

Telerehabilitation after Total Knee Replacement:

Business model proposals and insights from Tuscany

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Abstract—In the last years, Total Knee Replacement (TKR) has become one of the most performed surgical procedures and according to recent forecasts, its incidence is supposed to increase further. Rehabilitation after TKR is an effective treatment to ensure full recovery after surgery and its economic burden in Italy accounts for almost 182 million of Euro per year. By considering the impact in other sectors, the adoption of Information and Communication Technology was welcome as a tool able to reduce costs and preserve the quality of care. However, the actual adoption is not as high as it was expected. Perhaps it could be the results of a partial involvement of the stakeholders included into the telemedicine services. Decision makers, physicians, patients and informal caregivers, should be involved in business model development to elect the best one to satisfy their needs and increase the value of the telemedicine service. This article describes the preliminary results of the business modelling phase belonging to a broader project aiming at involving the whole set of stakeholders interested in telerehabilitation after TKR.

Keywords-Business model; telemedicine; telerehabilitation; healthcare management.

I. INTRODUCTION

Total Knee replacement (TKR) showed to be cost-effective in the last 30 years and it was largely performed in Italy (21st most performed procedure in Italy in 2013) [1]-[3]. According to “Agenzia Nazionale per i servizi Sanitari” (Age.na.s.), the trend observed in the last years by “Istituto Superiore di Sanità”, from 26’694 TKR performed in 2001, to 63’125 in 2011, is going to further increase since the reduction in average age of TKR patients and the extension of life expectancy [4][5]. Likewise, rehabilitation has a pivotal role in patients’ recovery after surgery [6][7]. By considering the high incidence of TKR in the last years, the related rehabilitation has a considerable socioeconomic impact both on Italian National Healthcare Service (Ita-NHS) and on patients [8]. According to Piscitelli et al., TKR patients lose on average 9 working days per year; this value increases up to 20 days per patient considering hospital length of stay. During 2005, a loss of 368’586 working days was estimated for TKR patients younger than 65 years, leading to a monetary loss of approximately 24 millions Euro (a working day is assumed to last 8 hours; average wage is assumed to be 7.73€ per hour) [9]. From Ita-NHS perspective, the costs accounted for TKR rehabilitation were

about 158 million of euro in 2005 (47 million in hospital rehabilitation and 111 million in home rehabilitation) [8]. By considering the results from the recent report of the “Agenzia Nazionale per i servizi Sanitari” (Age.Na.S.), the rehabilitation expenditure is expected to increase since the number of TKR will grow in the next years [5]. In this framework, digitalization seems to be a pivotal milestone to reduce costs and ensure at least the same quality of care. Many efforts have been made investigating telemedicine sustainability and the factors leading to successful business models without reaching a definitive conclusion [10][11]. Likewise, telerehabilitation after TKR was tested in different technical approaches (e.g. videoconferencing CODECs with cameras; wireless sensors) and contexts; especially in rural areas, where it could be an alternative to home visit and could reduce travelling expenses [12][13]. Although the social impact of rehabilitation is evident, to date there is little knowledge on the drivers leading to successful implementation of knee telerehabilitation programs. According to Osterwald [14], the final aim of a business model has to switch from creating value only for the firm, to creating value also for the society. Therefore, we believe that the approach to involve the most important stakeholders in the design of the business model could be a reasonable way to detect the best business models, and to assess and promote them in order to improve the societal value chain for telerehabilitation.

