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Tapping the Full Potential of eHealth: Business Models Need Economic Assessment Frameworks

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3.1 Introduction

Among the many manifestations in the phenomenon of health-care digitalization, telemedicine are probably the oldest. In the broadest sense, it refers to the delivery of health-care services through the use of information and communication technologies in a situation where the actors are at different locations (Kidholm et al. 2012) or, according to the US Institute of Medicine, the use of electronic information and communication technologies to provide and support health care when distance separates the participants. Long before the appearance of Institute of Chemical Technology (ICT), doctors have sought ways to use their skills remotely. In 1897, the *Lancet* reported on using telephone to diagnose a child with

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croup, and around 1910, Dutch physiologist Willem Einthoven used the telephone to record electrical heart signals of hospital patients 1.5 km away. However, the beginning of "modern" telemedicine is generally regarded to date back to the 1960s, particularly through establishing a program network for teleconsultation and tele-education around the Nebraska Psychiatric Institute, as well as the development of many projects, mainly in the USA. Telemedicine failed to find a place in medical practice, and the wave of enthusiasm declined at the end of the 1970s as projects were halted due to lack of funding and interest. However, telemedicine continued to grow through research programs by specialized organizations that were faced with the problem of delivering care to people with limited or no accessibility to care: NASA, the US Army, Antarctic Survey Stations, offshore oil exploration rigs. In the late 1980s, the launching of a Norwegian program entitled "Access to Health Care Services" revived interest in the wider use of telemedicine, supported by advances and lower-cost technology. This initiative marks the beginning of an uninterrupted period of development, which has accelerated over the past decade (Darkins and Cary 2000; Pascal et al. 2002; Dinesen et al. 2016).

If this enthusiasm reflects the magnitude of the expected benefits, telemedicine applications, however, are struggling to move through the project stages due to a lack of a solid demonstration of their impact on the health-care system. Traditional economic assessment frameworks recommended by health-care authorities are poorly adapted to the specificities of this new way to practice medicine. In this context, multidimensional assessment frameworks can help to better assess the added value of telemedicine, even if they are not themselves exempt from certain limitations.

3.2 Promises to Financing: Assessment as Prerequisite

3.2.1 A Favorable Context for Telemedicine

In recent years, telemedicine has experienced a resurgence of interest based on three main causes:

- The aging population: Increased life expectancy is accompanied by an increased prevalence of chronic diseases (diabetes, cancer, respiratory diseases, etc.) and the potential number of elderly populations with disabling conditions. The treatment of these diseases and disabilities requires regular monitoring to detect and, if possible, anticipate changes in their health status. Transportation barriers are important because they can lead to a deterioration of chronic disease management (Kidholm et al. 2012; Syed et al. 2013). As these populations often have difficulties with mobility, transportation reduction is a central issue.
- Medical demography: As the demand for care is constantly increasing, particularly because of the aging population, the ability to access medical services within a reasonable time becomes an issue in many Western countries. These difficulties particularly affect rural areas, which often have the largest elderly populations. This is exacerbated by the phenomenon of medical specializations, which requires the intervention of several different medical specialists to treat the same patient. The grouping of physicians in group practices or patient-centered homes improves their productivity and thus their availability, but it increases the distance from patients and the transportation time. Policies for transferring tasks to nurses and other health-care professionals are intended to relieve doctors of some duties to make them more available, but the effects are currently still quite minimal.
- Increasing health-care costs: Most developed countries are facing a continuous increase in health-care costs, using up very large portions of the gross domestic product (GDP). Financing these expenditures is a major concern because they are increasing faster than national wealth, leading to increased taxes, fees, and insurance premiums, having to give up other expenses, and/or go into debt. Funding also affects the competitiveness of companies and the purchasing power of individuals. The causes of this increase are multi-factorial: They are largely related to the extension of the definition of health care, which leads to continuously expanding the spectrum of interventions and their funding. The aging population and the consequences of this described above also play a large part. It also follows the rising cost of pharmaceutical and technological innovations in a system

characterized by diminishing returns. Finally, some of these costs are linked to the organization of health-care production, which is not efficient or not efficient enough, and which needs to be reengineered.

3.2.2 Expected Significant Benefits

On paper, the expected benefits of telemedicine provide particularly attractive answers to these challenges, in terms of quality of care, accessibility, and cost (Bashshur 1995).

