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XXVII. International RESER Conference

RECENT EVOLUTIONS FOR THE HEALTHCARE DIGITAL PLATFORMS AND THEIR IMPACTS ON THE TRANSFORMATION OF THE HEALTHCARE SYSTEM

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The healthcare digital platforms are characterized as Social Technical Devices acting as Health Interface Organizations. They now play a key role in the healthcare Information and Communication Organizational Ecosystem. After their emergence in a first period, they now reach a maturity level, with a model defined by both the increasing use of advanced digital technologies (big data analysis, artificial intelligence, block chain...) and the integration of numerous services for a more comprehensive offer. Some trends are underlined through case examples among two territorial pilot projects and one healthcare platform implemented by a startup. In an approach of evaluation, some value indicators are suggested in a multi dimensional analysis positioning.

We now witness the emergence of the power of holding data in the information economics, with huge amount of data that are scattered but centralized through digital platforms thanks to better data storage, take up and analysis. Many stakeholders are involved in this data gathering and processing chain and the consequences on knowledge are very important.

The concept of “data sphere” or “info sphere” is defined as the environment where information is generated and propagated; its represents a digital space constituted by volatile property in an often undetermined geographical space. This immaterial environment is however real, with all the data belonging to individuals or concerning them. (Vade-Mecum ADEL, 2018)

Important changes occur in the healthcare systems with the development of both the long-term care and digital technologies. This transition period is characterized by the emergence of various e-health digital platforms and new models with offers through “business to consumer” innovative services.

Healthcare platform services include not only information sharing or remote healthcare advice, medical appointments and other services, but also connected medical devices, artificial intelligence processes, smart healthcare data and tele-medicine stations...

According to some studies (Parson et al., 2016), “the impact of the platform revolution (...) has been limited – so far” in healthcare.

However, since the beginning of the 2000s, new forms of cooperation have emerged, such as collaborative or open approaches and specifically open-innovation practices (Daidj, 2017).

Various types of data are used: data, being either social, via networks and other media, personal (for example, tracking device data) or transactional or administrative probes...(Béranger, 2016).

The described collaborative practices are, in most cases, based on a platform approach. All platforms integrate a collaborative dimension in different forms, at the time that they renew cooperative strategies and relational practices, which extend beyond social networks (Daidj, 2017).

Digital technology changes the health ecosystem completely. (...) What appears for health professionals to be the ultimate provocation in the digital era resonates as the promise of a more precise and quicker diagnosis, indeed a totally personalized patient treatment...(Béranger, 2016).

The current landscape in healthcare is characterized by a juxtaposition of many different platforms. We will investigate some case examples for completing our tracks of reflection. We intend to outline some trends in the different strategies at stake for the implementation or extension of platforms. In the ongoing process of multiplication of digital platforms in the healthcare field, we first aim at revisiting the characteristics and the typology drawn in our previous reflections and analyze their impact.

In what consists the value of those healthcare digital platforms?

How do they interact with the healthcare system?

Will their development come out as the provision of digital healthcare services on the whole French territory and help to improve the healthcare access in rural and remote regions?

Do they contribute to the healthcare system transformation?

What could be the trend for their growth in the future after this period of great extension with more patients and healthcare providers involved, and extended services? Will the tendency in their evolution be specialization or normalization, territoriality or national implementation?

What are the real benefits or threats brought to the patients and to the healthcare system?

In order to answer to these questions, we state that an ecosystem approach should reveal the dynamic constitution of the healthcare system linked with recent digital deployment.

1. The Concept and Context

A platform has a function of intermediary for the access to the information, to the contents and the services provided by stakeholders.

The digital platforms display two characteristics as a minimum (Courmont, 2015):

- Data aggregation, centralization and standardization of data coming from heterogeneous stakeholders.

- Emergence of an authority in position of hyper mediation. The consequences are numerous on data, practices and especially in the repartition power/governance and the balance between the human and the machine.

They are a combination of technical devices for healthcare improvement purposes. In previous analysis, (Depeyrot et al., 2016, 2017), we pointed out that they are at the same time a technological and organizational object, with a perimeter designed by the population target, the objectives and the services provided.

They represent an area for interactions between numerous stakeholders and constitute an ecosystem, that is to say a system of interactions between the populations of different species living in a same place, and between those populations and the physical environment (Tansley, 1935).

An ecosystem is characterized by a double interaction: one between the actors, and one between the actors and the territory (Uzann, 2013).

The questions are to identify the populations included in the ecosystem, to characterize their interactions and to specify the environment that is not only in the physical space but also in the virtual dimension.

The numerical platforms take different forms.

Until last year, we had identified four types according to their offer of services that represented the interactions between identified actors:

- The information platforms,
- The platforms for advice/consultation/expertise,
- The platforms for the coordination,
- And last, the support for patients platforms.

Today, the main feature in the recent period is a noticeable extension of healthcare digital platforms, as well for their increasing number as for the services proposed on existing platforms. The expansion of the services offered by the different current platforms leads to differentiate the platforms on the basis of new criteria. With the analysis of three cases, this paper suggests to question the starting typology for appreciating the evolutions at work in the healthcare system. The current multiplication of healthcare platforms can be observed through several points of view: different strategies for their implementation, different stakeholders involved and their disruptive dimension. Two main factors can be noticed: a real acceleration in providing new services such apps, connected devices...and a wider access to services for patients and for the healthcare providers with more numerous territorial platforms.

The French national digital healthcare strategy orientates towards the coverage by of a territorial support platform (PTA) on every territory. For helping this evolution, the Healthcare regional agencies (in French, Agences Régionales de Santé, ARS) have to manage the implementation of Coordination support numerical services (in French, Services numériques d'appui à la coordination, SNACs).

2. The Evolution in Technologies

The evolution from acute to long-term healthcare with chronic diseases generates new needs. Plural and chronic pathologies require the patients' monitoring and follow up rather than immediate care in emergency situations. With the different causes and the interactions that may intervene in such diseases, more data have to be centralized for analysis analyzed, using complex algorithms and crossing

parameters to get better results for diagnosis and anticipate some treatments. Meanwhile, significant changes occurred for the Information Technology (IT).

“Digital technologies (viewed as combinations of information, computing, communication, and connectivity technologies) are fundamentally transforming (...) strategies.” (Bharadwaj et al., 2013)

The following illustration highlights the technological gap achieved.

