



Six important steps in the estimation of the economic aspects of telemedicine applications in Renewing Health

This document includes a short description of how the costs of implementing a telemedicine application and the potential effects on the patients' use of health care services should be estimated in the economic evaluation that is part of the Renewing Health project. The document also describes the implications for the design and reporting of the pilot studies.

The document is based on the draft protocols from the pilots in the Renewing Health project and the section about "Economic aspects" p. 22-26 in the MAST Manual presented in Berlin, May 2010. More information on estimation of costs in health economic evaluation can also be found in Drummond et al. (2005) *Methods for the Economic Evaluation of Health Care programmes* (Oxford Medical Publications).

STEP 1: Consider which types of resource consumption to be included

The pilots in Renewing Health should all estimate the costs per patient of using the telemedicine application and the costs of using the alternative (the comparator). Since costs are defined as the value of the resources used, each pilot team must start by considering where and when in the treatment process that the use of telemedicine can have an effect on the use of resources.

For example, the use of the COPD briefcase in the Danish pilot is expected to have an effect on the use of the following types of resources:

- Investment in the telemedicine application
 - Education of the staff
 - Physical changes in offices at the hospital
 - Time for staff meetings

- Running costs of delivering the telemedicine service:
 - Time used by staff on education of patients
 - Time used by staff at the call-centre
 - Number of tele-consultations
 - Time used by patients
 - Time used by relatives

- Effects on the patients' use of health care services:
 - Number of readmissions
 - Length of stay for each readmission
 - Staff time used by home care nurse
 - Number of contacts to GP
 - Number of contacts to emergency doctor

Thus, for each of these types of resources it is expected that the implementation of the telemedicine application will increase or decrease the use of resources. Therefore the assessment of the costs should include these elements. Notice that both use of resources in the form of investments and running costs of delivering the service must be included.

Whether broader societal costs like cost of patient time and transportation of patients are included depends on the perspective of the economic analysis. If, for example, the perspective is on the health care system, only use of resources within health care institutions is included. Therefore the perspective of the economic analysis must be defined.

STEP 2: Consider methods for data collection

Hereafter it should be considered how the quantity of resources used for each type of resource (described in step 1) can be assessed, i.e. which method that can be used for data collection.

With regard to investment, e.g. purchase of new devices or infrastructure, this can often be done quite simple by using information on the number of devices purchased or the expenditures on investment in new software etc.

However, with regard to the running costs of delivering the telemedicine service, it is crucial that the information is collected for each patient (i.e. at patient level). For example in the COPD Briefcase study, information on the use of staff time for each telemedicine consultation is collected. Similar in the Danish pilot of telemedicine for patients with diabetic foot ulcers information on the use of time for the nurse and the medical specialist is collected each time the patients are treated at home.

Therefore each pilot team should consider which types of resources that are most important in an assessment of the costs of using telemedicine and the comparator and how the information can be collected. Data from local registers can sometimes be used, however, in most cases these data must be complemented by use of case report forms (with questions to the staff about treatment of each patient) or questionnaires to patients.

Based on the decisions made by each pilot team in step 2, a table similar to Table 1 must be produced, describing the types of resources, the methods for data collection and whether the information is collected at patient level or group level. In the tables below the COPD briefcase study is used as an example.

Table 1. Types of resources included in the estimation of costs

Type of costs	Method of data collection	Estimation at patient or group level
Investment in the telemedicine application <ul style="list-style-type: none"> - Education of the staff - Physical change of offices - Time for staff meetings 	Interview with staff Interview with staff Interview with staff	Group level Group level Group level
Running costs of delivering the telemedicine service: <ul style="list-style-type: none"> - Time used by staff on education of patients - Time used by staff at the call centre - Number of tele-consultations - Rent of COPD Briefcase - Time used by patients - Time used by relatives 	Questionnaire to staff Questionnaire to staff Questionnaire to staff Questionnaire to staff Questions to patient Questions to patient	Patient level Patient level Patient level Patient level Patient level Patient level
Running costs of delivering the comparator <ul style="list-style-type: none"> - Number of inpatient days 	Register data	Patient level
Effects on patients use of health care: <ul style="list-style-type: none"> - Number of readmissions - Length of stay for each readmission - Staff time used by home care nurse - Number of contacts to GP - Number of contacts to emergency doctor 	Register data Register data Register data Register data Register data	Patient level Patient level Patient level Patient level Patient level

STEP 3: Collection of information of use of resources

When the types of resources and the data collection methods for each resource are decided, the data collection in the intervention and control group can be carried out.

STEP 4: Collection of information on prices

To calculate the costs of the resource consumption, information on the price of each resource must be found. In practise, information on the price for equipment can be found in the purchasing department in hospitals or municipalities. The price of 1 working hour for clinical staff can often be found in the Human Resources department in hospitals etc. Remember to include all expenditures e.g. related to pension, holidays etc. Information on the prices used should be included in a separate table similar to Table 2, when the results from the economic analysis are reported.

