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**Chapter 15. SROI methods for impact assessment in Economy of Wellbeing****Short Abstract**

Population ageing represents one of the major challenges that contemporary society is going to face in the coming years. This phenomenon is putting high pressure on the healthcare system and makes it necessary to identify specific instruments ensuring to live longer in healthy conditions, concept also referred to as healthy ageing. In this view, the European NESTORE H2020 project is a multi-dimensional and personalized virtual coaching technology for the enhancement of people's well-being and quality of life after their 65. However, the assessment of health promotion strategies like NESTORE is a thorny issue, being the benefits achieved in the long-term as a result of investments incurred for many years. Decision-makers need methodologies that show that what is invested today will pay back through the saving generated in the long-term. Traditionally, cost-benefit analysis (CBA) is employed: however, CBA has historically been under discussion. In recent times, social return on investment (SROI) methodology has been promoted as a more 'holistic' approach for demonstrating value-for-money of initiatives. Given the lack of evidence concerning SROI analysis of technologies, the authors developed and validated a model to perform a SROI analysis when evaluating innovative technologies promoting healthy ageing. To address the research question, an inductive approach has been employed, selecting as a starting point the real case of NESTORE, under the assumption of its future implementation in the Lombardy Region, in the autonomous community of Catalonia and in the province of South Holland. SROI for NESTORE has been defined involving as stakeholders the healthcare systems of the areas under consideration, beneficiaries (senior adults in health between 40 and 79 years) living in the three areas, the economic system and beneficiaries' familiar caregivers. In all the three areas analysed, the SROI ratios (calculated over a time horizon of 10 years) are higher than 1; therefore, the project results to be value-for-money. The result has been validated by NESTORE Consortium itself. This study contributes to the existing literature on the SROI, confirming that there is room for its application when dealing with healthcare technologies. In addition, it represents a useful aid for NESTORE decision-makers and distributors, supporting them in the definition of a suitable and detailed exploitation strategy for the initiative.

**Key Words:** cost-benefit analysis; social return on investment; virtual coaching; healthy ageing

## INTRODUCTION

The increasingly urgent social phenomenon known as population ageing implies a reduction in the number of economically active people per pensioner, thereby putting more pressure on the healthcare system (European Commission & Economic Policy Committee, 2014). Therefore, for the coming decades, there is a societal goal to maximize the number of people who remain healthier and independent for longer (World Health Organization, 2015). This phenomenon is frequently referred to as “**healthy ageing**”.

To face the challenge, we are assisting in a high-pace proposal for technologies aimed at promoting healthy ageing. Amongst them, **NESTORE**, a project funded by the European Union Horizon 2020 Research and Innovation Programme, is a multi-dimensional and personalized virtual coaching technology for the enhancement of people’s well-being and quality of life after their 65.

Budget constraints require to identify **proper methods to support decision-makers in assessing the proposed technologies and selecting those to implement** (D. Greenberg et al., 2005). Traditionally, value-for-money of technologies in healthcare has been assessed through cost-effectiveness, cost-utility and cost-benefit analyses.

**Cost-Benefit Analysis (CBA)**, in detail, measures the ratio between the economic consequences of a project (benefits and losses) and the costs incurred to realize such project. However, CBA has been historically criticized: it evaluates costs and benefits from a **single perspective** (usually the one of the payer), neglecting comprehensive contributions from the complex network of actors that initiatives in healthcare typically involve (Ackerman, 2008; Sen, 2000; Self et al., 2015).

In recent times, **Social Return On Investment (SROI)** approach has emerged: the underpinning idea is that investments should not only look at what pecuniary value they produce as direct shareholder value, but they should also include a wider range of benefits, from the view of multiple stakeholders, including the social and environmental dimensions besides the economic one (Gargani, 2017; Millar and Hall, 2013; Arvidson and McKay, 2013).

Table 1 summarizes the main points emerged from the literature analysis on CBA and SROI in healthcare and offers a direct comparison of the two methods.

Topic	CBA	SROI
<b>Perspectives involved</b>	Typically, point of view of <b>one single stakeholder</b> involved in the project: the healthcare system or patients.	<b>Multiple stakeholders’</b> perspectives (beneficiaries, promoters and implementers, third parties)

<b>Cost/input items involved</b>	Different cost items are considered, according to the perspective adopted and the subjects assessed (cost items involved are only those related to the actor whose perspective is assumed).	The input items involved become more exhaustive as the analysis shifts from mere beneficiaries' involvement to promoter and implementers' and third parties' involvement.
<b>Benefit/outcome items involved</b>	The considered outcomes are independent of the subject assessed. They are different according to perspective adopted (the benefit items involved are only those related to the actor whose perspective is assumed). The focus of CBA is mainly <b>on economic outcomes</b> .	The outcome items involved become more exhaustive as the analysis shifts from mere beneficiaries' involvement to promoter and implementers' and third parties' involvement. Not only <b>economic outcomes</b> are considered, but also <b>social outcomes</b> .
<b>Benefit/outcome items monetization</b>	Controversial. Authors <b>avoid monetizing outcomes not quantifiable as cost savings</b> .	Easily enabled by proper <b>financial proxies</b> . (using also methods such as Willingness To Pay and Human Capital)