A. The importance of the stakeholders in healthcare

Freeman defines stakeholders as “any group or individual who can legitimately affect or is affected by the achievement of the firm’s objectives” [15]. Every firm or organization has different set of stakeholders who can influence the performance of the organization directly or indirectly. For some type of organizations, different stakeholders should be weighted out differently from other stakeholders. Scholars introduced the importance of different stakeholders in NHS, from low to high [16][17]. Stakeholder’s perspective for health care can be different from other type of organizations. The role of stakeholders in health care can be underlined taking into account the differences between patients and customers. In the process of decision making in health care, relevant “stakeholders” should be more involved especially when introducing a new technology [18]. In terms of operationalization of stakeholders’ theory, many scholars formed various models to show the relationship between

stakeholders and organizations. Within the context of the NHS, healthcare services have an enormous number of potential stakeholders. In 1994, Brown and colleagues divided the stakeholders of NHS into three groups, professional clinicians, managers and patients [19]. To add healthcare policy makers is certainly useful. Adding to these three groups the role of policy makers for NHS cannot be denied. Scholars introduced the importance of *power level* of different stakeholders in the NHS, from low to high [16][17]. According to the literature, in order to design a sustainable business model for health care it is necessary to map the stakeholders according to their difference in power and pursued objectives. The main reason for the un-sustainability analysed in the study by Lin and Hsieh is the lack of value co-creation between the different stakeholders who participated in the new service development project [20]. Although all the stakeholders intended to provide telehealth services, in fact, each of them had different objectives. Even though some aims overlap, for example both policy makers, managers and patients want to improve care and simultaneously saving money, sometimes they also have specific objectives that may conflict with the other stakeholders' ones..

B. Economic evaluation in Health care

The necessity to deliver high quality healthcare to the largest amount of people associated with the monetary constraints that most countries are experiencing, has introduced the need to optimize the allocation of scarce resources. According to the latest guidelines for Telemedicine released by the Italian Ministry of Healthcare [21], telemedicine programs would be implemented and bolstered by Ita-NHS if they will show to have a better Incremental Cost Effectiveness Ratio (ICER) than the current care solutions (i.e., telemedicine programs should have a lower cost with at least the same effectiveness; likewise, higher costs could be acceptable if the telemedicine program shows also a better response in terms of effectiveness). In this direction, there are some preliminary results showing that telerehabilitation could be a cost-effective solution, especially if further assumptions are made on potential business models [22]. By considering the current scenario, an holistic approach merging business modelling, stakeholders' objectives and health economic evaluations could represent the way for a successful implementation of telerehabilitation.

The paper is organized in 4 sections. The next section, *Methods* (Section II), summarizes the approach used to address the research questions; *Results* (Section III) aims to report the preliminary outcomes of our research; *Discussion* (Section IV) addresses future directions and authors' remarks, *Conclusion* (Section V) closes the paper.

II. METHODS

Taking into account the complex scenario we described in Section I, we set up our research within the design science research methodology (DSRM) [23]. This five steps method is composed of: identification of the problem, definition of the objective of a solution, design and development,

demonstration and finally evaluation. The introduction of the current paper has described the problem; the objectives of the telerehabilitation service were defined through informal communications with a decision maker, 3 physiotherapists, 2 patients and 2 informal caregivers. The current paper addresses the “design” phase, which was developed according to visual thinking and scenarios approaches [5]. In addition we will highlight the concerns and future directions. The methodology of the forthcoming steps will be reported into the discussion section.

III. RESULTS

The first two steps of our research were aimed to deepen the knowledge into the rehabilitation area to comprehend the real unsolved issues and to identify the relevant stakeholders. According to Freeman, organizations are dependent on the support of stakeholders to achieve their main goal[15]; therefore identifying the main stakeholders in the arena of telehealth was the endpoint of the “problem identification” phase. Based on prior examination of latest rehabilitation guidelines and rehabilitation pathways we ended up identifying different groups based on their expectations [24][25]. As provided in the framework of Dansky and Gamm [26], stakeholders could be categorized into four main non-exclusive domains: political, commercial, community and clinical. Based on this framework we map telerehabilitation stakeholders as follows: Policy makers (Ita-NHS and Ministry of Economy and Finance – MEF, and healthcare units managers), Commercial (Telerehabilitation providers; sensor providers), Community (patients and informal caregivers) and Clinical (physiotherapists and healthcare units managers).

