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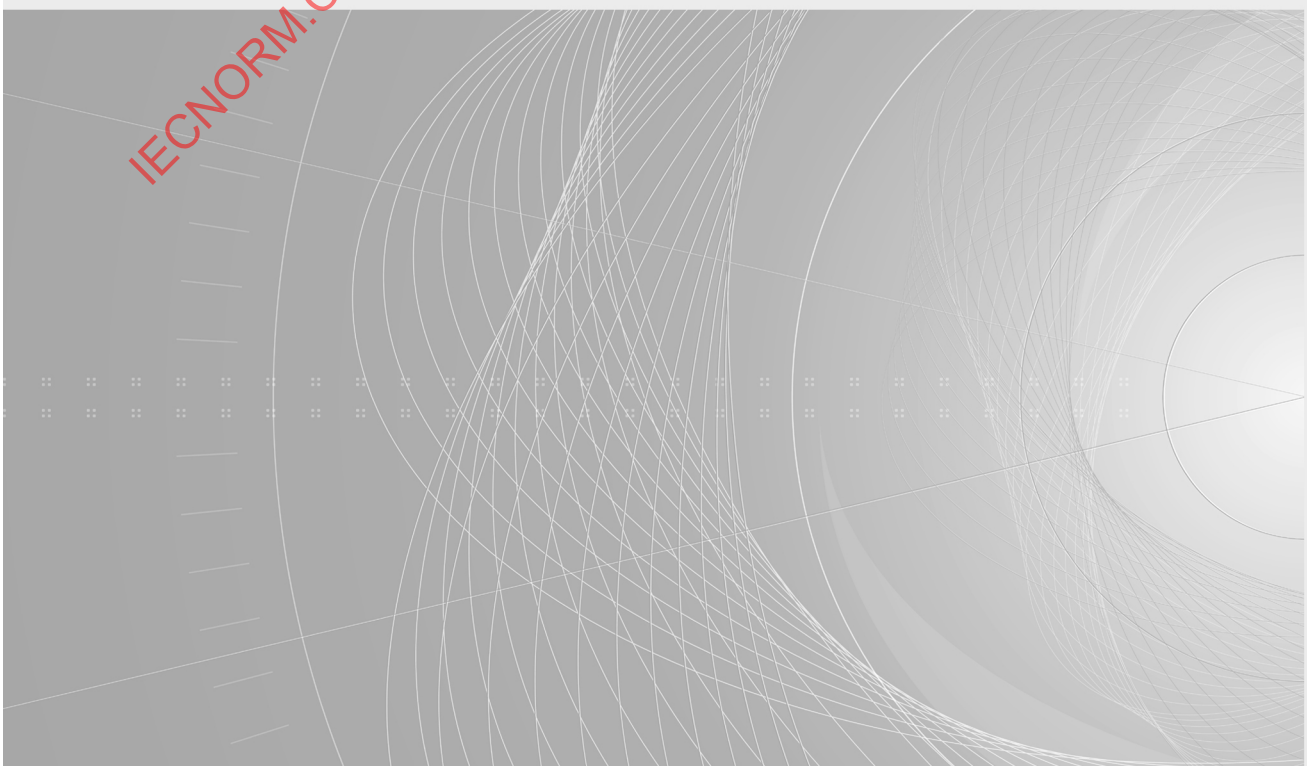
SYSTEMS REFERENCE DELIVERABLE

Economic evaluation of active assisted living services – Part 1: Framework



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Economic evaluation of active assisted living services – Part 1: Framework

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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ECONOMIC EVALUATION OF ACTIVE ASSISTED LIVING SERVICES –

Part 1: Framework

FOREWORD

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IEC SRD 63234-1, which is a Systems Reference Deliverable, has been prepared by IEC systems committee Active Assisted Living.

The text of this Systems Reference Deliverable is based on the following documents:

Draft SRD	Report on voting
SyCAAL/153/DTS	SyCAAL/165/RVDTS

Full information on the voting for the approval of this Systems Reference Deliverable can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC SRD 63234 series, published under the general title *Economic evaluation of active assisted living services*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

INTRODUCTION

Under the "Triple Aim" [1][1] concept (now "Quadruple Aim" [2]), a well defined, inclusive set of objectives for new interventions, leading to improvements in the local and national healthcare systems, consists of the following:

- improve the health of the population;
- improve the patients' (e.g. AAL care recipients) experience of care;
- lower (or hold constant) the per capita cost of care to the healthcare system to ensure sustainability; and
- (the recently added fourth aim) improve the work life of healthcare providers (e.g. healthcare professionals and AAL formal carers), clinicians, and other staff.

Economic evaluations of proposed new healthcare services and technologies involve the assessment of the costs and effects of any interventions in the healthcare system and provide input into the economic sustainability objective above. Where there are important health outcomes that can be evaluated in monetary terms, a cost-benefit analysis can be undertaken as a 'non-reference case analysis' (Alternate Scenario analysis) with details provided on the derivation of the monetary value of the health outcomes. Appropriate economic evaluations will provide evidence to address the financial considerations of proposed new interventions along with the impact on health outcomes.