Table 1 - Comparison between CBA and SROI

## METHODOLOGY FOR THE CALCULATION OF SROI OF VIRTUAL COACHES FOSTERING HEALTHY AGEING

A standard and generally accepted framework to assess healthcare technologies through SROI does not exist. The authors adapted the framework proposed by Nicholls and Lawlor (2012) to calculate the SROI targeting virtual coaching technologies fostering healthy ageing and then applied it to the real case of NESTORE. The adapted framework is made up of five steps:

### 1. Establishing scope and identifying key stakeholders

Establishing the scope of analysis means defining the boundaries of analysis. The authors assumed that NESTORE is configured as a closed system (not integrated with other devices) and distributed and paid by the healthcare system as a medical device. The authors performed a prospective analysis under the hypothesis to distribute NESTORE among 40-79 individuals in health (not affected by chronic diseases), living in the Lombardy Region (Italy), in the autonomous community of

Catalonia (Spain) and in the province of South Holland (the Netherlands) and willing to adopt a virtual coach. The next step is to identify the stakeholders, namely those people or organizations that affect or are affected by the initiative, either positively or negatively. The considered stakeholders are:

- **Beneficiaries**, namely the target of the virtual coach. They are the individuals in health between 40 and 79 years, living in the areas under consideration, and willing to adopt the virtual coach. More in detail, the adoption of a healthy ageing paths results in the reduced risk of morbidity of six morbidities: hypertension (Howard and McDonnell, 2015); type 2 diabetes mellitus (Howard and McDonnell, 2015); osteoporosis (Heath and Stuart, 2002); heart failure (Heath and Stuart, 2002); stroke (Howard and McDonnell, 2015); alzheimer (Scrafford et al., 2019).
- **The Lombardian, Catalan, Southern-Dutch healthcare systems**, which benefit from the reduction in morbidity of beneficiaries thanks to the virtual coach, since the economic burden related to such morbidities is reduced. The healthcare system is the stakeholder in charge of distributing and paying for the virtual coach.
- **Beneficiaries' familiar caregivers** are those relatives of the beneficiaries that cover the role of caregivers. Therefore, the reduction in morbidity of beneficiaries prevents their relatives from becoming familiar caregivers and suffering from a deterioration of their own health state. This situation would allow them to get a job position since they are not totally devoted and absorbed by the caring activity. The authors considered only full-time familiar caregivers who are forced to leave their job for assisting their relatives: given the diseases on which healthy ageing practices can have a positive effect, stroke is the only morbidity requiring assistance from a full-time familiar caregiver (Howard and McDonnell, 2015).
- **Lombardian, Catalan, Southern-Dutch economic systems**, which include the companies where beneficiaries are employed as well as professional caregivers (professionals offering support, in exchange for a salary, to people that are not autonomous in their daily life). As for the companies, the reduction in beneficiaries' morbidity implies a diminished absence due to illness from the beneficiaries and avoidance of leaving job position from familiar caregivers. As for professional caregivers, the beneficiaries' morbidity reduction would result in their job destruction, negatively impacting the economy of caring services (also in this case stroke is considered the only disease among those selected requiring assistance from a full-time caregiver).

## 2. Mapping outcomes

Outcomes can be defined as positive and negative consequences of the project. In this step, it is necessary to identify the outcomes perceived by each stakeholder. Table 2 synthesizes the outcomes of virtual coaches for healthy ageing.

<b>Stakeholder</b>	<b>Outcome</b>	<b>Rationale</b>
<b>Beneficiaries</b>	<b>Reduced beneficiary's risk of diseases</b>	Morbidity reduction represents the major relevant outcome for senior adults in case of adoption of a virtual coach for healthy ageing.
	<b>Reduced beneficiaries' need for professional caregivers</b>	Healthy ageing practices and the consequent reduction in beneficiaries' morbidity can lead to a reduced need for caregivers and, particularly, in a consistent fall in the number of employed professional caregivers. This would result in significant savings for the beneficiaries hiring them.
<b>Healthcare System</b>	<b>Cost reduction due to reduced beneficiaries' morbidity</b>	Reduced beneficiaries' morbidity represents the major relevant outcome for the healthcare system in case of adoption of a virtual coach for healthy ageing, which leads to significant savings related to healthcare expenditures.
	<b>Cost reduction due to reduced familiar caregivers' morbidity</b>	It is assumed that prevention technologies will also reduce the incidence of caregiving-related diseases resulting from lack of sleep, stress and heavy load handling, which leads to significant savings related to healthcare expenditures.
<b>Familiar caregivers</b>	<b>Reduced beneficiaries' need for caring activity</b>	Healthy ageing practices and the consequent reduction in the morbidity can lead to a reduced need for caregivers. Therefore, virtual coaches prevent the relatives of beneficiaries from becoming familiar caregivers and from contracting caregiving-related diseases resulting from lack of sleep, stress and heavy load handling.

<b>Economic System</b>	<b>Reduced beneficiaries' need for professional caregivers</b>	Healthy ageing practices and the consequent reduction in beneficiaries' morbidity can lead to a reduced need for caregivers and, particularly, in a consistent fall in the number of employed professional caregivers. This would result in a loss for the entire regional economic systems.
	<b>Reduced beneficiaries' work absence due to illness</b>	The reduction in beneficiaries' morbidity implies reduced beneficiaries' work absence due to illness.