In terms of quality, the ability for doctors to easily and frequently communicate with each other using tele-expertise or teleconsultation methods helps maintain and develop their knowledge as well as their individual and collective skills. From the patient's perspective, especially for chronic conditions, the gain is based on improving the continuity of care, defined as the degree to which a series of discrete health-care events is experienced as coherent and connected and consistent with the patient's medical needs and personal context (Haggerty et al. 2003). Telemedicine fosters improvements in the continuity of information by making necessary information available to all stakeholders, continuity in management by planning and triggering interventions in a coordinated and complementary manner, and relational continuity by creating virtual teams around the patient.

Improving population health is also highlighted when telemedicine allows large-scale treatment protocols to be used, without which they may not have existed. The implementation of telemedicine services for stroke thus facilitates the care of cerebrovascular accident (CVA) patients in hospitals that lack neurologists, and improves the chances of recovery without patient recurrence.

Accessibility is closely linked to the continuity and quality of care: If the patient does not have access to care, continuity will be broken, and it is likely that his/her health will be degraded. Similarly, if a doctor does not have timely access to advice or assistance from his/her colleagues, this can lead to inappropriate decisions or improper actions. It is measured in terms of time and cost. Remote medical practice reduces unnecessary transportation costs. It also affects time-sensitive availability by reducing the time to receive advice or a medical procedure through two main mechanisms: Creating virtual pools of doctors who can consolidate their time to respond quickly, and automating the monitoring and alert processes which would release doctors from their usual tasks to focus their activity on problematic medical conditions.

Finally, reduced cost is a regular argument for promoting telemedicine. This is most often presented from the perspective of the health-care system and society, highlighting transportation costs and hospitalizations that are avoided by better continuity and quality of care and optimizing the use of medical resources.

3.2.3 A Specific and Binding Business Model

Despite these promises, the use of telemedicine is still underdeveloped. In Europe, it is mainly limited to projects funded by governments, which are often related to geographic regions and smaller populations.

This underlines the specificity of the telemedicine business model: unlike other economic sectors, the health-care sector is based on a complex system of payments, or reimbursements, which typically do not ultimately come from the consumer, but rather from a third party. In most Western countries, health-care expenses are mainly covered by health insurance companies and/or national health systems. This is why patients are often very reluctant to pay out-of-pocket costs for new services that they see as helpful gadgets. Any service that is reimbursed must scientifically demonstrate its ability to meet new health-care needs (clinical safety and effectiveness), or meet existing ones in a more cost-effective way. The value proposition of a telemedicine service must therefore include both the individual perspective and an aggregated perspective of the insured population. It is traditionally popular with funders in terms of clinical benefits return compared to expenses. In a way, the business model of a telemedicine application must take into account not only the return on investment (ROI) for the owners but also the ROI for the health-care system.

Consequently, authorities are reluctant to finance large-scale telemedicine interventions since there has not been a solid demonstration of their benefits in relation to their cost. Permanently reimbursed telemedicine procedures are still scarce, and the inclusion of new procedures requires long negotiation processes. For their part, the care producers and manufacturers cannot develop telemedicine services since a sustainable funding model has not been established. The dissemination of telemedicine is thus faced with the problem of the chicken or the egg: The formulation of a sustainable business model requires financing of insurance systems, and insurance systems require scientific demonstration of telemedicine's efficiency before including it in their reimbursement plans. This situation stresses the importance of economic assessment of telemedicine to develop business models and tap into the full potential of the digitalization of health care.

3.3 Applying Economic Assessment to Telemedicine: Limitations and Challenges

3.3.1 A Brief Review of Methods

The economic assessment frameworks that are recommended by insurance systems for telemedicine resort to generic evaluation methods developed in health economics as a decision aid, mainly in the pharmaceutical field. They are divided into four categories (Fig. 3.1).