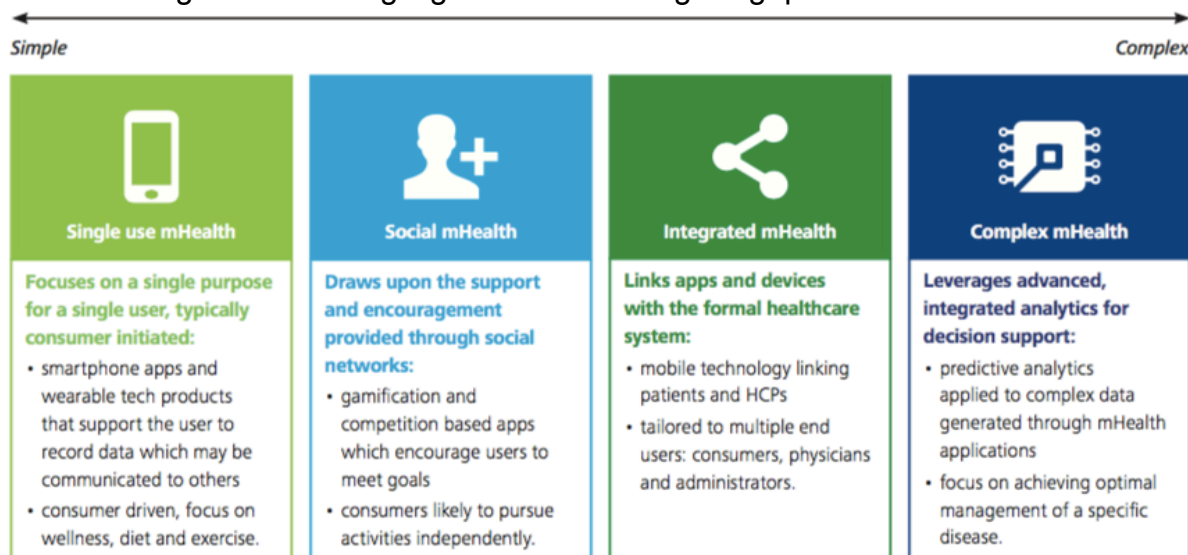


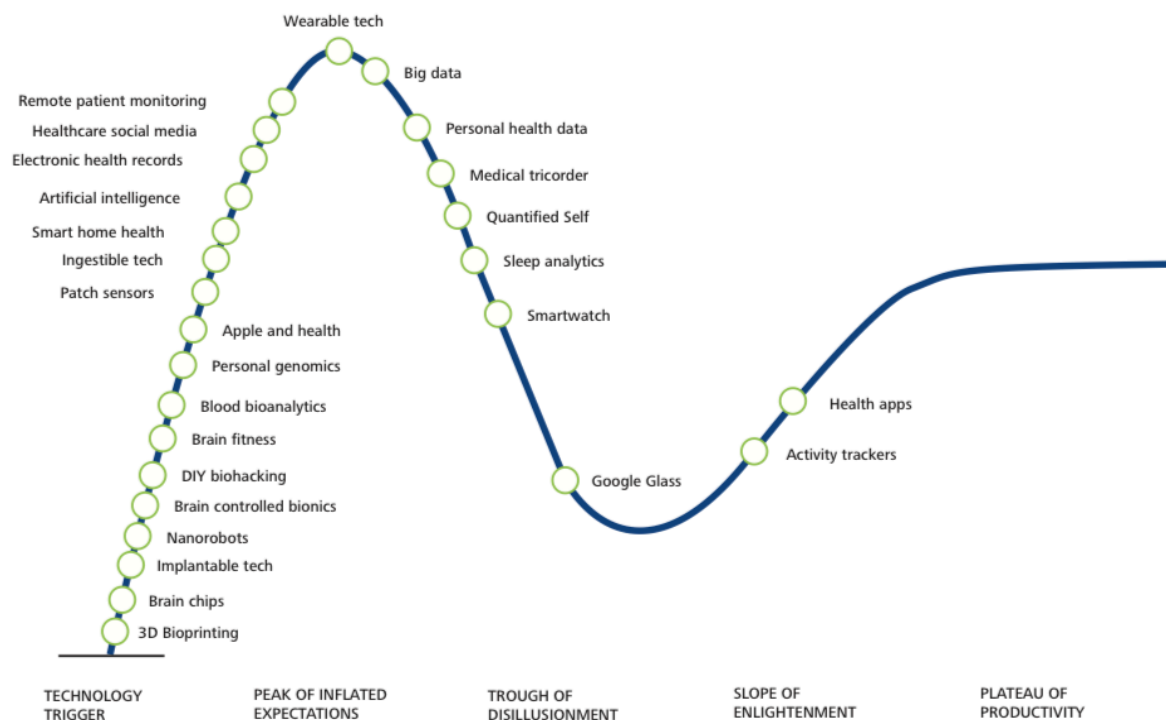
Fig.1: mHealth opportunities range from the simple to the complex (source: Connected Health - How digital technology is transforming health and social care Deloitte Centre for Health Solutions)

In self monitoring, there is to consider “the sociocultural dimensions of eliciting patients to become ‘digitally engaged’ in their own medical care and preventive health efforts (...) in relation with the complexities and ambivalences that are part of using self-monitoring and self-care technologies for monitoring health and illness states, (...) with all “the emotions and resistances they provoke, their contribution to the burden of self-care and the invisible work on the part of healthcare workers that they require to operate.” (Lupton, 2013)

“Interactive digital media platforms have been established in recent years to elicit lay people’s experiences of illness and health care. The overt function of these platforms is to provide forums where patients and caregivers can share their experiences with others, benefit from the support and knowledge of other users and contribute to large aggregated data” (...) with the use by the platforms’ owners of the data they contribute to produce. (Lupton, 2014)

Centralizing huge amounts of data from apps and connected devices, the healthcare platforms could take a step in maturity with the use of big data techniques that enable patients’ correlations in longitudinal records, analysis in the diagnostic cycle and predictive modeling. “By digitizing, combining and effectively using big data, healthcare organizations” could get potential benefits which “include detecting diseases at earlier stages when they can be treated more easily and effectively; managing specific individual and population health...” (Raghupathi, 2014)

The following chart illustrates how new technological devices have successively been implemented and how digital healthcare platforms may bring real benefits as combining and integrating them.