Table 2 - Outcomes per stakeholders

In this step it is also required to identify the inputs, that express what stakeholders are contributing in order to make the project possible. The healthcare systems of the three areas under consideration represent the only stakeholder in charge of providing NESTORE to the beneficiaries, paying for it: they will not go through any investment into fixed or intangible assets to provide NESTORE service. They will purchase all the elements needed to run the service (hardware, software, technical assistance, training courses) from external providers (identified by the consortium), on a monthly basis, simply paying for them to be provided to beneficiaries. In addition, the healthcare system will be in charge of paying a fee to GPs for each NESTORE prescription they realize.

### 3. Evidencing outcomes (and inputs) and giving them a value

Outcome indicators represent a preliminary step to monetize the identified outcomes: in fact, by multiplying each indicator value for its unitary monetary value, the monetary value for each corresponding outcome is obtained. To reach this purpose, financial proxies are used in SROI analysis to estimate the social value of non-traded goods. Sometimes monetization is a fairly straightforward process, other times monetization is harder. Table 3 synthesizes the indicators outlined for each outcome of NESTORE and the related value of the chosen financial proxies for each of the three areas under consideration. Given the prospective nature of the study, it was not possible to retrieve real data on field: therefore, indicators have been quantified by searching for quantitative studies on health and work consequences of healthy ageing paths for beneficiaries and familiar caregivers, as well as on costs for the healthcare system and enterprises.



Stakeholder	Outcome	Outcome indicator	Outcome financial proxy	Yearly value of outcome financial proxy			
				Lombardy	Catalonia	South Holland	
Beneficiaries	Reduced beneficiary's risk of diseases	Number of adults in health between 40 and 79 years old, willing to use NESTORE	Willingness To Pay (estimated as the sum of annual cost of a gym membership and the annual cost of a nutritionist)	1.265 € (Federconsumatori, 2017)	1.061 € (Ajuntament De Barcelona, 2017; Centro de Nutrición Jùlia Farr, 2020)	1.344 € (Expatisan, 2018; Voeding Plus Advies, 2020)	
	Reduced beneficiaries' need for professional caregivers	Reduction in the number of employed professional caregivers	Cost saving equal to annual wage for a professional caregiver	17.940 € (Assistere.net, n.a.)	14.726 € (Oliva-Moreno et al., 2013)	18.808 € (Job and Salary Abroad, 2017)	
Healthcare System	Cost reduction due to reduced beneficiaries' morbidity	Reduction in the number of morbid beneficiaries	Cost saving equal to annual unitary disease cost for the healthcare system:	Hypertension	864 € (Cerbino, 2019)	1.297 € (Saez and Barceló, 2012)	234 € (Volksgezondheidszorg.info, 2017)
				Type 2 diabetes mellitus	1.300 € (Cerbino, 2019)	3.184 € (Fundaciòn MAPFRE, 2017)	1.349 € (Volksgezondheidszorg.info, 2017)
				Osteoporosis	900 € (Cerbino, 2019)	5.970 € (Fundaciòn MAPFRE, 2017)	235 € (Volksgezondheidszorg.info, 2017)
	Cost reduction due to	Reduction in the number of morbid	Heart failure	1.500 € (Cerbino, 2019)	5.500 € (Vela et al., 2019)	3.370 € (Volksgezondheidszorg.info, 2017)	

Stakeholder	Outcome	Outcome indicator	Outcome financial proxy		Yearly value of outcome financial proxy		
					Lombardy	Catalonia	South Holland
	reduced familiar caregivers' morbidity	familiar caregivers		Stroke	1.180 € (Cerbino, 2019)	4.351 € (Fundación MAPFRE, 2017)	3.022 € (Volksgezondheidszorg.info, 2017)
				Alzheimer	4.269 € (Cerbino, 2019)	4.062 € (The Economist Intelligence Unit, 2017)	33.704 € (Volksgezondheidszorg.info, 2017)
<b>Familiar caregivers</b>	Reduced beneficiaries' need for caring activity	Reduction in the number of needed familiar caregivers	Income increase equal to annual average wage	Women	32.255 € (D'Andrea, 2019)	25.417 € (INE, 2012)	33.792 € (Centraal Planbureau, 2018)
				Men		28.717 € (INE, 2012)	
<b>Economic System</b>	(-) Reduced beneficiaries' need for professional caregivers	(-) Reduction in the number of employed professional caregivers	Economic loss equal to annual wage for a professional caregiver		-17.940 € (Assistere.net, n.a.)	-14.726 € (Oliva-Moreno et al., 2013)	-18.808 € (Job and Salary Abroad, 2017)
	Reduced beneficiaries' work absence due to illness	Reduction in beneficiaries' annual work absence days	Cost saving equal to cost of a day of work absence (calculated as $annual\ average\ wage * [(12\ months/year) / (13\ paid\ months/year)] / (220\ working\ days/year)$ )	Women	135 € (D'Andrea, 2019)	107 € (INE, 2012)	142 € (Centraal Planbureau, 2018)
		Men	120 € (INE, 2012)				

Table 3 - Outcome indicators and values of the related financial proxies

**Number of adults in health between 40 and 79 years old, willing to use the virtual coach:** the indicator to measure such outcome corresponds to the number of beneficiaries, namely those people between 40 years and 79 years, who are in health and are interested in adopting the virtual coach in order to reduce the risk of contracting morbidities. In detail, data regarding 40-79 adults in health in the three areas were drafted from national databases (Regione Lombardia, 2017; Gencat, 2019; CBS, 2019). The application of the Technology Acceptance Model to the case of a virtual coach for healthy ageing revealed an Intention To Use equal to 64,2% (Visconti and Volani, 2018). As a consequence, the authors applied a therapeutic adherence equal to 64,2% to compute the number of beneficiaries.