Once stakeholders were identified, at least one stakeholder of each category was informally interviewed to preliminary point out their needs. As result of this process, we report the current service description and revenues flows in usual care in the sub-section named “Business model as is”. According to the remarks of stakeholders' communications, we integrated them into the new business model design. The results are reported into the “Innovative business models for telerehabilitation” section.

A. Business model as is (Scenario I)

The informal communications with stakeholders lead to define the current business pathway for rehabilitation in Azienda Sanitaria Locale 12 (ASL 12) located in Lido di Camaiore (Viareggio, Tuscany Region, Italy). Rehabilitation procedures are provided throughout four channels: hospitals, outpatient service, home-based service and private care service. For our convenience, we assess the first three together as they compose the public health scenario; while private care will be addressed separately. All the stakeholders areas were covered both for public care and for private care.

1) Public Health

After TKR, patients have a rehabilitation program throughout 2 channels out of 3. Firstly, all patients spend on average 14 days in hospital for rehabilitation after surgery.

Secondly, physicians decide if he or she can have outpatient rehabilitation or in a home-based program. Almost the whole cost, including the transportation with ambulance, are sustained by Tuscany Region with funds belonging to regional taxations and “intramoenia” activities (i.e., private care procedures performed into a public healthcare unit) [25][27]. The patients are asked to contribute according to their income. If the Tuscany Region is not able to cover the entire costs, a national level coverage is provided. A further option consists into a mixed private-public outpatient treatment. Whereas the patients access to public healthcare facilities, the physiotherapy could be delivered in private care regimen (the so called “intramoenia” procedures). However, part of the physiotherapist revenue will be shared with the hospital. The monetary resources flow is graphically described in Figure 1 (Section 1).

2) Private Health

The private physiotherapy could be undertaken generally into 3 structures: Private care, public outpatients' department (“intramoenia”) and into the private care units partially subsidized by Ita-NHS. In all of these cases, the patients can access to private care paying the whole service including the transportation. The second scenario was described in the previous section. The third scenario is meant to have a partial co-payment of the Ita-NHS to the private care which had a reimbursement agreement. The monetary resources flow is graphically described in Figure 1 (Section 1).

B. Interactive business models for telerehabilitation

Because of the ethical and legal constrains, we believe that B2B scenarios are the best approaches in early adoption of telerehabilitation. Both from public health and from private healthcare perspectives, a partnership with healthcare providers is a pivotal point to achieve the maximum possible diffusion for telerehabilitation. In other terms, telerehabilitation has first to be recognized as at least a non-inferior mean of care, then its adoption could be discussed assessing the economic implications (i.e., cost-effectiveness and cost-utility analysis) [21]. However, considering the potential resistances of the other stakeholders involved into the healthcare service (e.g., patients, informal caregivers, physicians), a bottom-up acceptance of the service is also necessary. For this reasons, we plan to design different innovative business model scenarios that will have to be able to involve the whole set of stakeholders and deliver the highest possible value for each of them. To date, we developed the first two main scenarios, in which we imagine all the actors could have a benefit from adopting the telerehabilitation service.

1) Public Health (Scenario II)

A firm who that has a partnership with ASL units in a specific Italian region provides the telerehabilitation procedure. Adopting the firm perspective, the main revenue

is coming from the ASL, as they would pay for the service (device rental, maintenance, telerehabilitation software and internet connection), the rental and maintenance of the devices. Likewise, the patients contribute with a fee, which has to be shared between the firm and the ASL. We imagine two parts composing the patient payment: a fixed and a dynamic part. The fixed one relies on income and on whether patients hold a high-speed internet connection. The dynamic part is determined according to adherence to rehabilitation adjusted for socio-demographic and clinical features of the patients. Higher is the patients' effort in recovery, lower would be the dynamic part of the fee and vice versa. The forgone part of the fee would be paid by the Ita-NHS/Ministry of Economics and Finance, which could be interested in reducing the productivity loss and improve the quality of care. For graphical representation, please see Figure 1 (Section 2).

