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E-HEALTH START-UPS, AN OPPORTUNITY TO SUPPORT THE TRANSFORMATION OF SOUTH-MED HEALTH SYSTEMS

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Executive Summary

The health systems of the Southern Mediterranean region were in systemic crisis long before the advent of Covid-19. However, this pandemic exacerbated the fragility and revealed the unpreparedness of these health systems to deal with health emergencies. For several decades, these countries have been grappling with a continuing health transition, characterized by the growing impact of non-communicable diseases in the burden of diseases and causes of mortality. In the future, these countries will encounter further challenges, particularly as the population ages. This stresses the need for them to deploy new technological solutions to secure their health systems and face the growing expectations of their populations. The Covid-19 epidemic has given a strong and timely impetus for innovation and the implementation of technological solutions in the health sector and, as such, has highlighted the significant growth potential of digital health in the South-Med region.

The aim of this policy brief is to address the issue of e-health entrepreneurship and innovation in the countries of the South-Med region. After providing an overview of the situation of the health systems in the selected countries, we will explore the contextual elements relating to business climate, barriers to investment and ecosystems built to foster the creation of start-ups. We will then highlight the success stories of five start-ups from Algeria, Lebanon and Tunisia. We will outline the motivations leading the entrepreneurs to create their start-ups, the contribution of their innovations to the health systems of their countries, the challenges they faced, and the role of their experiences in the success of their entrepreneurial projects. Finally, we will conclude with some recommendations to bridge the digital divide and facilitate the creation of e-health start-ups in the region. The ultimate goal is to strengthen the capacity of the health systems to meet the needs of the population.

1.Introduction

Digital health refers to the use of information and communication technologies (ICT) to deliver and improve health services. Driven by mobile computing, artificial intelligence (AI), big data and genomics, digital health provides more personalised and coordinated care, faster and better treatment at lower cost. We are witnessing a paradigm shift in the way we treat and care for people's health needs. The arrival of new key players, i.e. Internet Tech giants, who show an unhidden appetite for the health sector, has accelerated the spread of digital innovations. The growth prospects for the healthcare market are now considerable. The global digital health market is expected to grow from $183 billion in 2020 to $201billion in 2021, at a CAGR of 9.79% (Research and Markets, 2021). The ongoing health crisis has shown the potential for the development of digital health around the world. While it is not a silver bullet for COVID-19 and other health problems, it is critical for improving overall health system outcomes. During this crisis, we have seen the deployment of teleconsultation devices for conditions that do not require a physical face to face consultation, the implementation of remote monitoring for the chronic diseases, the development of online platforms for advice and instruction to prevent the spread of COVID-19 new technological solutions are emerging regularly.

The relationship between health and digital technology is often the subject of lively and complex debates. Many of the technological solutions involve ethical issues, a number of which are new and therefore sometimes difficult to understand. The generalisation of digital health implies finding answers to questions such as: the confidentiality of personal data, the management and implementation of technical solutions covering the entire population, the digitalization of current health services, accountability, training, autonomy, and the monitoring of patients when e-health solutions will allow them to remain at home for their treatment (IRDES, 2019). Furthermore, the increasing use of e-health solutions could create inequalities between those who have access to digital tools (hardware and connection) and are able to use it (digital health literacy) and those who are deprived of material, connection or digital education. At present, there is no global framework for digital health. However, international organisations have already started to frame common principles, share best practices and design tools to help developing countries catch up with the leading countries and bridge the digital divide (WHO, 2020).