To achieve the Quadruple Aim objectives, all new technology-supported homecare or Active Assisted Living (AAL) services (such as remote monitoring of patient physiological measurements, in-home medication adherence monitoring and management, as well as mobility aids and emergency reporting services) should be evaluated to ensure they not only improve the quality of the patients' lives but also provide economic benefits greater than the cost of providing the service. Without financial benefits that exceed the cost of the service to the health system funder, or at the very least an economically neutral situation while improving patient outcomes over usual care pathways, the services will not be sustainable – or the healthcare services funder must be prepared to knowingly increase its cost per patient supported by the system to achieve the population health outcomes.

Furthermore, health system funders may be presented with a choice of options for investment in new or expanded services. In order to compare options from a financial costs and benefits perspective (as well as their health outcomes), economic evaluations of the options will provide an equal basis for comparison of the options.

[1] Numbers in square brackets refer to the Bibliography.

ECONOMIC EVALUATION OF ACTIVE ASSISTED LIVING SERVICES –

Part 1: Framework

1 Scope

This part of IEC SRD 63234 provides a descriptive framework and template for the economic evaluation of the implementation of technology-supported home healthcare or wellness services, or AAL services that support communications, transportation, etc. as defined in a series of AAL use cases. The financial analysis is completed from the point of view of the healthcare services funder, aged care services funder, or similar governmental or non-governmental organization (e.g. the government in a state-sponsored system, or possibly a health management/health insurance company in a privately funded system, a private or governmental organization financing delivery of home support or specialized transportation services).

This document is structured to provide a means of capturing data for a Reference Scenario (typically the current means of providing care, often known as 'usual care', to the target patient population) to compare against an Alternate Scenario (the service or technology intervention) for an economic comparison. Standard economic measures can be estimated (using an electronic spreadsheet or other analysis tool) such as Return on Investment (ROI), Net Present Value (NPV), and Payback Period of the investment.

This document is applicable to all potential AAL services and AAL systems that may be developed or the development and manufacture of any of the underlying components (whether hardware or software).

2 Normative references

There are no normative references in this document.

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1.1
AAL service
action or function of an AAL system creating an added value for customers

EXAMPLE 1 Configuration and maintenance of AAL systems.

EXAMPLE 2 Assistant systems to support the home environment.

[SOURCE: IEC 60050-871:2018, 871-01-04]

3.1.2
AAL user
person who uses or benefits from, or uses and benefits from, AAL devices, systems or services

[SOURCE: IEC 60050-871:2018, 871-02-05]

3.1.3
AAL care recipient
person who receives and consumes AAL care services

3.1.4
AAL informal carer
person who provides informal (or lay) services to the AAL care recipient

3.1.5
AAL formal carer
person who provides personal or homemaking services to the AAL care recipient

3.1.6
AAL system
for <AAL services> set of interrelated elements as a whole and separated from the environment

Note 1 to entry: A system is generally defined with the view of achieving a given objective, e.g. by performing a definite function.

Note 2 to entry: Elements of a system can be natural or man-made material objects, as well as modes of thinking and the results thereof (e.g. forms of organization, mathematical methods, programming languages).

Note 3 to entry: The system is considered to be separated from the environment and the other external systems by an imaginary surface, which cuts the links between them and the system.

Note 4 to entry: The term "system" should be qualified when it is not clear from the context to what it refers, e.g. control system, colorimetric system, system of units, transmission system.

[SOURCE: IEC 60050-151:2001, 151-11-27, modified – The domain "<AAL services>" has been added. In the definition, "in a defined context" has been deleted.]

3.1.7
remote monitoring
condition monitoring and monitoring of persons from a distance by using telecommunication

[SOURCE: IEC 60050-871:2018, 871-04-27]

3.2 Abbreviated terms

AAL Active Assisted Living

NPV Net Present Value

ROI Return On Investment

CSF critical success factors

4 General

4.1 Document objective

This document provides a framework and template for the economic evaluation of the implementation of technology-supported home healthcare, wellness or AAL services. This analysis is completed from the point of view of the healthcare system or services funder (for example, the government in a state-sponsored system or possibly a health management/health insurance company or Accountable Care Organization in a privately funded healthcare system).

4.2 Economic evaluation process overview

4.2.1 Alternate versus Reference Scenario

The economic evaluation process proposed is a comparison of a Reference Scenario against an Alternate Scenario, the AAL service or technology intervention, using a cashflow analysis over an appropriate time period.

The Reference Scenario (also commonly referred to as a "base case" or "base scenario") is typically the current means of providing healthcare or health services, often known as "usual care", to the target patient population. This can be for a specific disease or more general care as provided by the healthcare funder prior to the AAL service or technology being considered.

The Alternate Scenario describes AAL service or technology, the specific intervention or benefits it hopes to achieve, and outlines the impacts on the delivery of healthcare. In an economic evaluation context, these impacts would typically be financial cost savings to some part(s) of the healthcare system.

In some interventions under consideration, the focus of benefits can be almost entirely on population health outcomes (for example, improved quality of life for the AAL care recipient) with limited or no financial benefits. In this situation, the expected health outcomes should be validated and the objective of the analysis becomes largely determining the net cost to the healthcare system of achieving these outcomes.

4.2.2 Time period for analysis

While a five-year time period of analysis is very common, an appropriate time period should be determined based on specific aspects of the proposed intervention. For example, if components of the equipment (hardware, software, etc.) require a significant investment and have an expected seven-year lifecycle, then it may be more appropriate to complete a cashflow analysis for the seven-year period.

