGA with a comprehensive overview and analysis of the implication to German and European digital health market.

Telemedicine and remote monitoring has also witnessed legislative development in other countries than Germany[5].

Belgium

Definition	No definition given by law.
Mandatory Applications	No specific law governing telemedicine.
Restrictions	Physical interaction with the patient is mandatory before diagnosis. Teleconsultation only allowed if the doctor: knows the patient; has access to his or her medical information; can provide continuity of care.
Advertising telemedicine	Advertising is permitted but Article 9 of the Act on Medicinal Products lists some restrictions.
Prescription	Physicians and other specialists are required to use electronic prescriptions from 1st January 2020. Pharmacists cannot deliver drugs for human and veterinary use, medical devices or raw materials outside the pharmacy.

France

Definition	"Telemedicine is the remote practice of medicine based on information and communication technologies. It aims at having healthcare professionals liaising with each other, together with patients or not"
Mandatory Applications	In 2008 was introduced the French Code of Public Health (FCPH) that regulated the field.
Restrictions	Can only be provided by hospitals, clinics or other healthcare organizations.
Advertising telemedicine	Ethical rules prevent the promotion of telemedicine devices. Article 9 of the Act on Medicinal Products lists also other restrictions.
Prescription	There is the possibility to transfer electronically the receipt to the pharmacy. However, this method is still under development.

Italy

Definition	No definition given by law.
Mandatory Applications	No specific law governing telemedicine.
Restrictions	Telemedicine services must be assimilated to any diagnostic/ therapeutic health service. Telemedicine must also comply with all the rights and obligations of any medical act.
Advertising telemedicine	All forms of advertising or health communication by doctors and health facilities must comply with articles 55, 56 and 57 of the Code of Medical Ethics.
Prescription	In the public sector, prescriptions are mainly electronic, while in the private sector the switch to electronic format is still ongoing. Prescribed medicines can only be sold and supplied by stationary pharmacies to which the patient has to provide the prescription.

Netherlands

Definition	No definition given by law.
Mandatory Applications	No specific law governing telemedicine.
Restrictions	Laws that apply to the healthcare ecosystem also affect telemedicine.
Advertising telemedicine	Allowed for self-care conditions that can be diagnosed by the patient or have been diagnosed already by a doctor.
Prescription	Generally prohibited to prescribe medicines online. The Dutch Medicine Act defines as able to prescribe medicine only to those who also sell them.

Spain

Definition	No definition given by law.
Mandatory Applications	No specific law governing telemedicine.
Restrictions	No stated limitations.
Advertising telemedicine	Allowed under Law 34/1988 and Royal Decree 1/2007.
Prescription	Royal Decree 1718/2010 states that prescriptions may be issued physically or electronically, either in the public or private sector.

United Kingdom

Definition	No definition given by law.
Mandatory Applications	No specific law governing telemedicine.
Restrictions	Member states control if healthcare professionals abide by the rules.
Advertising telemedicine	No specific laws concerning advertising on telemedicine.
Prescription	The National Health Service has to authorise contractors to use electronic prescriptions.

1.4 A need that has always been in our society

According to European statistics, approximately 1 in 50 adults in the EU had an unmet need for medical examination and surveys highlighted 3 main causes of this phenomenon:

a. Financial constraints: the medical examination is too expensive and not covered by public or private insurance which cause the patients to not go to the relative specialists.
b. Distance constraints: usually has been found that many patients are too far from medical facilities to allow them to reach them. Therefore, the more vulnerable tiers of the population end up not receiving the necessary medical attention.
c. Time constraints: patients are discouraged by the length of time it takes for a particular examination or set of examinations to take place which leads to avoiding the checkup.