Source: Digital Health Hype Cycle, Bionically, 2014

Fig.2: The hype cycle for digital health technologies (source: Connected Health - How digital technology is transforming health and social care Deloitte Centre for Health Solutions)

As platforms are collecting, hosting and managing data from multiple connected objects and sensors, they contribute to the interoperability between several standards. Besides the cloud technologies with data storage capacities fueling big data analytics, there is an increase in sensing technologies and service chatbots for healthcare. As for sensors, “there are now numerous emerging (...) wearable sensing technologies (...) with a growing significance and potential utility of this unique class of sensing platforms. Applications include wearable consumer electronics, soft robotics, medical prosthetics, electronic skin, and health monitoring.” (Kenry et al., 2016). Furthermore, “the combination of wireless sensors and genomics may bring in relation to heart attack, cancer, transplant rejection, type 1 diabetes and asthma”. Numerous health apps have been launched and many of them have not worked because of the lack of contextualized information and good integration into the patient’s life. In order to help patients and follow the adherence to an assigned treatment, there is to collect data regarding therapies, patient demographics and engagement. Integrating location, timing and other personal data, machine learning and advanced analytics now enable to create appropriate digital healthcare solutions. The technological capacity of platforms may contribute to personalized medicine that needs to manage the huge data volumes related to the patients and their way of living and required for the longitudinal approach of the healthcare pathways.

A turning point has been reached with machine learning algorithms and Artificial Intelligence (AI), with voice apps and speech recognition, self healing and learning, through the use of very complex computing programs for human intelligence simulation and base of knowledge for drawing comparisons. The block chain is the last disruptive technology for healthcare.

3. Three Case Examples

We selected case studies in order to lighten our reflection about the impacts of the healthcare digital platforms for an approach through different viewpoints. As we made previously a survey about the information platforms, we chose to focus on a telemedicine platform and on coordination platforms.

MédecinDirect has been selected as a telemedicine platform: this selection among the numerous healthcare digital platforms designed by startups is due to the real recent increase in uses of telemedicine services and to the extension of complementary services with the integration of Artificial Intelligence, in order to illustrate the added value of new technology applications.

Then, we will observe the implementation of two different types of platforms held by public stakeholders for improving the healthcare coordination: Santé Landes and IsèreADOM. They have been selected in relation of their positioning towards the healthcare ambulatory field, which is so demanding for the coordination between stakeholders.

Santé Landes

Case example 1: Santé Landes

Model built as part of the territorial digital healthcare program TSN (in French, Territoire de Soins Numérique)

Project name

XL ENS (Excellence)

Promoter

Regional healthcare agency of Nouvelle Aquitaine

Scope

Healthcare providers and patients

Territory

At the beginning of the experimentation in 2015, a territory of 225.859 inhabitants; from 2016, the whole department of Landes with 403.234 inhabitants.

Services provided

The main goal of the project is the setting up of the territorial support platform Santé Landes (in French: plateforme territoriale d'appui, PTA) with an extended use of digital tools for improving the flow of the healthcare pathways for the patients suffering from chronic diseases.

The distinctive feature of the project is the organization of a personalized follow-up homecare in chronic diseases in order to limit hospital stays.

Impacts

From the beginning of the project, 3000 patients were accompanied.

General practitioners rely on the platform support for the follow-up of 39% of them.

A decrease of 5% of the activity is observed in the department of chronic diseases in the hospital of Mont de Marsan.

Table 1: The main characteristics of the project Santé Landes

In the region Nouvelle Aquitaine, the pilot was based on chronic diseases, and rather for homecare. The project took the shape of the support territorial platform, Santé Landes, for providing help and saving time to the healthcare professionals. The project perimeter was a small territory at the beginning, and then extended to the department of Landes. It is organized around the PTA of Mont de Marsan, which was the center in the initial perimeter, and on three MAIA (in French, Méthode d'Action pour l'Intégration des services d'Aide et de soins dans le champ de l'autonomie: structures mainly based on the case management principle for improving the global care for Alzheimer patients) in the department of Landes.

From the beginning, a pluridisciplinary team (doctors, nurses, social workers) works for accompanying around 3 000 patients and coordinate their healthcare pathways.

The services offered are both information and orientation services, and support for the complex pathways provided to general practitioners. The orientation of the patients is facilitated by the information pushed on the website sante-landes.fr. For the complex pathways, the PTA acts mainly for coordination during the admission and discharge periods in hospital stays.

Enabling their access on smartphones has brought an improvement of the digital tools: it is possible to send SMS; their easy and quick use facilitates the information supplying and the documents or records sharing by the healthcare professionals. The main tool (Globule / Paaco) can be used for all the patients, as well in the relation between the doctor and the nurse, as for the coordination of all the stakeholders in a complex pathway. As for its functionalities, this tool allows to record a healthcare personalized plan (in French, plan personnalisé de santé: PPS), to notify alerts and to carry out tele expertise acts.

Results have been achieved with a better anticipation of the needs of hospitalization, and reducing the length of hospital stays. A decrease around 5% of the hospital activity is observed in the department of chronic diseases (diabetes and respiratory medicine) in Mont de Marsan.

IsèreADOM

Case example 2: IsèreADOM

Example of a territorial platform in the medico-social field

Project name

IsèreADOM (initial project: Autonom@dom)

Promoter

Departmental Council of Isère

Scope

Support for home care to all professionals (nurses, life assistants, physiotherapists...) and all the patients and users in the department

Territory

Department of Isère divided in 4 areas: urban, peri-urban, mountainous, rural

Services provided

The main goal of the project is to provide a bunch of services to the population in loss of autonomy or suffering from an invalidating chronic disease, or in situation of convalescence.

The distinctive feature of the project is an approach of living laboratory for the implementation of a unique platform integrating several offers of healthcare and

medico-social services and permanent remote assistance.

Impacts

- The improvement of the integration of data coming from the different stakeholders and connected devices
 - A better information sharing between the professionals involved in the patients' care
 - Various benefits from extended aging at home
- 600 patients benefit from the supply of preventive and monitoring devices

Table 2: The main characteristics of the project IsèreADOM

The project has been led in an approach of living laboratory aiming at achieving a disruptive innovation: a unique platform integrating several offers of healthcare and medico-social services and permanent remote assistance.

