

Measuring the Value of Assistive Technology

A Cost-Effectiveness Framework Adapted from Health Technology Assessment

Mar 2026 Ver

*Assistive Technology
Value Evaluation*

Why Measure Value?

Translating Impact into a Shared Language

Many people report improvements from using assistive technology. But personal experiences alone are rarely sufficient as evidence in policy, procurement, or funding decisions.

Subjective satisfaction needs to be translated into a common language that society can understand and act on.



A common pitfall

Describing benefits without comparing costs cannot answer the question:
which option is the most rational choice for society?

Two questions required to evaluate value

Question 1

Compared to what – and by how much – does it work?

Question 2

How does that benefit compare to the cost?

Addressing both questions on equal footing is the starting point for communicating the value of assistive technology to society

Five Steps to Evaluate Value

Adapting the methods of health technology assessment, we demonstrate the value of assistive technology quantitatively through five steps

01

Who benefits, and what does it do for them?

Target population • QOL measure (EQ-5D-5L) • QALY

02

Compared to what – and by how much – does it work?

Comparator • Assumed time horizon

03

How does that benefit compare to the cost?

Cost categories • Analytical perspective • Identifying costs that change

04

Expressing benefits and cost on the same scale

ICER (Incremental Cost-Effectiveness Ratio) • Comparison with threshold

05

What happens long-term, and how reliable is the estimate?

Simulation model • Sensitivity analysis

Each step applies the same analytical framework used in health technology assessment

Who Benefits, and What Does It Do for Them? [1]

Why Define “Who”?

The Physical and cognitive challenges addressed by assistive technology are not uniform. Even within the same diagnosis, how a technology affects someone depends greatly on their condition, living environment, and prior experience. Defining the target population upfront is therefore essential to analytical precision.

Case: Visual impairment

Vibration navigation device

Whether a user has low vision or total blindness, and whether the condition is congenital or acquired, significantly affects their familiarity with movement and the nature of their anxiety. The starting point and degree of QOL change will differ accordingly

Case: SMA (Spinal Muscular Atrophy)

Advanced posture-control power wheelchair

A progressive condition in which the nerves controlling muscles gradually deteriorate. Users must constantly plan when to ask for help repositioning. However, as the wheelchair is large, some users may not be able to make full use of it depending on their home environment.

Case: Spinal cord injury

Robot-assisted gait rehabilitation

Targets individuals with partial motor function remaining after a spinal cord injury, for whom the possibility of regaining the ability to walk has not been fully closed. The degree of QOL improvement after gait recovery varies depending on the user's baseline QOL in a wheelchair.

Who Benefits, and What Does It Do for Them? [2]

Measuring QOL - EQ-5D-5L as a Common Language

Among the various tools available for measuring quality of life, the EQ-5D-5L is widely used in health economic evaluation internationally. It assesses health status across five dimensions, each rated on a five-level scale. Responses are converted into a QOL score ranging from 0 (death) to 1 (full health).

Mobility	Self-care	Usual activities	Pain / Discomfort	Anxiety / Depression
Any problems walking around?	Any problems washing or dressing?	Any problems with work, study, housework, or leisure?	Any pain or discomfort?	Any anxiety or depression?
No problems	No problems	No problems	None	None
Slight	Slight	Slight	Slight	Slight
Moderate	Moderate	Moderate	Moderate	Moderate
Severe	Severe	Severe	Severe	Severe
Unable	Unable	Unable	Extreme	Extreme

Responses across all five dimensions are combined to produce a QOL score between 0 and 1, where 1 = full health and 0 = a state equivalent to death

Who Benefits, and What Does It Do for Them? [3]

Measured QOL Changes – Three Cases

Case: Vibration navigation device (Ashirase)

User with low vision using a white cane

Mobility: Severe problems → Moderate problems

User with congenital total blindness using a white cane

Mobility: Slight problems → No problems

Case: Advanced posture-control power wheelchair (Hineru)

User with SMA, unable to reposition independently

Pain / Discomfort: Severe problems → No problems

Case: Robot-assisted gait rehabilitation

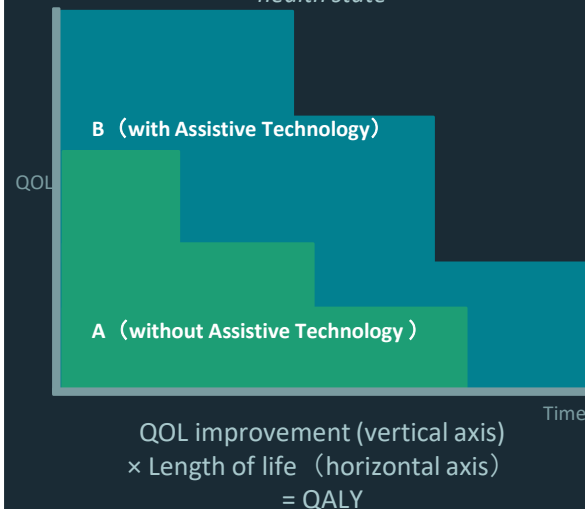
User with spinal cord injury with partial motor function remaining

Mobility: Severe problems → Slight problems

Usual activities: Severe problems → Slight problems

What is a QALY?

A QALY (Quality-Adjusted Life Year) combines quality of life with length of life to express the value of a health state



The gap between curve B (with AT) and curve A (without AT) represents the QALYs generated by the technology

Compared to What — and by How Much — Does It Work?