**Reduction in the number of morbid beneficiaries:** In order to calculate the reduction in the number of people contracting the considered morbidities thanks to the virtual coach, it was necessary to start from the epidemiology of such diseases in the areas under consideration. The epidemiology of the considered morbidities in Lombardy, Catalonia and South Holland has been calculated as the number of people currently affected by such diseases divided by the total number of inhabitants in the areas under consideration (Regione Lombardia, 2017; Gencat, 2018; Gencat, 2019; INE, 2014; Sociaal en Cultureel Planbureau, 2018). In order to estimate the probability for a healthy person to contract such morbidities during a year (without the adoption of virtual coach), to simplify the calculations, the age of 65 years old (the threshold between the two target groups included in the trial: 40-64 years and 65-79 years) has been considered as centroid age of analysis. In this way, it can be assumed that all beneficiaries are healthy people being 65 years old in the year n=0 of analysis. In detail:

- The probability to get morbidity between 65 and 79 years is obtained from the difference between the epidemiology of the morbidity at 80+ and the epidemiology of the morbidity at 40-64 years.
- The probability of morbidity between 65 and 79 years is assumed to be evenly distributed for each year of the 15 years of the range (from 65 to 79).

Therefore, the percentage of beneficiaries who get ill every year is computed as follows:

*Probability of becoming affected by the morbidity during a certain year = Probability to get the morbidity between the 65 and 80 years old / 15 years.*

In order to quantify the risk reduction of contracting such morbidities thanks to the adoption of a virtual coach, the authors investigated the literature to outline how performing physical activity and having proper nutrition can reduce the risk of contracting each of the listed diseases respectively for women and men. The overall risk reduction was calculated as follows:

*Overall risk reduction =*

$$Risk_{Physical\ activity} + Risk_{Nutrition} - [Risk_{Physical\ activity} * Risk_{Nutrition}]$$

Table 4 shows the overall risk reduction thanks to the adoption of NESTORE for all the morbidities.

	Risk reduction thanks to <b>physical activity</b>		Risk reduction thanks to <b>proper nutrition</b>		Overall risk reduction	
	Women	Men	Women	Men	Women	Men
<b>Hypertension</b>	15,0% (Abramson and Melvin, 2014)	14,0% (Chase et al., 2009)	18,0% (Cook et al., 2007)	18,0% (Cook et al., 2007)	30,3%	29,5%
<b>Type 2 diabetes mellitus</b>	30,0% (Bassuk and Manson, 2005)	11,0% (Bassuk and Manson, 2005)	40,0% (Salmeron et al., 2001)	16,0% (Van Dam et al., 2002)	58,0%	25,2%
<b>Osteoporosis</b>	36,0% (Gregg et al., 1998)	12,0% (Kujala et al., 2000)			36,0%	12,0%
<b>Heart failure</b>	25,0% (San Raffaele, n.a.)	25,0% (San Raffaele, n.a.)	24,0% (Pfister et al., 2011)	24,0% (Pfister et al., 2011)	43,0%	43,0%
<b>Stroke</b>	25,0% (Howard and McDonnell, 2015)	25,0% (Howard and McDonnell, 2015)	26,0% (Fisher et al., 2006)	25,0% (Fisher et al., 2006)	44,5%	43,8%
<b>Alzheimer</b>			36,0% (Hu et al., 2013)	36,0% (Hu et al., 2013)	36,0%	36,0%

Table 4 - Overall reduction in the risk of contracting morbidities thanks to the adoption of virtual coaches

Afterwards, the probability of contracting each of the listed morbidities during a certain year with the adoption of the virtual coach is calculated as follows:

*Probability of contracting morbidities during a certain year with NESTORE = Probability of contracting morbidities during a certain year without virtual coach \* (1 - overall risk reduction thanks to virtual coach).*

Eventually, in order to calculate the actual reduction in the number of people affected yearly by each of the selected morbidities thanks to the virtual coach, the following formula has been applied:

*Reduction in the number of morbid beneficiaries = Number of beneficiaries \* (Probability of contracting morbidities during a certain year without virtual coach - Probability of contracting morbidities during a certain year with virtual coach)*

**Reduction in the number of morbid familiar caregivers:** as mentioned, among the selected morbidities, only stroke requires the presence of full-time assistance (Howard and McDonnell, 2015). Firstly, the number of beneficiaries that each year requires a caregiver (without and with virtual coach) as a consequence of a stroke event is considered. Taking the aforementioned hypothesis that 100% of people that had a stroke event remains aid-dependent for the rest of their lives, the ratio morbid:caregiver is 1:1. In the case of NESTORE, the percentage of recourse to familiar caregivers by people affected by stroke, as well as the composition in age and gender of familiar caregivers in the three areas under consideration were retrieved by national databases and dedicated studies (Quotidiano Sanità, 2018; Giuliani, 2018; Gencat, 2019; Catalunya Religiò, 2020; Spora Sinergies, 2018; Sociaal en Cultureel Planbureau, 2017).