Critical Business issues: The strength of B2B in Healthcare is a top-down approach: to adopt the public healthcare provider channel is expected to have a positive influence in terms of trust. However, it could not be sufficient; by considering the potential barriers in adopting new solutions and an incremental cost, patients should perceive the new service as an enabler of time saving, improve their physical condition, comfort and let them be aware to what extent they could be able to influence the clinical outcome and costs. If the patients' performances influence their payment, it would make them more involved into the healing process, with huge societal implications in terms of productivity gain due to faster recovery. On the other hand, we do not know to what extent physiotherapists could perceive the telerehabilitation to be able to reduce their workload and income, leading to reluctance for the new procedure. In this case, the healthcare management should stress the opportunity forgone while treating one patient in usual care scheme, rather than checking telerehabilitation parameters of more patients simultaneously. It could result into a larger acceptance by physiotherapists, who are going to earn less for each patient, but would follow more patients hopefully increasing their overall income. A further implication in reducing the number of patients with a favourable prognosis having face-to-face treatments could be the reduction of waiting lists for those patients with a worse prognosis; resulting into an optimization of healthcare resources.

2) Private care (Scenario III)

Even in the private care scenario, telerehabilitation should access to the market with an initial top-down approach exploiting a partnership with a big private care institution focused on orthopaedics rehabilitation. The telerehabilitation provider furnishes a service (device rental, maintenance, telerehabilitation software and internet connection) based on fees to the private care institution, which provides the devices to its physiotherapists. In this scenario, we identify the highest market access barrier for physiotherapists, as telerehabilitation is perceived as a threat

for their income. The physicians providing the telerehabilitation service to their patients, compete with the others physiotherapists inside the private organization. The goal is to achieve the best results in terms of recovery for patients. Therefore, the patient assessment should notice also a minimum clinical outcome to preserve ethics and quality of care. In addition, the patients' score should be adjusted on socio-demographic features to ensure a balanced competition among physiotherapists (i.e., some physiotherapists could have patients with a better prognosis than the others, influencing the result of the competition). Succeeding at the competition, the private care organization will ensure a reward to the physiotherapist because of encouraging an innovative and cost-saving service for the organization. From patients' perspective, the fee varies according to travelling distance from the rehabilitation centres; however, it will never exceed the usual care tariff. Furthermore, informal caregivers would perceive the telerehabilitation as an improvement in their lives. Since the patient cannot drive during the rehabilitation period, employing a telerehabilitation scheme could half the number of travels with a consequential reduction in travelling expenses and productivity loss for the informal caregiver (please see Figure 1 - Section 3).

Critical Business issues: Although a bottom-up approach enrolling single physiotherapists could be an option, a top-down approach during the launch of the telerehabilitation service would ensure a greater adoption. Once the service would reach a sufficient diffusion in private care clinics, a B2B at the physiotherapist level could be a rewarding strategy. In the private care scenario we detected the most important barrier in the physiotherapists which could oppose resistance in adopting a service able to reduce their income. Telerehabilitation should be perceived from the physiotherapists as a tool to increase their income rather than a monitoring service able to threaten their job.

IV. DISCUSSION

In this article, we provided a preliminary insight about how telerehabilitation business model should be conceived. It has passed almost ten years since the first performance-based co-payment system in Italy [28]; the risk sharing strategy is aimed to bolster innovative treatments, which would be fully reimbursed from Ita-NHS if they are clinically effective. On the other hand, the pharmaceutical firm is going to cover part of or the whole costs for those patients who did not recover using the innovative pharmacological treatment. Although it could be right if the patients are thought to be a passive stakeholder (i.e., they would only receive a treatment and they do not directly influence the outcome), the performance based payment would be not suitable for rehabilitation at all. In such scenario the patients are directly involved into the healing process and it has an effect on society; likewise, they should be directly involved into the public health scenario as the main actor. Likewise, the private care is relying on professionals who have a direct relationship with the

patients. In this case we believe the private physiotherapist to have a pivotal role in diffusing the innovative processes. Therefore, any of these stakeholders could be excluded in the business model design pathway, and the final objective should be a model adjustable on their needs and perceptions.