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2. Status of the health systems in the South-Med countries

The health systems in the countries covered by this study face difficult and complex challenges, particularly evidenced by new pressures from the development of non-communicable diseases and population ageing. Available information on key health indicators shows significant improvements in recent decades: life expectancy is increasing, maternal and infant mortality are declining, and health coverage is increasing to various levels in benchmarked countries. The public sector remains dominant in all the countries of the region. However, the private sector is playing an increasingly important role in meeting the health needs of rich and poor populations, especially in the case of maternal and child health (MICS, DHS). In the absence of an efficient and quality public sector and sometimes of the relational capital to access it, populations have no other choice but to rely on the private sector with a risk of catastrophic health expenses for the poorest in these populations. In most countries, the private sector is fragmented or unorganised; its governance is limited and uneven. The increasing role of the private sector in health care provision is increasing health care expenditure, especially as higher healthcare costs exclude a large proportion of the population that is not covered by health insurance. Table 1 shows the level of health expenditure compared to the general domestic product (GDP), to the health expenditure per capita, and to the income per capita in the six selected countries of the South-Med region.

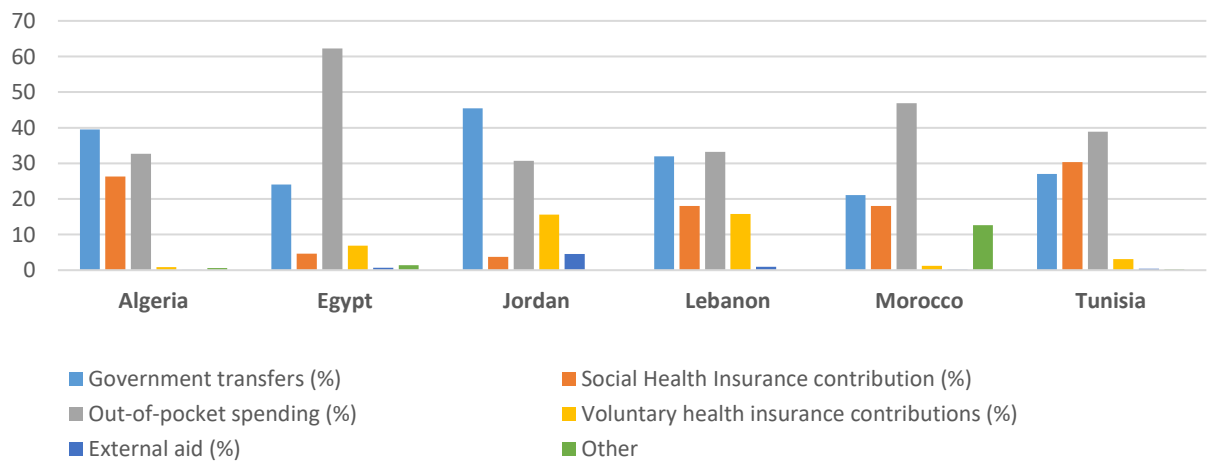
Table 1: The indicators on health system financing in the six selected countries of the South-Med region

	Algeria	Egypt	Jordan	Lebanon	Morocco	Tunisia
Health Spending (% GDP)	6,22	4,95	7,79	8,35	5,31	7,29
Health Spending per capita (US$)	256	125,5	330,1	686,5	174,8	251,5
GDP per capita (US$)	4 115	2 538	4 238	8 218	3 290	3 450

Source: WHO Global Health Expenditure Database, 2021.

In all countries covered, the share of out-of-pocket expenses is too high (at least 30% of total health expenditure on average). This is above the threshold for the incidence of "catastrophic expenditure", which is set at about 15% (WHO, 2005). Catastrophic expenditure is said to occur when households spend more than 40% of their disposable income on health services after deducting subsistence allowances (WHO, 2005).