Cost-minimization analysis (CMA): This type of analysis compares the costs of several treatments or technologies for which clinical outcomes are identical. This method is not only particularly attractive because of its apparent simplicity but also because it is intuitively easy to understand by decision-makers, since "cheapest is the best." Evidence of clinical equivalence is the Achilles heel of this method, because it is often treated lightly by evaluators who prefer to focus on the cost calculation. This is why economists are very suspicious of this kind of study (Briggs and O'Brien 2001). Ideally, clinical evidence must be

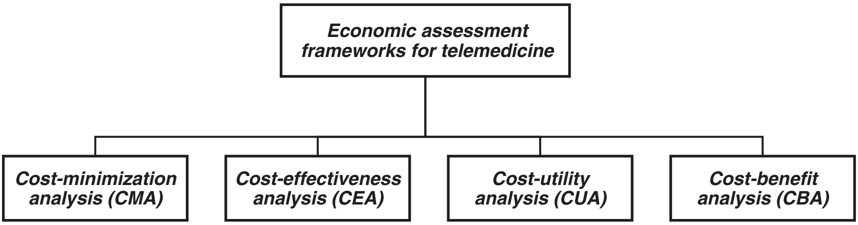

Fig. 3.1 Economic assessment frameworks for telemedicine

based on dedicated randomized clinical trials (RCT) or, if not possible, on a review of RCTs already conducted, which should be interpreted with caution. The comparison should not only include primary results but also secondary results, which may reveal significant differences in terms of safety, cost, or convenience (Jones et al. 1996). These differences may be significant enough to interfere with clinical results. This need for prior evidence of clinical equivalence makes it impossible to achieve a prospective evaluation of new technology based on a CMA.

Cost-effectiveness analysis (CEA): This method compares interventions or technologies that differ both in their cost and effectiveness. Patient outcomes are reported in nonmonetary terms such as blood glucose levels, reduction in wound size, anxiety, or pain levels. They are compared with the resources to be used to improve a unit as much as the committed result. For example, the cost-effectiveness study of wireless telemonitoring of continuous positive airway pressure (CPAP) treatment for Sleep Apnea syndrome reductions uses reductions in systolic blood pressure as a primary clinical outcome and the cost per millimeter of lowered mercury as measures of economic value for this treatment.

This approach is appropriate only if interventions or comparable technologies entail a change in the nature of the condition, and are conducted on similar patients in terms of disease and biological characteristics.

Cost-utility analysis (CUA): In this type of analysis, the outcome for the patient is represented by a composite indicator that combines the quality and length of life, measured in terms of Quality-Adjusted Life Years (QALY) or Disability-Adjusted Life Years (DALYs). It is then possible to calculate a cost per year of healthy life. This method compares interventions or technologies that produce different benefits, such as surgery compared to mammography.

Cost-benefit analysis (CBA) adopts a more overall perspective. It is a systematic analysis of one or more methods or programs for achieving a given objective and measuring both benefits and costs in monetary units (Aday and Begley 1993). CBA deals with what economists call allocative efficiency: It can determine whether a program is worth doing, in the sense that its benefits are greater than its costs.

These last three methods have developed considerably over the past 20 years to measure awareness of the need to control the increase in public spending in general, and in particular health-care expenditures. They are now the gold standard, and all health insurance systems require them to include new treatments or devices in their reimbursement plans.

3.3.2 Facing the Challenges of Complexity and Innovation

The results of such studies conducted in the field of telemedicine are contradictory: Some reports that telemedicine is cost-effective, others not. It is difficult for health-care authorities to use them because they often have significant methodological limitations that do not allow the production of valid and generalized results (Wootton 2012; Bergmo 2009).

These results portray the challenges for evaluating telemedicine. These challenges are financial and conceptual.

From a financial point of view, given the necessary investment budgets, telemedicine experiments are not sufficient to conduct large-scale projects. Because of this, the number of patients included is too small to produce statistically strong results. For the same reason, the duration of clinical studies rarely exceeds one or two years, as the clinical benefits are expected in the medium term, particularly in the case of monitoring chronic diseases (Alexander et al. 2008).

From a conceptual point of view, there are two types of challenges.

The first set of challenges relates to the measurement of outcomes and, more broadly, what economists call the utility function. Generic measures of quality of life such as QALYs are not sensitive enough to measure the small changes in health statuses produced by telemedicine. The use of measurement scales specific to a disease, such as cancer and heart disease, for example, is an alternative, but it prohibits comparison with programs whose QALY measurement uses other scales. On the other hand, the benefits of telemedicine are various and involve many actors. As part of the traditional economic evaluation methods, the need to choose a primary clinical outcome leads to neglect or underestimation of other clinical outcomes. More broadly, it asks the question of non-medical outcomes of telemedicine, which are potentially numerous and important, such as improving accessibility, skills transfer, and strengthening the sense of security.