A. *Toward an interactive business model*

After identifying different stakeholders in tele-health organizations, the necessity of a sustainable business model is showing up. Business models have received much attention in literature by focusing on the fact that business model innovation is a key success for business [29]-[31].

Although according to existing literature there is not a single definition for what a business model is, in this paper we refer to Chesbrough and Rosenbloom definition: A business model is a "focusing device that mediates between technology development and economic value creation" by emphasizing on the value chain for creating and distributing the offering [32].

A sustainable business model considers the society as key stakeholder [33], which is in line with healthcare perspective as long as patients play a key role in value-creation phase. Zott et al. emphasized on the role of customers, shareholders and any single stakeholder who capture values lied behind firm's entity [31]. According to Baden-Fuller et al., business models are not only the reflections of the firm's strategy to the logic of the firm but also they are the way to show how each firm creates value for its stakeholders [34]. Lehoux and his colleagues suggested that stakeholders vary in the type or quantity of the value that is attached to the characteristics of a given technology [35]. There are in fact multiple categories of customers in healthcare with various types of benefits (e.g., recovery for patients, revenues for physicians, a healthy work-force for employers). Therefore, when entrepreneurs are designing their business model addressing the value of their innovation, they can exploit a large range of dormant attributes of their model; nevertheless, it requires attending to the various and sometimes conflicting expectations of users, purchasers and regulators. Business model motivate entrepreneurs to redefine their key stakeholders and different attributes because their core business can be considered to be sensitive to certain stakeholders and not others especially in healthcare [36]. The healthcare industry is facing multiple challenges. In order to deal with those new arising problems, restructuring by means of industry architecture redesign, as well as business model innovations, may be an answer [37]. Therefore, in this study we suggested two possible business models for telemedicine considering different stakeholders' expectations. When it comes to the healthcare industry, the definition of business model as an activity system is a useful theoretical lens to analyse the latest changes that are why involving stakeholders can create a different perspective.

B. *Future directions*

The early stages of the design phase were described in this article; however, the forthcoming steps like demonstration and evaluation phases will be crucial for capturing and comparing the different options. Since the

heterogeneity of the stakeholder, of their values and of the related goals, a multidisciplinary approach is necessary to properly report the final results of the project. As first step we plan to employ a qualitative semi-structured questionnaire. According to the final aim of the demonstration phase, different questionnaires will be designed for the different stakeholders to fill the Osterwald's business canvas sections: key activities, key partners, key resources, customer relationship, customer segments, value proposition, channels, cost structure and revenue stream [14]. The demonstration will involve a set of stakeholders who will be not involved into the project; secondly, a pilot phase will be validated administering the questionnaire to the whole group of stakeholders of a specific ASL. Once the validation process is completed, the questionnaire will be administered to the whole set of stakeholders joining the study. The qualitative results will be reported into a matrix able to summarize the stakeholders' opinions. In the same matrix will be introduced quantitative results obtained from a previously developed decision analytic Markov model [22]. Here, we provide potential examples of quantitative results we wish to include: Clinical and Health Related Quality of Life outcomes, Costs per patient at least over 10 years (from social and third party payer perspective), Break Even Point and Return of Investment.

V. CONCLUSION

The current article provided an insight of the third phase of a larger project. Our preliminary results stressed what we found in the literature. Telemedicine is an innovative topic promising to reduce costs and to preserve quality of care. It is not still adopted as expected, resulting in an undefined market scenario. Proceeding into the study phases we will assess whether the proposed approach could fill the gap between experimental projects and real services in telemedicine. However, we believe an holistic approach, merging the best of managerial, social science and health economics methodologies could provide a better knowledge of the problem.