The innovation is focused on 3 directions:

- Homecare for frailty in the elderly population in risk or in situation of loss of autonomy; In this field, financing comes from the Departmental Council (in French, Conseil Départemental) and the Regional retirement pension insurance fund (in French, CARSAT) and the users;
- Homecare supporting continuity of care during the hospital discharge transitions and in the situation of pluri chronic diseases; The same organisms finance this field as the first one;
- Well-being health and ageing; the users, the additional healthcare cover mutual funds and the social sector of the pension funds currently finance this field.

Supported by the Departmental Council of Isère, Autonom@dom aimed at designing a demonstrator in order to develop an organization providing the integration of both technical and human support in order to avoid the worsening in the loss of autonomy and splits in the healthcare pathways.

Finally called IsèreADOM, the pilot consists of a bunch of services for the population in loss of autonomy or suffering from an invalidating chronic disease or in situation of convalescence.

The combination of services includes a permanent (7 days/7) call center or phone platform providing information; orientation and accompanying to all the users about the situation of loss of autonomy, a website for giving access to all the information and to directories for the medical and social services, for the home assistance, a bunch of services for preventive healthcare, homecare and services, tele assistance and tele medical monitoring and a coordinated organization between the stakeholders in charge of aging in place: detection of falls, information sharing, offer of home services before hospital admissions and after discharges in order to avoid splits in the healthcare pathways.

IsèreADOM now completes the TSN program in the Auvergne-Rhône Alpes region called Pascaline, in an integrative process and a comprehensive approach.

Besides IsèreADOM, the support territorial platform and the e-health services provided by the regional healthcare cooperation group (in French, Groupement de Coopération Sanitaire, GCS) SISRA, Pascaline includes TANDEM, a service provided in relation with a collective representation of the healthcare system users' associations for providing support and information to users in their healthcare pathways, connected devices, a vaccination electronic notebook and a social network for the healthcare professionals and a start-up incubator.

The integration of IsèreADOM in Pascaline conveys the link between the user's folder and the numerical connection notebook of IsèreADOM and the coordination folder of TSN and a combined offer for home services (with a directory, access to the coordination folder, management of their interventions) and for tele-assistance and medical tele-monitoring (with the integration of the data collected and the medical treatments in the coordination folder).

MédecinDirect

Case example 3: MédecinDirect

An illustration of the extension of the use of telemedicine, especially for workers

Project name

MédecinDirect

Promoter

Startup

Scope

The workers' healthcare with actions for medical monitoring in the firms and an offer of individual teleconsultations

Services provided to workers having policyholders in mutual funds which are partners of MédecinDirect

The main goal of the project is to provide remote medical advice and consultations with an offer orientated towards firms through additional healthcare cover contracts.

The distinctive feature of the project is the use of Artificial Intelligence (AI) for improving the quality of the services provided.

Impacts

The objectives are to raise the employees' productivity and thus to reduce the global healthcare expenses.

Table 3: The main characteristics of the development of MédecinDirect services

MédecinDirect offers wide screening programs detecting mainly high blood pressure, diabetes or asthma. MédecinDirect' nurses act in cooperation with the companies' medical professionals. They conduct interviews with the employees, take measurements (blood pressure monitor, scale, glucometer...) and interact with the remote medical specialists. Financed by the companies and mutual funds, the screening programs are free for the employees and policyholders.

MédecinDirect is now specialized in medical advice and remote consultations and provides those services through contracts with mutual funds and companies for both stockholders and employees.

At the end of the teleconsultation and under conditions, the doctors may now deliver a medical prescription.

Having to face to the increase of the activity in remote medical consultations, MédecinDirect resorts to Artificial Intelligence (AI) in order to keep the quality level: before giving an appropriate answer, the healthcare practitioners have to ask different questions without omitting to get an important information.

Built on the use of more than 30 000 exchanges recorded on the platform, the analysis aims at standardizing the different healthcare professionals' answers and reducing the length of time before getting an answer. A conversational agent may

be integrated to the process for the asked questions, and it may then be completed by a medical decision aid system.

The first TSN examples illustrate the geographical extension with more actors and interactions, the progressive integration of services or sectorial platforms from other projects with the emergence of a unique model for the healthcare coordination platforms through the digital and organizational convergence. The teleconsultation case is an example of platform in full development in a context of industrialization of the services.

4. The Various Promoters and Strategies

We now aim at investigating how the main actors in the healthcare system are involved in the observed evolution.

National and regional digital healthcare programs

The Ministry of solidarity and health and the Healthcare regional agencies play a key role in spanning regions with territorial support platforms after the pilot experiments. A framework has been defined for the digital policy with a common orientation to the regional implementation of services. The need of a frame of technical references in data collecting is pointed out with recommendation for ethical, technical, medical and regulatory criteria for the evaluation of digital applications.

The TSN program has been initiated in 2014. Five pilot territories have been selected in French regions: Aquitaine, Bourgogne, Ile-de-France, Océan Indien, Rhône-Alpes. The program was led thanks to many stakeholders in the regions, in particular healthcare providers for designing new organizational plans for better coordination on complex healthcare pathways, and industrials for providing innovative technological solutions. It has represented a laboratory for testing the territorial support platforms (PTA). In March 2017, the TSN program has been extended till 2021 with the “e-health program” (in French, e-parcours) aiming at the generalization of the five pilot projects with the extension of the digital territorial services for a better coordination between the hospitals, the social medical structures and social services and the ambulatory field.

The program for the elderly in risk of loss of autonomy (in French, Personnes Agées En Risque de Perte d'Autonomie Paerpa) takes place for implementing support platforms for coordination in healthcare.

And the implementation of the national patient's health record (in French, Dossier Patient Partagé, DMP) is now held by the National health insurance fund (in French, Caisse Nationale d'Assurance Maladie, CNAM).

Hospitals

For hospitals now, digital platforms often help healthcare providers and patients to book medical appointments, to access to an electronic health record, to find information about the pathologies, the treatments and the patients' healthcare pathways, the hospital stays conditions and continuing healthcare after discharge.

