Approaching 2014: Is Telemedicine Assessed from The Social Perspective?
A Brief 2013 Systematic Review

Francesco Fusco, Leopoldo Trieste, Giuseppe Turchetti.
Institute of Management-Management and Innovation (MAIN)
Scuola Superiore Sant’Anna
Pisa, Italy
e-mail: f.fusco@sssup.it, l.trieste@sssup.it, g.turchetti@sssup.it

Abstract—Recent reviews in Telemedicine (TM) detected methodological flaws in economic assessment. Our brief review addresses the perspective adoption problem, investigating to what extent adopting a broader point of view could have an impact on TM economic studies and consequential diffusion. Out of 486 articles found, 15 studies were selected for full-text assessment. Most of them showed an improvement in methodology if compared with the past TM economic evaluations. However, only 4 papers reported data from the social perspective and among them 3 presented productivity loss. Although some positive results in economic evaluation were observed, to date it is not clear to what extent TM is paid for by third parties or has to be paid by the patients. Nevertheless, effectiveness and cost-effectiveness of telemedicine and its related fields are not clear yet. Both early and the most recent literature reviews [5-10] report contradictory results on the actual impact of telemedicine in terms of costs and effectiveness. However, most of the reviewers observed a high prevalence of poor designed and developed studies, probably responsible for reluctance in adopting telemedicine. In addition, it is not clear to what extent telemedicine should be considered an only third-party payer's matter or not. There is a common agreement about cost-utility analysis to be performed adopting National Health Service (NHS) perspective. Nonetheless, estimating only third-party payer's costs could be responsible for partial cost assessment, and consequential partial benefit estimation. NHS perspective disregards all patients’ related cost, excluding indirect and out-of-pocket costs. Productivity loss is a very controversial point in economic evaluation in healthcare. In health economics it was extensively discussed whether indirect costs (productivity loss) should be included in Cost-Effectiveness Analysis (CEA), without reaching a final and wide consensus. The explanation for that could be found in the necessity for the NHS to optimize resource consumption as it is driven by spending cap issues. However, patients (and potential informal caregivers) perspective could consequentially report extra information able to influence society itself. Other issues frequently disregarded in economic evaluation are direct non-medical costs (i.e., travelling and accommodation expenditures), which account for a considerable amount of resources consumed if considering high prevalence diseases. The societal perspective is able to embrace all these costs, merging NHS costs (medical and not medical direct cost) to patient ones (out-of-pocket medical and non-medical direct cost; indirect and intangible costs). The object of our brief review is to investigate to what extent economic evaluations in telemedicine published up to 2013 were able to capture potential benefits considering the social perspective issue.

The article is composed by five sections. Introduction addresses state of art and the systematic review aim. Methods section describes the procedures used to select the included articles. Results section explores and highlights the main findings. Discussion reports issues and possible solution to assess properly telemedicine. Finally, conclusion accounts for authors considerations.
II. METHODS

In order to identify all published studies inherent to economic evaluation in telemedicine, a systematic review was conducted throughout the following databases: EBSCO host (Medline; Cinahl; EconLit; PsycInfo); Database of Abstracts of Reviews of Effectiveness (DARE); ISI Databases (Science Citation Index; Social Science Citation Index; Arts and Humanities Citation Index); Embase; NHS Economic Evaluation Database; Health Technology Assessment Database and the Cochrane Databases. The studies included in the review are full economic evaluations according to Drummond [11]; therefore, the following terms were included in the search strategy: Cost-Minimization Analysis (CMA), Cost-Consequences Analysis (CCA), Cost-Effectiveness Analysis (CEA), Cost-Utility Analysis (CUA), Cost-Benefit Analysis (CBA) of telemedicine and its explosion in mesh tree. Studies reporting only costs or only effectiveness were excluded. Other exclusion criteria were: email-only or telephone-only based studies and different languages than English. Results were limited to the period January 1st, 2013 to November, 2013, as previous reviews extensively reported and discussed data and methodological issues [8,10].