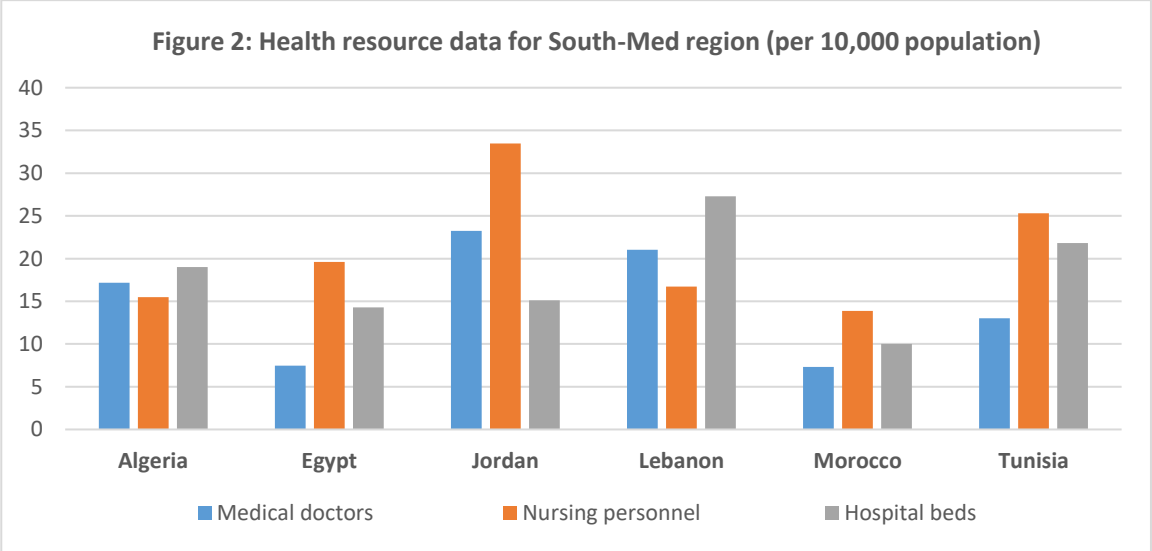
Figure 1 : Healthcare Expenditure by Financing Schemes (%) in the in the South-Med region



Source: WHO Global Health Expenditure Database, 2021.

According to the World Health Organisation (WHO) regional office for the Eastern Mediterranean countries, the average health expenditure was about 5.4% of GDP in 2018. Most of the countries included in this analysis have a percentage above the regional average, with the exception of Egypt and Morocco, which have 4.95% and 5.31% respectively. Lebanon and Jordan have the highest levels of national income devoted to health, at 8.35% and 7.79% respectively. Tunisia and Algeria are at an intermediate level between the two groups of countries. The low level of public spending on health in some countries, such as Egypt and Morocco, is correlated with the increasing burden on households to finance health expenditures. This has implications for catastrophic health expenditures, meaning that there is a high risk that households will become impoverished as a result of paying for health care. This is a serious obstacle to progress towards universal health coverage. Financial aid from donors and international agencies remains limited to countries like Jordan mainly in the form of budget support and funding for specific projects. Some countries in the region also face issues in training and retaining health workers, especially young doctors and those working in rural areas.

Recent WHO statistics on medical, health workers and bed densities reveal, depending on the indicator used, significant disparities between countries in 2018, as shown in the following figure.



Source: WHO Health Workforce Database, 2021.

Jordan stands out from the other five countries of the Southern Mediterranean region by having the highest medical and paramedical personnel densities. Note that the average density in the MENA region is respectively 13 doctors and 25 nurses per 10,000 inhabitants, 23 and 51 in Latin America and the Caribbean, and 29 and 96 in the OECD countries. Lebanon, on the other hand, has the highest number of beds per 10 000 inhabitants, followed by Tunisia and Algeria. These latter have higher indicators than the average for the MENA, and then the Latin America or Caribbean regions, which have 15 and 18 beds per 10,000 inhabitants respectively. However, they are far from the OECD average of 50 beds per 10,000 inhabitants. Notwithstanding the appreciable level of density recorded, the countries of the South-Med region are struggling to offer satisfactory access to care for their entire population, whether at geographical or financial coverage levels.