The organization of territorial groups of hospitals (in French, Groupements Hospitaliers de Territoire, GHT) contributes to develop the use of digital platforms for exchange between the hospitals forming the group.

Healthcare insurance companies, mutual funds and assistance groups

In this field, the strategy is to have more attractive offers including digital services for their policyholders. Providing digital services is a means of differentiation and not part of a global healthcare improvement plan. Aiming at reducing the risks, the offer is mainly orientated towards prevention with connected objects and teleconsultation, especially through collective contracts for firm workers.

With digital monitoring, the anticipation of treatments to face some pathologies helps to reduce the reimbursement charges thanks to less complications for patients' healthcare. Helping the patients for staying or returning at home after hospital discharge is another means to lighten the healthcare cost burden with the reduction of hospital stay duration.

The technologies now enable to identify persons suffering from chronic or genetic diseases. Patients' pathways can be suggested; targeted messages and personalized communication about pathologies and behaviors help to heighten the results of prevention plans. (Vade-Mecum ADEL, 2018)

The Mutuelle Générale de l'Education Nationale (MGEN), which provides insurance contracts to teachers, went into a wide prevention program called Vivoptim, focused on nutrition, observance, information about disease and physical activity. This program was first proposed to 40 000 persons before being generalized to all policyholders. In order to arouse the patient's empowerment and stimulate the will of a real behavior change, policyholders are given the choice for several healthcare pathways.

An increasing number of healthcare insurance companies and mutual funds now provide services of teleconsultation to their policyholders: Axa assistance developed its own service, other resort to MédecinDirect.

A tele health cabin was launched by La Mutuelle des Etudiants (LMDE) for students in Paris for checking some health parameters. Then this mutual fund associated to Smerep, another mutual fund involved for students, and Intérieure which covers the Home office civil servants and policemen, for this device enabling to realize a whole check-up (heart analyses, size, body mass index, temperature, hearing and vision tests), mainly for students. The use the e-healthcare cabin has been extended to telemedicine a tele (visio) consultation with emergency healthcare providers.

Intérieure also organize screening programs for the early discovery of cancers.

Some mutual funds and groups as Harmonie Mutuelle, MGEN, La Mutuelle Générale, have their own healthcare structures and thanks to the strategy held by the Mutualité Française, telemedicine expands between medical centers and hospitals and in structures for elderly people (in French, Etablissement d'Hébergement pour Personnes Agées Dépendantes, EHPAD), for instance with the project Telehpad in the department of Côtes d'Armor.

Many Assistant or support companies: IMA, Europ Assistance or Mondial Assistance... have implemented phone platforms that now get extensions to digital platforms. They have a real expertise in dealing with a great number of calls, sometimes for emergency or difficult situations.

Pharmaceutical industry

In a context of harder competition, the production of medicine now takes place with new strategies for pharmaceutical groups (example: Lab 39bis Sanofi: Diabeo...) with the diffusion of a palette of services for the patients around the pharmaceutical product itself or digital tools for the professionals.

A new trend is observed in the medtech industry, where “platforms that combine individual medtech products and services into holistic care solutions underpin this transformation.” (Medical technology report, EY 2017)

Start-ups

Innovation emerges with a profusion of new ideas and projects from the startups, and partnerships that may successfully lead to operational projects and integration of new services in digital platforms. The use of Internet of Things (IoT) and connected devices seems to reach a maturity level in the healthcare sector with the trend of associate services for more comprehensive digital platform.

Data are consolidated and analyzed with a real added value: for instance in medical prescription, the platform Hospiville has recently been launched by a start-up MaPUILabs for drug delivery in order to improve the drug therapy for patients in cooperation with healthcare providers between the ambulatory field and the hospital.

Diabnext is an example of contribution to the diabetic patients' compliance thanks to a combination of services on a platform for insulin dependent patients with automated data capture for blood glucose level and insulin rate, carbs ratios and diabetes automatized monitoring based on AI.

Connected devices enable the glycaemia data capture directly from glucometers for glycaemia measurements. The follow-up of the insulin injection data is recorded through a small special clip adjusted to the disposable insulin pens. Carbs ratios are estimated through image recognition software.

An example of alliance strategies for providing a more complete combination of services is the partnership between Weda, a platform for managing patients' electronic healthcare records (EHR) and MonDocteur, a service for on line medical appointments organization. The aim of this partnership is to propose to the healthcare professionals to access directly to their appointments through the interface Weda for managing the care pathway. On an unique platform, they can now manage their medical appointments with detailed information to the patients before their consultations, send them some instructions, access to their EHR and use a secured messaging unit or certified prescription services.

Some healthcare insurance groups invest in start-ups, as VYV with MesDocteurs, start-up specialized in tele advice and medical tele consultation with a network of general practitioners and specialists. The mutual fund Kovers includes in its offer services developed by Visiomed Group, consisting of personalized monitoring (individual profiles from data originated from connected objects and medical devices and reproduced on curves and dashboards) and services of artificial intelligence and algorithmic medicine (virtual medical consultation for the first diagnosis orientations).

Many actors of the healthcare ecosystem: public authorities, health institutions, payers, private groups, startups... are now involved in the implementation of digital healthcare platforms. In reference to our typology, the implementation of coordination platforms rely mainly on the national frame and regional programs for digital patients' pathways; an increasing number of services is released by the other actors as partial or sectorial solutions in response to specific needs or particular populations. A proliferation of sectorial platforms for different types of pathologies,

or patients (women) or ages... is observed and may contribute to maturity models for the different types of platforms with the integration of single connected devices or services as clusters for a more comprehensive digital hub.

5. The Process of Integration

In order to clarify the process observed, it became necessary in our analysis to have a bottom up approach: first, we identify the main types of services in the following table.

The types of services	
Information for the patients through <ul style="list-style-type: none"> • Websites, videos, apps, chatbots... • Social networks: experience sharing... 	Information for the professionals <ul style="list-style-type: none"> • Data bases for medical prescriptions • Electronic clinical guidelines...
Orientation <ul style="list-style-type: none"> • Directories, geolocation • Waiting time for emergency rooms • Medical consultation at home • Hospital rating... 	Medical appointments <ul style="list-style-type: none"> • Schedule booking • Text message reminders • Patients' rides booking...
Support for the patients <ul style="list-style-type: none"> • Coaching, phone advice, tele-assistance • Tele-advice, second medical opinion... 	Monitoring (connected devices) Tele-surveillance (wearable sensors, home devices)...
<ul style="list-style-type: none"> • Tele-consultation • Tele-expertise • Data collection and analysis • Web based clinical trials... 	<ul style="list-style-type: none"> • Patient medicine compliance • Digitalization: electronic healthcare books • Diagnostic images, genetic tests results, biometric information...