The reduction in the number of familiar caregivers required every year by people suffering from stroke thanks to virtual coaches is calculated by multiplying the reduction in number of people affected by stroke and the percentage of recourse to familiar caregivers in the corresponding area. Literature reports the percentages of

increase in morbidity as a consequence of being a caregiver (due to stress, lack of sleep or heavy load handling): 67% for the familiar caregivers of people affected by hypertension (Gangwisch et al., 2006), 67% for type 2 diabetes mellitus (Chaput et al., 2007), 26% for osteoporosis (Verbeek et al., 2017), 7% for heart failure (Walia et al., 2014), 24% for stroke (Miller et al., 2014), 34% for Alzheimer (Chen et al., 2016). Therefore, the probability for a caregiver to contract each of the considered morbidities is calculated as:

*Probability for a caregiver to contract a morbidity = [(Epidemiology women 40-64 years) \* (%female caregivers \* %caregivers between 40-64 years) + (Epidemiology women 65-79 years) \* (%female caregivers \* %caregivers between 65-79 years) + (Epidemiology men 40-64 years) \* (%male caregivers \* %caregivers between 40-64 years) + (Epidemiology men 65-79 years) \* (%male caregivers \* %caregivers between 65-79 years)] \* (1 + Percentages of increase in morbidity as a consequence of being a caregiver)*

Eventually, the reduction in the number of morbid familiar caregivers is calculated by multiplying the reduction in the number of familiar caregivers and the probability for a caregiver to get each morbidity.

**Reduction in the number of needed familiar caregivers:** the calculation of the reduction in the number of familiar caregivers required yearly by people suffering from stroke thanks to NESTORE is the same reported for the outcome “reduction in the number of morbid familiar caregivers” of the healthcare system.

**Reduction in the number of employed professional caregivers:** as mentioned, it is assumed that 100% of the beneficiaries affected by stroke are in need of assistance from a full-time caregiver: those not resorting to familiar caregivers employ a professional caregiver. The percentage of recourse to professional caregivers is calculated as follows:

*Percentage of recourse to professional caregivers = 1 - Percentage of recourse to familiar caregivers*

The reduction in the number of professional caregivers required every year by people suffering from stroke thanks to virtual coach is calculated by multiplying the reduction in number of people affected by stroke and the percentage of recourse to professional caregivers in the corresponding area.

**Reduction in beneficiaries’ annual work absence days:** literature has been investigated to determine the average hospital length of stay that is usually required by each of the diseases impacted by virtual coaches: 6,9 days of work absences for those affected by hypertension, osteoporosis and Alzheimer (OECD, 2017), 7 days for type 2 diabetes mellitus (Donnan et al., 2000), 7 days for heart failure (Martin-Sanchez et al., 2016) and 18,6 days for stroke (Kim et al., 2013). Thanks to the adoption of virtual coaches, these absences may be avoided. The reduction in beneficiaries’ annual work absence days is calculated by multiplying the reduction in

the number of people affected yearly by each of the selected morbidities thanks to virtual coaches and the corresponding amount of days of work absence per year.

As for the input, the input indicator is represented by the number of beneficiaries, for each of whom the healthcare system incurs the costs of service and the fees to GPs. Such costs represent the financial proxy to monetize the input indicator. Since the NESTORE project is still in a development phase, the authors estimated the costs with NESTORE Consortium, considering an optimistic scenario where the yearly cost for implementing the project is equal to €600.

#### 4. Establishing impact

This stage requires to account for how much of the outcomes would have happened anyway without the initiative and what proportion of the outcome can be isolated as being added by the analysed initiative. Therefore, four phenomena need to be quantified into percentages: *displacement* (how much of the outcome displaced other outcomes - e.g. reducing crime in one area may displace criminal activity to another area), *drop-off* (mitigation or decay of the outcomes over time), *deadweight* (amount of outcome that would have happened even if the initiative had not taken place), *attribution* (how much of the outcome was caused by the contribution of other organizations or people).

The authors assumed a value equal to **0% for displacement**: prevention paths for senior adults cannot result in worse health conditions for senior adults in adjacent regions or for those who are unwilling to join the NESTORE project. Analogously, **drop-off** value is assumed to be equal to **0%**: the authors assumed that the engagement encouraged by GPs results in an effective implementation of the project and resonance of its results along the whole selected time horizon. **Deadweight** is typically estimated through the creation of a control group. Therefore, the authors assumed a value equal to **0%**. However, the impossibility to estimate deadweight is involved as one of the limitations of the present research analysis. The authors considered an **attribution** equal to **95%** (5% outcome loss) for all outcomes (percentage of the outcome that is attributable to the NESTORE project itself). They assumed that only 5% of beneficiaries' morbidity reduction (and thus of all the outcomes it provokes) is caused by prevention interventions different from NESTORE. Such a low value is justified by the fact that beneficiaries involved in the analysis are individuals explicitly willing to adopt NESTORE.