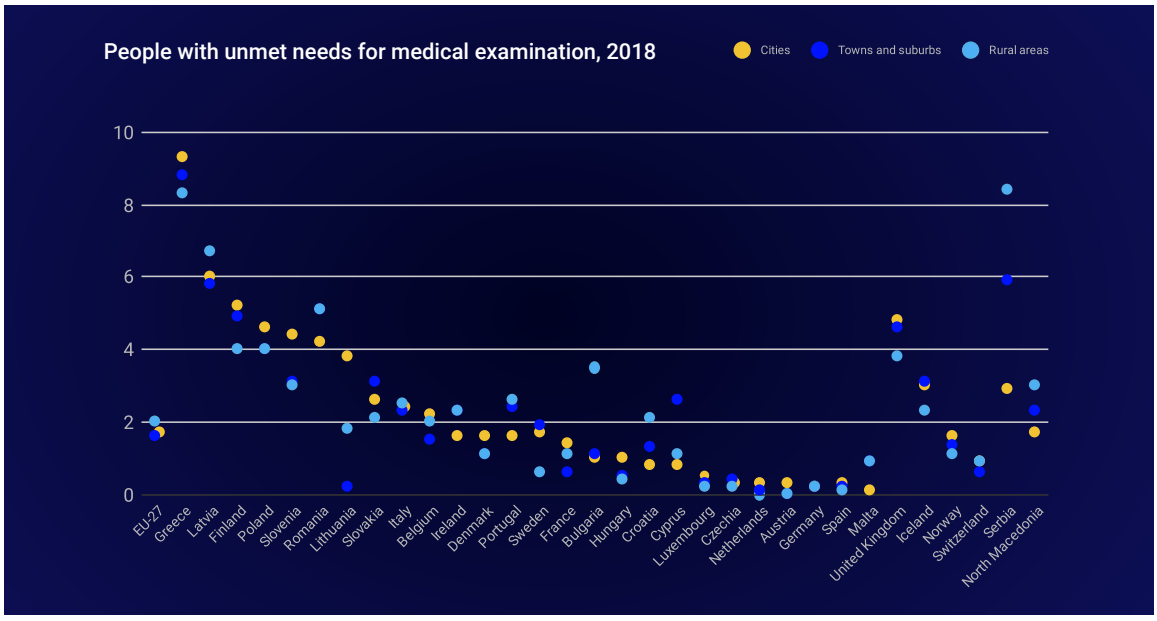

Figure 1 - People with unmet needs for medical examination, 2018 [6]

The chart above provides a clearer picture of the scenario in the European Union in 2018. As we can notice, even though the percentage over the total population is rather low, around 2%, it means that still in 2018 there were approximately 9 million people who didn't have their medical needs satisfied. Striking percentages come from the United Kingdom which has more than 8% of its rural population not satisfied with the healthcare system and Greece that pushed that number above 9% followed closely by its cities and suburb areas for an average unmet medical needs of 8.8%. Moreover, the statistics furtherly focus on citizens that did not receive the medical treatment that they needed in a 2-month time window which increased the data to 3.2% of adults (above 16 years old) in EU-27, increasing the overall case number to more than 14 Million

Europeans. Costs, long waiting times and distance are the main factors that account for 56% of these cases. The remaining cases mentioned fear of doctors and lack of time among others.

Financial constraints remain one of the main reasons for unmet medical needs.

We might immediately blame the different types of healthcare systems across the European Union, however, the type of healthcare system only plays one part in the definition of this number. Socio-economic factors, especially after the second world war caused this problem.