4.2.3 The cost of money

This cashflow analysis should also include the "cost of money" or time value of money to the organization proposing the new service. This cost of money could be interest rate on a loan by the organization required to invest in the intervention or setting up the AAL service. A stricter definition would be the opportunity cost (forgone income) of the money invested in government bonds.

4.2.4 The economic or financial indicators

The proponent of the intervention or introduction of the service will gather the appropriate cost details of the two (or more) scenarios and calculate standard financial measures (using an electronic spreadsheet or other analysis tool). These measures should include, as a minimum:

- Return On Investment (ROI) – the gain or loss generated by an investment relative to the amount of money invested (typically expressed as a percentage);
- Net Present Value (NPV) – the difference between the discounted future cash flows from an investment and the original investment amount;
- Payback period – the length of time to recoup the initial investment in a project, product development or service implementation.

A sustainable AAL service or intervention will have a positive ROI and NPV. The Payback Period will vary based on the size of the initial investment required to implement the service and the rate of economic benefits realized.

4.2.5 Multiple Alternate Scenarios

Comparing multiple Alternate Scenarios is common. If multiple Alternate Scenarios are being evaluated or contemplated, they should each be compared to the Reference Scenario, the same economic indicators determined, and the different Alternate Scenarios compared to each other on an economic sustainability basis using the financial indicators described above.

4.2.6 Risks and critical success factors

The term "estimated" is used intentionally above. While it is assumed that the evaluator will use evidence-based inputs in the economic model to the greatest extent possible, as a forward-looking model there will always be an amount of uncertainty in future outcomes. Similarly, critical success factors (CSFs) in the implementation of the service should be identified at the outset.

For identified areas of uncertainty and critical success factors, the user of this template should also:

a) identify which inputs are the most sensitive in determining economic results and either try to reduce the margin of uncertainty in the values used in the calculation; or

b) conduct a sensitivity analysis by trying a range of potential values for these factors to determine if the level or risk is too high to continue to implement the intervention (for example, a positive, sustainable project could turn into a costly unsustainable service).

If a decision is made by the healthcare funder to implement a new service and/or underlying technology, then special attention should be paid to the identified critical success factors during the implementation stages of the project.

4.3 Document structure and how to use the framework

This document provides a descriptive framework and a set of templates. It is structured as a step-by-step means of completing the evaluation process outlined above and coming to a set of conclusions and recommendations about the proposed intervention. Users should complete the set of blank templates contained in Annex A while progressing through the descriptive aspect of the framework in the main body of this document.

Clause 5 presents a format for a summary overview or abstract (sometimes known as an Executive Summary) of the AAL service, its analysis and recommendations.

Clause 6 recommends a format for providing a descriptive overview of the AAL service or intervention.

Clause 7 describes a template for gathering the information required to complete the economic evaluation, for both the Reference Scenario and the Alternate Scenario(s).

Clause 8 provides a means for calculating the economic and financial indicators.

Clause 9 describes critical success factors in more detail and proposes a set of considerations.

Lastly, Clause 10 suggests a format for developing final considerations and recommendations which would be made as a result of the economic evaluation.

Annex A contains a set of empty templates for the user to complete an analysis.

5 Overview of the AAL service and analysis results

Table 1 provides an overview of the AAL service or system, the existing problem or need being addressed, and a short description of the expected benefits and financial impact. More detailed information is developed and presented in Clauses 6 through to 10.

Table 1 – Overview of the AAL service

Element	Description of entry
Title	The name of the AAL service or intervention.
Summary	A short description of the AAL service or intervention.
Current need or existing problem addressed	Provide a short description of the need or the problem to be addressed by the intervention. (For example, improved transportation or socialization among the aged population, high usage of the acute care facilities by chronic disease patients, high incidence of a particular morbidity, or limited quality of life among a particular population.)
Target Population – Overview	Describe the *relevant* characteristics of the addressable AAL care recipient population such as age range, health morbidities/conditions, geographic distribution, socio-economic factors, addressable population size, etc.
AAL Service Description (intervention scenario)	Provide a short description of the AAL service and how it would be used by the AAL care recipients, their families (AAL informal carers) if relevant, and the supporting clinicians (AAL formal carer or healthcare professional).
Expected benefits	Provide a short description of the expected non-economic value (e.g. improved population health or wellness outcomes) delivered to the AAL care recipients and sustainable economic value to the healthcare system or aged care services system.
Financial impact	Provide a short description of the financial impact of the implementation considering factors such as total up-front investment required and financial result indicators such as Net Present Value and Return on Investment if available.
Conclusion and recommendation(s)	As a result of the detailed analysis, state what conclusions have been drawn and state the recommendation for the implementation (or not) of the AAL service.

6 Detailed description of the AAL service or intervention

Table 2 provides a descriptive overview of the important aspects of the specific intervention (e.g. remote patient monitoring or other tele-homecare or AAL service) being considered in the economic evaluation.