The second set of problems relates to the nature of telemedicine. Originally, the economic evaluation methods were developed for the pharmaceutical sector. While it is relatively easy to isolate and specify the precise clinical and organizational conditions for the delivery of drugs through protocols and procedures, it is quite different for telemedicine (Campbell et al. 2000).

Telemedicine is an ICT-enabled innovation, but is not limited to technological innovation. It is primarily an organizational innovation (Schumpeter 1983) under new care production methods and the realization of new work organization. The impact of this innovation is the result of changes produced by the interaction between the technology and the organizational, professional, regulatory, and cultural system in which it occurs. In this perspective, telemedicine can be regarded as a plan of action as defined by Foucault (Foucault 2001; Agamben 2007), that is, “a decidedly mixed bag featuring discussions, institutions, architectural arrangements, regulatory decisions, laws, administrative measures, scientific statements, as well as philosophical, moral, and philanthropic propositions.” In this plan, the communication technique tool is only one of the connections to a system of interactions (Engeström 2000) involving broader subjects (doctors and nursing users, actual or potential patients), a set of rules that govern the division of labor, and a community (community health workers of an establishment, territory, or specialty) that have a targeted purpose (the objective pursued by each telemedicine application). The impact of introducing a single telemedicine service will be different depending on the local form taken by the plan of action. This plan is particularly complex since telemedicine services by definition involves the interaction of several organizational entities that have their own structuring, practices, workflow, and funding models. Telemedicine applications can thus be considered as complex interventions (Campbell et al. 2000; Shiell et al. 2008), that is, interventions made up of various interconnecting parts between which the nature, intensity, and effects of causal links are difficult to establish and reproduce.

These characteristics make it very difficult to generalize the findings of telemedicine evaluations. While economic studies usually use a randomization of patient characteristics, this should be done on the organizational characteristics of the plans. The description of these organizational characteristics is often overlooked in health-care economic evaluations. When approached, it suffers from a lack of a clear organizational analysis framework from a scientific point of view.

One final challenge occurs based on the rapid evolution of ICT. These technologies are still immature, and the benefits of certain advancements or developments may not be taken into account because they were not expected. In particular, harmonizing information exchange standards allows an increased sharing of communication and equipment infrastructures. These economies of scope are difficult to predict and lead to over-estimating future operating costs. The invention of new uses for current users is also difficult to predict.

Therefore, the object to be evaluated, telemedicine, is a moving target. The timeline for conducting these studies are too long for these developments, which often makes the findings of studies obsolete upon publication.

3.4 Toward Multidisciplinary Evaluation Models

To overcome these limitations, much work has been done to provide a more comprehensive evaluation framework integrating more than just economic measurements.

3.4.1 Health Technology Assessment Models

The concept of Health Technology Assessment (HTA) is included in this perspective, defined for the first time in 1978 in the USA by the Office of Technology Assessment. This concept has quickly been very successful and is used by many national agencies, federated within a network of over 55 members in 32 countries and established in 1993.

HTA's activities are based on a model that covers 9 areas or "domains" to evaluate. Each domain is divided into topics, and each topic is divided into one or more issues, which are the questions to ask to assess a technology. The combination of a domain, a topic, and an outcome constitutes an evaluation component.

The scope of this approach is particularly broad, since it covers "any intervention that may be used to promote health, to prevent, diagnose or treat disease, or for rehabilitation or long-term care. This includes the pharmaceuticals, devices, procedures and organizational systems used in health care."[1] In fact, the generic model has been declining for a small number of technologies, primarily medical and surgical treatments, but also diagnostic and pharmaceutical technologies.

Based on a project funded by the European Union in 2009, Model for Assessment of Telemedicine (MAST) is an extension of the HTA model. Its goal is to establish a common model for evaluating telemedicine in Europe. Like HTA, it aims to provide decision support to the different stakeholders confronted with the question of investment choices in telemedicine: governments, insurers, institutions, and professional companies (MedCom and Telemedicine 2010; Kidholm et al. 2012; Ekeland and Grøttland 2015) (Fig. 3.2).

It uses basically the same domains as the HTA model, with two differences:

- A set of preliminary questions ("preceding considerations") is added, to determine whether to engage in the evaluation and the potential

[1] INAHTA (International Network of Agencies for Health Technology Assessment) (October 8, 2013). HTA glossary. HTAi.