The analysis of public and private health care sectors shows a little complementarity between the two sectors. In general, this combined offering has not made it possible to re-establish the

balance between the different regions and even less between the different provinces in terms of health services. Indeed, a policy of public-private partnership, as part of a comprehensive strategy for equitable health care provision, is urgently needed.

The health crisis has shown on the one hand the structural weaknesses of the health systems in the countries of the region, and on the other hand, revealed the significant growth capacity of digital health. Not only can digital health help the countries of the South-Med region to overcome traditional obstacles, in particular constraints related to personnel and other physical resources, it can also contribute to achieving universal health coverage (WHO, 2015 &2021). It is in this context that entrepreneurs in the South-Med countries have launched start-ups to take advantage of this growth opportunity with the aim of participating in the transformation of health systems in the countries in question.

3. Some of the challenges facing start-ups in the South-Med region

The MENA economies are experiencing low economic growth, limited economic diversification, and high unemployment rates, especially among youth and women. Despite notable reforms, many aspects of the investment climate continue to limit or refrain investors and the private sector growth on a broader level. Table 2 lists the main obstacles to private sector investment in five countries of the South-Med region. These include limited access to finance, the burden of corruption, the perceived high tax rate and the large share of the informal sector in the economy.

Table 2: The biggest obstacles experienced by private sector firms in some South-Med countries

Indicator	Egypt	Jordan	Lebanon	Morocco	Tunisia	MENA	All countries
Percent of firms identifying access to finance as a major constraint	18.3	17.4	47.8	28.4	47.4	27.5	23.8
Percent of firms identifying corruption as a major constraint	34.8	30.4	77.9	46.2	56.1	43.5	30.9
Percent of firms identifying tax rates as a major constraint	24.4	22.9	41	40.5	39.4	28.6	31.1
Percent of firms identifying practices of competitors in the informal sector as a major constraint	21.1	25	45.5	41.7	58.8	30.5	28.6

Source: World Bank Data. Enterprise surveys, what businesses experience, 2020.

The weight of each of these constraints varies according to the country. Unlike Lebanon, Tunisia and Morocco, both Egypt and Jordan have better business climate indicators. In terms of access to finance, loans to Small and medium-sized enterprises (SMEs) are currently under-represented in total bank assets. They represent no more than 6% of total loans in Egypt (Boushnak et al., 2018) and 15% in Tunisia (CAE, 2018). In general, banks are wary of SMEs, which they consider to be carrying a much higher risk to finance than large companies. The development of efficient financial markets in the countries of the region would reduce reliance on internal funds or informal sources such as family and friends. So far, the financial sector in the South-Med region has not met the needs of many innovative SMEs with high growth potential. In addition, several countries in the South-Med region have set up Islamic finance schemes in order to capture resources from the informal sector on the one hand, and on the other hand to contribute to the financing of SMEs, thanks in particular to an offer of financial products complementary to the traditional system. This will help meet the growing needs of SMEs that are still struggling to find adequate sources of financing.

In order to accelerate the transition to the new economy, most South-Med countries have put in place a legal framework and ecosystems to encourage the creation and promotion of start-ups. Everywhere, Start-up Acts are emerging; initiatives led by governments to put their countries in the "Start-up Nations" leaders' field. In the Maghreb, start-up ecosystems are relatively new, such as the Start-up Act in Tunisia (2018), Algeria Disrupt (2020) and StartUp Maroc (2011) & Tatwir-Start-up (2021). Coordination between the various Moroccan, Tunisian, Algerian and Libyan entrepreneurial ecosystems seems to be taking shape through the "Maghreb start-up Network" initiative, which is supported by some forty stakeholders and backed by the World Bank.