Table 2 – Description of the AAL service

Factor	Details
Current need or existing healthcare problem addressed	Describe the healthcare problem, aged care need, or other assisted living need to be addressed (e.g. improving transportation or socialization among the aged population, high usage of the acute care facilities by chronic disease patients, hospital overcrowding, high incidence of a particular morbidity, or limited quality of life among a particular population).
Target Population – Description	Describe the relevant characteristics of the target population (patients, aged population, physically challenged, etc.) such as age range, health morbidities/conditions, geographic distribution, socio-economic factors, etc. In a research project, members of the control group and experimental (intervention) group would be members of this population.
Reference Scenario	Describe the current situation or "usual care"; how the assisted living problem is currently addressed, or healthcare service provided, standard care pathway, etc.
AAL service description or Intervention to be evaluated	Describe the proposed service and how it would be used by the AAL care recipients, their families (AAL informal carers) if relevant, and the supporting carers or clinicians (AAL formal carer or healthcare professional). An overview of any technology deployed should be provided, the length of the deployment (if short term) and the specific clinician or user interventions required.
Description of Expected Benefits	Provide an overview of the expected non-economic value (improved population health or wellness outcomes) delivered to the members of the target population and sustainable economic value to the healthcare system (e.g. reduced hospitalizations and/or in-patient days, reduced homecare nursing visits, etc.).
Patient Population – Overall Size	The maximum number of patients (AAL care recipient) that could be addressed by the AAL service within the proposed scope of the patient population described above.
Patient Population – Addressed by the Intervention	Identify how many patients (AAL care recipients) the intervention proposes to address (specific number or percentage of the identified patient population) distributed over the years of the economic evaluation period.
Length of Evaluation	The number of years considered in the economic evaluation (five years is typical).

7 The non-financial benefits of the AAL service

7.1 Overview

Clause 7 captures a description of the non-financial benefits provided by the AAL service. These benefits follow aspects of the Quadruple Aim [2] and each area may or may not be applicable to the specific implementation of the AAL service.

7.2 Improving the health and wellness of the population

The evaluation team should assess and describe the potential positive effects on the health of the broader population, at least those for whom the AAL service will be deployed, the AAL care recipients. A non-exhaustive list of potential population health benefits includes

- longer population lifespan;
- improved quality of life for a number of years across the population;
- reduced incidence of acute or chronic diseases or personal impact of chronic disease;
- improved target population safety;
- improved target population mobility or transportation, communications or socialization;
- improved efficacy of the healthcare services delivered (which may or may not also have an economic sustainability impact);
- improved collection of healthcare and population data which will assist in the planning of the healthcare system and services delivery.

NOTE Reduced usage of healthcare services by the AAL care recipients may be noted here, but resulting reduced costs are identified in the financial analysis in Clause 8.

7.3 Improving the patient experience with healthcare or wellness services

The evaluation team should assess and describe the potential positive effects on the experience of the AAL care recipients, as well their caregivers or AAL informal carers. A non-exhaustive list of potential population benefits includes:

- reduced usage of healthcare services by the AAL care recipient, not from a cost impact, but as an AAL care recipient experience improvement (for example fewer appointments to attend);
- improved ability to access services and reduced wait times to receive healthcare or related aged care services;
- feeling that the AAL care recipients own health has improved, also known as “patient reported outcome measures”;
- eliminating the need to travel to receive care services (for example, by now receiving care in their home rather than in a care clinic or hospital);
- reduced length of stay in hospital or other care settings resulting in faster return to work or other personal life activities for the AAL care recipients (which will also have an economic impact on the healthcare system);
- a better understanding of the care services being provided and the expected outcomes from the care;
- reduced strain on the AAL care recipients' family members, AAL informal carers, because of the assistance provided through the AAL service.

Improved AAL care recipient and family (AAL informal carers) experience with the healthcare, aged care, or assisted living systems is usually measured through self-reported feelings of satisfaction or other experiences with these systems, often captured through AAL care recipient experience surveys.

7.4 Improving the work life of healthcare workers

The evaluation team should assess and describe the potential positive effects on the experience of the workers in the health care system impacted by the AAL service. These workers may be healthcare professionals (for example, physicians, nurses, therapists) and/or AAL formal carers (personal support workers, personal attendants, etc.). A non-exhaustive list of potential benefits to healthcare workers includes:

- simplified diagnosis and treatment of the patients;
- easier-to-use technology supports the delivery of healthcare or other care services, resulting in improved (self-reported) user satisfaction;
- reduced injuries or potential for physical or psychological injuries that would be avoided by the healthcare professionals (for example, avoiding a number of back injuries from lifting of heavy care recipients);
- improved personal productivity (which may or may not have resulting economic benefits);
- improved satisfaction in the ability to deliver healthcare, personal support, or other services to patients;

Improved healthcare professional and AAL formal carer experience with the AAL service is usually measured through self-reported feelings of satisfaction with the service or technology and their ability to deliver care, often captured through user (AAL user) experience and competency surveys.

8 The financial/sustainability analysis

8.1 Gathering the financial analysis cost data

Clause 8 provides aspects for consideration in the development of the Scenario costs, both Reference Scenario and the Alternate Scenario, for services in the Active Assisted Living domain. Because AAL services generally involve health and wellness, they generally include aspects of healthcare services delivery and in the Alternate Scenario include the costs of the AAL technology and service implementation (as well as the, hopefully lower, healthcare delivery costs).

Not all of these costs will be relevant to all AAL services, and perhaps there will be additional costs not identified. In addition, while current technology costs have not been considered in the Reference Scenario, it is possible that they should be included to provide the best representation of the current healthcare costs (e.g. if the Alternate Scenario eliminates these technology costs).