Table 4: The main types of digital healthcare services

Many initiatives from different promoters as startups or pharmaceutical laboratories arise in partial response to some patients and healthcare professionals' needs. Simultaneously, the extension of digital services is structured in accordance with the national e-health strategy. As partial or sectorial solutions, some information and support for the patients services platforms tend towards their integration in the coordination ones that orientates to mutualize.

Then we try to represent how the integration operates; we observe both an extension of the services provided on sectorial platforms and the integration of bunches of services in more comprehensive platforms. We illustrate those two trends by assembling the different types of services and including sectorial platforms in the following drawing.

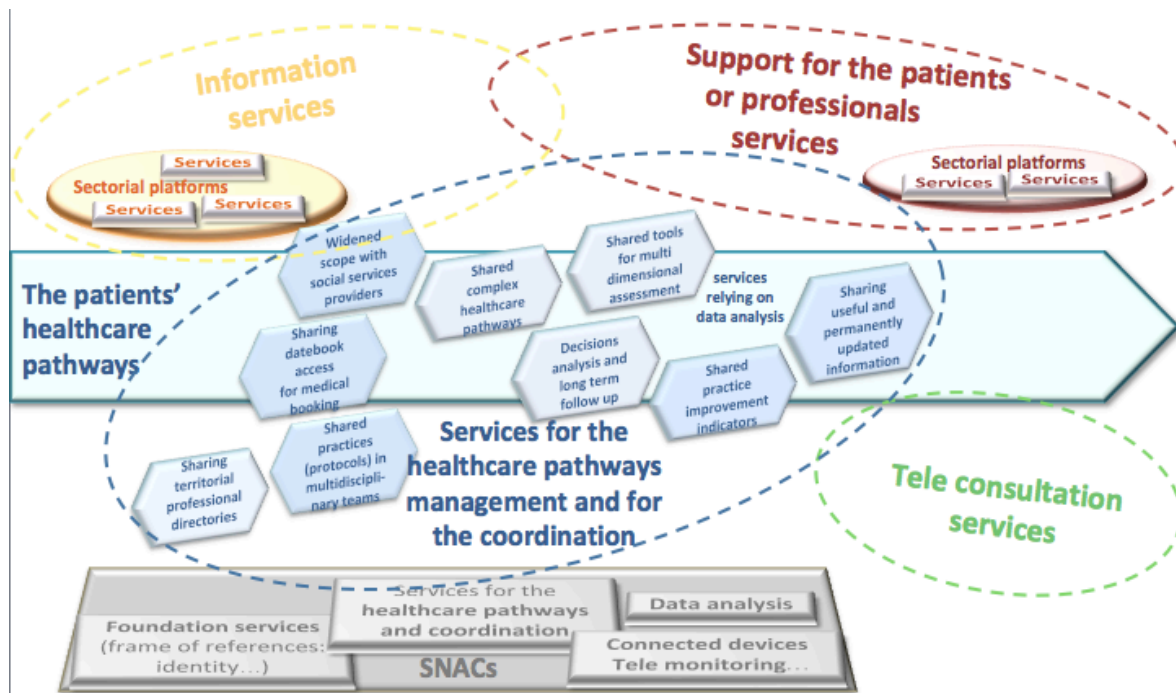


Fig.3: The gradual structuring of the ecosystem with healthcare platforms

Thus, platforms contribute to the structuring of ecosystems through their functionalities. We noticed the current experimentation of sectorial platforms, and this trend might facilitate the conception and deployment of services in a logic of value creation and sharing, leading to the implementation of a full spectrum of applications. Sectorial platforms might be mutualized, providing undifferentiated access to all the stakeholders of the different ecosystems. (Villani, 2018)

We reviewed our typology considering the distinction between the sectorial platforms build in response to the promoters' ideas of the patients' and professionals' needs and the progressive deployment of the territorial platforms through experimentations in the public sector.

Types - Objectives	Promoters	Main target audience	Recent trends
The information platforms	Very diverse <ul style="list-style-type: none"> Public or private initiatives Insurance companies 	All Internet healthcare system users	Proliferation for prevention aims
The support for patients (or professionals) platforms	<ul style="list-style-type: none"> Startups Insurance and assistance companies Pharmaceutical firms 	<ul style="list-style-type: none"> Patients of some types (ages) or suffering from some pathologies Specific medical practices 	Increased multiplication in relation to the promoters' economic model purpose
The tele-advice, tele-consultation tele-expertise platforms	<ul style="list-style-type: none"> Private initiatives Private insurance companies and mutual funds 	<ul style="list-style-type: none"> Insurance mutual funds collective policy holders Aged patients in institutions 	Emergence due to some flexibility in regulations
The platforms for the coordination for the patients' pathways	Healthcare national strategy <ul style="list-style-type: none"> TSN* CTA* PTA* 	All territorial healthcare system users	Implementation <ul style="list-style-type: none"> Based on SNACs* Aggregation of all services

Table 5: The reviewed typology of healthcare platforms

6. The Impacts on the Healthcare System

Before highlighting those impacts, we considered the way platforms are evaluated. For the evaluation of the TSN pilot projects, 4 tracks have been defined:

- The effectiveness of the uses for the different services implemented;
- The efficacy for the patients and users of the healthcare system in terms of quality and access to care and optimization of the healthcare pathways;
- The efficacy for the organization of the work of all the professionals involved;
- The economical and operational efficiency for a sustainable business model.

The value is not created only by the technologies themselves: part of the value created by the digital healthcare platforms arises from their characteristic of digital hub and clusters, which heightens the connections between stakeholders and extends the uses of each isolated service when provided in a complete bunch. Combining services, the platforms act as a value catalyst for innovative services.