III. RESULTS

Once identifying the article titles, duplicates were deleted using MS excel 2013 (Microsoft Corporation). 486 articles were obtained from search strategy terms research. After titles revision 451 articles were excluded because they were not economic evaluation. Abstracts revision has led to exclude 20 articles: 6 considered only cost, 4 were reviews, 3 considered only effectiveness, 2 were study protocols and 5 were excluded for other reasons (telephone based, different language than English, patients preference, validation study). After the abstract assessment, 15 articles were included for full-text evaluation (Figure 1). NHS and Social perspective were the most adopted respectively 10 and 4 studies.

A. NHS perspective

Among the included trials (Table I), the majority adopted the NHS perspective. The whole set of studies was assessing performance of telemonitoring devices in chronic diseases (Heart failure, Chronic Obstructive Pulmonary Disease, Diabetes, Hypertension), reporting in most of the cases utility outcomes (e.g., Quality Adjusted Life Years - QALYs). Time horizon ranged from 6 months to 16 months. Out of 6 decision models (Table II), 4 of them were Markov model-based economic evaluation and 2 decision tree ones. Although most of them adopted a third-party payer point of view, QALY was chosen as effective outcome in 5 studies. The time horizon covered period ranging from 3 years up to lifetime. Beyond clinical trials and decision models, 2 out of 5 studies with various designs (Table III) assessed TM from the NHS perspective. The interventions were compared with results belonging to the same patients, but observed before telemedicine procedure started. No Health Related Quality of Life (HRQOL) outcomes were considered; authors chose monetary benefits or clinical outcomes.

B. Social perspective

Most of the studies assessing costs alongside clinical trials adopted NHS perspective. Nevertheless, Zanaboni et al. [13] showed costs experienced by patients for travelling and private visits in both study arms; however, patients’ costs were excluded in CUA. No significant difference in cost for NHS was observed, on the other hand patients in TM arm experienced a lower expense of 100€ per patient/year (p<0.05). This difference was detectable in all the patients' related costs (Protocol-defined visits and Emergency Department visits) with exception of “Non-urgent in-office visits”, where usual care was less expensive (p>0.05). The authors concluded that remote monitoring led to cost saving for patients of about 24% of their cost per year. However, limiting analysis to patients for whom QALY was available, it was considered only NHS costs and was observed a cost reduction of €888.10 per patient over 16 months. Only one Markov model assessed CEA from both the NHS and social perspective [14]. Once household costs were considered, the TM intervention cost increased. However, Rachapelle et al. [14] stated that most of TM costs are related to additional hospital fees rather than to travelling costs or productivity loss. Among studies adopting different design than clinical trials or decision models, 2 of them developed the study from the society point of view. No HRQOL outcomes were used in these studies. Levin et al. [15] performed an uncontrolled retrospective study, assessing cost reduction adopting telemedicine in diabetes teleconsulting in Denmark. In this case, results compared haemoglobin A1c (HbA1c) levels in diabetic patients using TM to Dansk Voksen diabetes database (DVDD) patients’ levels [15]. Isetta et al. [16] results compared telemonitoring for low risk newborns with usual care in terms of Emergency Department (ED) accesses. Indirect costs concerning one of the newborn’s parents were

![Figure 1. Study selection flow chart.](Image)
assumed to be €15 for missed hour of work, while €30 for travelling expenses to reach the hospital. Sensitivity analyses varied the following costs by ±75%: Emergency Department visit, hospital visit, nurses’ salary per hour, travelling to hospital and parents’ productivity loss. Even in these cases, the ICER was in favour of telemonitoring.

IV. DISCUSSION

In the last years, many authors questioned the methodological approach to capture costs and effectiveness of telemedicine [5-10]. The most important problems identified were: study design, small samples, limited time horizon, heterogeneous cost-related variables and proxies for effectiveness, control group absence and cost analysis perspective. In the papers published in 2013, we registered a somewhat improvement with regards to most of these elements. In particular, most of the studies retrieved have a sufficiently broad sample and used well-defined cost items and outcomes variables. However, the perspective of analysis remains an unsolved issue. In Italy, it is not clear if telemedicine should be reimbursed or not [13].