8.2 Reference Scenario costs

Complete Table 3 describing the costs of the current healthcare delivery processes for the healthcare problem to be addressed. The factors identified below are for the evaluator's consideration but:

- not all may be applicable to the AAL service or care scenario addressed;
- additional factors that are as or more relevant should be identified;
- if the AAL service or intervention is unlikely to impact (increase or decrease) any individual cost factor, then it may be ignored.

All assumptions and sources of the information below should be noted.

Table 3 – Reference Scenario healthcare costs

Cost Factor	Measure or Value	Description
Period for Measures	Annual or per month	The period of time over which the data is measured and used in the analysis. Annual measures are the most common.
In-patient Hospitalizations	Number in period	The mean number of times the targeted population are admitted to a hospital for care.
	Length of stay (LOS) – total or average days	The number of days the measured population spends in a hospital, typically the mean number of days per admitted person is used, but the total number of days may also be used.
	Cost per in-patient day	The mean cost per day of treating the person in the hospital.
	Cost of Procedure (e.g. operation)	If a specific care procedure is required (e.g. a hip replacement), this is the typical cost of the procedure as determined by the funder (typically the cost to the hospital or as billed to the funder by the hospital).
Emergency Department Visits	Number in period (e.g. annual)	The number of times the targeted population visits a hospital Emergency Department (ED) for care.
	Cost per visit (average or total costs)	The mean cost per ED visit as determined by the funder.
Remote visits or clinician support (if applicable)	Number in period (e.g. annual)	The number of times the targeted population receives a remote visit (e.g. via two-way voice or video communications) by a healthcare professional.
	Cost per visit (average or total)	The mean cost of the remote visit by the clinician.
OR (an alternate way to calculate remote visit costs)	Number of Full Time Equivalent Employees (FTE)	The number of healthcare professionals and/or AAL formal carers paid for by the funder to provide care to the population targeted by the AAL service.

Cost Factor	Measure or Value	Description
	Cost per FTE (salary, benefits, facilities, support, etc.)	The mean cost of the people providing the care. This cost should include all costs including basic salary, cost to provide applicable benefits (e.g. healthcare insurance, pension contributions, etc.) and supporting infrastructure costs such as information technology and dedicated office space (would not include clinic or hospital space which would be included above).
Home visits (This should be identified for each type of clinician or home care worker impacted.)	Number in period	The number of times an AAL formal carer visits the patient in the home to receive healthcare services (medical or personal support).
	Cost per visit (time)	The mean cost to the funder to provide home visits
	Travel expenses of clinicians (time and/or cost)	The mean cost paid for travel expenses of the healthcare professionals or AAL formal carers to provide healthcare service in the home.
Primary care physician visits	Number in period	The number of times a member of the targeted population visits their Primary Care Physician (healthcare professional providing primary healthcare services).
	Cost per visit (average or total)	The mean cost per visit (or total costs for all visits in the period) paid for by the funder for the primary care visit.
Specialist physician visits	Number in period	The number of times a member of the targeted population visits a specialist Physician (a healthcare professional providing specialty medical or health services).
	Cost per visit (average or total)	The mean cost per visit (or total costs for all visits in the period) paid for by the funder for the specialist healthcare professional visits.
Deferral of admission to long-term care	Number of days deferred	The number of days a member of the targeted population is kept at home, out of a long-term care home (also known as a nursing home), as a result of services under the current services. This value is rarely required in the Reference Scenario.
	Cost per day in long-term care	The mean cost per day paid by the funder of caring for a member of the target patient population in a long-term care home (nursing home). This would not typically include any costs as borne by the member of the population to be a resident of the long-term care home.
Other	To be determined	Any other possible relevant cost factors to the care provided in the Reference Scenario that would be impacted in the Alternate Scenario should also be identified. Costs not likely to be impacted may be ignored.

8.3 Intervention/Alternate Scenario costs

Table 4 captures the one-time and ongoing operational costs of the intervention/AAL service or technology deployed for the AAL care recipient population. Identify and quantify those factors as appropriate (not all will be incurred in all service scenarios).