Compared to the Maghreb countries, Egypt, Lebanon and Jordan are relatively better equipped in terms of support and guidance for start-ups. They concentrate the largest number of start-ups benefiting from regional and global recognition. Jordan is one of the main actors of the MENA forum on information and communication technologies (ICT). After the establishment of accelerators and venture capital companies, Egyptian start-ups have been provided with financial resources to allow for unprecedented development. According to the latest reports from specialised platforms (Partech, 2020 & MAGNiTT, 2021), Egypt is among the most attractive countries in Africa and the MENA region for start-ups, not only in terms of the number of deals (26% in 2020) but also in terms of volume. In the space of a few years, Lebanon has seen the rise of its technology start-ups. By 2019, the country had more than 2,000 start-ups operational and supported by accelerators, incubators, venture capitalists and many other ecosystem actors (WB,2017). Despite the progress made by the countries of the South-Med region, their ecosystems are either in a nascent or intermediate stage of growth; they are still far from maturity.

According to their national contexts, entrepreneurs have launched digital health start-ups to tackle this growth opportunity. Their objective is to participate in the transformation of health systems in the countries of the South-Med region.

4. Finding solutions to the Health systems challenges through Digital Health Entrepreneurship

Five start-ups operating in the digital health, founded by academics and researchers, have been included in this analysis. Three of them were supported by the European Commission funded project "THE NEXT SOCIETY" (TNS). This support has been very beneficial for the development of their business models. In addition, Design Thinking method implementation was valuable as it has helped modify and readjust many aspects of their projects. The start-ups had specific challenges to face during their creation process. This section looks at the motivations of the entrepreneurs in creating their start-ups, the contribution of their innovations to the health systems of their countries, the challenges they faced, and the role of their experiences in the success of their entrepreneurial projects.

The initial motivations of the start-up entrepreneurs refer to a multi-faceted spectrum. There are economic motivations, with the desire to escape the unemployment that strikes young graduates in the countries of the South-Med region, as well as motivations that are of interest to practices that will improve the way in which care is provided or trained and finally they also have altruistic motivations to improve patient care. The analysis of the entrepreneurs' paths in the creation of their start-ups shows that some elements are individual (professional experience, motivation, etc.) and others connected to their environment that may have favoured their projects and guided them differently. Indeed, new organisations emerged at the

intersection of the singular (the entrepreneur), the plural (the supporting actors), and the contextual spaces.

Through their innovations, the entrepreneurs have offered original solutions to diverse problems in their countries' health systems. For example, OCTAnalysis has improved the quality and time of diagnosis of keratoconus patients, their follow-up and the discovery of new treatments for this condition. AngelDoc and Checkskin offer solutions for real-time monitoring of chronically ill patients and early detection of melanoma. This would significantly reduce unnecessary hospitalizations and irrelevant care. DoctHus offers an online continuing medical education platform to meet the needs of healthcare professionals who want to access relevant and up-to-date training. Techgraph (now Medetic) has implemented a solution to minimise the risk of injection error during surgical procedures. In addition to the clinical benefits for patients and the improved skills of healthcare professionals, innovations have a significant impact on reducing waiting times for patients and public and private healthcare expenditure.

The constraints faced by start-ups differ from those identified by the World Bank study on private sector SMEs (see Table 2) with the exception of access to finance, which remains a common issue. Nevertheless, start-ups seem to suffer doubly from delays in setting up financing mechanisms adapted to their specificities and the difficulty of finding funds from commercial banks, which are highly risk-averse. In order to meet the challenge of financing and accelerating the development of their projects, start-ups have approached investors and financial experts, sought grants and donations and in some cases utilized their own resources. They have also participated in numerous national and international competitions to benefit from mentoring sessions and prizes. Administrative burden also cited as a barrier to risk-taking. The slowness and inflexibility of local administrations characterise the entrepreneurial environment in the countries in question. In addition to this, the lack of legal framework in some countries and the need to evolve for others, call for action to meet the requirements of start-ups. The question of personal data protection and security on a national cloud infrastructure has arisen. Some start-ups have sought authorisations, hardly obtained, to process health data. The problem of prototyping and industrialisation was cited as one of the major obstacles. One of the start-ups worked with a world leader to use its technologies in its product. Start-ups complain about the lack of skills at the local level. Even though they were able to hire high-level people who collaborated in all phases of the project, it was difficult to retain them in the long run.