#### 5. Calculating the SROI

The Net Present Value (NPV) of the outcomes is calculated by adding up all the benefits and by subtracting any negative effect in different time periods through a discount rate. To calculate the actual impact of the initiative under analysis, it is necessary to deduct the four percentages previously calculated from the NPV of the outcomes. In the case of NESTORE, the NPV was computed on a time horizon of 10 years (i.e. the maximum time window allowing a complete overview of the benefits of NESTORE, without the risk of obsolescence of the technology) considering

a cost of capital equal to 3,5% as HM Treasury (2003) Green Book for public authorities recommends. Eventually, the SROI ratio is computed by dividing the NPV of the actual impact by the NPV of inputs.

## **RESULTS**

Table 5 synthesizes the calculation of the yearly value of the outcome indicators for each of the three areas under consideration. By multiplying the indicator values by the corresponding unitary financial proxies (**Table 3**), the monetization of each outcome item for a single year is obtained.

Eventually, Table 6 synthesizes the final value of each outcome, the total outcome, the impact, the input and the final computation of SROI.

Stakeholder	Outcome	Outcome indicator	Yearly value of outcome indicator (optimistic scenario of risk reduction)			
			Lombardy	Catalonia	South Holland	
Beneficiaries	Reduced beneficiary's risk of disease	Number of adults in health between 40 and 79 years old, willing to use NESTORE	1.713.672	2.357.268	651.080	
	Reduced beneficiaries' need for professional caregivers	Reduction in the number of employed professional caregivers	32	420	575	
Healthcare System	Cost reduction due to reduced beneficiaries' morbidity	Reduction in the number of morbid beneficiaries suffering from:	Hypertension	6.208	17.820	5.906
			Type 2 diabetes mellitus	5.344	8.885	3.471
			Osteoporosis	11.956	3.843	1.778
			Heart failure	135	7.199	2.857
			Stroke	212	3.713	1.315
	Cost reduction due to reduced familiar caregivers' morbidity	Reduction in the number of morbid familiar caregivers suffering from:	Alzheimer	868	554	947
			Hypertension	39	1.561	198
			Type 2 diabetes mellitus	13	495	82
			Osteoporosis	26	220	24
			Heart failure	1	165	7
Familiar caregivers	Reduced beneficiaries' need for caring activity	Reduction in the number of needed familiar caregivers	Women	81	1.696	331
			Men	99	1.597	409
Economic System	Reduced beneficiaries' need for professional caregivers	(-) Reduction in the number of employed professional caregivers	32	420	575	
	Reduced beneficiaries' work absence due to illness	Reduction in beneficiaries' annual work absence days	Women	130.597	194.138	73.677
			Men	43.023	140.815	54.643

Table 5 - Yearly values of the outcome indicators of NESTORE in the areas under consideration

			Lombardy	Catalonia	South Holland
<b>N.P.V. OF OUTCOMES</b> (time horizon 10 years)	<b>Beneficiaries</b>	Reduced beneficiary's risk of diseases	18.028.695.911,22 €	20.795.633.329,04 €	7.277.453.183,22 €
		Reduced beneficiaries' need for professional caregivers	24.740.579,56 €	268.615.466,54 €	469.557.836,51 €
	<b>Healthcare System</b>	Cost reduction due to reduced beneficiaries' morbidity	1.182.345.935,74 €	5.746.653.500,93 €	2.258.441.481,53 €
		Cost reduction due to reduced familiar caregivers' morbidity	829.212,53 €	67.854.708,09 €	2.929.943,16 €
	<b>Familiar caregivers</b>	Reduced beneficiaries' need for caring activity	252.064.765,74 €	3.859.563.883,23 €	1.084.676.483,82 €
	<b>Enterprises</b>	(-) Reduced beneficiaries' need for professional caregivers	-24.740.579,56 €	-268.615.466,54 €	-469.557.836,51 €
		Reduced beneficiaries' work absence due to illness	1.019.434.686,77 €	1.634.352.554,79 €	789.353.215,98 €
	<b>N.P.V. TOTAL OUTCOME</b>			20.483.370.511,99 €	32.104.057.976,08 €
<b>N.P.V. TOTAL IMPACT</b> (attribution 95%)			<b>19.459.201.986,39 €</b>	<b>30.498.855.077,28 €</b>	<b>10.842.211.592,33 €</b>
<b>N.P.V. TOTAL INPUT</b>			<b>8.551.160.115,99 €</b>	<b>11.762.679.585,79 €</b>	<b>3.248.863.028,23 €</b>
<b>SROI</b> (NPV Impact / NPV Input)			<b>2,28</b>	<b>2,59</b>	<b>3,34</b>

Table 6 - Calculation of the SROI of NESTORE in the areas under consideration

## DISCUSSION

A first relevant conclusion is given by the fact that the SROI ratio assumes a final value higher than 1 in all the three areas under consideration: as a result, NESTORE is value-for-money.

Analysing the **contribution of stakeholders** to the total impact, it results that beneficiaries are the actors that benefit the most from the implementation of the project in each area under analysis (Figure 1).