Effect can only be measured against a comparator

The 'effect' of assistive technology must always be measured as the difference relative to a comparator. Without a comparator, it is impossible to show how much value the technology adds. The assumed time horizon is also set based on the nature of the technology and the target population.

Case: Vibration navigation device

Comparator: White cane only



Intervention: White cane + vibration navigation device

Case: Advanced posture-control power wheelchair

Comparator: Conventional repositioning (assistance from others)



Intervention: Self-operated 3D posture-control function

Case: Robot-assisted gait rehabilitation

Comparator: Wheelchair-centred lifestyle



Intervention: Life after gait recovery

Time horizon: Set according to the nature of the technology and the circumstances of the target population

Defining 'compared to what' is what makes it possible to measure the value of assistive technology.

How Does That Benefit Compare to the Cost? [1]

Cost Categories and Analytical Perspective

Costs come in many forms. The scope of costs to include also changes depending on whose perspective the analysis takes. Clearly defining the scope of costs according to the analytical purpose is essential.

Cost Categories			Analytical Perspective		
Direct costs <i>(monetary transfer)</i>	Medical costs Long-term care costs Disability welfare costs	Insurer burden	Payer's perspective <ul style="list-style-type: none">Public healthcarePublic healthcare + long-term care		Societal perspective
	Non-Medical costs <i>(e.g. transport)</i> Long-term care costs Disability welfare costs	Out-of-pocket costs			
Indirect costs (productivity loss) <i>(no monetary transfer)</i>		Patient burden		Patient / family perspective	
		Family burden			

How Does That Benefit Compare to the Cost? [2]

Which Costs Are Likely to Change?

While all costs must be accounted for, it is important to identify which costs are likely to change as a result of introducing the assistive technology, compared to the baseline comparator.

Case: Vibration navigation device

Cost change: Reduction in escort support service costs

"I think around 30–40% of the escort support I used before, I would choose to go out on my own now."

— User voice

Case: Advanced posture-control power wheelchair

Cost change: Reduction in caregiver time (productivity change)

Assistance time during 3 hours of work:

60+ min → ~10min

Annual reduction of 226 hours

More focused work time for the user;
less burden on caregivers.

Expressing Benefit and Cost on the Same Scale

ICER (Incremental Cost-Effectiveness Ratio) — A Common Language for Decision-Making

$$\text{ICER} = \frac{\text{Cost (intervention)} - \text{Cost (comparator)} \text{ [Incremental cost]}}{\text{QALY (intervention)} - \text{QALY (comparator)} \text{ [Incremental QALY]}} = \text{Additional cost required to gain one additional QALY}$$

Cost-effectiveness threshold: approx. ¥5-6 million per QALY

Dominant
(Always preferred)

Cost↓ and Effect↑

No reason not to adopt

Below threshold

Incremental cost < ¥5-6M / QALY

Superior
cost-effectiveness

Above threshold

Incremental cost > ¥5-6M / QALY

Inferior
cost-effectiveness

Dominated
(Always inferior)

Cost↑ and Effect↓

No reason to adopt

If the ICER falls below the threshold (~¥5–6M/QALY), the technology is judged to be cost-effective.

What Happens Long-Term, and How Reliable Is the Estimate?

Simulation Model and Sensitivity Analysis

It is not realistic to track participants for decades until death to observe costs and effects. Instead, future changes in health states are simulated based on data and prior research to estimate long-term cost-effectiveness.

Simulation Model

e.g. A Markov model is used: possible health states are defined, transition probabilities between states are assigned for each time period, and changes over time are modelled.

► Visual impairment:

Risks of falls/fractures and depression are incorporated as health states; the model estimates how AT reduces these risks.

► SMA:

The possibility of requiring respiratory support as the disease progresses is incorporated, and long-term QOL and cost changes are estimated.

Sensitivity Analysis

Model results depend heavily on assumptions. Sensitivity analysis shows how results vary when assumptions change, indicating the range of analytical reliability.

Deterministic Sensitivity Analysis

Each parameter is varied within a defined range to identify which assumptions have the greatest impact on results.

Probabilistic Sensitivity Analysis

Probability distributions are assigned to all parameters, and the distribution of results is confirmed through 1,000+ simulations.

Results: Applying the Five Steps to Three Cases

We applied this framework to three assistive technologies. All results fell below Japan's benchmark of ¥5 million per QALY

Case: Vibration Navigation Device	Case: Advanced Posture-Control Power Wheelchair	Case: Robot-Assisted Gait Rehabilitation
QALY improvement ~4.2 QALY	QALY improvement ~2.3 QALY	QALY improvement ~7.4 QALY
ICER Dominant	ICER ~¥1.37M / QALY	ICER ~¥4.31M / QALY
Cost ↓ and Effect ↑	Well below threshold of ¥5M	Below threshold of ¥5M
QR Code (available from 20 June)	QR Code (available from 20 June)	QR Code (available from 20 June)
Details and assumptions for each case are available via the QR code.		

Results are estimates based on a limited number of participants and a restricted time period. Accumulating further evidence is a future priority.

As Value Evaluation Becomes Widespread

The value of assistive technology becomes something that individuals and policymakers alike can evaluate with a shared language.

Better decisions become possible for allocating limited resources to their highest use.

Assistive technology gains its rightful place as a target for policy, funding, and investment.

**Assistive technology is not a 'tool of charity' —
it is a 'strategic investment' for building a sustainable society.**