In this setting, a narrow perspective is not suitable to properly answer to this question. The societal point of view is by definition the broadest one, embracing NHS, patients and caregivers perspective. From the patients and the caregivers point of view, direct (medical and non-medical), indirect, and intangible costs (HRQOL) should be assessed [11]. In effect, telemedicine, theoretically, could sharply decrease all of these cost items. One of the focal points of telemedicine adoption is abridging distances and consequently to reduce productivity loss, and delivering high quality healthcare outside the healthcare centre. This has of course an influence in patient’s expenditure in terms of travelling and/or accommodation. Zanaboni et al. reported reduction in out-of-pocket costs for in-office and clinic visits. Even if the authors did not report non-medical direct and indirect costs, it is consequential that a number of visits was reflected in a reduction in travelling costs and productivity loss for the telemonitoring arm. Likewise, Isetta et al. [16] reported positive results in their cost-effectiveness study including non-medical direct and indirect costs (estimated by assumption). On the other hand, Rachapelle et al. assessed TM intervention adopting the NHS and societal perspective. From the latter point of view, the intervention was no more cost effective in the same timeframe where it was for NHS. In all the cases the introduction of exclusion or productivity loss and travelling/accommodation costs was able to influence the study results.

The other 10 studies reported only the third-party payer’s perspective. However, in comparison to the previous reviews, 2013 brought an improvement in terms of methodological reliability in telemedicine studies. Although the number of well-designed studies has somewhat increased, further methodological reliable studies have to be developed in order to confirm telemedicine cost-effectiveness. In addition, the adopted perspective and indirect cost assessment still represent a pivotal unsolved point. Introduction of indirect cost in CEA and CUA was extensively discussed; the main issues raised in the literature were equity, measurement, double counting in HRQOL benefits and opportunity cost [17]. Of course, to convert productivity loss in monetary terms, therefore, limiting it to employed patients, could influence the equity purpose in healthcare, giving priority to employed patients [18]. However, unpaid job could be involved in the analysis attempting to overcome this problem (e.g., considering the aver costs for the closest paid job) [17].

Another important issue to be considered is the measurement of indirect costs, as there is little agreement about what methods among human capital or friction approach is the best in capturing indirect cost. The first one estimating the productivity gain as an averted earning, while the latter depend on the productivity reduction of each patient during the condition and the amount of time (friction period) required to completely restore patient’s productivity. Double counting point concerns about whether the observed monetarized outcome (productivity loss) has been fully incorporated in the non-monetarized effectiveness unit. Therefore, double counting could be avoidable considering clinical outcomes instead of HRQOL ones, as in this case outcomes would not express patient’s preferences. However, it would lead to lose all the comparability and generalization advantages in using HRQOL outcomes like QALYs. Regarding to this topic Olsen et al. [19] stated that whether the preference based outcome did not report dimension clearly describing income changes related to health gain, it is not possible to know if the patient provided or not these data in his/her utility. In our review the productivity loss was included in 3 studies [14-16], two of them assess indirect cost by assumption, while Rachapelle and colleagues reported productivity loss only for those who had a paid job. On the other hand, Isetta et al. [16] included an estimation of indirect cost for only one of the newborn parents.

A constrained number of studies adopted a broad perspective, and even a smaller number introduced productivity loss. In a public healthcare setting, opportunity costs should be carefully assessed. Although NHS expenditure reduction is straightforward to assess, assessing productivity gain is more complex. Let us consider a hypothetic innovative procedure to be no more expensive than usual care from the NHS perspective, but less expensive from the societal one, the additional resources obtained could be invested directly or indirectly in healthcare again. This would be reflected in extended budget for every single activity able to influence QALYs in favour to the least expensive procedure from social perspective [17].

V. CONCLUSION

Although the controversial issue about including indirect costs in CUA, societal perspective should be adopted considering non-medical direct costs, while productivity loss could be assessed in terms of usual activities loss, but not included in CUA. This would report all the most remarkable
items of cost and highlight indirect gains (included in QALY, but perhaps hidden in it), resulting in the best informing data for policymakers.

Further methodologically robust studies should be designed and conducted in order to drive both the adopters and the policy makers to more informed and reliable investment decisions.

ACKNOWLEDGMENT

The authors thank: Ms Carla Papa and Ms Maria Teresa Nevigato for the help in retrieving all the articles.