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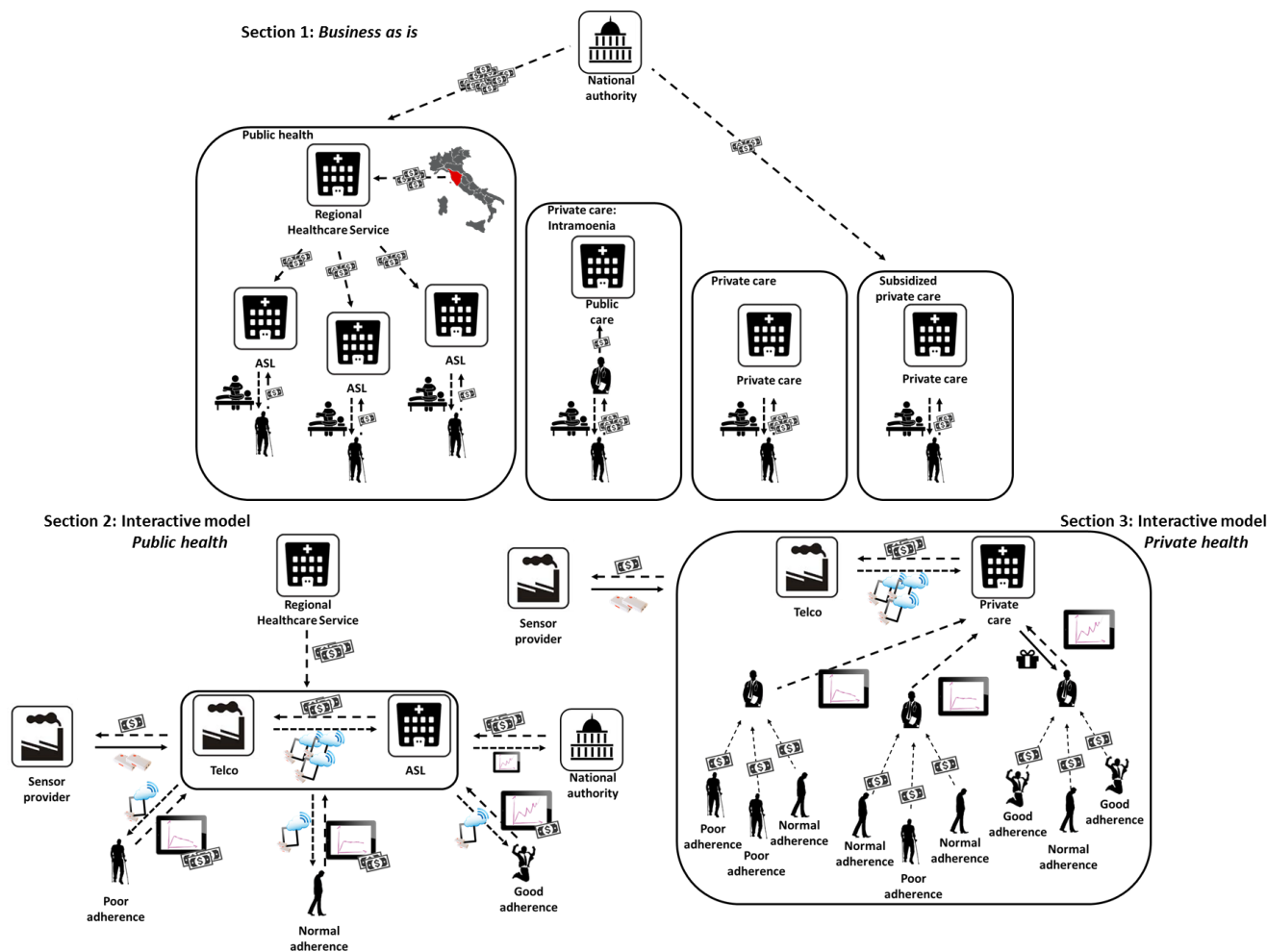


Figure 1. Healthcare business models: from traditional (Section 1) to innovative proposals (Section 2 and 3).