Table 2. Prices used in the calculation of costs

Type of costs	Price per unit
Investment in the telemedicine application <ul style="list-style-type: none"> - Staff - Physical change in offices 	€€ per hour €€ in total
Running costs of delivering the telemedicine service: <ul style="list-style-type: none"> - Time used by staff - Rent of COPD Briefcase - Time used by patients - Time used by relatives 	€€ per hour €€ per Briefcase €€ per hour €€ per hour
Running costs of delivering the comparator <ul style="list-style-type: none"> - Number of inpatient days 	€€ per bed day
Effects on patients use of health care: <ul style="list-style-type: none"> - Readmissions - Length of stay for each readmission - Staff time used by home care nurse - Number of contacts to GP - Number of contacts to emergency doctor 	€€ per readmission €€ per day €€ per hour €€ per visit €€ per visit

STEP 5: Reporting of the results

Finally, the results from the economic analysis can be reported. When reporting the results, information on purpose of the economic evaluation and the methods used for data collection should be described. Hereafter a table should be presented with information on the average use per patient in the intervention and control group. An example is described in Table 3.

The table should also include information about the variation by use of confidence intervals (c.i.)

This kind of table is important because it increases the transparency of the estimated costs and because the information is helpful to readers from other countries where the price of resources (e.g. the wages) are different. Based on the table these readers can produce an estimate of the costs of implementing the telemedicine application in their country. Thus, this table improves also the transferability of the results.

Based on the described Table 3, the average costs per patient in the intervention and control group can be estimated by multiplying the quantity of each resource used by the price of the resource. The results should be presented in a table similar to Table 4. Again the table should also include information about the variation in the different cost elements (confidence intervals) and whether the differences are statistically significant.

When reporting the results attention should also be made towards potential uncertainty of the estimated costs. This can be done in sensitivity analysis, where e.g. the effect variation in a single parameter on the average costs per patient can be estimated.

If analysis of the clinical effectiveness shows a statistically significant improvement in the primary or secondary health outcomes of the telemedicine application, the estimated costs can also be used in cost-effectiveness analysis (see the MAST-Manual and Drummond et al. for further information).

STEP 6: Consider the need for collection of additional data for the business case

As described in the MAST-Manual, the economic analysis of telemedicine applications should, in addition to the economic evaluation described above, also include a business case in which the expenditures and revenues for the institution using telemedicine is assessed.

In most cases the expenditures can be estimated based on the information collected on resource consumption in the economic evaluation as described above. However, for the estimation of the revenue for e.g. a hospital introducing a telemedicine application, additional information is needed. For example, information on the effects on hospital activity (e.g. changes in number of admission and outpatient visits) and information on reimbursement rates is needed. A plan for collection of this information must therefore be made by the pilot team.

More information:

Questions about data collection and analysis of the economic effects of the telemedicine applications in the pilots can be submitted to: Kristian.Kidholm@ouh.regionyddanmark.dk.

Table 3. Average use of resources per patient in the intervention and control group

Type of costs	Mean use per patient in the intervention group		Mean use per patient in the control group	
Running costs of delivering the telemedicine service:				
- Time used by staff on education of patients	## min.	ci: ##-##		
- Time used by staff at the call centre	## min.	ci: ##-##		
- Number of tele-consultations	#	ci: ##-##		
- Time used by patients	## min.	ci: ##-##		
- Time used by relatives	## min.	ci: ##-##		
Running costs of delivering the comparator:				
- Number of inpatient days	# days	ci: ##-##	# days	ci: ##-##
Effects on patients' use of health care:				
- Number of readmissions	## readmis.	ci: ##-##	## readmis.	ci: ##-##
- Length of stay for each readmission	## days	ci: ##-##	## days	ci: ##-##
- Staff time used by home care nurse	### min.	ci: ##-##	### min.	ci: ##-##
- Number of contacts to GP	## contacts	ci: ##-##	## contacts	ci: ##-##
- Number of contacts to emergency doctor	## contacts	ci: ##-##	## contacts	ci: ##-##

Table 4. Average costs of the treatment per patient in the intervention and control group

Type of costs	Mean cost per patient in the intervention group		Mean cost per patient in the control group	
Investment in the telemedicine application				
- Education of the staff	€ #####			
- Physical change of offices	€ #####			
- Time for staff meetings	€ #####			
Total investment costs	€ #####	ci: ##-##	€ 0	
Running costs of delivering the telemedicine service:				
- Time used by staff on education of patients	€ #####	ci: ##-##		
- Time used by staff at the call centre	€ #####	ci: ##-##		
- Number of tele-consultations	€ #####	ci: ##-##		
- Rent of COPD Briefcase	€ #####	ci: ##-##		
- Time used by patients	€ #####	ci: ##-##		
- Time used by relatives	€ #####	ci: ##-##		
Running costs of delivering the comparator:				
- Number of inpatient days	€ #####	ci: ##-##	€ #####	ci: ##-##
Total running costs	€ #####	ci: ##-##	€ #####	ci: ##-##
Effects on patients use of health care:				
- Number of readmissions	€ #####	ci: ##-##	€ #####	ci: ##-##
- Length of stay for each readmission	€ #####	ci: ##-##	€ #####	ci: ##-##
- Staff time used by home care nurse	€ #####	ci: ##-##	€ #####	ci: ##-##
- Number of contacts to GP	€ #####	ci: ##-##	€ #####	ci: ##-##
- Number of contacts to emergency doctor	€ #####	ci: ##-##	€ #####	ci: ##-##
Total costs	€ #####	ci: ##-##	€ #####	ci: ##-##