		REASONS RELATED TO HEALTH SYSTEM				REASONS NOT RELATED TO HEALTH SYSTEM					
	All reasons	Total	Too expensive	Too far to travel	Waiting List	Total	No time	Didn't know any good doctor or specialist	Fear of Doctor, Hospitals, Examination or treatment	Wanted to wait and see if problem got better on its own	Other
EU-28	3.2	1.8	1.1	0.1	0.6	1.4	0.3	0.1	0.1	0.6	0.3
EA-19	2.3	1.4	1	0	0.4	0.9	0.2	0	0.1	0.4	0.2
Estonia	18.8	16.4	0.6	0.8	15	2.4	0.3	1	0.1	0.2	0.8
Latvia	11	6.1	4.2	0.5	1.4	4.9	1.2	0.5	0.3	2.7	0.2
Greece	10.1	8.7	8.3	0.1	0.3	1.4	0.2	0	0.3	0.7	0.2
Poland	8.5	4.2	1.1	0.3	2.8	4.3	1.5	0.1	0.2	2.1	0.4
Romania	7	4.9	3.4	0.5	1	2.1	0.4	0.2	0.3	0.9	0.3
Denmark	6.3	1.2	0.3	0	0.9	5.1	0.9	0.3	0.5	1.8	1.6
Hungary	5.6	0.8	0.3	0.2	0.3	4.8	1.5	0	0.3	2.6	0.4
UK	5.6	3.2	0.1	0.1	3	2.4	0.2	0.1	0.1	0.1	1.9
Finland	5.4	4.7	0	0	4.7	0.7	0	0	0	0	0.7
Slovakia	5.1	2.4	0.7	0.3	1.4	2.7	0.8	0.3	0.3	0.9	0.4
Croatia	4.3	1.5	0.5	0.7	0.3	2.8	0.8	0	0.2	1.2	0.6
Sweden	4	1.5	0.1	0	1.4	2.5	0.2	0.4	0	0.3	1.6
Slovenia	3.8	3.3	0.1	0	3.2	0.5	0.1	0.1	0	0.1	0.2
Portugal	3.7	2.1	1.6	0.1	0.4	1.6	0.4	0	0.3	0.6	0.3
Bulgaria	3.3	1.9	1.5	0.3	0.1	1.4	0.3	0	0.1	0.9	0.1
Ireland	3.3	2.8	1.3	0	1.5	0.5	0.1	0	0.1	0.2	0.1
France	3.3	1.1	0.7	0	0.4	2.2	0.5	0	0.2	1.2	0.3
Lithuania	3.1	2.2	0.4	0.1	1.7	0.9	0.1	0.1	0	0.6	0.1
Italy	2.6	2.4	2	0	0.4	0.2	0.1	0	0	0.1	0
Czechia	2.3	0.2	0	0.1	0.1	2.1	0.4	0	0.1	1.4	0.2
Belgium	2	1.7	1.7	0	0	0.3	0.1	0	0	0.1	0.1
Cyprus	1.6	1.4	1.4	0	0	0.2	0	0	0	0.2	0
Luxembourg	0.8	0.2	0.2	0	0	0.6	0.2	0	0	0.4	0
Germany	0.7	0.2	0.1	0	0.1	0.5	0.1	0.1	0.1	0.1	0.1
Netherlands	0.7	0.2	0.1	0	0.1	0.5	0	0	0	0.1	0.4
Spain	0.5	0.2	0.1	0	0.1	0.3	0.1	0	0	0.1	0.1
Malta	0.5	0.2	0.1	0	0.1	0.3	0	0	0	0.1	0.2
Austria	0.3	0.1	0.1	0	0	0.2	0.1	0	0	0.1	0
Iceland	7.5	2.9	2.1	0.1	0.7	4.6	0.4	0.1	0.3	1.3	2.5
Switzerland	2.7	0.7	0.6	0	0.1	2	0.5	0.1	0.1	0.8	0.5
Norway	2.6	1.4	0.4	0	1	1.2	0.2	0	0	0.2	0.8
Serbia	11.8	5.8	3.1	0.8	1.9	6	2.6	0.1	0.5	1.8	1
Turkey	7	2.6	2.3	0.3	0	4.4	1.3	0.1	0.3	2.2	0.5
North Macedonia	6.4	2.5	1.6	0.4	0.5	3.9	0.3	0.1	0.5	2.5	0.5
Montenegro	4	2.6	1.2	0.4	1	1.4	0.3	0	0	0.7	0.4

Figure 2 - Persons reporting unmet needs for medical examination or treatment, 2018 [7]

Cost, time and distance are all factors that might be solved via telemedicine services. Numerous studies are providing evidence that care delivered through remote tools can be both safe and effective, beside the obvious cost savings given by the light-asset nature of the system. Even though European telemedicine is lagging behind countries like the USA or China, it is on the rise due to recent legalization of remote services and electronic prescription.