Table 4 – Alternate Scenario AAL service implementation costs

Cost Factor	Measure or Value	Description
Central installation	Hardware costs (one time or annual)	The cost of computing and networking equipment in the AAL System at a site to provide the AAL service. These costs may be the initial purchase costs or may be determined on an annual basis (such as in a case where the equipment is leased).
	Software costs (development or license purchase costs; one-time)	The cost of software in the AAL System at a site to provide the AAL service as paid for by the AAL service Provider. This may be the purchase costs of the software or the full development costs if developed by the funder.
	Annual software support and maintenance	The annual cost paid by the AAL service Provider to maintain and provide support for the software (may be an annual licensing fee to a software vendor or the cost of people to maintain the software).
	Data network costs (annual)	The cost paid by the AAL service Provider for networking services (typically public Internet access but may also include private networking costs).
	Facility costs (annual)	The costs (typically annually) paid by the AAL service provider for the building real estate to house the AAL System components and related personnel (e.g. AAL Operators or AAL formal carers) to provide the AAL service.
Service implementation costs	Project team	The fully loaded costs of the project team members to develop and implement the AAL service (e.g. project management, process designers, healthcare professional doing clinical design, documentation developers, and trainers).
	Clinician training	The cost to provide training to the healthcare professionals and/or AAL formal carers who will be the users (AAL users) of the AAL service.
Per patient (AAL care recipient) Costs	Number of patients – enrolled annually/per period	The number or AAL care recipients who will be newly enrolled in each of the periods (typically annually) once the service is implemented.
	Per-patient hardware	Cost of hardware deployed at each AAL care recipient's home or other location.
	Per-patient software licence	Purchase cost of software deployed at each AAL care recipient's home or other location (if licenses).
	Installation and set-up costs	Cost to send a person (e.g. an AAL Technical Assistant) to install and configure the home installation (if not installed by the user or their family).
	Data network (internet or cellular if provided by funder – per patient or per patient/annual)	Annual or monthly internet access costs per each AAL care recipient but only included if paid for by the AAL service Provider (i.e. if the AAL care recipient already has internet service and this is used then there are no additional costs).
	Support costs (software and hardware maintenance, technical support, etc.)	Annual or monthly costs to support each user. This could include annual software maintenance fees or costs for call centre support personnel (e.g. if an AAL Technical Assistant is hired for each 200 patients, then the cost would be 1/200 of the Assistant's fully loaded cost).
	Discharge costs (pick-up and refurbishment of equipment)	The cost to uninstall and pick up any equipment deployed at the AAL care recipient's home or other location if required.
Other (Describe)		Include any other possible relevant cost items to the deployment of the AAL service not already identified above.

8.4 Intervention/Alternate Scenario health system costs

Table 5 is similar to Table 3 but should be completed to reflect the healthcare services costs for the AAL care recipients (patients in the group for whom the service has been or will be deployed). Where significant changes in the values are expected, evidence should be provided if available (and noted in the Bibliography) of the effectiveness of the intervention in achieving these changes.

Net reduced healthcare system costs (overall or per patient) represent the economic benefits of the AAL service.

Table 5 – Alternate Scenario health system cost factors

Cost Factor		Description
Period for measures	Annual (or monthly)	See Table 3
In-patient hospitalizations	Number in period (e.g. annual)	See Table 3
	Length of stay (LOS) – total or average days	See Table 3
	Cost per in-patient day	See Table 3
	Cost of Procedure (e.g. operation)	See Table 3
Emergency department visits	Number in period (e.g. annual)	See Table 3
	Cost per visit (average or total)	See Table 3
Remote visits or clinician support (if applicable)	Number in period (e.g. annual)	See Table 3
	Cost per visit (average or total)	See Table 3
OR (an alternate way to calculate remote visit costs)	Number of Full Time Equivalent Employees (FTE)	See Table 3
	Cost per FTE (salary, benefits, facilities, support, etc.)	See Table 3
Home visits (This should be identified for each type of clinician or home care worker impacted.)	Number in period	See Table 3
	Cost per visit (time)	See Table 3
	Travel Expenses of clinicians (time and/or cost)	See Table 3
Primary care physician visits	Number in period	See Table 3
	Cost per visit (average or total)	See Table 3
Specialist physician visits	Number in period	See Table 3
	Cost per visit (average or total)	See Table 3
Deferral of admission to long-term care	Number of days deferred	If the AAL service allows the AAL care recipients to remain in their own homes longer before being admitted to a long-term care home, the mean number of additional days each AAL care recipient remains in their home should be included.
	Cost per day in long-term care	See Table 3
Other	To be determined	See Table 3

9 Cashflow analysis and calculating the financial indicators

9.1 A simple cash flow analysis

Table 6 provides a very simple cash flow analysis template for the calculation of the financial evaluation indicators.

NOTE The Cash Outflow section of Table 6 includes the following entries by default (based on Table 3, Table 4 and Table 5), but categories of costs may be edited to identify additional categories and remove those that are not relevant.

Use of the template requires:

- Costs to be entered for each year in the analysis be they one-time costs (typically in the first year) or annual costs (each year). These may be:
  a) One-time costs such as hardware and software costs, development and deployment team costs would be entered in the first year.
  b) Annual maintenance costs for the central installation and central networking costs would be entered for each year of the analysis.
  c) The average number of AAL care recipients (patients) for whom the service is deployed each year should be considered carefully. For example, if the capacity for the AAL service Provider is to install equipment to 100 AAL care recipients a month, resulting in 1 200 installed at year end, then while total cost of per patient equipment will be that amount required for all 1 200 AAL care recipients, the average number of patients installed in the first year is only 600 so annualized costs (e.g. Internet access and support) would be calculated on this average installed basis. In the second year, with another 1 200 installed over the year, the average number of AAL care recipients is 1 800 (the 1 200 at the previous year end plus the 600 average installed for the second year).
  d) Per-patient costs of hardware and software in each year would be the unit cost of each multiplied by the number of AAL care recipients for whom the service is newly deployed in that year.

     EXAMPLE 1 If hardware costs are $200 and software costs are $100 and there are 1 200 patients deployed in that year, then the annual values are $240 000 and $120 000, respectively.

  e) Not all years may have newly deployed AAL care recipients, they may all be brought on in the first one of two years; in such cases, future annual values of per patient costs would be nil.
  f) Similarly, per patient annual network costs would be based on the annual costs per patient multiplied by the average number of AAL care recipients installed for the year (in accordance with the paragraph c) above).