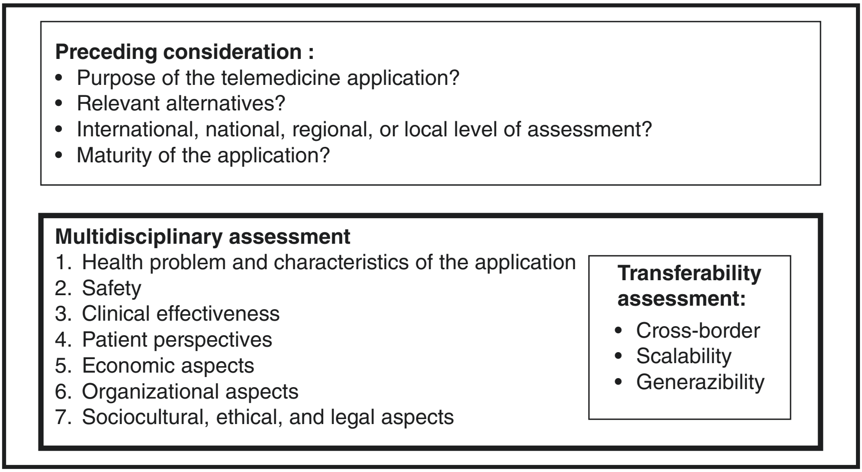

Fig. 3.2 Model for assessment of telemedicine evaluation framework

strength of this assessment. They focus on the main limitations in medico-economic assessments, in particular the project scale and its regulatory, financial, and technological maturity.

- The importance of the subject of the generalization is affirmed by the creation of a "transferability" domain, which includes issues already present in the HTA, related to the external validity and generalization of results.

3.4.2 GEMSA[2] Model

Appearing almost at the same time, the GEMSA method shares the same goal as MAST. It takes into consideration five axes of synthesized analysis, each by a central question (Le-Goff-Pronost and Picard 2011):

- Strategy: "How and what will the project contribute to resolving a clearly identified public policy in the health and social fields?"

[2] Grille d'Evaluation Multidisciplinaire Santé Autonomie—Multidimensional Evaluation Grid for Health and Autonomy.

- Technology, technological, and industrial expertise: "Are the type and extent of innovation brought by the solution defined, understood, and in accordance with professional and standard requirements? Is the developer of the solution credible and able to implement and deploy the solution?"
- Organization: "What are the benefits of the solution to the overall functioning of the users within the framework of their assignments?"
- Quality: "Does the service rendered by the solution to professionals, patients, and their support groups have the characteristics required in terms of quality, usefulness, and satisfaction for meeting their fundamental needs?"
- Economics: "Is the project economically viable and does it generate new economic activity?"

As shown in Table 3.1. (Le-Goff-Pronost and Picard 2011), these axes intersect and regulate domains already studied in MAST. The aspects studied are mostly the same, except for the technological dimension that is more developed in GEMSA and is not limited to safety, and also the quality dimension, which puts more emphasis on the concept of use and the value for the patient. The two grids use both quantitative and qualitative measures. In particular, the organizational impacts focus largely on semi-structured interviews and process descriptions (work flow and patient flow), as well as sociocultural and ethical considerations. This pluralism of measuring provides a more detailed understanding of the impacts, but it is problematic when it comes to comparing several telemedicine interventions.

Table 3.1 Domains of Health Technology Assessment

1. Health problem and current use of technology (CUR)
2. Description and technical characteristics of technology (TEC)
3. Safety (SAF)
4. Clinical effectiveness (EFF)
5. Costs and economic evaluation (ECO)
6. Ethical analysis (ETH)
7. Organizational aspects (ORG)
8. Patients and social aspects (SOC)
9. Legal aspects (LEG)

Both methods can be used either at the project design as a checklist, or after implementation.

Finally, the main difference between the two methods is the degree of standardization. The MAST Toolkit only suggests result measurement criteria examples for each domain (without going to the indicators), and it does not specify how the criteria should be used to produce a multi-criteria evaluation.

GEMSA offers a more formalized approach. Each axis is divided into sub-questions, which have proposed performance indicators with a measured value and a target value. The reliability and validity of the information used to populate these indicators is measured by a quality indicator of the process, which is qualitatively assessed on a 5-level scale. Each criterion is scored on a scale from 0 to 5, which then allows the use of multi-criteria decision methods. This approach allows the opportunity to compare multiple applications or views of various actors on the same application (e.g., patients vs. the establishment) (Table 3.2).

3.4.3 Perfectible Models

Even though both multidimensional models provide significant added value compared to purely economic assessments, they still have some limitations.