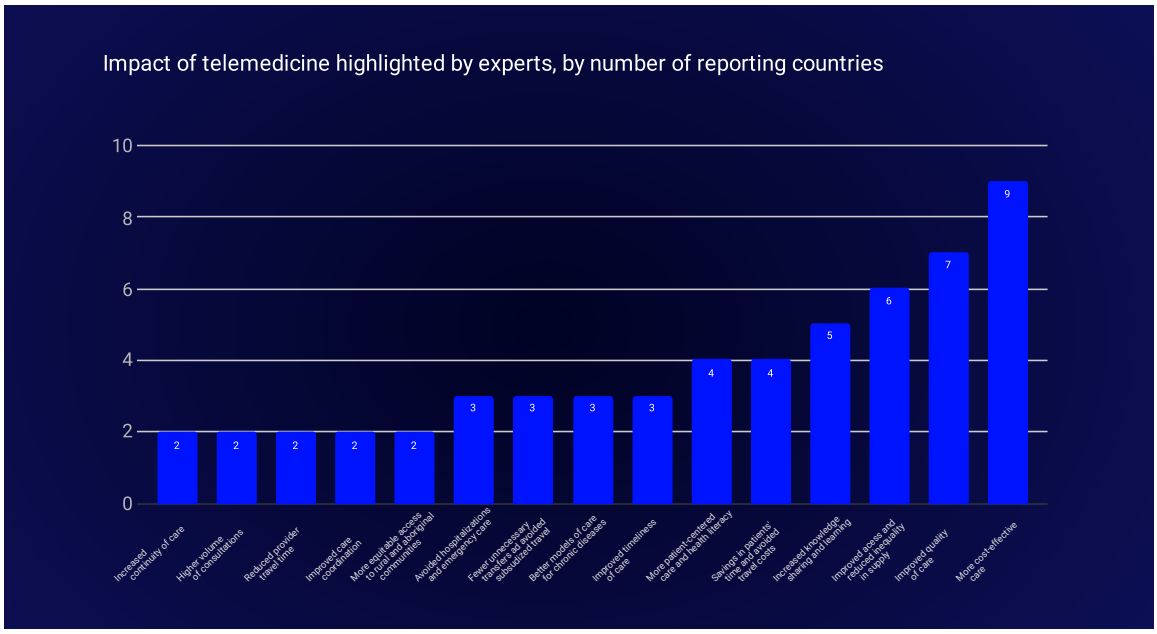

Figure 3 - Impact of telemedicine highlighted by experts, by number of reporting countries [8]

According to this OECD analysis over 13 expert interviews, it was mentioned that cost-effectiveness, improved quality of care, greater access and reduced inequality in supply of medical services comprised the main solutions that telemedicine might bring to the final consumer. These solutions need to be the base on which to build up a legal framework to allow the frailest parts of the population to receive at least the minimum level of care. Moreover, we might expect a plethora of indirect effects by switching from in-person and passive care to a remote and active one. Patients would start to manage their own health and become active in the care process, rather than following blindly a set of prescriptions, furthermore, there are a lot of possibilities in terms of knowledge sharing, community building and learning among patients and healthcare workers.

It is essential to mention that telemedicine is already disrupting and bringing benefits to the population. According to Kotb et al., structured phone support was found to reduce the mortality rate and hospitalization-related heart failures compared to usual care[9]. We have also literature related to the effect of telemedicine on musculoskeletal conditions. According to Cottrell et al. telerehabilitation is effective in improving physical functions compared to usual

care[10]. Subgroup analysis in this research revealed that telerehabilitation together with traditional care is more advantageous than standard care, while treatments provided via telerehabilitation have the same outcome as live intervention for the improvement of physical functions. Moreover, pain improvement was also found to be comparable between the groups following intervention.

2. CHALLENGES IN THE IMPLEMENTATION OF RPM TECHNOLOGIES

The healthcare system has been evolving in the last decades pursuing a new equilibrium in order to provide essential care to everyone in accordance to their needs. Saturation of medical facilities, ever-extending waiting times, increment of chronic diseases needs to be addressed and Remote Patient Monitoring (RPM) can be the solution every state is waiting for. Remote monitoring and telemedicine feel appropriate also at a time where reimbursement policies are constantly changing in order to allow for a higher standard of care, lower readmission rate and shorter length of stays. If we look overseas, according to a report of Definitive healthcare[11] only 25% of hospitals have adopted RPM technologies however a reassuring 88% of providers show that they are willing or have invested in RPM methods. However, as the RPM market rises so do the underlying challenges.

2.1 Patient Challenges

Network Availability: RPM relies as most of the services nowadays on the availability of network and connectivity. Since RPM needs to collect and transfer a big quantity of data, a strong connection is required to assure data is transmitted in a correct and complete manner. Interruptions, lag or other disturbances could alter the quality of the data and thus hamper the diagnosis.

Use of devices: patients will have to understand how to use remote devices and be aware of the usage conditions: heating resistance, waterproof capability, battery lifetime, obsolescence, warranty et cetera. Therefore, patients will not only have to use the device but also manage it. Thus, training might be required and background and condition of patients might have an impact on the learning outcomes.

Higher costs due to certification: RPM devices need to receive approval from the relevant authorities to be commercialized. Testing from public institutions would raise the cost of the device which will be transferred to the final patient.