Box 1. List of start-ups that participated in the study

Country	Name	Description
Algeria	DoctHus	DoctHus provides an online medical continuing platform that serves the need of health professionals to get access to updated training, attend relevant events and have the history of their continuous learning journey according to the regulatory framework on medical continuing education. www.docthus.com
Algeria	Techgraph	Techgraph is a medical tool to avoid medical mistakes in Anesthesia. It ensures a minimum risk of error rate during interventions. It combines technology and medical knowledge. Her product aims to bring organization and security to an area where the lives of people who place their trust in the hands of medical teams are at stake. https://www.facebook.com/SarlTechgraph/

Lebanon	OCTAnalysis*	OCTAnalysis propose the first solution that offers the measurements needed for corneal haze and demarcation line examination in a fast, automated and objective manner with good agreement compared to manual measurements, while being more repeatable and reproducible. https://octanalysis.com/
Tunisia	AngelDoc*	AngelDoc is a diversified healthcare start-up that aims to support patients with chronic diseases to live healthier lives. It offers leading international connected medical devices and a software platform to intervene instantly in the case of health concerns. https://angeldocadoc.wixsite.com/accueil
Tunisia	Check Skin Health*	Check Skin Health offers an IoT application based on software and hardware solution for a telemedicine service for the early detection of the deadliest skin cancer: Melanoma. This IoT application connects patients, dermatologists, hospitals, and clinics via technology and software with a fundamental mission to optimize for better health. https://www.thenextsociety.co/check-skin-health

*Note: * These entrepreneurships participated in THE NEXT SOCIETY Project funded by the European Commission*

On another note, most start-ups lacked entrepreneurial culture and sufficient business practice and knowledge, in particular marketing tools. They are often unaware of how to grab market opportunities, seek funding and draft business plans. They try to raise their level of knowledge in this area by participating in numerous training courses at national, regional and even international levels (e.g. The Next Society project which promotes and strengthens innovation ecosystems favourable to the development of start-ups in the South-Med region). Some start-ups regularly participate in numerous national and international medical events to raise awareness among health professionals, to increase their visibility and improve their attractiveness.

These constraints have not deterred the start-ups; on the contrary. Rather, they have pushed them to work harder and put all their efforts and energy into the success of their projects. The experiences of the entrepreneurs have shown that they have been able to cope with hostile national environments for entrepreneurship and innovation, but they also have been able to create and develop their start-ups. In terms of education, start-ups in these countries have nothing to envy to those in developed countries. This proves that these countries have a pool of talents on which they can rely to achieve the digital transformation of their economies.

The start-ups' launch paths cannot be free of mistakes. They had to re-evaluate their project idea several times and modify it to fit the needs and expectations of the users. These entrepreneurial success stories highlight three main lessons learned that are useful to share with peers: firstly, the importance of keeping an open mind during the start-up journey, as this broadens the realm of possibilities. The original idea of the project can be completely modified to fit the reality and ultimately lead to pivot. Secondly, the need to remain agile and to be aware that one cannot always get it right the first time. Thirdly, the obligation to prioritise the market's need for an idea and to share it to solve an existing problem. Start-up entrepreneurs from academia do not always think in terms of society's needs. Many of their ideas are chosen solely for their originality. This approach is not recommended. Such ideas rarely succeed and do not offer much value to the users.

Conclusion and Policy Recommendation

The review of the experiences presented in this policy brief shows the potential for countries in the South- Med region to achieve significant progress through the digital transformation of their health systems. Disparities exist between the countries of the region in terms of progress in the process of implementing digital solutions. The experiences of the entrepreneurs in creating their start-ups highlight the magnitude of the challenges to be overcome in order to make the transition to digital health. Several recommendations can be formulated, some of which relate to the global environment and others to specific sectors.