REFERENCES


## TABLE I. CLINICAL TRIAL BASED ECONOMIC ANALYSES.

<table>
<thead>
<tr>
<th>Clinical-trial</th>
<th>Features</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stoddart et al. 2013[22]</td>
<td>401 patients with uncontrolled hypertension. Mean age: 60.6 years. Pragmatic randomized controlled trial. Perspective: NHS. Time horizon: 6 months.</td>
<td>Intervention: Telemonitoring based service for the management of uncontrolled hypertension. Control: Usual care. Direct Costs: Outpatients, nurse consultations emergency telephone, ER visits; drugs. Effectiveness Outcomes: Mean daytime systolic ambulatory blood pressure (SABP). Costs: Mean difference (TM vs UC) cost-patient per 6 months: +109.23. Effectiveness Outcome: SABP difference (6 months): -6.05 mm Hg (TM); -1.72 mm Hg (UC). Mean difference between TM-UC (6 months): -4.51 mm Hg (p&lt;0.001).</td>
</tr>
<tr>
<td>Zanaboni et al. 2013 [13]</td>
<td>200 patients heart failure patients implanted. Mean age: not stated, TM median age: 66 years. UC median age: 69 years. Prospective, randomized, open, multicentre clinical trial. Perspective: NHS Patient. Time horizon: 16 months.</td>
<td>Intervention: Wireless implantable defibrillator. Control: Usual care. NHS costs: Direct medical costs, TM follow-up. Patient cost: Outpatient private visits; ED visits, out-of-pocket expenses. Effectiveness outcomes: QALY. NHS cost: Mean cost per patient (1 year): €1’962.78 (TM) vs €2’130.01(UC);(p=0.80). Patient cost: Mean cost per patient (1 year): €381.34 (TM) vs €291.36 (UC);(p=0.01). Cost-utility analysis: Mean cost per patient (16 months) €2’074.70 (TM) vs €2’962.80 (UC);(p=0.33). QALYs gained (16 months):1.03 (TM) vs 0.97 (UC);(p=0.03) . Even if a €900 fee would be applied to TM, the cost-effectiveness ratio would be negative. (i.e., TM is cost-effective and dominant solution compared to usual care).</td>
</tr>
<tr>
<td>Decision model</td>
<td>Population</td>
<td>Study design</td>
</tr>
<tr>
<td>------------------------</td>
<td>------------</td>
<td>--------------</td>
</tr>
<tr>
<td>Kirkizlar et al. 2013</td>
<td>900 diabetic patients (type 1 and type 2) belonging to those enrolled in the medical centre before or after the teleretinal screening (2005) [26,27]. Mean age: not clearly stated.</td>
<td>Retrospective cohort study plus Markov model for cost-effectiveness analysis. Perspective: NHS. Time horizon: patient’s death or at 99 years.</td>
</tr>
<tr>
<td>Decision model</td>
<td>Population</td>
<td>Study design</td>
</tr>
<tr>
<td>----------------</td>
<td>------------</td>
<td>--------------</td>
</tr>
<tr>
<td>Kaambwa et al. 2013 [30]</td>
<td>Patients with hypertension belonging to TASMINH2 trial [31] Mean age: 66.0 years.</td>
<td>Markov model-based probabilistic cost-effectiveness analysis. Perspective: NHS. Time horizon: 35 years.</td>
</tr>
<tr>
<td>Other study design</td>
<td>Population</td>
<td>Study design</td>
</tr>
<tr>
<td>--------------------</td>
<td>------------</td>
<td>--------------</td>
</tr>
<tr>
<td>Levin et al. 2013 [15]</td>
<td>78 patients: 23 type 1 diabetes mellitus (T1DM). 55 type 2 diabetes mellitus (T2DM). Mean age: 66.4 years.</td>
<td>Uncontrolled retrospective study</td>
</tr>
<tr>
<td>Akematsu et al. 2013[36]</td>
<td>208 patients with various diseases (Chronic and not chronic conditions). Mean age: 75.7 years.</td>
<td>Regression model to assess cost reduction adopting telecare. Perspective: not stated</td>
</tr>
</tbody>
</table>