2.2 Facilities Challenges

Data security: Facilities need to build up a platform or a system that is able to satisfy requirements of privacy and data protection. In this case medical facilities have two options: develop a proprietary platform and manage it internally or outsource the data management process. The former fashion would allow a higher degree of control over data processing, but a higher cost needs to be born. The latter method would be less cumbersome, however the possibility to experience data theft is higher.

Data accuracy: this is often referred to as the main issue when it comes to RPM. Doctors, nurses and medical professionals are then forced to deliver treatments and diagnosis by relying on the subjective perceptions of the patient and the data coming through the remote infrastructure or tool. We can understand the importance of accuracy if we refer to chronic diseases where a lack of appropriate treatment might lead to serious consequences.

Real-Time access to data: This problem concerns the complexity of data management over multiple data transfer. Not only does the patient need to upload the data or remember to follow all the steps to allow the infrastructure or device to record the data, but also the data needs to be correctly transferred to the care provider that needs to have a flawless database and infrastructure to store and analyze the data.

System Integration: data from RPM can be used for different purposes, therefore medical facilities need to be able to develop an integrated set of platforms in order to use the data collected at their maximum potential and at the same time avoid data corruption or loss. Moreover, medical facilities need to also make sure that the interaction between multiple platforms is not going to cause errors over the value chain.

Cost of devices: healthcare facilities are capital-intensive and asset-heavy investments that require time to extrapolate all the value from their resources and therefore are sometimes reluctant to allow new investments. Telemedicine investments would decrease the utilization rate of medical facilities infrastructure which also mean less income per asset and that could cause the facility to become unprofitable between the time of the new investment in telemedicine and the breakeven of it.

Device classification: Providers need to also decide on the type of devices to implement in their RPM programs. Not only is it important the technology and quality of the data produced but also the comfort and usability of the device to enhance the interaction with the patient. It is of the utmost importance to find the right balance between device performance and satisfaction of the patient.

Seriousness classification: RPM practices need to have a range concerning condition severity to respect. Medical facilities will have to decide a scale that assess the patient condition and decide whether RPM or in-person visit is necessary.

2.3 Government Challenges

Unclear definition of Telemedicine: The definition of telemedicine can vary in scope and level of detail. Beside the fact that in many countries there is no legal definition of this practice, in others such as the UAE this practice is heavily defined under the "Remote Diagnosis Services" which includes: remote medical intervention, remote medical monitoring, remote medical prescription, remote diagnosis and remote medical consultation. Moreover, in each Emirate the terms telemonitoring, telemedicine and teleconsultation are separately defined and are wide enough to include even "audio only" and e-mailing services for medical practices[12].

Lack of regulatory framework: As we have previously noticed, in some countries it might happen that there are no direct laws related to the delivery of remote healthcare services, however the healthcare service is still regulated by code of conduct or existing laws regulating any type of medical practice. Therefore, it might happen that sometimes these rules don't include doctors

who are not in that country physically, in the case of cross border medicine for example. Such scenarios can result in a major challenge in the creation of a remote model for those cross border providers.

Identification of medical practitioner: one of the most important questions concerning remote medicine is when and how the medical practitioner is recognized as practicing its profession. As an example, in China providing remote diagnosis constitutes practicing medicine and it is therefore restricted to locally licensed doctors or foreigners with a local practice license, while remote consultation practices are not recognized as medical activities[12].

Different perspective on licensing: Different countries have different requirements for doctors that practice remote services. In some countries, doctors are obliged to have the practicing license in the country they are providing the service while in others it is only needed the abilitation in the country of origin of the practitioner. Moreover, different states have different opinions on services that do not require a final diagnosis. Some countries would ask the doctor to provide the medical license while others would not even classify them as medical practitioners in case of a consulting service.

3. BENEFITS OF RPM IMPLEMENTATION

Remote solutions help facilitate crucial components of care delivery, enabling providers to deliver consistent high-quality services.

Increased data for improved patient care

Remote services can aid healthcare workers in the management of different patient classes so that high-risk ones such as those with heart diseases, asthma, diabetes or hypertension among others can be monitored and taken care of. The higher the amount of data, implying a system able to use the data efficiently, the more actively healthcare professionals can reach out to these patients and provide a better or more effective service. Numerous studies have been performed on cardiac and similar chronic illnesses to understand whether a remote monitoring system would actually create a safer environment for the patient. Especially the usage of wearable sensors has been found to provide patients not only a way to reach out to doctors or specialists in due time but also a safe mechanism that warns the patient in case of critical circumstances or critical values that he or she should be aware of[12].