At the global level

Education and training in the use of digital technologies are necessary. ICT should be included in the school curriculum starting at the first levels of the education system. The insufficiency in ICT infrastructure is particularly large, and the percentages of the population connected to the Internet negatively affect the potential of digital health. These gaps need to be filled in order to increase the level of connectivity. As security is a key issue, governments will also need to ensure that they have adequate policy frameworks in place, regarding the privacy of patient data and to facilitate the transfer of such data between providers, in line with patients' demands (Tsakas, 2021).

The implementation of a favourable ecosystem for investment in the digital sector is essential. Governments should facilitate both private and public investment in the digitalisation of enterprises, attract foreign direct investment, encourage R&D spending, and help attract talented people through tax incentives for start-ups. Countries in the South-Med region should collaborate with all international partners such as the WHO, development banks and private entities to benefit from their expertise to leverage and unlock their potential in digital health.

At the sector level

The definition and implementation of national digital health strategies are crucial. Several countries in the South-Med region do not have dedicated national plans. Digital technologies will not deliver their full potential without a plan that gathers the necessary resources, coordination, cooperation and leadership. These countries might provide incentives and tailored support to facilitate the creation of digital health start-ups. In addition, the creation of dedicated banks, as the financing constraint is a recurrent barrier to investment, would help better finance and perpetuate start-ups. They should design specific programmes and create platforms to strengthen the skills of project promoters.

Learning from successful experiences, it is clear that empowering entrepreneurs with tools to develop their skills and encouraging them to overcome challenges, while keeping an open mind and flexibility, are key successful approaches. It is to note that most of the entrepreneurs in this study were young graduates with or without previous experience. Young people should be encouraged to pursue further education and training, including subjects that move away from the traditional educational schemes.

Finally, introducing doctors and academics to entrepreneurial education programmes during higher education and during working life will allow them to be fully equipped with the necessary knowledge and the proper mind-set. This will open new horizons for them and increase the potentials of joining collaborative high tech projects, start-ups or launching their own venture. Incidentally, this would enable them to be more creative in finding solutions to current health problems..

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Entrepreneurs who participated in this study

Check Skin Health - Wiem Abbes

Wiem Abbes is a project leader of a spin-off company "Check Skin Health". She holds a Ph.D. in the National Engineering School of Sfax (ENIS), Tunisia. She obtained her engineering degree in computer sciences in 2013 from the National School of Computer Sciences (ENSI), Tunisia. Her research interests include artificial intelligence, computer vision, image processing, and ontology.

OCT Analysis - Jad Assaf

Jad Assaf is currently a medical student at the American University of Beirut, Lebanon. His interests and research are focused on biomedical analytics and artificial intelligence in ophthalmology, namely corneal imaging and corneal tomography.

AngelDoc - Tesnim Charrad

Tesnim Charrad is a Doctor in Computer Science graduated from the Higher Management Institute, University of Tunis. She holds three (CH and TN) patents. Her research is centered on inventing new telemedicine systems for chronic disease monitoring using Artificial Intelligence techniques. Her startup named AngelDoc will be launched soon.

DoctHus - Adam Selamnia

Adam Selamnia has 20yrs+ entrepreneurship experience in health and technologies. He managed Pharma international development and clinical studies, and designed digital health solutions. Recently, he co-founded Nium (Luxembourg) and DoctHus (Algeria). Adam holds a PhD in Physiology of Human Nutrition (Univ. Paris, FR) and an MBA (EMLV La Défense, FR).

Techgraph - Bilel DOUDAH

Bilel Doudah, computer engineer from the National School of Computer Science (ESI) Algiers, 4 years of experience in startups activating in the field of education and health, co-founder of the 9rayti startup which designed several educational applications, one of which has exceeded 1.2M users, Bilel is also vice-president of the techgraph startup where he contributed to the design of several medical devices.

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