     EXAMPLE 2 If the annual internet access cost per patient is $1 000 per year, the first year's costs would be $600 000 and the second year's costs would be $1 800 000.

  g) Up to seven years are available in the spreadsheet, although many evaluations only consider five years.
- Cost Avoidance/Savings to be entered in each year in the lower part of Table 6 are the following.
  h) Annual savings of Hospital Inpatient costs, Emergency Department avoidance cost savings, etc. as determined from the differences in the Table 3 Reference Scenario and Table 5 Alternate Scenario value tables above.
  i) These annual savings would be the difference between the Reference Scenario Costs of the usual care (8.2) pathways and the Alternate Scenario costs considering the intervention of the AAL service (8.4).

j) These annual costs are calculated by determining the annual savings per AAL care recipient (Reference Scenario Cost minus Alternate Scenario costs) and multiplying by the average number of AAL care recipients for whom the AAL service is deployed in that year.

EXAMPLE 3 Continuing with the example calculation in c) above, if the annual hospital inpatient savings are $5 000 per year, then the total savings in the first year would be (600 × $5 000) or $3 000 000.

k) It is possible that there will be no healthcare system savings, the costs of delivering healthcare services in the Alternate Scenario may be higher than the Reference Scenario. This may be acceptable if the funder is willing to incur the up-front costs and increased annual costs in order to achieve other AAL service benefits such as improved health of the population or the improved patient experience. If multiple Alternate Scenarios are being compared, then the most financially valuable scenario is the one with the least increase in costs.

- The financial "Cost of Money", typically the cost for the funder to "borrow" the money to implement the new service, or the minimum Return On Investment required of the investor, or the return on investment foregone by not investing in another opportunity. This is typically a percentage interest and will vary by funder type, by country and by global economic conditions. Typical values might be in the 2 % to 15 % range.
- Calculating the Annual Net Cashflow is completed at the bottom of the spreadsheet.
  - For each year, the individual line items are added to calculate the Cash Outflow subtotals.
  - For each year, the individual Savings line items are added to calculate the subtotal annual Cost Savings.
  - The Annual Cashflow is calculated by subtracting the Cost savings from the Cash Outflow subtotal.
  - The Net Cumulative Cashflow is determined by adding up the Annual Cashflows to the year specified.

Table 6 – Cash flow analysis table

AAL service financial evaluation: NAME								
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**TOTAL**
Cash outflows	2019	2020	2021	2022	2023	2024	2025	
Central – Hardware costs								
Central – Software costs								
Central – Network costs								
Service implementation								
Per-patient costs – HW								
Per-patient costs – SW								
Per-patient costs – Network								
Per-patient costs – Install								
Per-patient costs – Support								
Per-patient costs – Discharge								
Other								
Total outflow	$0	$0	$0	$0	$0	$0	$0	**$0**
Savings – In-patient								
Savings – ED								
Savings – Home visits								
Savings – Primary care								
Savings – Long-term care								
Other								
Cost savings	$0	$0	$0	$0	$0	$0	$0	**$0**
Net annual cashflow	$0	$0	$0	$0	$0	$0	$0	**$0**
Net Cumulative Cashflow	$0	$0	$0	$0	$0	$0	$0	

Table 6 may be created in an electronic spreadsheet with the formulas below entered to calculate the Economic Indicators. There are other financial analysis tools available on the market that can also be used in the evaluation.

A note on currency: although the text above uses 'dollars' and '$' in the examples, the financial calculations may be made using any currency (e.g. euros, yuan, yen) as long as all values are consistent.

9.2 Financial indicators

The key financial indicators which summarize the financial value and investment risk of the AAL service are described in Table 7.

Table 7 – Financial indicators

Financial indicator	Description
Return on Investment (ROI)	The gain or loss generated by an investment relative to the amount of money invested, typically over the full analysis period. This is described as a percentage, for example, an ROI of 200 % will provide a financial return of twice the invested costs (after annual operating costs) in current year currency. For a conservative estimate, the value is calculated by subtracting Total Cash Outflows ("**TCO**") from the Total Cost Savings ("**TS**") at the end of the study period (last column in Table 6) and dividing by the absolute value of the Total Cash Outflows ("**TCO**"), or $$\mathbf{ROI} = \frac{\mathbf{TS} - \mathbf{TCO}}{\mathbf{TCO}}$$ A slightly more accurate value (and generally higher) would use only the upfront one-time costs of the AAL service implementation in the Denominator rather than total Cash Outflows considering future year cash outflows as operating costs rather than the initial investment.
Net Present Value (NPV)	The total amount (e.g. dollars, euros, etc.) of the annual cashflows from AAL service where future year cashflows are discounted back to the 'present year value' based on the number of years in the future and the 'cost of money' value assumed in the study. PV = Present Value of a future year cashflow NC = Net annual cashflow in a year = Total Outflow − Cost Savings R = Cost of money or discount rate Y = years in the future Each year's present value of the cashflows is: $$\mathbf{PV_y} = \frac{\mathbf{NC}}{\mathbf{(1+R)^Y}}$$ The Net Present Value is the sum total of the Present Value for each year. $$\mathbf{NPV = Sum[\ PV_1, PV_2, \ldots PV_7\ ]}$$ Microsoft® Excel®[a] contains a built-in function to easily calculate NPV: =NPV(Cost of Money, Cashflow Year 1, Cashflow Year 2, …) where each year is entered through the full analysis period (e.g. seven years in Table 6).
Payback Period	The length of time to recoup the initial one-time investment (e.g. development costs, equipment purchases, etc.) in a project, product development, or AAL service implementation. This is when the Net Cumulative Cashflow in the final line of Table 6 becomes a positive value and is usually calculated in (fractions of) years. For example, if the Net Cumulative Cashflow becomes positive 18 months after the initial service is created and deployed, then the Payback Period is 1,5 years.
Total One-Time Investment	The total amount of invested funds to bring the first patient onto the service. This is calculated separately by adding up the initial year (or occasionally a couple of years) one-time costs identified in Table 4. This value is important because with greater upfront, one-time investment, there is greater financial risk if the AAL service does not achieve the expected healthcare service delivery cost savings or improved population health outcomes.