Higher practice efficiency[13]

We can mention a recent example of how remote medicine can help people and facilities to reduce unnecessary costs. The example of Jefferson Health in the US is quite straightforward. Jefferson Health offers a 24/7 service via JeffConnect, a on-demand telehealth platform. Each JeffConnect client had a flat $49 fee for their on-demand service. The study they developed has proved that each time they were able to divert a recovery into an emergency room, the system saved costs ranging from $300 to over $1,400. For other follow-up cares, the cost savings were reported to be $114 less per visit.

Improved intervention and patient tracking

By using traditional models, healthcare workers have always found it difficult to keep track of the patient and assess his or her adherence to the prescribed plan. Remote monitoring would allow doctors and other healthcare professionals to keep track of the patient actions and at the same time intervene to correct misbehaviors. Moreover, remote monitoring can also be used by caregivers, relatives and friends by allowing them to play an active role in the care of the patient, a possibility that was not even remotely accessible up to a decade ago.

Increased Access to Care

RPMs are one of the few ways in which providers can actively support rural markets, giving patients access to care in case the visit would require extensive travels. At the same time, it becomes easier to interact and monitor elderly or critical patients that face mobility constraints. These benefits will enhance the state of our healthcare system as the Baby Boomer generation continues to grow and ask for 24/7 monitoring.

4. CASE STUDY

RPM is a booming market whose value has already been proven; Research showed 38% of healthcare institutions reported that the RPM system reduced patient re-admissions, in the meantime, 25% proved an improvement in patient satisfaction and 25% reported cost reductions after implementation of a RPM system[14].

After analysis of the current RPM solutions, we evaluate and summarize the solutions and existing companies features of various aspects, for instance, chronic obstructive pulmonary disease specification, congestive heart failure specification, data collection, real-time data sharing, patients dashboard of medical monitoring, emergency system alert, monitoring features embedded with intelligence, patient-caregiver communication program, end to end framework and healthy habit adherence.

Medical internet of things that connects medical devices digitally are beneficial for both patients and healthcare providers. Medical devices are usually designed for a specific use case. Enabling connectivity to medical devices allows data to be generated and gathered according to a patient's health situation and device's mechanism of operations.

Therefore, the increasing connectivity can be levered to improve treatment and monitoring performance and care outcomes, here are the specific use cases.

4.1 Bruin Biometrics

Pressure ulcers (PU), are a partial damage to particular areas of the skin and underlying tissue which are a universal medical problem that can lead to patients' pain, tissue fester and necrosis, disfigurement, infection and even death. The universality of PU in caring centers across Europe varies from 18% to 23% and in the worst situation, this can be up to 57%. However, around 80 % of PUs can be prevented with early detection and monitoring.

Bruin Biometrics developed SEM scanner™, a hand-held skin tissue assessment device which can detect pressure-caused tissue damage in advance. The mechanism of this device is that it detects changes in the subepidermal moisture (SEM), since research shows SEM are found to be able to indicate tissue damage 3 to 10 days in advance before the formation of visual skin damage or PU. This device has been utilized with success in 13 participating NHS hospitals.

Analysis out of the observation and research outcomes for over 1,200 patients showed that:

- Over 50% of hospitals successfully prevent new bed sores in the evaluation period
- The bed sores symptoms are observed to be reduced up to 90% in the hospitals
- Reported reduction of nursing time consumption and improve in productivity
- Reported reduction on length of patient stay and decrease of treatment and caring costs

4.2 Philips HealthSuite

Phillips HealthSuite is an open and secured platform with healthcare-oriented services, capabilities and tools embedded. The platform allows data of medical devices to be shared in a secured and unitary platform that collects, compiles and analyzes clinical and operational data out of a variety of devices and patient data sources. This data can afterwards be accessed by physicians, patients and caregivers remotely via mobile and desktop applications that can generate and present real-time patient data. Philips HealthSuite develops this technology that delivers accurate, predictive, and customized insights and can be levered to enable telemedicine, remote patient monitoring, genomics analytics and precision diagnostics, and help boost behavior changes, and improve the care outcomes of health care providers and help users with tailored services that help them enhance their health and wellbeing.