	Lombardy	Catalonia	South Holland
Beneficiaries	€17.150.764.666	€20.011.036.356	€7.359.660.469
Healthcare System	€1.124.016.391	€5.523.782.799	€2.148.302.853
Familiar caregivers	€239.461.527	€3.666.585.689	€1.030.442.660
Enterprises	€944.959.402	€1.297.450.234	€303.805.610

Table 7 - Impact per stakeholder

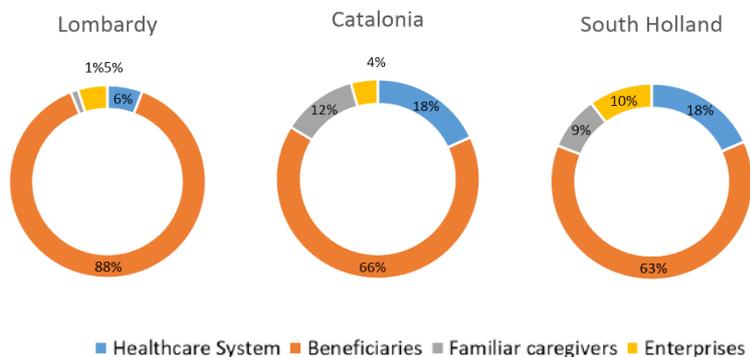


Figure 1 - Impact per stakeholder

Moreover, exploring the contribution of each specific impact item (Figure 2), it results that beneficiary's reduced morbidity (measured through Willingness to Pay) plays the most relevant role.

Impact item	CONTRIBUTION OF EACH IMPACT ITEM		
	Lombardy	Catalonia	South Holland
Reduced beneficiary's risk of diseases	18.028.695.911,22 €	20.795.633.329,04 €	7.277.453.183,22 €
Cost reduction due to reduced beneficiaries' morbidity	1.182.345.935,74 €	5.746.653.500,93 €	2.258.441.481,53 €
Cost reduction due to reduced familiar caregivers' morbidity	829.212,53 €	67.854.708,09 €	2.929.943,16 €
Reduced beneficiaries' need for caring activity	252.064.765,74 €	3.859.563.883,23 €	1.084.676.483,82 €
Reduced beneficiaries' work absence due to illness	1.019.434.686,77 €	1.634.352.554,79 €	789.353.215,98 €

Table 8 - Contribution of each impact item

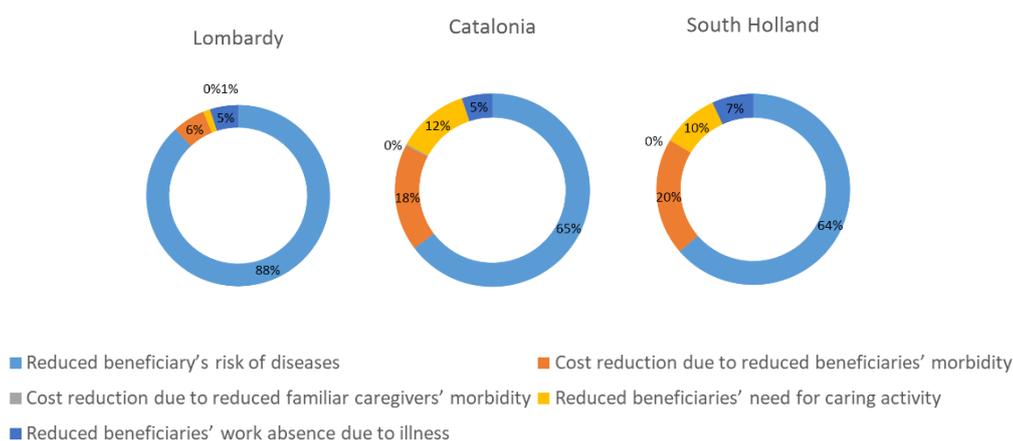


Figure 2 - Contribution of each impact item on the overall impact

This result is particularly relevant since it outlines the contribution that a SROI analysis can bring to the evaluation of a project, especially when compared to the traditional CBA method. In fact, CBA, performed involving only the outcomes and inputs related to the payer of the project's perspective, the healthcare system, would have neglected the role of beneficiaries, thus leading to the following results (Table 9):

	Lombardy	Catalonia	South Holland
Benefits for the healthcare system	1.124.016.391 €	5.523.782.799 €	2.148.302.853 €
Costs incurred by the healthcare system	8.551.160.116 €	11.762.679.586 €	3.248.863.028 €
<b>CBA ratio</b>	<b>0,13</b>	<b>0,47</b>	<b>0,66</b>

Table 9 - Cost-Benefit Analysis of NESTORE

The CBA on NESTORE provides a result that is lower than 1 in all the three areas considered. Differently from SROI, according to the CBA the NESTORE project is not value-for-money.

### THEORETICAL AND MANAGERIAL CONTRIBUTION

In terms of theory, the current study represents a **first attempt to create a replicable standard of the SROI model** to evaluate technologies in healthcare.

In fact, given the lack of a structured framework of SROI for assessing technologies, the developed model has defined a standard, easily replicable for the assessment of technologies fostering healthy ageing, for the evaluation of economic and social outcomes related to preventive initiatives and for the straightforward monetization of social outcomes thanks to the possibility to follow a step-by-step framework.

The creation of a standard framework has relevant managerial contributions, since it can be adopted by different decision-makers willing to assess the impact of technologies for healthy ageing in the area and society they represent. In particular, the model developed to assess the impact of NESTORE in the Lombardy Region, in the autonomous community of Catalonia and in the province of South Holland could be easily adopted to evaluate the same technology in the different areas where NESTORE promoters are willing to launch the initiative.