[a] This information is given for the convenience of users of this document and does not constitute an endorsement by IEC of the product named. Equivalent products may be used if they can be shown to lead to the same results.

10 Identifying risks and critical success factors

This section should be completed by identifying the Critical Success Factors (CSFs) and Risks of implementing the AAL service or technology.

- Critical Success Factors – are those elements in the implementation of the service that are critical to achieving the economic outcomes (or other outcomes such as population health) in the implementation or operation of the healthcare and AAL service. These may cover a wide range of considerations such as cost components, patient adoption and acceptance, quality or usability of the technology, etc.
- Risks – are uncertain conditions or possible events that will have a negative effect on the service implementation project outcome if they occur.

Critical Success Factors
1.
2.
3.
4.
5.
6.

Implementation or Operational Risks
1.
2.
3.
4.
5.
6.

11 Developing conclusions and recommendations

11.1 Developing conclusions

Based on the financial evaluation completed by following the steps in this document, plus evaluations of the other factors in the Quadruple Aim (improvements in the health of the population, improvement in patient experience, improvements in healthcare worker experience), complete the following table by selecting the most appropriate answer.

Is implementing the AAL service or technology financially sustainable?	Choose one of: – Is sustainable – Is NOT sustainable
The financial impact of implementation:	Choose one of: Increases cost to the system Breaks even Decreases cost to the system
Do the non-economic benefits (e.g. patient quality of life, mortality rates) outweigh the net present value of the service?	Choose one of: Yes No
The risk level of not achieving the health and financial outcomes of the planned AAL service implementation is:	Choose one of Low Medium High Very High

11.2 Recommendations

Based on the financial and non-financial evaluation captured herein, the evaluator will recommend one of the following options (select one).

a) Continue with the implementation or expansion of the deployment of the AAL service.

b) Continue with a controlled expansion of the service and conduct a follow-up financial evaluation based on a greater AAL care recipient user base.

c) Cap the current AAL service operation with existing AAL care recipients, reducing the service scope as patients are discharged.

d) Discontinue the AAL service or its implementation immediately as other projects, technologies or services will likely have a greater benefit to the patients and the healthcare system.

The above recommendation is based on the evaluation and financial sustainability of the service within the healthcare system. However, other factors should be considered (for example, efficacy of the proposed solution, health human resource availability, amount of investment required) when making a final overall recommendation to continue or proceed.

Other comments and considerations should also be noted as part of the recommendations.

Other Considerations:

Annex A
(informative)

Financial evaluation data templates

A.1 Overview of AAL service and analysis results

Table A.1 is a template of Table 1 in Clause 5.

Table A.1 – Overview (template)

Element	Description of entry
Title	
Summary	
Current Need or existing problem addressed	
Target Population – Overview	
AAL Service Description (intervention scenario)	
Expected Benefits	
Financial impact	
Conclusion and Recommendation(s)	

A.2 AAL service description

Table A.2 is a template of Table 2 in Clause 6.

Table A.2 – Description of the AAL service or technology (template)

Factor	Details
Healthcare problem addressed	
Base Scenario	
Intervention/Service Description to be evaluated	
Description of Expected Benefits	
Patient Population – Description	
Patient Population – Overall Size	
Patient Population – Addressed by the Intervention	
Length of Evaluation (in years)	

A.3 Reference Scenario – health system cost data

Table A.3 is a template of Table 3 in 8.2.

Table A.3 – Reference Scenario healthcare costs (template)

Cost Factor		Value
Period for cost data	Annual (or monthly)	
In-patient Hospitalizations	Number in period (e.g. annual)	
	Length of stay (LOS) – total or average days	
	Cost per in-patient day	
	Cost of Procedure (e.g. operation)	
Emergency Department Visits	Number in period (e.g. annual)	
	Cost per visit (average or total)	
Remote visits or clinician support (if applicable)	Number in period (e.g. annual)	
	Cost per visit (average or total)	
OR	Number of Full Time Equivalent Employees (FTE)	
	Cost per FTE (salary, benefits, facilities, support, etc.)	
Home visits (This should be identified for each type of clinician or home care worker impacted.)	Number in period	
	Cost per visit (time)	
	Travel Expenses of clinicians (time and/or cost)	
Primary care physician visits	Number in period	
	Cost per visit (average or total)	
Specialist physician visits	Number in period	
	Cost per visit (average or total)	
Deferral of admission to long-term care	Number of days deferred	
	Cost per day in long-term care	
Other		