Currently, it is appraised that the Philips HealthSuite stores over 15 petabytes of data collected from hundreds of millions research on imaging, medical records and patient profiles and feedback. Philips announced HealthSuite Insights in 2018, a pioneer service that provides healthcare-focus tools and technologies to tackle the overall process of establishing, maintaining, deploying and growing Artificial Intelligence solutions. With the help of HealthSuite's open-source platform, Philips has cooperated with research institutions to develop innovative solutions for patients who endure chronic long-term illnesses. For instance, Phillips worked with a Medical Center of a university to develop an integrated solution that levers wearable sensors that can be placed on the chest of chronic obstructive pulmonary disease (COPD) patients after they are discharged. The sensor gathers data on health situation indicators such as physical and respiratory activity and heart rate, and it allows both patients and physicians to track the health status of the patient[15].

4.3 Qualcomm Life

QUALCOMM Life aims at providing solutions to improve connectivity in healthcare and life sciences companies and institutions. Product of Qualcomm Life, Capsule, can be used to gather and analyze data from hundreds of kinds of medical devices and integrate it into patient EHRs. Over 2200 hospitals have integrated this solution into its management system to automate the data collection and show and inform vital signs to the hospital's EHR system which are formally entered and detected manually by nurses. As a result, this solution can save up to 30% of nursing time.

A research conducted in a hospital located in France shows by avoiding manual data gathering and data transcription into the EHR system, the technology is able to save more than 164 hours per year, which gives nurses more time to provide care services for patients, in the meantime also increases the data volume collected from patients by 54%. Qualcomm Life has also cooperated with Philips to improve the connectivity of medical devices through Qualcomm's 2net Platform for Philips' Healthsuite Platform[16].

4.4 Medtronic's Cath managed services

Medtronic developed Integrated Health Solutions (IHS) which focused on developing long-term collaborations with health institutions, hospitals, clinics, physicians and insurances to provide customized services and solutions to improve clinical, operational and financial outcomes[17]. HIS's services include the design, operations management, technology updating and innovation and majorization of Cath labs, with the aim of helping cardiology departments in various hospitals to: enhance care outcomes for patients, improve operational management outcomes, save and manage cost within health system.The beauty of Medtronic's Cath Labs managed services (CLMS) is that it's vendor independent and is capable to manage all aspects of a Cath lab no matter what products are used[18]. Currently, Medtronic IHS developed 170 ongoing long-term collaborations in 24 countries across Europe, for example the UK, Italy and the Netherlands, and the Middle East, where Medtronic HIS delivers value to healthcare institutions and companies and in the meantime contributing to the delivery of high-quality care more cost effectively.

Taking one example from its partners, Medtronic IHS realized in the Maastricht University Medical Centre in the Netherlands:

- $2.5 million costs saved per year
- The patient admission time are reduced by 90%
- The length of stay of cardiac resynchronization therapy patients witness a reduction of 33%
- The cancelled procedures reduced by 37% due to better planning and scheduling
- The staff overtime saved up to 43%

IHS Managed Services solution also covers different care units and department beyond the Cath Lab, such as Operating rooms and ICUs.

5. FUTURE OUTLOOK

Cost-effective and purposefully-designed, technology-enabled health care solutions can improve the well-being of millions of people and radically change the way services are delivered to patients.

Digitalization innovation enhances the care continuity, improves patient health and promotes patient's self-consciousness to health and proactiveness to prevent chronic diseases. The technology innovation might revolutionize the health system and propose new models to shift the current hospital-centered systems into a more patient-centered care system with more focus on community and care integration. Digital tools are able to realize better use of health data in order to promote customized healthcare and enhance utilization of healthcare data. The shift of orientation is essential for both the medtech industry and the pharma industry since connected medical devices and the IoMT will be of great significance to fill in the process of a new model.

6. CONCLUSION

RPM and telemedicine are going to be integrated into care management practices but the speed of adoption will depend on how effectively institutions want or are allowed to leverage on these technologies. Corporations, institutions, complexes and clusters all need to work towards an integration of RPM programs in their daily operations. However, this evolution won't be easy. They will need a consistent, flawless and methodical workflow that seamlessly integrates all the parties and information. This new ecosystem will also necessitate a behavioral change from the consumer/patient side. There will be no more passive health management where patients react to treatments and recommendations but they will start developing a routine of active health management. Moreover, this evolution falls within the betterment of security infrastructures. Data is becoming the new economy currency and as valuable as they are, they need well-suited infrastructures. The future of healthcare might be online and it is up to each one of us to put down the effort to make this possibility a reality.