Some specific indicators have to be defined for evaluating the digital platforms (Treyer et al., 2018): the collected data, especially the new types, the number of stakeholders affected by the data sharing, the number of use cases provided by the data collected on the platforms, the data security level, the connection frequency or number of up loadings, the number of partners, the number of multi channel interactions: website, e-mail, mobile app, mobile message, video and the number of services provided.

The following indicators concern their specific characteristics as healthcare platforms (Minvielle, 2014):

- The quality: the clinical efficacy, the healthcare security;
- The patients' and professionals' satisfaction;
- The economical impacts: reduction of the avoidable hospitalizations and readmissions with reduction of redundant hospital days, unjustified stays in emergency services;
- The reduction of inequalities in health and access to care;
- The improvement in the coordination even for remote medical acts and monitoring, with the enhancement of the interdependence of the stakeholders.

The healthcare platforms have specific impacts in coordination with the interactions that strengthen communication between stakeholders, especially in care transition and after hospital discharge, with system-wide effects. Helping to formalize expertise exchanges, they contribute to the knowledge transfer.

As their benefits are different for each stakeholder, we point them out for the patients, the professionals and the promoters:

Breakthroughs	
For the patients	For the professionals
Empowerment	Access to medical information
Access to healthcare	Access to other healthcare professionals and hospital departments (networks)
Autonomy	Work organization: calendar...
Preventive healthcare Medication compliance Falls detection	
Anticipated diagnosis Healthcare follow-up Continuum of care	
	Healthcare knowledge Personalized medicine Medical research

Table 6: The main breakthroughs of the services provided on platforms

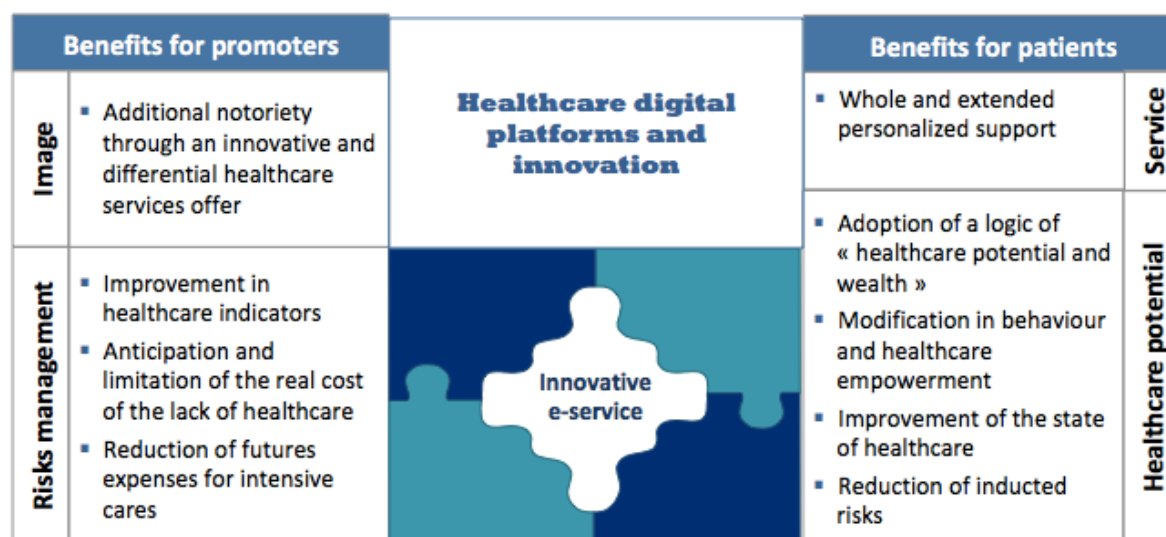


Fig.4: The types of benefits provided by the platforms

Based on the main tracks highlighted by the case examples, we now examine the links between the different phases of the patients' healthcare pathways and the value creation by the digital platforms.

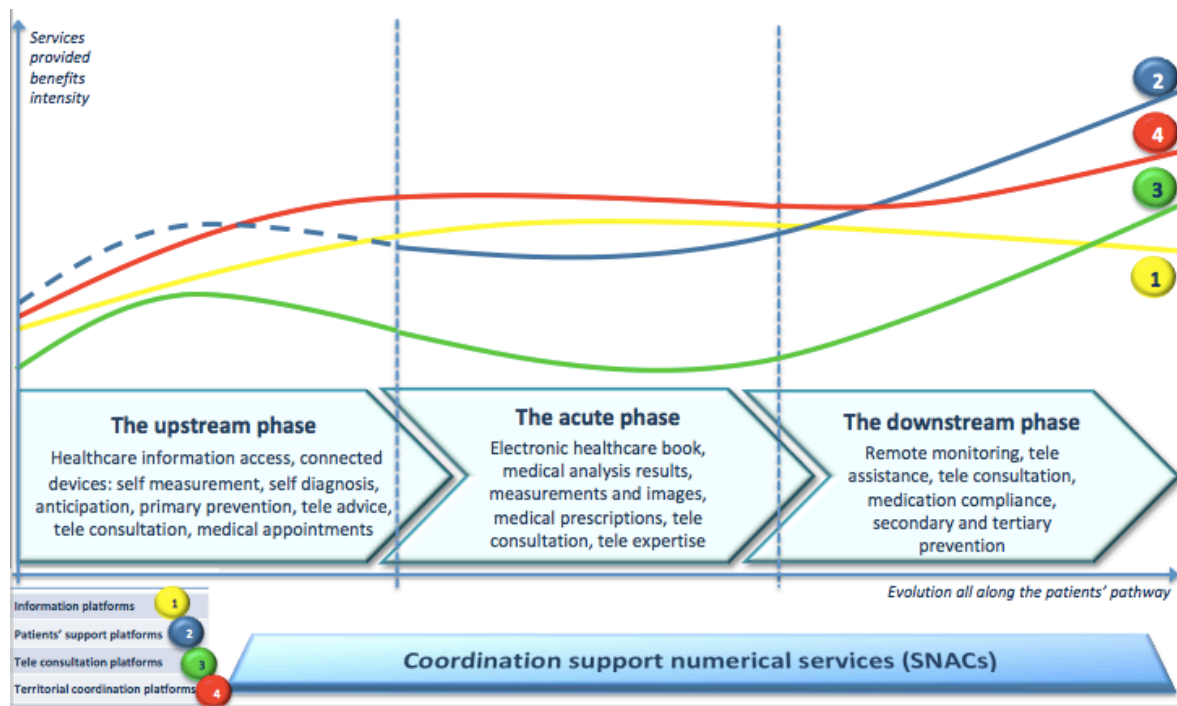


Fig.5: The services benefits intensity depending on the phases of the healthcare pathways