Moreover, promoters and developers of a general project have to guarantee three main points, when proposing such a solution (Social Value UK, 2012):

1. the **positive impact**, not only for the target but **for the whole society**;
2. the positive impact according to the **strategic objective** of the entity they represent;
3. the **economic sustainability of the initiative for the payer** (the SROI analysis has to guarantee that the entity in charge of the payment would return on the investment).

A SROI framework can play as a strategic tool to meet each of these points, thus providing the decision-makers with all the necessary information to make the most proper decisions, ensuring that the initiative they are promoting is managing the most economic and social implications and risks. As a matter of fact, in its complete

and general form, the computation of SROI offers an overview on the general impact of an initiative, clearly stating which the **value generated for all the stakeholders** involved is.

## LIMITATIONS AND FURTHER DEVELOPMENT

The project limitations (and thus future developments) have been drafted retracing, step by step, the route followed by the authors to build the model.

**1.Establishing scope and identifying stakeholders:** as for the **scope**, the authors designed a model in which the National/Regional healthcare system plays the role of the payer and the virtual coach is presented as a medical device. Of course, as NESTORE case itself envisions, this is not the only viable alternative. The virtual coach could be conceived as a **“peace of mind” device** (not a medical device) and thus be distributed by health insurance companies, enterprises (as part of welfare programs) or paid directly by its target. As regards the stakeholders, the authors made the decision **not to involve** in the analysis **pharmaceutical and biomedical companies, family and friends and influencers**. The authors invite future researchers to analyse and involve these alternatives and aspects in their analyses.

**2.Mapping Outcomes:** this step concerns identifying inputs, valuing inputs, clarifying outputs, describing outcomes. Looking at the **inputs** and their valuation, the authors envisioned a model in which the healthcare system oversees a monthly cost covering the whole service provision. However, when it comes to NESTORE case study, given its prospective nature, the quantification of this value **could not be precisely defined**. The authors invite future researchers, aware of the real cost for implementing the project, to correct the data and, if necessary, the whole consideration on the NESTORE initiative. Coming to the **outcomes** for a generic model, when dealing with the National/Regional healthcare system, the authors neglected some secondary aspects: **loss for those physicians and specialists** (especially nutritionists) that operate and work as private or public entities; **increased incomes for the service sector** coming from healthier adults (e.g. theatres, cinemas, restaurants, travel agencies, airline companies, hotels, etc.). Future analysis should quantify these implications and define how they affect the overall SROI ratio for a virtual coach for healthy ageing.

**3.Evidencing outcomes and giving them a value:** given the **prospective nature** of the authors' analysis, the choice of indicators has been suggested by the literature, as well as the choice of financial proxies. Anyway, the impossibility to directly experience the outcomes provided by a virtual coach and to collect data regarding them represents the major limitation of the current study. Once NESTORE will be launched and used by citizens, future researchers will have the chance to conduct and ex-post evaluation of NESTORE, highlighting the main gaps between prospective and real evaluations. This consideration becomes particularly relevant when it

comes to beneficiaries' **Willingness To Pay** for reduced morbidity enabled by the virtual coach, which builds up the majority of the overall impact in all the three areas analyzed. Another limitation of the current research is represented by the decision of the authors to involve the consequences and benefits resulting from **only two (physical activity and nutrition) out of the four domains** of healthy ageing covered by NESTORE (physical activity, nutrition, social sphere, and cognitive ability). Another critical aspect regards the **collection of the data**: epidemiological data about the population, costs incurred by the healthcare system to treat specific pathologies as well as the composition by gender, age and typology of caregivers. The sources to collect such data vary from country to country and, what is more, the same item may be quantified in a different way and considering different elements, depending on the source. Therefore, in order to insert the data in the model, it is required to make additional assumptions and adaptations on the data retrieved. In sum, the order of magnitude of the outcomes quantified may slightly vary from country to country, which makes the final results difficult to be compared.

**4.Establishing impact:** this step requires to define deadweight, displacement, attribution, and drop-off. As already evidenced by a literature review on the SROI, their estimation results to be really complex, above all when dealing with a prospective study. In detail, as it comes to deadweight, it requires the definition of comparison groups or benchmarks whose trends can be observed only in case of retrospective studies. Therefore, future researchers are invited to define control groups and to involve ex-post and proven-on-the-field values for deadweight.

**5.Calculating the SROI:** this step is mainly concerned with the choice of a proper time horizon and discount rate. For the time horizon, its selection is mainly related to the nature of the technology in place and its risk of obsolescence. This observation can be assumed as a major guideline for the model. However, when it comes to NESTORE case study, once again, it was possible to merely define an approximation of this value.

**6.Reporting, using and embedding:** an interesting aspect that rotates around mHealth solutions is that of using the data from users to improve the solution itself and to sell them to third parties. The authors decided to neglect this aspect in drafting a generic model for healthy ageing solutions because of its complex technicalities and privacy implications; however, its involvement could reinforce the idea of SROI as a complete and holistic methodology. The last limitation to be underlined is the weak validation that the model has obtained so far. In fact, having shown the SROI model for NESTORE to the NESTORE Consortium represents just an initial approval step, without proving its definitive effectiveness. To overcome this limit, future researchers could try to adapt the SROI model developed by the authors to other contexts such as other technologies operating in the healthcare field, in order to verify its robustness and versatility.

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