REFERENCES (APA)

1. Vavilis, S., Petković, M., & Zannone, N. (2012)
   Impact of ICT on home healthcare In ICT Critical Infrastructures and Society (pp. 111-122). Springer Berlin Heidelberg

2. Shelagh Dolan, list of the top remote patient monitoring companies, v endors, and startups in 2020, 2020,
   Retrieved from: *https://www.businessinsider.com/remote-patient-monitoring-companies-startups?IR=T*

3. Andrew R. Watson, The Value of Remote Monitoring for the COVID-19 Pandemic,
   Retrieved from: *https://www.liebertpub.com/doi/10.1089/TMJ.2020.0134*

4. Federal Ministry of Health,Driving the digital transformation of Germany's healthcare system for the good of patients, 2020,
   Retrieved from: *https://www.bundesgesundheitsministerium.de/digital-healthcare-act.html*

5. Osborne Clarke, Telemedicine in Europe, 2020,
   Retrieved from: *https://www.osborneclarke.com/wp-content/uploads/2020/05/H_2004141116LSH_Telemedicine-Questionnaire_v03.pdf*

6. Eurostat, People with unmet needs for medical examination, 2018,
   Retrieved from: *https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:People_with_unmet_needs_for_medical_examination,_2018_(%25,_share_of_population_aged_%E2%89%A516_years,_by_degree_of_urbanisation)_RYB20.png*

7. Eurostat, Persons reporting unmet needs for medical examination or treatment, by main reason 2018 , 2018,
   Retrieved from: *https://ec.europa.eu/eurostat/databrowser/view/hlth_silc_08/default/table?lang=en*

8. OECD, Impacts of telemedicine highlighted by experts, by number of reporting countries, 2020,
   Retrieved from: *https://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=DELSA/HEA/WD/HWP(2020)1&docLanguage=En*

9. Kotb, Ahmed & Cameron, Chris & Hsieh, Shu-Ching & Wells, George, Comparative Effectiveness of Different Forms of Telemedicine for Individuals with Heart Failure (HF): A Systematic Review and Network Meta-Analysis, 2015,
   Retrieved from: *https://pubmed.ncbi.nlm.nih.gov/25714962/*

10. Cottrell MA, Galea OA, O'Leary SP, Hill AJ, Russell TG. Real-time telerehabilitation for the treatment of musculoskeletal conditions is effective and comparable to standard practice: a systematic review and meta-analysis, 2017 May, Retrieved from: *https://pubmed.ncbi.nlm.nih.gov/27141087/*

11. Alanna Moriarty, Definitive Healthcare, The State of the Remote Patient Monitoring Market in 2019, 2019, Retrieved from: *https://blog.definitivehc.com/remote-patient-monitoring-market-2019*

12. William Ferreira, Adilene Rosales, International Telemedicine: A Global Regulatory Challenge, 2020, Retrieved from: *https://www.engage.hoganlovells.com/knowledgeservices/analysis/international-telemedicine-a-global-regulatory-challenge*

13. Ortholive, New Study Shows Telehealth Saves $1,500 Per Visit, 2019, Retrieved from: *https://www.ortholive.com/blog/new-study-shows-telehealth-saves-1500-per-visit/*

14. Meg Bryant, Remote patient monitoring cuts hospital admissions, ER visits, report finds, 2018, Retrieved from: *https://www.healthcaredive.com/news/remote-patient-monitoring-cuts-hospital-admissions-er-visits-report-finds/539073/*

15. Philips, Is connected care the future for the NHS?, 24 August 2017 Retrieved from: *https://www.hsj.co.uk/technology-and-innovation/is-connected-care-the-future-for-the-nhs/7020418.article*

16. Kathy O'Reilly, Joost Maltha, Jamie Eisinger Philips and Qualcomm announce strategic collaboration to advance personalized connected health care, Phillips, 2016. Retrieved from: *https://capsuletech.com/fr/press-releases/collaboration-to-advance-personalized-connected-health-care*

17. Frost & Sullivan, European Managed Services for Cath Labs Market Leadership Award, 2016, Retrieved from: *https://pdf4pro.com/view/2016-european-managed-services-for-cath-labs-194baf.html*

18. Medtronic, Integrated health solutions, 2018 Retrieved from: *https://www.medtronic.com/fr-fr/professionnels-de-sante/integrated-health-solutions.html*