First, examining the economic aspects does not free them from traditional economic evaluation frameworks and their limits. An economic evaluation from a societal perspective is explicitly recommended by MAST, based on the methods presented earlier in this chapter. The subject is approached more diffusely in different GEMSA domains. Questions are designed to ensure that the actual benefits for public health are considered and that clinical studies have been conducted, and that the costs of the benefit are calculated. These assessments remain fundamentally microeconomic, and their generalization remains problematic in a macroeconomic perspective (Zamora 2013). Meanwhile, the two models recommend economic analysis from the institution's point of view. MAST recommends calculating the ROI from the expenses, income, and reimbursements (business case), while GEMSA goes further

Table 3.2 Coherence matrix between GEMSA and MAST

	Health problem and characteristics of the application	Safety	Clinical effectiveness	Patient perspective	Economic	Organizational	Sociocultural, ethical, and legal
Strategy	X		X				X
Technology		X					
Organization						X	
Quality and usage				X			
Economic aspects						X	

and focuses on the business model and its sustainability factors. The various addressed business model components are fragmented in different axes of the model, which does not promote a comprehensive understanding of its dynamics.

Reforming this model in a framework adapted to telemedicine, similar to the CompBizMod Framework (Peters et al. 2015) developed specifically for complex services, will allow the opportunity to better assess the model's consistency and sustainability (Fig. 3.3).

Dimension	Parameter	Characteristic			
Value proposition	Overall purpose	Prevention	Diagnosis	Therapy, curative	Therapy, palliative
	End consumer	Professional provider, physician (B2B)		Patient, relatives (B2C)	
	Partner network	A fixed set of other partners is involved	A flexible, competing set of partners is involved		No partners are involved, or if at all indirectly
	Realization of benefits for the patient	By application		(if at all) indirectly	
Value co-creation	Portfolio role	One of several offerings in the same area	Complement offering		Singular, stand-alone offering
	Contact with patient	Direct	Indirect		No
	Domain-specific know-how	Not necessary	Necessary, provided by own employees/in-house		Necessary, requires cooperation with (external) domain experts
	Required responsiveness	Immediate personal reaction	Automated immediate info forwarding, non-immediate personal reaction		Non-critical
Value communication & transfer	Required means of communication*	No*	Platform (server, database)*		Measuring devices/ wearables & platform
Value capture	Type of revenue	Transaction-based	Transaction-independent		Mixed
	Paying entity	Health insurance	Patient	Other stakeholder	Mixed
	Cost drivers	Personnel costs		Equipment	
* Internet, telephone, mobile phone including mobile data are considered as given					

Fig. 3.3 The CompBizMod framework

On the other hand, the Achilles heel of these models is the question of organization. The proposed criteria for evaluating the organizational aspects in MAST focus on the quantitative description of patient flow, skills and training, information flow, organizational structure, culture, and management, but the suggested indicators are few and mainly qualitative. The GEMSA model not only studies the distribution of competencies and the improvement of information exchanges and coordination processes between professionals but it also stresses compliance with regulatory requirements in terms of delegations and responsibilities, as well as the support provided to users of the service in case of problems. However, it does not directly address the impact on structural components such as the number, size, and geographic distribution of units, nor the impact on transportation times. These differences clearly show the lack of consensus in how to address the organization determinants and the need for further research in this area. Considering that telemedicine is innovative, work on the organizational and behavioral factors for adopting innovations could be usefully mobilized for this purpose (Scott 1990; Damanpour 1991; Rogers 2003; May et al. 2007; Van Dyk 2014).

3.5 Conclusion

While traditional economic evaluations have many drawbacks, it is unlikely that health authorities waive these requirements given the financial pressure on health insurance systems. Multidimensional models can moderate the results and limitations of these assessments by incorporating other criteria, but they do not prevent them from being done. The demands of these economic evaluations are usually impossible to achieve during pilot phases of telemedicine projects and calls for a better integration of these evaluative constraints starting in the design phase.

While waiting to demonstrate the economic benefits retroactively once telemedicine services are widespread, business models must support these start-up phases by independent financing or they must be added to insurance financing. Widening the value proposition through the inclusion of telemedicine services in clusters of eHealth services to a larger and more lucrative range is certainly an interesting solution. During these design phases, multidimensional models can be of great use as guidelines to ensure that the key success factors are considered within the business model.

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