Then we try to illustrate the combination of factors that takes part of the evaluation of the value creation of the digital healthcare platforms:

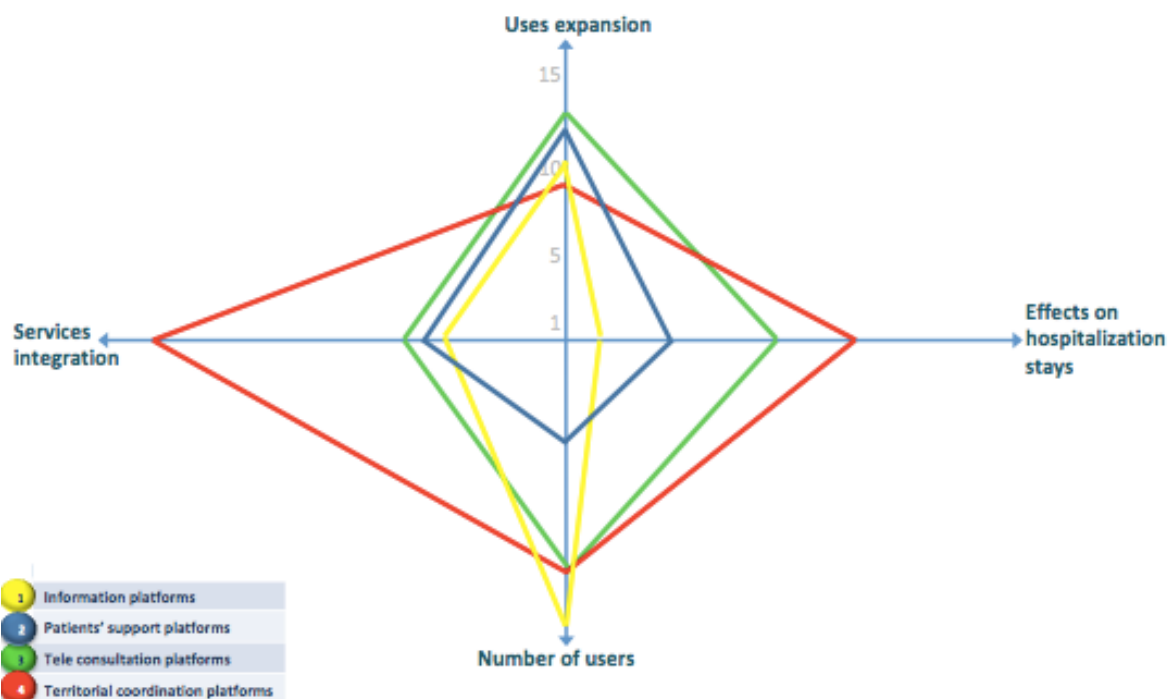


Fig.6: An exploration for a multi-dimensional representation of the value creation

The territorial coordination platforms are the only type characterized by a geographical delimitation. Would a maturity model of digital healthcare platforms be a combination of the different types targeting to a more exhaustive range of services provided on a territory with integration of information, teleconsultation and patients' support platforms?

Conclusions

As a means of connection to the healthcare system for the patients, the professionals and the devices involved in the monitoring and treatments, platforms bring real value in integrating services and consolidating data from different sources. Changes will be effective when the digital convergence will take place; a completed framework might be achieved with the real combination of data from genomics and all types of wireless sensors.

Several questions remain: the observed trend is it only temporary or the result of an adjustment due to a delay in the French healthcare system? Could it go on in a long-term evolution?

There is an increase in both the patients' empowerment and the digital uses for healthcare providers and patients at the meantime. With the current epidemiologic transition to chronic diseases, the burden of healthcare expenses will be heavier, as patients will have to be followed on long-term periods. It will be more and more important to give them information and a lot of support for maintaining their state of health in order to avoid hospitalizations and onerous heavy treatments. Many digital services could help patients in that way and contribute to reduce the healthcare costs. Telemedicine, real time medical screening, self-monitoring and connected objects enable to reduce the healthcare risks and foster predictive medicine.

Analyzing the impacts of the digital platforms on the healthcare system where current changes are important, we aimed at addressing the question of digital value and outlining the way each process interact on the other.

"E-health is considered as one of the solutions for alleviating a part of some structural difficulties." (Daidj, 2017)

The digital platforms provide solutions to patients' and healthcare providers' needs: those are mainly information access and sharing, better links between all the healthcare providers in the patient's pathway, especially between the hospital and the ambulatory system and quicker orientation for medical care in desertified regions. The patients and the clinicians have to work together to improve the patient's health in the perspective of a participatory medicine – in which patients have an equal access to all data and act as case managers of their own illness and co-producers of their own health.

As objects of organizational convergence of ecosystems and data centralization for analysis, the platforms begin to be more comprehensive with the integration of services that is much more than stacking them. The period where services could be launched with unproved value (especially for apps) is ended and the evaluation approaches for platforms may lead to a maturity phase in their evolution.

The question of the size of the platform area is asked. In the extension of their scope, several ways can be observed with the enlargement in terms of geographical areas for the patients, of related pathologies or of additional services. The main current trend is the implementation of the healthcare coordination platforms on a territorial scope for all types of patients and not only for the complex pathological situations.

The question to address is to size the perimeter of the ecosystem: which actors are in and which actors are in the periphery? Which recommendations could be formulated?

Are they smarter and their impacts higher if they remain small?

The transformation of the healthcare system is required for adapting the organization to the new patients' needs, for facing to the multiple chronic disease situations

in a context of longer life expectancy, the strong desire for many elderly persons to get homecare and avoid hospitalizations...

May digital platforms be a form of answer for such needs? Meanwhile, do they participate to the transformation of the healthcare system? At a first level, they represent a way of facing new needs in relation to mobility, remote and asynchronous exchanges. Can they be considered as the place of data consolidation that paves the way for modern medicine?

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